To: Bob Rogers (bob.rogers@shelbycountytn.gov)[bob.rogers@shelbycountytn.gov]; Christopher Boyd[Christopher.Boyd@shelbycountytn.gov]
Cc: Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Wong, Richard[Wong.Richard@epa.gov]; Myers, Dianna[Myers.Dianna@epa.gov]; Sheckler, Kelly A.[Sheckler.Kelly@epa.gov]
From: Akers, Brad
Sent: Thur 12/1/2016 8:43:31 PM
Subject: RVP Call Follow-Up
Letter to Heather McTeer Toney and (ADEM RVP Demonstration) 11-14-2014.pdf
APCSIP-RVP-Letter&SIP&Notices-20161121.pdf

Hi Bob and Chris,

See attached examples. Let us know if you have any questions.

- Birmingham – See page 33 of 49 for the multiple NAAQS write-up
- Middle Tennessee – See pages 4 – 5 for the 110(l) certification

Thanks,

Brad

D. Brad Akers | Environmental Engineer | U.S. Environmental Protection Agency

Region 4 | Air, Pesticides & Toxics Management Division | Air Regulatory Management Section

61 Forsyth St. SW | Atlanta, GA 30303

404.562.9089 | akers.brad@epa.gov

To: gallen@nescaum.org[gallen@nescaum.org]; kathleen.knight@ct.gov[kathleen.knight@ct.gov]; paul.farrell@ct.gov[paul.farrell@ct.gov]; paul.bodner@ct.gov[paul.bodner@ct.gov]; wendy.jacobs@ct.gov[wendy.jacobs@ct.gov]; kurt.kebschull@ct.gov[kurt.kebschull@ct.gov]; pete.babich@ct.gov[pete.babich@ct.gov]; Jaimeson.Sinclair@ct.gov[Jaimeson.Sinclair@ct.gov]; michael.geigert@ct.gov[Michael.Geigert@ct.gov]; Kiernan Wholean[Kiernan.Wholean@ct.gov]; mark.wert@state.ma.us[mark.wert@state.ma.us]; Azin Kavian[azin.kavian@state.ma.us]; Glenn.Keith@state.ma.us[Glenn.Keith@state.ma.us]; Tom Downs[Tom.Downs@maine.gov]; jeff.s.crawford@maine.gov[jeff.s.crawford@maine.gov]; Tom.Graham@maine.gov[Tom.Graham@maine.gov]; Michele.Roberge@des.nh.gov[Michele.Roberge@des.nh.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; michael.fitzgerald@des.nh.gov[michael.fitzgerald@des.nh.gov]; Sharon.Davis@dep.nj.gov[Sharon.Davis@dep.nj.gov]; Judy.Rand@dep.nj.gov[Judy.Rand@dep.nj.gov]; robert.bielawa@dec.ny.gov[robert.bielawa@dec.ny.gov]; scott.griffin@dec.ny.gov[scott.griffin@dec.ny.gov]; Diana.Rivenburgh@dec.ny.gov[Diana.Rivenburgh@dec.ny.gov]; michael.sheehan@dec.ny.gov[michael.sheehan@dec.ny.gov]; karen slattery[karen.slattery@dem.ri.gov]; Barbara.H.Morin@health.ri.gov[Barbara.H.Morin@health.ri.gov]; Bennet.Leon@vermont.gov[Bennet.Leon@vermont.gov]; Jeff.Merrell@vermont.gov[Jeff.Merrell@vermont.gov]; Simcox, Alison[simcox.alison@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Arnold, Anne[Arnold.Anne@epa.gov]; Burkhart, Richard[burkhart.richard@epa.gov]; Conroy, David[Conroy.Dave@epa.gov]; Biton, Leiran[biton.leiran@epa.gov]; Judge, Robert[Judge.Robert@epa.gov]; McConnell, Robert[mcconnell.robert@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]; Greene, Cynthia[Greene.Cynthia@epa.gov]; Wong, Shutsu[Wong.Shutsu@epa.gov]; Kelly, Bob[Kelly.Bob@epa.gov]
Cc: Paul.Kritzler@ct.gov[Paul.Kritzler@ct.gov]; Judge, Robert[Judge.Robert@epa.gov]
From: Charla Rudisill
Sent: Mon 4/24/2017 5:50:34 PM
Subject: RE: APC Meeting April 11-12, 2017 - Handouts - email #2
NJDEP - EE Presentation 2017_Final.pptx

-----Original Message-----
From: Charla Rudisill
Sent: Monday, April 24, 2017 1:48 PM
To: George Allen <gallen@nescaum.org>; 'Kathleen.Knight@ct.gov' <Kathleen.Knight@ct.gov>; 'paul.farrell@ct.gov' <paul.farrell@ct.gov>; 'paul.bodner@ct.gov' <paul.bodner@ct.gov>; 'wendy.jacobs@ct.gov' <wendy.jacobs@ct.gov>; 'kurt.kebschull@ct.gov' <kurt.kebschull@ct.gov>; 'Pete.Babich@ct.gov' <Pete.Babich@ct.gov>; 'Jaimeson.Sinclair@ct.gov' <Jaimeson.Sinclair@ct.gov>; 'michael.geigert@ct.gov' <michael.geigert@ct.gov>; 'Kiernan.Wholean@ct.gov' <Kiernan.Wholean@ct.gov>; 'mark.wert@state.ma.us' <mark.wert@state.ma.us>; 'Azin.Kavian@state.ma.us' <Azin.Kavian@state.ma.us>; 'Glenn.Keith@state.ma.us' <Glenn.Keith@state.ma.us>; 'tom.downs@maine.gov' <tom.downs@maine.gov>; 'jeff.s.crawford@maine.gov' <jeff.s.crawford@maine.gov>; 'Tom.Graham@maine.gov' <Tom.Graham@maine.gov>; 'Michele.Roberge@des.nh.gov' <Michele.Roberge@des.nh.gov>; 'Jeffrey.Underhill@des.nh.gov' <Jeffrey.Underhill@des.nh.gov>; 'Michael.Fitzgerald@des.nh.gov' <Michael.Fitzgerald@des.nh.gov>; 'Sharon.Davis@dep.nj.gov' <Sharon.Davis@dep.nj.gov>; 'Judy.Rand@dep.nj.gov' <Judy.Rand@dep.nj.gov>; 'robert.bielawa@dec.ny.gov' <robert.bielawa@dec.ny.gov>; 'scott.griffin@dec.ny.gov' <scott.griffin@dec.ny.gov>; 'Diana.Rivenburgh@dec.ny.gov' <Diana.Rivenburgh@dec.ny.gov>; 'michael.sheehan@dec.ny.gov' <michael.sheehan@dec.ny.gov>; 'karen.slattery@dem.ri.gov' <karen.slattery@dem.ri.gov>; 'Barbara.H.Morin@health.ri.gov' <Barbara.H.Morin@health.ri.gov>; 'Bennet.Leon@vermont.gov' <Bennet.Leon@vermont.gov>; 'Jeff.Merrell@vermont.gov' <Jeff.Merrell@vermont.gov>; 'Simcox.Alison@epa.gov' <Simcox.Alison@epa.gov>; 'McWilliams.Anne@epa.gov'

<McWilliams.Anne@epa.gov>; 'arnold.anne@epa.gov' <arnold.anne@epa.gov>; 'burkhart.richard@epa.gov' <burkhart.richard@epa.gov>; 'conroy.dave@epa.gov' <conroy.dave@epa.gov>; 'biton.leiran@epa.gov' <biton.leiran@epa.gov>; 'judge.robert@epa.gov' <judge.robert@epa.gov>; 'McConnell.Robert@epa.gov' <McConnell.Robert@epa.gov>; 'ruvo.richard@epa.gov' <ruvo.richard@epa.gov>; 'greene.cynthia@epa.gov' <greene.cynthia@epa.gov>; 'Wong.Shutsu@epa.gov' <Wong.Shutsu@epa.gov>; 'kelly.bob@epa.gov' <kelly.bob@epa.gov>
Cc: 'Paul.Kritzler@ct.gov' <Paul.Kritzler@ct.gov>; 'judge.robert@epa.gov' <judge.robert@epa.gov>
Subject: APC Meeting April 11-12, 2017 - Handouts - email #1

Hi all -

I am just going to email the handouts to you. Drop Box is not an option for many of you. I will email in several rounds.

Charla

To: Conroy, David[Conroy.Dave@epa.gov]; Anne Gobin[anne.gobin@ct.gov]; amarin@nescaum.org[amarin@nescaum.org]; Becky Ohler[Rebecca.Ohler@des.nh.gov]; Christine Kirby[christine.kirby@state.ma.us]; Craig A. Wright[CRAIG.WRIGHT@DES.NH.GOV]; Doug McVay[doug.mcvay@dem.ri.gov]; Gary Rose[Gary.Rose@ct.gov]; Glenn Keith[Glenn.Keith@state.ma.us]; Heidi Hales[heidi.hales@vermont.gov]; Jeff Crawford[jeff.s.crawford@maine.gov]; junderhill@des.state.nh.us[junderhill@des.state.nh.us]; Grandchamp, Laurie (DEM)[laurie.grandchamp@dem.ri.gov]; Marc Cone[marc.a.cone@maine.gov]; Michele Roberge[michele.roberge@des.nh.gov]; Mike Fitzgerald[mfitzgerald@des.state.nh.us]; Paul Farrell[paul.farrell@ct.gov]; Paul Miller[pmiller@nescaum.org]; Richard Pirolli[ric.pirolli@ct.gov]; Pirolli, Ric[Ric.Pirolli@ct.gov]
Cc: Burkhart, Richard[burkhart.richard@epa.gov]
From: Arnold, Anne
Sent: Thur 6/22/2017 3:05:38 PM
Subject: RE: Letter on ozone designations

FYI

Yesterday, Administrator Pruitt signed a Federal Register notice regarding the delay in ozone designations for the 2015 ozone standard.

https://www.epa.gov/ozone-designations/extension-deadline-area-designations-2015-ozone-standards

Anne Arnold, Manager
Air Quality Planning Unit
EPA Region I
617-918-1047

Mail Address:
EPA Region I
5 Post Office Square - Suite 100
Mail Code OEP05-02
Boston, MA 02109-3912

From: Conroy, David
Sent: Wednesday, June 07, 2017 9:53 AM
To: Anne Gobin <anne.gobin@ct.gov>; amarin@nescaum.org; Becky Ohler <Rebecca.Ohler@des.nh.gov>; Christine Kirby <christine.kirby@state.ma.us>; Craig A. Wright <CRAIG.WRIGHT@DES.NH.GOV>; Doug McVay <doug.mcvay@dem.ri.gov>; Gary Rose <Gary.Rose@ct.gov>; Glenn Keith <Glenn.Keith@state.ma.us>; Heidi Hales <heidi.hales@vermont.gov>; Jeff Crawford <jeff.s.crawford@maine.gov>; junderhill@des.state.nh.us; Grandchamp, Laurie (DEM) <laurie.grandchamp@dem.ri.gov>; Marc Cone <marc.a.cone@maine.gov>; Michele Roberge <michele.roberge@des.nh.gov>; Mike Fitzgerald <mfitzgerald@des.state.nh.us>; Paul Farrell <paul.farrell@ct.gov>; Paul Miller <pmiller@nescaum.org>; Richard Pirolli <ric.pirolli@ct.gov>
Cc: Arnold, Anne <Arnold.Anne@epa.gov>; Burkhart, Richard <burkhart.richard@epa.gov>; Mackintosh, David <Mackintosh.David@epa.gov>

Subject: Letter on ozone designations

FYI. This letter was sent to Governors yesterday.
<< File: EPA ozone letter.pdf >>
See press release at: https://www.epa.gov/newsreleases/epa-extend-deadline-2015-ozone-naaqs-area-designations

David Conroy
Air Programs Manager
U.S. Environmental Protection Agency, Region 1

Office: 617-918-1661
iPhone: 857-829-8239
Fax: 617-918-0661

To: Conroy, David[Conroy.Dave@epa.gov]; kathleen.knight@ct.gov[kathleen.knight@ct.gov]; paul.farrell@ct.gov[paul.farrell@ct.gov]; paul.bodner@ct.gov[paul.bodner@ct.gov]; wendy.jacobs@ct.gov[wendy.jacobs@ct.gov]; kurt.kebschull@ct.gov[kurt.kebschull@ct.gov]; pete.babich@ct.gov[pete.babich@ct.gov]; Jaimeson.Sinclair@ct.gov[Jaimeson.Sinclair@ct.gov]; michael.geigert@ct.gov[michael.geigert@ct.gov]; Kiernan.Wholean@ct.gov[Kiernan.Wholean@ct.gov]; mark.wert@state.ma.us[mark.wert@state.ma.us]; Azin Kavian[azin.kavian@state.ma.us]; Glenn.Keith@state.ma.us[Glenn.Keith@state.ma.us]; Tom Downs[Tom.Downs@maine.gov]; jeff.s.crawford@maine.gov[jeff.s.crawford@maine.gov]; Tom.Graham@maine.gov[Tom.Graham@maine.gov]; Michele.Roberge@des.nh.gov[Michele.Roberge@des.nh.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; Michael.Fitzgerald@des.nh.gov[Michael.Fitzgerald@des.nh.gov]; Sharon.Davis@dep.nj.gov[Sharon.Davis@dep.nj.gov]; Judy.Rand@dep.nj.gov[Judy.Rand@dep.nj.gov]; robert.bielawa@dec.ny.gov[robert.bielawa@dec.ny.gov]; scott.griffin@dec.ny.gov[scott.griffin@dec.ny.gov]; Diana.Rivenburgh@dec.ny.gov[Diana.Rivenburgh@dec.ny.gov]; michael.sheehan@dec.ny.gov[michael.sheehan@dec.ny.gov]; karen slattery[karen.slattery@dem.ri.gov]; Barbara.H.Morin@health.ri.gov[Barbara.H.Morin@health.ri.gov]; Bennet.Leon@vermont.gov[Bennet.Leon@vermont.gov]; Jeff.Merrell@vermont.gov[Jeff.Merrell@vermont.gov]; Simcox, Alison[simcox.alison@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Arnold, Anne[Arnold.Anne@epa.gov]; Burkhart, Richard[burkhart.richard@epa.gov]; Biton, Leiran[biton.leiran@epa.gov]; Judge, Robert[Judge.Robert@epa.gov]; McConnell, Robert[mcconnell.robert@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]; Greene, Cynthia[Greene.Cynthia@epa.gov]; Wong, Shutsu[Wong.Shutsu@epa.gov]; Kelly, Bob[Kelly.Bob@epa.gov]
From: George Allen
Sent: Fri 1/6/2017 5:27:28 PM
Subject: RE: Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone NAAQS

Dave - thanks! George

At 12:25 PM 1/6/2017, Conroy, David wrote:
George - The deadline is listed on the Regulations.gov website as
April 6. See https://www.regulations.gov/document?D=EPA-HQ-OAR-2016-0751-0001

-----Original Message-----
From: George Allen [mailto:gallen@nescaum.org]
Sent: Friday, January 06, 2017 12:03 PM

As promised by Anne A. The actual deadline for comments is not
included in this FR notice, but it is ~ 1st week of April.
George

Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone
National Ambient Air Quality Standard, 1733-1741
https://www.gpo.gov/fdsys/pkg/FR-2017-01-06/html/2017-00058.htm
https://www.gpo.gov/fdsys/pkg/FR-2017-01-06/pdf/2017-00058.pdf

To: gallen@nescaum.org[gallen@nescaum.org]; kathleen.knight@ct.gov[kathleen.knight@ct.gov]; paul.farrell@ct.gov[paul.farrell@ct.gov]; paul.bodner@ct.gov[paul.bodner@ct.gov]; wendy.jacobs@ct.gov[wendy.jacobs@ct.gov]; kurt.kebschull@ct.gov[kurt.kebschull@ct.gov]; pete.babich@ct.gov[pete.babich@ct.gov]; Jaimeson.Sinclair@ct.gov[Jaimeson.Sinclair@ct.gov]; michael.geigert@ct.gov[michael.geigert@ct.gov]; Kiernan.Wholean@ct.gov[Kiernan.Wholean@ct.gov]; mark.wert@state.ma.us[mark.wert@state.ma.us]; Azin Kavian[azin.kavian@state.ma.us]; Glenn.Keith@state.ma.us[Glenn.Keith@state.ma.us]; Tom Downs[Tom.Downs@maine.gov]; jeff.s.crawford@maine.gov[jeff.s.crawford@maine.gov]; Tom.Graham@maine.gov[Tom.Graham@maine.gov]; Michele.Roberge@des.nh.gov[Michele.Roberge@des.nh.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; Michael.Fitzgerald@des.nh.gov[Michael.Fitzgerald@des.nh.gov]; Sharon.Davis@dep.nj.gov[Sharon.Davis@dep.nj.gov]; Judy.Rand@dep.nj.gov[Judy.Rand@dep.nj.gov]; robert.bielawa@dec.ny.gov[robert.bielawa@dec.ny.gov]; scott.griffin@dec.ny.gov[scott.griffin@dec.ny.gov]; Diana.Rivenburgh@dec.ny.gov[Diana.Rivenburgh@dec.ny.gov]; rob.sliwinski@dec.ny.gov[rob.sliwinski@dec.ny.gov]; karen slattery[karen.slattery@dem.ri.gov]; Barbara.H.Morin@health.ri.gov[Barbara.H.Morin@health.ri.gov]; Bennet.Leon@vermont.gov[Bennet.Leon@vermont.gov]; Jeff.Merrell@vermont.gov[Jeff.Merrell@vermont.gov]; Simcox, Alison[simcox.alison@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Burkhart, Richard[burkhart.richard@epa.gov]; Conroy, David[Conroy.Dave@epa.gov]; Biton, Leiran[biton.leiran@epa.gov]; Judge, Robert[Judge.Robert@epa.gov]; McConnell, Robert[mcconnell.robert@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]; Greene, Cynthia[Greene.Cynthia@epa.gov]; Wong, Shutsu[Wong.Shutsu@epa.gov]; Kelly, Bob[Kelly.Bob@epa.gov]
Cc: pmiller@nescaum.org[pmiller@nescaum.org]; crudisill@nescaum.org[crudisill@nescaum.org]
From: Arnold, Anne
Sent: Thur 1/5/2017 4:28:32 PM
Subject: NODA will published in FR tomorrow

FYI - The NODA for the preliminary transport modeling for the 2015 ozone standard will be published in the Federal Register tomorrow. All info will be in the docket then.

Anne Arnold, Manager
Air Quality Planning Unit
EPA Region I
617-918-1047

Mail Address:
EPA Region I
5 Post Office Square - Suite 100
Mail Code OEP05-02
Boston, MA 02109-3912

-----Original Message-----
From: Arnold, Anne
Sent: Wednesday, January 04, 2017 3:35 PM
To: 'George Allen' <gallen@nescaum.org>; kathleen.knight@ct.gov; paul.farrell@ct.gov; paul.bodner@ct.gov; wendy.jacobs@ct.gov; kurt.kebschull@ct.gov; pete.babich@ct.gov; Jaimeson.Sinclair@ct.gov; michael.geigert@ct.gov; Kiernan.Wholean@ct.gov; mark.wert@state.ma.us; Azin Kavian <azin.kavian@state.ma.us>; Glenn.Keith@state.ma.us; Tom Downs <Tom.Downs@maine.gov>; jeff.s.crawford@maine.gov; Tom.Graham@maine.gov; Michele.Roberge@des.nh.gov; jeffrey.underhill@des.nh.gov; Michael.Fitzgerald@des.nh.gov;

Sharon.Davis@dep.nj.gov; Judy.Rand@dep.nj.gov; robert.bielawa@dec.ny.gov; scott.griffin@dec.ny.gov; Diana.Rivenburgh@dec.ny.gov; rob.sliwinski@dec.ny.gov; karen slattery <karen.slattery@dem.ri.gov>; Barbara.H.Morin@health.ri.gov; Bennet.Leon@vermont.gov; Jeff.Merrell@vermont.gov; Simcox, Alison <simcox.alison@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Burkhart, Richard <burkhart.richard@epa.gov>; Conroy, David <Conroy.Dave@epa.gov>; Biton, Leiran <biton.leiran@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McConnell, Robert <mcconnell.robert@epa.gov>; Ruvo, Richard <Ruvo.Richard@epa.gov>; Greene, Cynthia <Greene.Cynthia@epa.gov>; Wong, Shutsu <Wong.Shutsu@epa.gov>; Kelly, Bob <Kelly.Bob@epa.gov>
Cc: pmiller@nescaum.org; crudisill@nescaum.org
Subject: RE: Agenda for Wed. Jan. 4 10-1130 am quarterly APC call

HI Folks:

In response to the questions on today's call regarding item #5, I checked with EPA HQ and they responded:

The TSDs will be available from the docket once the NODA is published in the FR.

The emissions modeling TSD is now available from the 2023 link on this page:
https://www.epa.gov/air-emissions-modeling/2011-version-63-platform

The data files for 2023 will be updated later today and available from the 2011v6.3 Data Files and Summaries link on that same page.

Anne Arnold, Manager
Air Quality Planning Unit
EPA Region I
617-918-1047

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5 Post Office Square - Suite 100
Mail Code OEP05-02
Boston, MA 02109-3912

-----Original Message-----
From: George Allen [mailto:gallen@nescaum.org]
Sent: Tuesday, January 03, 2017 2:46 PM
To: kathleen.knight@ct.gov; paul.farrell@ct.gov; paul.bodner@ct.gov; wendy.jacobs@ct.gov; kurt.kebschull@ct.gov; pete.babich@ct.gov; Jaimeson.Sinclair@ct.gov; michael.geigert@ct.gov; Kiernan.Wholean@ct.gov; mark.wert@state.ma.us; Azin Kavian <azin.kavian@state.ma.us>; Glenn.Keith@state.ma.us; Tom Downs <Tom.Downs@maine.gov>; jeff.s.crawford@maine.gov; Tom.Graham@maine.gov; Michele.Roberge@des.nh.gov; jeffrey.underhill@des.nh.gov; Michael.Fitzgerald@des.nh.gov; Sharon.Davis@dep.nj.gov; Judy.Rand@dep.nj.gov; robert.bielawa@dec.ny.gov; scott.griffin@dec.ny.gov; Diana.Rivenburgh@dec.ny.gov; rob.sliwinski@dec.ny.gov; karen slattery <karen.slattery@dem.ri.gov>; Barbara.H.Morin@health.ri.gov; Bennet.Leon@vermont.gov; Jeff.Merrell@vermont.gov; Simcox, Alison <simcox.alison@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Arnold, Anne <Arnold.Anne@epa.gov>; Burkhart, Richard <burkhart.richard@epa.gov>; Conroy, David <Conroy.Dave@epa.gov>; Biton, Leiran <biton.leiran@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McConnell, Robert <mcconnell.robert@epa.gov>; Ruvo, Richard <Ruvo.Richard@epa.gov>; Greene, Cynthia <Greene.Cynthia@epa.gov>; Wong, Shutsu <Wong.Shutsu@epa.gov>; Kelly, Bob <Kelly.Bob@epa.gov>
Cc: pmiller@nescaum.org; crudisill@nescaum.org

Subject: Agenda for Wed. Jan. 4 10-1130 am quarterly APC call

Hi everyone; here's the call-in info and Agenda for tomorrow's APC 10am call. We have 90 minutes booked.
-- George

877-594-8353
code: Ex. 6 - Personal Privacy

Agenda:

1. State Updates

2. SO2 Data Requirements Rule: January 13, 2017 deadline for modeling; Revised Designation Recommendation submittal if desired by state

3. 2008 Ozone NAAQS Attainment Demonstration SIP

4. 2015 Ozone NAAQS Implementation Rule: Comments due 1-19-2017

5. 2015 Ozone NAAQS Notice of Data Availability: Preliminary Interstate Ozone Transport Modeling Data [more info below]

6. Final revisions to the Regional Haze Rule (December 14, 2016)

7. Comments on EPA Inventory Guidance (due 1-16-2017)

8. Comments on PM2.5 Precursor Guidance (due 1-31-2017)

9. Annual Meeting Planning - March? Location?

#5. Notice of Data Availability - Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone NAAQS, signed 12/28/16.
Comments must be received on or before 90 days after publication in the Federal Register [~ 1st week in April, tbd] EPA has completed preliminary interstate ozone transport modeling relevant for the 2015 ozone national ambient air quality standard (NAAQS). This information may help states develop "good neighbor"
state implementation plans for the 2015 ozone air quality standards.
The Clean Air Act's "good neighbor" provision requires states to develop plans that ensure they do not contribute to downwind states'
failure to attain or maintain air quality standards. As part of a Notice of Data Availability (NODA), the Agency is providing an opportunity for public review of this modeling data, including projected ozone concentrations and contributions for 2023, as well as projected emissions, including emissions from the power sector, that were used for this modeling. The notice and additional information is available at:
https://www.epa.gov/airmarkets/notice-data-availability-preliminary-interstate-ozone-transport-modeling-data-2015-ozone
Pre-Pub PDF:
https://www.epa.gov/sites/production/files/2016-12/documents/2015_o3_naaqs_transport_aq_modeling_noda_final_12-29-16_web_0.pdf

To: gallen@nescaum.org[gallen@nescaum.org]; kathleen.knight@ct.gov[kathleen.knight@ct.gov]; paul.farrell@ct.gov[paul.farrell@ct.gov]; paul.bodner@ct.gov[paul.bodner@ct.gov]; wendy.jacobs@ct.gov[wendy.jacobs@ct.gov]; kurt.kebschull@ct.gov[kurt.kebschull@ct.gov]; pete.babich@ct.gov[pete.babich@ct.gov]; Jaimeson.Sinclair@ct.gov[Jaimeson.Sinclair@ct.gov]; michael.geigert@ct.gov[michael.geigert@ct.gov]; Kiernan.Wholean@ct.gov[Kiernan.Wholean@ct.gov]; mark.wert@state.ma.us[mark.wert@state.ma.us]; Azin Kavian[azin.kavian@state.ma.us]; Glenn.Keith@state.ma.us[Glenn.Keith@state.ma.us]; Tom Downs[Tom.Downs@maine.gov]; jeff.s.crawford@maine.gov[jeff.s.crawford@maine.gov]; Tom.Graham@maine.gov[Tom.Graham@maine.gov]; Michele.Roberge@des.nh.gov[Michele.Roberge@des.nh.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; Michael.Fitzgerald@des.nh.gov[Michael.Fitzgerald@des.nh.gov]; Sharon.Davis@dep.nj.gov[Sharon.Davis@dep.nj.gov]; Judy.Rand@dep.nj.gov[Judy.Rand@dep.nj.gov]; robert.bielawa@dec.ny.gov[robert.bielawa@dec.ny.gov]; scott.griffin@dec.ny.gov[scott.griffin@dec.ny.gov]; Diana.Rivenburgh@dec.ny.gov[Diana.Rivenburgh@dec.ny.gov]; rob.sliwinski@dec.ny.gov[rob.sliwinski@dec.ny.gov]; karen slattery[karen.slattery@dem.ri.gov]; Barbara.H.Morin@health.ri.gov[Barbara.H.Morin@health.ri.gov]; Bennet.Leon@vermont.gov[Bennet.Leon@vermont.gov]; Jeff.Merrell@vermont.gov[Jeff.Merrell@vermont.gov]; Simcox, Alison[simcox.alison@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Burkhart, Richard[burkhart.richard@epa.gov]; Conroy, David[Conroy.Dave@epa.gov]; Biton, Leiran[biton.leiran@epa.gov]; Judge, Robert[Judge.Robert@epa.gov]; McConnell, Robert[mcconnell.robert@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]; Greene, Cynthia[Greene.Cynthia@epa.gov]; Wong, Shutsu[Wong.Shutsu@epa.gov]; Kelly, Bob[Kelly.Bob@epa.gov]
Cc: pmiller@nescaum.org[pmiller@nescaum.org]; crudisill@nescaum.org[crudisill@nescaum.org]
From: Arnold, Anne
Sent: Wed 1/4/2017 8:35:19 PM
Subject: RE: Agenda for Wed. Jan. 4 10-1130 am quarterly APC call

HI Folks:

In response to the questions on today's call regarding item #5, I checked with EPA HQ and they responded:

The TSDs will be available from the docket once the NODA is published in the FR.

The emissions modeling TSD is now available from the 2023 link on this page:
https://www.epa.gov/air-emissions-modeling/2011-version-63-platform

The data files for 2023 will be updated later today and available from the 2011v6.3 Data Files and Summaries link on that same page.

Anne Arnold, Manager
Air Quality Planning Unit
EPA Region I
617-918-1047

Mail Address:
EPA Region I
5 Post Office Square - Suite 100
Mail Code OEP05-02
Boston, MA 02109-3912

-----Original Message-----

From: George Allen [mailto:gallen@nescaum.org]
Sent: Tuesday, January 03, 2017 2:46 PM
To: kathleen.knight@ct.gov; paul.farrell@ct.gov; paul.bodner@ct.gov; wendy.jacobs@ct.gov; kurt.kebschull@ct.gov; pete.babich@ct.gov; Jaimeson.Sinclair@ct.gov; michael.geigert@ct.gov; Kiernan.Wholean@ct.gov; mark.wert@state.ma.us; Azin Kavian <azin.kavian@state.ma.us>; Glenn.Keith@state.ma.us; Tom Downs <Tom.Downs@maine.gov>; jeff.s.crawford@maine.gov; Tom.Graham@maine.gov; Michele.Roberge@des.nh.gov; jeffrey.underhill@des.nh.gov; Michael.Fitzgerald@des.nh.gov; Sharon.Davis@dep.nj.gov; Judy.Rand@dep.nj.gov; robert.bielawa@dec.ny.gov; scott.griffin@dec.ny.gov; Diana.Rivenburgh@dec.ny.gov; rob.sliwinski@dec.ny.gov; karen slattery <karen.slattery@dem.ri.gov>; Barbara.H.Morin@health.ri.gov; Bennet.Leon@vermont.gov; Jeff.Merrell@vermont.gov; Simcox, Alison <simcox.alison@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Arnold, Anne <Arnold.Anne@epa.gov>; Burkhart, Richard <burkhart.richard@epa.gov>; Conroy, David <Conroy.Dave@epa.gov>; Biton, Leiran <biton.leiran@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McConnell, Robert <mcconnell.robert@epa.gov>; Ruvo, Richard <Ruvo.Richard@epa.gov>; Greene, Cynthia <Greene.Cynthia@epa.gov>; Wong, Shutsu <Wong.Shutsu@epa.gov>; Kelly, Bob <Kelly.Bob@epa.gov>
Cc: pmiller@nescaum.org; crudisill@nescaum.org
Subject: Agenda for Wed. Jan. 4 10-1130 am quarterly APC call

Hi everyone; here's the call-in info and Agenda for tomorrow's APC 10am call. We have 90 minutes booked.
-- George

877-594-8353
code: Ex. 6 - Personal Privacy

Agenda:

1. State Updates

2. SO2 Data Requirements Rule: January 13, 2017 deadline for modeling; Revised Designation Recommendation submittal if desired by state

3. 2008 Ozone NAAQS Attainment Demonstration SIP

4. 2015 Ozone NAAQS Implementation Rule: Comments due 1-19-2017

5. 2015 Ozone NAAQS Notice of Data Availability: Preliminary Interstate Ozone Transport Modeling Data [more info below]

6. Final revisions to the Regional Haze Rule (December 14, 2016)

7. Comments on EPA Inventory Guidance (due 1-16-2017)

8. Comments on PM2.5 Precursor Guidance (due 1-31-2017)

9. Annual Meeting Planning - March? Location?

#5. Notice of Data Availability - Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone NAAQS, signed 12/28/16. Comments must be received on or before 90 days after publication in the Federal Register [~ 1st week in April, tbd]
EPA has completed preliminary interstate ozone transport modeling

relevant for the 2015 ozone national ambient air quality standard (NAAQS). This information may help states develop "good neighbor" state implementation plans for the 2015 ozone air quality standards. The Clean Air Act's "good neighbor" provision requires states to develop plans that ensure they do not contribute to downwind states' failure to attain or maintain air quality standards. As part of a Notice of Data Availability (NODA), the Agency is providing an opportunity for public review of this modeling data, including projected ozone concentrations and contributions for 2023, as well as projected emissions, including emissions from the power sector, that were used for this modeling. The notice and additional information is available at:
https://www.epa.gov/airmarkets/notice-data-availability-preliminary-interstate-ozone-transport-modeling-data-2015-ozone
Pre-Pub PDF:
https://www.epa.gov/sites/production/files/2016-12/documents/2015_o3_naaqs_transport_aq_modeling_noda_final_12-29-16_web_0.pdf

To: kathleen.knight@ct.gov[kathleen.knight@ct.gov]; paul.farrell@ct.gov[paul.farrell@ct.gov]; paul.bodner@ct.gov[paul.bodner@ct.gov]; wendy.jacobs@ct.gov[wendy.jacobs@ct.gov]; kurt.kebschull@ct.gov[kurt.kebschull@ct.gov]; Jaimeson.Sinclair@ct.gov[Jaimeson.Sinclair@ct.gov]; michael.geigert@ct.gov[michael.geigert@ct.gov]; Kiernan.Wholean@ct.gov[Kiernan.Wholean@ct.gov]; mark.wert@state.ma.us[mark.wert@state.ma.us]; Azin.Kavian@state.ma.us[Azin.Kavian@state.ma.us]; Glenn.Keith@state.ma.us[Glenn.Keith@state.ma.us]; Tom Downs[Tom.Downs@maine.gov]; jeff.s.crawford@maine.gov[jeff.s.crawford@maine.gov]; Tom.Graham@maine.gov[Tom.Graham@maine.gov]; Michele.Roberge@des.nh.gov[Michele.Roberge@des.nh.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; Michael.Fitzgerald@des.nh.gov[Michael.Fitzgerald@des.nh.gov]; Sharon.Davis@dep.nj.gov[Sharon.Davis@dep.nj.gov]; Judy.Rand@dep.nj.gov[Judy.Rand@dep.nj.gov]; robert.bielawa@dec.ny.gov[robert.bielawa@dec.ny.gov]; scott.griffin@dec.ny.gov[scott.griffin@dec.ny.gov]; Diana.Rivenburgh@dec.ny.gov[Diana.Rivenburgh@dec.ny.gov]; rob.sliwinski@dec.ny.gov[rob.sliwinski@dec.ny.gov]; karen.slattery@dem.ri.gov[karen.slattery@dem.ri.gov]; Barbara.H.Morin@health.ri.gov[Barbara.H.Morin@health.ri.gov]; Bennet.Leon@vermont.gov[Bennet.Leon@vermont.gov]; Jeff.Merrell@vermont.gov[Jeff.Merrell@vermont.gov]; Simcox, Alison[simcox.alison@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Arnold, Anne[Arnold.Anne@epa.gov]; Burkhart, Richard[burkhart.richard@epa.gov]; Conroy, David[Conroy.Dave@epa.gov]; Biton, Leiran[biton.leiran@epa.gov]; Judge, Robert[Judge.Robert@epa.gov]; McConnell, Robert[mcconnell.robert@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]; Greene, Cynthia[Greene.Cynthia@epa.gov]; Wong, Shutsu[Wong.Shutsu@epa.gov]; Kelly, Bob[Kelly.Bob@epa.gov]; richard.marriner@maine.gov[richard.marriner@maine.gov]; Andy.Johnson@maine.gov[Andy.Johnson@maine.gov]; Tom Downs[Tom.Downs@maine.gov]; Danielle.O.Twomey@maine.gov[Danielle.O.Twomey@maine.gov]; catherine.c.demers@maine.gov[catherine.c.demers@maine.gov]; Michael.Fitzgerald@des.nh.gov[Michael.Fitzgerald@des.nh.gov]; Rebecca.Ohler@des.nh.gov[Rebecca.Ohler@des.nh.gov]; Heidi.Hales@vermont.gov[Heidi.Hales@vermont.gov]; Robert.Lacaillade@vermont.gov[Robert.Lacaillade@vermont.gov]; Jenny.Berschling@vermont.gov[Jenny.Berschling@vermont.gov]; Thomas.Mcgrath@state.ma.us[Thomas.Mcgrath@state.ma.us]; randall.semagin@ct.gov[randall.semagin@ct.gov]; michele.chaffee@ct.gov[michele.chaffee@ct.gov]; Paul.Sierzenga@dec.ny.gov[Paul.Sierzenga@dec.ny.gov]; Dirk.Felton@dec.ny.gov[Dirk.Felton@dec.ny.gov]; Brian.Lay@dec.ny.gov[Brian.Lay@dec.ny.gov]; Luis Lim[luis.lim@dep.nj.gov]; james.Oxley@dep.nj.gov[james.Oxley@dep.nj.gov]; melinda.viera@health.ri.gov[melinda.viera@health.ri.gov]; gina.friedman@dem.ri.gov[gina.friedman@dem.ri.gov]; Kendall Perkins[kendall.perkins@des.nh.gov]; Timothy.Verville@des.nh.gov[Timothy.Verville@des.nh.gov]; Judge, Robert[Judge.Robert@epa.gov]; Simcox, Alison[simcox.alison@epa.gov]; Conroy, David[Conroy.Dave@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Van Arsdale, Alan[vanarsdale.alan@epa.gov]; Khan, Mazeeda[Khan.Mazeeda@epa.gov]; Kahn, Peter R.[kahn.peter@epa.gov]; Taylor, Catherine[taylor.catherine@epa.gov]; glenn.keith@state.ma.us[glenn.keith@state.ma.us]; mark.wert@state.ma.us[mark.wert@state.ma.us]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]
From: George Allen
Sent: Thur 10/20/2016 5:35:03 PM
Subject: next Thurs. October 27, 1-2 pm: exceptional event rule call with EPA R1 and R2

Hi Everyone; Please ignore if you just got this. but I wanted to make sure lthat all the APC and MAC folks were aware of this.

Based on the doodle poll, the best time for this call is Thursday Oct

27, 1 to 2 pm. 877-594-8353, code: 170-427-22#

My apologies to those that can't make this time. We will take notes.
George

At 05:40 PM 10/17/2016, Paul Miller wrote:
Following up on George's email to many of you earlier today (and adding a few more email addresses to this email), I wanted to provide a little more context for the call we're trying to schedule. NESCAUM is following up on a request from the NESCAUM directors on the possibility of NESCAUM providing regional support for interested states that may be planning on developing exceptional event demonstrations to be submitted to EPA. Specifically, this would be looking at ozone exceedances in the region on or about May 25-28, 2016 that are thought to have been heavily influenced by upwind wildfires. Not all states may be interested in this, so no need to respond to the poll if not relevant to your state.

One key area the NESCAUM directors would like us to discuss on the call with EPA is if there are regional elements for an exceptional event demonstration that could be coordinated through NESCAUM. The goal would be to minimize duplicative work by individual states. States would still be the ones making the submissions, but NESCAUM could help coordinate and perhaps develop some elements that would be common to all submittals. One example might be identifying a consistent approach for HY-SPLIT back trajectories (assuming this would be one element of a demonstration). A second possibility would be a common regional analysis of the meteorological pattern during this period, and how it may, or may not, differ from historically "normal" high ozone meteorological patterns. For those who have an interest in pursuing this further, please respond to the poll when you can (if you haven't already), and feel free to suggest other areas that might be amenable to a regional approach. Thanks, Paul

Paul J. Miller, Deputy Director & Chief Scientist
Northeast States for Coordinated Air Use Management
89 South Street, Suite 602
Boston, MA 02111
Ph: 617-259-2016
Fax: 617-742-9162
www.nescaum.org

From: George Allen
Sent: Monday, October 17, 2016 10:45 AM
To: Kathleen.Knight@ct.gov; paul.farrell@ct.gov; paul.bodner@ct.gov; wendy.jacobs@ct.gov; kurt.kebschull@ct.gov; Pete.Babich@ct.gov; Jaimeson.Sinclair@ct.gov; michael.geigert@ct.gov; Kiernan.Wholean@ct.gov; mark.wert@state.ma.us; Azin.Kavian@state.ma.us; Glenn.Keith@state.ma.us; tom.downs@maine.gov; jeff.s.crawford@maine.gov; Tom.Graham@maine.gov; Michele.Roberge@des.nh.gov; Jeffrey.Underhill@des.nh.gov; Michael.Fitzgerald@des.nh.gov; Sharon.Davis@dep.nj.gov; Judy.Rand@dep.nj.gov; robert.bielawa@dec.ny.gov;

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Jeff.Merrell@vermont.gov; Simcox.Alison@epa.gov;
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burkhart.richard@epa.gov; conroy.dave@epa.gov; biton.leiran@epa.gov;
judge.robert@epa.gov; McConnell.Robert@epa.gov; ruvo.richard@epa.gov;
greene.cynthia@epa.gov; Wong.Shutsu@epa.gov; kelly.bob@epa.gov
Cc: Anne.Gobin@ct.gov; Paul Miller
Subject: poll for times for exceptional event rule call with EPA R1 and R2

Hi APC members; we're scheduling a call with EPA R1 and R2 to discuss
Revisions to the 2007 Exceptional Events Rule, finalized September
16. If you are interested in participating, please fill out this
poll for a time by this Wednesday if possible:
http://doodle.com/poll/6ctq7qmmqppxe3gw

More information on the rule is below. Please pass this along to
others in your agency who might be interested.
Thanks - George

Guidance and additional information on the rule is at:
https://www.epa.gov/air-quality-analysis/treatment-data-influenced-exceptional-events
and
https://www.epa.gov/sites/production/files/2016-09/documents/exceptional_events_guidance_9-16-16_final.pdf

The Federal Register notice published Oct. 3: Treatment of Data
Influenced by Exceptional Events, 68216-68282
https://www.gpo.gov/fdsys/pkg/FR-2016-10-03/pdf/2016-22983.pdf
https://www.gpo.gov/fdsys/pkg/FR-2016-10-03/html/2016-22983.htm

To: Paul Miller[pmiller@nescaum.org]; kathleen.knight@ct.gov[kathleen.knight@ct.gov]; paul.farrell@ct.gov[paul.farrell@ct.gov]; paul.bodner@ct.gov[paul.bodner@ct.gov]; wendy.jacobs@ct.gov[wendy.jacobs@ct.gov]; kurt.kebschull@ct.gov[kurt.kebschull@ct.gov]; pete.babich@ct.gov[pete.babich@ct.gov]; Jaimeson.Sinclair@ct.gov[Jaimeson.Sinclair@ct.gov]; michael.geigert@ct.gov[michael.geigert@ct.gov]; Kiernan.Wholean@ct.gov[Kiernan.Wholean@ct.gov]; mark.wert@state.ma.us[mark.wert@state.ma.us]; Azin.Kavian@state.ma.us[Azin.Kavian@state.ma.us]; Glenn.Keith@state.ma.us[Glenn.Keith@state.ma.us]; Tom Downs[Tom.Downs@maine.gov]; jeff.s.crawford@maine.gov[jeff.s.crawford@maine.gov]; Tom.Graham@maine.gov[Tom.Graham@maine.gov]; Michele.Roberge@des.nh.gov[Michele.Roberge@des.nh.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; Michael.Fitzgerald@des.nh.gov[Michael.Fitzgerald@des.nh.gov]; Sharon.Davis@dep.nj.gov[Sharon.Davis@dep.nj.gov]; Judy.Rand@dep.nj.gov[Judy.Rand@dep.nj.gov]; robert.bielawa@dec.ny.gov[robert.bielawa@dec.ny.gov]; scott.griffin@dec.ny.gov[scott.griffin@dec.ny.gov]; Diana.Rivenburgh@dec.ny.gov[Diana.Rivenburgh@dec.ny.gov]; rob.sliwinski@dec.ny.gov[rob.sliwinski@dec.ny.gov]; karen.slattery@dem.ri.gov[karen.slattery@dem.ri.gov]; Barbara.H.Morin@health.ri.gov[Barbara.H.Morin@health.ri.gov]; Bennet.Leon@vermont.gov[Bennet.Leon@vermont.gov]; Jeff.Merrell@vermont.gov[Jeff.Merrell@vermont.gov]; Simcox, Alison[simcox.alison@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Arnold, Anne[Arnold.Anne@epa.gov]; Burkhart, Richard[burkhart.richard@epa.gov]; Conroy, David[Conroy.Dave@epa.gov]; Biton, Leiran[biton.leiran@epa.gov]; Judge, Robert[Judge.Robert@epa.gov]; McConnell, Robert[mcconnell.robert@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]; Greene, Cynthia[Greene.Cynthia@epa.gov]; Wong, Shutsu[Wong.Shutsu@epa.gov]; Kelly, Bob[Kelly.Bob@epa.gov]
Cc: Anne.Gobin@ct.gov[Anne.Gobin@ct.gov]; Steitz, Francis[Francis.Steitz@dep.nj.gov]; Peg Hanna (peg.hanna@dep.state.nj.us)[peg.hanna@dep.state.nj.us]; Laurie Grandchamp[laurie.grandchamp@dem.ri.gov]; Ric Pirolli (ric.pirolli@ct.gov)[ric.pirolli@ct.gov]; darren.austin@dem.ri.gov[darren.austin@dem.ri.gov]
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Sent: Thur 10/20/2016 5:18:34 PM
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George

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Paul J. Miller, Deputy Director & Chief Scientist
Northeast States for Coordinated Air Use Management
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Fax: 617-742-9162
www.nescaum.org

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To: Kathleen.Knight@ct.gov; paul.farrell@ct.gov; paul.bodner@ct.gov; wendy.jacobs@ct.gov; kurt.kebschull@ct.gov; Pete.Babich@ct.gov; Jaimeson.Sinclair@ct.gov; michael.geigert@ct.gov; Kiernan.Wholean@ct.gov; mark.wert@state.ma.us; Azin.Kavian@state.ma.us; Glenn.Keith@state.ma.us; tom.downs@maine.gov; jeff.s.crawford@maine.gov; Tom.Graham@maine.gov; Michele.Roberge@des.nh.gov; Jeffrey.Underhill@des.nh.gov; Michael.Fitzgerald@des.nh.gov; Sharon.Davis@dep.nj.gov; Judy.Rand@dep.nj.gov; robert.bielawa@dec.ny.gov; scott.griffin@dec.ny.gov; Diana.Rivenburgh@dec.ny.gov; rob.sliwinski@dec.ny.gov; karen.slattery@dem.ri.gov; Barbara.H.Morin@health.ri.gov; Bennet.Leon@vermont.gov; Jeff.Merrell@vermont.gov; Simcox.Alison@epa.gov; McWilliams.Anne@epa.gov; arnold.anne@epa.gov; burkhart.richard@epa.gov; conroy.dave@epa.gov; biton.leiran@epa.gov; judge.robert@epa.gov; McConnell.Robert@epa.gov; ruvo.richard@epa.gov; greene.cynthia@epa.gov; Wong.Shutsu@epa.gov; kelly.bob@epa.gov
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and
https://www.epa.gov/sites/production/files/2016-09/documents/exceptional_events_guidance_9-16-16_final.pdf

The Federal Register notice published Oct. 3: Treatment of Data Influenced by Exceptional Events, 68216-68282
https://www.gpo.gov/fdsys/pkg/FR-2016-10-03/pdf/2016-22983.pdf
https://www.gpo.gov/fdsys/pkg/FR-2016-10-03/html/2016-22983.htm

To: Casburn, Tracey[casburn.tracey@epa.gov]
Cc: Graf, Wayne[wayne.graf@dnr.mo.gov]; Wilbur, Emily[emily.wilbur@dnr.mo.gov]
From: Bybee, Darcy
Sent: Wed 6/7/2017 8:20:48 PM
Subject: RE: 2015 Ozone Designations Delay

Thanks Tracey

Thanks,

Darcy

From: Casburn, Tracey [mailto:casburn.tracey@epa.gov]
Sent: Wednesday, June 07, 2017 3:19 PM
To: Bybee, Darcy
Cc: Graf, Wayne; Wilbur, Emily
Subject: FW: 2015 Ozone Designations Delay

This just in…to us.

From: Scott, Denise
Sent: Wednesday, June 07, 2017 1:10 PM
To: Algoe-Eakin, Amy <Algoe-Eakin.Amy@epa.gov>; Arnold, Anne <Arnold.Anne@epa.gov>; Becoat, gregory <becoat.gregory@epa.gov>; Bell, Tiereny <Bell.Tiereny@epa.gov>; Benjamin, Lynorae <benjamin.lynorae@epa.gov>; Bohnenkamp, Carol <Bohnenkamp.Carol@epa.gov>; Bohning, Scott <Bohning.Scott@epa.gov>; Brown, Ethan <Brown.Ethan@epa.gov>; Burkhart, Richard <burkhart.richard@epa.gov>; Cakir, Halil <Cakir.Halil@epa.gov>; Casburn, Tracey <casburn.tracey@epa.gov>; CHANG, RANDALL <Chang.Randall@epa.gov>; Clover, Fletcher <Clover.Fletcher@epa.gov>; Colon, Toni <Colon.Toni@epa.gov>; D'Agostino, Kathleen <dagostino.kathleen@epa.gov>; Dolwick, Pat <Dolwick.Pat@epa.gov>; Donaldson, Guy <Donaldson.Guy@epa.gov>; Doty, Edward <Doty.Edward@epa.gov>; Dresser, Chris <Dresser.Chris@epa.gov>; Driver, Laurel <Driver.Laurel@epa.gov>; Evangelista, Mark <Evangelista.Mark@epa.gov>; Flagg, MichaelA <Flagg.MichaelA@epa.gov>; Fulton, Abby <Fulton.Abby@epa.gov>; Gabrilovich, Lev <Gabrilovich.Lev@epa.gov>; Garcia, Ariel <Garcia.Ariel@epa.gov>; Gillam, Rick <Gillam.Rick@epa.gov>; Graham, AshleyR <Graham.AshleyR@epa.gov>; Gutierrez, Roberto <Gutierrez.Roberto@epa.gov>; Hammad, Omar <hammad.omar@epa.gov>; Holladay, Cleveland <Holladay.Cleveland@epa.gov>; Israels, Ken <Israels.Ken@epa.gov>; Jay, Michael <Jay.Michael@epa.gov>; Jones, Rhea <Jones.Rhea@epa.gov>; Kapichak, Rudolph <kapichak.rudolph@epa.gov>; Kay, Rynda <Kay.Rynda@epa.gov>; Kelly, Bob

<Kelly.Bob@epa.gov>; Kelly, Johnj <Kelly.Johnj@epa.gov>; Kemp, Lachala <Kemp.Lachala@epa.gov>; Khadr, Asrah <Khadr.Asrah@epa.gov>; Lakeman, Sean <Lakeman.Sean@epa.gov>; Langdon, Robin <Langdon.Robin@epa.gov>; LAWRENCE, LAURA <Lawrence.Laura@epa.gov>; Liljegren, Jennifer <Liljegren.Jennifer@epa.gov>; Lingard, Robert <Lingard.Robert@epa.gov>; Maghran, Lauren <Maghran.Lauren@epa.gov>; Mckelvey, Laura <Mckelvey.Laura@epa.gov>; McKinley, Gobeail <McKinley.Gobeail@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Mebust, Anna <Mebust.Anna@epa.gov>; Mills, Derek <Mills.Derek@epa.gov>; Mooney, John <Mooney.John@epa.gov>; Morales, Monica <Morales.Monica@epa.gov>; Naess, Liz <Naess.Liz@epa.gov>; Oldham, Carla <Oldham.Carla@epa.gov>; Paige, Carrie <Paige.Carrie@epa.gov>; Payton, Richard <Payton.Richard@epa.gov>; Pepple, Karl <Pepple.Karl@epa.gov>; Perlmutt, Lars <perlmutt.lars@epa.gov>; Pino, Maria <Pino.Maria@epa.gov>; Rice, Joann <Rice.Joann@epa.gov>; Rosenthal, Steven <rosenthal.steven@epa.gov>; Salem, Nevine <Salem.Nevine@epa.gov>; Sather, Mark <sather.mark@epa.gov>; Schmitt, Ellen <Schmitt.Ellen@epa.gov>; Schwartz, Colin <Schwartz.Colin@epa.gov>; Simon, Heather <Simon.Heather@epa.gov>; Snyder, Doug <Snyder.Doug@epa.gov>; Solomon, Douglas <Solomon.Douglas@epa.gov>; Spann, Jane <Spann.Jane@epa.gov>; Stackhouse, Butch <Stackhouse.Butch@epa.gov>; Stanton, Marya <Stanton.Marya@epa.gov>; Suzuki, Debra <Suzuki.Debra@epa.gov>; Svingen, Eric <Svingen.Eric@epa.gov>; Tax, Wienke <Tax.Wienke@epa.gov>; Terry, Astrid <Terry.Astrid@epa.gov>; Tierney, Jan <tierney.jan@epa.gov>; Vallano, Dena <Vallano.Dena@epa.gov>; Velez-Rosa, Emlyn <Velez-Rosa.Emlyn@epa.gov>; Wells, Benjamin <Wells.Benjamin@epa.gov>; Williams, Jennifer <Williams.Jennifer@epa.gov>; Wong, Richard <Wong.Richard@epa.gov>; Wright, Rhonda <Wright.Rhonda@epa.gov>; YOSHIMURA, GWEN <Yoshimura.Gwen@epa.gov>; Young, Carl <young.carl@epa.gov>
Subject: 2015 Ozone Designations Delay

Good Afternoon,

By now you have probably heard that Administrator Pruitt sent a letter to the states yesterday notifying them that EPA is extending the deadline for promulgating designations for the 2015 ozone NAAQS for 1 year. This letter is posted on our designations home page at: https://www.epa.gov/ozone-designations.

Once we find out more information regarding the new timeline, we will set up a workgroup call to discuss. In the meantime, if you have any questions, please do not hesitate to call me at the number listed below.

Thanks!

Denise Scott, QEP, MESH

Environmental Protection Specialist

USEPA Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711
(919) 541-4280

To: Bybee, Darcy[darcy.bybee@dnr.mo.gov]; Wayne Graf[wayne.graf@dnr.mo.gov]; Emily Wilbur (emily.wilbur@dnr.mo.gov)[emily.wilbur@dnr.mo.gov]
From: Casburn, Tracey
Sent: Wed 6/28/2017 4:23:36 PM
Subject: FW: Extension of Deadline for Promulgating Designations for the 2015 Ozone National Ambient Air Quality Standards
Extension of Deadline for 2015 Ozone_NAAQS.pdf

FYI

From: Simpson, Jan
Sent: Wednesday, June 28, 2017 7:52 AM
To: Jay, Michael <Jay.Michael@epa.gov>; Bhesania, Amy <Bhesania.Amy@epa.gov>; Kemp, Lachala <Kemp.Lachala@epa.gov>
Cc: Hamilton, Heather <Hamilton.Heather@epa.gov>; Casburn, Tracey <casburn.tracey@epa.gov>; Crable, Gregory <Crable.Gregory@epa.gov>; Bredehoft, Deborah <bredehoft.deborah@epa.gov>
Subject: Extension of Deadline for Promulgating Designations for the 2015 Ozone National Ambient Air Quality Standards

ENVIRONMENTAL PROTECTION AGENCY

40 CFR PART 81

[EPA–HQ–OAR–2017–0223; FRL–9964–37–OAR]

Extension of Deadline for Promulgating Designations for the

2015 Ozone National Ambient Air Quality Standards

AGENCY: Environmental Protection Agency (EPA).

ACTION: Extension of deadline for promulgating designations.

SUMMARY: The Environmental Protection Agency (EPA) is announcing that it is using its authority under the Clean Air

Act (CAA) to extend by 1 year the deadline for promulgating initial area designations for the ozone national

ambient air quality standards (NAAQS) that were promulgated in October 2015. The new deadline is October 1, 2018.

Jan Simpson

Program Analyst

U.S. EPA Region 7

Air and Waste Management Division

11201 Renner Blvd., Lenexa, KS 66219

(913) 551-7089; simpson.jan@epa.gov

Region 7 Federally approved rules may be found at the link below.

https://wcms.epa.gov/air-quality-implementation-plans/approved-air-quality-implementation-plans-region-7

To: Bybee, Darcy[darcy.bybee@dnr.mo.gov]
Cc: Wayne Graf[wayne.graf@dnr.mo.gov]; Emily Wilbur (emily.wilbur@dnr.mo.gov)[emily.wilbur@dnr.mo.gov]
From: Casburn, Tracey
Sent: Wed 6/7/2017 8:18:58 PM
Subject: FW: 2015 Ozone Designations Delay

This just in…to us.

From: Scott, Denise
Sent: Wednesday, June 07, 2017 1:10 PM
To: Algoe-Eakin, Amy <Algoe-Eakin.Amy@epa.gov>; Arnold, Anne <Arnold.Anne@epa.gov>; Becoat, gregory <becoat.gregory@epa.gov>; Bell, Tiereny <Bell.Tiereny@epa.gov>; Benjamin, Lynorae <benjamin.lynorae@epa.gov>; Bohnenkamp, Carol <Bohnenkamp.Carol@epa.gov>; Bohning, Scott <Bohning.Scott@epa.gov>; Brown, Ethan <Brown.Ethan@epa.gov>; Burkhart, Richard <burkhart.richard@epa.gov>; Cakir, Halil <Cakir.Halil@epa.gov>; Casburn, Tracey <casburn.tracey@epa.gov>; CHANG, RANDALL <Chang.Randall@epa.gov>; Clover, Fletcher <Clover.Fletcher@epa.gov>; Colon, Toni <Colon.Toni@epa.gov>; D'Agostino, Kathleen <dagostino.kathleen@epa.gov>; Dolwick, Pat <Dolwick.Pat@epa.gov>; Donaldson, Guy <Donaldson.Guy@epa.gov>; Doty, Edward <Doty.Edward@epa.gov>; Dresser, Chris <Dresser.Chris@epa.gov>; Driver, Laurel <Driver.Laurel@epa.gov>; Evangelista, Mark <Evangelista.Mark@epa.gov>; Flagg, MichaelA <Flagg.MichaelA@epa.gov>; Fulton, Abby <Fulton.Abby@epa.gov>; Gabrilovich, Lev <Gabrilovich.Lev@epa.gov>; Garcia, Ariel <Garcia.Ariel@epa.gov>; Gillam, Rick <Gillam.Rick@epa.gov>; Graham, AshleyR <Graham.AshleyR@epa.gov>; Gutierrez, Roberto <Gutierrez.Roberto@epa.gov>; Hammad, Omar <hammad.omar@epa.gov>; Holladay, Cleveland <Holladay.Cleveland@epa.gov>; Israels, Ken <Israels.Ken@epa.gov>; Jay, Michael <Jay.Michael@epa.gov>; Jones, Rhea <Jones.Rhea@epa.gov>; Kapichak, Rudolph <kapichak.rudolph@epa.gov>; Kay, Rynda <Kay.Rynda@epa.gov>; Kelly, Bob <Kelly.Bob@epa.gov>; Kelly, Johnj <Kelly.Johnj@epa.gov>; Kemp, Lachala <Kemp.Lachala@epa.gov>; Khadr, Asrah <Khadr.Asrah@epa.gov>; Lakeman, Sean <Lakeman.Sean@epa.gov>; Langdon, Robin <Langdon.Robin@epa.gov>; LAWRENCE, LAURA <Lawrence.Laura@epa.gov>; Liljegren, Jennifer <Liljegren.Jennifer@epa.gov>; Lingard, Robert <Lingard.Robert@epa.gov>; Maghran, Lauren <Maghran.Lauren@epa.gov>; Mckelvey, Laura <Mckelvey.Laura@epa.gov>; McKinley, Gobeail <McKinley.Gobeail@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Mebust, Anna <Mebust.Anna@epa.gov>; Mills, Derek <Mills.Derek@epa.gov>; Mooney, John <Mooney.John@epa.gov>; Morales, Monica <Morales.Monica@epa.gov>; Naess, Liz <Naess.Liz@epa.gov>; Oldham, Carla <Oldham.Carla@epa.gov>; Paige, Carrie <Paige.Carrie@epa.gov>; Payton, Richard <Payton.Richard@epa.gov>; Pepple, Karl <Pepple.Karl@epa.gov>; Perlmutt, Lars <perlmutt.lars@epa.gov>; Pino, Maria <Pino.Maria@epa.gov>; Rice, Joann <Rice.Joann@epa.gov>; Rosenthal, Steven <rosenthal.steven@epa.gov>; Salem, Nevine <Salem.Nevine@epa.gov>; Sather, Mark <sather.mark@epa.gov>; Schmitt, Ellen <Schmitt.Ellen@epa.gov>; Schwartz, Colin

<Schwartz.Colin@epa.gov>; Simon, Heather <Simon.Heather@epa.gov>; Snyder, Doug <Snyder.Doug@epa.gov>; Solomon, Douglas <Solomon.Douglas@epa.gov>; Spann, Jane <Spann.Jane@epa.gov>; Stackhouse, Butch <Stackhouse.Butch@epa.gov>; Stanton, Marya <Stanton.Marya@epa.gov>; Suzuki, Debra <Suzuki.Debra@epa.gov>; Svingen, Eric <Svingen.Eric@epa.gov>; Tax, Wienke <Tax.Wienke@epa.gov>; Terry, Astrid <Terry.Astrid@epa.gov>; Tierney, Jan <tierney.jan@epa.gov>; Vallano, Dena <Vallano.Dena@epa.gov>; Velez-Rosa, Emlyn <Velez-Rosa.Emlyn@epa.gov>; Wells, Benjamin <Wells.Benjamin@epa.gov>; Williams, Jennifer <Williams.Jennifer@epa.gov>; Wong, Richard <Wong.Richard@epa.gov>; Wright, Rhonda <Wright.Rhonda@epa.gov>; YOSHIMURA, GWEN <Yoshimura.Gwen@epa.gov>; Young, Carl <young.carl@epa.gov>
Subject: 2015 Ozone Designations Delay

Good Afternoon,

By now you have probably heard that Administrator Pruitt sent a letter to the states yesterday notifying them that EPA is extending the deadline for promulgating designations for the 2015 ozone NAAQS for 1 year. This letter is posted on our designations home page at: https://www.epa.gov/ozone-designations.

Once we find out more information regarding the new timeline, we will set up a workgroup call to discuss. In the meantime, if you have any questions, please do not hesitate to call me at the number listed below.

Thanks!

Denise Scott, QEP, MESH

Environmental Protection Specialist

USEPA Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711
(919) 541-4280

To: Bybee, Darcy[darcy.bybee@dnr.mo.gov]; Wayne Graf[wayne.graf@dnr.mo.gov]; Emily Wilbur (emily.wilbur@dnr.mo.gov)[emily.wilbur@dnr.mo.gov]; todd.ellis@nebraska.gov[todd.ellis@nebraska.gov]
Cc: Bhesania, Amy[Bhesania.Amy@epa.gov]; Algoe-Eakin, Amy[Algoe-Eakin.Amy@epa.gov]; Crable, Gregory[Crable.Gregory@epa.gov]
From: Casburn, Tracey
Sent: Wed 11/16/2016 2:59:04 PM
Subject: FW: WEBINAR ANNOUNCEMENT: Proposed Rule: Implementation of the 2015 O3 NAAQS

Please see the forwarded message below.

Todd, Greg is out of the office today and I am forwarding this to you on his behalf. My apologies if I missed the target audience ☺

Tracey

From: Algoe-Eakin, Amy
Sent: Wednesday, November 16, 2016 8:37 AM
To: Schulingkamp, Joseph <Schulingkamp.Joseph@epa.gov>; Casburn, Tracey <casburn.tracey@epa.gov>; Hamilton, Heather <Hamilton.Heather@epa.gov>; Bredehoft, Deborah <bredehoft.deborah@epa.gov>; Crable, Gregory <Crable.Gregory@epa.gov>
Subject: FW: WEBINAR ANNOUNCEMENT: Proposed Rule: Implementation of the 2015 O3 NAAQS

FYI

From: Perez, Idalia
Sent: Tuesday, November 15, 2016 2:51 PM
To: Air Division Directors and Deputies <Air_Division_Directors_and_Deputies@epa.gov>; Air Program Managers - Regions <Air_Program_Managers_Regions@epa.gov>
Cc: Whitlow, Jeff <Whitlow.Jeff@epa.gov>; Lingard, Robert <Lingard.Robert@epa.gov>; Johnson, Yvonne W <Johnson.Yvonnew@epa.gov>
Subject: WEBINAR ANNOUNCEMENT: Proposed Rule: Implementation of the 2015 O3 NAAQS

ADDs and APMs – FYI and please share with your contacts. –Idalia

For distribution to Regions, State, Local and Tribal Air Agencies, communities, industry, environmental groups, and the general public:

Webinar: **PROPOSED RULE: IMPLEMENTATION OF THE 2015 NATIONAL AMBIENT AIR QUALITY STANDARDS FOR OZONE: NONATTAINMENT AREA CLASSIFICATIONS AND STATE IMPLEMENTATION PLAN REQUIREMENTS**
Date: Wednesday, December 7, 2016
Time: 2:00 – 3:30 PM Eastern Time
Intended Audience: Regions, State, Local, and Tribal Air Agencies, communities, industry, environmental groups, and the general public
Link to Join Webinar: https://epawebconferencing.acms.com/nonattainment-sip

Description: On November 2, 2016, the U.S. Environmental Protection Agency proposed requirements that would apply to state, local, and tribal air agencies for implementing the 2015 National Ambient Air Quality Standards (NAAQS) for ground-level ozone. The EPA revised both the health-based and welfare-based standards for ozone on October 1, 2015. This proposed action largely retains and updates the implementing regulations that apply for the 2008 ozone NAAQS, for purposes of the 2015 ozone standards, which creates stability in the planning process. This action also proposes two options for revoking the 2008 ozone NAAQS. The EPA is also seeking comment on a number of additional topics, including: (1) managing emissions from wildfires and wildland prescribed fires; (2) transportation conformity and general conformity; (3) contingency measures; (4) international transport and background ozone; and (5) additional policies for achieving emissions reductions. This webinar is intended to provide highlights of the proposed rule and address clarifying questions. To download a copy of the proposed rule or for more information go to https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state.

Logistics: You will listen to the audio via your computer. We highly recommend running a connect test on your system before logging into the webinar to ensure that the proper add-ins are enabled and the audio is working properly:
http://admin.adobeconnect.com/common/help/en/support/meeting_test.htm.

SLT Call Meeting: Wednesday, January 25th, 10 AM – 11 AM, CT
Call Number: 877-226-9607
Conference Code: Ex. 4 - CBI

Next call: **Wednesday, February 22nd, 10 AM – 11 AM, CT**

Action Items:

1. State agencies will review the "O3_site_combinations.xlsx" spreadsheet, determine if a site combination for trends data is acceptable, adjust Y/N column, and send back to their respective Region 5 state lead (*See #2*).
2. SLT agencies should inform J. McGrath (EPA) if they are still unable to upload CSN flow data.
3. State agencies will send SO_2 DRR site evaluation coordination dates and QAPPs to B. Qazzaz (EPA) once they are determined or received/completed, respectively.
4. State agencies can submit comments to proposed settlement (*See #7*).
5. EPA Region 5 will send air quality sensor survey to SLT agencies.
6. EPA Region 5 leads for QA meeting sessions will be reaching out to selected states or locals to provide examples or requests to present their process/perspectives.

Agenda:

1. **Implementation of low calibration O_3 scales (S. Hamilton)**

Scott Hamilton (EPA) sent an email on Dec 29th, 2016 describing the implementation of the low calibration O_3 scales. It has been in the QA handbook since 2013 (calibration vs. upper range limits), in sections 10 and 12. The primary idea is to conduct calibrations that allow for QC check points to be more in range of calibration scale.

WDNR stated that there is concern that the distribution of calibration points does not include the lowest required audit point. WDNR suggested picking a span point, and then equally distributing points across the range. Also, WDNR recommend using the same points for calibration as what is required in the annual performance evaluations. For example, WDNR is doing 15-160 pbbv, and is evenly spacing 5 points across that range.

- Report Out for top calibration point:

STATE	RANGE REPORTED	CALIBRATION SET POINT
MN	0-500	140
WI	0-200	160
IL	0-200	180
CCDEC	0-200	180
IN	0-200	160
MI	0-250	200

- OH 0-200 180

2. **O_3 site combination for trend data (J. McGrath)**

OAQPS has kept an ad-hoc list of site combinations, but they would like to have monitor pairs documented within AQS. OAQPS has requested that states review combinations of: An O_3 site that shut down and a new site that was installed near the previous one, and where the new sits began shortly before or after the end date for the shut-down site. Please review the steps below to complete the O_3 site combination task:

- Please review the attached file "O3_site_combinations.xlsx" and mark which sites should have combined data sets, due by February 21st. The accompanying file, "O3sitecombos.kml", shows where the monitors are located.
    - Only sites with an "N" in the "existing" column (column T) need to be reviewed.
    - For sites that should be combined, mark the column as "Y".
    - For sites that should not be combined, leave the column as "N".
    - In instances where you've already discussed whether sites could be combined with EPA Region 5, please retain that decision.
    - **Combining these data sets will not overturn previous design value decisions, since old design value periods are not revisited**. This information will, however, be used for Air Trends reporting by potentially increasing the number of sites with longer historical data records.

3. **Ft. McMurray Exceptional Event (J. McGrath)**

The Fort McMurray wildfire occurred in Alberta, Canada from May 1st, 2016 through early July 2016. EPA Region 5 requested to know if any sites within the region were affected by this event. WDNR stated that they were affected but not exceptionally.

4. **Follow-up on CSN flow upload (J. McGrath)**

EPA Region 5 stated that very few states have been successful in uploading CSN flow data. Every single case that was occurring was because states don't have rights to upload or to change the access. AQS has list of every single site and was fixing the issue as of January 25th, 2017. They were manually uploading sites, and the issue should have been fixed as of January 27th, 2017. Please inform Jesse McGrath (EPA) if the problem persists.

5. **SO_2 DRR TSAs (B. Qazzaz)**

As of 1/1/17, SO_2 DRR monitoring sites should have been operational. EPA Region 5 is going to be conducting TSAs on these sites in 2017. EPA will be looking at submitted QAPPs as review documents before the TSA schedule is released. EPA would like agencies to send the following to Bilal Qazzaz (Qazzaz.bilal@epa.gov and Vijay Limaye (Limaye.vijay@epa.gov):

- **Any known dates that the agency will be performing a site evaluation**, to potentially couple with Region 5's TSA of the site
- QAPPs as they are received

Additionally, if there are self-approved (by the State PQAO) QAPPs, please send to EPA Region 5 so a courtesy copy can be maintained. Also, EPA mentioned that we will be prioritizing through the probes (TTP's) at the SO_2 DRR sites. TTP's will be conducted within two years by contractors as long as the DRR site is reported under the State's PQAO. If the sites are not reporting under the State's PQAO, then the State is ultimately responsible for working with the facility (site operators) to complete the audits.

6. **Mass Foil Calibrators for Thermo SHARP (Canton)**

Canton received a calibrator that was certified in September 2015, but was received in September 2016. There is not existing guidance within the technical documents for recertification of the calibrators. OAQPS gave subsequent guidance stating that:

"Since these are FEMs, go with what is stated in the corresponding operator's manual…If [no requirement is in the manual], there is no requirement."

7. **Proposed settlement for monitoring suit (Hamilton County)**

Sierra Club has sued EPA after 2016 revisions to monitoring rule. Last week, a federal register notice was published for the proposed settlement. It is open for public comment for 30 days (deadline: February 21st, 2017). The proposed settlement relies on two nonbinding guidance documents, which recommends for public notification practices to "stakeholders" from state agencies, and the other is concerning approval of annual network plans and EPA providing a notice of approvals/disapprovals to "stakeholders". If you would like to provide a comment on the register, please follow the instructions provided in the FR notice at the following url:

https://www.federalregister.gov/documents/2017/01/19/2017-01099/proposed-settlement-agreement-clean-air-act-petition-for-review

Announcements:

8. **Regional sensor survey upcoming (V. Limaye)**

Nationally, EPA is taking a more active role for citizens in regards to air sensors.

EPA is going to launch a short survey within Region 5 to find out which air quality sensors are being used and where. Information that is received will be shared to understand best practices and national inventory. Once EPA Region 5 sends the survey, please share it with your community partners.

9. Air Quality Awareness Week (V. Limaye)

EPA and other federal partners, NOAA and CDC, have announced that May 1st-5th, 2017 will be air quality awareness week. There are five topics that are planned, one for each day of the week. If there are any events happening that week, please inform EPA Region 5 (Vijay Limaye) or Debra Lee (lee.debra@epa.gov), and it will be shared through the Airnow website (https://www3.epa.gov/airnow/airaware/).

10. GMAP solicitation (S. Hamilton)

EPA Region 5 has the capability to conduct mobile air monitoring to measure CH_4, H_2S, SO_2, BTEX, meteorology, and GPS coordinates simultaneously. Region 5 can produce Google satellite images of concentrations over time and space. If any agency hears from state enforcement employees about sites where this system would be useful, please inform Scott Hamilton (Hamilton.scott@epa.gov).

11. $PM_{2.5}$ Teflon filter delivery confirmation (J. Coughlin)

EPA Region 5 acknowledged that Teflon $PM_{2.5}$ filters should have now been received by agencies from OAQPS. Please inform Justin Coughlin (Coughlin.justin@epa.gov) if your agency has not received your respective filters yet. WDNR stated that a new matrix barcode has been added to the filters, and they wanted to know what it was for and receive assurance that it would not result in filter issues. Subsequent follow-up with OAQPS resulted in Region 5 stating:

"The barcode is being used by agencies that use a robotic weighing device for the filters. It was implemented to allow for an easier and quicker way of identifying filters as they are going through the weighing process. **If your agency is not using a robotic weighing device, then you can continue using the ID number that is printed on the filter**. These barcodes have been used and tested in the past and there have not been any issues due to the barcodes."

Please inform Justin Coughlin or Chad McEvoy (mcevoy.chad@epa.gov) if your lab does have issues with the Teflon $PM_{2.5}$ filters due to the new barcode.

12. Regional QA Meeting (B. Qazzaz)

EPA Region 5 is holding a regional QA meeting from March 22nd to the March 23rd. The format will be similar to the previous meeting in 2015. EPA Region 5 is going to poll the region next month to begin getting a head count, and will also being reaching out to states to request specific examples from agencies for certain topics. The agenda has been attached.

Additional Topics Raised:

13. On Jan 26th and 27th, Hamilton County and WDNR are attending the NAACA Monitoring Steering Committee, which includes many staff from OAQPS.
14. EPA Region 5 is in need of 2 spare solar shields for Anderson $PM_{2.5}$.
15. Report Out:
    - WDNR will be submitting early data certifications for O_3 in mid-February
    - Hamilton County has replaced an O_3 site for March 1st start date

From: Paul Miller
Location: Dial 877-594-8353; code 16843362#
Importance: Normal
Subject: NESCAUM directors' monthly call Wed. June 21, 11am-noon
Start Date/Time: Wed 6/21/2017 3:00:00 PM
End Date/Time: Wed 6/21/2017 4:00:00 PM
STAG FY2016 breakdown of special projects from DConroy 20160919.pdf

;
The next monthly NESCAUM directors' call is Wednesday, June 21, 11am-noon.
Dial: 877-594-8353
Code: 16843362#
The draft call agenda is:

1. NESCAUM sec. 105 dues, ZEV and other contributions FY2017 (FY2016 levels attached)
2. Ozone season update
3. EPA 1-yr delay of 2015 ozone NAAQS designations
4. NOAA proposal to defund HYSPLIT and other tools
5. Other items?

Please send me any other agenda items by noon Tuesday, June 20. Thanks, Paul

To: Anne Gobin[anne.gobin@ct.gov]; Arthur Marin[amarin@nescaum.org]; Becky Ohler[Rebecca.Ohler@des.nh.gov]; Christine Kirby[christine.kirby@state.ma.us]; Craig A. Wright[CRAIG.WRIGHT@DES.NH.GOV]; Doug McVay[doug.mcvay@dem.ri.gov]; Gary Rose[Gary.Rose@ct.gov]; Glenn Keith[Glenn.Keith@state.ma.us]; Heidi Hales[heidi.hales@vermont.gov]; Jeff Crawford[jeff.s.crawford@maine.gov]; Jeff Underhill[junderhill@des.state.nh.us]; Laurie Grandchamp[laurie.grandchamp@dem.ri.gov]; Marc Cone[marc.a.cone@maine.gov]; Michele Roberge[michele.roberge@des.nh.gov]; Mike Fitzgerald[mfitzgerald@des.state.nh.us]; Paul Farrell[paul.farrell@ct.gov]; Paul Miller[pmiller@nescaum.org]; Richard Pirolli[ric.pirolli@ct.gov]
Cc: Anne Arnold[Arnold.Anne@epa.gov]; Richard Burkhart[burkhart.richard@epa.gov]; David Mackintosh[MacKintosh.David@epa.gov]
From: Conroy, David
Sent: Wed 6/7/2017 1:52:45 PM
Subject: Letter on ozone designations
EPA ozone letter.pdf

FYI. This letter was sent to Governors yesterday.

See press release at: https://www.epa.gov/newsreleases/epa-extend-deadline-2015-ozone-naaqs-area-designations

David Conroy
Air Programs Manager
U.S. Environmental Protection Agency, Region 1

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iPhone: 857-829-8239
Fax: 617-918-0661

E. SCOTT PRUITT
ADMINISTRATOR

June 6, 2017

The Honorable Doug Ducey
Governor of Arizona
State Capitol
1700 W. Washington Street
Phoenix, AZ 85007

Dear Governor Ducey:

I am writing to update you on the status of the U.S. Environmental Protection Agency's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. Pursuant to section 107(d)(1)(B) of the Clean Air Act (CAA), I am extending the deadline for promulgating initial area designations for the 2015 ozone NAAQS by one year. I have determined that there is insufficient information, and taking additional time is appropriate in order to consider completely all designation recommendations provided by state governors pursuant to CAA section 107(d)(1)(A) and to rely fully on the most recent air quality data. This additional time will also provide the Agency time to complete its review of the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states, localities and regulated entities. As part of the review process, the Agency is evaluating these issues primarily focusing on: fully understanding the role of background ozone levels; appropriately accounting for international transport; and, timely consideration of exceptional events demonstrations. Additionally, pursuant to language in the recently-enacted FY 2017 omnibus bill, I have established an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

States have made tremendous progress and significant investment cleaning up the air. Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased. I am committed to working with you and your local officials to effectively implement the ozone standard in a manner that is supportive of your air quality improvement efforts, without interfering with local decisions or impeding economic growth.

1200 PENNSYLVANIA AVE. NW • MAIL CODE 1101A • WASHINGTON, DC 20460 • (202) 564-4700 • FAX: (202) 501-1450

This paper is printed with vegetable-oil-based inks and is 100-percent postconsumer recycled material, chlorine-free-processed and recyclable.

I appreciate the information you and your staff have shared with EPA already as part of this process. I am confident this progress will continue as we work together towards our shared goal of clean air, a robust economy and stronger, healthier communities. If you have questions or concerns, please contact me or your staff may contact Troy Lyons, Associate Administrator for the Office of Congressional and Intergovernmental Relations, at lyons.troy@epa.gov or (202) 564-4987.

Respectfully yours,

E. Scott Pruitt

To: Conroy, David[Conroy.Dave@epa.gov]
From: Underhill, Jeff
Sent: Wed 6/7/2017 2:58:18 PM
Subject: RE: Letter on ozone designations

Thanks Dave,

Do you have any information on the Ozone Cooperative Compliance Task Force? Who it consists of and what their charge is?

Jeff

From: Conroy, David [mailto:Conroy.Dave@epa.gov]
Sent: Wednesday, June 7, 2017 9:53 AM
To: Anne Gobin; amarin@nescaum.org; Ohler, Becky; Christine Kirby; Wright, Craig; Doug McVay; Gary Rose; Glenn Keith; Heidi Hales; Jeff Crawford; Underhill, Jeff; Grandchamp, Laurie (DEM); Marc Cone; Roberge, Michele; Fitzgerald, Mike; Paul Farrell; Paul Miller; Richard Pirolli
Cc: Arnold, Anne; Burkhart, Richard; Mackintosh, David
Subject: Letter on ozone designations

FYI. This letter was sent to Governors yesterday.

See press release at: https://www.epa.gov/newsreleases/epa-extend-deadline-2015-ozone-naaqs-area-designations

David Conroy

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To: Anne Gobin (Anne.Gobin@ct.gov)[Anne.Gobin@ct.gov]; Beth Thornton[beth.thornton@dec.ny.gov]; Bill O'Sullivan[Bill.O'Sullivan@dep.nj.gov]; Chris Salmi[Chris.Salmi@dep.nj.gov]; Christine Kirby (Christine.Kirby@state.ma.us)[Christine.Kirby@state.ma.us]; Craig Wright (craig.wright@des.nh.gov)[craig.wright@des.nh.gov]; Doug Elliott (doug.elliott@vermont.gov)[doug.elliott@vermont.gov]; Glenn Keith[Glenn.Keith@state.ma.us]; Heidi Hales[Heidi.Hales@vermont.gov]; Jeff Crawford[jeff.s.crawford@maine.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; Kenneth Ratzman (Kenneth.ratzman@dep.nj.gov)[Kenneth.ratzman@dep.nj.gov]; Grandchamp, Laurie (DEM)[laurie.grandchamp@dem.ri.gov]; Linda Miller (Linda.Miller@dep.nj.gov)[Linda.Miller@dep.nj.gov]; Marc Cone (Marc.A.Cone@maine.gov)[Marc.A.Cone@maine.gov]; michael.fitzgerald@des.nh.gov[michael.fitzgerald@des.nh.gov]; Peg Hanna (peg.hanna@dep.state.nj.us)[peg.hanna@dep.state.nj.us]; Rebecca Ohler (rebecca.ohler@des.nh.gov)[rebecca.ohler@des.nh.gov]; Ric Pirolli (ric.pirolli@ct.gov)[ric.pirolli@ct.gov]; Richelle Wormley[Richelle.Wormley@dep.nj.gov]; Rob Sliwinski (rob.sliwinski@dec.ny.gov)[rob.sliwinski@dec.ny.gov]; Sharon Weber[Sharon.Weber@state.ma.us]; Steitz, Francis[Francis.Steitz@dep.nj.gov]; 'Steve Flint'[steven.flint@dec.ny.gov]; Conroy, David[Conroy.Dave@epa.gov]; Filippelli, John[Filippelli.John@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]
Cc: All_Staff[All_Staff@nescaum.org]; David Foerter (dfoerter@otcair.org)[dfoerter@otcair.org]
From: Paul Miller
Sent: Tue 6/20/2017 7:48:02 PM
Subject: NESCAUM directors' call final agenda for Wed., 6/21, 11am-noon
STAG FY2016 and special projects 20160919.pdf
ZEV Campaign NECOE 20160601.docx
NESCAUM region O3 season to date 20170613.xlsx

Here are additional items and the final agenda for the next monthly NESCAUM directors' call on Wednesday, June 21, 11am-noon.

Dial: 877-594-8353

Code: Ex. 6 - Personal Privacy

The final call agenda is:

1. NESCAUM sec. 105 dues, EV Outreach, ZEV and other contributions FY2017 (items attached)

2. Ozone season update (summary attached)

3. EPA 1-yr delay of 2015 ozone NAAQS designations

4. NOAA proposal to defund HYSPLIT and other tools

5. Other items as raised on call

Paul J. Miller, Deputy Director & Chief Scientist

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Follow us:

To: Paul Miller[pmiller@nescaum.org]; Anne Gobin (Anne.Gobin@ct.gov)[Anne.Gobin@ct.gov]; Beth Thornton[beth.thornton@dec.ny.gov]; Bill O'Sullivan[Bill.O'Sullivan@dep.nj.gov]; Chris Salmi[Chris.Salmi@dep.nj.gov]; Christine Kirby (Christine.Kirby@state.ma.us)[Christine.Kirby@state.ma.us]; Craig Wright (craig.wright@des.nh.gov)[craig.wright@des.nh.gov]; Doug Elliott (doug.elliott@vermont.gov)[doug.elliott@vermont.gov]; Doug McVay[doug.mcvay@dem.ri.gov]; Glenn Keith[Glenn.Keith@state.ma.us]; Heidi Hales[Heidi.Hales@vermont.gov]; Jeff Crawford[jeff.s.crawford@maine.gov]; jeffrey.underhill@des.nh.gov[Jeffrey.Underhill@des.nh.gov]; Kenneth Ratzman (Kenneth.ratzman@dep.nj.gov)[Kenneth.ratzman@dep.nj.gov]; Laurie Grandchamp[laurie.grandchamp@dem.ri.gov]; Linda Miller (Linda.Miller@dep.nj.gov)[Linda.Miller@dep.nj.gov]; Marc Cone (Marc.A.Cone@maine.gov)[Marc.A.Cone@maine.gov]; michael.fitzgerald@des.nh.gov[michael.fitzgerald@des.nh.gov]; Peg Hanna (peg.hanna@dep.state.nj.us)[peg.hanna@dep.state.nj.us]; Rebecca Ohler (rebecca.ohler@des.nh.gov)[rebecca.ohler@des.nh.gov]; Ric Pirolli (ric.pirolli@ct.gov)[ric.pirolli@ct.gov]; Richelle Wormley[Richelle.Wormley@dep.nj.gov]; Rob Sliwinski (rob.sliwinski@dec.ny.gov)[rob.sliwinski@dec.ny.gov]; Sharon Weber[Sharon.Weber@state.ma.us]; Steitz, Francis[Francis.Steitz@dep.nj.gov]; 'Steve Flint'[steven.flint@dec.ny.gov]; Conroy, David[Conroy.Dave@epa.gov]; Filippelli, John[Filippelli.John@epa.gov]; Ruvo, Richard[Ruvo.Richard@epa.gov]
Cc: All_Staff[All_Staff@nescaum.org]
From: Charla Rudisill
Sent: Thur 2/16/2017 6:33:24 PM
Subject: Next NESCAUM directors' meeting - set

The meeting will be held on April 26-27 at the Whispering Pines Conference Center, University of Rhode Island W. Alton Jones Campus, West Greenwich, RI. Details and travel agenda will be forthcoming.

From: Paul Miller
Sent: Thursday, February 16, 2017 8:17 AM
To: Anne Gobin (Anne.Gobin@ct.gov) <Anne.Gobin@ct.gov>; Beth Thornton <beth.thornton@dec.ny.gov>; Bill O'Sullivan <Bill.O'Sullivan@dep.nj.gov>; Chris Salmi <Chris.Salmi@dep.nj.gov>; Christine Kirby (Christine.Kirby@state.ma.us) <Christine.Kirby@state.ma.us>; Craig Wright (craig.wright@des.nh.gov) <craig.wright@des.nh.gov>; Doug Elliott (doug.elliott@vermont.gov) <doug.elliott@vermont.gov>; Doug McVay <doug.mcvay@dem.ri.gov>; Glenn Keith <Glenn.Keith@state.ma.us>; Heidi Hales <Heidi.Hales@vermont.gov>; Jeff Crawford <jeff.s.crawford@maine.gov>; Jeff Underhill <jeffrey.underhill@des.nh.gov>; Kenneth Ratzman (Kenneth.ratzman@dep.nj.gov) <Kenneth.ratzman@dep.nj.gov>; Laurie Grandchamp <laurie.grandchamp@dem.ri.gov>; Linda Miller (Linda.Miller@dep.nj.gov) <Linda.Miller@dep.nj.gov>; Marc Cone (Marc.A.Cone@maine.gov) <Marc.A.Cone@maine.gov>; Mike Fitzgerald <Michael.Fitzgerald@des.nh.gov>; Peg Hanna (peg.hanna@dep.state.nj.us) <peg.hanna@dep.state.nj.us>; Rebecca Ohler (rebecca.ohler@des.nh.gov) <rebecca.ohler@des.nh.gov>; Ric Pirolli (ric.pirolli@ct.gov)

<ric.pirolli@ct.gov>; Richelle Wormley <Richelle.Wormley@dep.nj.gov>; Rob Sliwinski (rob.sliwinski@dec.ny.gov) <rob.sliwinski@dec.ny.gov>; Sharon Weber <Sharon.Weber@state.ma.us>; Steitz, Francis <Francis.Steitz@dep.nj.gov>; 'Steve Flint' <steven.flint@dec.ny.gov>; Dave Conroy <Conroy.Dave@epamail.epa.gov>; John Filippelli <Filippelli.john@epa.gov>; Richard Ruvo (ruvo.richard@epa.gov) <ruvo.richard@epa.gov>
Cc: All_Staff <All_Staff@nescaum.org>; David Foerter (dfoerter@otcair.org) <dfoerter@otcair.org>
Subject: NESCAUM directors' call notes from 2/15/17

Below are the summary notes from the 2/15/17 NESCAUM monthly directors' call:

On call:

CT: Anne Gobin, Ric Pirolli

ME: Jane Gilbert

MA: Christine Kirby

NH: Craig Wright

NJ: Peg Hanna, Frank Steitz

NY: Steve Flint

RI: Doug McVay

EPA R1: Dave Conroy

OTC: Dave Foerter

NESCAUM: Paul Miller, Kara Murphy, Matt Solomon, Elaine O'Grady, Dick Valentinetti, Kathy Kinsey

Call notes and action items:

1. Update on VW settlement activities

a. Electrify America – potential partnership with NASEO and NESCAUM. Draft MOU sent to directors – there isn't a more recent draft yet. MOU identifies areas of activities NESCAUM would engage with NASEO and Electrify America. Directors would like to avoid a COI on biennial competitive grants program. NASEO has had experience running competitive grants programs. NESCAUM's understanding is that the grants program would provide opportunity for innovative projects outside of priority cities to receive funding from Electrify America.

b. Possible Appendix C challenge – continuing arguments against Appendix C in Congress and possibly courts. NESCAUM will continue tracking.

2. NESCAUM letter to MassDPU on Eversource EV infrastructure and outreach proposal. Draft letter is general support for EV infrastructure and a role for utilities, not specific comments on individual proposals before state utility regulators. Asking for comments from directors in the next 2 weeks. Public comment deadline is open until end of May.

3. Congressional update

a. HR 694 to repeal NSPS for new wood burning devices

b. HR 732 to prohibit future Supplemental Environmental Projects (SEPs)

CT: would like summaries of these as they arise that identify potential impacts if bill passes, and implications for states. Would be up to states to pass along or not.

MA: would like to have discussion at directors' meeting on this, how to flag for states, how to circulate.

NESCAUM asks that if states get contacted with questions on pending bills that we haven't yet flagged, please let us know.

Request made that NESCAUM should provide summary updates on pending bills for NSPS, SEPs, ozone NAAQS delay, CSAPR update.

This will be a topic for further discussion at the April directors' meeting.

4. NESCAUM directors' meeting set for April 26-27, with a tentative location at the Whispering Pines Conference Center, University of Rhode Island W. Alton Jones Campus, West Greenwich, RI. Details and travel agenda will be forthcoming.

Paul J. Miller, Deputy Director & Chief Scientist

Northeast States for Coordinated Air Use Management
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Boston, MA 02111

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Follow us:

To: Underhill, Jeff[Jeffrey.Underhill@des.nh.gov]
Cc: Anne Arnold[Arnold.Anne@epa.gov]
From: Conroy, David
Sent: Wed 6/7/2017 5:06:56 PM
Subject: RE: Letter on ozone designations

I do not, but will see what I can find out.

David Conroy

Air Programs Manager

U.S. Environmental Protection Agency, Region 1

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Fax: 617-918-0661

From: Underhill, Jeff [mailto:Jeffrey.Underhill@des.nh.gov]
Sent: Wednesday, June 07, 2017 10:58 AM
To: Conroy, David <Conroy.Dave@epa.gov>
Subject: RE: Letter on ozone designations

Thanks Dave,

Do you have any information on the Ozone Cooperative Compliance Task Force? Who it consists of and what their charge is?

Jeff

From: Conroy, David [mailto:Conroy.Dave@epa.gov]
Sent: Wednesday, June 7, 2017 9:53 AM
To: Anne Gobin; amarin@nescaum.org; Ohler, Becky; Christine Kirby; Wright, Craig; Doug McVay; Gary Rose; Glenn Keith; Heidi Hales; Jeff Crawford; Underhill, Jeff; Grandchamp, Laurie (DEM); Marc Cone;

Roberge, Michele; Fitzgerald, Mike; Paul Farrell; Paul Miller; Richard Pirolli
Cc: Arnold, Anne; Burkhart, Richard; Mackintosh, David
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To: Anne Gobin[anne.gobin@ct.gov]; Arthur Marin[amarin@nescaum.org]; Becky Ohler[Rebecca.Ohler@des.nh.gov]; Christine Kirby[christine.kirby@state.ma.us]; Craig A. Wright[CRAIG.WRIGHT@DES.NH.GOV]; Doug McVay[doug.mcvay@dem.ri.gov]; Gary Rose[Gary.Rose@ct.gov]; Glenn Keith[Glenn.Keith@state.ma.us]; Heidi Hales (heidi.hales@state.vt.us)[heidi.hales@state.vt.us]; Jeff Crawford[jeff.s.crawford@maine.gov]; Jeff Underhill[junderhill@des.state.nh.us]; Marc Cone[marc.a.cone@maine.gov]; michele.roberge@des.nh.gov[michele.roberge@des.nh.gov]; Mike Fitzgerald[mfitzgerald@des.state.nh.us]; Nancy Seidman[nancy.seidman@state.ma.us]; Paul Farrell[paul.farrell@ct.gov]; Paul Miller[pmiller@nescaum.org]; Richard Pirolli[ric.pirolli@ct.gov]
Cc: Anne Arnold[Arnold.Anne@epa.gov]; Anne Mcwilliams[mcwilliams.anne@epa.gov]; Richard Burkhart[burkhart.richard@epa.gov]; Robert Judge[Judge.Robert@epa.gov]
From: Conroy, David
Sent: Tue 9/20/2016 5:29:39 PM
Subject: Webinar: Final Revisions to the Exceptional Events Rule and Announcement of Availability of Final Exceptional Events Implementation Guidance for Wildfire Events

More information on webinar

David Conroy

Air Programs Manager

U.S. Environmental Protection Agency, Region 1

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Webinar: **Final Revisions to the Exceptional Events Rule and Announcement of Availability of Final Exceptional Events Implementation Guidance for Wildfire Events**
Date: Wednesday, September 21, 2016
Time: 2:00 – 3:30 PM Eastern Time
Intended Audience: Regions, State, Local, and Tribal Air Agencies, communities, industry, environmental groups, and the general public
Link to Join Webinar: https://epawebconferencing.acms.com/e-events

Description: On September 16, 2016, the EPA finalized revisions to the 2007 Exceptional Events Rule to address issues raised by stakeholders since finalizing the 2007 rule and to increase the administrative efficiency of the Exceptional Events Rule process. This action also provides notice to States with areas subject to newly issued mitigation requirements and

announces the availability of the final version of the non-binding guidance document, *Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*, which explains how to apply the rule revisions to wildfire events that could influence monitored ozone concentrations. The EPA will host an informational webinar to summarize the key elements of the final rule revisions and the final exceptional events implementation guidance for wildfire/ozone events. For more information or to download a copy of this final rule and guidance, go to the EPA's Exceptional Events website at https://www.epa.gov/air-quality-analysis/treatment-data-influenced-exceptional-events.

Logistics: You will listen to the audio via your computer. We highly recommend running a connect test on your system before logging into the webinar to ensure that the proper add-ins are enabled and the audio is working properly: http://admin.adobeconnect.com/common/help/en/support/meeting_test.htm.

To: Anne Gobin[anne.gobin@ct.gov]; Arthur Marin[amarin@nescaum.org]; Becky Ohler[Rebecca.Ohler@des.nh.gov]; Christine Kirby[christine.kirby@state.ma.us]; Craig A. Wright[CRAIG.WRIGHT@DES.NH.GOV]; Doug McVay[doug.mcvay@dem.ri.gov]; Gary Rose[Gary.Rose@ct.gov]; Glenn Keith[Glenn.Keith@state.ma.us]; Heidi Hales (heidi.hales@state.vt.us)[heidi.hales@state.vt.us]; Jeff Crawford[jeff.s.crawford@maine.gov]; Jeff Underhill[junderhill@des.state.nh.us]; Marc Cone[marc.a.cone@maine.gov]; michele.roberge@des.nh.gov[michele.roberge@des.nh.gov]; Mike Fitzgerald[mfitzgerald@des.state.nh.us]; Nancy Seidman[nancy.seidman@state.ma.us]; Paul Farrell[paul.farrell@ct.gov]; Paul Miller[pmiller@nescaum.org]; Richard Pirolli[ric.pirolli@ct.gov]
Cc: Anne Arnold[Arnold.Anne@epa.gov]; Ida McDonnell[McDonnell.Ida@epa.gov]
From: Conroy, David
Sent: Mon 9/19/2016 5:50:50 PM
Subject: OAQPS Actions Signed on Friday

FYI

David Conroy

Air Programs Manager

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Exceptional Events:

EPA has finalized revisions to the 2007 Exceptional Events Rule. These revisions clarify the process states follow when deciding whether air quality monitoring data influenced by an "exceptional event" should be included when determining if an area is meeting national air quality standards. Exceptional events include natural events such as wildfires, stratospheric ozone intrusions and volcanic and seismic activities. Given the possible influence of wildfires on ozone concentrations, EPA also released final, non-binding guidance document that provides states with additional information on preparing exceptional events demonstrations for wildfires that could influence monitored ozone concentrations. A prepublication version of the notice, a fact sheet and the guidance are available at: http://www.epa.gov/air-quality-analysis/treatment-data-influenced-exceptional-events.

Notice of Informational Public Webinar to Discuss Rule Revisions and Final Guidance

•Date: Wednesday, September 21, 2016

•Time: 2:00 – 3:30 pm EDT

•Webinar URL: https://epawebconferencing.acms.com/e-events

Final Lead NAAQS Decision

After carefully reviewing the most recent available scientific evidence, consulting with the Agency's independent science advisors and considering comments from the public, EPA is retaining, without revision, the national ambient air quality standards for lead. A fact sheet and the prepublication version of the notice is available at: https://www.epa.gov/lead-air-pollution/national-ambient-air-quality-standards-naaqs-lead-pb.

General Permits and Permits by Rule for the Indian Country Minor New Source Review Program for Six Source Categories

This action finalizes general permits under the Indian Country Minor New Source Review (NSR) rule to streamline the minor source NSR permitting process, while ensuring the protection of air quality in Indian Country. EPA is providing general permits for new or modified minor sources in the following six source categories: (1) concrete batch plants; (2) boilers and emergency engines; (3) stationary spark ignition engines; (4) stationary compression ignition engines; (5) graphic arts and printing operations; and (6) sawmill facilities. A face sheet and the prepublication version of the notice will be available at: https://www.epa.gov/tribal-air/tribal-minor-new-source-review

To: Bloomberg, David E.[David.Bloomberg@Illinois.gov]; Bizot, David A - DNR[David.Bizot@wisconsin.gov]; MaryJean Fenske[MaryJean.Fenske@state.mn.us]; Mary Maupin[maupinm@michigan.gov]; SCOTT DELONEY[SDELONEY@idem.IN.gov]; Jennifer.VanVlerah@epa.ohio.gov[Jennifer.VanVlerah@epa.ohio.gov]
Cc: Doty, Edward[Doty.Edward@epa.gov]; D'Agostino, Kathleen[dagostino.kathleen@epa.gov]; Liljegren, Jennifer[Liljegren.Jennifer@epa.gov]; Svingen, Eric[Svingen.Eric@epa.gov]
From: Aburano, Douglas
Sent: Wed 11/2/2016 7:56:16 PM
Subject: RE: Proposed Implementation Rule for 2015 O3 Standard Signed
FACT SHEET 2015 ozone Implementation proposal.pdf

Looks like I jumped the gun in my rush to get you the news and didn't use the language HQ wanted me to use. So, here it is:

I wanted to let you know that EPA Administrator Gina McCarthy signed the proposed Classifications & SIP Requirements Rule for the 2015 ozone NAAQS on Wednesday, November 2, 2016. The rule is posted on the EPA web site at https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state. We anticipate publication of this rule in the *Federal Register* in approximately two weeks.

A webinar covering the contents of the final SIP Requirements Rule will be scheduled for early December 2016, with details forthcoming. Materials will not be distributed prior to the webinar. Participants will have the opportunity to ask questions during the webinar.

If you have any questions, please contact:

Me, Kathleen D'Agostino or Ed Doty in the Region or

Bob Lingard at (919) 541-5272 or at lingard.robert@epa.gov at OAQPS.

Thanks,

Doug

Douglas Aburano

Chief, Attainment Planning and Maintenance Section
U.S. EPA - Region 5
Phone: (312) 353-6960
Fax: (312) 408-2279
e-mail: aburano.douglas@epa.gov

From: Aburano, Douglas
Sent: Wednesday, November 02, 2016 1:21 PM
To: Bloomberg, David E. <David.Bloomberg@Illinois.gov>; 'Bizot, David A - DNR' <David.Bizot@wisconsin.gov>; MaryJean Fenske <MaryJean.Fenske@state.mn.us>; Mary Maupin <maupinm@michigan.gov>; SCOTT DELONEY <SDELONEY@idem.IN.gov>; 'Jennifer.VanVlerah@epa.ohio.gov' <Jennifer.VanVlerah@epa.ohio.gov>
Cc: Edward Doty <Doty.Edward@epa.gov>; D'Agostino, Kathleen <dagostino.kathleen@epa.gov>; Liljegren, Jennifer <Liljegren.Jennifer@epa.gov>; Svingen, Eric <Svingen.Eric@epa.gov>
Subject: Proposed Implementation Rule for 2015 O3 Standard Signed

The Administrator signed the proposal for implementing the 2015 ozone standards. This proposed action largely retains and updates the implementing regulations that apply for the 2008 ozone standards, for purposes of the 2015 ozone standards. We are taking comment, for 60-days, on a number of specific issues including nonattainment area classification thresholds and deadlines for planning, implementation of emission controls, and attainment.

https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state

Doug

Douglas Aburano
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FACT SHEET

PROPOSED RULE: IMPLEMENTATION OF THE 2015 NATIONAL AMBIENT AIR QUALITY STANDARDS FOR OZONE: NONATTAINMENT AREA CLASSIFICATIONS AND STATE IMPLEMENTATION PLAN REQUIREMENTS

ACTION

- On November 2, 2016, the U.S. Environmental Protection Agency proposed requirements that would apply to state, local, and tribal air agencies for implementing the 2015 National Ambient Air Quality Standards (NAAQS) for ground-level ozone. The EPA revised both the health-based and welfare-based standards for ozone on October 1, 2015.

- Implementation of the NAAQS is a shared responsibility of the EPA, states and tribes. This proposed rule interprets the requirements of the Clean Air Act (CAA) and seeks public comment on proposed requirements that ensure public health protection is achieved by meeting the 2015 ozone standards, while giving the EPA's partners flexibility to reduce administrative burdens, where possible.
    - These requirements would apply to states with nonattainment areas, and states in an ozone transport region (OTR).
    - The EPA will work closely with states, tribes and communities to provide assistance in achieving the 2015 ozone standards.

- This proposed action largely retains and updates the implementing regulations that apply for the 2008 ozone NAAQS, for purposes of the 2015 ozone standards, which creates stability in the planning process. This action is seeking public comment on a number of issues, including:
    - nonattainment area classification thresholds and deadlines for areas to attain the 2015 ozone standards;
    - milestone compliance demonstrations to address reasonable further progress requirements;
    - planning and implementation deadlines for reasonably available control technology;
    - consideration of pollution sources within a state but outside of a nonattainment area for purposes of attainment planning;
    - reconsideration of the optional ozone NAAQS trading provisions for pollutants that react to form ozone, which would allow either volatile organic compounds (VOC) or oxides of nitrogen (NOx) emissions reductions to satisfy nonattainment New Source Review permitting emissions offset requirements for VOC or NO_x emissions increases; and
    - requirements for emissions inventories and emissions statements.

- This action also proposes two options for revoking the 2008 ozone NAAQS.
    - Consistent with the EPA's approach for revoking the 1997 ozone standards, Option 1 would revoke the 2008 NAAQS in all areas effective 1 year after the effective date of designations for the 2015 ozone NAAQS. This option would establish a set of protective anti-backsliding requirements for all nonattainment areas that have not yet attained the 2008 NAAQS at the time of its revocation.
    - Option 2 proposes to revoke the 2008 ozone NAAQS in areas designated attainment for that NAAQS 1 year after the effective date of the designations for each area for the 2015 ozone NAAQS. Under Option 2, the 2008 ozone NAAQS would continue to apply in any

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area designated nonattainment for the 2008 standards until that area is redesignated to attainment. Option 2 would follow the approach established most recently for the $PM_{2.5}$ NAAQS.

- The EPA is also seeking comment on a number of additional topics, including: (1) managing emissions from wildfires and wildland prescribed fires; (2) transportation conformity and general conformity; (3) contingency measures; (4) international transport and background ozone; and (5) additional policies for achieving emissions reductions.

BACKGROUND

- Ozone is formed from NO_X and VOC in the presence of sunlight. Cars, trucks, buses, engines, industries, power plants and products, such as solvents and paints are among the major manmade sources of ozone-forming emissions. Exposure to ground-level ozone pollution is linked to a variety of significant health problems.

- Ozone levels are most commonly elevated in the warm summer months, when hot sunny days make it more likely that ozone will form. But this isn't always the case. In parts of the western United States with high levels of local VOC and NO_X emissions and unique meteorological conditions, ozone levels have been high when snow is on the ground.

- The CAA directs the EPA to set and review air quality standards for common pollutants known as "criteria pollutants," which the agency has identified based on their likelihood of harming public health and welfare. The EPA established air quality standards for ozone in 1979. The EPA subsequently revised the ozone standards in 1997, 2008 and 2015 based on the most recently available scientific studies at the time.
    - In October 2015, the EPA strengthened the ozone NAAQS from 75 parts per billion (ppb) to 70 ppb to ensure the protection of public health and welfare

- After the EPA establishes or revises an air quality standard, the agency follows a process by which states recommend area designations (*i.e.*, as nonattainment, attainment, or unclassifiable) to the EPA. The EPA then evaluates their recommendations and air quality data and other factors prior to making its proposed and final determinations regarding area designations. Ozone nonattainment areas are classified by the severity of their air quality problem based on air quality monitoring data, with classifications ranging from "Marginal" to "Extreme." The EPA anticipates finalizing area designations and classifications for the 2015 ozone NAAQS in late 2017.

- States, and in some cases local agencies or tribes, are the primary implementers of the NAAQS. They are responsible for developing and submitting to the EPA, implementation plans that meet the nonattainment planning requirements of the CAA. The EPA promulgates implementation rules to clarify its interpretation of applicable statutory provisions.

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HOW TO COMMENT

- The EPA will accept comments for 60 days beginning when this proposal is published in the *Federal Register*. All comments should be identified by Docket ID No. EPA-HQ-OAR-2016-0202 and submitted to the Federal e-rulemaking portal (www.regulations.gov). Follow the online instructions for submitting comments. If anyone requests a public hearing within 15 days of the proposal publication date, we will publish a subsequent *Federal Register* document announcing details of the hearing.

- For additional information about other ways to submit comments, please visit https://www.epa.gov/dockets/commenting-epa-dockets.

FOR MORE INFORMATION

- To download a copy of the proposed rule from the EPA website, go to "Regulatory Actions" at the following address: https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state

- This proposed rule and other background information are also available either electronically at http://www.regulations.gov, the EPA's electronic public docket and comment system, or in hardcopy at the EPA Docket Center's Public Reading Room.
    - The Public Reading Room is located in the EPA Headquarters, Room Number 3334 in the EPA William Jefferson Clinton West Building, located at 1301 Constitution Ave., NW, Washington, D.C. Hours of operation are 8:30 a.m. to 4:30 p.m. eastern standard time, Monday through Friday, excluding federal holidays.
    - Visitors are required to show photographic identification, pass through a metal detector and sign the EPA visitor log. All visitor materials will be processed through an X-ray machine as well. Visitors will be provided a badge that must be visible at all times.
    - Materials for this action can be accessed using Docket ID EPA-HQ-OAR-2016-0202.

- Additional information on the ozone nonattainment areas is available on the EPA Green Book at https://www.epa.gov/green-book/green-book-8-hour-ozone-2008-area-information.

- For more information on the proposed rule, contact Robert Lingard at (919) 541-5272 or *lingard.robert@epa.gov*.

ED_001361_00003549

To: Rodrigues, Cecil[rodrigues.cecil@epa.gov]
Cc: Chow, Alice[chow.alice@epa.gov]; Hence, Kia[hence.kia@epa.gov]; Joerger, Verena[joerger.verena@epa.gov]
From: Michael Woodman -MDE-
Sent: Fri 5/26/2017 11:26:01 AM
Subject: Maryland's Letter & Exceptional Event Demonstrations Attached
SIGNED_MDE_EE_LTR_26May2017.pdf
MDE_MAY_25_26_2016_EE_demo.pdf
MDE_JUL_21_22_2016_EE_demo.pdf

Dear Acting Regional Administrator Rodrigues,

Attached are the Maryland Department of the Environment (MDE) letter and two exceptional event demonstrations. Hard copies of the letter and both exceptional event demonstrations will follow in the mail.

Regards.

Mike

--
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Chief, AQ Measurements, Modeling, and Analysis Division
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the Environment

Larry Hogan
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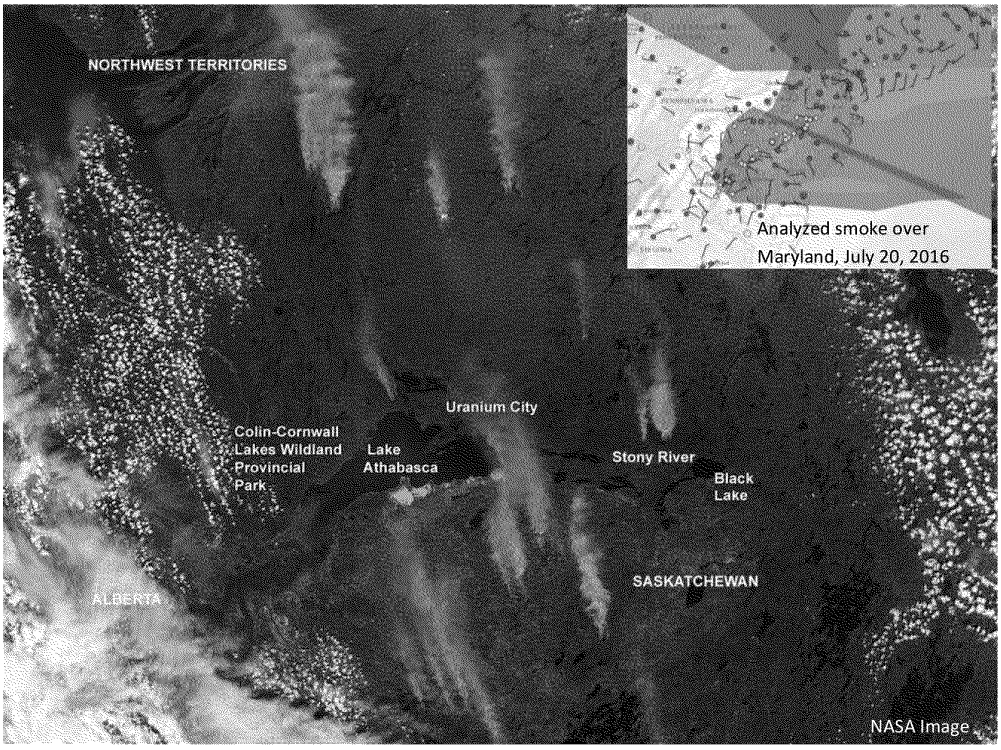
Lieutenant Governor

Ben Grumbles
Secretary

State of Maryland
Exceptional Event Demonstration and Analysis of the Northwestern Canada Wildfires' Impact on Maryland's Air Quality
July 21 and 22, 2016



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May 26, 2017

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1. Overview

1.1. Introduction

A preponderance of fires across northwestern Canada produced smoke covering a wide area of North America for much of the month of July, 2016. During a period of extensive burning across the region, particularly within and around the Northwest Territories of Canada, a combined smoke plume was transported several thousand kilometers within the free atmosphere (well above the surface air) and subsided over the northern Mid-Atlantic States of the Continental United States (CONUS). Maximum daily 8-hour average ozone (MD8AO) concentrations across Pennsylvania and Maryland on July 21 and 22, 2017 exceeded of the 2005 and 2008 ozone National Ambient Air Quality Standards (NAAQS) after the precursor-rich smoke plume[1] subsided to the surface (Figure 1). Maryland MD8AO concentrations reached 87 ppb at the peak of the event at the Fair Hill monitor in northeast Maryland, which is considered "Unhealthy" and was the highest MD8AO during the 2016 ozone season for that site. Between the two days of the event 55% of the Maryland ozone monitoring network observed MD8AO which were among the fourth-highest MD8AO observations of the 2016 season (Table 1).

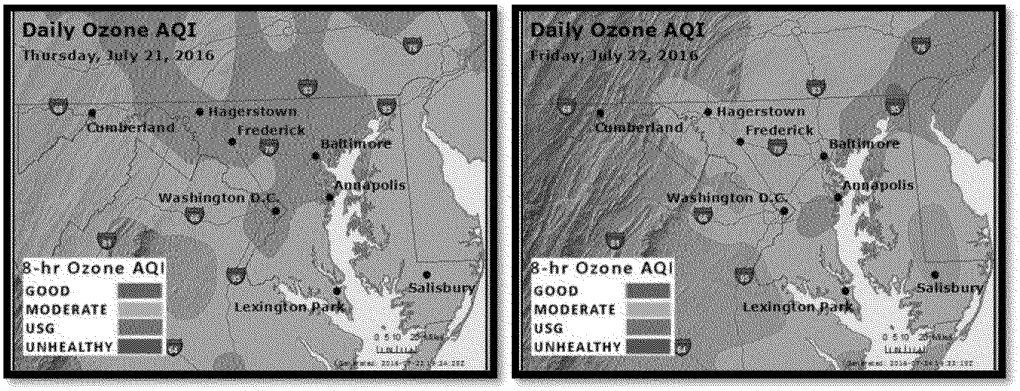

Figure 1. Ozone Air Quality Index (AQI) maps from July 21 and 22, 2016.

Following the U.S. Environmental Protection Agency's (EPA) Exceptional Events Rule (Title 40 of the Code of Federal Regulations Part 50.14), the Maryland Department of the Environment (MDE, "The Department") flagged the data as being influenced by a Canadian wildfire and communicated to EPA our intention of submitting an exceptional event package for July 21 and 22, 2016. This analysis is to demonstrate that Maryland's 8-hour ozone concentrations that exceeded the 2015 standard meet the requirements for having been influenced by an exceptional event and should therefore be excluded from design value (DV) calculations used to determine Maryland's ozone attainment status.

1.2. July 2016 Exceptional Event Summary of Approach

The Exceptional Events Rule as defined in 40CFR 50.14 states that an event may be excluded from regulatory use if it had the following characteristics:

---

[1]Smoke from biomass burning contains volatile organic compounds (VOCs) and nitrogen oxides (NOx), which react to form ozone.

1) There is a clear, causal relationship between the event and the monitored exceedance that affects air quality;

2) The event was of human origins not likely to recur or was natural in origins;

3) The occurrence was not reasonably controllable or preventable.

Table 1. Maximum 8-hour ozone concentrations and ranks on July 21 and 22, 2016 for all Maryland sites. Maryland sites are listed using the common site name and Air Quality System (AQS) identification number (AQSID). Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 ozone season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the 2016 season. The final columns indicate the current fourth high and design value with no exclusion of any data. Sites with an asterisk indicate the site does not have a valid design value in 2016. Monitors exceeding 70ppb during the event are highlighted in orange (for USG Air Quality Index) or red (for Unhealthy Air Quality Index).

SiteName	AQSID	MD8AO[ppb] (rank)		2016	
		July 21	July 22	Fourth High [ppm]	Design Value [ppm]
Aldino	240259001	77 (3)	72 (9)	0.077	0.073
Beltsville CASTNET	240339991	78 (1)	70 (4)	0.070	0.068
Blackwater NWR CASTNET	240199991	54 (39)	56 (29)	0.068	0.066
Calvert	240090011	61 (17)	59 (28)	0.070	0.069
Edgewood	240251001	72 (9)	82 (1)	0.079	0.073
Essex	240053001	75 (7)	72 (13)	0.078	0.072
Fair Hill	240150003	65 (15)	87 (1)	0.080	0.076
Frederick	240210037	75 (2)	62 (8)	0.070	0.067
Furley	245100054	74 (5)	65 (15)	0.075	0.069
Glen Burnie	240031003	76 (4)	69 (11)	0.076	0.076*
Hagerstown	240430009	74 (1)	56 (38)	0.070	0.066
Horn Point	240190004	59 (18)	56 (27)	0.067	0.064
HU-Beltsville	240330030	78 (1)	65 (9)	0.070	0.069
Millington	240290002	62 (22)	66 (13)	0.072	0.070
Padonia	240051007	73 (4)	63 (24)	0.073	0.072
PG Eq Cntr	240338003	65 (18)	76 (4)	0.076	0.071
Piney Run	240230002	59 (17)	54 (28)	0.066	0.065
Rockville	240313001	68 (4)	59 (18)	0.068	0.068
South Carroll	240130001	70 (5)	61 (16)	0.072	0.068
S. Maryland	240170010	67 (10)	63 (18)	0.073	0.070

Finalized revisions to the Exceptional Events Rule were established by the EPA by October of 2016[2]. The revised rule describes the procedures for treating data which has been influenced by an exceptional event. These were further clarified in an Exceptional Events Guidance Document[3] promulgated about the same time. Accordingly, an exceptional events demonstration must include all the following elements:

---

2 Federal Register / Vol. 81, No. 191 / Monday, October 3, 2016: Treatment of Data Influenced by Exceptional Events

[3]Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016: https://www.epa.gov/sites/production/files/2016-09/documents/exceptional_events_guidance_9-16-16_final.pdf

1) A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);
2) A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;
3) Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times. The Administrator shall not require a State to prove a specific percentile point in the distribution of data;
4) A demonstration that the event was both not reasonably controllable and not reasonably preventable;
5) A demonstration that the event was caused by human activity that is unlikely to recur at a particular location or was a natural event; and
6) Documentation that the submitting air agency followed the public comment process.

Furthermore, 40CFR50.14(b)(4) states that the EPA " … Administrator shall exclude data from use in determinations of exceedances and violations where a State demonstrates to the Administrator's satisfaction that emissions from wildfires caused a specific air pollution concentration in excess of one or more national ambient air quality standard at a particular air quality monitoring location and otherwise satisfies the requirements of this section. Provided the Administrator determines that there is no compelling evidence to the contrary in the record, the Administrator will determine every wildfire occurring predominantly on wildland to have met the requirements identified in paragraph (c)(3)(iv)(D) [item (4) above] of this section regarding the not reasonably controllable or preventable criterion."

The guidance document also recommends following a tiered based approach to the analysis, providing evidence of "Key Factors" in each tier. Following the elements suggested in the Exceptional Events Guidance Document[3] as outlined above, MDE contends and demonstrates here-in that the transported wildfire smoke had a direct role in amplifying ozone concentrations on July 21 and 22, 2016 to a level which would not have been possible in the absence of smoke constituents and satisfies the three core exceptional event criterion. Based on recommendations from the EPA, Maryland used a Tier 3, weight of evidence approach for this analysis. MDE addresses each of the necessary elements cited previously in the subsequent sections of this document. EPA guidance offers suggestions for appropriate analyses to demonstrate the clear causal relationship between the wildfire and excessive ozone levels and recognizes that appropriate levels of analysis will vary for particular locations and conditions. EPA does not intend for the guidance to constrain the analysis. MDE therefore includes some of the suggested analytics and variations on those methods to support our conclusion that the high ozone concentrations in Maryland on July 21 and 22, 2016 were caused and/or worsened by the wildfire smoke plume from the fires across northwestern Canada in July of 2016.

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1.3. Regulatory Significance of the Exclusion

1.3.1. July 2016 Exclusion Request

There are 20 ozone monitors in the state of Maryland (Figure 2) covering three different Metropolitan Statistical Areas (MSAs). MDE operates 18 of these regulatory ozone monitors while the EPA Clean Air Status and Trends Network (CASTNET) program operates the additional two monitors. On July 21 and 22, 2016, ten and five monitors, respectfully, (12 separate monitors) exceeded the 70ppb ozone NAAQS across the state of Maryland and meet the criteria for further analysis and potential exclusion if given concurrence that an exceptional event occurred by the EPA, according to criteria listed in 40 CFR 50.14(a)(1)(i). MDE asks for exclusion of all the MD8AO observations on July 21 and 22, 2016 which exceeded the 70ppb ozone NAAQS (Table 2). While MDE does not operate the CASTNET monitors, MDE requested the CASTNET monitor data be flagged by the Clean Air Markets Division (CAMD) of EPA (Appendix A), who responded by flagging the data for exclusion in this demonstration. Therefore Maryland asks for exceptional event concurrence of 15 MD8AO observations between July 21 and 22, 2016 which exceeded 70 ppb at the following 12 monitors: Aldino (240259001), Beltsville-CASTNET (240339991), Edgewood (240251001), Essex (240053001), Fair Hill (240150003), Furley (245100054), Glen Burnie (240031003), Hagerstown (240430009, HU-Beltsville (240330030), Padonia (240051007), and PG Eq Cntr (240338003). MDE requests that these observed ozone data on July 21 and 22, 2016 at these monitors as listed in Table 2 be flagged as impacted by an exceptional event and be excluded from regulatory use.

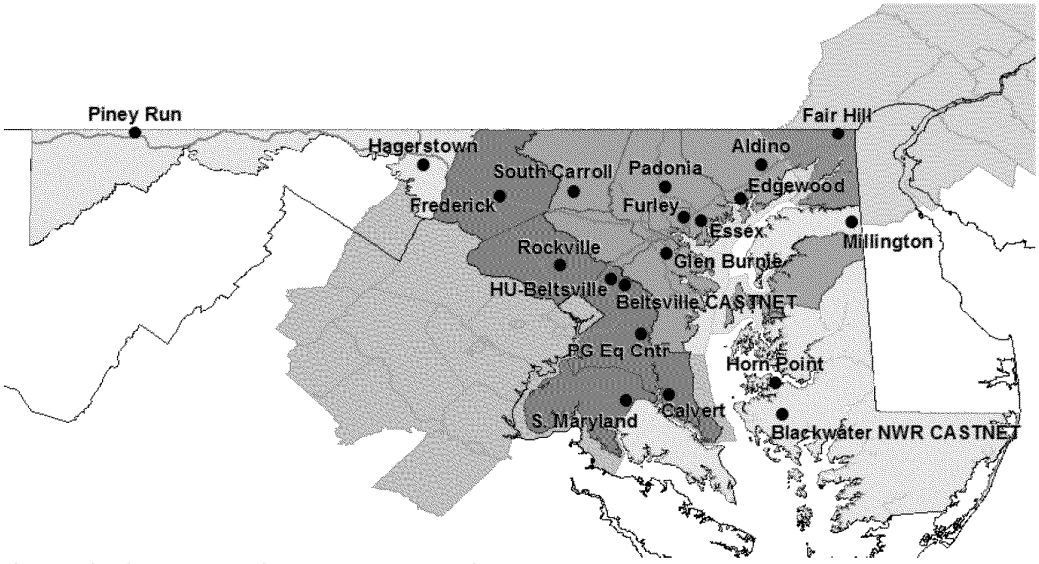

Figure 2. The Maryland ozone air quality monitoring network as of July 21, 2016. Black dots indicate the location of ozone monitors. Metropolitan Statistical Areas (MSAs) for Baltimore-Towson (Blue), Washington-Arlington-Alexandria (Green) and Philadelphia (Orange – Non-Attainment Area) show that Maryland monitors include three policy relevant areas and several states; all areas of which are above the new 70ppb standard. The Philadelphia MSA is in non-attainment of the old 2008 75ppb standard. The rest of Maryland is colored in light cyan. The blue lines show major interstates. Gray lines are county political boundaries. Other lines are state borders.

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1.3.2. Design Value and Fourth High Impacts

Exclusion of the MD8AO concentrations on July 21 and 22, 2016 lowers the DV at several monitors in Maryland. The EPA designates an area's attainment status of the NAAQS via the DV metric. For 8-hour ozone, each monitor's annual fourth-highest daily 8-hour maximum concentration averaged over the past three years designates the attainment status for that particular area. Ozone concentrations on July 21 and 22 were within the fourth-highest 8-hour average observations of 2016 at 11 monitors (Table 1), though only 10 of those monitors exceeded the 70 ppb NAAQS to be included in this analysis. Excluding the July 21 and 22 MD8AO at the 10 requested monitors (Table 2) would reduce five monitors' DV, including the Fair Hill monitor (240150003), which would drop below the 2008 75 ppb level (from 76 to 74 ppb) and also bring the PG Eq Cntr monitor (240338003) into attainment of the 70ppb 2015 standard (71ppb to 70ppb). Details of specific site DVs with and without exceptional event concurrence along with changes in the fourth highest MD8AO concentrations for the 2016 season are provided in Table 2 for all 12 Maryland monitors that MDE is requesting exceptional event status. Reduction of these sites' DV would potentially be used to demonstrate compliance through 2018. Additionally, while MDE acknowledges the EPA's interpretation of 40 CFR 50.14(a)(1)(i), MDE also recognizes the importance of the fourth highest value in a given year potentially determining future year DVs. While not currently requesting sites based solely on their fourth high values, those monitors which observed one of their fourth highest ozone concentrations during the two day event but did not exceed an MD8AO of 70 ppb are listed in Appendix B.

Table 2. Ozone monitors at which MDE is seeking EPA concurrence to exclude data.
Local names and Air Quality System (AQS) identification numbers (AQSID) identify monitors in the text. Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the season. The final columns indic ate the 2016 fourth high and design value with no exclusion of data (Including) and if the requested data from July 21 and 22 are excluded from fourth high and design value calculations (Excluding). Sites with an asterisk indicate the site does not have a valid design value in 2016. Cells showing "-" are MD8AO at sites which did not exceed 70ppb and therefore cannot seek exclusion.

		2016							
		MD8AO[ppb] (rank)		Fourth High [ppm]			Design Value [ppm]		
SiteName	AQSID	July 21	July 22	Including	Excluding	Excluding May & July	Including	Excluding	Excluding May & July
Aldino	240259001	77 (3)	72 (9)	0.077	0.077	0.074	0.073	0.073	0.072
Beltsville CASTNET	240339991	78 (1)	-	0.070	0.070	0.069	0.068	0.068	0.068
Edgewood	240251001	72 (9)	82 (1)	0.079	0.079	0.077	0.073	0.073	0.072
Essex	240053001	75 (7)	72 (13)	0.078	0.078	0.077	0.072	0.072	0.072
Fair Hill	240150003	-	87 (1)	0.080	0.076	0.075	0.076	0.074	0.074
Frederick	240210037	75 (2)	-	0.070	0.067	0.067	0.067	0.066	0.066
Furley	245100054	74 (5)	-	0.075	0.075	0.067	0.069	0.069	0.066
Glen Burnie*	240031003	76 (4)	-	0.076	0.076	0.074	0.076	0.076	0.074
Hagerstown	240430009	74 (1)	-	0.070	0.068	0.068	0.066	0.065	0.065
HU-Beltsville	240330030	78 (1)	-	0.070	0.069	0.069	0.069	0.068	0.068
Padonia	240051007	73 (4)	-	0.073	0.073	0.073	0.072	0.072	0.072
PG Eq Cntr	240338003	-	76 (4)	0.076	0.074	0.073	0.071	0.070	0.070

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Excluding the ozone concentrations associated with the July event will impact not only DVs in 2016, but also in 2017 and 2018, particularly in light of another wildfire smoke plume impacting Maryland in May (MDE will be submitting another exceptional event demonstration for that event separately). Excluding all the requested data associated with the July ozone event will decrease five monitors' DV and fourth-highest observations in 2016. However, if the May event was also concurred, three additional monitors' DV and seven monitors' fourth-high would decrease further than if July or May were excluded alone. Given the fourth high value will impact the DV calculation through 2018, the exclusions have large ramifications for regional attainment. For example, an EPA concurrence of only the May exceptional event at Aldino (240259001) changes that monitor's fourth high from 0.077 to 0.076ppm, but does not reduce Aldino's 2016 DV. However, if the July exceptional event demonstration receives EPA concurrence at Aldino, the fourth high is reduced an additional 0.02 ppm (bringing it to 0.074 ppm) and the 2016 DV drop 0.01 ppm to 0.075 ppm. If July does not receive EPA concurrence, there is no change to the DV at the Aldino site if only May receives EPA concurrence.

1.3.3. NAAQS Attainment Considerations

As discussed above, the fourth-highest observations have ramifications for a monitor's design value for the next three years. At Fair Hill (240150003), an EPA concurrence of both the May and July events drops the 2016 fourth high from 0.080 ppm to 0.075 ppm, which would keep the monitor in attainment of the 75ppb NAAQS level, given similar years in 2017 and 2018. Regardless of the future year considerations concerning the fourth-highest values, exclusion of the requested MD8AO observations on July 21 and 22, 2016 in Maryland will bring the Fair Hill monitor (240150003, Philadelphia Non-Attainment Area (NAA)) into attainment of the 2008 ozone standard already in 2016.

At this time only the Fair Hill monitor would be re-classified as attainment of the 2008 NAAQS should EPA concur with Maryland's exceptional event demonstration. However, the Fair Hill monitor is part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE NAA and EPA would need to concur with the Exceptional Event demonstration submitted by Pennsylvania Department of Environmental Protection (PA DEP) for the NAA to be found attaining the 2008 ozone NAAQS. It is therefore uncertain if the Philadelphia NAA will achieve attainment of the 75 ppb standard even if EPA concurs with MDE's demonstration. The EPA evaluation of the May exceptional event in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE NAA would potentially affect its designation status, which is due later in 2017. In any case the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE area would still be classified as non-attainment of the 2015 ozone NAAQS. All other Maryland monitors are attaining the 2008 standard currently. EPA concurrence with the July exceptional event will also bring the PG Eq Cntr monitor (240338003) into attainment of the 70ppb 2015 standard (71ppb to 70ppb), helping to keep the DC area near the 70 ppb NAAQS threshold. Therefore, depending on future year ozone concentrations, this demonstration may significantly impact Maryland's attainment status in regards to the 2008 and 2015 ozone NAAQS. The Baltimore, Maryland area needs to demonstrate continued attainment of the 2008 ozone standard by 2018. This continued attainment of the 2008 ozone standard might only occur if EPA concurs with this exceptional event demonstration for July 21 and 22, 2016. If EPA does not concur with this exceptional event demonstration the Baltimore area

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designation might change as a result. Thus, concurrence of this demonstration may significantly impact Maryland's attainment status in regards to the 2008 and 2015 ozone NAAQS.

1.4. Summary of Findings

This report demonstrates that:

- There was a clear causal relationship between the smoke and the MD8AO exceedances;
- The wildfire causing smoke was considered a natural event;
- The smoke events in question were not reasonably preventable and are unlikely to recur;

Key findings and evidence supporting these assertions include the following:

- Ozone concentrations above the 70ppb NAAQS were associated with a plume of wildfire smoke which subsided over Maryland late on July 20, 2016.
- Temperatures remained elevated (near or above 90°F) before, during, and after the ozone exceedance days. Ozone concentrations changed significantly only in the presence of the smoke.
- Ozone concentrations decreased on July 23, in the middle of a sunny day after the smoke departed.
- Ozone concentrations were higher than historical norms, beating the 99th percentile at most monitors, even within an environment of historically low anthropogenic precursors.
- Q/d analysis and conclusions were consistent with other previous long range smoke and ozone transport events from Canada to Maryland.
- Fine Particle ($PM_{2.5}$), Carbon Monoxide (CO) and Nitrogen Oxides (NOx) were elevated during the event, which are consistent with a wildfire smoke plume.
- $PM_{2.5}$ speciated data showed elevated wildfire attributable concentrations.
- VOC concentrations were the highest over entire month of July during the event, increasing with the onset of the smoke plume's arrival.
- Satellites captured a smoke plume transported to the northeastern US which was also associated with satellite retrieved CO, both which tracked from northwestern Canada.
- Similar day analysis showed similar days in previous years did not yield as much ozone.
- Photochemical modeling during the event showed under prediction due to the absence of gaseous wildfire emissions within the ozone chemistry of the model.

Several analysis methods were used to develop a weight of evidence demonstration that the 8-hour ozone concentrations above 70 ppb in the July 2016 event meet the rules for data exclusion as an Exceptional Event. In summary, satellite, meteorological data, trajectory analysis, emissions data, speciated $PM_{2.5}$ data, and numerical air quality model comparisons were used to assess whether conditions were favorable for transport of smoke from the Northwestern Canada wildfires to monitors that showed 8-hour ozone concentrations above 70 ppb. The data also show that the transported smoke subsided over the Maryland region, creating a spatially and temporally focused enhanced ozone period (July 20-22) over the northern Mid-Atlantic.

Substantial changes in chemistry in the eastern United States due to regional NOx emissions reductions have occurred over the last decade. The following analysis puts the 8-hour ozone concentrations in Maryland during this ozone event in the context of these. Comparison of emissions during July of 2016 to previous

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years showed Electric Generating Unit (EGU) NOx emissions were lower than any other year on record during the smoke event. Yet, ozone concentrations in July of 2016 exceeded ozone concentrations in earlier years during similar meteorology and under heavier anthropogenic precursor emissions. Analysis of the airmass associated with the Maryland ozone exceedances on July 21 and 22, 2016 revealed a composition characteristic of wildfires with an abundance of ozone precursors not typically or largely attributable to anthropogenic sources.

MDE's analysis strongly supports that MDE monitors were impacted by smoke, that all of the MD8AO concentrations above 70ppb in Maryland on July 21 and 22, 2016 meet the rules of an Exceptional Event, and that the 12 monitors and 15 MD8AO observations in Table 2 should be excluded from DV calculations. The following analysis justifies these claims and is outlined as follows: Section 2 contains a conceptual model overview of the event including a synopsis of the meteorological and air quality conditions, emissions, transport and characteristics defining the event. Section 3 demonstrates a clear causal relationship between the exceedance via a tiered, weight of evidence approach. Section 4 demonstrates that this event fulfills the definition of the natural event unlikely to recur while Section 5 fulfills the requirements that demonstrate the event was not reasonably controllable or preventable. Section 6 documents the public comment process while section 7 summarizes and concludes the analysis.

2. Conceptual Model and Overview of the July 20-22, 2016 Smoke and Ozone Event

2.1. Maryland Area Description

As part of the Clean Air Act (CAA), both local and state air quality agencies are required to maintain and operate ambient air quality monitoring networks. MDE complies with all EPA regulations defined in 40 CFR Part 58 and maintains a dense network of in situ and remote sensing pollution sampling platforms in Maryland. Surface monitors used for regulatory purposes include 20 ozone monitors as of July 21, 2016 (Figure 2) (including two EPA CASTNET sites, (EPA, 1997)), nine hourly fine particle ($PM_{2.5}$) Beta Attenuation Monitors (BAMs) with additional $PM_{2.5}$ hourly observations from six locations in Washington D.C. (DC) and northern Virginia, various $PM_{2.5}$ Federal Reference Method (FRM) filter speciations, VOC canisters and three 915 MHz radar wind profilers (RWP; Ryan, 2004; MDE, 2015). A full description of the various instrumentation used by MDE is available in the MDE Network Plan (MDE Ambient Air Monitoring Plan, 2017).

The dense MDE network exists to account for a densely populated area of the United States between DC and Baltimore. The distribution of ozone monitors across the state favors the I-95 corridor (blue line running southwest to northeast from DC to just south of the Fair Hill ozone monitor on Figure 2), which stretches across the central part of the state from DC to along the northern portion of the Chesapeake Bay. Approximately 9,000,000 people reside along the I-95 corridor (including DC and northern Virginia) as of 2012. Statewide, Maryland's population was estimated to be 6,000,000 as of 2016 by the US Census

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Bureau. The state of Maryland also has diverse geography, with mountains greater than 2,000 ft to the west and coastal plains near sea level to the east that border the Chesapeake Bay and Atlantic Ocean. Outside of urban areas, Maryland is characterized by a mix of farmland to the east and mainly deciduous forests in the mountains to the west. The dynamic interplay between the dense population and diverse geography, particularly biogenic emissions, lee side subsidence by the mountains, and land/water interaction gives Maryland distinct and variable air quality issues, which previously gave the Baltimore, Maryland area the distinction of having the highest reading ozone monitor (Edgewood; 240251001) along the US East Coast.

2.2. Characteristics of Typical, Non-Event Ozone Formation

Over the past two decades MDE has contracted with universities in and around Maryland to conduct thorough research of air quality in Maryland. In particular this collaboration has focused on the origin of ozone in Maryland. This research was done utilizing balloon-borne ozonesondes and airplane flights to capture vertical profiles of atmospheric composition. Computer modeling based on these observations further enhanced our understanding of the origin of ozone in Maryland. The understanding garnered from years of vertical and surface ozone measurements indicated a significant fraction of ozone and ozone precursors observed in Maryland were due to transport by winds from upstream states into Maryland which mixed with and compounded local emission issues. Major legislation resulting from conclusions of this research resulted in robust changes in the air composition in the eastern United States over the past 10 years. Full details of this ongoing collaboration may be found on the RAMMPP[4] webpage. The following describes the current understanding of ozone formation in Maryland.

In the absence of a-typical airmass composition (e.g. exceptional events, smoke plumes), ozone formation in Maryland occurs primarily due to the photolization of volatile organic compounds (VOCs) and a combination of regional and locally sourced anthropogenic NOx in the presence of sunlight. The combination of high density population (pollution sources) and topography often focuses these reactions in well-defined areas that have historically created ozone issues east and northeast of DC and Baltimore. The main sources of anthropogenic emissions contributing to these issues are stationary point sources such as EGUs, mobile sources (cars, trucks, boats, locomotives and non-road equipment), and area sources that include industrial processes and consumer products. The urban pollution plumes that develop along the I-95 corridor between DC and Baltimore (mobile, industrial, area) and surrounding point sources (EGUs) constitute the overwhelming percentage of locally sourced NOx which contributes to Maryland ozone formation. However, these emissions alone regularly fall short of producing ozone capable of MD8AO concentrations above 70 ppb in Maryland. Photochemical modeling supports the assertion that exclusive of light winds and recirculation which build up the local emissions, Maryland EGU and mobile emissions alone are not great enough to support ozone exceedances. However, Maryland is also at the "tail pipe" end of the EGU rich Ohio River Valley (ORV) where a high density of large EGU point sources create a regional NOx plume upstream that transports NOx and/or ozone in to Maryland. The majority of Maryland exceedances historically have been associated with such transport. Thus the amount of ozone and ozone precursors (typically NOx) within the residual layer (layer of air immediately above the surface, typically around 500-2000m above ground level) transported into Maryland adds to and raises local Maryland ozone

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[4] Regional Atmospheric Measurement Modeling and Prediction Program (RAMMPP): http://www.atmos.umd.edu/~rammpp/

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concentrations to and above NAAQS thresholds. Without significant transport, Maryland no longer observes wide spread or frequent ozone exceedances of the NAAQS.

In the past four years, Maryland has had few cases of pollutant transport comparable to historical (pre-2013) norms. In these recent years (2013-2016), the amount of ozone/precursors within the residual layer has declined to the lowest levels ever recorded, leading to a reduction of maximum ozone concentration on any one day in Maryland and thus a decrease in the number of ozone exceedance days. This has caused local effects (meteorology, emissions) which previously were overwhelmed by regional signals to become more prominent, but overall has made exceedances isolated spatially and infrequent in occurrence at all NAAQS levels (Figure 3). Point source NOx emissions from states upstream of and including Maryland (Maryland, DC, Virginia, West Virginia, Pennsylvania, Ohio, Indiana – "Total NOx" in Figure 3) have dropped to record low levels each of the last three consecutive years. Said simply, EGU NOx emissions as a whole in 2016 were the lowest ever in states upstream of and including Maryland for the ozone season as a whole and for each month through the season, representing a total regional anthropogenic NOx decrease of nearly 50% in the past six years (Figure 4). Despite increasing vehicular traffic and vehicle miles traveled, NOx from mobile sources also has decreased over the same period, though the magnitude decrease is dwarfed by the EGU NOx decrease. However, even while mobile NOx has decreased less than EGU NOx, current Maryland mobile emissions, even with added local EGU emissions, are incapable of all but isolated, infrequent ozone exceedance days in Maryland on their own. Maryland therefore continues to require additional transported NOx precursors for ozone exceedance days, which is still sourced predominately from upstream EGUs.

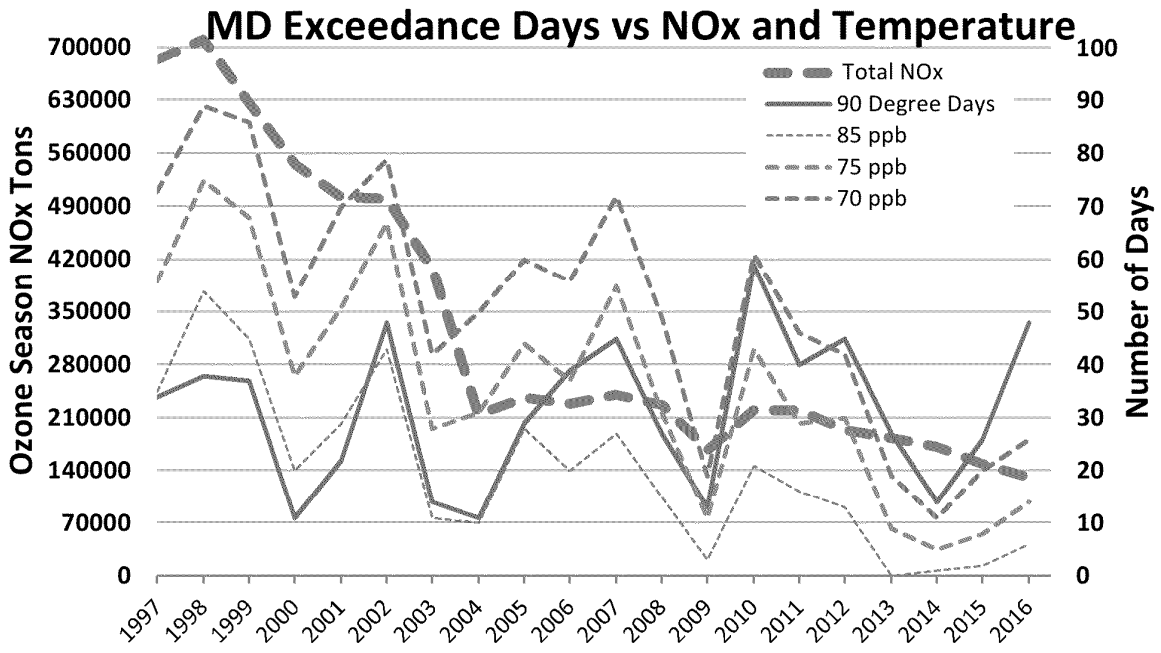

Figure 3. Total Ozone Season EGU NOx from Maryland and upwind states, number of days at or above 90°F at Baltimore - Washington Airport (90 DD) and exceedance days at various standards.

2.2.1. Emissions Trends

The Clean Air Markets Database (CAMD) records NOx output from EGU point sources across the country. In the typical, non-exceptional event model of a Maryland ozone exceedance day described above, transport of NOx into the state was primarily from upwind EGU point sources which vertically mixed ozone or ozone precursors (i.e. NOx) downward the next day to produce high concentrations of ozone which added to local emissions. Significant and sustained reductions in NOx across the eastern US have occurred in the past 10-15 years (Figure 3). Aggregate NOx emissions from upstream areas are only 25% of their pre-2003 amounts in 2016, a reduction of approximately 75%. Aggregate monthly total NOx emissions in the 2016 ozone season (May - September) were the lowest ever observed from upwind states, which included Indiana, Ohio, West Virginia, Virginia, Pennsylvania, and the District of Columbia (also including Maryland), as shown in Figure 4. These states represent an area which contributes to the amount of ozone or ozone precursors transported into Maryland under typical summer conditions where the Bermuda High moves over the southeastern US. The month of July, 2016 observed roughly half the NOx emissions from these areas compared to 2010 and 2011.

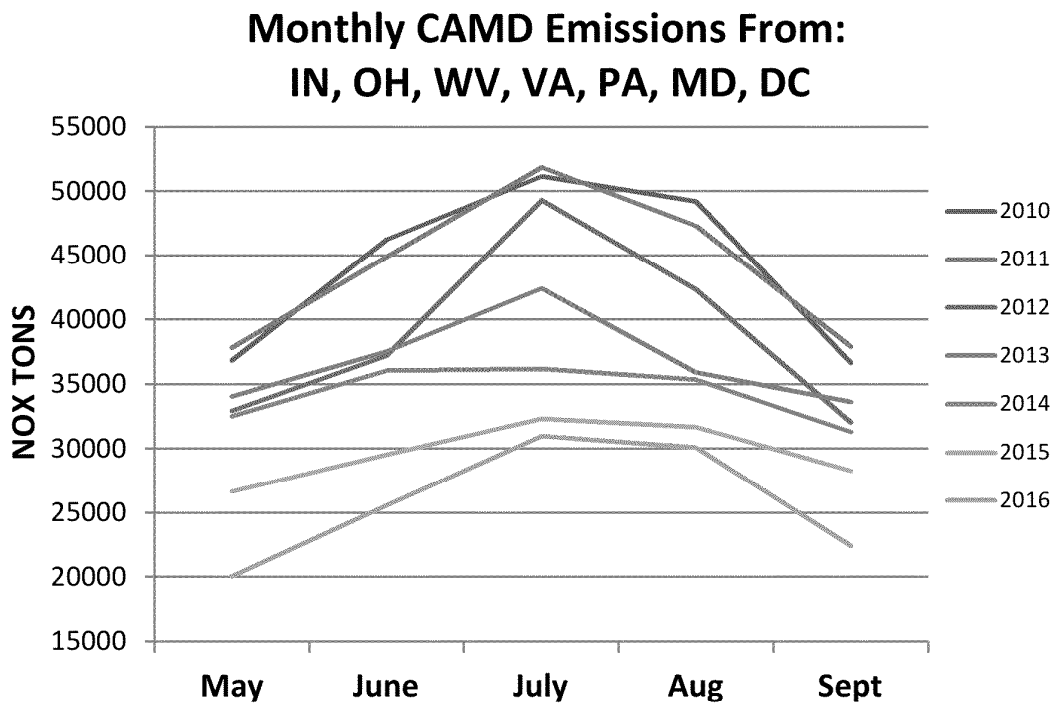

Figure 4. Monthly NOx emissions aggregated from the group of upwind states, including Maryland, by month of ozone season.

Daily emissions for the same states reflect the same reductions. Daily aggregate NOx emissions of Indiana, Ohio, West Virginia, Virginia, Pennsylvania Maryland and the District of Columbia for only the month of July from 2010 – 2016 pulled from CAMD showed emissions during late July 2016 were some of the lowest daily emissions ever (blue line, Figure 5). There is also an obvious downward trend, most notable in2014 - 2016.

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For the month as a whole, July of 2016 had the lowest emission ever (Figures 4 and 5). Even with these record low emissions in July of 2016, Maryland recorded two consecutive days of near-record high ozone concentrations in the state for the month of July (red outlined bars, Figure 5) and had two consecutive days of the greatest number of monitors exceeding 70 pbb since 2012 (black bars, Figure 5) on July 21 and 22, 2016.

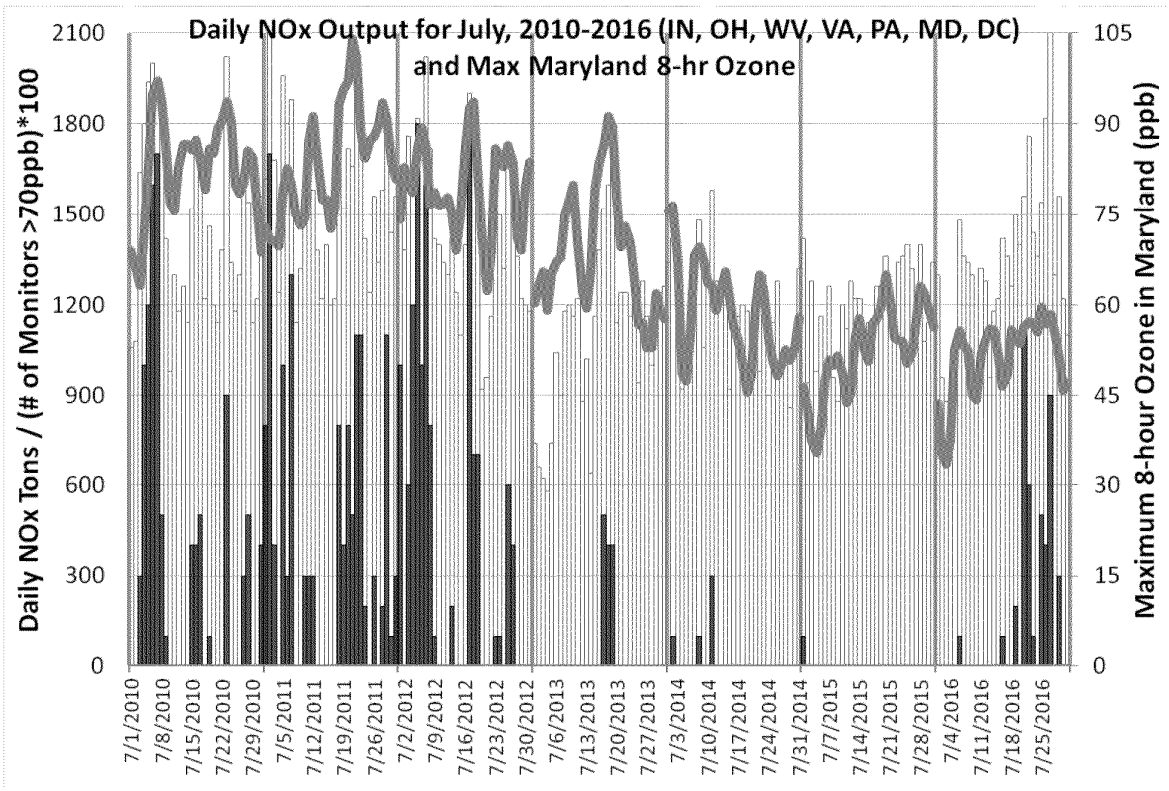

Figure 5. Daily aggregate NOx, maximum Maryland ozone, and monitors exceeding 70ppb in July, 2010-2016. Aggregate NOx emissions from EGU point sources for states upwind of Maryland (Indiana, Ohio, Pennsylvania, West Virgini a, Virginia, DC and Maryland) from the CAMD database for 2010 – 2016 are shown with a thick blue line. The maximum 8-hour average ozone at any monitors in Maryland for each day in July 2010-2016 (red hollow bars) and the number of monitors exceeding 70ppb in Maryland (black bars x 100) is also shown. Number of exceeding monitors is multiplied by 100 for scale purposes. A downward trend in emissions is noticeable from 2013-2016. Each year/month is divided by a solid vertical line.

2.2.2. Ozone Production in Maryland

Research has found ozone production in Maryland to be a complicated mix of VOCs and NOx and that the atmospheric stoichiometry (the balance of compounds needed to make a third, such as ozone) can change on a daily basis. Previously the balance of either precursor group was insignificant to their absolute measure in the atmosphere; both precursors were always in abundant supply for ozone exceedances and were simply dependent on weather. For example, the variability in exceedances in Figure 3 at 70ppb is strongly correlated (R^2 = 0.51) to the number of 90°F days from 1997 to 2015. However, adding just 2016,

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one of the hottest years of the past three decades, decreases this correlation (1997-2016: $R^2 = 0.40$). Notice also that in Figure 5, the number of exceedances and the spatial magnitude (number of monitors exceeding) dropped in 2013-2016 as the aggregate NOx emitted declined by around 30-40%. Maryland now exists primarily in the NOx limited regime due to regional NOx reductions. The stoichiometry of the ozone production is no longer balanced and daily ozone production is instead based on the daily availability of precursors and/or the amount of ozone transported into the state. As a secondary consequence therefore, hot temperatures are no longer a reliable predictor of daily ozone exceedances of the NAAQS.

Ozone production is controlled by the relative availability of NOx and VOCs, with ample heat and sunlight. VOCs relevant to ozone production in Maryland are both naturally occurring and anthropogenic. A significant but lesser decrease in anthropogenic VOCs was observed concurrent with NOx reductions. However, daily ozone production due to biogenic (naturally occurring) VOCs cannot be regulated and remain important to ozone production chemistry in Maryland. Isoprene, for example, a naturally occurring VOC, has the highest maximum incremental reactivity (i.e., easily makes more ozone) of VOCs tested in Maryland and is the highest VOC contributor on high ozone days. Isoprene is released by the biosphere (i.e., trees) due to environmental stresses such as heat. NOx output also increases from stationary sources on warm summer days in response to increased energy demand. Mobile emissions are not dependent on temperature and are relatively constant between workdays; Mobile emissions' impact on ozone generally decreases on the weekend. At the same time that relative NOx output increases, biogenic VOCs are released into the local environment, and, in the presence of sunlight and heat, create local ozone. When ozone and ozone precursors transported into the state combine with these local emissions, Maryland observes MD8AO above 70ppb and exhibits its fundamental non-event ozone exceedance. In this NOx limited regime, without additional transported ozone or ozone precursors, Maryland's local NOx emissions are insufficient to produce ozone exceedance days.

2.2.3. Weather Patterns Leading to Ozone Formation

Summertime meteorology is variable in Maryland. Occasional April ozone exceedance days are possible, but most of the ozone exceedance days occur primarily from May through September. The intra-seasonal variations of weather that occur through the ozone season therefore result in various meteorological patterns conducive to ozone formation. In no specific order, the generic patterns are lee-side troughing (where downward air motions in the lee of the Appalachian Mountains induces an area of pollutant convergence along I-95 [parallel to the mountains]), airmass/ozone/pre-cursor transport, and local recirculation and stagnation (to include reverse[from the northeast] I-95 corridor flow). Ozone production in each pattern depends on ozone conducive local weather conditions (i.e., warm, sunny conditions with light to moderate surface winds). The location of the Bermuda high ultimately determines which, if any, of these scenarios develops. Average summer conditions place the Bermuda High off the southeast Atlantic coast of the US, which gives Maryland westerly (south-southwest to north-northwest depending on height) transport of upstream air. Lee-troughing is dependent on weak (<15 kts) cross-mountain flow around 850mb creating compressional heating/column stretching in the lee of the mountains. This induces a "trough" of lower pressure which often aligns with the I-95 corridor. Convergence along the trough

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increases ozone concentrations there. Both transport and lee troughing patterns may occur simultaneously or independently of each other. Assuming at least some downward mixing of transported ozone lee-troughing may lead to an ozone exceedance day. Recirculation and stagnation over several days can cause local pollution concentrations to increase to levels exceeding the NAAQS. All three of these patterns are most probable during the summer months of June through August which, historically, were the climatological maximum for ozone production in Maryland. Shoulder seasons (Spring and Fall) typically are not warm enough and have active weather patterns preventing local or regional emissions from building. Winter is too cold for ozone exceedances and Maryland's Appalachian peaks are too low for Stratospheric ozone intrusion that could lead to an ozone exceedance day.

Differential heating at the land and water interface recirculates local and transported pollution near coastal areas via a thermally driven solenoidal circulation. Such circulations are believed to be the cause of high ozone DVs northeast of Baltimore. With increasing temperatures, super-regional NOx output increases from upstream EGUs in locations such as the ORV and western Pennsylvania, increasing residual layer concentrations of ozone and ozone precursors. After being transported these mix downwards at later times, combining with local sources, contributing to Maryland's ozone exceedances. This downward mixing is enhanced by the solenoidal circulation of the Chesapeake Bay Breeze (BB). Then lower mixing heights over the water "overcook" the precursors, creating greater concentrations over the Bay than nearby land sites. As a result, coastal sites achieve greater ozone concentrations as both regional and local emissions are concentrated by the land/water meteorology. It is no coincidence that the area of peak ozone in Maryland during a typical non-event ozone exceedance is northeast of Baltimore where local I-95 corridor emissions (the urban plume) are enhanced by transported regional pollution concentrated by land-water meteorology dynamics.

2.3. Exceptional Event Description: July 2016 Northwest Canada Wildfires

Abnormally warm and dry conditions across central Canada in late Spring of 2016 promoted wildfire conditions in the provinces of Alberta and Saskatchewan. In May, fire concern was most concentrated around or near the town of Fort McMurrary when a large fire consumed over a million acres of woodland through early July. Fire prone conditions persisted even as this fire was extinguished, and the area prone to wildfires expanded into northeastern British Columbia and the Northwest Territories of Canada. Between July 13 and July 20, 2016 the NOAA Daily Hazard Mapping System (HMS) smoke and fire analyses (McNamara, et al., 2004) detected a large increase in the number of fires across British Columbia and the Northwest Territories, in addition to a number of fires across the Alberta and Saskatchewan (Figure 6). Fires and associated smoke plumes analyzed by HMS were derived from the GOES Imager, the POES AVHRR, MODIS satellites and expert subjective analysis. In fact a total of 205 new fires started across northwestern Canada burning 109,724 ha (271,134 acres) over that week period. The majority of these fires (65%) occurred in British Columbia, Alberta and the Northwest Territories. The majority of the area burned (60%) was in the Northwest Territories.[5] Lightning was suspected as starting the majority of the fires reported across the area.

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[5]Burn information is provided by the Canadian Wildland Fire Information System (CWFIS): http://cwfis.cfs.nrcan.gc.ca/home

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HMS analysis of smoke across North America indicated that a large fraction of the smoke which impacted Maryland on July 20-22 came from northern Alberta and Saskatchewan, and the southern Northwest Territories (Figure 6). There were additional fires located across southern Saskatchewan and Alberta which produced smoke plumes of their own though less expansive or intensive than the combined northern plume. Thus, no single fire was responsible for the large aggregate smoke plume which existed across central and southern Canada between July 13 and July 20. Together the large number of fires and associated aggregate smoke plume affected the air quality in Maryland as smoke was transported into and subsided over the northern Mid-Atlantic region.

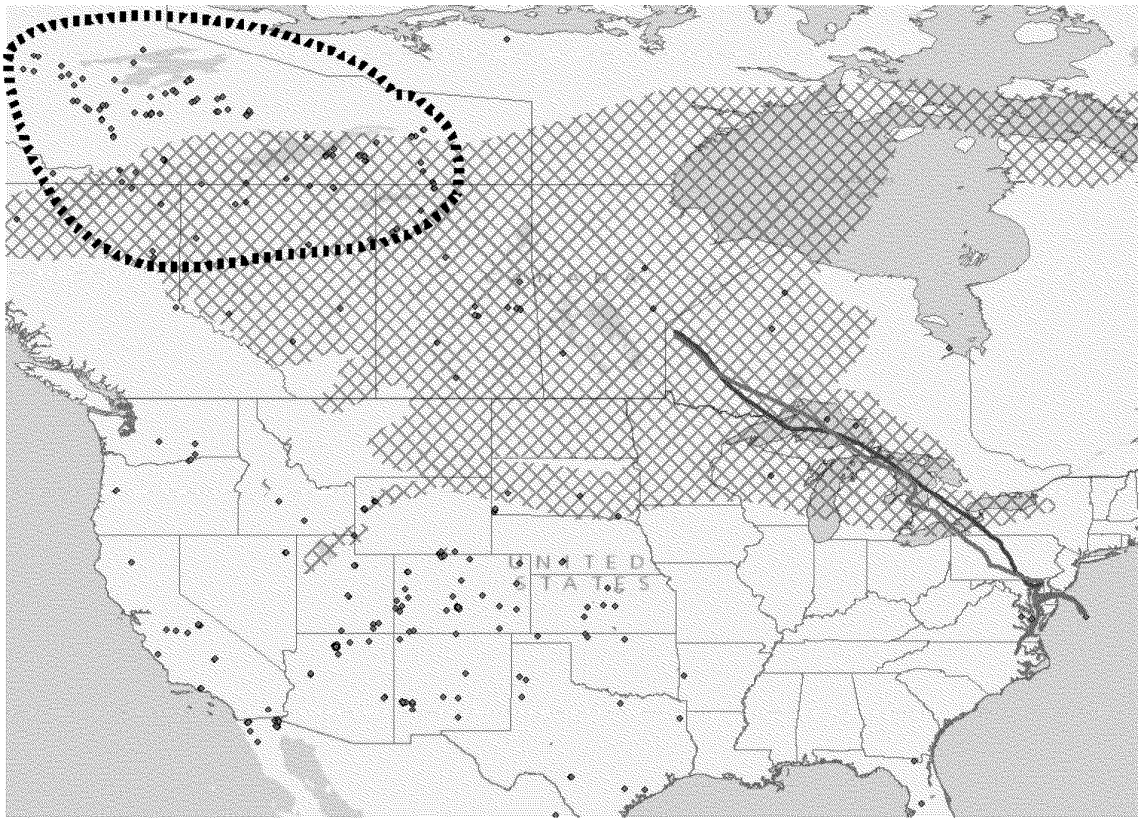

Figure 6. Location of fires and smoke on July 18, 2016.
Fires (orange dots) analyzed by the Hazard Mapping System (HMS) derived from the GOES Imager, the POES AVHRR, MODIS satellites and expert subjective analysis are shown for the period from July 13-17, 2016. The relevant fires discussed in the text are circled by the dashed line. HMS analyzed smoke (hatching) on July 18, 2016 is overlain to display the expansive nature of the plume created by these fires prior to moving into Maryland. Backwards trajectories originating at Fair Hill, Maryland on Jul y 21, 2016 at 4pm for 96-hours (4 days) in time showed that transport at 3000m (green) and 1500m (blue) came from within the HMS analyzed smoke plume. Surface trajectories (50m, red) remain mainly local to Maryland during this time.

2.4. Conceptual Model of Ozone Formation from May 2016 Fort McMurray Fire

2.4.1. Overview and Literature Review

Wildfires are known sources of emissions responsible for both primary and secondary pollutants including CO, $PM_{2.5}$, NOx, VOCs, as well as ozone (Andreae and Merlet, 2001; McKeen et al., 2002; Bytnerowicz, et al., 2010). Similar to the study presented here, Canadian wildfires have increased ozone concentrations in Houston, TX (Morris et al., 2006) and as far away as Europe (Spichtinger et al., 2001). Evidence of Canadian wildfire smoke and biomass burning affecting the Mid-Atlantic's particulate matter (PM) air quality was also previously reported (Adam et al., 2004; Colarco et al., 2004; Sapkota et al., 2005) but wildfire smoke has also been recognized in high-ozone events on the east coast (Fiore et al., 2014). DeBell et al., (2004) presented a chemical characterization of the July 2002 Quebec wildfire smoke plume and its impact on atmospheric chemistry in the northeastern US. Most recently, Dreessen et. al., (2016) presented a case where a Saskatchewan, Canada wildfire smoke plume amplified ozone in Maryland in June of 2015, similar to the May 2016 case presented here. While relatively infrequent in the Mid-Atlantic, wildfire smoke has been an increasing fractional contribution to high-ozone exceedance days, particularly in light of increased fire frequency in a warming climate (Flannigan and Wagner, 1991; Marlon et al., 2009; Westerling et al., 2006; Spracklen et al., 2009; Pechony and Shindell, 2010), decreasing regional emissions (Gégo, et al., 2007) and tighter ozone NAAQS (http://www3.epa.gov/ozonepollution/actions.html).

2.4.2. Ozone Generation from the Fire

Dreessen et. al. (2016) previously showed that smoke plumes from Alberta and Saskatchewan are capable of transporting ozone precursors to the Mid-Atlantic and causing ozone NAAQS exceedances, even in the contemporaneously low NOx emission environment. In the present July 2016 exceptional event case, sufficient amounts of NOx and/or VOCs were generated by fires across northwest Canada in mid-July of 2016, were lofted and transported long distances, and then contributed to ozone production in Maryland where the smoke plume subsided to the surface.

In the 2015 case study examined by Dreessen et al. (2016), it was hypothesized the VOC-rich smoke plume was the key to ozone development. In that study, once the smoke-sourced VOC-rich plume interacted with anthropogenic NOx sources profuse ozone production began, which was capable of being transported long distances as either ozone or within ozone reservoir species. Dreessen et al. (2016) also acknowledged NOx contribution from the fire itself, though focused on the plume's interaction with anthropogenic sources. In that 2015 study, smoke subsided across the eastern Midwest and northern Mid-Atlantic and took over 24 hours of aging before ozone above 70ppb was widespread across the region. This delay in ozone production while the airmass aged is consistent with previous studies such as Putero et al. (2014) which observed the largest increases in ozone from fires five days (120 hours) after the initial pollutants were emitted from the fire (Figure 7). This observation was also consistent with the behavior of the smoke plume in the July 2016 case, where smoke was already well-aged, was entrained to the surface on July 20 but did not produce ozone in excess of the NAAQS until July 21, suggesting aging in the presence of diminutive anthropogenic emissions was necessary, similar to the June 2015 and May 2016 Maryland smoke cases. Thus while

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sufficient precursors were generated by the fires in July of 2016 for ozone production, it was as the plume aged and mixed with anthropogenic NOx (albeit the lowest NOx on record) that ozone concentrations were augmented to and above levels exceeding the NAAQS not possible without the smoke.

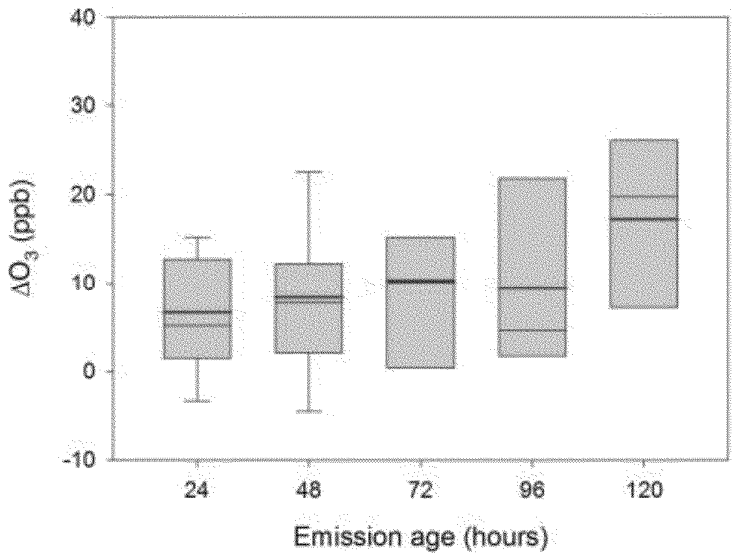

Figure 7. Ozone enhancement with smoke plume age.
(from Putero et al. (2014), their Figure 7)

The ozone precursor-rich smoke plume subsided to the surface behind a cold front which passed through Maryland on July 20. Smoke was undoubtedly present in the PBL on July 21 and 22. Precursor observations within Maryland showed the smoke and/or the ozone precursors it carried persisted in concentrations above normal to contribute to ozone formation on July 21 and 22. After a day without an exceedance (July 20) during a prolonged hot period in Maryland, 10 monitors exceed the 70ppb standard on July 21. Five monitors also exceeded on July 22 as smoke bi-products (ozone and ozone precursors) persisted. With the additional ozone precursors delivered to the surface on July 20, ozone concentrations on July 21 were 7ppb higher than July 20, and increased to 87ppb on July 22, 16ppb higher than July 20, as the smoke filled air photochemically aged and combined with local emissions. Then, all ozone concentrations decreased again on July 23 despite even warmer temperatures as winds turned to the southwest and removed the smoke filled airmass off the coast. This removal process decreased hourly ozone concentrations in Maryland in the middle of the day on July 23, despite temperatures climbing to 98°F at BWI airport!

MDE contends that the chemical composition of the air changed due to smoke. An over-abundance of VOCs observed at Essex showed there were never more VOCs available in a 24-hour period during the month of July than during the evening of July 20 into the morning of July 21. While Maryland and Pennsylvania EGUs were running, the NOx emissions they delivered were still lower than the previous four years of emissions during the same time period. Thus, ozone concentrations would not have been as high in the absence of the smoke. Once the smoke-influenced airmass was removed from the region, the constituents associated with

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ozone production were also removed on the regional scale. Without the support of the smoke, local emissions were mixed out and ozone concentrations dropped despite the warm temperatures on July 23.

While ozone exceedance days in Maryland are historically common place during the month of July, the magnitude, and spatial scale of these exceedance days was beyond contemporary norms. As one of the hottest months of the year, July is typically the climatological maximum for ozone exceedance days in Maryland. However, in recent years July has had very few exceedance days (Figure 5) and even fewer covering such a wide area or large number of Maryland monitors since at least 2012. Thus, it was unlikely such a widespread area of ozone exceedance could have occurred in the contemporaneously low emissions without additional supportive atmospheric chemistry (ozone precursors) provided by the wildfire smoke.

2.4.3. Meteorological Conditions Driving Smoke and Ozone Transport

2.4.3.1. Conceptual Model Overview

A significant increase in the intensity and spatial coverage of the conglomerate smoke plume across northwest Canada took place between July 16 and July 18 (Figure 8, #1). Impacting the plume was an area of low pressure moving across southern Canada from July 17-19, 2016 (Figure 8, #2). The back side (west side) of this low pressure area provided northerly transport winds which pushed the smoke plume southeastward towards the northern CONUS and into southern Ontario by July 19. A cold front trailing the low pressure moving across Canada (Figure 8, #3) led the transported smoke plume into the CONUS and was located across the northern Mid-Atlantic by that same time. The continued northwest transport of the smoke combined with the subsidence under high pressure behind the cold front brought the smoke to the surface in Maryland (Figure 8, #4). Continued southward transport of the smoke was stifled however, and smoke was only analyzed as far south as Maryland. Temperatures behind the cold front were not significantly cooler than temperatures ahead of it and as the cold front moved southward it lost its defining characteristics (wind shift and/or temperature change) and dissolved. Then, as low pressure over Canada and High pressure over the US both moved eastward, surface winds over Maryland turned back towards the southwest and persisted that way from July 21-23, through the duration of the high ozone event (Figure 8, #5).

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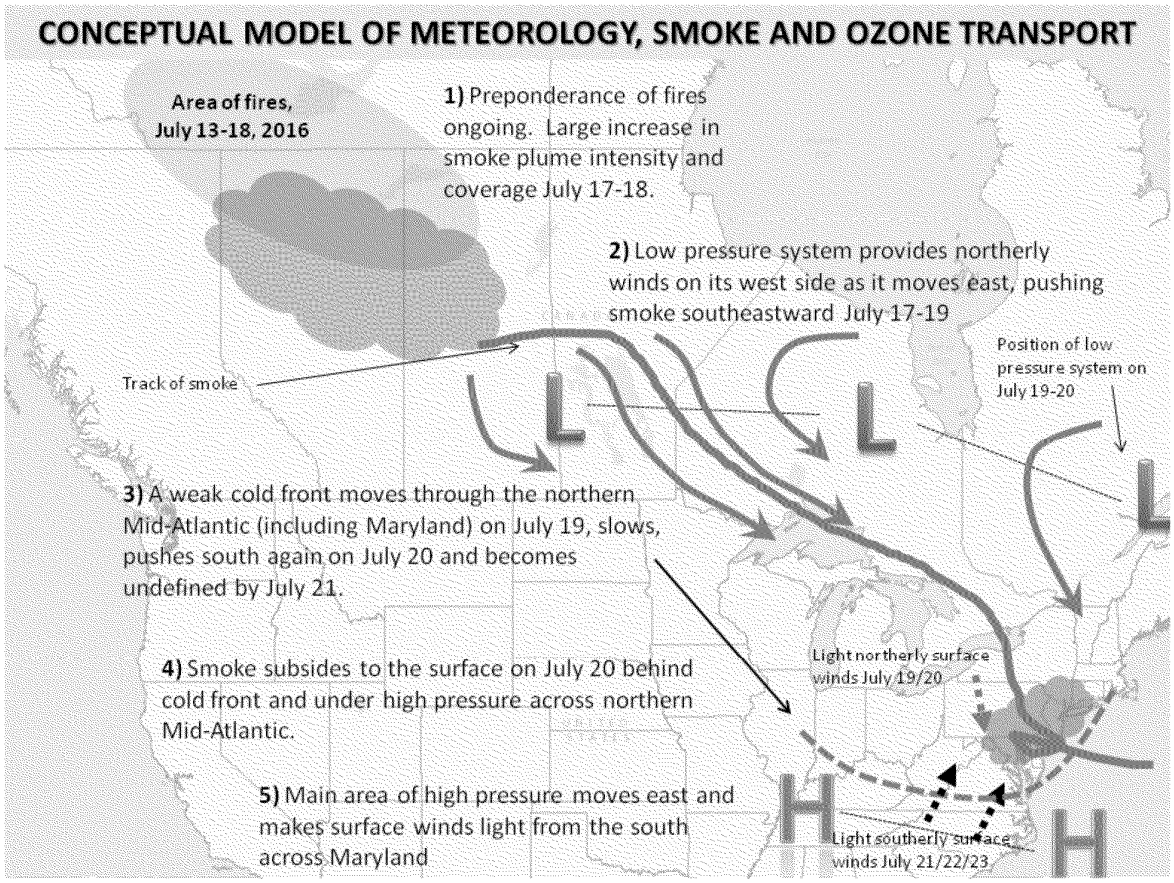


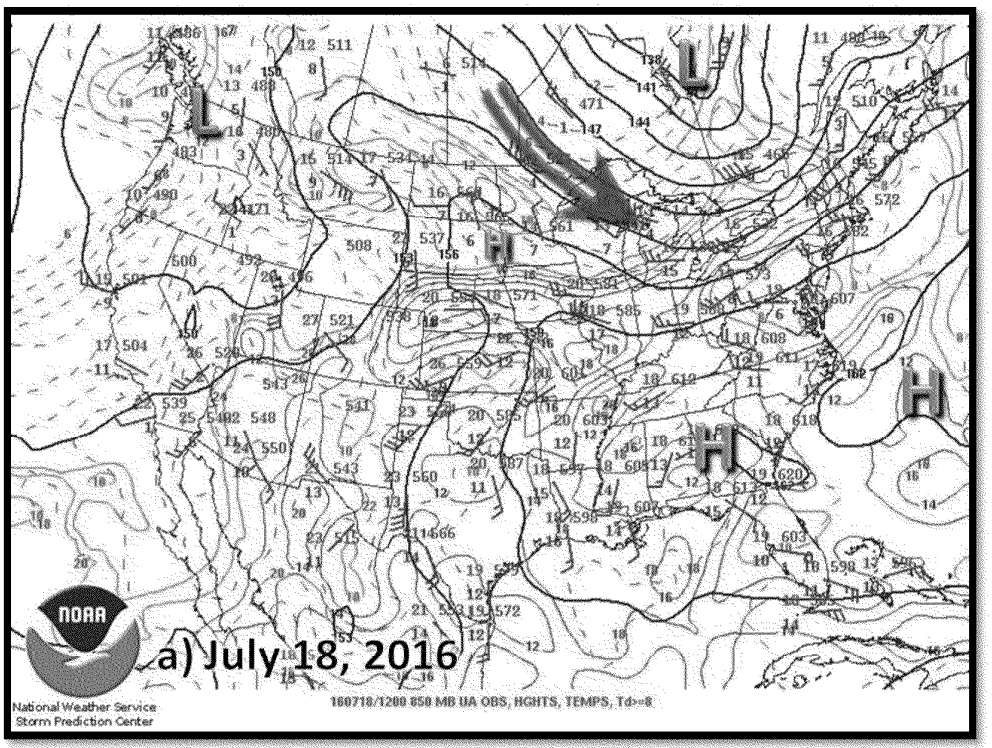
Figure 8. A simplified illustrated conceptual model of the July 21 and 22, 2016 wildfire influenced ozone event.

2.4.3.2. Upper Level Pattern Overview

The 850mb level (approximately 1500m above sea level) sits near the top of the planetary boundary layer, the atmospheric layer in which ozone pertinent to surface observations and human health develops. The 850mb height level can serve as a guide for the transport of pollutants. The morphology of this atmospheric level is given for July 18-23 in Figure 9. The upper level transport across Maryland remained from the northwest through nearly the entire period. A continental ridge persisted across the central CONUS in mid July of 2016. As the area of low pressure at 850mb progressed eastward across Canada the continental ridge over the central CONUS was strengthening in the Mississippi and Ohio River Valley areas on July 18 and 19, 2016 (Figure 9a and b). These two features kept northwest winds over the Great Lakes area at 850mb, which kept the smoke plume moving southeastward towards the Mid-Atlantic.

Continued eastward movement of the low pressure system in Canada weakened the pressure gradient between it and the ridge of high pressure across the east-central US. A weakening pressure gradient weakened the wind speed at 850mb, however, the transport direction remained persistent from the northwest on July 20 (Figure 9c). While the amplitude of the east central CONUS ridge of high pressure weakened on July 21 (Figure 9d), the 850mb winds remained from the northwest, albeit rather light at

around 10 knots on the first day of the exceedance. Flow at 850mb turned more west-northwesterly on July 22 (Figure 9e) as an area of low pressure across eastern Canada flattened the ridge of high pressure, which had now moved southeastward. Thus, pollutant transport on the second day of the exceedance was slightly more from the west-northwest than directly northwest. However, by July 23, transient low pressure across southern Canada had moved the trough farther east, again turning the transport relevant (850mb) flow back to the northwest (Figure 9f).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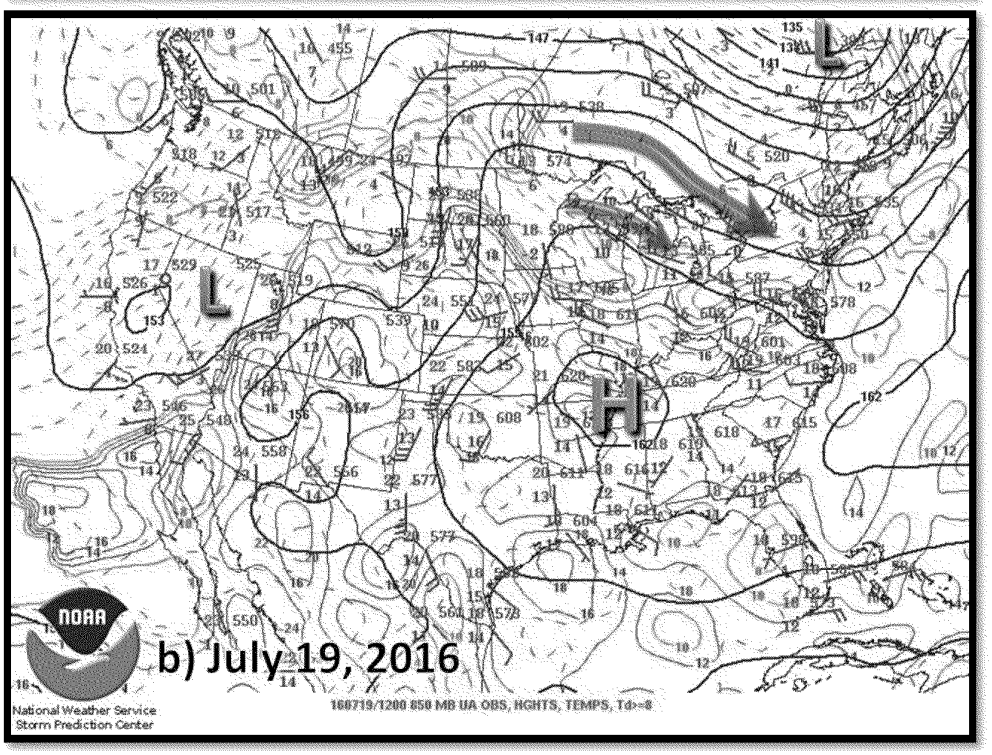
National Weather Service
Storm Prediction Center
160718/1200 850 MB UA OBS, HGHTS, TEMPS, Td>=8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Storm Prediction Center
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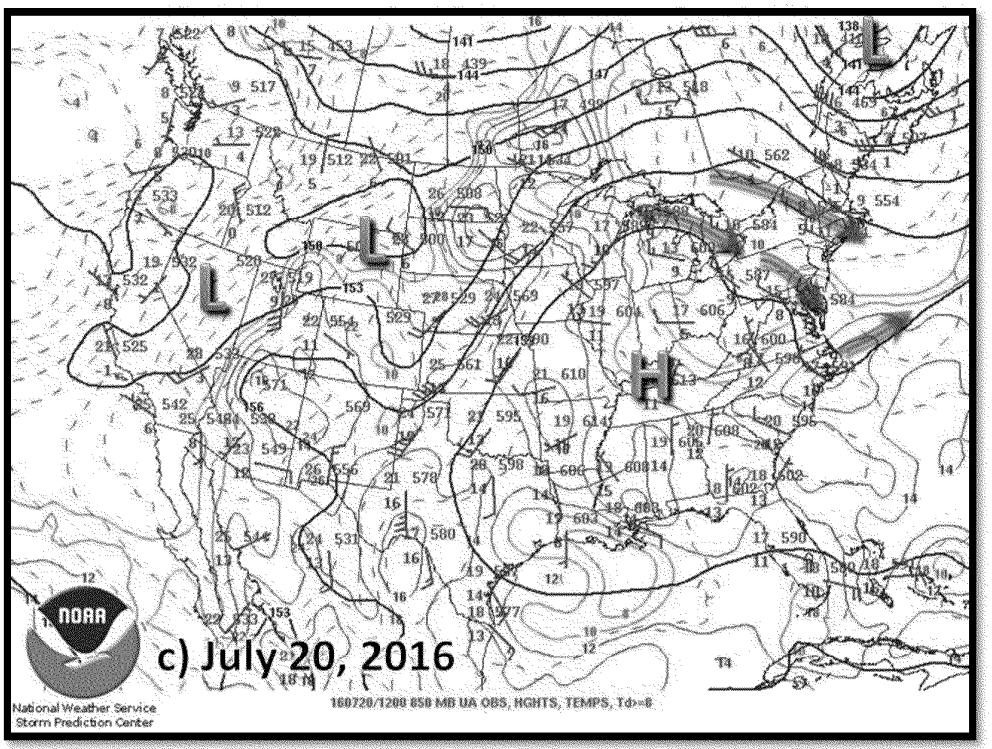
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Storm Prediction Center
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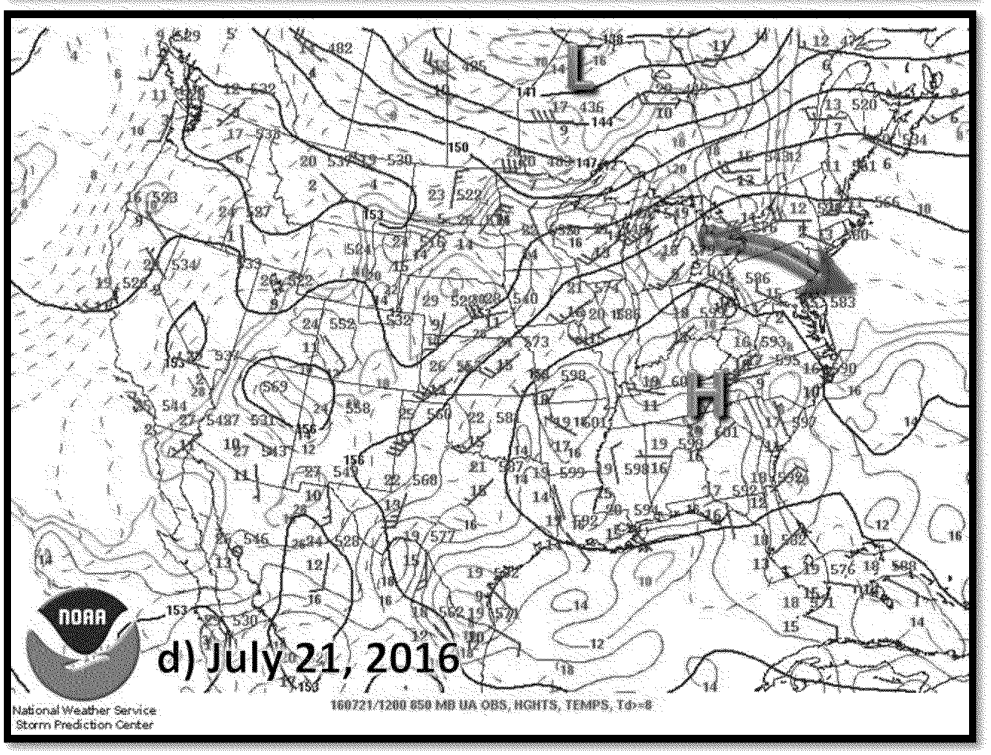
d) July 21, 2016
National Weather Service
Storm Prediction Center
160721/1200 850 MB UA OBS, HGHTS, TEMPS, Td>=8

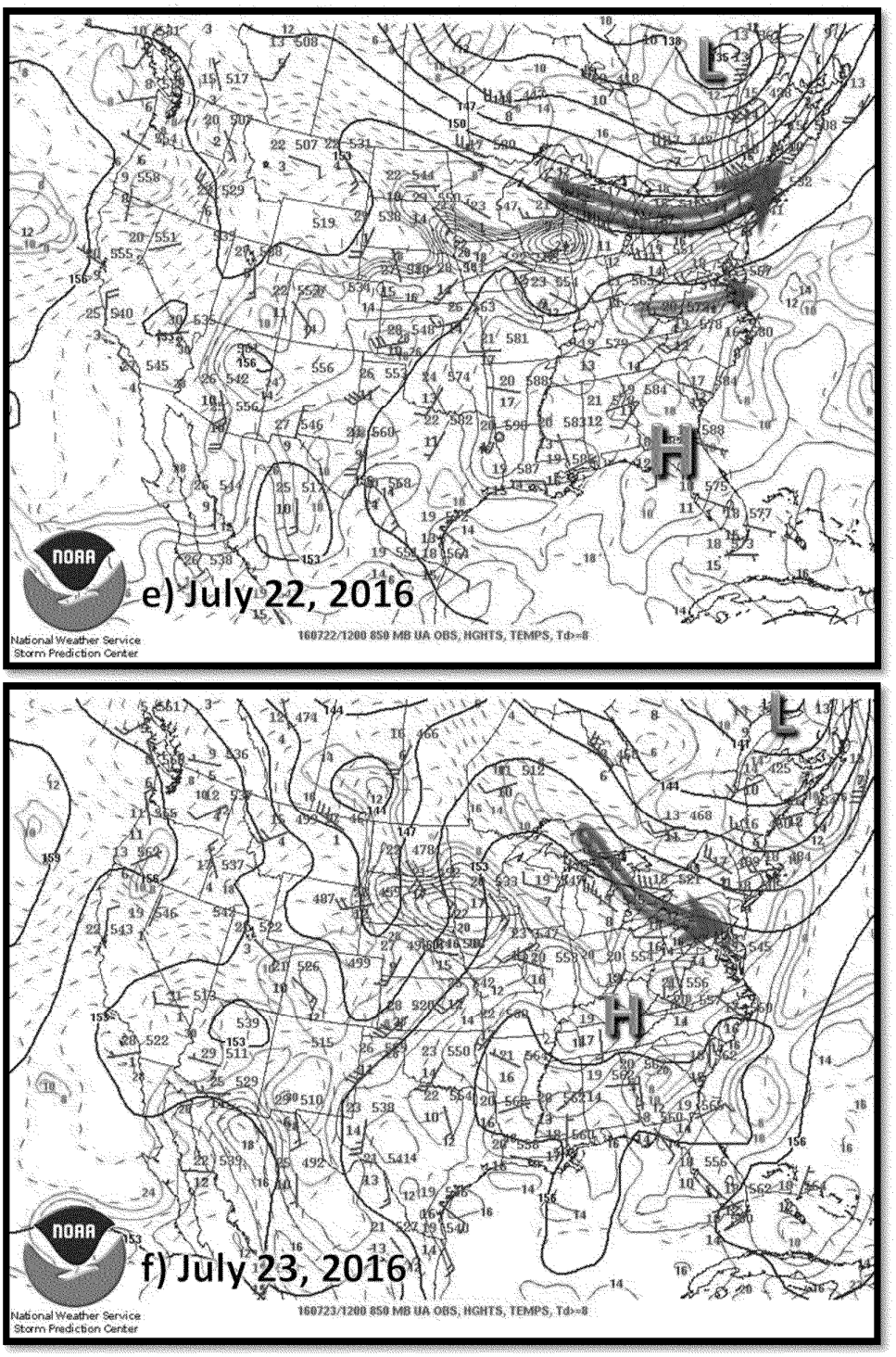

Figure 9. The 1200UTC 850mb pattern for the CONUS on July 18-23.
Upper level charts at 850mb are for a) July 18, b) July 19, c) July 20, d) July 21, e) July 22, f) July 23. Red arrows show the general transport pattern. Big letter "H" is high pressure, letter "L" is low pressure . Heights (black lines), temperatures (red dashed lines), dewpoint (green lines), and winds (blue barbs) are also analyzed.

2.4.3.3. Surface Pattern Overview

While transport winds provide information on the transport of airmasses and weather systems, surface conditions and features dictate whether an airmass may be capable of ozone production. As an area of low pressure moved across southern Canada a cold front dropped southward across the Great Lakes region of the CONUS and provided northerly and northwesterly flow in its wake (Figure 10a). Ahead of the front southwesterly winds existed across Maryland within warm and moist air. Thunderstorms developed on July 18 in a surface trough ahead of the front. By midday on July 19, northerly flow behind the front existed in Maryland (Figure 10b). Despite the passage of the front and northerly winds, temperatures were not significantly cooler behind the front. With sunny skies and relatively light winds, Maryland did have one monitor near Baltimore exceed 70ppb for its MD8AO (Essex – 75ppb). However, this was only one monitor which exceeded due to local influences related to the land/water interface near the site. The front briefly retreated as weak low pressure developed off the coast (Figure 10b) before again pushing southward and further weakening on July 20 (Figure 10c). High pressure originally over northern Minnesota (Figure 10a) also worked its way southeastward over this time, settling over western Pennsylvania by July 20 (Figure 10c). Both the strength of this high pressure and the characteristics of the cold front dropping southward across the Mid-Atlantic faded on July 21 (Figure 10d). Because of the weakening high pressure over the West Virginia, Maryland, Pennsylvania tri-state area as compared to that of the Bermuda High, the surface pressure gradient changed from favoring northerly winds to southwesterly winds (Figure 10d). This continued on July 22 (Figure 10e) and through July 23 (Figure 10f). Consistent with lowering pressure ahead of another front dropping from the north as well as lee-subsidence with the northwest flow at 850mb, a surface pressure trough (lee trough) developed along the I-95 corridor on July 22 and July 23 (Figure 10e and f).

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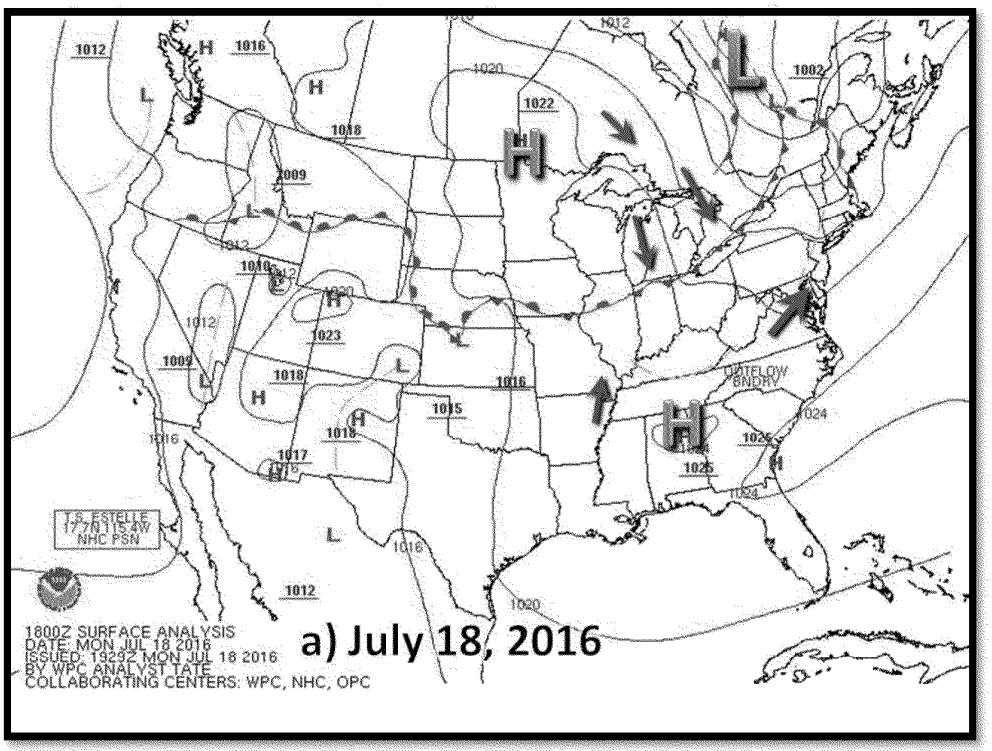
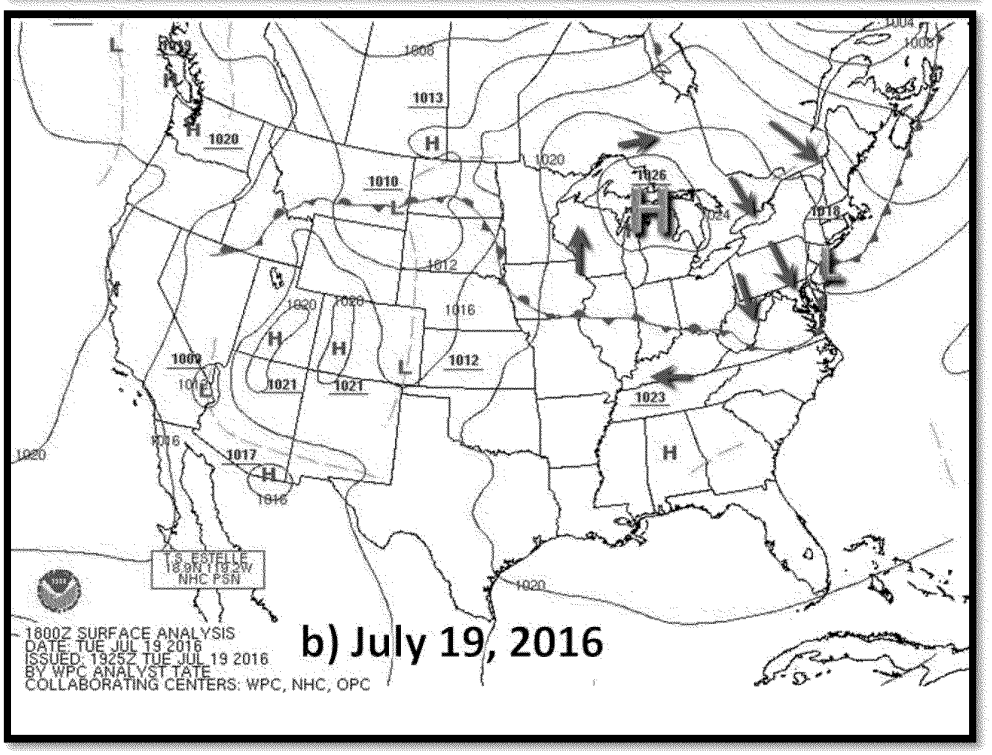
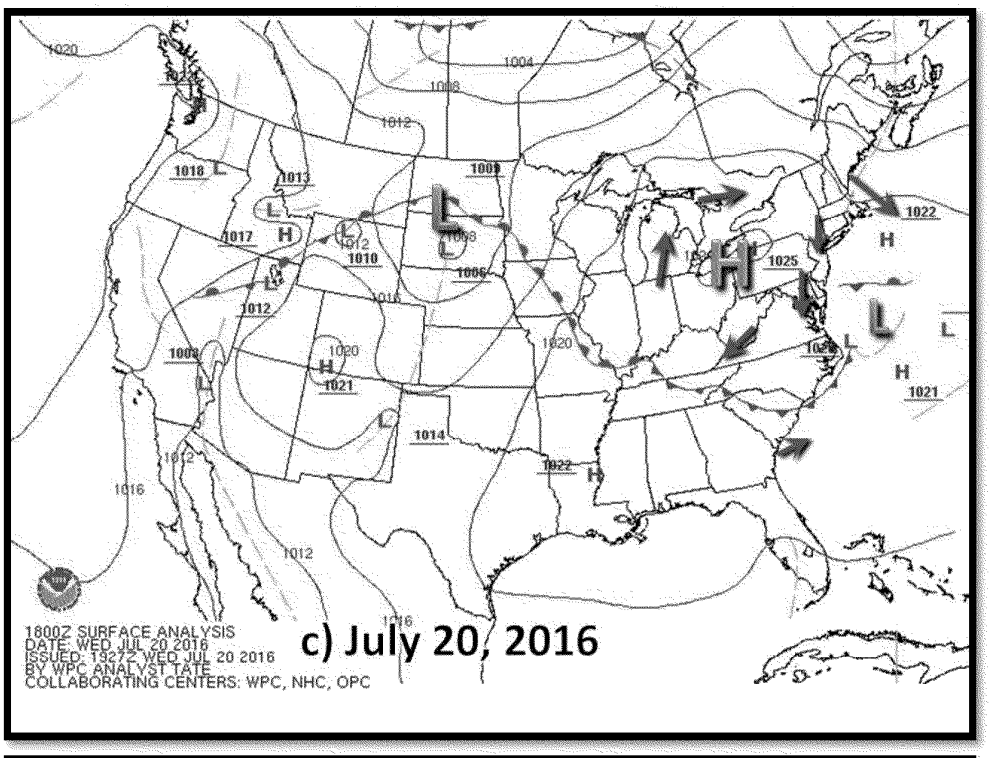

T.S. ESTELLE
17.7N 115.4W
NHC PSN
1800Z SURFACE ANALYSIS
DATE: MON JUL 18 2016
ISSUED: 1929Z MON JUL 18 2016
BY WPC ANALYST TATE
COLLABORATING CENTERS: WPC, NHC, OPC
a) July 18, 2016


T.S. ESTELLE
18.9N 119.2W
NHC PSN
1800Z SURFACE ANALYSIS
DATE: TUE JUL 19 2016
ISSUED: 1925Z TUE JUL 19 2016
BY WPC ANALYST TATE
COLLABORATING CENTERS: WPC, NHC, OPC
b) July 19, 2016



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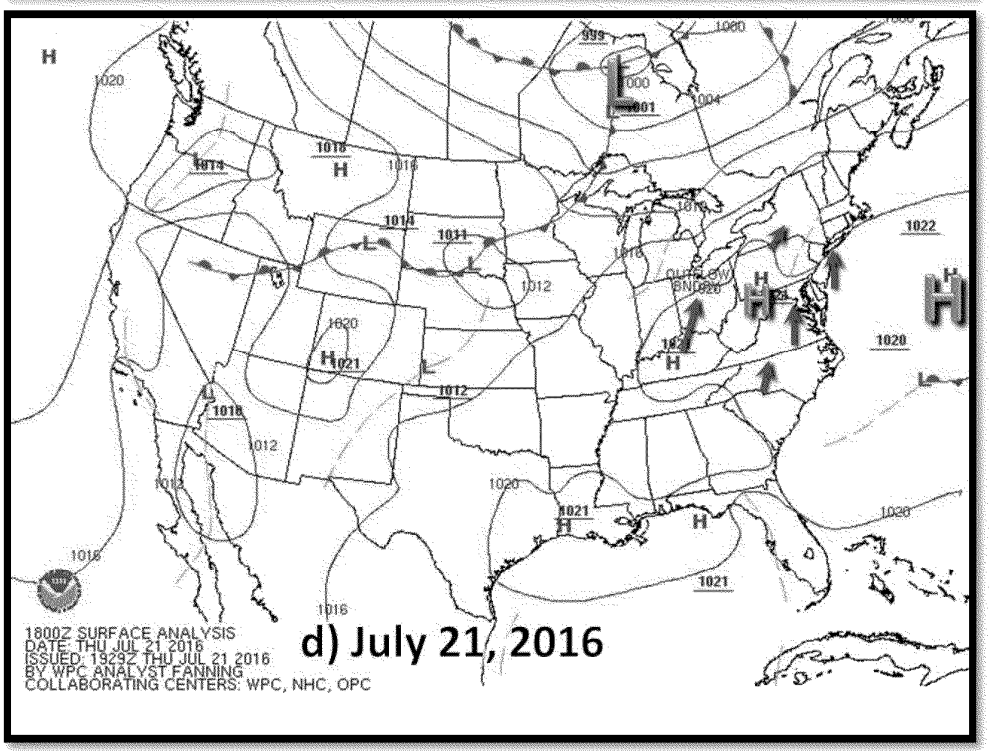

d) July 21, 2016

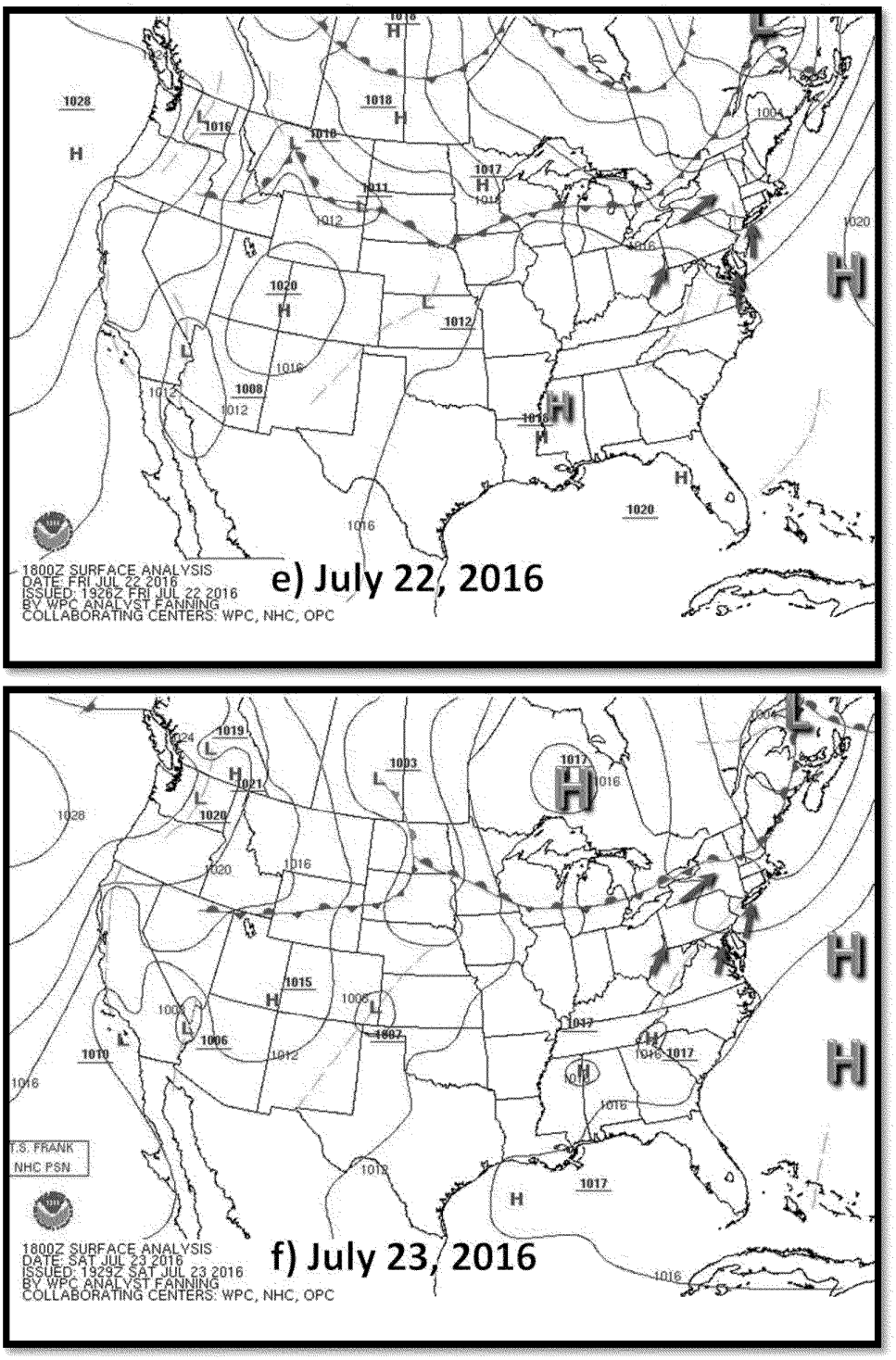

Figure 10. Surface analysis at 1800 UTC (2pm LDT in Maryland) for July 18-23, 2016.
Surface level charts are for a) July 18, b) July 19, c) July 20, d) July 21, e) July 22, f) July 23, 2016. Red arrows show the general surface wind pattern/direction. The letter "H" highlights high pressure, letter "L" is low pressure. Heights (brown lines) and fronts are also analyzed.

2.4.3.4. Temperature

Despite a period of prolonged warmth prior to the smoke event, ozone increased above the 70ppb standard over a wide area only in the presence of smoke. The hottest temperatures between July 15 and 23 occurred the day after the highest ozone concentrations occurred in Maryland (i.e., July 23), indicating that while warm temperatures supported ozone production, they did not drive it. Only one day between July 15 and July 23 was below 90°F and/or below normal (Table 3). As asserted earlier and exemplified over this period of warm weather, temperatures no longer necessarily predict ozone production. In fact, temperatures were warmer than normal through the 2016 ozone season, but recent data has shown that warm temperatures are no longer sufficient for ozone exceedances in Maryland. For example, the once steady ratio of "hot days" to ozone exceedances from 1980 – 2003 hit an all time high in 2016 with nearly twice as many hot days as ozone exceedances at the 70ppb standard (Figure 11). Previously, greater probability of ozone NAAQS exceedance in Maryland was shown with higher temperatures (Lin et al., 2001) and historically, MDE has tracked Maryland's ozone exceedance days with temperatures equal to or exceeding 90°F (MDE, 2012; Warren, 2013). However, Maryland also had near-record warmth throughout the 2016 ozone season but recorded a very low number of exceedance days. In fact, in a year with 48 days at or above 90°F, the greatest number of days in the last 17 years, there were only 26 exceedance days, which is the highest ratio of hot days to ozone exceedances at the 70 ppb level ever (Figure 11 and Figure 3). For example, in August of 2016, a string of several days in the mid 90s produced no ozone exceedances. The number of hot days to the number of ozone exceedances has been steadily increasing since 2003 indicating that temperature alone as a factor in ozone production is decreasing in importance in Maryland and emphasizes the important role of smoke and the additional ozone precursors it provided in this case.

All but one day was at or above the 90 °F threshold from July 14 – July 23 (Table 3). Except for the two and a half days with smoke influence, maximum one-minute ozone concentration measured in ppb was always lower than the maximum 10m temperature measured at the same sites (Figure 12). This is not to suggest that the absolute temperature is a proxy for ozone concentrations, rather, this is offered as a relative comparison for this period. For example, notice the similar diurnal temperature profiles on July 17 and July 21, 2016 but the drastic difference in ozone concentrations between the two days (Figure 12). This suggested substantial atmospheric composition differences between the two days. Additionally, on the day with the warmest temperature in the period (July 23), minute averaged ozone decreased after concentrations reached their peak around noon. This peak was also lower than ozone concentrations at the same time on the previous two days. Maryland did experience scattered evening thunderstorms on July 23, but the ozone concentrations peaked at 69ppb at HU-Beltsville at 11:56am while the temperature peaked several hours later at 92°F at 3:11pm. A fair weather cumulus field was present but insufficient for UV shielding and afternoon cloud cover due to thunderstorms did not impact Fair Hill (FH) or Hagerstown ("Hager" on figure) until approximately 4pm. Thus storm influences were an unlikely cause for the decrease in ozone concentrations after noon on July 23. Since the smoky airmass had been removed by July 23 by persisting transport of unaffected (non-smoky) air, the drop in ozone supported the assertion that the removal of smoke from the region is what improved air quality conditions and thereby the smoke was what

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caused MD8AO in exceedance of the NAAQS at multiple monitors in Maryland on the previous two days, July 21 and 22, 2016.

Table 3. Temperatures at BWI & MD8AO for Maryland July 14-23, 2016.
Maximum and minimum daily temperature, average maximum daily temperature and departure from normal (observation minus normal/average) at BWI. All temperatures are in degrees Fahrenheit.

DATE	Tmax (°F)	Tmin (°F)	Normal Tmax(°F)	Departure (°F)	MD MD8AO (ppb)
7/14/2016	96	75	88	8	59
7/15/2016	90	73	88	2	61
7/16/2016	92	68	88	4	71
7/17/2016	90	65	88	2	65
7/18/2016	94	71	87	7	63
7/19/2016	90	70	87	3	75
7/20/2016	86	66	87	-1	70
7/21/2016	90	63	87	3	78
7/22/2016	94	69	87	7	87
7/23/2016	98	73	87	11	66

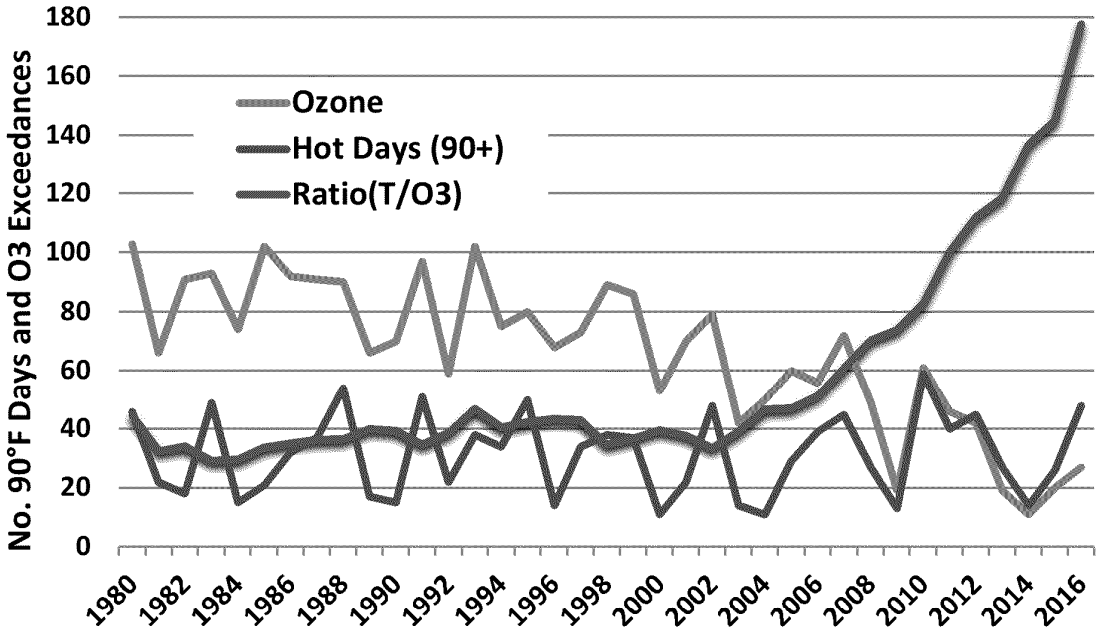

Figure 11. Ozone exceedance days to high temperature ratio.
A graph of the number of days with MD8AO in Maryland greater than 70ppb in a given ozone seas on (blue line), the number of days where the temperature at BWI airport reached at least 90°F in a given year (brown, thin line), and the five year moving average (multiplied by 100) of the ratio of "hot days" to ozone exceedances (thick red, shadowed line) from 1980-2016. The dramatic increase in the ratio of hot days to ozone exceedances indicates the decreasing significance temp erature has on ozone exceedance days in Maryland.

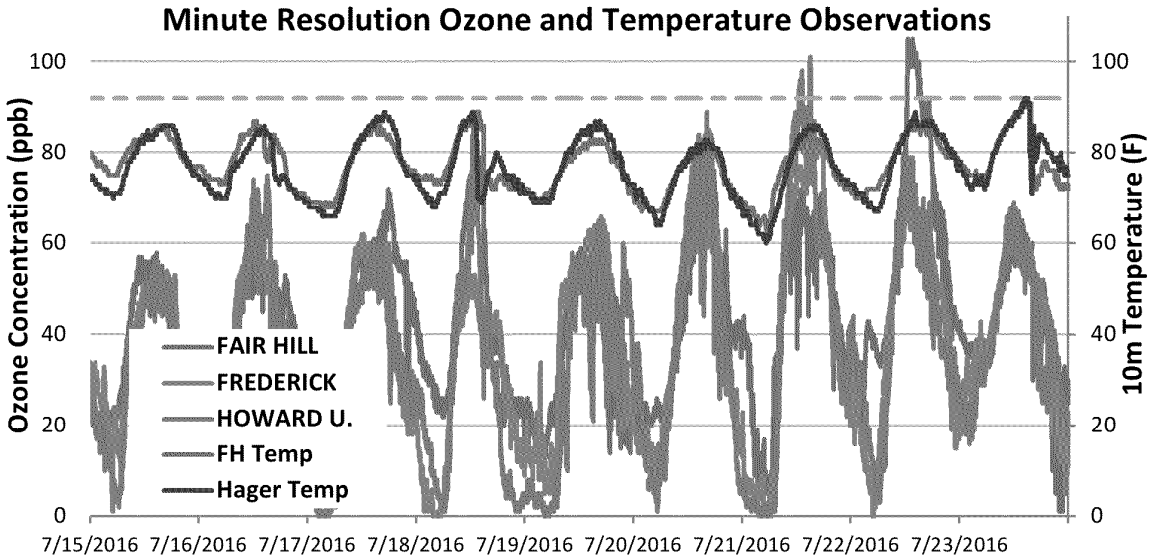

Figure 12. Minute resolution surface temperature (°F) and ozone (ppb).
Days with similar temperature to July 21 and 22 had ozone lower than the maximum achieved in the presence of a smoke - modified airmass. Ozone concentrations on July 23, 2016 at Fair Hill, Frederick and Howard U. (HU -Beltsville) all declined while temperatures continued to increases and prior to the sharp decline in temperatures at both Fair Hill (FH) and Hagerstown (Hag er) dropped due to approaching storms.

2.4.4. Tracking Smoke and Wildfire Emissions Transport to Maryland

Unlike the May 25 and 26, 2016 Maryland smoke and ozone event in which smoke degraded air quality well upstream of Maryland, July's smoke plume appears to have remained mostly elevated until subsiding in Maryland on July 20. Lidar imagery acquired by the University of Maryland Baltimore County (UMBC) Elastic Lidar Facility (ELF) aerosol Lidar, located in Catonsville, MD (39.255°N, -76.711°W) or about 10 km west of the Baltimore Inner Harbor showed that a layer of aerosols (smoke) subsided over Maryland and was incorporated into the planetary boundary layer (PBL; near surface layer of air) on July 20 between 4:00 and 6:00pm (Figure 13). The sinking motion of the smoke is consistent with subsidence typical of post frontal airmasses and high pressure as was present across the northern Mid-Atlantic on July 20 (Figure 10c). While the cold front passed through Maryland on July 19, the smoke had not yet been transported into the subsiding air by the northwesterly flow at 850mb, which continued through the smoke transport period into Maryland between July 18 and July 20 (see below).

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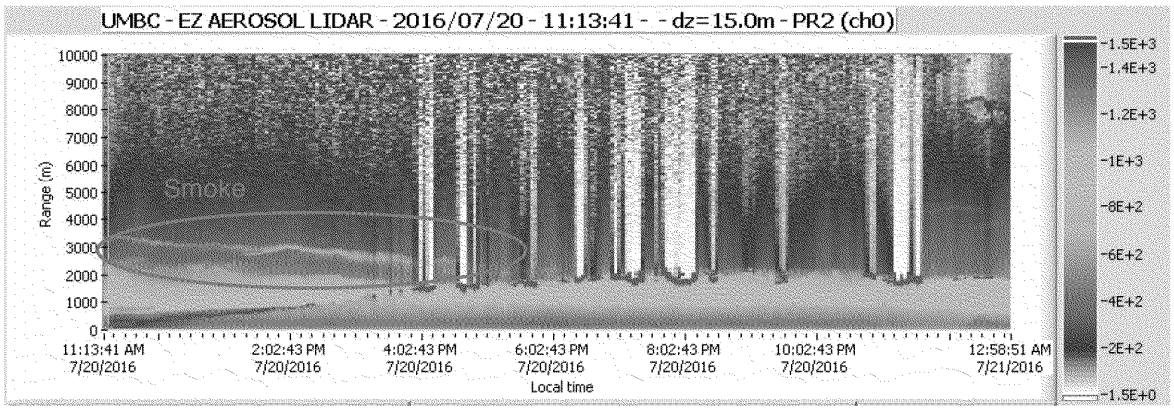

Figure 13. UMBC Aerosol Lidar from July 20 -21, 2016.
Increased back scatter is indicated by warmer colors. A layer of aerosols subsiding from above 3000m is circled and identified as smoke. The smoke is seen mixing with the planetary boundary layer (PBL) between 4:00 and 6:00pm on July 20, 2016, indicating smoke mixed into the local air in the greater Baltimore region the evening before the exceedances on Jul y 21. White vertical banding is due to cloud interference.

As a result of the evolution of the upper level and surface weather patterns, smoke from northwestern Canada was transported to Maryland. HMS smoke analysis prior to the ozone event clearly showed a smoke plume originating over northwestern Canada which progressed southeastward towards the northeastern US and northern Mid-Atlantic (Figure 14). Smoke was analyzed already on July 14 from fires over northwestern Canada across Alberta, British Columbia and the Northwest Territories (Figure 14a). This plume grew in size and worked southeastward across northern Alberta, Saskatchewan, Manitoba, and Ontario on July 15 (Figure 14b) where it persisted into July 16 (Figure 14c). The remnants of this first plume moved southward on July 17 to be across the US/Canada border as the number of fires across the fire region also grew according to fire information from the Canadian Wildland Fire Information System (CWFIS) for the week of July 13 -20, 2016. The new fires reinvigorated smoke across the Northwest Territories and northern Alberta (area in red, Figure 14d). As discussed previously, the upper level winds moved this new plume of smoke (and whatever remnant smoke there was across the US/Canada border) southeastward. By July 18 the smoke plume stretched from the fire source area across northwest Canada all the way to the Great Lakes as it was impacted by the passing low pressure system that moved across Canada (Figure 14e). The first mentioned remnant plume appeared to be across the great lakes while the new plume seemed to be still concentrated a bit farther northwest across central Canada where greater smoke concentrations existed over a wider area.

By July 19, the main, concentrated smoke plume which started out as an area of analyzed heavy smoke on July 17, stretched from the Hudson Bay to the northern Great Lakes (Figure 14f). The remnant plume emitted earlier in the period was no longer analyzed ahead of the thicker plume and/or was no longer distinguishable as separate from the plume generated at the later date. The smoke plume by July 19 had pushed southward, caught in the northwest flow around or above 850mb. Though at this time it was well behind the surface cold front and also just to the east of the center of high pressure located over the

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western Great Lakes (compare Figures 14f and 9b and 10b). The smoke plume continued southeastward on July 20 (Figure 14g). However, by this time subsidence associated with the high pressure and post frontal air mass moving southward over the northern Mid-Atlantic had been acting on the smoke plume, forcing it downwards towards the surface. Lidar imagery showed the smoke subsided from heights greater than 3000m above the surface, suggesting the path of the smoke was consistent with the 3000m (green) trajectory seen in Figure 6 which showed transport of the smoke plume from southern Canada several days earlier. This path is also consistent with the HMS smoke analysis evolution over several days, presented in Figure 14, conclusively showing the smoke was transported not only to Maryland, but to the surface air in Maryland and made available for ozone production on July 21. Analyzed smoke was no longer present over Maryland on July 21 (Figure 14h), though further analysis presented below showed the impact from the smoke on the composition of the atmosphere in Maryland persisted on July 21 and 22, 2016.

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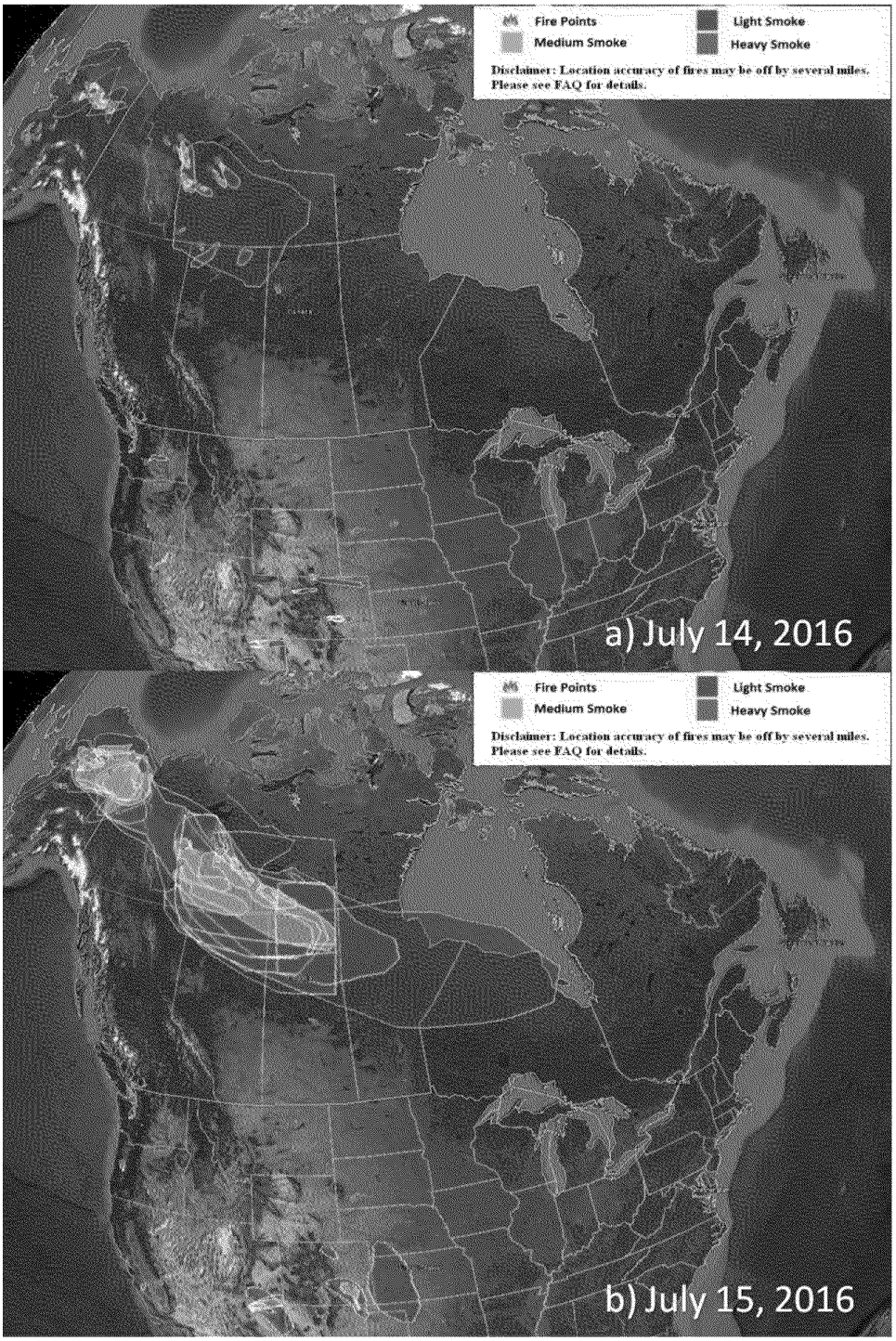
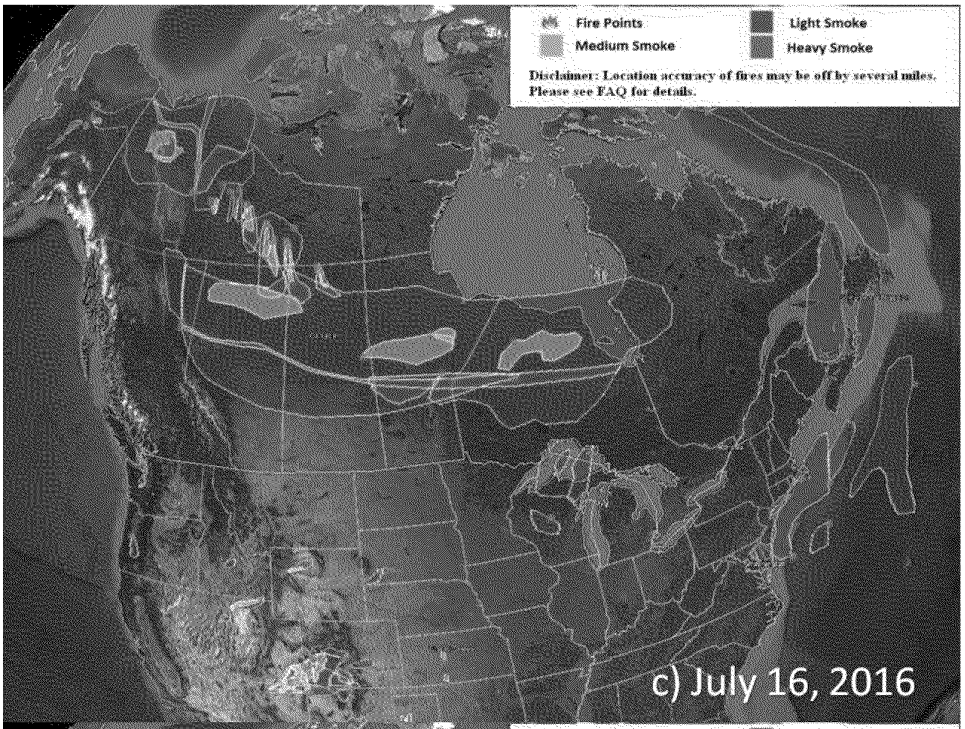

Fire Points
Light Smoke
Medium Smoke
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles.
Please see FAQ for details.
a) July 14, 2016
Fire Points
Light Smoke
Medium Smoke
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles.
Please see FAQ for details.
b) July 15, 2016


Fire Points
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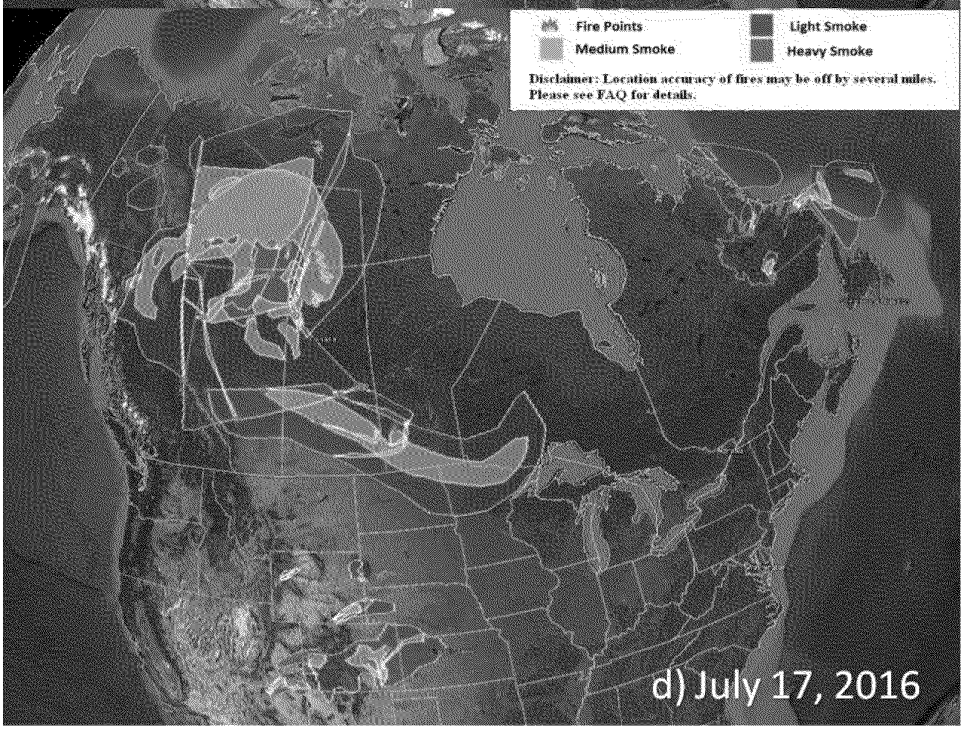
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles.
Please see FAQ for details.
c) July 16, 2016


Fire Points
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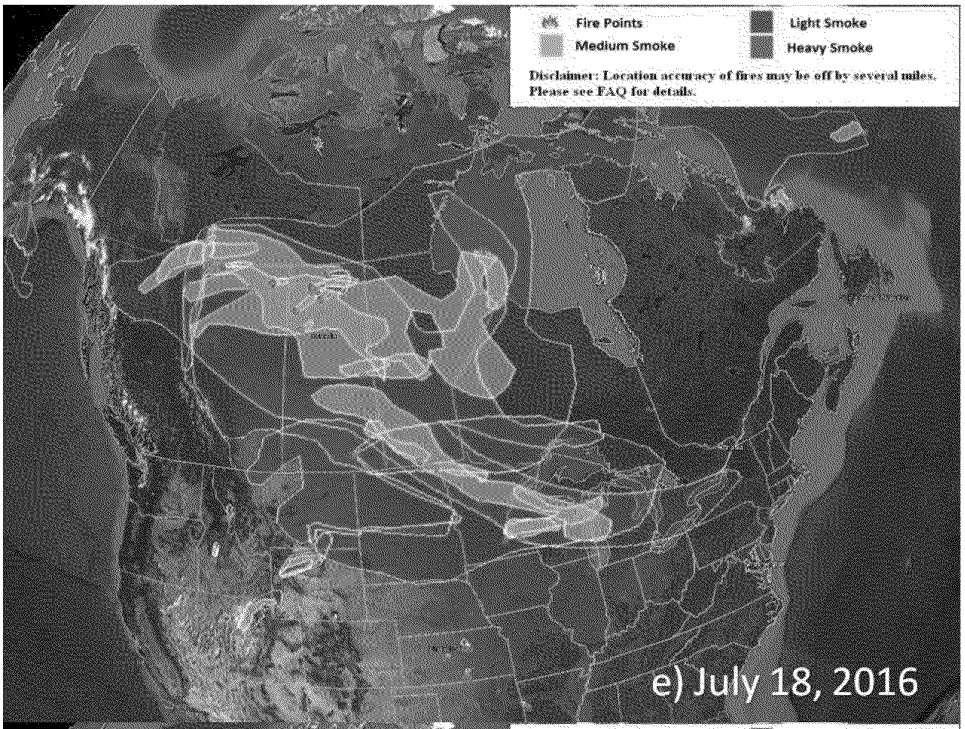
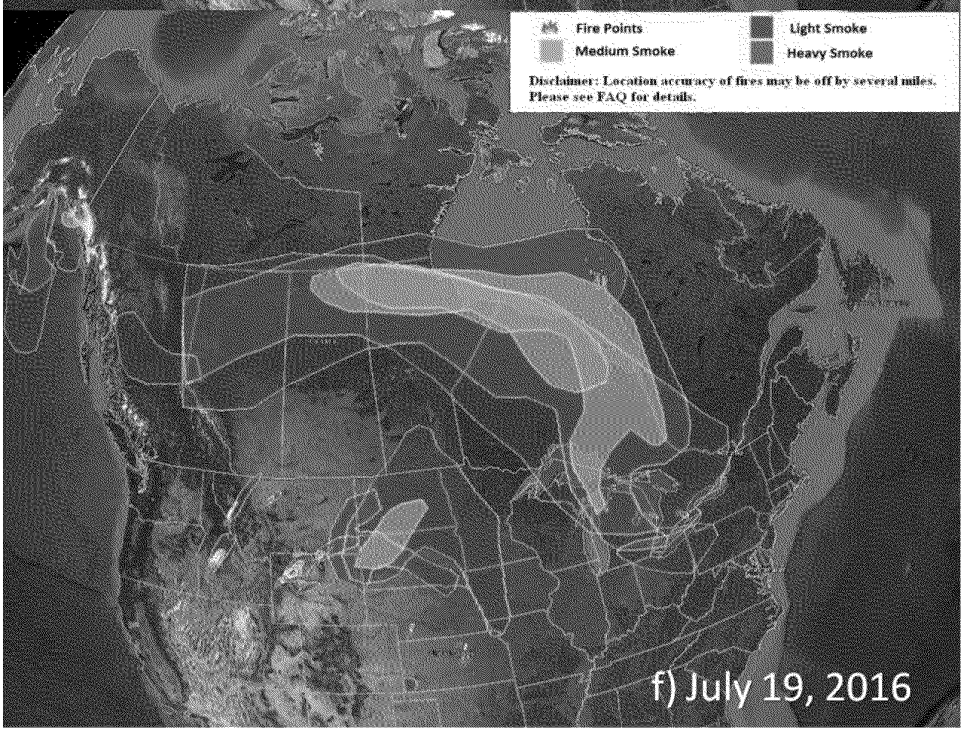
Medium Smoke
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles.
Please see FAQ for details.
d) July 17, 2016


Fire Points
Light Smoke
Medium Smoke
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles.
Please see FAQ for details.
e) July 18, 2016


Fire Points
Light Smoke
Medium Smoke
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles.
Please see FAQ for details.
f) July 19, 2016

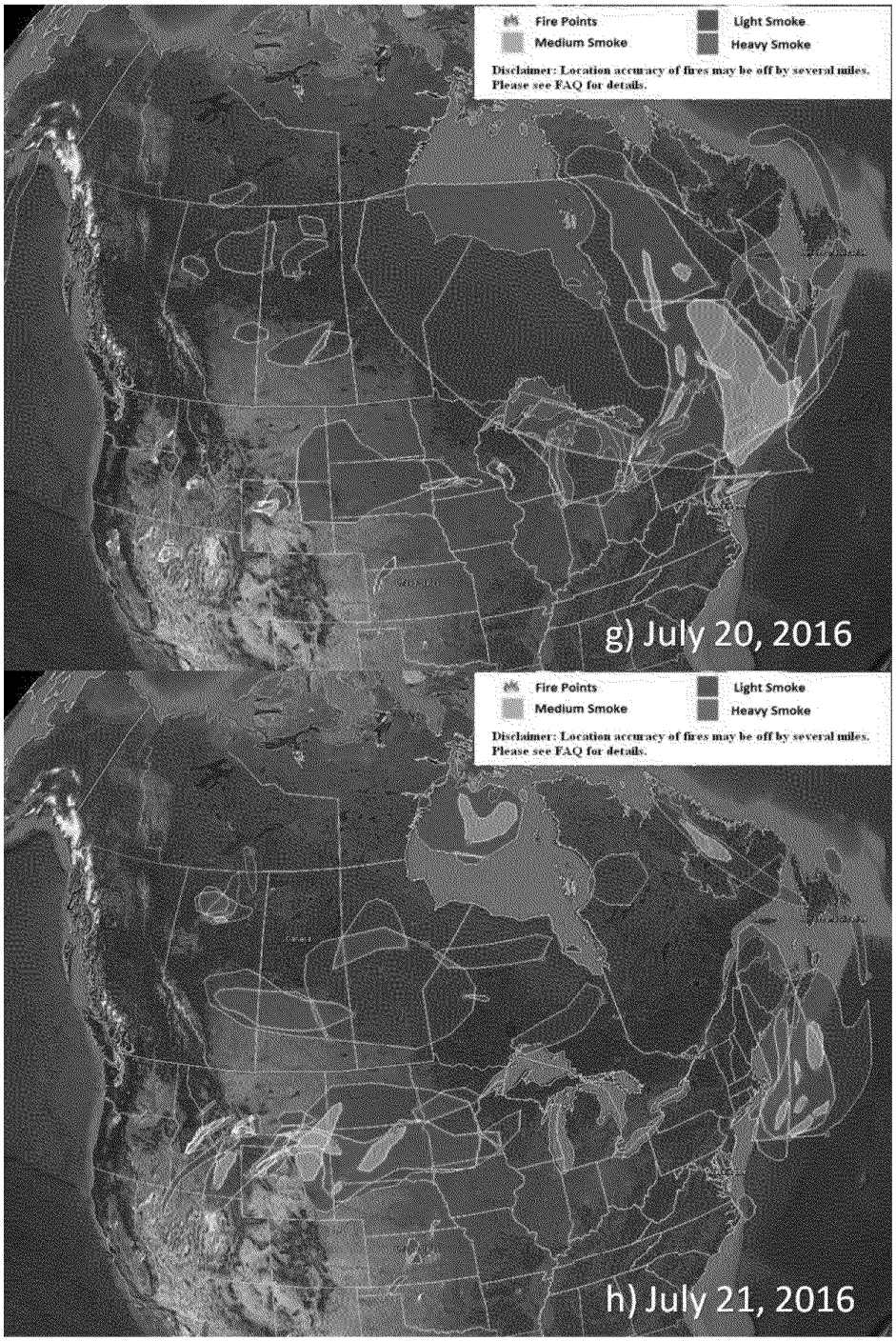


Figure 14. HMS analyzed smoke showing transport from the fire region to Maryland.
The North America view showed the transport of smoke from the fire source region to Maryland over the course of several days: (a) July 14, (b) July 15, (c) July 16, (d) July 17, (e) July 18, (f) July 19, (g) July 20, (h) July 21. Green shading shows light smoke, yellow medium/moderate smoke, and red heavy smoke coverage. Notice smoke from northwest Canada was present beginning July 14, drifting towards the CONUS, but a large increase in the smoke coverage occurred between July 17 and July 18. This plume moved into Maryland by July 20.

2.4.5. Smoke and Ozone Discussion and Analysis

Spatial analysis of contoured MD8AO concentrations and HMS analyzed smoke were consistent with the transport of an elevated smoke plume across the upper Great Lakes into the northeast CONUS that subsided to the surface across the northern Mid Atlantic. The subsidence of the smoke to the surface in Maryland was clearly connected to the onset of an ozone exceedance event. The magnitude of ozone concentrations across the entire eastern US remained quite low on July 18 and 19 (Figures 15a and b). Outside of the single exceedances around Chicago and at Essex, Maryland on July 19, any MD8AO above 55 ppb was extremely isolated. In these early analysis days there appears to be little correlation of the location of the smoke plume to surface ozone. This is logical, since the plume was shown to be elevated during this time and was not yet impacting the surface air. Thus, the lack of correlation of ozone and the smoke plume on July 18 and 19 actually bolsters the argument that the smoke heightened the MD8AO concentrations once the smoke reached the surface. Slightly cooler temperatures and initially cleaner air in northern Pennsylvania behind the front kept ozone values low there on July 19 but also brought the elevated smoke farther south across areas such eastern Ohio and western Pennsylvania (Figure 15b). The cold front created a well defined ozone gradient across central Pennsylvania on July 19 that persisted on July 20 while temperatures recovered regionally (Figure 15c) and smoke began impacting the surface.

By July 20, the combination of high pressure northwest of Maryland and the weak low pressure associated with the cold front just off the east coast (see Figure 10b and c) caused near-surface winds to turn northeasterly in Maryland on July 20 (red and blue trajectories on Figure 15c) bringing smoke down to the surface across Maryland with a slight easterly component. MD8AO concentrations increased along the I-95 corridor to around 65ppb on July 20 (Figure 15c), but only along the I-95 corridor. Elsewhere, concentrations were at or below 60ppb. Particularly of note are the low (<55ppb) MD8A in locations across Pennsylvania, New Jersey, New York and Connecticut. These were important to note for comparison of these same locations on July 21, the first day of an ozone exceedance across the region. As the smoke subsided across the area, substantial ozone production began. MD8AO concentrations in excess of 70ppb were observed from western Pennsylvania southward through DC to Richmond and Hampton Roads, Virginia and northeastward all the way to Connecticut. Recall areas over Connecticut and New York on the previous day had MD8AO concentrations below 55ppb. Other areas exceeding 75ppb on July 21 (Figure 15d) had MD8AO concentrations on July 20 (Figure 15c) of only 60ppb or less. All locations saw about a 15ppb jump between days. The main difference between the days was the arrival of smoke across the region late on July 20, with influences persisting on July 21.

Although smoke was only analyzed by HMS over northeastern Maryland on July 20, the analysis can be off by several tens of miles. Additionally, HMS is a “one time” capture of the smoke by satellite, with further interpretation by subjective expert analysis. In other words, the smoke is only mapped once during the day and does not account for continued transport southwards towards areas such as Richmond. Nor does it account for residual smoke influences dispersing across the entire area exceeding 70ppb on July 21, regardless of HMS not analyzing smoke over these areas (Figure 15d). In fact, HMS DOES analyze a bit of smoke just east of the Richmond/Hampton Roads area of Virginia, showing that smoke did progress that far

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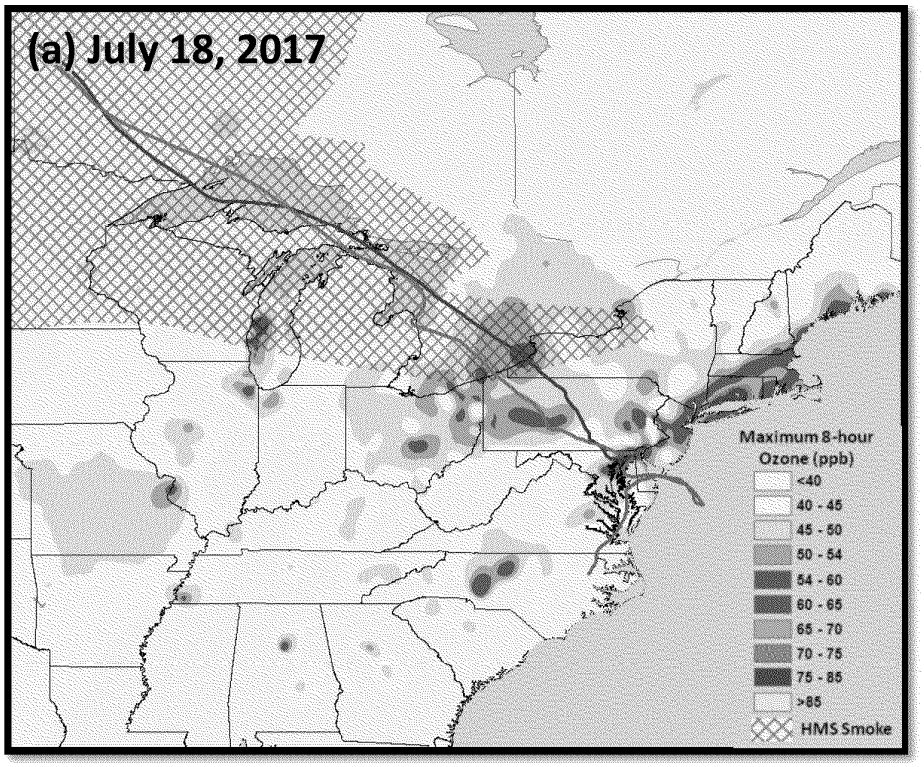
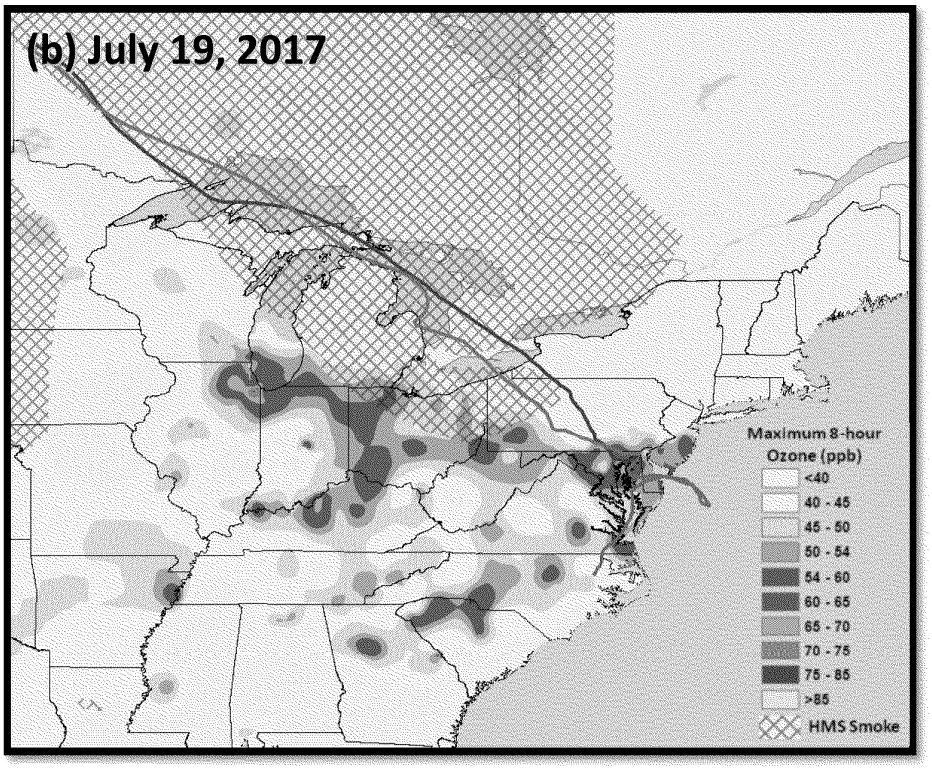
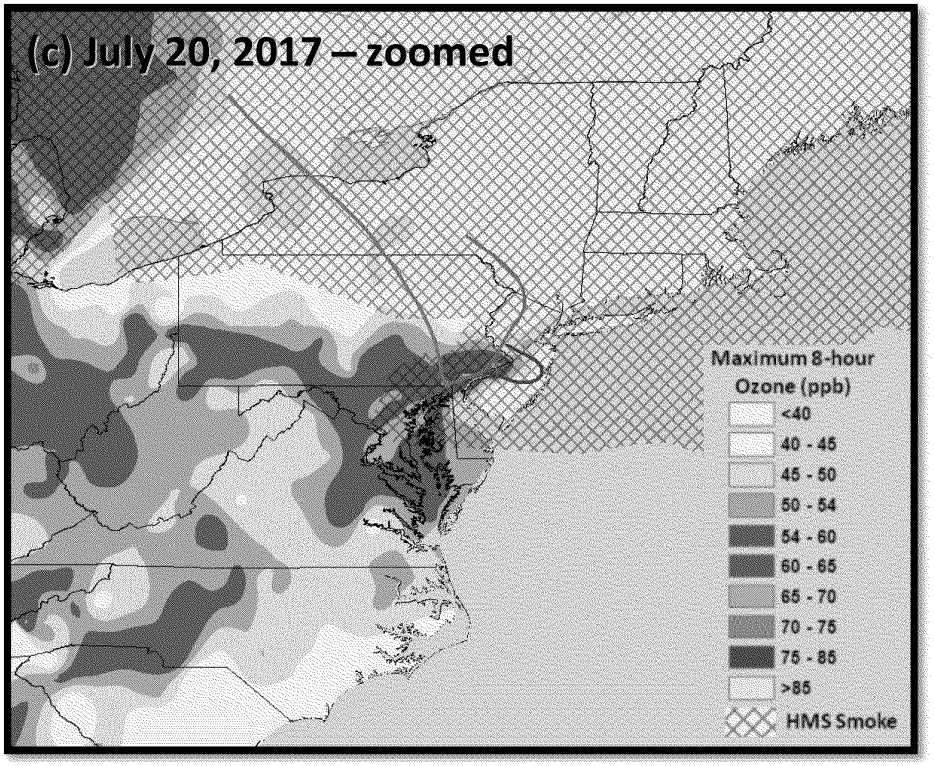
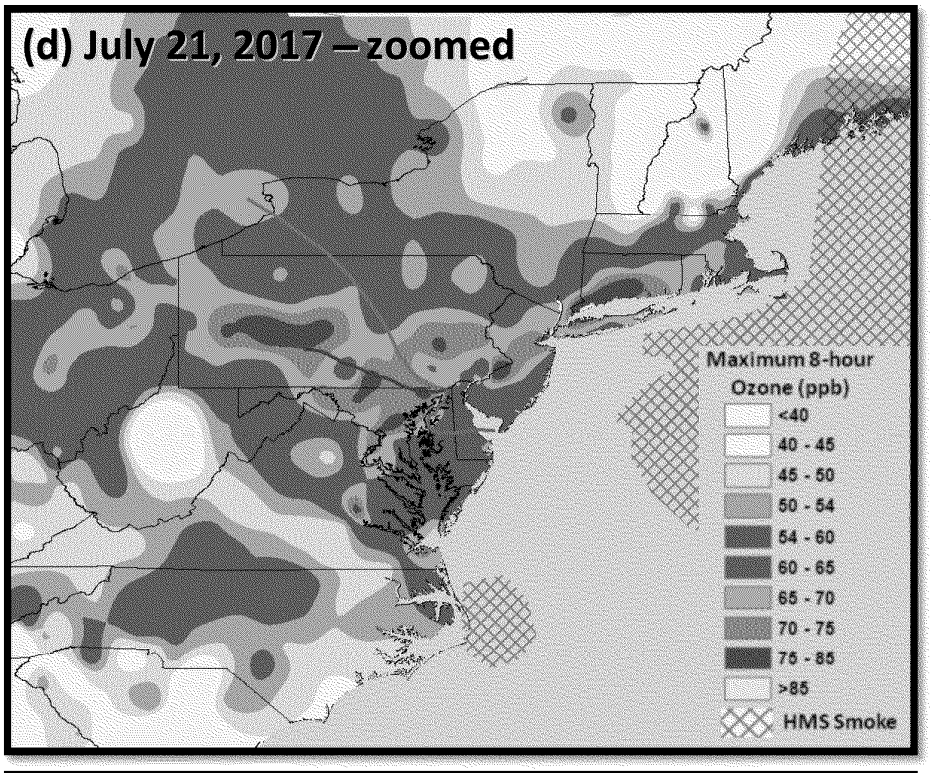
south, even if smoke was not analyzed directly over all the areas exceeding. In essence, smoke constituents had been introduced into the surface air and created conditions ripe for ozone production over a wide area, even as the surface smoke could no longer be picked up via satellite analysis. The impact of the smoke persisted on July 21 and 22 even as some analyzed smoke (that which was thick enough that it could be detected by satellite) moved offshore.

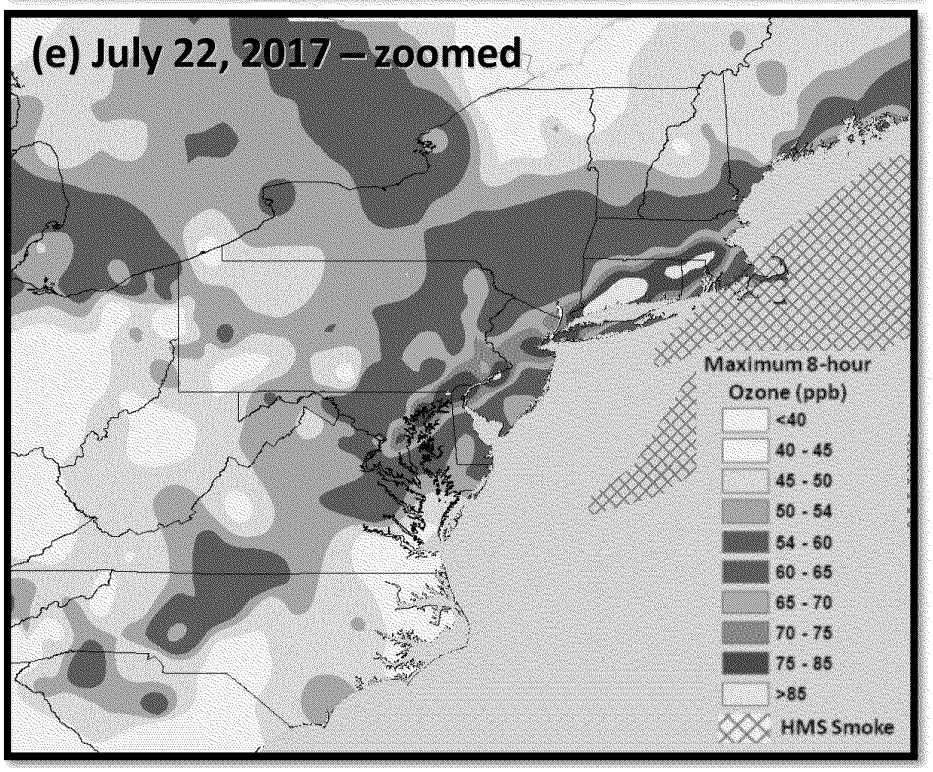
Transport winds at 850mb continued from the west and northwest on July 22 and 23 while surface winds persisted from the southwest. This favored the development of the lee trough (Figure 10e) which concentrated the remaining pollution into a tight corridor along I-95 from DC through Connecticut. As in earlier cases, as the smoky air aged, ozone concentrations also increased, and the Fair Hill monitor observed its highest MD8AO of the 2016 and similarly, areas like Connecticut had wide spread exceedances of the old 84ppb standard. Persistent conditions on July 23 across Maryland yielded decreasing ozone concentrations. Thus, as the smoke-affected air dissipated across the region, so too did the ozone concentrations. As Figure 15f showed, without the aid of additional smoke on these days, Maryland was unable to exceed the 70ppb ozone standard with its own "home grown" emissions.




(b) July 19, 2017
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke


(c) July 20, 2017 – zoomed
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke


(d) July 21, 2017 – zoomed
Maximum 8-hour
Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke


(e) July 22, 2017 – zoomed
Maximum 8-hour
Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke

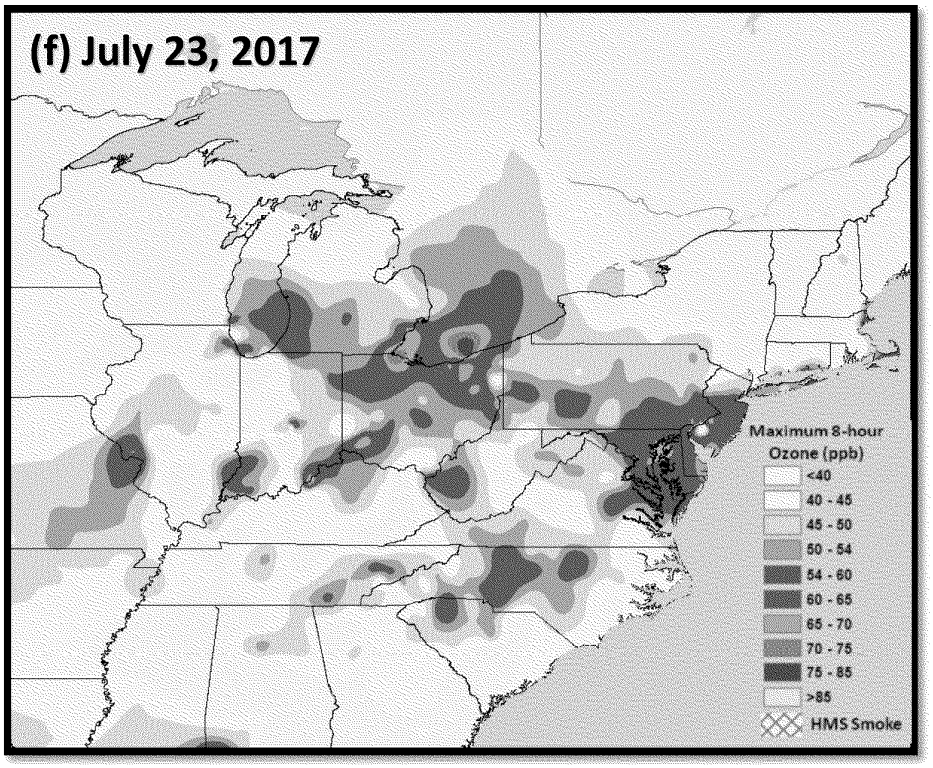


Figure 15. Smoke and maximum daily 8-hour average ozone concentrations for the eastern CONUS.
July 18-23 maximum 8-hour average ozone concentrations and Hazard Mapping System (HMS) analyzed smoke (hatching). Figures a, b, and f show most of the eastern CONUS while c, d, and e show a regional, zoomed -in view of the Mid-Atlantic area for greater detail. Backwards trajectories starting at 2100UTC running for 24 hours at 3000m (green), 1500m (blue), and 50m (red) are drawn in c, and d (July 20 and 21) while a 96 hour (4-day) backward trajectory at the same heights is shown in a and b, similar to Figure 6. No trajectories are shown in e or f. Transported smoke was closely associated with ozone in Maryland beginning on July 20.

3. Clear Causal Relationship Between The Event and Monitored Ozone Concentrations

The event presented in this analysis illustrates an example of the impact of subsidence of a smoke plume to the surface on ozone concentrations in Maryland. MDE here presents necessary evidence to show the smoke event affected air quality in Maryland and clearly was associated with ozone concentrations beyond what otherwise is expected in the absence of smoke and that smoke caused the exceedance days. Comparisons to historical concentrations and a Q/d analysis (Tier 1 and 2 steps) are provided. While MDE believes these analyses alone show a causal relationship between the ozone and smoke, the complicated nature of the event and the historically similar concentrations (though under greater anthropogenic emissions) may not clearly demonstrate a clear causal relationship. After conversations with EPA, it was deemed further analysis was necessary to establish and demonstrate a clear causal relationship. Therefore,

a weight of evidence (Tier 3) approach is used to build an irrefutable case that smoke transport was responsible for the ozone concentrations and the ozone exceedance days in Maryland.

3.1. Historical concentrations

Scatter plots of MD8AO at the 12 Maryland monitors exceeding the 70ppb NAAQS showed that the July 21 and 22, 2016 concentrations were elevated compared to seasonal observations from the last five years and were "exceptional", being above the 99th percentile of observations at most sites (Figures 16-27). All ozone data during the 2012-2016 ozone seasons (April 1 to September 30) were plotted for each monitor against that monitor's multi-season 99th percentile. However, recall significant and sustained reductions in ozone precursors across the eastern US have occurred in the past 10 years. These reductions have been particularly evident in NOx. Consequently, this has lead to a noticeable decrease in ozone concentrations and exceedance days in the past three to four years. Five of lowest seasonal number of exceedance days occurred in the past 8 years, with four in the past four years, due to these NOx reductions.

The July 21-22, 2016 period had one of lowest mid-July NOx emissions, ever, from 2010-2016 and July of 2016 as a whole had the lowest emissions ever (Figures 4 and 5). Therefore, amplified MD8AO concentrations on July 21 and 22, 2016 represented substantially more ozone generated from available NOx than in 2012, when emissions were substantially higher. Since 2012 is within the previous five years of data that EPA requests for historical comparisons, MDE feels the data from 2012 raises the 99th percentile higher than what is otherwise now representative of Maryland's ozone. Even 2013 appeared to be a transition year as the NOx downward trend continued. To address the outlier-like status of ozone and emissions in 2012 MDE also offered two additional 99th percentiles to compare each monitor's MD8AO on July 21 and 22. These additional 99th percentiles are calculated using data which excludes 2012 (2013-2016) for the entire season, then another which compares only July from 2013-2016. MDE believes this increases the robustness of the historical comparison.

The results at many of the monitors show that at least one of the two days (July 21 or 22) was close to or exceeded the 99th percentile at that monitor for the dataset using 2013-16. A few monitors still beat the full multi-seasonal (2012-2016) 99th percentile level (Hagerstown and Fair Hill for example) despite the inclusion of 2012 data.

Of the 12 monitors that MDE is pursuing as being influenced by an exceptional event, on July 21, 2016:

- Three (3) monitors met or exceeded the 99th percentile using all data from April 1 – September 30, 2012-2016 [Frederick (240210037), Hagerstown (240430009), HU-Beltsville (240330030)].

- Seven (7) monitors met or exceeded the 99th percentile of the data when comparing only July ozone from 2013-2016 [Aldino (240259001), Beltsville CASTNET (240339991), Frederick (240210037), Furley (245100054), Hagerstown (240430009), HU-Beltsville (240330030), Padonia (240051007)].

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- Seven (7) monitors met or exceeded the 99th percentile of the data set when the entire 2012 ozone season was excluded. [Aldino(240259001), Beltsville CASTNET (240339991), Essex (240053001), Frederick (240210037), Furley (245100054), Hagerstown (240430009), HU-Beltsville (240330030)].

Of the 12 monitors that MDE is pursuing as being influenced by an exceptional event, on July 22, 2016:

- Two (2) monitors met or exceeded the 99th percentile using all data from April 1 – September 30, 2012-2016 [Edgewood (240251001), Fair Hill (240150003)].

- Three (3) monitors met or exceeded the 99th percentile of the data when comparing only July ozone from 2013-2016 [Edgewood (240251001), Fair Hill (240150003), PG Eq Cntr (240338003)].

- Three (3) monitors met or exceeded the 99th percentile of the data set when the 2012 ozone season was excluded [Edgewood (240251001), Fair Hill (240150003), PG Eq Cntr (240338003)].

All 12 monitors that MDE seeks concurrence for the influence of the wildfire smoke on ozone equaled or exceeded a 99th percentile. Additionally, 10 of the 12 monitors had one of the fourth highest observations of the 2016 season at the monitor. The Beltsville CASTNET (240339991), Hagerstown (240430009), and HU-Beltsville (240330030) had their highest observation of the 2016 season on July 21 while Edgewood (240251001) and Fair Hill (240150003) had their highest of the 2016 season on July 22. It is safe to say the event caused one of the highest ozone concentraitons at all monitors which exceeded the standard (and even at those that did not – see Appendix B). Scatterplots from all 12 monitors using all data from April 1 – September 30 (the typical months which historically have experienced ozone exceedance days) from 2012-2016 are given in Figures 16-27. Along with the 70ppb NAAQS threshold, three additional threshold lines show the 99th percentile for all ozone season data 2012-2016, ozone season data from 2013-2016, and only ozone in July, 2013-2016.

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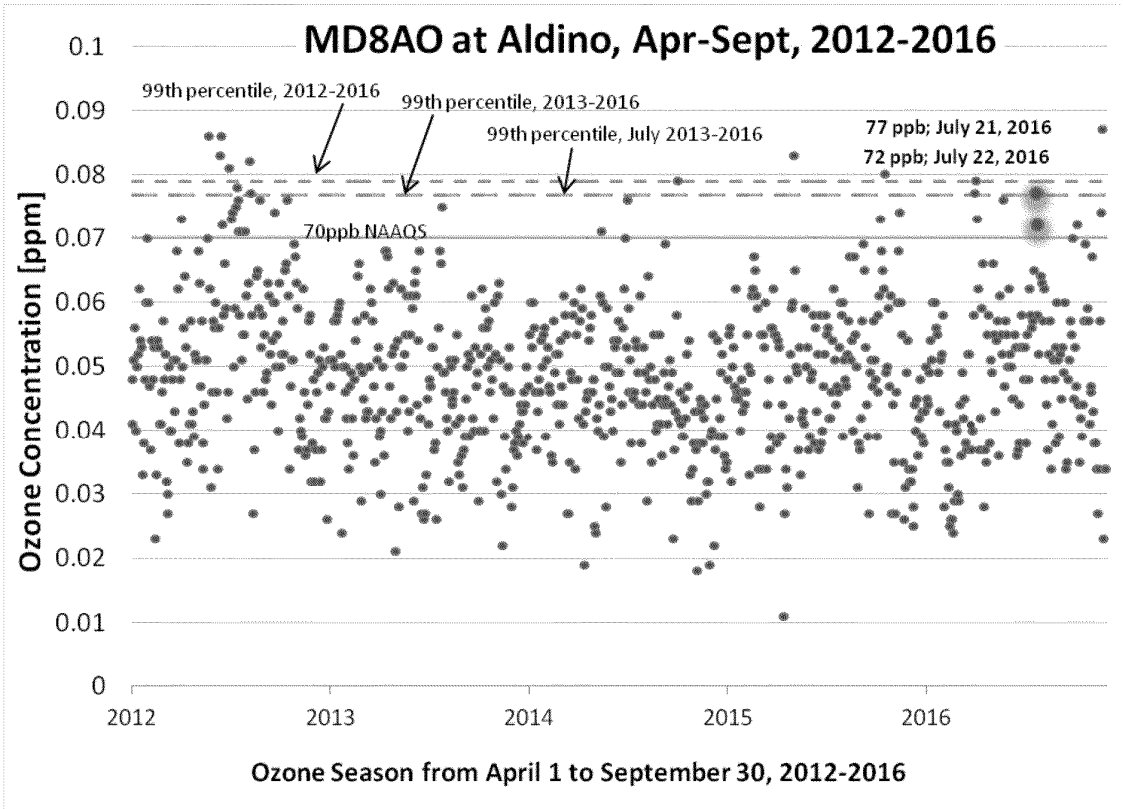

Figure 16. Scatterplot of Maximum Daily 8-hour Average Ozone (MD8AO) concentrations at Aldino (blue dots), April 1 – September 30, 2012-2016.
The days that exceeded the NAAQS on July 21 and/or 22 and for which MDE is seeking exclusion of the data are colo red red. Textual annotations give the MD8AO for the red colored data point. Along with the NAAQS level (70ppb – red line), three 99th percentile lines are given to account for the changing NOx emissions and ozone levels in Maryland over the past 5-years. The 99th percentile for all ozone season data (April – September), 2012-2016, is given in dashed purple. All season data 2013-2016 is given in blue (dash-dot) while data only from July 2013-2016 is given in long-dashed green.

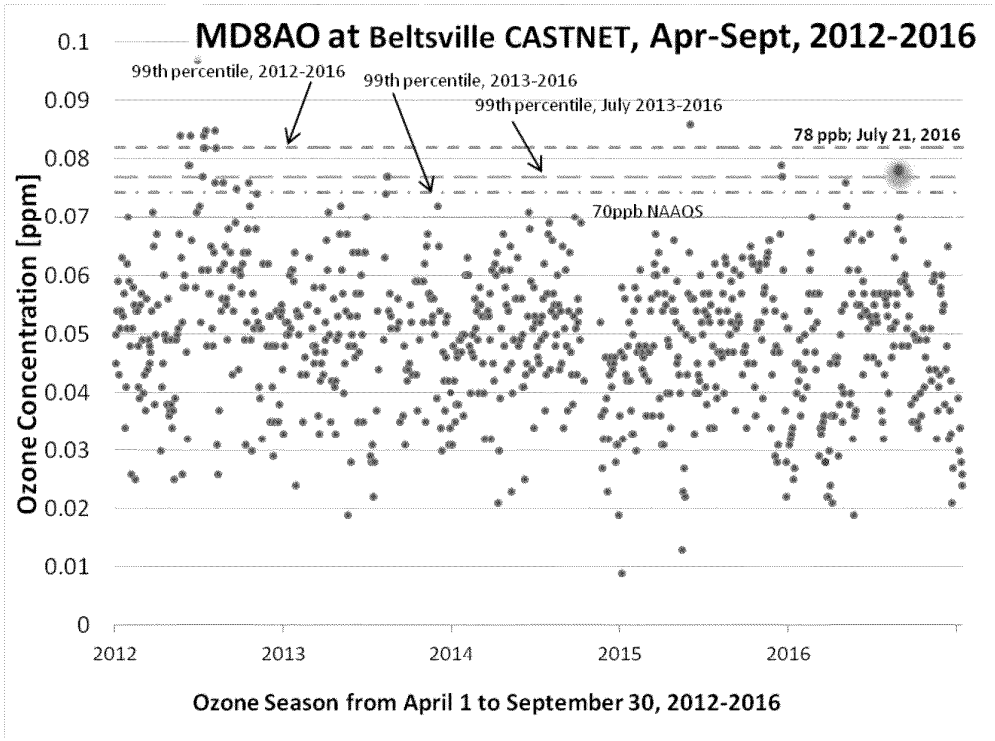

Figure 17. Same as Figure 16, except for the Beltsville CASTNET site.

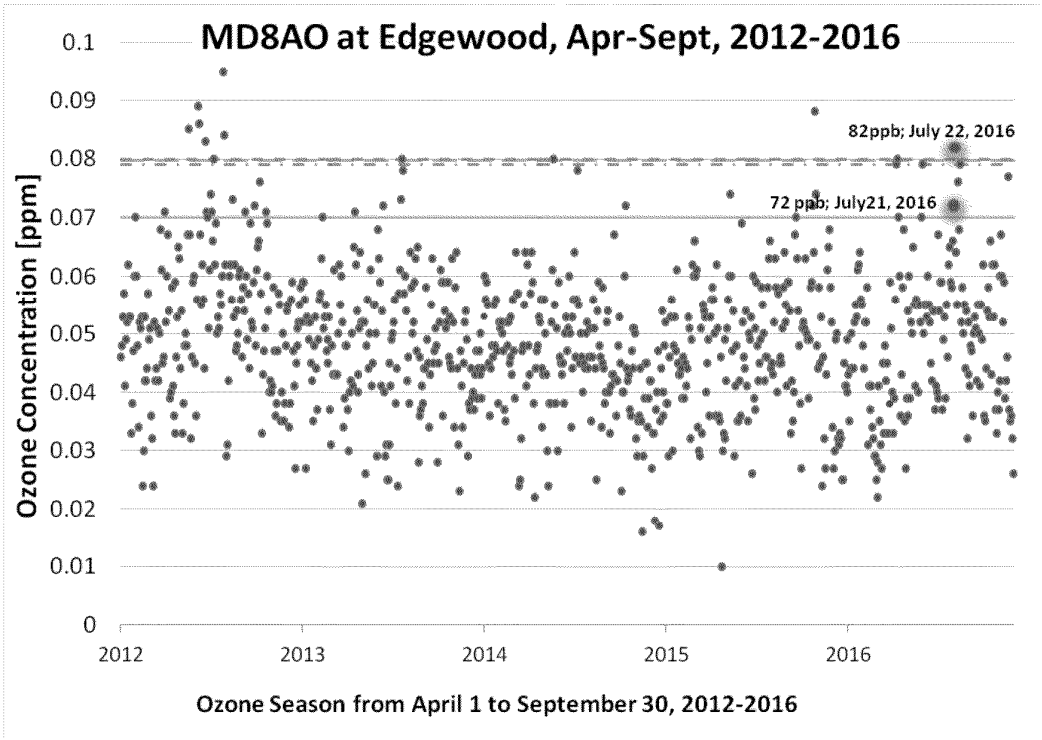

Figure 18. Same as Figure 16, except for the Edgewood site.

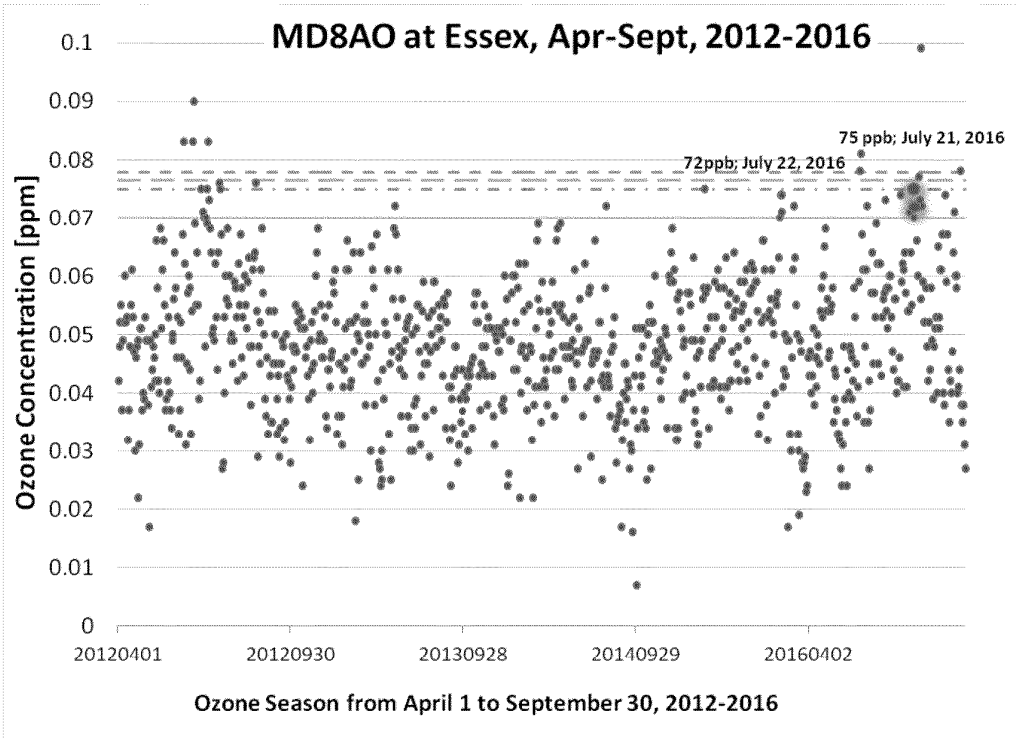

Figure 19. Same as Figure 16, except for the Essex site.

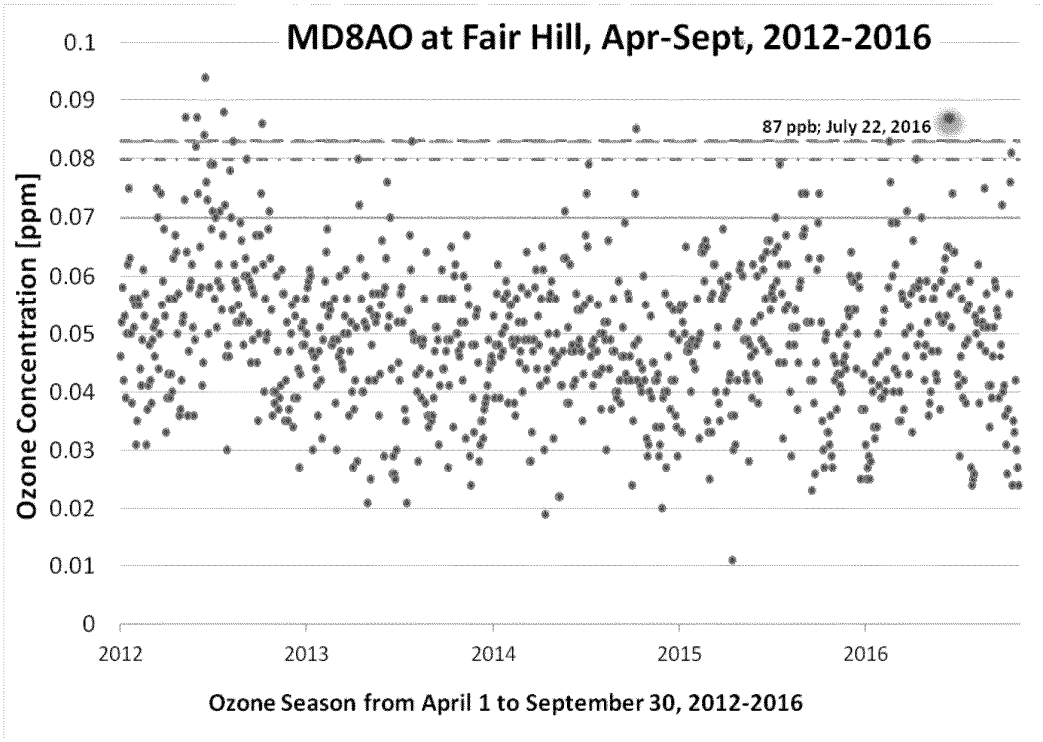

Figure 20. Same as Figure 16, except for the Fair Hill site.

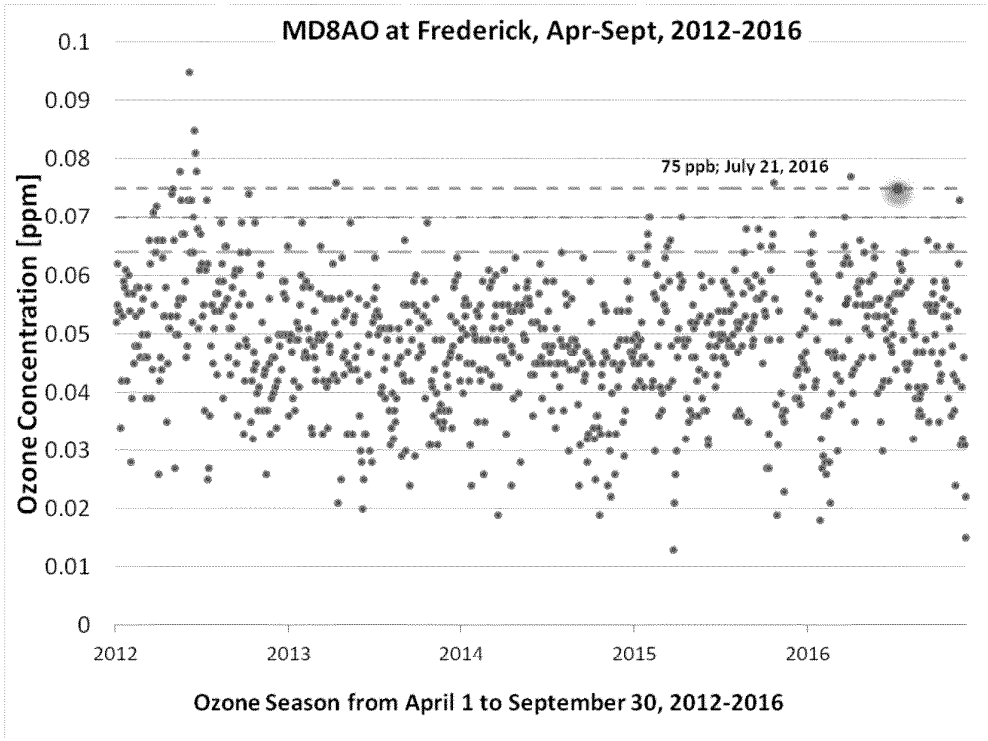

Figure 21. Same as Figure 16, except for the Frederick site.

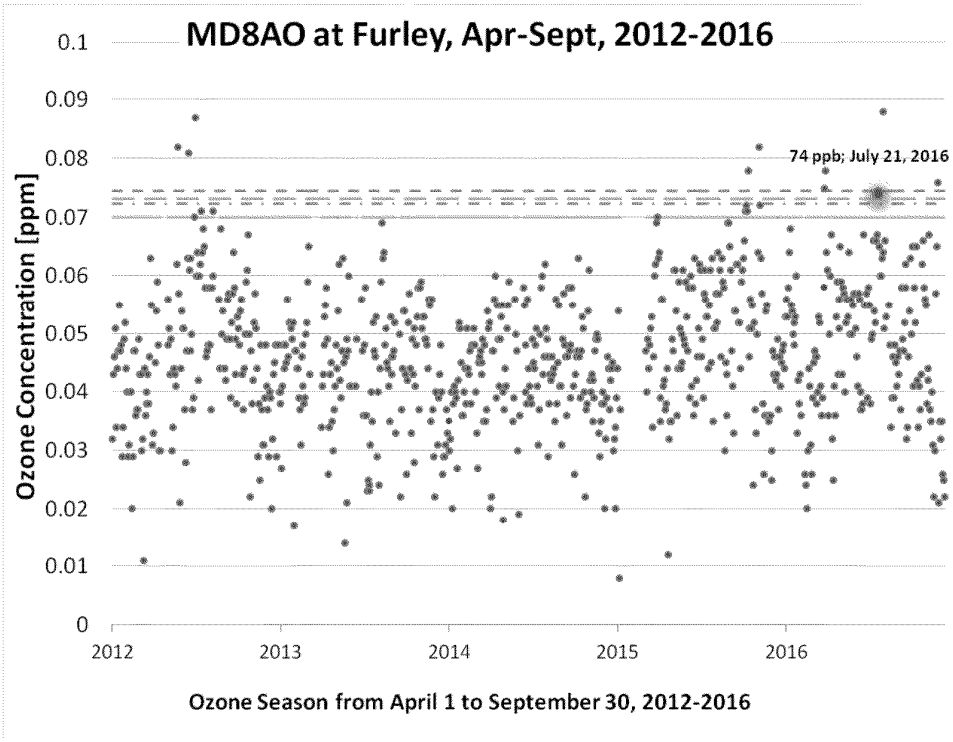

Figure 22. Same as Figure 16, except for the Furley site.

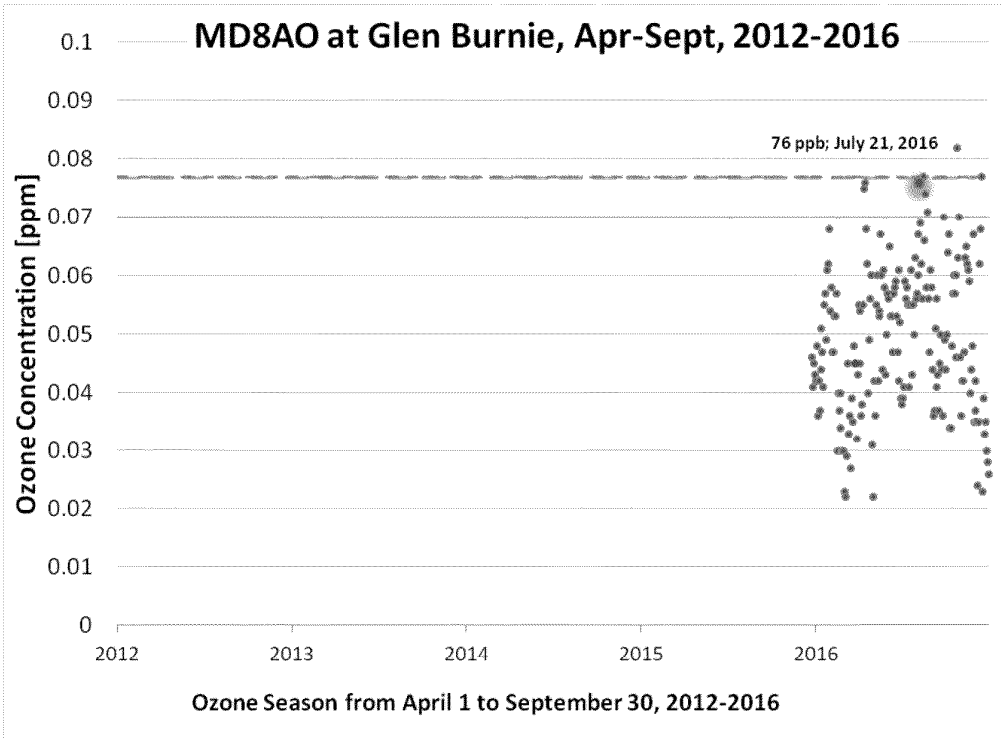

Figure 23. Same as Figure 16, except for the Glen Burnie site. Glen Burnie became operational in 2016.

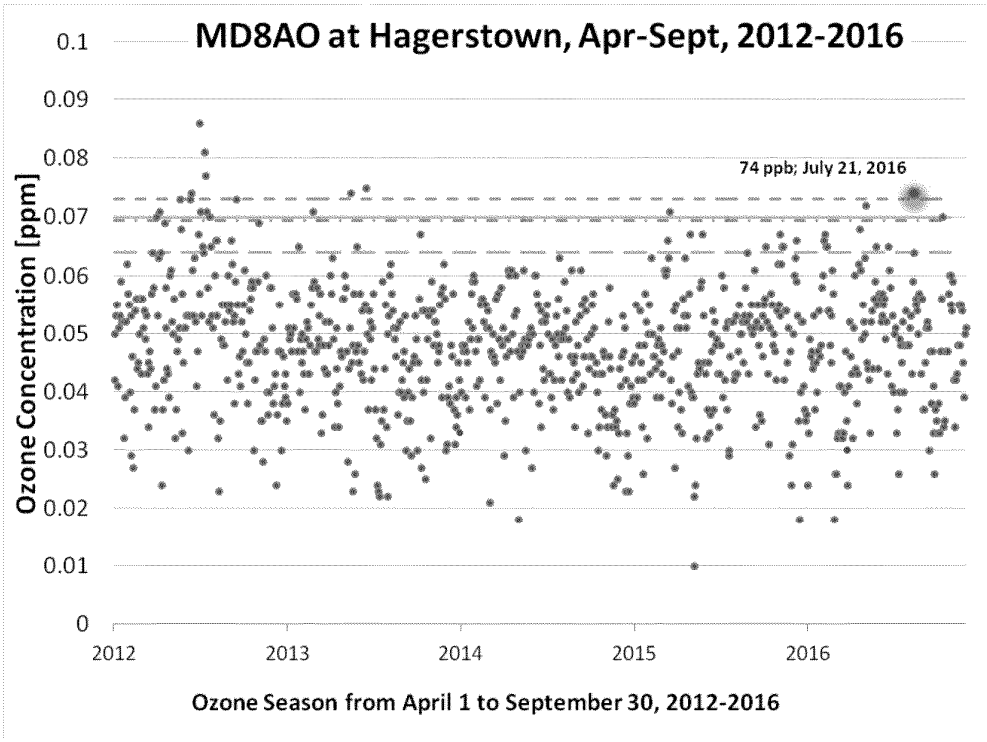

Figure 24. Same as Figure 16, except for the Hagerstown site.

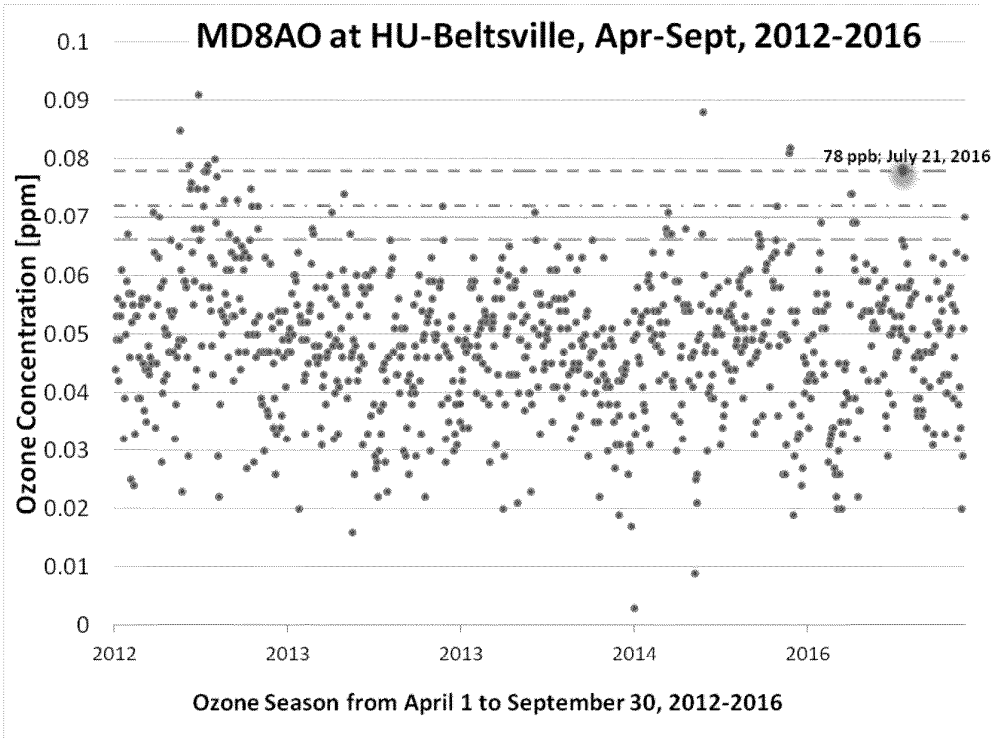

Figure 25. Same as Figure 16, except for the HU-Beltsville site.

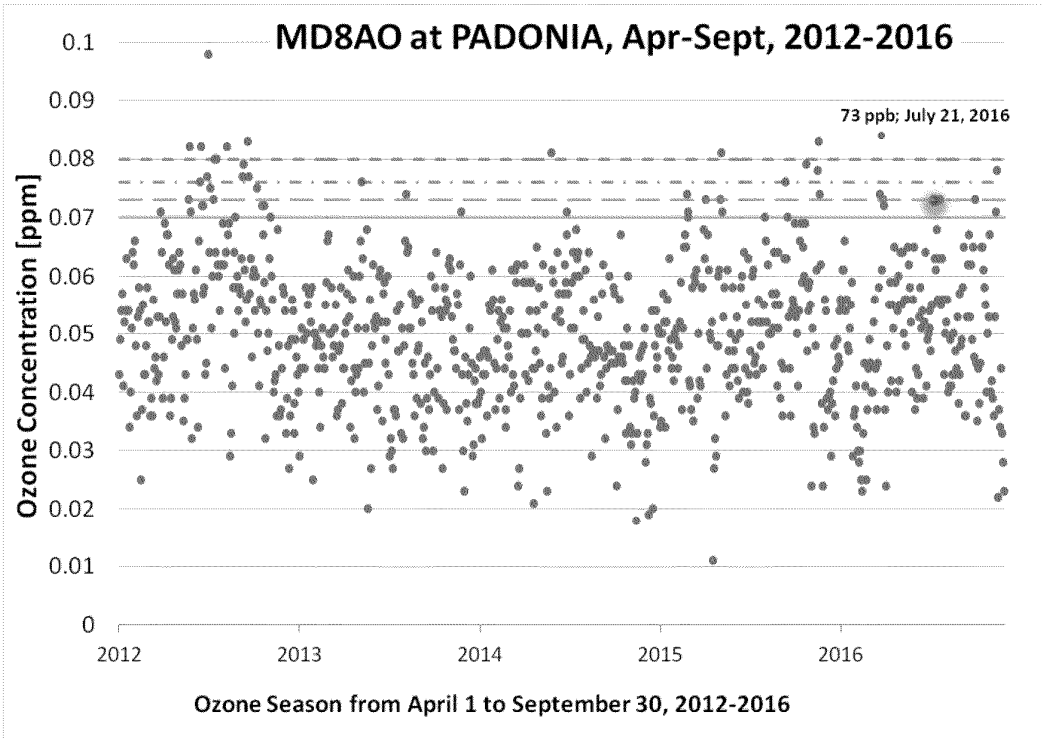

Figure 26. Same as Figure 16, except for the Padonia site.

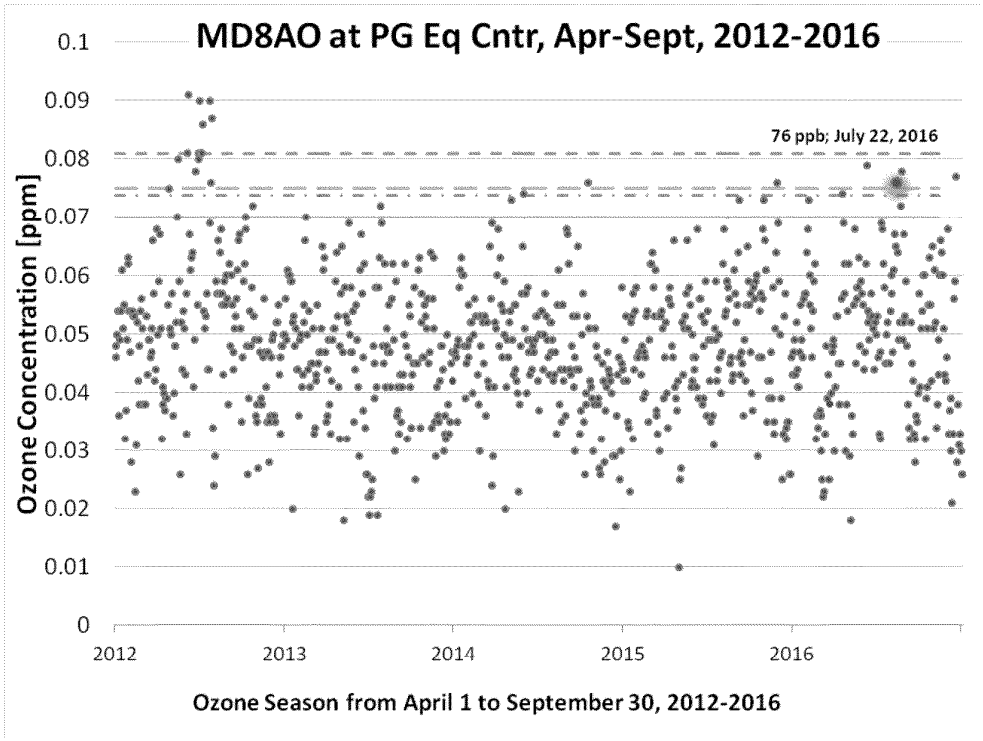

Figure 27. Same as Figure 16, except for the PG Eq Cntr site.

The preponderance of the monitors for which MDE is seeking as being influenced by an exceptional event show a "distinctive level" of monitored ozone concentration. Eleven of the 15 observations for which exclusion is requested were at or above a 99th percentile level with a majority of monitors observing one of the top four highest MD8AO concentrations of the 2016 season. Concentrations during the smoke-influenced event exceeded the 99th percentile of not just July data but also the entire seasonal dataset at some monitors. Therefore, the July event should be considered exceptional in nature. MDE has observed concentrations like those observed in July 2016 previously, but with greater anthropogenic NOx emissions, such as in 2012. The uncharacteristically high ozone concentrations, particularly in light of the huge precursor reductions over the past five years, and the exceptional spatial coverage of the event over a wide area compared to previous exceedances (see Figure 5), all which occurred with a big change in MD8AO concentration regionally (around 15ppb change between days before and after the smoke) all suggest the monitors were influenced by wildfire smoke. MDE believes the evidence presented thus far indicates a clear causal relationship. Additional supportive analysis is presented below.

3.2. Evidence that Fire Emissions were Transported to Maryland

To further demonstrate that the northwest Canada wildfire emissions were transported to the Maryland ozone network, the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT; Rolph, 2015; Stein et al., 2015) model was used to calculate forward trajectories originating from within the smoke plume at the

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fire sites and backward trajectories from Maryland. Meteorological data driving these trajectories was from the North American Regional Reanalysis (NARR) and North American Mesoscale (NAM) model datasets. For the forward trajectories, the reanalysis dataset was used; the origin of the trajectories was near the northern edge of the NAM domain, so it was thought prudent the reanalysis dataset would decrease error, even while sacrificing spatial resolution. These forward trajectories showed transport from the fire and smoke locations towards Maryland which mimicked the path of the HMS analysis presented in Figure 14. A matrix of forward trajectories (Figure 28a) centered across the location of the smoke plume as of July 17 showed a transport pattern to the east and east-southeast. A group of trajectories moved more southeastward compared to the rest of the group (blue shading in Figure 28a) and it appeared these were responsible for transport of smoke towards Maryland. Running a matrix of trajectories (several trajectories which start from a gridded pattern over the source area) instead of a single trajectory allows the trajectories to show a spread of possible dispersion of the plume while increasing the confidence in the general transport pattern/direction of the smoke plume. Due to increasing model error with time (an intrinsic occurrence when modeling the atmosphere) no single trajectory should be considered representative of the exact path of the smoke plume, and the longer the trajectory is run, the greater the error of the modeled path is likely to be. Therefore, clusters of trajectories increase confidence of the path of the smoke. The trajectories in this case showed general agreement with the main smoke plume analyzed by HMS (Figure 14). The difference in end location (trajectories not quite in Maryland by July 20) was simply attributed to increasing error with model run time. Thus, the trajectories continue to support smoke transport to Maryland. These forward trajectories also support the assertion that smoke did not subside to the surface before the afternoon of July 20, as observed by the UMBC Lidar. The vertical distribution of the trajectories (bottom panel of Figure 28a) showed the forward trajectories subsiding downwards, but not yet impacting the near-surface layer: the lowest trajectories are around 1500m, which was the height of the boundary layer (near surface layer of air) as seen in the Lidar retrieval (transition from light blue to dark blue vertically, on Figure 13).

Backward trajectories took a path northwestward which more directly indicated transport to northeast Maryland from the upper Great Lakes and southern Canada (Figure 28b). Consistent with prior presented information, the smoke plume was transported southeast across southern Canada and the Great Lakes then pushed southward and downward behind a cold front sweeping across the northeast US. Eventually, this allowed the plume's southern fringe to reach Maryland. Similar to the forward trajectories, the back-trajectories illustrate the downward motion of the trajectory well, with subsidence clearly indicated in all three trajectory levels (line dropping downwards with time). The 50m (red) trajectory even indicated it reached near the surface between 18 and 00 UTC, which was between 2pm and 8pm LDT on July 20, 2016 and in very good agreement with the Lidar image from UMBC.

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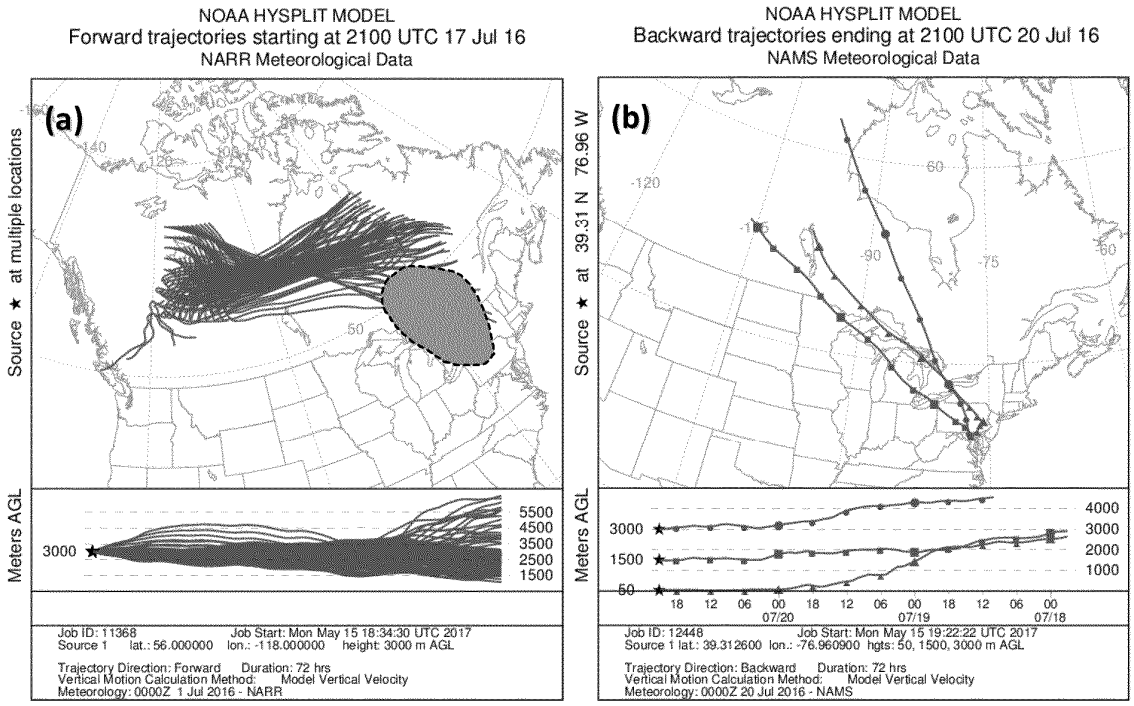

Figure 28. Forward and Backward Transport Trajectories.
(a) A Matrix of 72-hour (3 day) North American Regional Reanalysis (NARR) data forward trajectories with starting points centered around the location of the smoke plume on July 17, 2016 across northwestern Canada. The trajectory cluster shaded in blue show general transport towards the northeast US. (b) 72-hour North American Model (NAM) back trajectories from central Maryland beginning on July 20 showing transport from the area of the smoke into Maryland over the course of about 3 days.

3.2.1. Evidence of Residual Layer Ozone via Ozonesondes

MDE requested ozonesondes in time to capture the morning vertical profile of the exceptional event on July 22. These ozonesondes recorded substantial ozone concentrations within the nocturnal residual layer (i.e., pre-dawn, ozone above the surface). The ozone vertical profile observed by the ozonesonde had approximately 70ppb of ozone between 1.5 and 2km where winds were from the west northwest (Figure 29). This layer had been previously influenced by smoke (per backwards trajectories into Maryland – Figure 28b). This layer vertical layer of ozone is also from prior day's (July 21) concentrations across Pennsylvania (per trajectories – Figure 30) that were now preserved in the residual layer. At night ozone is removed from the layer of air a few tens of meters from the surface as it interacts with other molecules or objects. However, the layer of air immediately above the surface at night "preserves" ozone overnight making it the "transport relevant" layer or simply known as "the residual layer." The residual layer is usually found from around 500m to 1,500-2,000m above ground level at night. Therefore, surface ozone may be at or near zero at night while just a few hundred meters above the ground ozone may still be 50-80ppb. The ozonesonde on the morning of July 22 therefore verifies that the airmass over Maryland on July 22 had substantial ozone available within the residual layer to create an ozone exceedance day on July 22. The ozonesonde, along with trajectories, also showed this ozone-laden air came from areas of Pennsylvania and Maryland (such as around Hagerstown) on July 21. Since high ozone concentrations across these upstream areas were due to the impacts of smoke transported from Canada on July 21, by extension, the ozone exceedance days on

both July 21 and 22 were caused by the influence of the Canadian wildfire smoke transport. Said another way, smoke subsided late on July 20, caused substantial and widespread ozone formation on July 21 which lingered into July 22 via the residual layer.

The ozone concentrations exceeding the ozone standard on July 22 were chiefly in northeastern Maryland, which was consistent with the light westerly transport during the night and early morning on July 22 taking ozone from areas which had experienced heighted ozone on July 21 towards northeast Maryland. This eventually also led to high MD8AO in northeastern Maryland where Fair Hill reached an MD8AO of 87ppb, its highest of the entire 2016 season. Ozone was focused along the I-95 corridor around and northeast of Baltimore due to the development of a lee-trough, as discussed in the surface analysis above.

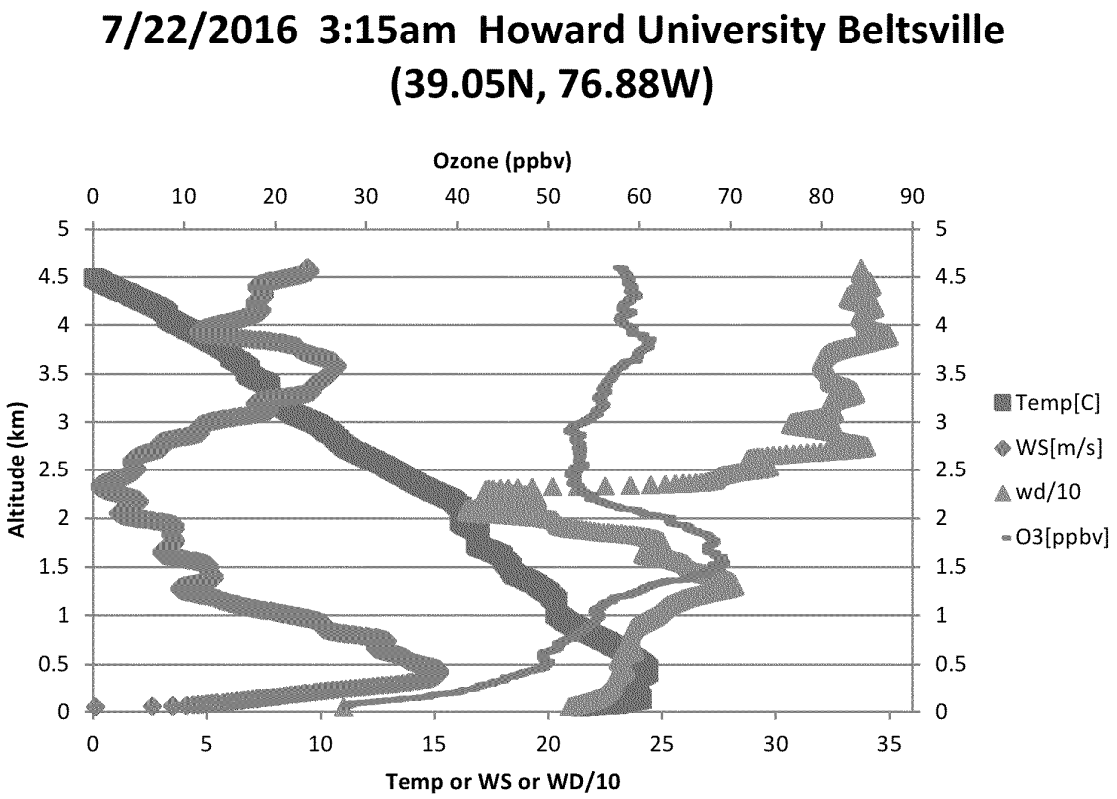

Figure 29. Ozonesonde launched from Howard University Beltsville (HU-Beltsville) on the morning of July 22, 2016. Temperature (°C, red squares), wind direction (degrees divided by 10 [180° is shown as 18 on graph], green triangles), wind s peed in m/s, blue diamonds), and ozone (ppb, purple dashes) are shown from the surface through 5km AGL. Ozone is given on the top horizontal axis. Temperature and winds are given by the bottom horizontal axis. The profiles show a substantial amount of ozone between 0.5 and 2km was transported into and/or present above Maryland on the morning of July 22, 2016, the second day of the exceedance event.

As a verification of the transport of the residual layer towards northeastern Maryland, forward trajectories from the site of the ozonesondes launch and backwards trajectories from Fair Hill were constructed. Meteorology was driven by the High Resolution Rapid Refresh (HRRR) model, which is updated every 6

hours for trajectory construction at 1 hour time intervals at 3km resolution. The HRRR dataset was chosen in this case for its high resolution and the short time scale (12 hours) analyzed here. The forward trajectories run forward from HU-Beltsville at 3am (0700 UTC, Figure 30a) showed that air located at 500m (red, triangles), roughly the bottom of the residual layer, moved northeastward towards Fair Hill overnight. At the same time, shorter trajectories at 1500m (blue, squares) and 2000m (green, circles) within the residual layer indicated substantial subsidence over the next 12 hours, mixing ozone at these levels downwards towards the surface. While these trajectories stayed south of the 500m trajectory, the same vertical movement can be assumed true across Maryland (weather does not often change dramatically from one location to another in the absence of phenomenon such as thunderstorms), thus the downward mixing of ozone was significant for ozone considerations once the sun rose on July 22.

Backwards trajectories beginning from Fair Hill at 3pm on July 22 (at time when Fair Hill was observing hourly ozone concentrations above 90ppb) suggested that low-level flow around 500m came from areas such as Hagerstown during the night hours (Figure 30b). Recall that Hagerstown exceeded 70ppb the day before (July 21). The exceedance at Hagerstown on July 21 was the highest ozone that site observed in 2016. Upper level trajectories were northwesterly with subsidence clearly evident. In general, the two sets of 12-hour trajectories showed considerable wind shear (changing wind direction with height) within the residual layer, which was consistent with the ozonesonde. Westerly flow around 1500m coincident with a layer of ozone of almost 70ppb was observed by the ozonesonde. Trajectories both from the ozonesonde time and point of origin (Figure 30a) and backwards from the Fair Hill monitor (Figure 30b) were consistent with the westerly flow observed by the ozonesonde and also consistent with the slight turn towards westerly at 850mb discussed in the upper air analysis. Southwesterly winds below 1500m were also displayed on both sets of trajectories. As a whole then, the ozonesonde and trajectories showed that residual ozone from July 21, which had already been influenced by a smoke laden PBL, carried over to July 22. This was why on July 22 most of the ozone monitors exceeded the 70ppb ozone NAAQS were located in northeastern Maryland. In fact, high concentrations of ozone and ozone exceedances were located from northeast of DC northeastward through Connecticut. It was no coincidence that areas upwind of these same areas also exceeded on July 21. Even greater ozone was generated on July 22 as the smoke influenced air photochemically aged and the lee trough concentrated the pollutants along the I-95 corridor from Maryland through Connecticut.

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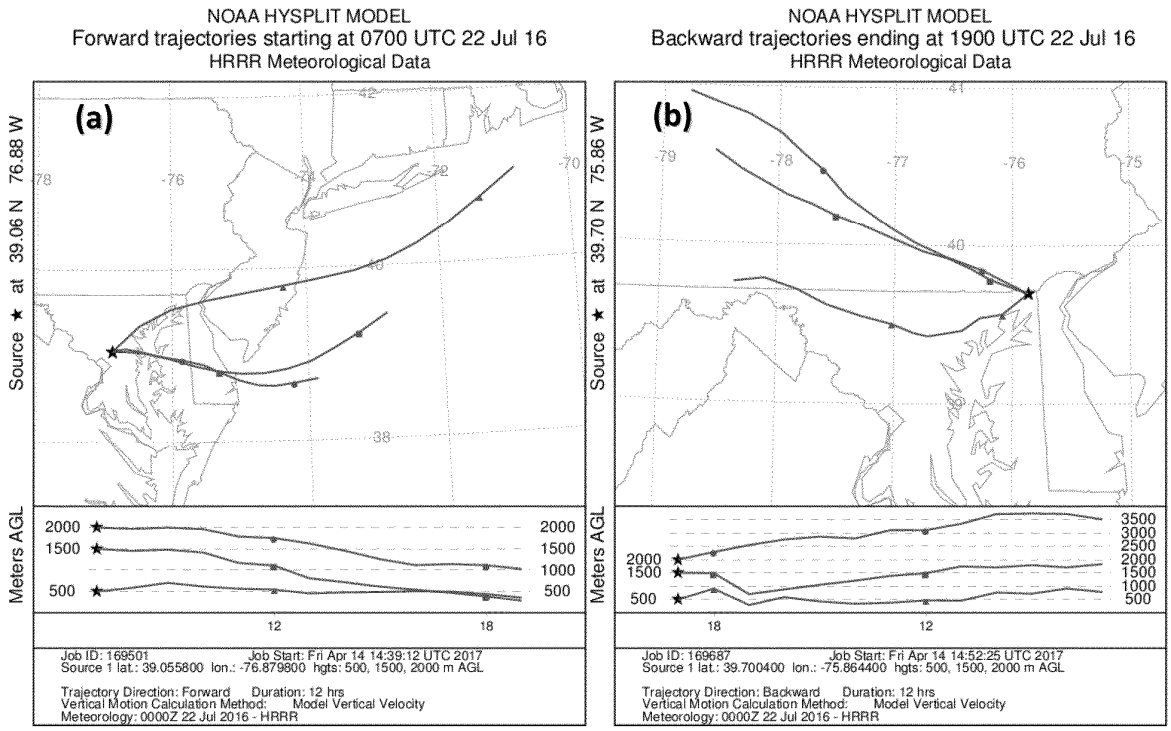

Figure 30. HYSPLIT trajectories related to the ozonesonde on July 22, 2016.
The trajectories shown are 12 hour forward trajectories (a) beginning at the time of the ozonesonde launched at the HU -Beltsville site in Maryland at 3:15am (~0700 UTC) on July 22, 2016 using the HRRR meteorological dataset. Backwards trajectories from F air Hill at 3:00pm (1900UTC) were also shown (b). Fair Hill observed its highest ozone concentration for the 2016 seaso n on July 22, 2016. Trajectory heights chosen are the same in both (2000m, green; 1500m, blue; 500m red) and are based on features within the July 22 ozonesonde.

3.2.2. Evidence of Wildfire Emissions via Satellite

Smoke analyses from the HMS already showed a plume of smoke being transported across the Great Lakes and Midwest towards Maryland and the northeastern CONUS. Satellites retrievals are capable of tracking wildfire species as well. When in combination with the expertly analyzed HMS smoke plume, they can together provide irrefutable evidence of the transport of wildfire ozone precursors. CO has been previously identified as a wildfire smoke indicator (Andreae and Merlet, 2001; McKeen et al., 2002, DeBell et al., 2004, Dreessen et al., 2016), can play a role in ozone production. Total column CO (that is the sum of the CO between the ground and the satellite, most of which is near the ground unless lofted as a consequence of a large combustion source) was observed to follow a pattern of transport similar to Maryland's ozone exceedance conceptual model (Figure 8). Animations of total column CO from satellite retrieval via Giovanni Data (https://giovanni.sci.gsfc.nasa.gov/giovanni/) indicated an area of enhanced CO starting over Canada meandering southeastward across the Great Lakes and southern Ontario, Canada, coincident with the analyzed smoke. Individual images were captured and shared here to illustrate the transport of CO to the area (Figure 31). The largest concentrations of CO through the atmospheric column (deeper reds) stayed north of the Mid-Atlantic, but show a south and southwestward turn between July 19 and July 21. For example, an area of high concentration of CO associated with the main smoke plume was observed west of

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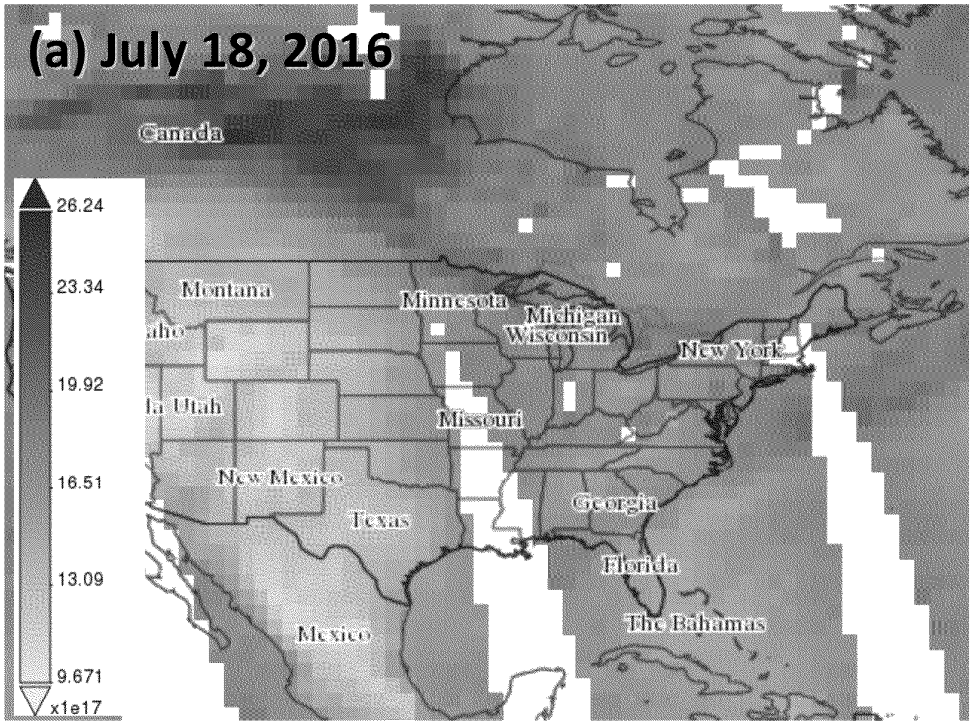
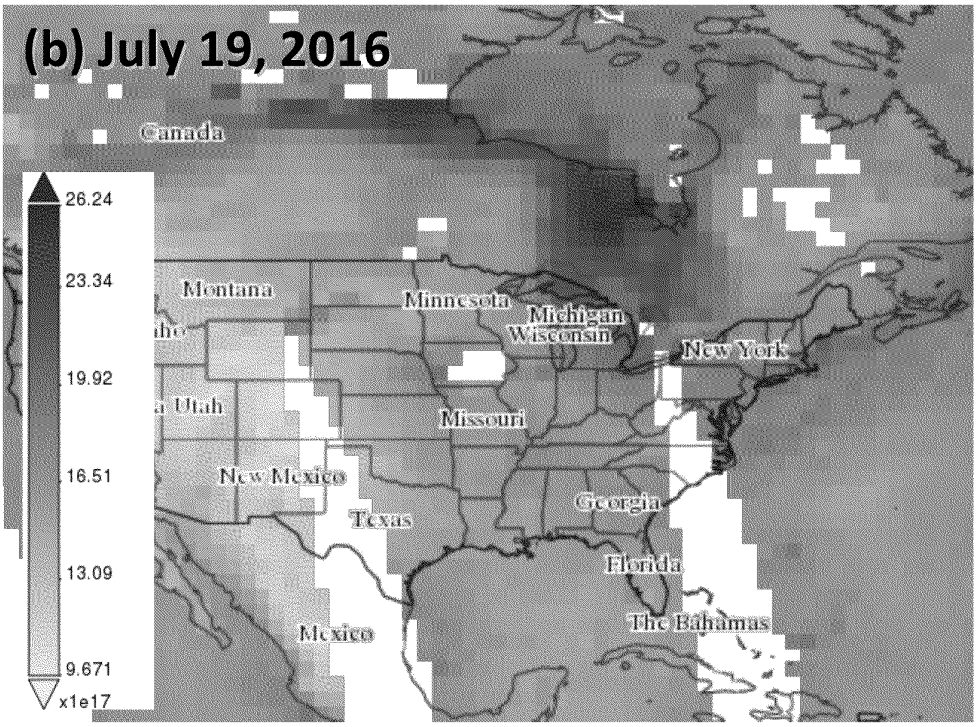
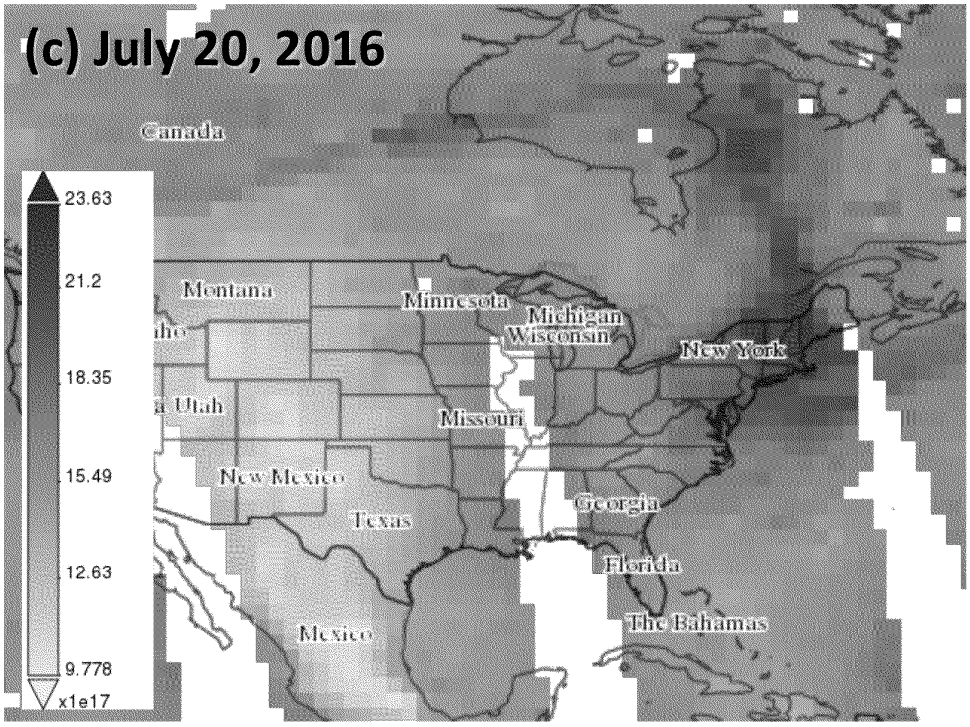
the Hudson Bay across central Canada on July 18 (Figure 31a). The smoke and CO plume then was located over the northern Great Lakes and south of the Hudson Bay on July 19 (Figure 31b). By July 20, however, areas of red (high CO) were located over New York, New Hampshire and Vermont, with orange (slightly lower concentrations of CO) from Pennsylvania southward to Virginia (Figure 31c). The CO then slowed its trek eastward and persisted off the coast of the central Mid-Atlantic on July 21 (Figure 31d). This motion is consistent with the smoke plume analysis shown previously indicating the smoke moved south and then slightly southwestward from locations across Pennsylvania and New York (See Figure 14) which was consistent with post-frontal subsidence into July 20. Though the satellite coverage missed a direct overpass of Maryland on July 21, the areal extent of the CO plume was still obtainable by interpolating between the deep red/orange areas east and northeast of Maryland over the ocean to orange areas still visible across southern Virginia. That interpolation puts a CO plume of lower concentration still over the central Mid-Atlantic into July 21, 2016. Therefore, the CO analysis presented here showed a plume of CO came from the northwestern Canada fires and remained over the Maryland area for at least the first day of the July 21-22 ozone exceedance.




(b) July 19, 2016
Canada
26.24
23.34
19.92
16.51
13.09
9.671
x1e17
Montana
Minnesota
Michigan
Wisconsin
New York
Utah
Missouri
New Mexico
Texas
Georgia
Florida
The Bahamas
Mexico


(c) July 20, 2016
Canada
23.63
21.2
18.35
15.49
12.63
9.778
x1e17
Montana
Minnesota
Michigan
Wisconsin
New York
Utah
Missouri
New Mexico
Texas
Georgia
Florida
The Bahamas
Mexico

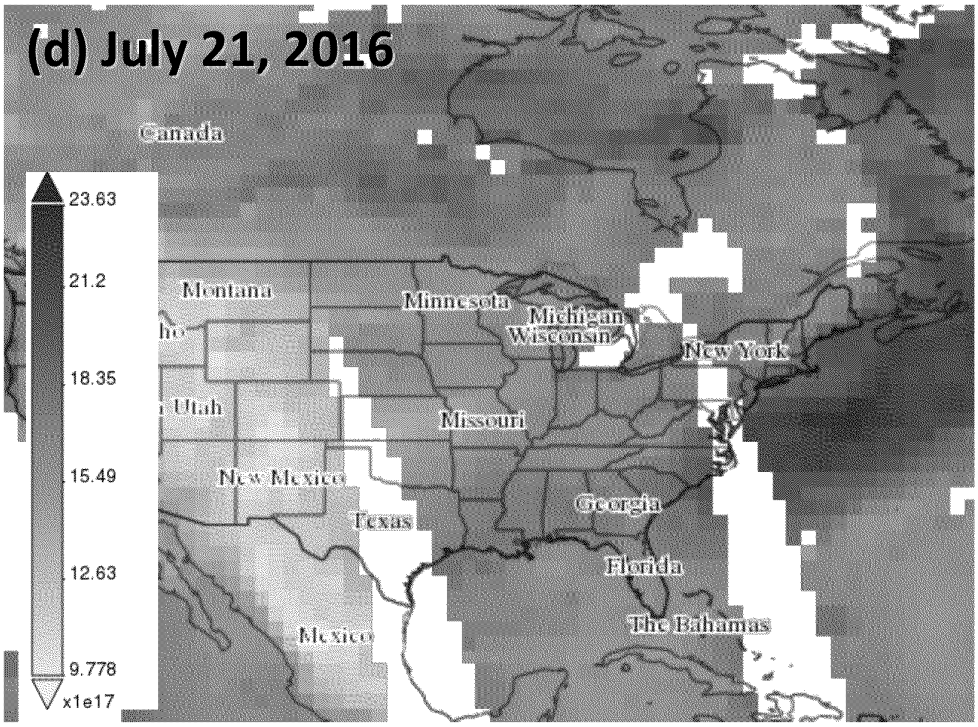


Figure 31. Carbon Monoxide from satellite.
Giovanni carbon monoxide images from July 18 (a), 19 (b), 20 (c), and 21 (d), 2016. Deeper reds indicate higher concentratio ns of carbon monoxide through the atmospheric column. Note that for detail, the color scale (mols/cm ^{2}) for a and b is different than that used in c and d.

3.3. Q/d Analysis

EPA guidance [Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016] recommends conducting a Q/d analysis as a rough assessment of the ability of a wildfire to cause increased ozone concentrations. The Q/d analysis is simply a comparison of the ratio of Q, the daily tons of VOC and NOx emitted from the fire, to d, the distance in kilometers from the fire to the point of concern. If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern. The comparison to other fires is a key point that will be brought up again.

EPA guidance indicates that a fire should have a Q/d in excess of 100 tons per day per kilometer (tpd/km) in order to be considered to have a clear causal impact on ozone. EPA developed this value based on analyses of four fires which occurred in 2011. Due to the large distances which Canadian wildfire plumes must travel to Maryland, the Q/d analysis will regularly fail to achieve the 100 deemed acceptable by the EPA guidance. Therefore, MDE feels the 100 value is not representative for long-range east-coast smoke events. MDE instead presents several alternatives based on this analysis.

3.3.1. Estimate of Q

The emissions from the fire can be estimated using information from EPA's AP-42 Compilation of Air Emission Factors Section 13.1 Wildfires and Prescribed Burning. The equations given are as follows:

Fi = Pi * L (Equation 1)
Ei = Fi * A (Equation 2)

Fi = emission factor (mass of pollutant/unit area of forest consumed)
Pi = yield for pollutant "i" (mass of pollutant/unit mass of forest fuel consumed)
= 12 kg/Mg (24 lb/ton) for total hydrocarbon (as CH4)
= 2 kg/Mg (4 lb/ton) for nitrogen oxides (NOx)

L = fuel loading consumed (mass of forest fuel/unit land area burned)
A = land area burned
Ei = total emissions of pollutant "i" (mass pollutant)

Combining equations 1 and 2, we have:

Ei = Pi * L * A

Pi is given above for total hydrocarbons and for nitrogen oxides. The fuel loading is given in AP-42 for different regions of the United States and ranges from 9 to 60 tons per acre. Conservatively, we will estimate a low end emission rate using 10 tons per acre which is associated with North Central US conifer forests. Note that our results could increase by a factor of 6 were we to expect the high end of emissions.

Information provided by the Canadian Wildland Fire Information System (CWFIS) reported that between July 13 and July 20, 2016, fires across mostly northwestern Canada consumed 109,724 hectares (271,134 acres). For reference, the total land area of Rhode Island is approximately 270,000 hectares.[#] Daily acres burned was not available, however, satellite retrieval of the number of fires across the northwestern region of Canada shows a marked increase in the number of fires between July 13 and July 17 (jumping from 14 to 31 fires across this area) then a decrease in number thereafter. Assuming the number of fires retrieved can be a surrogate for percentage of acreage burned, the majority of the 271,134 acres burned in 4 days and the majority of the acreage was across northwestern Canada. Therefore, ignoring the smoldering of previously burned areas the total hydrocarbon emissions from the period can be estimated to be:
Ehc = 24 lbs of HC / ton of forest fuel consumed * 10 tons fuel / acre * 271,134 acres
Ehc = 65,072,160 pounds of HC
Ehc = 32,536 tons of HC emitted during the period from July 13 to July 17

[#]A contextual comparison to the State of Rhode Island makes the fires' size more comprehensible.

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Similarly for NOx:
Enox = 4 lbs of NOx / ton of forest fuel consumed * 10 tons fuel / acre * 271,134 acres
Enox = 10,845,360 pounds of NOx
Enox = 5,423 tons of NOx emitted during the period from July 13 to July 17

Q is the total daily emission rate in tons per day of reactive hydrocarbons and nitrogen oxides. EPA recommends in the exceptional events guidance that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions become rHC = 0.6 * Ehc or 0.6 * 32,536 = 19,522 tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NOx emissions. Therefore the total rHC and NOx emissions over the period are 19,522 + 5,423, or 24,945 tons over the four days. On average this results in a daily emission rate, or Q, of 6,236 tons per day.

3.3.2. Estimate of d

Based on the large distance, there will not be individual analyses completed for each monitor in Maryland but an estimate of the distance from the fire centroid to Fair Hill, MD, the most distant smoke impacted monitor, will be calculated. The fire centroid was near the border between Alberta and the Northwest territories, approximately halfway between the east and west borders of Alberta (60°N, 115°W). Using this location supplies a conservative yet representative distance the smoke traveled to the Maryland ozone network. The flight distance between these two locations gives a value 3530 km for d.

3.3.3. Q/d Estimate

Using the values determined above, Q/d becomes 6,236 tpd divided by 3530 km or 1.8 tpd/km (Table 4). This value is well below the EPA recommended level of 100 tpd/km indicating clear causality. If instead we aggressively assumed the out of control fire consumed most of its fuel in 2 days time, Maryland's Q/d value climbs to 3.5; Still well below 100.

Table 4. Q/d analysis.

ACRES	Ehc (tons)	Enox (tons)	Q (tons)	No. days burning	d (km)	Q/d	DESCRIPTION
271,134	32,536	5,423	24,945	4.0	3530	1.8	Standard Q/d

EPA guidance states that *"If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern."* Since 2015, at least three major Canadian wildfire episodes have impacted Maryland: June 9-12, 2015 (as thoroughly described in Dreessen et al., 2016); May 25-26, 2016; and July 20-22, 2016. Thus, by EPA's Q/d definition, MDE now has a small subset to compare other wildfire impacts on ozone within the contemporary emissions environment. A Q/d analysis for July 2016 is done in that exceptional event analysis. For June of 2015, Q/d was calculated using values in Dreessen et al., 2016, which listed 77,000 acres burned in a two (2) day period and smoke transported 3100km from central Saskatchewan. Dreessen et al., 2016, goes on to show the impact of the smoke plume as it descended on the eastern Midwest and

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Mid-Atlantic on June 9-11, 2015 and showed clear wildfire signatures and influences on ozone. Based on that research, Q/d for that ozone episode would have been 1.1 (Table 5). The May 2016 event had a Q/d four times as large (4.1). The July 2016 event had a Q/d of 1.8. Some research has noted the uncertainties in the influence of wildfire emissions in terms of strength and composition on ozone production (e.g., Hu et al., 2008). Thus it is quite plausible the value of 100 for Q/d is not relevant for long-range transport cases. It appears a more appropriate Q/d number for Canadian wildfire smoke transport cases to Maryland is closer to one (1), 100 times lower than the EPA suggested value. As the July 21-22 ozone event had a Q/d value which compared favorably with other fire events in Maryland, MDE believes this shows a clear causal relationship between the ozone and smoke.

Table 5. Q/d Analysis for three Canadian Wildfire events impacting Maryland.

ACRES	Ehc (tons)	Enox (tons)	Q (tons)	No. days burning	d (km)	Q/d	DESCRIPTION
368,187	44,182.00	7,364.00	33,873.20	2.5	3280	4.1	Fort McMurray - May 2016
271,134	32,536	5,423	24,945	4.0	3530	1.8	Northwest Territories - July 2016
77,000	5,544.00	1,540.00	7,084.00	2.0	3100	1.1	Lac La Ronge - June 2015

Noting the wide variability in emissions estimates from different approaches, and as the Q/d method does not generally satisfy the expectation of a clear causal impact per EPA guidance, MDE presents other evidence demonstrating that the plume from the northwestern Canada fires caused elevated ozone levels in Maryland.

3.3.3.1. 99th Percentiles (July)

As part of demonstrating a clear causal relationship between ozone concentrations and the fire event, monitored concentrations were put in the context of historical observations. Observations at monitors falling at or above the 99th percentile in the past five years establish statistical evidence that the event was likely influenced by an exceptional event and are a "Key Factor" used to determine whether a Tier 2 application is appropriate. Following the Exceptional Events Guidance documents, the 99th percentile was calculated for all Maryland monitors for all days of the ozone season (April – September) from 2012-2016. Additionally the 99th percentile was calculated for all days of the ozone season excluding 2012, and all days of the month of July 2013-2016 to account for the rapid emission changes ongoing across the eastern US. These percentiles have been presented previously in scatterplots in Figures 16-27 and summarized in section 3.1. However, for the reader's convenience a summary table with comparisons of all the 99th percentiles is given in Table 6.

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Table 6. 99th percentile values and comparisons to observations on July 21 and 22, 2016 for all Maryland monitors. The 12 Maryland monitors for which MDE is seeking exclusion of event influenced ozone data have their 99th percentiles presented based on data from April 1 – September 30, 2012-2016, only 2013-2016, and only July 2013-2016. The final 6 columns highlight which monitors exceed their 99th percentile level ("YES") for a given data set and day (July 21 or 22). Blanks indicate the monitor did not meet the 99th percentile for that dataset.

		99th Percentile [ppm]			July 21, 2016			July 22, 2016		
Name	AQScode	All Data	No 2012	July '13 - '16 Only	All Data	No 2012	July '13 - '16 Only	All Data	No 2012	July '13 - '16 Only
Aldino	240259001	0.0790	0.0768	0.0768		YES	YES			
Beltsville CASTNET	240339991	0.0820	0.0743	0.0770		YES	YES			
Edgewood	240251001	0.0800	0.0790	0.0798				YES	YES	YES
Essex	240053001	0.0780	0.0750	0.0765		YES				
Fair Hill	240150003	0.0831	0.0799	0.0828				YES	YES	YES
Frederick	240210037	0.0750	0.0700	0.0640	YES	YES	YES			
Furley	245100054	0.0744	0.0724	0.0729		YES	YES			
Glen Burnie	240031003	0.0770	0.0770	0.0767						
Hagerstown	240430009	0.0730	0.0695	0.0640	YES	YES	YES			
HU-Beltsville	240330030	0.0780	0.0720	0.0660	YES	YES	YES			
Padonia	240051007	0.0800	0.0760	0.0730			YES			
PG Eq Cntr	240338003	0.0809	0.0737	0.0751					YES	YES

3.4. Evidence that the Fire Emissions Affected the Monitors

3.4.1. Evidence of Fire Emissions in Maryland

Wildfires produce both primary and secondary pollutants which may be utilized to track the impact of smoke downstream from the fire source. While satellites may be able to track smoke plumes over wide areas and track their transport, they do not necessarily confirm the existence of smoke at the surface by themselves. The Lidar at UMBC showed that the smoke plume subsided to the surface on the afternoon of July 20, thus, if the smoke impacted surface air chemistry by providing ozone precursors within the smoke, these would be observable about that time in the surface monitor network. The MDE monitoring network observes both total $PM_{2.5}$ mass and speciated compounds such as ionic potassium (K+) and organic carbon (OC), as well as other pollutants such as CO and NOx and VOCs, which can act as tracers of wildfire emissions. Analyses of the various species which can be attributed to wildfires are presented. The analyses show the ozone episode in Maryland was characterized by enhanced precursors attributable to wildfire species. Unfortunately, the specific days of interest in Maryland (July 21 and 22) did not fall on 1 in 3 run PM speciation days. Additionally, MDE did not receive speciation data from days bracketing the event by the time of the submittal of this analysis. The data presented below were available as preliminary data.

3.4.2. Particles

$PM_{2.5}$ can be both a primary pollutant and as a resultant secondary pollutant of wildfire emissions downstream as photochemistry within the plume converts certain species to aerosol. The entire MDE

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network of hourly $PM_{2.5}$ data at the BAM sites showed an increase in $PM_{2.5}$ 6-hour averages from July 20-22 which aligned with the onset of the smoke plume in Maryland on July 20 (Figure 32a). No other period of the month exhibited such as consistent increase across the entire Maryland network. The absence of very low observations (< 5 µg/m^3) at any monitor during the three day smoke period was also distinctly different than other periods of the month. Though the July period did not possess the highest hourly particle observations of the month, it did have the highest network 6-hour average which persisted through the period of smoke impact on the Maryland network (yellow box in figure).

Daily average fine particle concentrations showed a similar pattern to the hourly concentrations (Figure 32b). Beginning on July 20, daily average concentrations across the entire network increased, primarily into the Moderate AQI range (> 12 µg/m^3). Daily average concentrations did increase earlier than July 20. For instance, there appears to be an upward trend in daily average fine particles on July 18, 2016. However, the entire network also saw a noticeable increase in daily average particle concentrations between July 20 and July 21 distinct from the increase beginning on July 18. Thus, the earlier increase in particle concentrations should not be incorrectly concluded as the cause of the increase on July 20-21, rather, the increase on July 20-21 was independent of the increase seen a couple of days earlier.

Similar to observations in Dreessen et al. (2016), particle concentrations increased over the three day period instead of a rapid increase coincident with the first onset of the smoke. While fires are primary sources of $PM_{2.5}$ the reaction of wildfire emissions with other biogenic and anthropogenic sources creates secondary $PM_{2.5}$ creation. As the airmass photochemically aged, the smoky airmass became more $PM_{2.5}$ laden. Hourly fine particle observations (Figure 32a) showed the network 6-hour average to be increasing during the duration of the event. For example, the 6-hour running average peaked on July 22, then fell about 5 µg/m^3 on July 23 as the smoke (and created particles) was removed from the region. The fine particle observations therefore provide additional evidence that wildfire affected air reached the surface at timing consistent with that observed by the UMBC Lidar.

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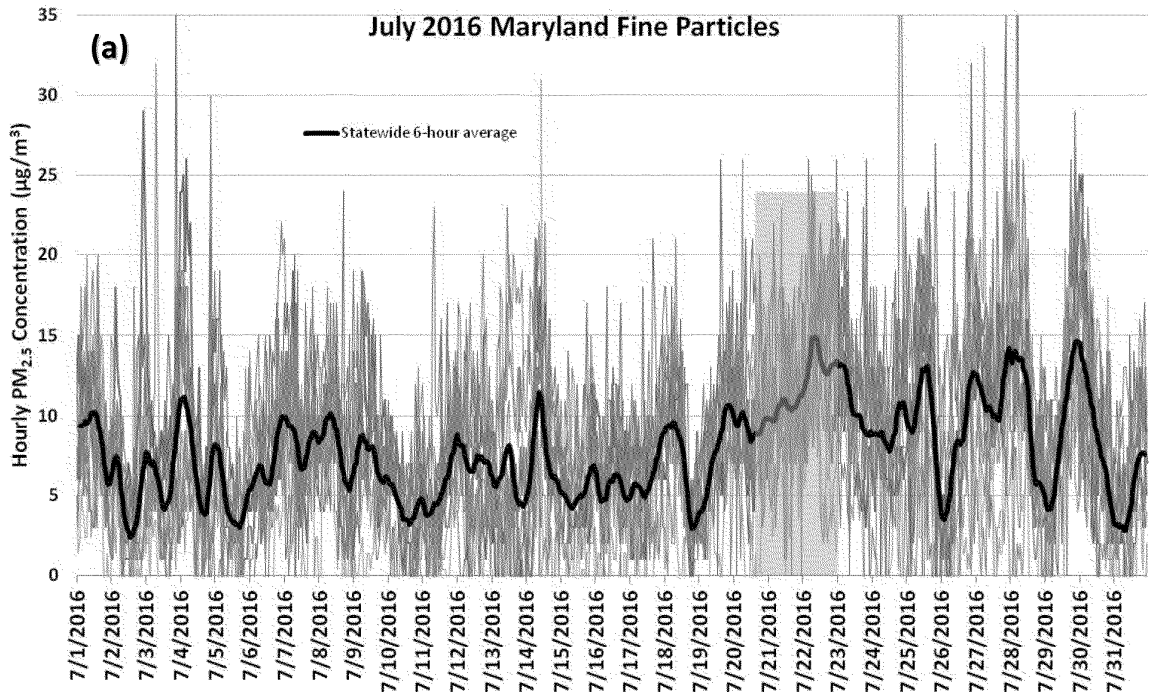

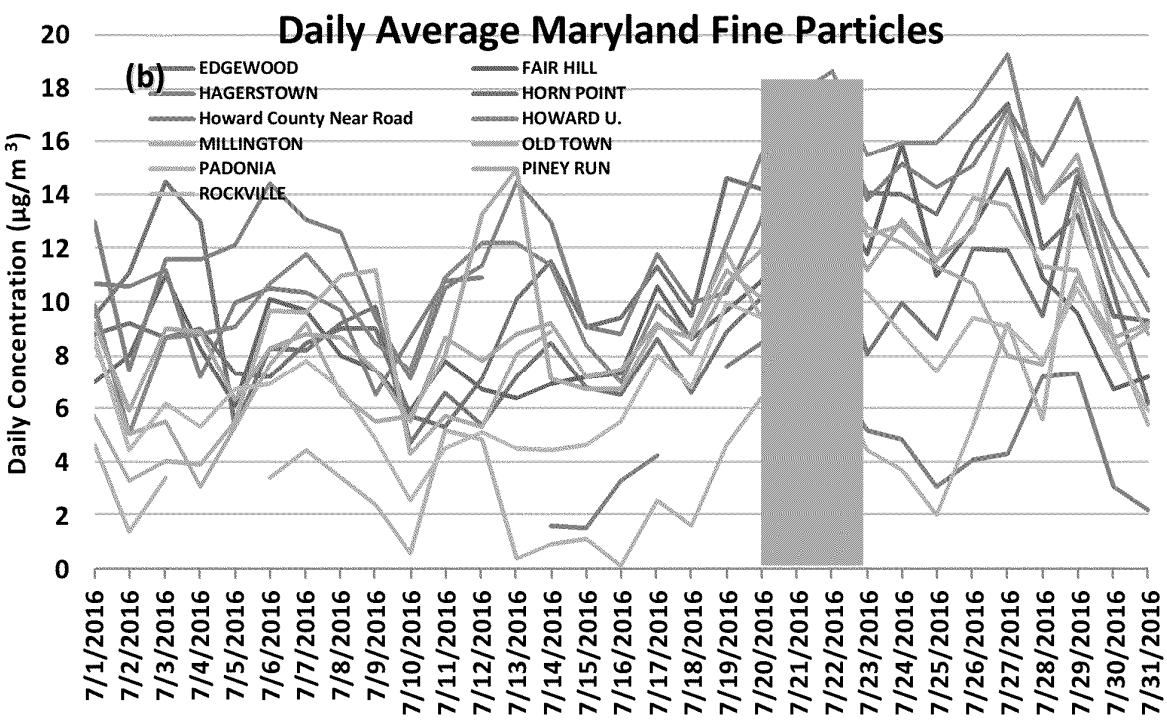

Figure 32. Hourly averaged (a) and daily averaged (b) fine particle ($PM_{2.5}$) concentrations for all Maryland sites in July 2016. The smoke influence as defined by the HMS analysis and described in the conceptual model of this document is h ighlighted by the yellow shading from July 20-22.

3.4.2.1. Potassium Ions and Organic Carbon

Particle pollution generated from biomass burning is typically dominated by organic carbon (OC) and black carbon (BC; Martins et al., 1998), and possesses ions such as potassium (Lee et al., 2010). Ionic potassium (K+) acts as a useful tracer of wildfire smoke because there are few anthropogenic sources, and concentrations above background levels are a signature of wildfire emissions. Unfortunately, speciation data (such as OC and K+) was not provided to MDE in time to be included in this analysis. However, based on other evidence provided below, MDE believes the speciated PM data will continue to support that wildfire emissions, to include ozone precursors, impacted Maryland on July 21 and 22.

3.4.2.2. Black Carbon

An aethalometer located at the HU-Beltsville site indicated heightened black carbon (BC) from July 20-22 (Figure 33). While BC can also be sourced from mobile emissions, globally one-third of BC is sourced from biomass burning, such as forest fires (Lamarque et al., 2010; U.S. EPA, 2010). The optical absorptions of UV (370 nm) and near-infrared (880 nm) wavelengths of the aethalometer are generally very similar when observing anthropogenic-sourced particles such as diesel exhaust, but increased absorption at shorter wavelengths causes a separation of the signals(deemed "Delta-C") while observing naturally sourced BC due to the presence of VOCs (Hansen, 2005; Allen et al., 2004). The actual magnitude of BC was measured by the 880-nm, near-infrared wavelengths in the sampled air. Beginning in the evening of July 20 and coincident with the first smoke entrainment to the surface layer as observed by the UMBC aerosol Lidar (Figure 13), the aethalometer observed a distinct increase in BC concentration (Figure 33). BC concentrations near 1 $\mu g/m^3$ were sustained for multiple days (July 21-22), twice the seasonal average concentration between June and September in 2016 (0.5 $\mu g/m^3$).

With more power from the UV wavelengths the added VOCs in the environment implied the increased Delta-C was due to wildfire BC particles (Hansen, 2005). [VOCs impact UV wavelengths more than near-infrared wavelengths. The stronger UV signal implies VOCs are present in the ambient air and caused more impact on the UV Aethalometer signal. VOCs are present in wildfire smoke.] Given the preponderance of evidence of smoke and the coincidental timing of the Delta-C increase, Delta-C and BC can also be considered tracers of wildfire smoke near the surface. Under this assumption, July 21-22 exhibited concentrations of BC twice the seasonal average which was indicative of surface wildfire smoke. This was coincident with an ozone exceedance event in which some monitors observed the greatest ozone concentration during the whole of the 2016 season.

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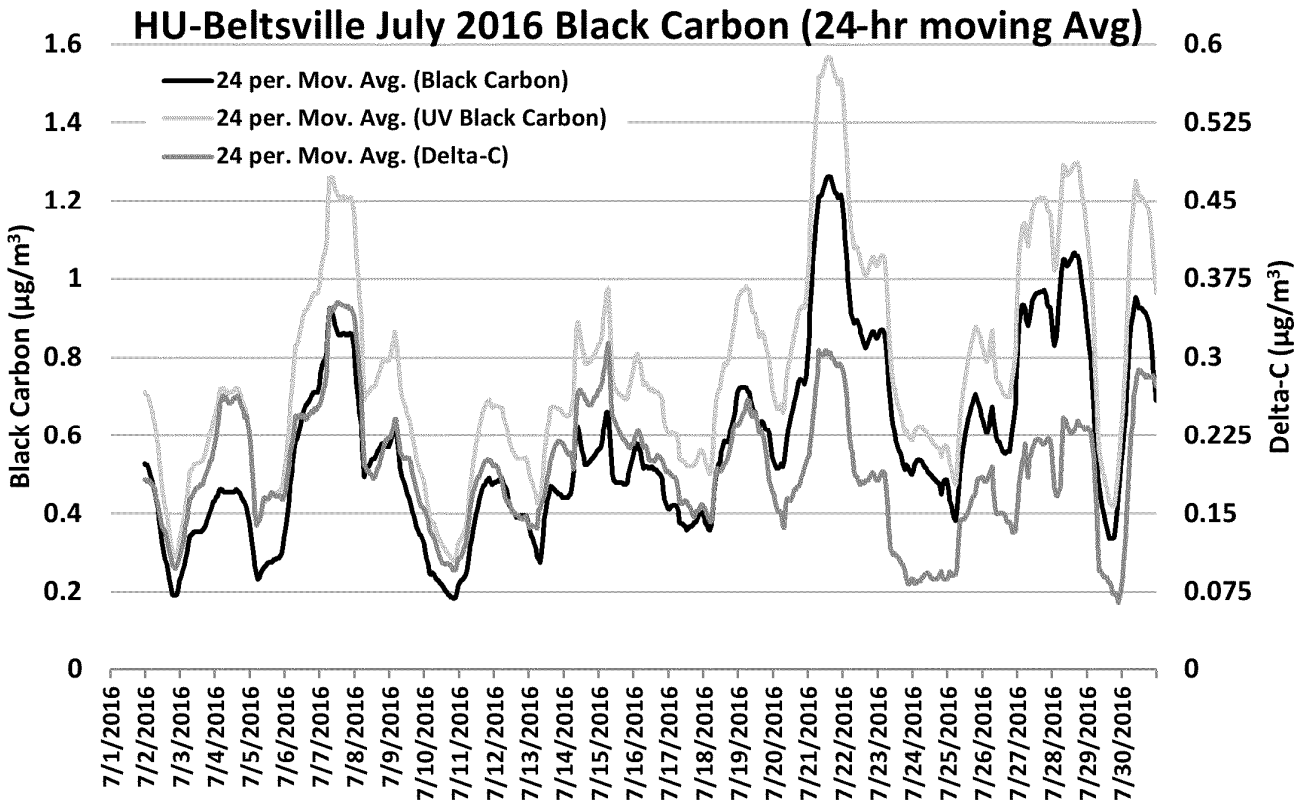

Figure 33. HU-Beltsville Aethalometer for July, 2016.
The Aethalometer observed an increase in Black Carbon concentratio ns (Black line) which ended up being the highest concentration observed all month. At the same time a sustained increase in Delta -C was observed (blue line), indicative of an increase in VOCs within the sampled air. Typically this may be interpreted as a signature indicating the Black Carbon was sourced from natural combustion, such as wildfires.

3.4.3. Carbon Monoxide (CO)

CO has been previously identified as a wildfire smoke indicator (Andreae and Merlet, 2001; McKeen et al., 2002, DeBell et al., 2004, Dreessen et al., 2016), can play a role in ozone production, and followed similar patterns to other pollutants over the lifetime of the event, though with a relatively subtle signal in surface data (Figure 34). Piney Run, Essex, and Horn Point showed varying degrees of CO influence from July 20-22 and were the three monitors observing CO during the event. The timing of the CO increase at Essex (thin blue line) occurred late in the day on July 20, the same timing of the smoke subsidence to the surface, shown earlier in the Lidar data (Figure 13). Horn Point (thin red line in Figure 15) was far from major sources, yet showed a spike in CO around midday on July 20. Such timing would also be consistent with smoke mixing to the surface as seen at UMBC with the different location resulting in different timing. At no other time in the month did Horn Point observe such high concentrations of CO. Piney Run also showed an increase in CO late on July 20, fairly consistent with the Essex monitor.

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The state-wide peak in CO late on July 20 (black line, Figure 34) was consistent with the onset of smoke and the arrival of the CO plume on satellite to the region (Figure 31). However, the CO concentrations did not remain consistently high through the period. There may be several reasonable explanations for this. The primary and most likely explanation is that CO can itself be an ozone precursor. As such, CO can react with other atmospheric constituents, reducing its concentration in the atmosphere. Regardless of its quantitative contribution to ozone specifically, CO was likely removed from the atmosphere via photochemical reactions beginning on July 21 (the big drop in concentrations). Thus the onset of the smoke with an increase in CO is more indicative of smoke emissions impacting the surface network than sustained elevated CO concentrations would be.

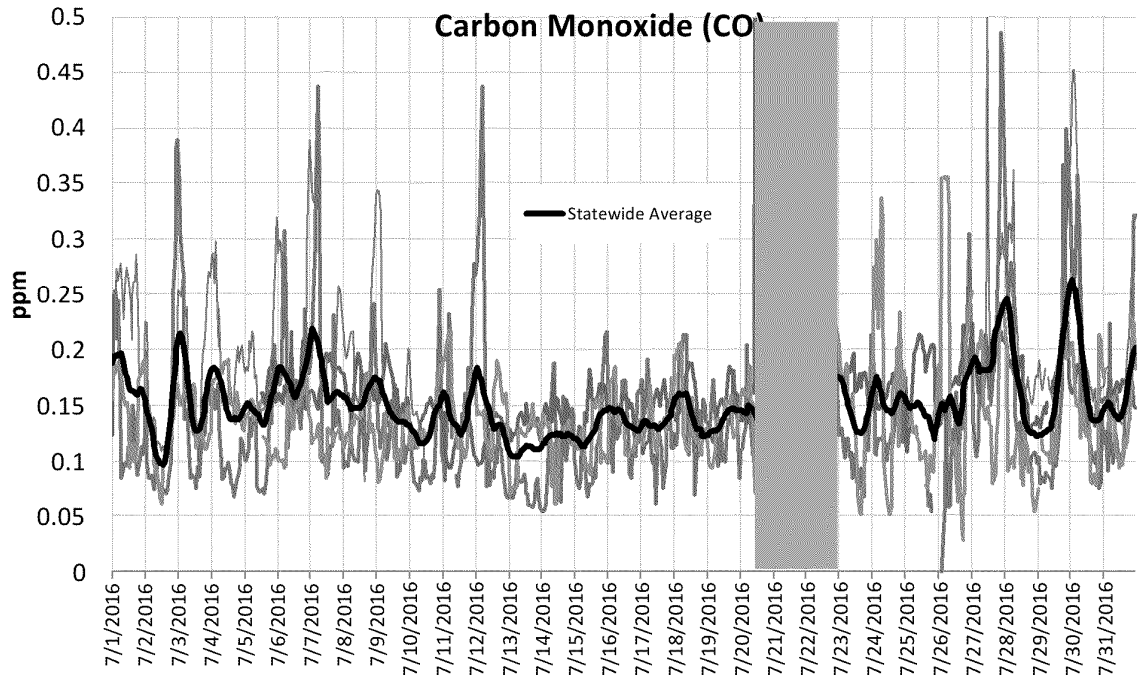

Figure 34. Hourly Carbon Monoxide (CO) overlaid with a running 24-hour average.
Hourly data at five sites in Maryland are displayed, though only Essex (thin blue), Piney Run (thin green), and Horn Point (thin red) operated from July 20-22. The smoke event is highlight in yellow. The "statewide average" is a running 12-hour hour boxcar average of the underlying hourly data, given as a bold black line. The average is taken of all available data points in that time period.

3.4.4. Nitrogen Oxides

Singh et al. (2012) showed that ozone production rates from wildfires in California were dependent upon available nitrogen oxides (NOx = sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2)) and that NOx from the fires themselves was relatively low. However, NOx emissions from fires can vary greatly and the Fort McMurray Fire in May of 2016 was associated with large amounts of NOx from the fire itself, detected as far away as Maryland. Since the smoke plume in the July case subsided from a height of over 3km on July 20 to reach the surface layer, any change in atmospheric composition at the onset of the smoke was highly likely

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due to fire emissions due to lower reactivity (due to lower anthropogenic inputs) at higher elevations above the ground. For example, increases in NOx coincident with the timing of the smoke plume's subsidence are most likely a consequence of transport within the smoke plume, which was devoid of most anthropogenic sources as the plume remained aloft during transport. On July 20 a NOx increase was observed which persisted through the days of the event, suggesting some NOx enhancement within the smoke (Figure 35). However, the degree of NOx observed was not particularly high in relation to other days through the 2016 season, but all sites, saw an increase in NOx concentrations at hourly averages. Additionally, the concentration of NOx was the highest observed during the month of July in 2016. The timing of the NOx increase and the amount of NOx observed coincident with the smoke arrival all suggest the smoke played a large role in ozone production via added NOx during the high ozone period of July 21-22, 2016.

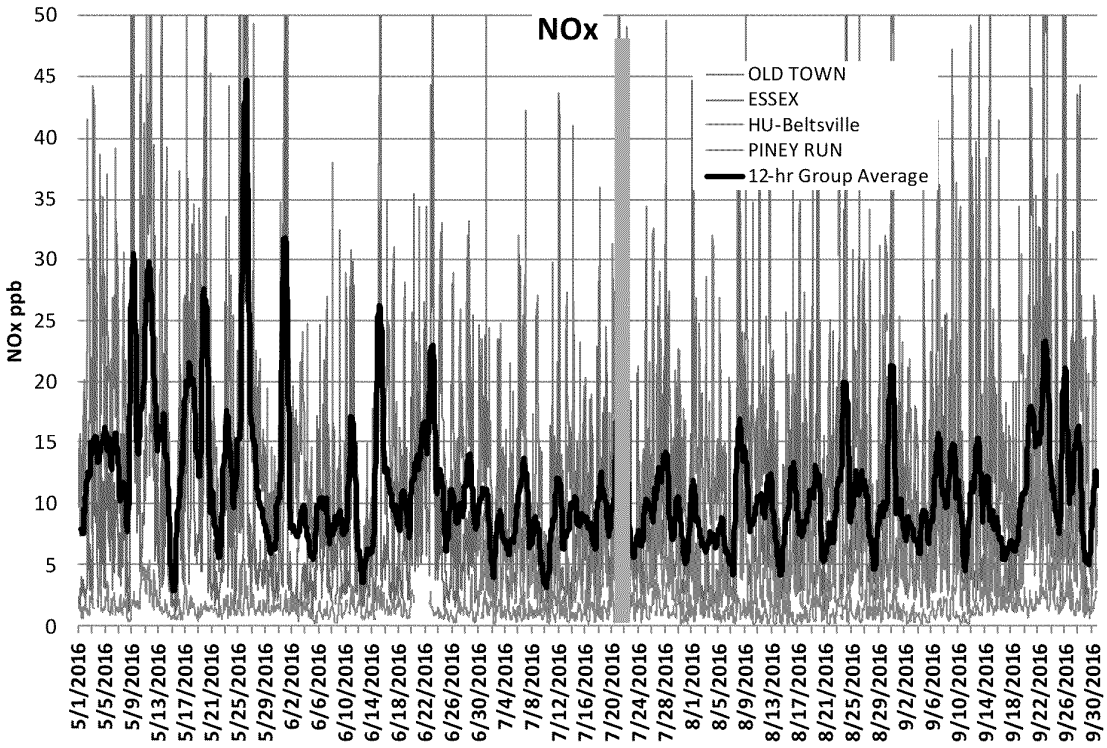

Figure 35. Nitrogen oxides (NOx) from available Maryland monitors for May-September of the 2016 ozone season. The thin yellow box highlights the July smoke event. The dark black line was a 12-hour box-car running average concentration of NOx using Oldtown, Essex and HU-Beltsville. Piney Run was not included in the average because spatial evidence suggests it was not greatly influenced by smoke during the event. Hourly concentrations of NOx at each site were given with fine lines.

3.4.4.1. Total Reactive Nitrogen, and Reservoir/Aged Nitrogen

The several day travel time of the smoke plume provided plenty of time for nitrogen to age within the smoke plume. Thus, in similar fashion to Dreessen et. al, (2016), NOy and NOz should be much higher than other times of the season if an aged plume of NOx traveled with the smoke plume. In essence, in the

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presence of sunlight, the NOx and VOCs present within the plume should react and "age". The HU-Beltsville site had observed both NOy and NOx at the time of the smoke even in July. Together, these observations can also give NOz, which is a category of nitrogen compounds encompassing "reservoir species" which can be transported long distances, indicate aged pollution, and which can dissociate (break apart) in sunlight to enhance ozone production by providing additional NOx for chemical reactions. Observations of these chemical species showed an increase in total active nitrogen (NOy) coincident with the second highest observed daily running average of NOz of the entire 2016 season during the smoke event on July 20-22 (Figure 36). As mentioned, NOz concentration is often an indicator of not only the age of an airmass, but also a measure of available "transported" NOx, locked up in molecular bonds created by reactive VOCs within the smoke. The measure of NOz then, when available, is a pseudo-measure of total available ozone precursors, since it encompasses reactive VOCs and actually measures available nitrogen. The timing of NOz increase coincident with the arrival of the smoke is irrefutable evidence that the smoke supplied necessary atmospheric constituents to foster exceptional ozone production in Maryland which led to exceedances of the 70ppb NAAQS on July 21 and 22, 2016.

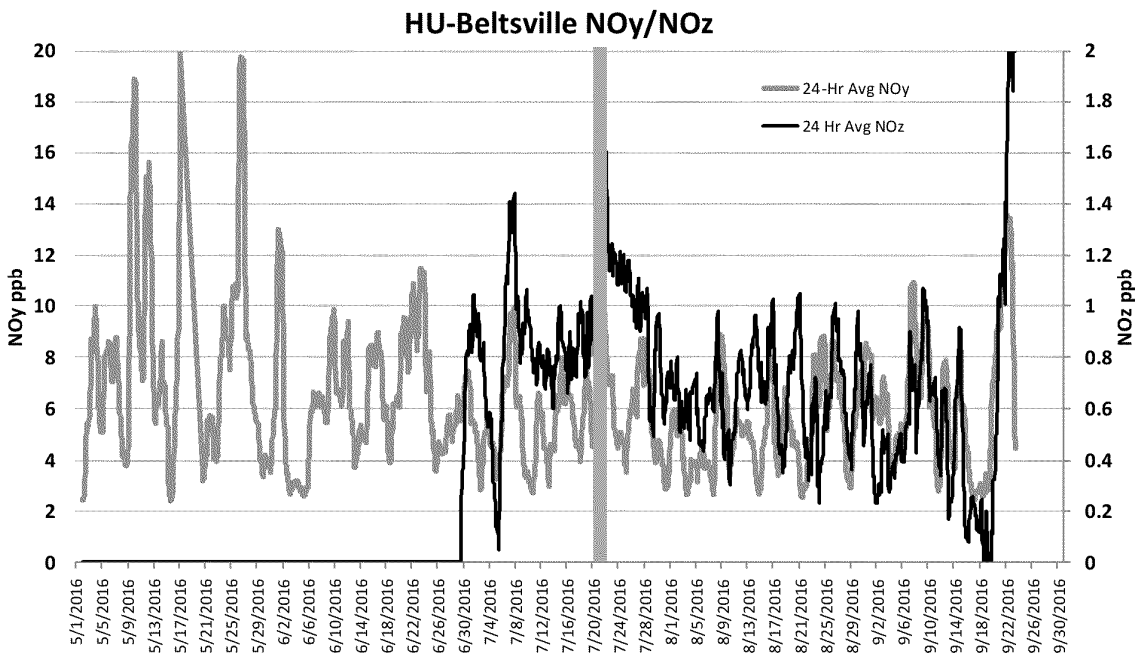

Figure 36. Total reactive nitrogen (NOy, blue) and other non-NOx species (NOz, black) at HU-Beltsville for the 2016 season. NOy was observed during the entire 2016 season, however NOx was only available beginning in late June (necessary for NOz calculations). NOz showed a pronounced spike at the onset of the smoke event.

3.4.5. Volatile Organic Compounds

Wildfires are known emission sources of Volatile Organic Compounds (VOCs) and the importance of VOCs emitted from wildfires on ozone production has been well documented (i.e, Dreessen et al (2016), Hu et al. (2008)). An airmass characterized by abundant VOCs will be more able to not only form ozone but also transport it or ozone precursors long distances due to the reactivity of the VOCs (which can also store the NOx). Thus, a significant increase in VOC concentrations coincident with the arrival of smoke and rising ozone concentrations are therefore likely interconnected. While VOCs are reactive and thus would "react away," decreasing VOC concentrations, not all VOCs are equally reactive nor would all VOCs be expected to be removed from the plume, particularly when the smoke is transported while apart from the surface layer (above and separate from other anthropogenic sources which may react with the plume).

Hourly VOC concentrations were captured by the hourly Automatic Gas Calibrator (AutoGC) located at Essex. While MDE also conducts VOC canister collection through the ozone season, the two ozone days fell between canister collection days, leaving only the hourly AutoGC chromatograph data during the height of the ozone event. The AutoGC VOC data showed a large and sustained increase in hourly total non-methane organic compound (TNMOC; VOCs) concentrations beginning in the early evening of July 20, 2016 (Figure 39). This was coincidental with the arrival of the smoke plume seen on the Lidar in Figure 13. Using a 24-hour running average the period starting late on July 20 through July 21 had the highest TNMOC concentration for the entire month of July. Hourly concentrations of VOCs (thin blue lines in Figure 39) also showed the dramatic increase in VOCs occurred beginning at 6:00pm local time, which was far too coincidental with the arrival of the smoke on the Lidar imagery being entrained towards to surface to be circumstantial.

Hourly concentrations of VOCs do decrease quickly on July 21 and into July 22. This can either be attributed to smoke being transported from the area or the remaining VOCs reacting within the airmass to augment ozone concentrations to exceed the NAAQS. In either case, the decrease in VOC concentrations does not deduct from the influence of smoke on ozone for July 22. Instead, as stated earlier, the "damage had been done" on July 21. The ozonesonde on the morning of July 22 (Figure 29) showed substantial ozone left over from July 21, which had been created by the influx of smoke and caused the additional exceedance on July 22. That ozone generation on July 21 would have only have been possible to the degree that occurred with the additional VOCs and NOx within the smoke plume. So regardless of VOC content on July 22, their impact on air quality was already exemplified. Therefore, the VOCs have provided additional, irrefutable evidence that wildfire ozone precursors were delivered to the surface air in Maryland to augment ozone production to levels exceeding the NAAQS.

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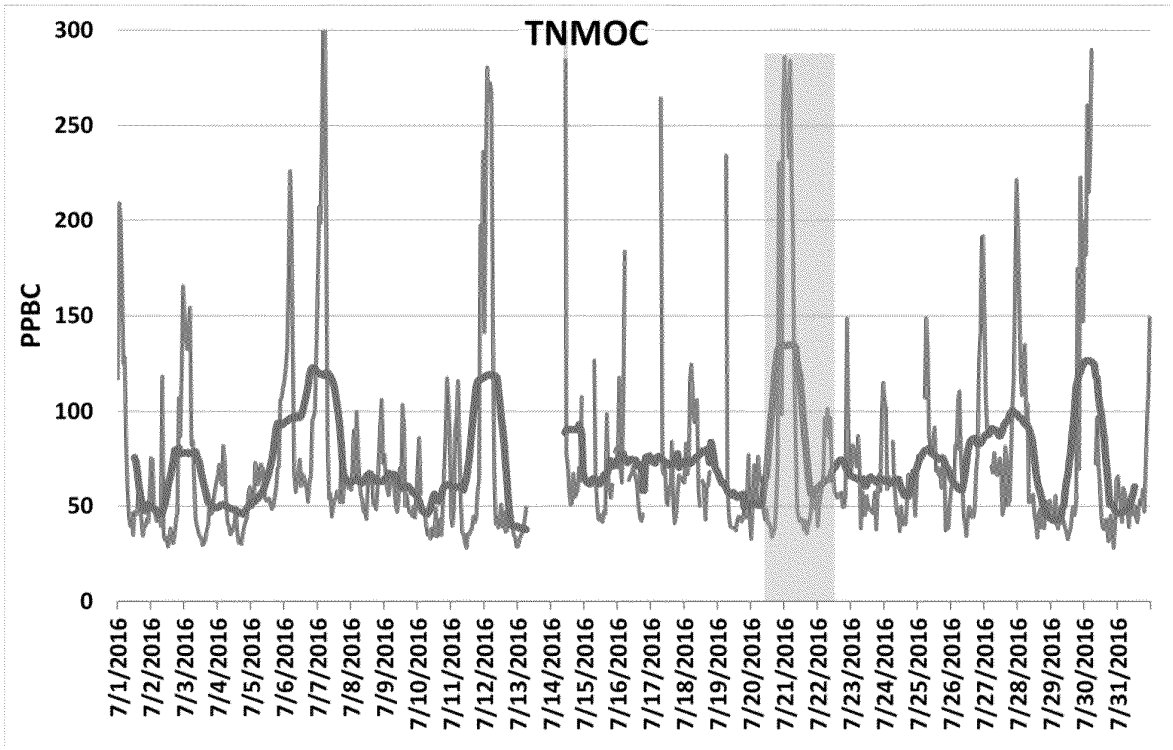

Figure 37. Total non-methane organic compounds(TNMOC)
Hourly TNMOC (blue thin line) and 24-hour box-car moving average (red thick line) in parts per billion carbon (PPBC) were observed by the AutoGC located at Essex Maryland. The yellow box highlights the smoke and ozone period.

3.5. Analysis Methods to assess impact of the SMOKE

3.5.1. Ozone to NOx ratio

MDE has asserted the excess NOx and NOy observed in the Maryland monitoring network was either from the fire itself or due to excessive storage of NOx within the smoke plume due to excess reactive VOCs supplied by the smoke as suggested in Dreessen et al., (2016). To further evaluate whether the increased NOx observed was carried within the smoke plume and was not simply from upstream EGUs (a typical "non-event" exceedance characteristic), MDE generated an ozone to NOx ratio for the past seven years. In a NOx limited environment, less NOx means less ozone. Thus, an airmass characterized by an abundance of ozone but also impacted by copious EGU NOx emissions will maintain a low or constant ozone to NOx ratio. A reduction in emissions leading to reductions in ozone and again the ratio would remain relatively constant. However, an airmass producing abundant ozone without substantial increases in anthropogenic NOx emissions produces a high ratio and indicates a highly efficient, ozone-productive airmass composition. Such a scenario indicates additional influences on the airmass composition.

The ozone values on July 21 and 22, 2016 reached MD8AO concentrations not often seen over the previous five years except with more EGU NOx emitted within the Maryland upstream airshed (Maryland,

Pennsylvania, West Virginia, Northern Virginia and Ohio, the states from which emissions would often affect Maryland ozone concentrations) such as in 2012. To further illustrate that the amount of ozone which was generated in Maryland was beyond normal in the context of decreasing regional NOx concentrations, the ratio of ozone produced against the NOx emissions from Maryland and Pennsylvania (the two main upstream states impacting the air on July 21/22, based on trajectories [Figure 15a, b and Figure 28]) was analyzed. The MD8AO on July 21 and 22 reached concentrations which were not uncommon in Maryland on exceedance days. But in previous years these ozone concentrations were achieved with abundant EGU NOx emissions. As a result, the ozone to NOx ratio (maximum statewide 8-hour average concentration divided by total NOx output from Pennsylvania and Maryland) reached the 24th and 13th highest ratio on July 21 and July 22, respectfully, using data since 2010 (217 days). The higher than typical ratio suggested ozone production was beyond classic event production and was likely aided by other constituents (Figure 38).

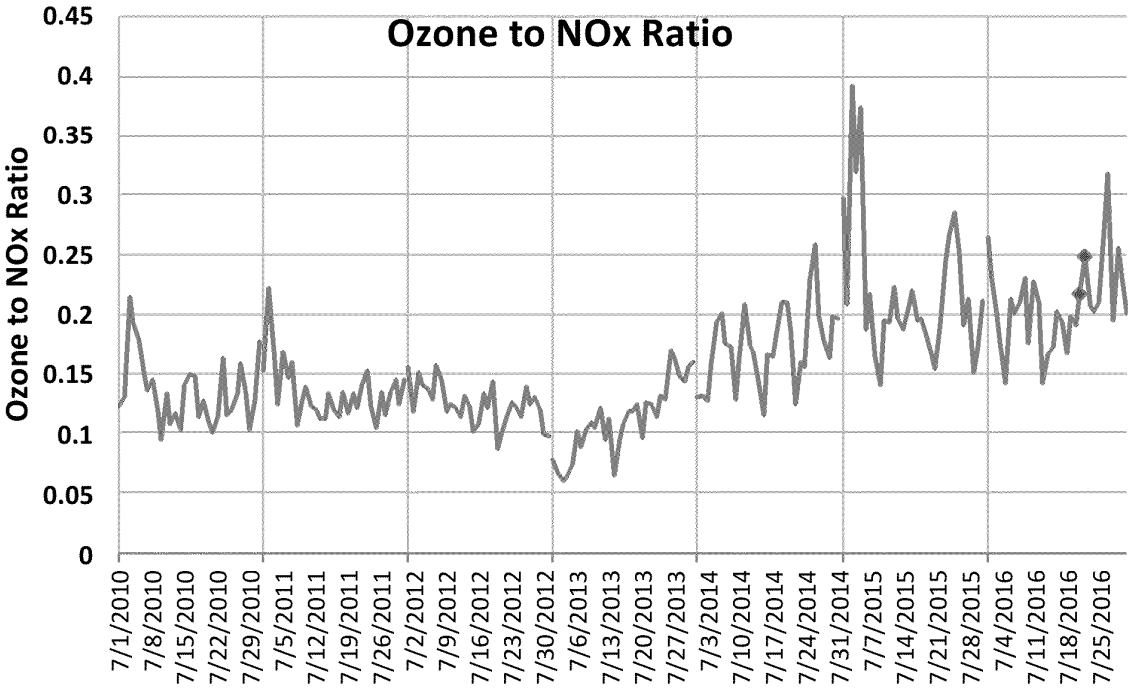

Figure 38. Ozone to NOx ratios for Maryland.
The higher the ratio, the more ozone is created for a given amount of NOx output from EGUs. NOx output used in each case is described in the text but is based on statewide EGU emissions from Pennsylvania and Maryland. States used were selected base d on backward trajectories as described in the text. The red diamonds highlight the event on July 21 and 22, 2016, which were the 24 and 13 ranked ozone to NOx ratio in July, respectfully, since 2010, a period of 217 days.

3.5.2. Model Data: CMAQ Underestimation of Ozone

The presence of smoke during the July 21 and 22 ozone exceedance days and its associated tracers (such as VOCs and $PM_{2.5}$) provided clear evidence that significant portions of ozone production were attributable to smoke. Given the presence of increased smoke tracers at the surface and ozone values climbing to and above the 99th percentile levels of the past 5 years of data, the impact of smoke constituents on ozone was incontestable. To quantify the attribution, however, MD8AO concentrations forecast with the operational NOAA CMAQ ozone model were compared to observed concentrations. Source information from the Canadian fires as well as gas phase chemical interactions from wildfire smoke and their interactions with ozone were not included in the NOAA operational CMAQ model during 2016. Therefore, the NOAA operational CMAQ model represented a prediction of ozone in the absence of smoke. The NOAA CMAQ ozone model reported ~7ppbv high bias and 15.1ppbv RMSE for June ozone predictions in 2010 (Chai et al., 2013) (i.e., it tends to over-forecast ozone concentrations). The over prediction error has improved since 2010, but the model maintained a high bias in the Maryland area through 2016 (Figure 39). With this information in mind, the difference in the model forecast ozone to actual observations in July of 2016 provided an estimate of the increase in ozone due to smoke and the spatial extent of the influence.

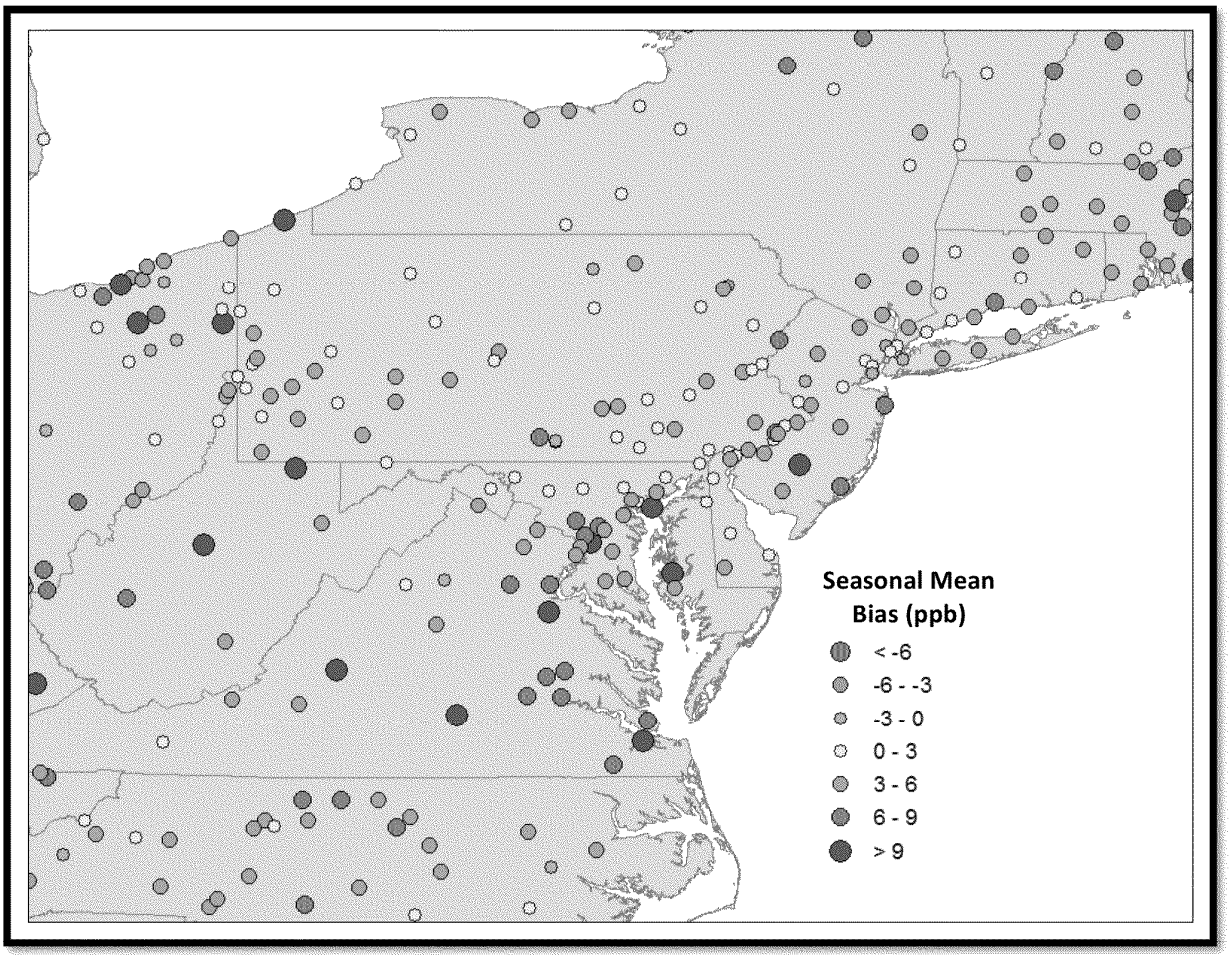

Figure 39. NOAA 2016 operational CMAQ ozone prediction errors at monitors across the northeast US.

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Gridded model data was extracted at observation points throughout the eastern CONUS for July 19-23, 2016. The difference between the predicted and observed 8-hour maximums were interpolated across the region on a daily basis and showed an area of modeled under prediction of MD8AO across Pennsylvania and Maryland on July 20 and 21, moving eastward to the US northeast by July 23 (Figure 40). Cross referencing Figures 14 and 15 with Figure 40 showed similar patterns of smoke, ozone, and under-prediction by the NOAA CMAQ model. Additionally, the NOAA CMAQ model traditionally over-predicts ozone by mid-season in the Mid-Atlantic. Since the NOAA CMAQ did not include smoke emissions in 2016, under predictions by the model were the result of fire emissions and ozone precursors which were not accounted for in the model input, leading to higher than predicted MD8AO. The underlying assumption then was that extreme under prediction of 8-hour maximums coincident with smoke to be due to the smoke itself. It would be very coincidental for the model to under predict both quantitatively and spatially in line with the smoke plume, particularly in the time of the season with documented model high bias.

Sequential examination of the images reveals an area of modeled under prediction that developed across Pennsylvania and northern Maryland between July 19 (Figure 40a) and July 20 (Figure 40b), increased in magnitude on July 21 (Figure 40c) across these same areas and also farther northeastward into New York, then began to weaken and/or move northeastward out of the domain on July 22 and July 23 (Figure 38d,e). By July 22, warm temperatures and a high model bias nearly eliminated the area of under prediction (i.e., the model predictions were closer to correct but for the wrong reason – hot temperatures and over-aggressive anthropogenic emissions along I-95 causing a high model bias which incorrectly forecast the higher smoke concentrations) but the near zero bias across much of Maryland when the model was known for over predicting still suggests smoke influence and carry-over from the previous days into July 22, 2016. Then an area of near zero bias was located farther northeastward on July 23 to reside across New England; evidence of the transport of the airmass northeastward and away from Maryland. The area of under prediction in the model closely correlates to the movement of ozone and HMS analyzed smoke (compare Figures 14 and 15). Together, with the data presented previously, helps to quantify the ozone impact from the smoke and shows a wide area from at least Maryland through the northeast with ozone under predictions of at least 5ppb and as much as 10-15ppb over wide spread areas on July 21. This extra ozone carried over into July 22, where the model predicted values were closer to accurate, but for incorrect reasons.

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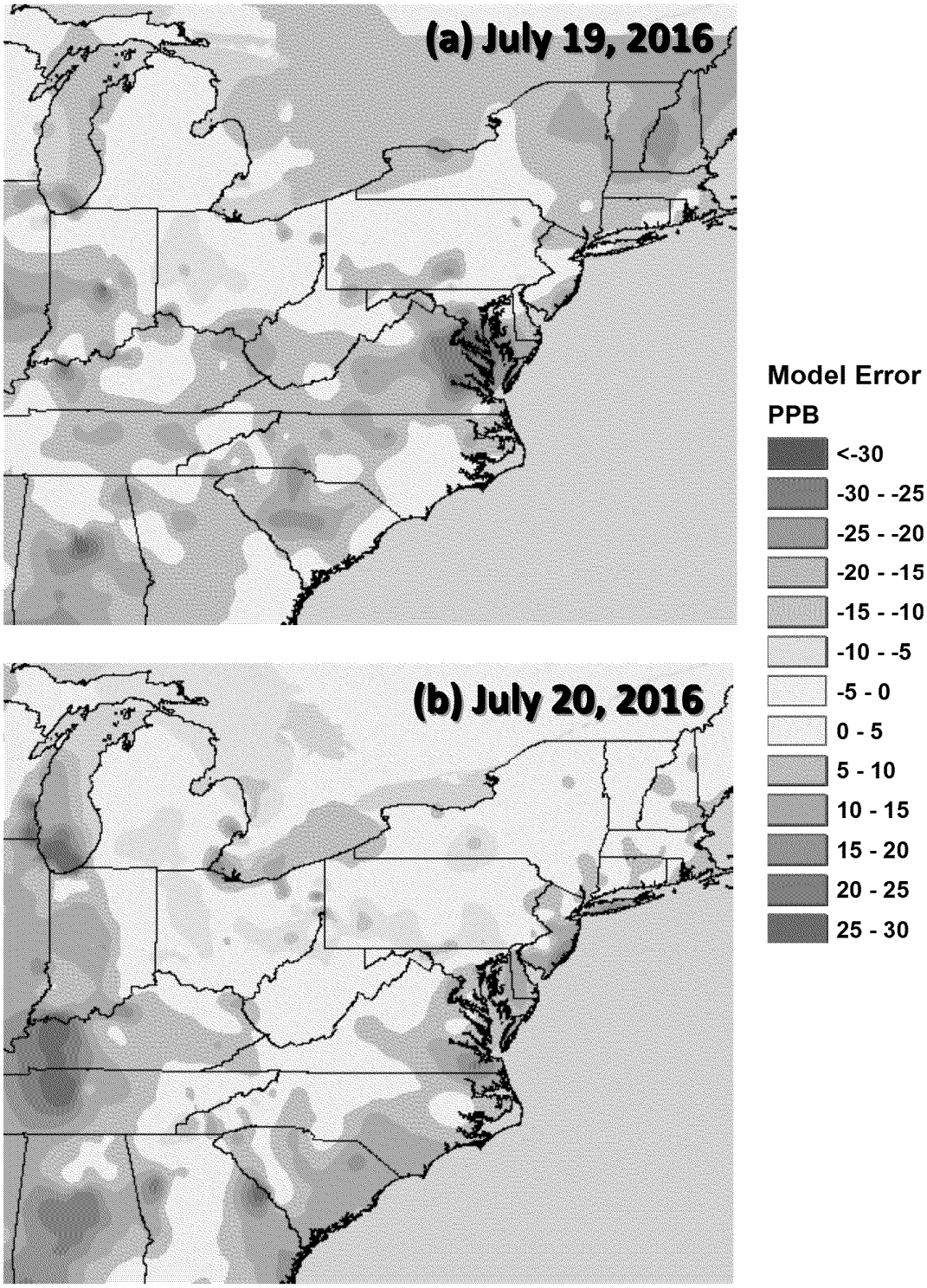
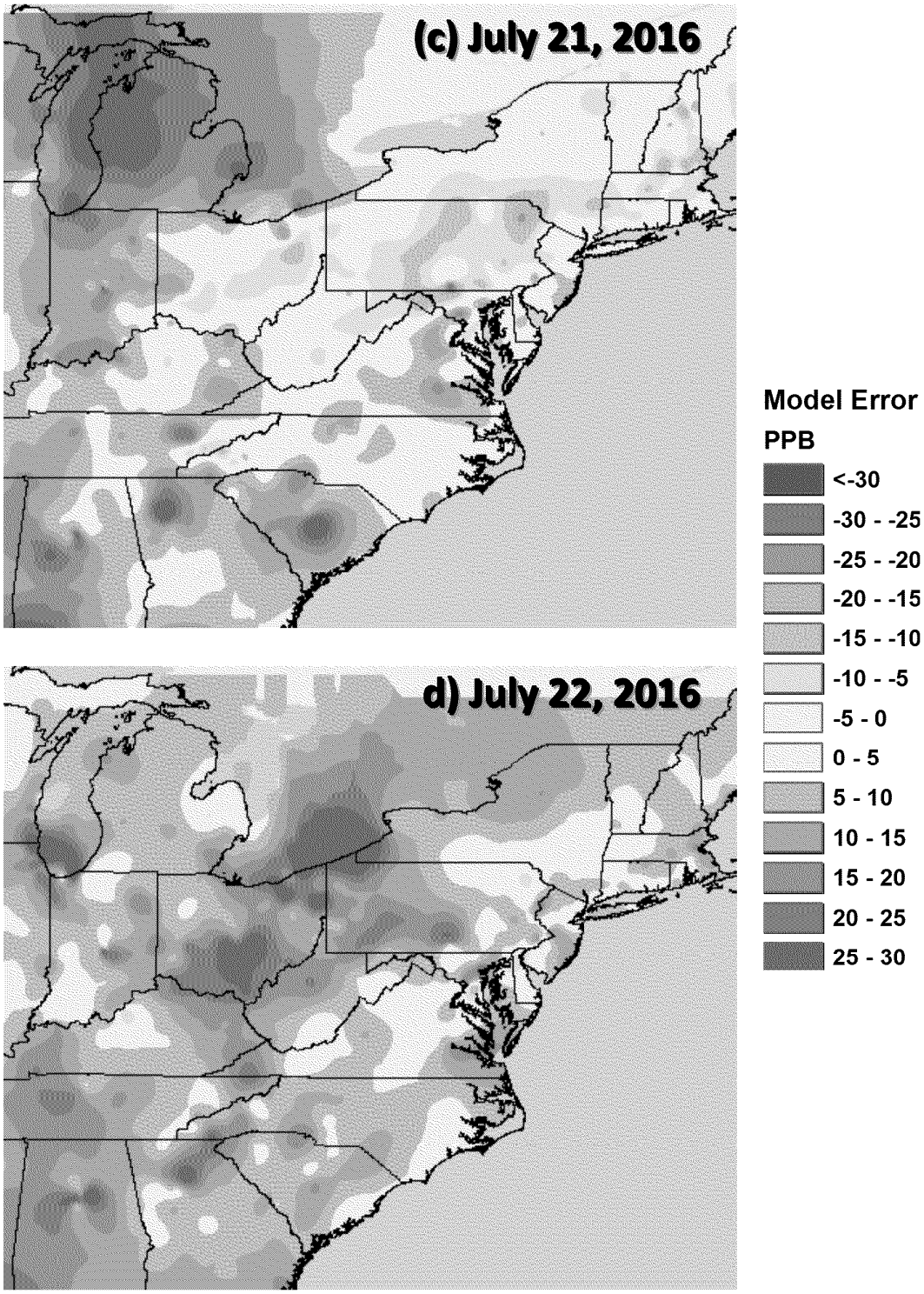

(a) July 19, 2016
(b) July 20, 2016
Model Error
PPB
<-30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30


(c) July 21, 2016
d) July 22, 2016
Model Error
PPB
<-30
-30 - -25
-25 - -20
-20 - -15
-15 - -10
-10 - -5
-5 - 0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30

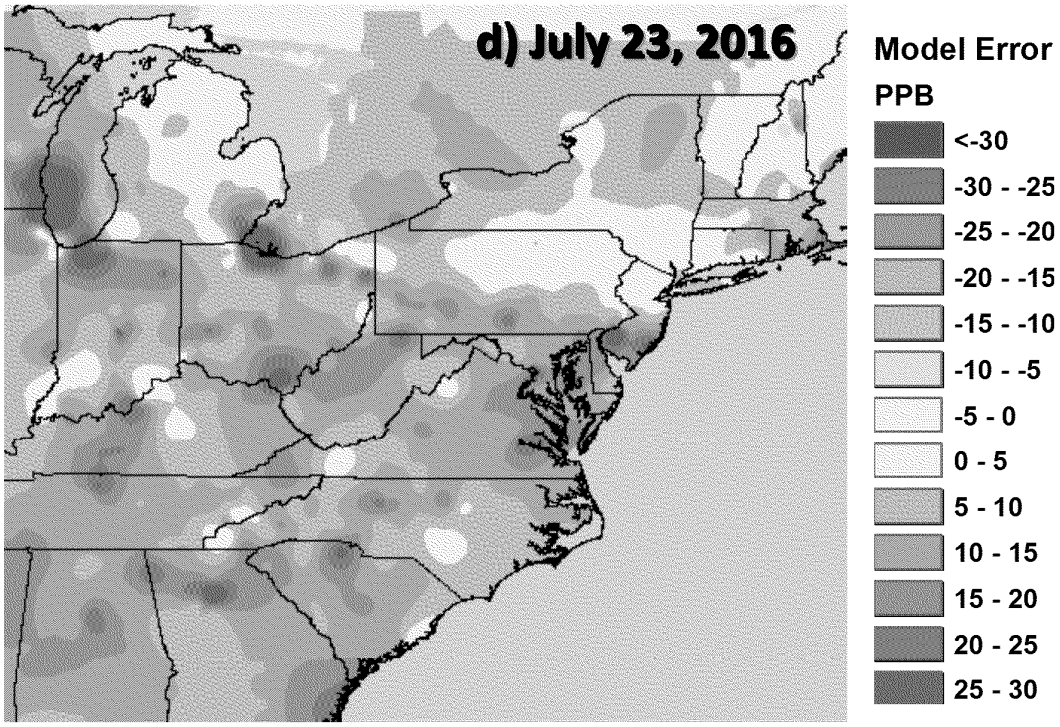


Figure 40. The NOAA CMAQ model MD8AO predictions for July 19-23, 2016 compared to AQS observations. Operational NOAA CMAQ model predicted MD8AO minus observations are contoured from July 18-28, 2016. Darker areas of blue show more significant model under prediction, while areas of red show areas of model over-prediction. Colors begin at +/- 5ppb error magnitude. Days shown are (a) July 19, (b) July 20, (c) July 21, (d) July 22, (e) July 23, 2016.

3.6. Similar Day Analysis

Similar meteorology in the absence of smoke should not produce ozone exceedances as was observed in Maryland on July 21 and 22, 2016. A similar day analysis attempts to identify days which are similar in pattern and characteristics (temperatures, winds, transport regime) but without the burden of smoke on ozone production. In an analog comparison of such days, affected monitors should show substantially less ozone when not impacted by smoke. To isolate such days within the past five years, days in July reaching at least 90°F at BWI airport were identified. From that list, days with morning winds at 925mb (approximately 1000m) from the northeast (>25° and <60°) based on the MDE wind profiler network on the morning of July 21 narrowed the group further. MDE's radar wind profiler (RWP) at Horn Point observed northeasterly winds on the morning of July 21 (Figure 41), consistent with Figure 15c which showed trajectories from the northeast on July 20, before turning northwesterly over northern areas of the state later on July 21. At 12Z the wind direction on the profiler around 1000m above ground level was from the northeast, or approximately between 25° and 60°. This wind direction and time was ultimately chosen for the similar day analysis since the smoke was first seen to subside to the surface late on July 20 and the first exceedance was on the afternoon of July 21; the morning (12Z) on July 21 falls in the middle of these two times and was therefore representative of the conditions leading up to the exceedance on July 21. Finally, those days subjectively similar to the pattern on July 21, 2016 over the eastern US determined the final group of days used for similar day comparisons.

Thirty-seven days in July of 2012-2016 were identified as meeting the temperature criteria which were not already connected or adjacent to the smoke event of 2016 (i.e., July 23, 2016 was not used). Of these 37 days, only 13 were found with northeast flow at 925mb and of these 13, none had weather patterns which closely matched the pattern on the exceedance day. Loose pattern similarity (post front, clear skies, with ridging over the eastern US) with some comparability to the July event was seen on three days and were used for comparison analysis (Table 6).

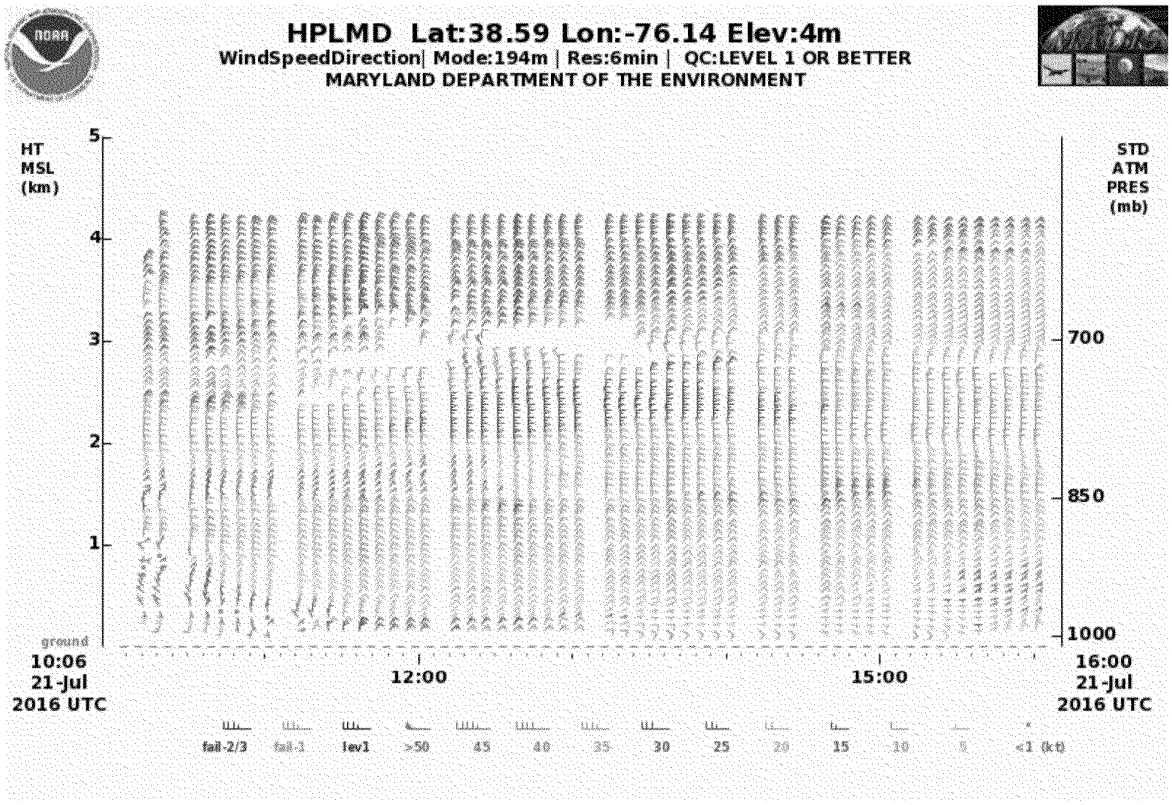
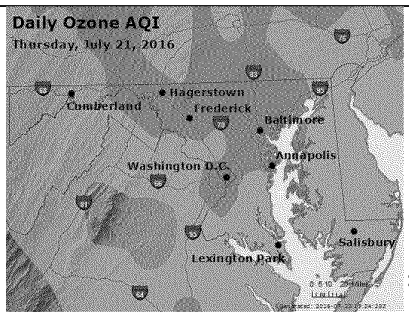
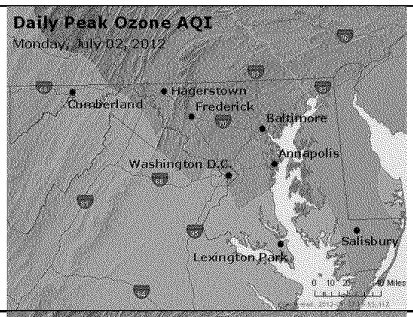
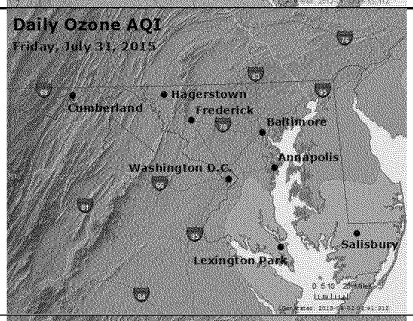
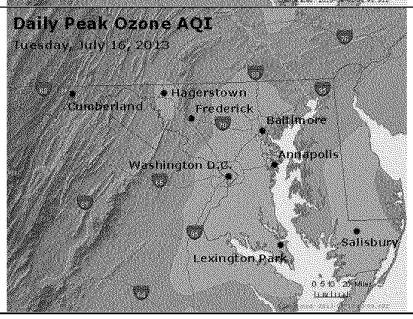


Figure 41. Radar Wind Profiler (RWP) output at Horn Point Maryland from 1006 UTC (6:06am LDT) on July 21 through 1600 UTC (12pm LDT) July 21, 2016.

Based on the similar day analysis, no other day in July from 2012 - 2016 which had similar meteorological characteristics produced similar levels of ozone. The highest ozone on July 21, 2016 was 78pb. On July 22, the highest MD8AO was 87ppb which qualified as an "unhealthy" AQI day based on the 2015 NAAQS. The next highest MD8AO concentration on a similar day was July 2, 2012 when temperatures 4°F warmer than in 2016 produced ozone which was 9ppb lower. Spatial coverage of ozone on the similar days was not comparable to the 2016 event either. More than half of the state was under code orange conditions in July

of 2016 when in the other events no monitors were above 70ppb. This analysis reveals that similar meteorological conditions in previous years did not produce as much ozone as on July 21 and 22 of 2016. This was true despite decreased emissions over the entire 5-year period, with the lowest anthropogenic precursor emissions occurring in 2016. Thus, analog evidence suggested the July 2016 exceedance event was influenced by factors not explained by a similarity analysis. The only conclusion was that the influence of wildfire smoke created the ozone exceedances July 21 and 22, 2016.

Table 7. Similar Day Analysis for July 21, 2016.
Three dates compared to the July 2016 ozone event were chosen by a similar maximum temperature (Tmax >=90°F) at BWI airport, 925mb winds from the northeast (>25° and <60°) on the 12 UTC (8am LDT) Sterling, VA sounding and comparable synoptic pattern characterized by high pressure over the southeastern US. **Due to the change in the ozone standard, the AQI color sca le on the 2016 map is based on orange being greater than 70ppb for MD8AO. Earlier years use 75ppb for orange.

DATE	Ozone (ppb)	T_{max} (°F)	Mapped AQI
July 21, 2016	78	90	 *
July 2, 2012	69	94	
July 31, 2015	67	90	
July 16, 2013	69	95	

4. The Occurrence was a Natural Event

According to the Clean Air Act (CAA) and the Exceptional Events Rule (40 CFR 50), an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location or a natural event." The EPA also believes that treating all wildfires on wildland as natural events is consistent with the CAA and Exceptional Events Rule. Based on the documentation provided in section 2 of this submittal which discusses the origin and evolution of the wildfire events, the fires across the Northwest Territories and west-central areas of Canada qualify as a natural event because lightning activity was suspected as the cause of the unplanned fire event. Wildfire emissions affecting ozone concentrations in Maryland were generated predominantly from sparely populated forested areas, meeting the definition of wildland. The EPA generally considers the emissions of ozone precursors from wildfires on wildland to meet the regulatory definition of a natural event at 40 CFR 50.1(k). Accordingly, the Maryland Department of the Environment has shown that the event is a natural event and under this criteria may be considered for treatment as an exceptional event.

5. The Occurrence was Not Reasonably Controllable or Preventable

Based on the documentation provided in section 2, the majority of the fires relevant in this petition were likely due to lightning. These fires were considered natural wildfire events by the EPA as outlined in section 4, were outside of the United States, and were therefore neither reasonably controllable or preventable by the state of Maryland. No policy that Maryland enacted could have prevented the fire or the smoke which it caused, to enter the United States or Maryland. MDE was not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable. Therefore, emissions from these wildfires were not reasonably controllable or preventable and meet the criterion for treatment as an exceptional event.

6. Public Comment

MDE posted notice of this exceptional events demonstration on May 26 on the MDE website for a comment period of 30 days. [Number] public comments were received and have been included in [Section X] of the exceptional events demonstration, along with MDE's responses to these comments

7. Concluding Statements

On July 21 and 22, 2016 smoke associated with wildfires located in northwestern Canada occurred that generated ozone precursors. These precursors was subsequently transported east and southeastward towards Maryland and impacted most of the monitoring sites across the Maryland ozone network. The monitored 8-hour ozone concentrations reaching as high as 78 and 87ppb on July 21 and 22, respectively,

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established the highest observed MD8AO concentration at five sites in the Maryland ozone network during the 2016 season and were within the four-highest ranked 8-hour average observations of 2016 at 11 monitors, (Table 1), though only 10 of those monitors exceeded the 70 ppb NAAQS to be included in this analysis and to be considered for exclusion.

Exclusion of the MD8AO concentrations on July 21 and 22, 2016 lowers the DV at several monitors in Maryland. Excluding the July 21 and 22 MD8AO at the 12 requested monitors (Table 2 and 8) would immediately reduce five monitors' DV, including the Fair Hill monitor (240150003), which would drop below the 2008 75 ppb level (from 76 to 74 ppb) and also bring the PG Eq Cntr monitor (240338003) into attainment of the 70ppb 2015 standard (71ppb to 70ppb). Reduction of all the sites' DVs would potentially be used to demonstrate compliance through 2018.

Additionally, MDE also recognizes the importance of the fourth highest value in a given year potentially determining future year DVs. Exclusion of the July event will impact not only DVs in 2016, but also in 2017 and 2018, particularly in light of MDE's May exceptional event demonstration. An exclusion of the requested data in July will decrease five monitors' DV and fourth-highest observations in 2016. However, if the May event was also excluded a total of 12 monitors' DV would decrease with 3 monitors' DV decreasing only if both are concurred. An additional seven monitors' fourth-high would decrease further with both exclusions than if only the July or May events were concurred alone. Given the fourth high value will impact the DV calculation through 2018, the exclusions have large ramifications for regional attainment.

The analyses provided in this demonstration support MDE's position that the wildfire events affected air quality in such a way that there exists a clear causal relationship between the specific event (fires in northwestern Canada) and the monitored ozone exceedance on July 21 and 22, 2016 and thus satisfies the clear causal relationship criterion for recognition as an exceptional event. Based on these facts, MDE requests that EPA recognize the 15 MD8AO concentrations between July 21 and 22, 2016 (Table 8), exceeding the 70ppb NAAQS at the following 12 monitors: Fairhill (240150003), Frederick (240210037), Hagerstown (240430009), HU-Beltsville (240330030), PG Equestrian Center ("PG Eq Cntr", 240338003) Aldino (240259001), Edgewood (240251001), Furley (245100054), Rockville(240313001), S. Carroll (240130001), Glen Burnie (240031003), Beltsville CASTNET (240199991), as impacted by an exceptional event. MDE formally requests that the data from these 12 monitors on these days be flagged as such and be excluded from use for regulatory determinations.

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Table 8. The 12 ozone monitors at which MDE is seeking data exclusion.
Local names and Air Quality System (AQS) identification numbers (AQSID) identify monitors in the text. Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the season. The final columns indicate the 2016 fourth high and design value with no exclusion of data (Including) and if the requested data from July 21 and 22 are excluded from fourth high and design value calculations (Excluding). Sites with an asterisk indicate the site does not have a valid design value in 2016. Blank cells ("-") are MD8AO at sites which did not exceed 70ppb and therefore cannot seek exclusion.

		2016							
		MD8AO[ppb] (rank)		Fourth High [ppm]			Design Value [ppm]		
SiteName	AQSID	July 21	July 22	Including	Excluding	Excluding May & July	Including	Excluding	Excluding May & July
Aldino	240259001	77 (3)	72 (9)	0.077	0.077	0.074	0.073	0.073	0.072
Beltsville CASTNET	240339991	78 (1)	-	0.070	0.070	0.069	0.068	0.068	0.068
Edgewood	240251001	72 (9)	82 (1)	0.079	0.079	0.077	0.073	0.073	0.072
Essex	240053001	75 (7)	72 (13)	0.078	0.078	0.077	0.072	0.072	0.072
Fair Hill	240150003	-	87 (1)	0.080	0.076	0.075	0.076	0.074	0.074
Frederick	240210037	75 (2)	-	0.070	0.067	0.067	0.067	0.066	0.066
Furley	245100054	74 (5)	-	0.075	0.075	0.067	0.069	0.069	0.066
Glen Burnie*	240031003	76 (4)	-	0.076	0.076	0.074	0.076	0.076	0.074
Hagerstown	240430009	74 (1)	-	0.070	0.068	0.068	0.066	0.065	0.065
HU-Beltsville	240330030	78 (1)	-	0.070	0.069	0.069	0.069	0.068	0.068
Padonia	240051007	73 (4)	-	0.073	0.073	0.073	0.072	0.072	0.072
PG Eq Cntr	240338003	-	76 (4)	0.076	0.074	0.073	0.071	0.070	0.070

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Appendix: A

Letter of request to EPA CAMD to flag CASTNET monitors in Maryland.

ED_001361_00013058

Maryland
Department of
the Environment

Larry Hogan
Governor

Boyd Rutherford
Lieutenant Governor

Ben Grumbles
Secretary

May 4, 2017

Timothy Sharac
USEPA Headquarters
William Jefferson Clinton Building
1200 Pennsylvania Avenue, N.W.
Mail Code: 6204M
Washington D.C. 20460

Tim

~~Mr. Sharac~~,

MDE requests placement of RF data flags indicating the influence of Canadian wildfire smoke on air quality be placed on the two CASTNET monitors residing in Maryland. The dates and times at the following sites are as follows:

- Beltsville (240339991):

  May 25, 2016, hour 0 to May 26, 2016, hour 23
  July 21, 2016, hour 0 to July 22, 2016, hour 23

- Blackwater NWR (240199991):

  May 25, 2016, hour 0 to May 26, 2016, hour 23

Per the requirements to pursue data exclusion, the EPA requires flagging of data prior to submitting an exceptional event demonstration package to the EPA. Maryland is finalizing demonstrations showing the impact of two wild fires on the regulatory monitor sites. In May, fires near Fort McMurray, Alberta lofted a smoke plume which impacted ozone concentrations across the entire state of Maryland and much of the northeast US. In July, a large number of fires in aggregate across northwestern Canada lofted a smoke plume which again subsided over the northern Mid-Atlantic. Both instances were tied to ozone exceedances of the 70ppb NAAQS in Maryland. Maryland has determined exclusion of these data points will impact current and future design values and possibly the future attainment status of the state.

Sincerely,

David Krask
Manager, Ambient Air Monitoring Program

1800 Washington Boulevard | Baltimore, MD 21230 | 1-800-633-6101 | 410-537-3000 | TTY Users 1-800-735-2258
www.mde.maryland.gov

Appendix: B

Table 9. Ozone monitors at which MDE recognizes potential impacts on future year designations.
Table description is identical to Table 8.

		2016							
		MD8AO[ppb] (rank)		Fourth High [ppm]			Design Value [ppm]		
SiteName	AQSID	July 21	July 22	Including	Excluding	Excluding May & July	Including	Excluding	Excluding May & July
Beltsville CASTNET	240339991		70 (4)	0.070	0.070	0.069	0.068	0.068	0.068
Rockville	240313001	68 (4)		0.068	0.068	0.068	0.068	0.068	0.068
South Carroll	240130001	70 (5)		0.072	0.072	0.068	0.068	0.068	0.067

These monitors did not exceed 70ppb on July 21 or 22, 2016. However, they observed MD8AO concentrations which were within the fourth highest of the season. Therefore, exclusion of these data points could lower future year DVs since they depend on the fourth highest over three years. Exclusion of these data points, even though they are not above 70ppb could lower these monitor's DV for the next 3 years.

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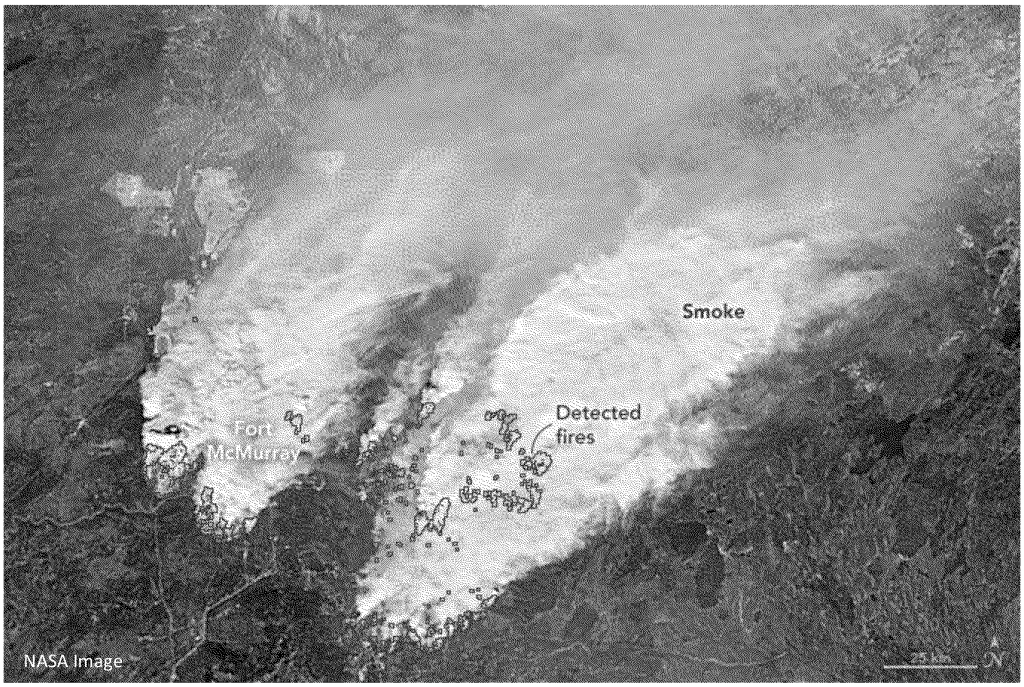
Maryland
Department of
the Environment

Larry Hogan
Governor

Boyd Rutherford
Lieutenant Governor

Ben Grumbles
Secretary

State of Maryland
Exceptional Event Demonstration and Analysis of the May 2016 Fort McMurray, Alberta Canada Wildfire and its Impact on Maryland's Air Quality on May 25 and 26, 2016



ARMA / Ambient Air Monitoring Program
Maryland Department of the Environment
1800 Washington Blvd., Suite 730
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May 26, 2017

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i. Acknowledgements

The Maryland Department of the Environment (MDE) would like to thank the Connecticut Department of Energy and Environmental Protection (CT DEEP), Northeast States for Coordinated Air Use Management (NESCAUM), and EPA regions 1, 2 and 3 for the collaborative effort put forth in an event which impacted a wide area of the eastern United States simultaneously. Special thanks to Michael Geigert (CTDEEP) for his coordination of information and resources.

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1. Overview

1.1. Introduction

A wildfire near Fort McMurray in Alberta, Canada burned out of control through the month of May, 2016. During a particularly intense period of fire growth an expansive and concentrated smoke plume was lofted into the atmosphere and transported several thousand kilometers into the central United States (US). Upon photochemically aging, the wildfire smoke[1] produced widespread ozone across the upper Midwest and Great Lakes of the US and was then transported to the northeastern US. Ozone concentrations exceeded the 2015 70 ppb National Ambient Air Quality Standard (NAAQS) by May 23, 2016 across the central US. By May 25 and 26, 2016 ozone concentrations exceeding 70ppb were widespread across the northeast US and Maryland (Figure 1). In Maryland the maximum daily 8-hour average ozone (MD8AO) concentration reached a peak of 85 ppb with 16 of the 20 Maryland ozone monitors exceeding the 70 ppb standard on one or both days due to the influences of the Fort McMurray wildfire smoke. Those monitors that exceeded the 70ppb standard are highlighted in Table 1. Approximately 73% of the Maryland MD8AO concentrations during the two day event were among the four-highest 8-hour ozone observations of the 2016 season.

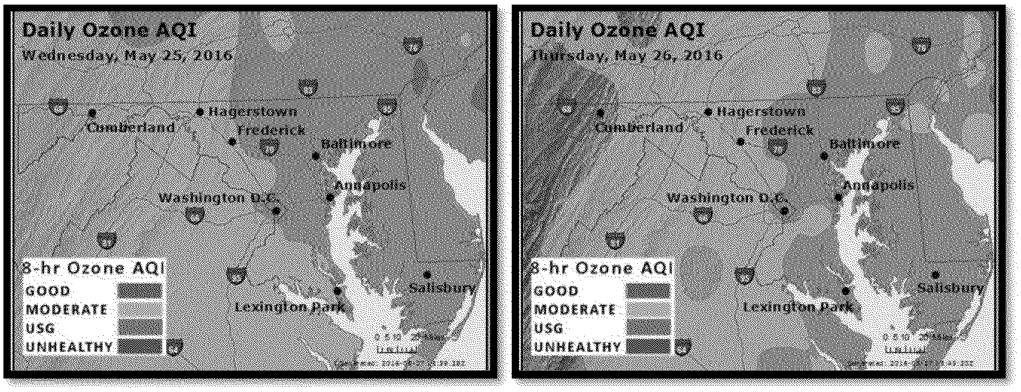

Figure 1. AQI maps from May 25 and 26, 2016.

Following the U.S. Environmental Protection Agency's (EPA) Exceptional Events Rule (Title 40 of the Code of Federal Regulations Part 50.14), the Maryland Department of the Environment (MDE, "The Department") flagged the data as being influenced by a Canadian wildfire and communicated to EPA Maryland's intention of submitting an exceptional event package for ozone on May 25 and 26, 2016. This analysis is to demonstrate that Maryland's 8-hour ozone concentrations that exceeded the 2015 standard meet the requirements for having been influenced by an exceptional event and should therefore be excluded from design value (DV) calculations used to determine Maryland's ozone attainment status.

1.2. Exceptional Events Summary of Approach

The Exceptional Events Rule as defined in 40CFR 50.14 states that an event may be excluded from regulatory use if it had the following characteristics:

---

[1]Smoke from biomass burning contains volatile organic compounds (VOCs) and nitrogen oxides (NOx), which react to form ozone.

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1) There is a clear, causal relationship between the event and the monitored exceedance that affects air quality;

2) The event was of human origins not likely to recur or was natural in origins;

3) The occurrence was not reasonably controllable or preventable.

Table 1. Maximum 8-hour ozone concentrations and ranks on May 25 and 26, 2016 for all Maryland sites. Maryland sites are listed using the common site name and Air Quality System (AQS) identification number (AQSID). Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 ozone season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the 2016 season. The final columns indicate the current fourth high and design value with no exclusion of any data. Sites with an asterisk indicate the site does not have a valid design value in 2016. Monitors exceeding 70ppb during the event are highlighted in orange.

SiteName	AQSID	MD8AO [ppb] (rank)		2016	
		May 25	May 26	Fourth High [ppm]	Design Value [ppm]
Aldino	240259001	77 (3)	79 (2)	0.077	0.073
Beltsville CASTNET	240339991	76 (2)	72 (3)	0.070	0.068
Blackwater NWR CASTNET	240199991	70 (3)	76 (1)	0.068	0.066
Calvert	240090011	70 (4)	75 (1)	0.070	0.069
Edgewood	240251001	79 (4)	80 (2)	0.079	0.073
Essex	240053001	78 (4)	81 (2)	0.078	0.072
Fair Hill	240150003	83 (2)	76 (5)	0.080	0.076
Frederick	240210037	70 (4)	65 (8)	0.070	0.067
Furley	245100054	75 (4)	78 (2)	0.075	0.069
Glen Burnie	240031003	75 (6)	76 (4)	0.076	0.076*
Hagerstown	240430009	68 (5)	61 (18)	0.070	0.066
Horn Point	240190004	71 (2)	77 (1)	0.067	0.064
HU-Beltsville	240330030	74 (2)	74 (2)	0.070	0.069
Millington	240290002	85 (1)	76 (2)	0.072	0.070
Padonia	240051007	74 (3)	84 (1)	0.073	0.072
PG Eq Cntr	240338003	74 (5)	69 (8)	0.076	0.071
Piney Run	240230002	64 (7)	53 (39)	0.066	0.065
Rockville	240313001	69 (2)	67 (6)	0.068	0.068
South Carroll	240130001	72 (4)	75 (2)	0.072	0.068
S. Maryland	240170010	69 (7)	73 (4)	0.073	0.070

Finalized revisions to the Exceptional Events Rule were established by the EPA by October of 2016[2]. The revised rule describes the procedures for treating data which has been influenced by an exceptional event. These were further clarified in an Exceptional Events Guidance Document[3] promulgated about the same time. Accordingly, an exceptional events demonstration must include all the following elements:

---

2 Federal Register / Vol. 81, No. 191 / Monday, October 3, 2016: Treatment of Data Influenced by Exceptional Events

[3]Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016: https://www.epa.gov/sites/production/files/2016-09/documents/exceptional_events_guidance_9-16-16_final.pdf

1) A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);

2) A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;

3) Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times. The Administrator shall not require a State to prove a specific percentile point in the distribution of data;

4) A demonstration that the event was both not reasonably controllable and not reasonably preventable;

5) A demonstration that the event was caused by human activity that is unlikely to recur at a particular location or was a natural event; and

6) Documentation that the submitting air agency followed the public comment process.

Furthermore, 40CFR50.14(b)(4) states that the EPA " … Administrator shall exclude data from use in determinations of exceedances and violations where a State demonstrates to the Administrator's satisfaction that emissions from wildfires caused a specific air pollution concentration in excess of one or more national ambient air quality standard at a particular air quality monitoring location and otherwise satisfies the requirements of this section. Provided the Administrator determines that there is no compelling evidence to the contrary in the record, the Administrator will determine every wildfire occurring predominantly on wildland to have met the requirements identified in paragraph (c)(3)(iv)(D) [item (4) above] of this section regarding the not reasonably controllable or preventable criterion."

The guidance document also recommends following a tiered based approach to the analysis, providing evidence of "Key Factors" in each tier. Following the elements suggested in the Exceptional Events Guidance Document[3] as outlined above, MDE contends and demonstrates here-in that the transported wildfire smoke had a direct role in amplifying ozone concentrations to a level which would not have been possible in the absence of smoke constituents and satisfies the three core exceptional event criterion. Based on recommendations from the EPA and the Guidance Document, Maryland used a Tier 3, weight of evidence approach for this analysis. MDE addresses each of the necessary elements cited previously in the subsequent sections of this document. EPA guidance offers suggestions for appropriate analyses to demonstrate the clear causal relationship between the wildfire and excessive ozone levels. In addition, EPA recognizes that appropriate levels of analysis will vary for particular locations and conditions. EPA does not intend for the guidance to constrain the analysis. MDE includes some of the suggested analytics and variations on those methods to support our conclusion that the high ozone concentrations throughout Maryland were caused or worsened by the wildfire smoke plume from the Fort McMurray fire in May of 2016.

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1.3. Regulatory Significance of the Exclusion

1.3.1. May 2016 Exclusion Request

There are 20 ozone monitors in the state of Maryland (Figure 2) covering three different Metropolitan Statistical Areas (MSAs). MDE operates 18 of these regulatory ozone monitors while the EPA Clean Air Status and Trends Network (CASTNET) program operates the additional two monitors. On May 25 and 26, 2016 13 and 15 monitors, respectfully, exceeded the 70ppb ozone NAAQS across the state of Maryland and meet the criteria for further analysis and potential exclusion if given concurrence by the EPA that an exceptional event occurred, according to criteria listed in 40 CFR 50.14(a)(1)(i). MDE asks for exclusion of all the MD8AO observations above 70 ppb on May 25 and 26, 2016 as listed on Table 2. While MDE does not operate the CASTNET monitors, MDE requested the CASTNET monitor data be flagged by the Clean Air Markets Division (CAMD) of EPA (Appendix A), who responded by flagging the data for exclusion in this demonstration. Therefore Maryland asks for exclusion of 28 MD8AO observations between May 25 and 26, 2016 which exceeded 70 ppb at the following 16 monitors: Aldino (240259001), Calvert (240090011), Edgewood (240251001), Essex (240053001), Fair Hill (240150003), Furley (245100054), Glen Burnie (240031003), Horn Point (240190004), HU-Beltsville (240330030), Millington (240290002), Padonia (240051007), PG Eq Cntr (240338003), South Carroll (240130001), S. Maryland (240170010), and the two CASTNET sites – Beltsville (240339991) and Blackwater NWR (240199991). MDE requests that these observed ozone data on May 25 and 26, 2016 at these monitors as listed in Table 2 be flagged as impacted by an exceptional event and be excluded from regulatory use.

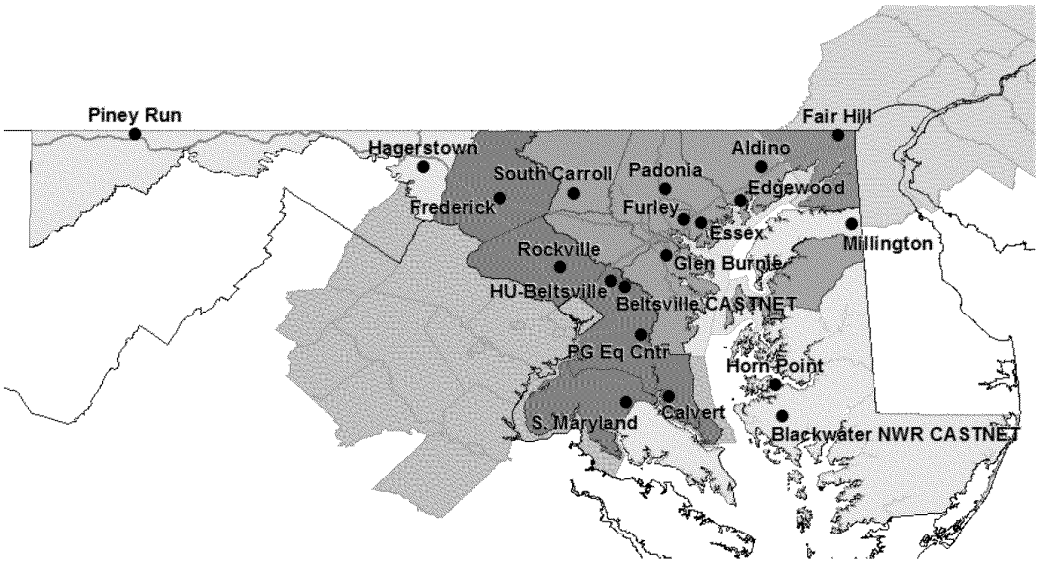

Figure 2. The Maryland ozone air quality monitoring network as of May 25, 2016. Black dots indicate the location of ozone monitors. Metropolitan Statistical Areas (MSAs) for Baltimore-Towson (Blue), Washington-Arlington-Alexandria (Green) and Philadelphia (Orange – Non-Attainment Area) show that Maryland monitors include three policy relevant areas and several states; all areas of which are above the new 70ppb standard. The Philadelphia MSA is in non-attainment of the old 2008 75ppb standard. The rest of Maryland is colored in light cyan. The blue lines show major interstates. Gray lines are county political boundaries. Other lines are state borders .

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Table 2. Ozone monitors at which MDE is seeking EPA data exclusion concurrence.
Local names and Air Quality System (AQS) identification numbers (AQSID) identify monitors in the text. Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the season. The final columns indicate the 2016 fourth high and design value with no exclusion of data (Including) and if the requested data from May 25 and 26 are excluded from fourth high and design value calculations (Excluding). Sites with an asterisk indicate the site does not have a valid design value in 2016. Cells showing "-" are MD8AO at sites which did not exceed 70ppb and therefore cannot seek exclusion.

		2016					
		MD8AO [ppb] (rank)		Fourth High [ppm]		Design Value [ppm]	
SiteName	AQSID	May 25	May 26	Including	Excluding	Including	Excluding
Aldino	240259001	77 (3)	79 (2)	0.077	0.076	0.073	0.073
Beltsville CASTNET	240339991	76 (2)	72 (3)	0.070	0.070	0.068	0.068
Blackwater NWR CASTNET	240199991	-	76 (1)	0.068	0.068	0.066	0.066
Calvert	240090011	-	75 (1)	0.070	0.069	0.069	0.068
Edgewood	240251001	79 (4)	80 (2)	0.079	0.079	0.073	0.073
Essex	240053001	78 (4)	81 (2)	0.078	0.077	0.072	0.072
Fair Hill	240150003	83 (2)	76 (5)	0.080	0.076	0.076	0.074
Furley	245100054	75 (4)	78 (2)	0.075	0.068	0.069	0.066
Glen Burnie*	240031003	75 (6)	76 (4)	0.076	0.076	0.076	0.076
Horn Point	240190004	71 (2)	77 (1)	0.067	0.067	0.064	0.064
HU-Beltsville	240330030	74 (2)	74 (2)	0.070	0.069	0.069	0.068
Millington	240290002	85 (1)	76 (2)	0.072	0.069	0.070	0.069
Padonia	240051007	74 (3)	84 (1)	0.073	0.073	0.072	0.072
PG Eq Cntr	240338003	74 (5)	-	0.076	0.076	0.071	0.071
South Carroll	240130001	72 (4)	75 (2)	0.072	0.068	0.068	0.067
S. Maryland	240170010	-	73 (4)	0.073	0.073	0.070	0.070

1.3.2. Design Value and Fourth High Impacts

Exclusion of the MD8AO concentrations on May 25 and 26, 2016 lowers the DV at several monitors in Maryland. The EPA designates an area's attainment status of the NAAQS via the DV metric. For 8-hour ozone, each monitor's annual fourth-highest daily 8-hour maximum concentration averaged over the past three years designates the attainment status for that particular area. Ozone concentrations on May 25 and 26 were within the fourth-highest 8-hour average observations of 2016 at eighteen monitors (Table 1). Excluding the May 25 and May 26 MD8AO at the 16 requested monitors (Table 2) would reduce six (6) monitors' DV, including the Fair Hill monitor (240150003), which would drop below the 2008 75 ppb NAAQS level (from 76 to 74 ppb). Details of specific site DVs with and without exceptional event status along with changes in the fourth highest MD8AO concentrations for the 2016 season are provided in Table 2 for all 16 Maryland monitors that MDE is requesting exceptional event status. While no additional monitors would be classified as attainment of the 2015 70 ppb standard, reduction of these sites' DV would potentially be used

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to demonstrate compliance through 2018. While MDE acknowledges the EPA's interpretation of 40 CFR 50.14(a)(1)(i), MDE also recognizes the importance of the fourth highest value in a given year potentially determining future year DVs. While not currently requesting sites based solely on these fourth high values, those monitors which observed one of their fourth highest ozone concentrations during the two day event but did not exceed the 70ppb standard are listed in Appendix B.

Excluding the ozone concentrations associated with the May event will impact not only DVs in 2016, but also 2017 and 2018, particularly considering another wildfire smoke plume impacting Maryland in July (MDE will present this exceptional event in another demonstration). Excluding all the requested MD8AO concentrations associated with the May event will reduce six monitor's DVs immediately in 2016. In addition, it will reduce a total of eight monitors' 2016 fourth high MD8AO and have future implications in 2017 and 2018. For example, an EPA concurrence of the May exceptional event at Aldino (240259001) changes its fourth high from 0.077 to 0.076ppm, but does not reduce Aldino's 2016 DV. However, if the July exceptional event demonstration receives EPA concurrence at Aldino, the fourth high is reduced an additional 0.02 ppm and the 2016 DV drops 0.01 ppm to 0.075 ppm. If May does not receive EPA concurrence, there is no ramification at the Aldino site if only July receives concurrence.

1.3.3. NAAQS Attainment Considerations

EPA concurrence of the requested MD8AO observations on May 25 and 26, 2016 in Maryland will bring the Fair Hill monitor (240150003, Philadelphia Non-Attainment Area (NAA)) into attainment of the 2008 ozone standard. At this time only the Fair Hill monitor would be re-classified as attainment of the 2008 NAAQS should EPA concur with Maryland's May exceptional event demonstration. However, the Fair Hill monitor is part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE NAA and EPA would need to concur with the Exceptional Event demonstration submitted by Pennsylvania Department of Environmental Protection (PA DEP) for the NAA to be found attaining the 2008 ozone NAAQS. It is therefore uncertain if the Philadelphia NAA will achieve attainment of the 75 ppb standard even if EPA concurs with MDE's demonstration. The EPA evaluation of the May exceptional event in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE NAA would potentially affect its designation status, which is due later in 2017. In any case the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE area would still be classified as non-attainment of the 2015 ozone NAAQS. All other Maryland monitors are attaining the 2008 standard currently; no monitor's attainment status of the 2015 70 ppb standard will change. However, depending on future year ozone concentrations, this demonstration may significantly impact Maryland's attainment status in regards to the 2015 ozone NAAQS.

The Baltimore, Maryland area needs to demonstrate continued attainment of the 2008 ozone standard by 2018. This continued attainment of the 2008 ozone standard might only occur if EPA concurs with this exceptional event demonstration for May 25 and26, 2016. In addition, if EPA does not concur with this exceptional event determination the Baltimore area designation might change as a result.

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1.4. Summary of Findings

This report demonstrates that:

- There was a clear causal relationship between the smoke and the MD8AO exceedances;
- The wildfire causing smoke was considered a natural event;
- The smoke events in question were not reasonably preventable and are unlikely to recur;

Key findings and evidence supporting these assertions include the following:

- Copious ozone was generated upstream of Maryland due to the presence of wildfire smoke then transported into the state.
- Ozone higher than historical norms within an environment of historically low anthropogenic precursors.
- A Q/d analysis which does not meet EPA thresholds for clear causal influence but is consistent with other previous long range smoke and ozone transport events from Canada to Maryland.
- Fine Particle ($PM_{2.5}$), Carbon Monoxide and Nitrogen Oxides (NOx) were elevated during the event, which are consistent with a wildfire smoke plume.
- $PM_{2.5}$ speciated data showed elevated wildfire attributable concentrations.
- Satellites captured a visual smoke plume transported to the northeastern US which was also associated with satellite retrieved CO, both which tracked from the Fort McMurray area.
- Similar day analysis showed similar days in previous years did not yield as much ozone.
- Photochemical modeling during the event showed a significant under prediction due to the absence of gaseous wildfire emissions within the ozone chemistry of the model.

Several analysis methods were used to develop a weight of evidence demonstration that the 8-hour ozone concentrations above 70 ppb in the May 2016 event meet the rules for data exclusion as an Exceptional Event. In summary, satellite, meteorological data, trajectory analysis, emissions data, speciated $PM_{2.5}$ data, and numerical air quality model comparisons were used to assess whether conditions were favorable for transport of smoke from the Fort McMurray Canadian wildfires to monitors that showed 8-hour ozone concentrations above 70 ppb. The data also showed that the transported smoke degraded air quality northwest (upstream) of Maryland first, then this photochemically aging airmass was transported eastward, creating a prolonged period (May 21-28) of enhanced ozone from the Mississippi River eastward to the east coast, including Maryland.

Substantial changes in chemistry in the eastern United States due to regional NOx emissions reductions have occurred over the last decade. The following analysis puts the 8-hour ozone concentrations in Maryland during this ozone event in the context of these reductions and in comparison to ozone in previous months of May. Comparison of emissions during late May of 2016 show Electric Generating Unit (EGU) NOx emissions were lower than any other year on record during the smoke event. Yet, ozone concentrations in May of 2016 exceeded ozone concentrations in earlier years during similar meteorology and under heavier anthropogenic precursor emissions. Analysis of the airmass associated with the Maryland ozone exceedances on May 25 and 26, 2016 revealed a composition characteristic of wildfires with an abundance of ozone precursors despite substantial reductions in anthropogenic sources.

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MDE's analysis strongly supports that all monitors, regardless of MD8AO concentration, were impacted by smoke, that all the MD8AO concentrations above 70ppb in Maryland from May 25 and 26, 2016 meet the rules as an Exceptional Event, and the 16 monitors and 28 MD8AO observations in Table 2 should be excluded from DV calculations. The following documentation justifies these claims and is outlined as follows: Section 2 contains a conceptual model overview of the event including a synopsis of the meteorological and air quality conditions, emissions, transport and characteristics defining the event. Section 3 demonstrates a clear causal relationship between the exceedance via a tiered, weight of evidence approach. Section 4 demonstrates that this event fulfills the definition of a natural event that is unlikely to recur while Section 5 fulfills the requirements that demonstrate the event was not reasonably controllable or preventable. Section 6 documents the public comment process while section 7 summarize and concludes the analysis.

2. Conceptual Model and Overview of the May 21-28, 2016 Smoke and Ozone Event

2.1. Maryland Area Description

As part of the Clean Air Act (CAA), both local and state air quality agencies are required to maintain and operate ambient air quality monitoring networks. MDE complies with all EPA regulations defined in 40 CFR Part 58 and maintains a dense network of in situ and remote sensing pollution sampling platforms in Maryland. Surface monitors used for regulatory purposes include 20 ozone monitors as of May 25, 2016 (Figure 2) (including two EPA CASTNET sites, (EPA, 1997)), nine hourly fine particle ($PM_{2.5}$) Beta Attenuation Monitors (BAMs) with additional regional coverage of ozone and $PM_{2.5}$ hourly observations locations in Washington D.C. (DC) and northern Virginia, as well as various $PM_{2.5}$ Federal Reference Method (FRM) filter speciations, VOC canisters and three 915 MHz radar wind profilers (RWP; Ryan, 2004; MDE, 2015) in Maryland. A full description of the various instrumentation used by MDE is available in the MDE Network Plan (MDE Ambient Air Monitoring Plan, 2017).

The dense MDE network exists to account for a densely populated area of the United States between DC and Baltimore. The distribution of ozone monitors across the state favors the I-95 corridor (blue line running southwest to northeast from DC to just south of the Fair Hill ozone monitor on Figure 2), which stretches across the central part of the state from DC to along the northern portion of the Chesapeake Bay. Approximately 9,000,000 people reside along the I-95 corridor (including DC and northern Virginia) as of 2012. Statewide, Maryland's population was estimated to be 6,000,000 as of 2016 by the US Census Bureau. The state of Maryland also has diverse geography, with mountains greater than 2,000 ft to the west and coastal plains near sea level to the east that border the Chesapeake Bay and Atlantic Ocean. Outside of urban areas, Maryland is characterized by a mix of farmland to the east and mainly deciduous forests in the mountains to the west. The dynamic interplay between the dense population and diverse geography, particularly biogenic emissions, lee side subsidence by the mountains, and land/water interaction gives

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Maryland distinct and variable air quality issues, which previously gave the Baltimore, Maryland area the distinction of having the highest reading ozone monitor (Edgewood; 240251001) along the US East Coast.

2.2. Characteristics of Typical, Non-Event Ozone Formation

Over the past two decades MDE has contracted with universities in and around Maryland to conduct thorough research of air quality in Maryland. In particular this collaboration has focused on the origin of ozone in Maryland. This research was done utilizing balloon-borne ozonesondes and airplane flights to capture vertical profiles of atmospheric composition. Computer modeling based on these observations further enhanced our understanding of the origin of ozone in Maryland. The understanding garnered from years of vertical and surface ozone measurements indicated a significant fraction of ozone and ozone precursors observed in Maryland were due to transport by winds from upstream states into Maryland which mixed with and compounded local emissions issues. Major legislation resulting from conclusions of this research resulted in robust changes in the air composition in the eastern United States over the past 10 years. Full details of this ongoing collaboration may be found on the RAMMPP[4] webpage. The following describes the current understanding of ozone formation in Maryland.

In the absence of a-typical airmass composition (e.g. exceptional events, smoke plumes), ozone formation in Maryland occurs primarily due to the photolization of volatile organic compounds (VOCs) and a combination of regional and locally sourced anthropogenic NOx in the presence of sunlight. The combination of high density population (pollution sources) and topography often focuses these reactions in well-defined areas that have historically created ozone issues east and northeast of DC and Baltimore. The main sources of anthropogenic emissions contributing to these issues are stationary point sources such as EGUs, mobile sources (cars, trucks, boats, locomotives and non-road equipment), and area sources that include industrial processes and consumer products. The urban pollution plumes that develop along the I-95 corridor between DC and Baltimore (mobile, industrial, area) and surrounding point sources (EGUs) constitute the overwhelming percentage of locally sourced NOx which contributes to Maryland ozone formation. These emissions alone regularly fall short of producing ozone capable of MD8AO concentrations above 70 ppb in Maryland. Photochemical modeling supports the assertion that exclusive of light winds and recirculation which build up the local emissions, Maryland EGU and mobile emissions are not great enough to support ozone exceedances. However, Maryland is also at the "tail pipe" end of the EGU rich Ohio River Valley (ORV) where a high density of large EGU point sources create a regional NOx plume upstream that transports NOx and/or ozone in to Maryland. The majority of Maryland exceedances historically have been associated with such transport. Thus the amount of ozone and ozone precursors (typically NOx) within the residual layer (layer of air immediately above the surface, typically around 500-2000m above ground level) transported into Maryland adds to and raises local Maryland ozone concentrations to and above NAAQS thresholds. Without significant transport, Maryland no longer observes wide spread or frequent ozone exceedances of the NAAQS.

In the past four years, Maryland has had few cases of pollutant transport comparable to historical (pre-2013) norms. In these recent years (2013-2016), the amount of ozone/precursors within the residual layer

[4] Regional Atmospheric Measurement Modeling and Prediction Program (RAMMPP): http://www.atmos.umd.edu/~rammpp/

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has declined to the lowest levels ever recorded, leading to a reduction of maximum ozone concentration on any one day in Maryland and thus a decrease in the number of ozone exceedance days. This has caused local effects (meteorology, emissions) which previously were overwhelmed by regional signals to become more prominent, but overall has made exceedances isolated spatially and infrequent in occurrence at all NAAQS levels (Figure 3). Point source NOx emissions from states upstream of and including Maryland (Maryland, DC, Virginia, West Virginia, Pennsylvania, Ohio, Indiana – "Total NOx" in Figure 3) have dropped to record low levels each of the last three consecutive years. Said simply, EGU NOx emissions as a whole in 2016 were the lowest ever in states upstream of and including Maryland for the ozone season as a whole and for each month through the season, representing a total regional anthropogenic NOx decrease of nearly 50% in the past six years (Figure 4). Despite increasing vehicular traffic and vehicle miles traveled, NOx from mobile sources also has decreased over the same period, though the magnitude decrease is dwarfed by the EGU NOx decrease. However, even while mobile NOx has decreased less than EGU NOx, current Maryland mobile emissions, even with added local EGU emissions, are incapable of all but isolated, infrequent ozone exceedance days in Maryland on their own.

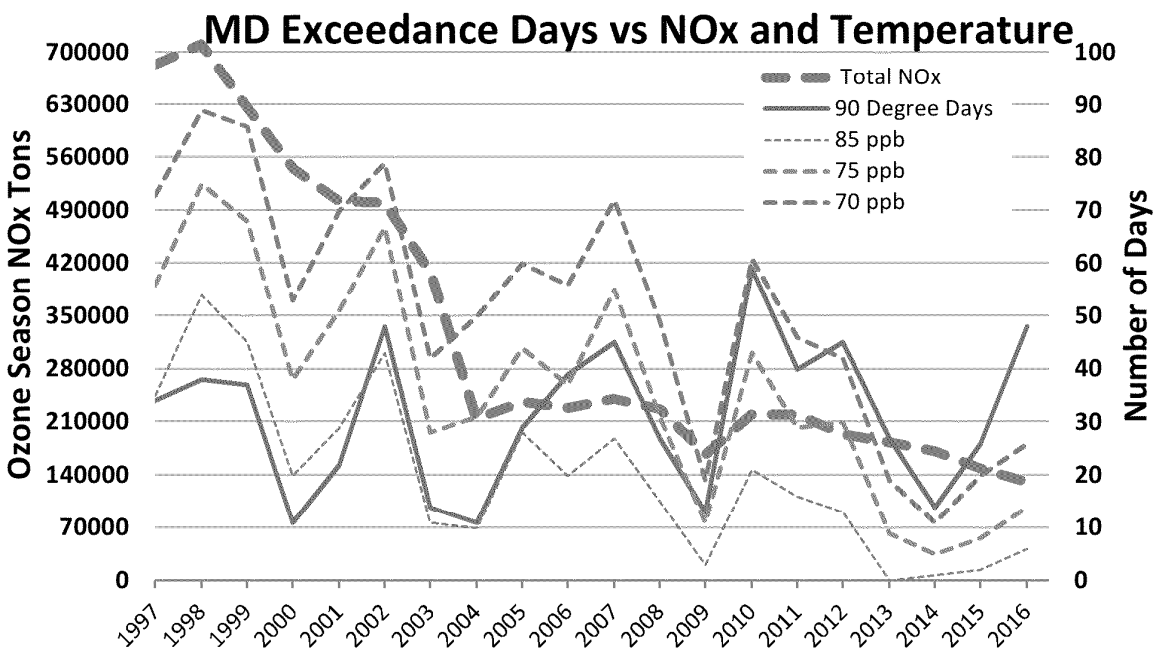

Figure 3. Total Ozone Season EGU NOx from Maryland and upwind states, number of days at or above 90°F at Baltimore-Washington Airport (90 DD) and exceedance days at various standards.

2.2.1. Emissions Trends

The Clean Air Markets Database (CAMD) records NOx output from EGU point sources across the country. In the typical, non-exceptional event model of a Maryland ozone exceedance day described above, transport of NOx into the state was primarily from upwind EGU point sources which vertically mixed ozone or ozone precursors (NOx) downward the next day to produce high concentrations of ozone which added to local

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emissions. Significant and sustained reductions in NOx across the eastern US have occurred in the past 10-15 years (Figure 3). Aggregate NOx emissions from upstream areas are only 25% of their pre-2003 amounts in 2016, a reduction of approximately 75%. Aggregate monthly total NOx emissions in the 2016 ozone season (May - September) were the lowest ever observed from upwind states, which included Indiana, Ohio, West Virginia, Virginia, Pennsylvania, and the District of Columbia (also including Maryland), as shown in Figure 4. These states represent an area which contributes to the amount of ozone or ozone precursors transported into Maryland under typical summer conditions where the Bermuda High moves over the southeastern US. The month of May, 2016 observed roughly half the NOx emissions from these areas compared to 2010 and 2011.

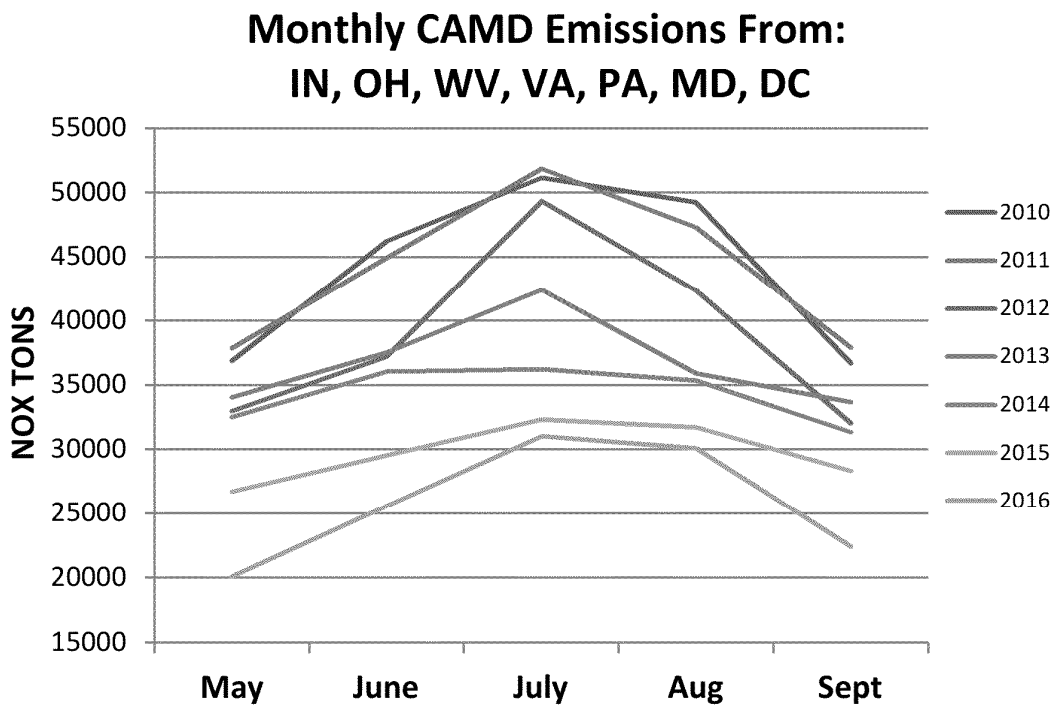

Figure 4. Monthly NOx emissions aggregated from the group of upwind states, in cluding Maryland, by month of ozone season.

Daily emissions for the same states reflect the same reductions. Daily aggregate NOx emissions of Indiana, Ohio, West Virginia, Virginia, Pennsylvania Maryland and the District of Columbia for only the month of May from 2010 – 2016 pulled from CAMD showed emissions during May 2016 were the lowest ever (blue line, Figure 5). Generally there is also a downward trend, most notable in 2015 and 2016. There is a noted increase in emissions toward the final 10 days of the month each year when many EGUs come online for the summer season. Even still, the late May increase in NOx emissions in 2016 was the lowest daily late May emissions in the record. Even with these record low emissions in May of 2016, Maryland recorded two consecutive days of near-record high ozone in the state for the month of May (red outlined bars, Figure 5) and had two consecutive days of the greatest number of monitors exceeding 70 pbb since 2010 (black bars, Figure 5) on May 25 and 26, 2016.

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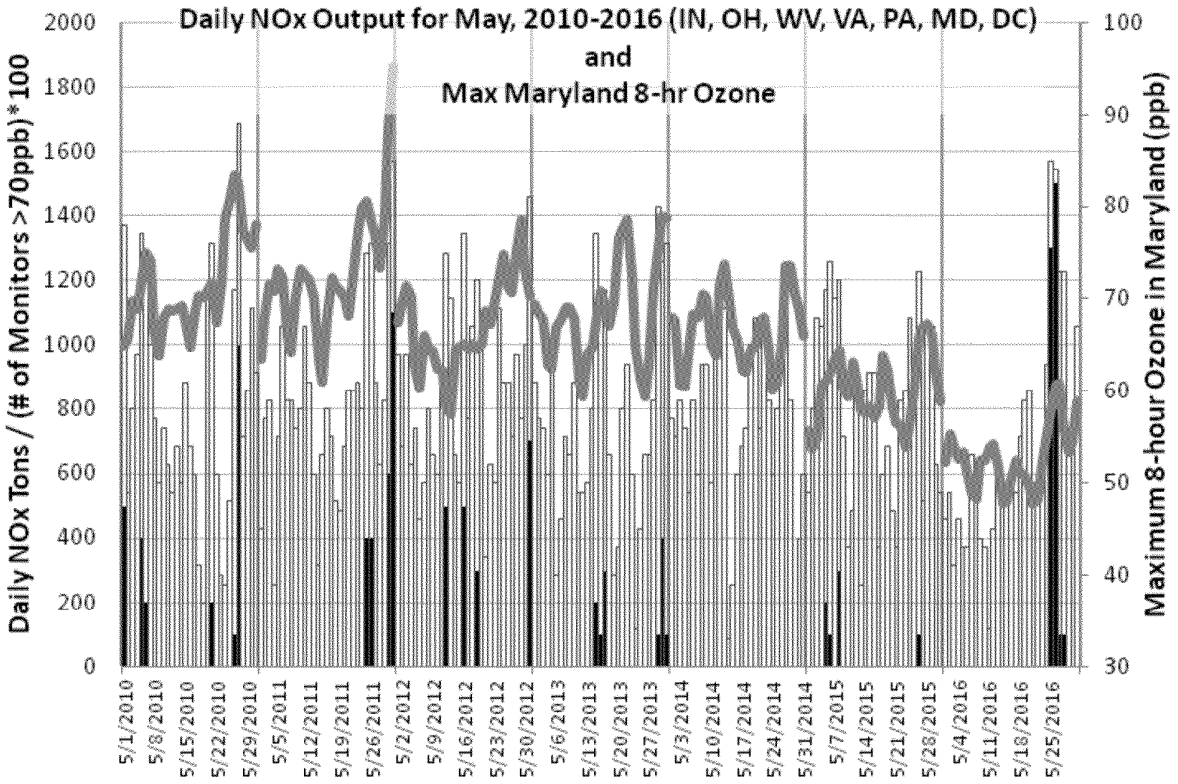

Figure 5. Daily aggregate NOx, maximum Maryland ozone, and monitors exceeding 70ppb in May, 2010-2016. Aggregate NOx emissions from EGU point sources for states upwind of Maryland (Indiana, Ohio, Pennsylvania, West Virginia, Virginia, DC and Maryland) from the CAMD database for 2010 – 2016 are shown with a thick blue line. The maximum 8-hour average ozone at any monitors in Maryland for each day in May 2010-2016 (red hollow bars) and the number of monitors exceeding 70ppb in Maryland (black bars x 100) is also shown. Number of exceeding monitors is multiplied by 100 for scale purposes. A downward trend in emissions is noticeable from 2014-2016. An increase in NOx emissions towards the end of the month each year is apparent but the 2016 increase is the smallest increase in the CAMD record. Each year/month is divided by a solid vertical line.

2.2.2. Ozone Production in Maryland

Research has found ozone production in Maryland to be a complicated mix of VOCs and NOx and that the atmospheric stoichiometry (the balance of concentrations necessary to produce bi-products like ozone) can change on a daily basis. Previously the balance of either precursor group was insignificant to their absolute measure in the atmosphere; both precursors were always in abundant supply for ozone exceedances and were simply dependent on weather. For example, the variability in exceedances in Figure 3 at 70ppb is strongly correlated (R^2 = 0.51) to the number of 90°F days from 1997 to 2015. However, adding just 2016, one of the hottest years of the past three decades, decreases this correlation (1997-2016: R^2 = 0.40). Maryland now exists in the NOx limited regime due to regional NOx reductions. The stoichiometry of the ozone production is no longer balanced and daily ozone production is instead based on the daily availability

of either of these precursor groups and/or the amount of ozone already formed upstream which is transported into the state. As a secondary consequence, hot temperatures are no longer a reliable predictor of daily ozone exceedances of the NAAQS.

Ozone production is controlled by the relative availability of NOx, VOCs, with ample heat and sunlight. VOCs relevant to ozone production in Maryland are both naturally occurring and anthropogenic. A significant but lesser decrease in anthropogenic VOCs was observed concurrent with NOx reductions. However, daily ozone production due to biogenic (naturally occurring) VOCs cannot be regulated and remain important to ozone production chemistry in Maryland. Isoprene, for example, a naturally occurring VOC, has the highest maximum incremental reactivity (i.e., easily makes more ozone) of VOCs tested in Maryland and is the highest VOC contributor on high ozone days. Isoprene is released by the biosphere (i.e., trees) due to environmental stresses such as heat. NOx output also increases from stationary sources on warm summer days in response to increased energy demand. Mobile emissions are not dependent on temperature and are relatively constant between workdays; Mobile emissions' impact on ozone generally decreases on the weekend. At the same time that relative NOx output increases, biogenic VOCs are released into the local environment, and, in the presence of sunlight and heat, create local ozone. When ozone and ozone precursors transported into the state combine with these local emissions, Maryland observes MD8AO above 70ppb and exhibits its fundamental non-event ozone exceedance. In this NOx limited regime, without additional transported ozone or ozone precursors, Maryland's local emissions are insufficient to produce ozone exceedance days.

2.2.3. Weather Patterns Leading to Ozone Formation

Summertime meteorology is variable in Maryland. Occasional April ozone exceedance days are possible, but most of the ozone exceedance days occur primarily from May through September. The intra-seasonal variations of weather that occur through the ozone season therefore result in various meteorological patterns conducive to ozone formation. In no specific order, the generic patterns are lee-side troughing (where downward air motions in the lee of the Appalachian Mountains induces an area of pollutant convergence along I-95 [parallel to the mountains]), airmass/ozone/pre-cursor transport, and local recirculation and stagnation (to include reverse [from the northeast] I-95 corridor flow). Ozone production in each pattern depends on ozone conducive local weather conditions (i.e., warm, sunny conditions with light to moderate surface winds). The location of the Bermuda high ultimately determines which, if any, of these scenarios develops. Average summer conditions place the Bermuda High off the southeast Atlantic coast of the US, which gives Maryland westerly (south-southwest to north-northwest depending on height) transport of upstream air. Lee-troughing is dependent on weak (<15 kts) cross-mountain flow around 850mb creating compressional heating/column stretching in the lee of the mountains. This induces a "trough" of lower pressure which often aligns with the I-95 corridor. Convergence along the trough increases ozone concentrations there. Both transport and lee troughing patterns may occur simultaneously or independently of each other. Assuming at least some downward mixing of transported ozone, lee-troughing may lead to an ozone exceedance day. Recirculation and stagnation over several days can also cause local pollution concentrations to increase to levels exceeding the NAAQS. All three of these patterns

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are most probable during the summer months of June through August which, historically, were the climatological maximum for ozone production in Maryland. Shoulder seasons (Spring and Fall) typically are not warm enough and have active weather patterns preventing local or regional emissions from building. Winter is too cold for ozone exceedances and Maryland's Appalachian peaks are too low for Stratospheric ozone intrusion that could lead to an ozone exceedance day.

Differential heating at the land and water interface recirculates local and transported pollution near coastal areas via a thermally driven solenoidal circulation. Such circulations are believed to be the cause of high ozone DVs northeast of Baltimore. With increasing temperatures, super-regional NOx output increases from upstream EGUs in locations such as the ORV and western Pennsylvania, increasing residual layer concentrations of ozone and ozone precursors. These mix downwards at later times, combining with local sources, contributing to Maryland's ozone exceedances. This downward mixing is enhanced by the solenoidal circulation of the Chesapeake Bay Breeze (BB). Then lower mixing heights over the water "overcook" the precursors, creating greater concentrations over the Bay than nearby land sites. As a result, coastal sites achieve greater ozone concentrations as both regional and local emissions are concentrated by the land/water meteorology. It is no coincidence that the area of peak ozone in Maryland during a typical non-event ozone exceedance is northeast of Baltimore where local I-95 corridor emissions (the urban plume) are enhanced by transported regional pollution concentrated by land-water meteorology dynamics.

2.3. Exceptional Event Description: May 2016 Fort McMurray Wildfire

Abnormally warm and dry conditions across central Canada in late spring of 2016 promoted wildfire conditions in the provinces of Alberta and Saskatchewan. On May 1, 2016 a wildfire was spotted 15 km southwest of Fort McMurray, Alberta. A Provincial State of Emergency was declared and in the next few days the fire consumed 10% of the town of Fort McMurray, forced the evacuation of 80,000+ residents and came to be known as "The Beast." The fire was still burning out of control through mid-June before it was no longer expected to grow and was not fully extinguished until July 2016 though smoldering continued for many additional months. The cause of the fire is under investigation, but human activity is suspected[5]. Over 2,000 firefighters battled this and other wildfires across the province of Alberta. By May 19, 2016, the fire was estimated to have burned 505,645 hectares (1.25 million acres), was burning out of control and experienced a significant increase in size in just 48 hours. Firefighters from South Africa, the United States, and Canada assisted local teams battling the blaze. By June 10, 2016 589,995 hectares (1.46 million acres) had burned and approximately 2500 firefighters had battled various blazes across the province[6]. Amid "The Beast" at Fort McMurray, Alberta, which was spreading eastward in to Saskatchewan, dozens of additional fires were analyzed by the NOAA Daily Hazard Mapping System (HMS) smoke analyses (McNamara, et al., 2004) in southern Saskatchewan and the north central US by May 17 and 18 (Figure 6). Fires and associated smoke plumes analyzed by HMS were derived from the GOES Imager, the POES AVHRR, MODIS satellites and expert subjective analysis. Additionally, a large number of fires were ongoing across Mexico in mid-late May with a large concentration located in the Yucatan Peninsula (Figure 6). All fires across southern Canada and Mexico were dwarfed by the size of the Fort McMurray fire. While the collection of smaller fires still produced noticeable amounts of smoke which may have had some contribution to the plume which moved

[5] http://www.cbc.ca/news/canada/edmonton/fort-mcmurray-wildfire-cause-investigation-rcmp-1.3635241

[6]

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into the northeast US on May 25 and 26, their fractional impact has been ignored in this demonstration. The analysis for the remaining demonstration will focus on the emissions from the Fort McMurray fire alone, which was extremely large, long-lasting, and produced a prolific smoke plume (Figure 7) that was created from a burn area larger than the US state of Rhode Island (Figure 8). News outlets reported impacts from the fire in New England and all the way to Spain.

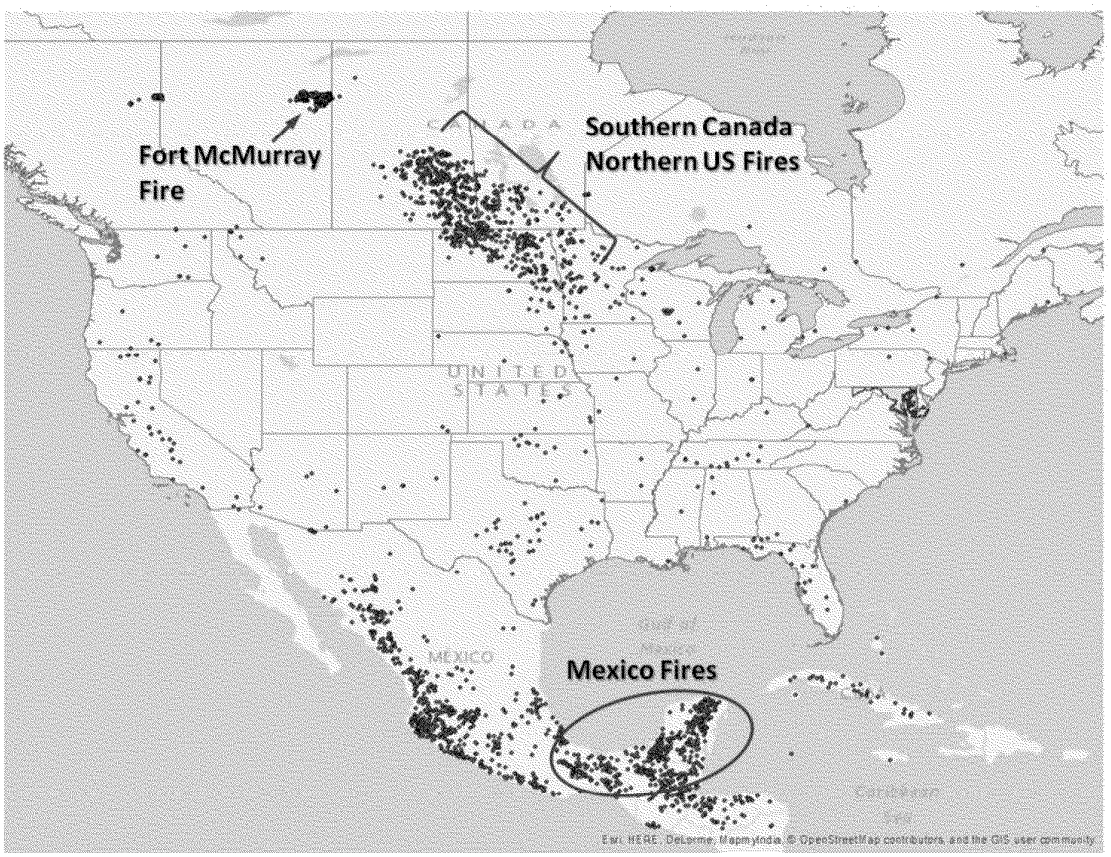

Figure 6. Hazard Mapping System (HMS) analyzed fires, May 17-20, 2016
Fires analyzed by HMS derived from the GOES Imager, the POES AVHRR, MODIS satellites and expert subjective analysis between May 17 and May 20. The Fort McMurray fire, southern Canada and Mexican fires referenced in the text are labeled accordingly. Maryland has been colored emphasize its location compared to the fire sources.

Figure 7. Fort McMurray Fire.
Image showing the immense, thick and elevated smoke plume from the fires near Fort McMurray.
http://globalnews.ca/news/2685123/in-photos-the-fort-mcmurray-fire-that-displaced-80000-people/ [Source: Scott Olson/Getty Images; globalnews.ca]

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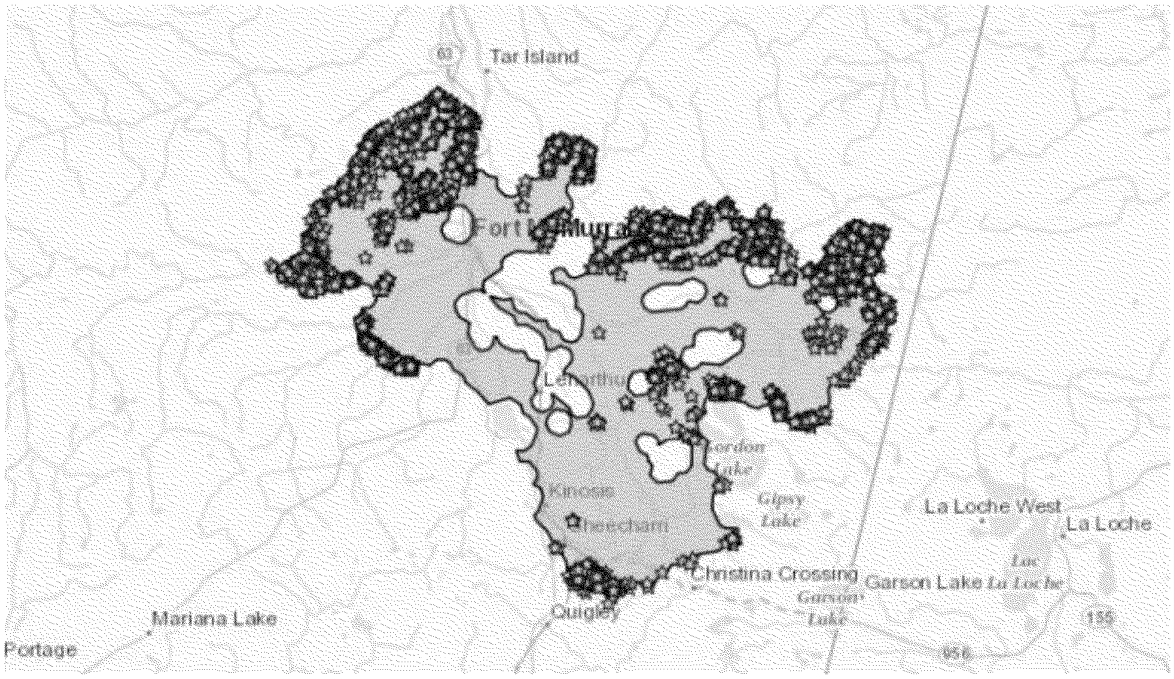

Figure 8. Fort McMurray fire extent as of May 17, 2016.
The size of the area in gray is larger than the size of state of Rhode Island. [Natural Resources Canada]

2.4. Conceptual Model of Ozone Formation from May 2016 Fort McMurray Fire

2.4.1. Overview and Literature Review

Wildfires are known sources of emissions responsible for both primary and secondary pollutants including CO, $PM_{2.5}$, NOx, VOCs, as well as ozone (Andreae and Merlet, 2001; McKeen et al., 2002; Bytnerowicz, et al., 2010). Similar to the study presented here, Canadian wildfires have increased ozone concentrations in Houston, TX (Morris et al., 2006) and as far away as Europe (Spichtinger et al., 2001). Evidence of Canadian wildfire smoke and biomass burning affecting the Mid-Atlantic's particulate matter (PM) air quality was also previously reported (Adam et al., 2004; Colarco et al., 2004; Sapkota et al., 2005) but wildfire smoke has also been recognized in high-ozone events on the east coast (Fiore et al., 2014). DeBell et al., (2004) presented a chemical characterization of the July 2002 Quebec wildfire smoke plume and its impact on atmospheric chemistry in the northeastern US. Most recently, Dreessen et. al., (2016) presented a case where a Saskatchewan, Canada wildfire smoke plume amplified ozone in Maryland in June of 2015, similar to the May 2016 case presented here. While relatively infrequent in the Mid-Atlantic, wildfire smoke has been an increasing fractional contribution to high-ozone exceedance days, particularly in light of increased fire frequency in a warming climate (Flannigan and Wagner, 1991; Marlon et al., 2009; Westerling et al., 2006; Spracklen et al., 2009; Pechony and Shindell, 2010), decreasing regional NOx emissions (Gégo, et al., 2007) and tighter ozone NAAQS (http://www3.epa.gov/ozonepollution/actions.html).

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2.4.2. Ozone Generation from the Fire

Dreessen et. al. (2016) previously showed that smoke plumes from Central Canada are capable of transporting ozone to the Mid-Atlantic and causing NAAQS exceedances, even in the contemporaneously low NOx emission environment. As in the June 2015 ozone case covered in Dreessen et al., (2016), the May 2016 ozone event across the northeast US was characterized by a smoke plume associated with ozone concentrations increasing as the smoke plume aged. The ozone was transported into Maryland after being produced in a modified airmass upstream of Maryland.

In the 2015 case study examined by Dreessen et al. (2016), it was hypothesized that once the smoke-sourced VOC-rich plume interacted with anthropogenic NOx sources that copious ozone production began, which was capable of being transported long distances as either ozone or within ozone reservoir species. Dreessen et al. (2016) also acknowledged NOx contribution from the fire itself was possible, though focused on the plume's interaction with anthropogenic sources. In that 2015 study, smoke subsided across the eastern Midwest and northern Mid-Atlantic and took over 24 hours of aging before ozone above 70ppb was widespread across the region. This delay in ozone production while the airmass aged is consistent with previous studies such as Putero et al. (2014) which observed the largest increases in ozone from fires five days (120 hours) after the initial pollutants were emitted from the fire (Figure 9). This observation was also consistent with the behavior of the smoke plume in the May 2016 case. While sufficient amounts of NOx and VOCs were generated by the Fort McMurrary fire in early and mid-May of 2016 for ozone production, as the plume aged and mixed with anthropogenic NOx (albeit the lowest NOx on record) across the Midwest and Great Lakes of the US, ozone concentrations were augmented to and above levels exceeding the NAAQS not possible without the smoke.

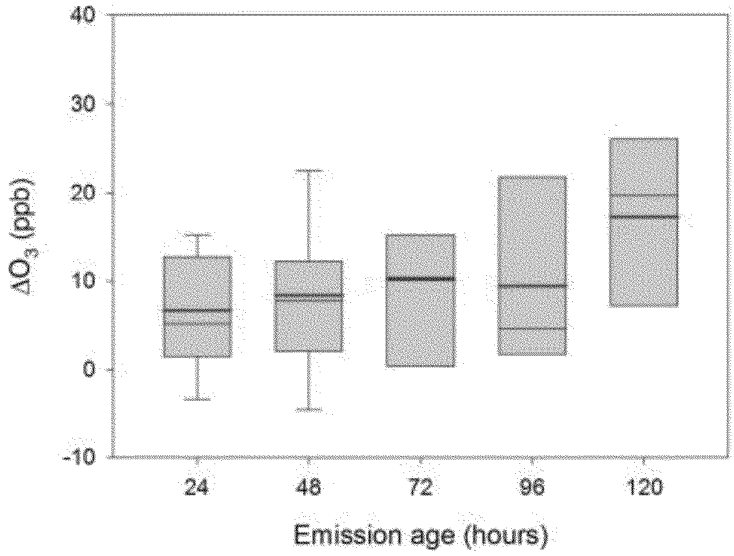

Figure 9. Ozone enhancement with smoke plume age.
(from Putero et al. (2014), Figure 7)

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The main smoke plume and ozone precursors of interest connected to Maryland's ozone exceedances on May 25 and 26, 2016 dispersed southward into the northern plains and Midwest of the US beginning on May 20-21. Across these areas, which were upstream of Maryland, daily ozone concentrations increased with the temperature, creating a photochemically aged and modified (dirty) airmass. The main smoke influence on ozone concentrations in Maryland was accomplished within this photochemically aged airmass upstream, which was then transported in to the state. Ozone was elevated across Maryland beginning on May 24 as the modified airmass transport began when winds turned to the northwest, though exceedances of the NAAQS associated with the smoky airmass did not occur until May 25 and 26. Thus, high ozone concentrations were transported into Maryland which, while similar in nature to, were not associated with a non-event-type transport pattern. The path, residency and meteorological setup of the smoke plume indicate a dispersing smoke plume conducive to ozone transported from Canada, subsiding through the upper Midwest and Great Lakes, then moving into the northern Mid-Atlantic and Northeast states of the US. An additional ozone exceedance at one monitor on May 27 and May 28 were also arguably attributable to lingering smoke influences, but the May 25 and 26 exceedances were undoubtedly influenced by smoke and unequivocally exceptional.

While ozone exceedance days in Maryland are not unusual during the month of May, the magnitude and spatial scale of these particular exceedance days were beyond contemporary norms. Meteorological conditions and emissions on May 23 – May 26, 2016 (when the majority of ozone exceedances occurred) were not sufficient to cause the large spatial scale and multi-day exceedance event without additional wildfire-related ozone precursor emissions. Historical comparisons during the month of May show ozone concentrations and the number of monitors exceeding the standard at these magnitudes are rare (reference Figure 5), and are even rarer considering massive emissions reductions evident during that time period across the entire eastern US. Thus, it is unlikely such a widespread area exceeding the standard would have occurred without additional supportive atmospheric chemistry provided by the wildfire smoke.

2.4.3. Meteorological Conditions Driving Smoke and Ozone Transport

2.4.3.1. Conceptual Model Overview

An amplified atmospheric pattern developed across the continental United States (CONUS) characterized by a digging trough along the Northwest US Coast which reinforced a central CONUS ridge of high pressure building northward in to the central plains of Canada from May 18-26, 2016 (Figure 10, #1 & 2). Ahead of the high amplitude west coast trough, a low amplitude upper-level weather disturbance moved across the interior CONUS on May 20-21. This disturbance and associated weak surface low developed from the lee of the Colorado Rockies to the lower Mississippi River Valley by the morning of May 20 and moved eastward, taking clouds and associated precipitation to the east coast by May 21. There the weak upper level shortwave intensified, closed-off, and became stationary, not progressing northeastward until May 24 and providing a three day period of unsettled or cloudy weather in Maryland and a trough-ridge-trough pattern in the upper levels across the CONUS (Figure 10, #3). The overall morphology of the atmosphere created an expansive surface high pressure area across the Midwest and Great Lakes of the US. At the same time, winds above the surface supported transport of the Fort McMurray smoke plume into these same areas

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(Figure 10, #4). The subsidence (sinking motion) associated with surface the high pressure (the physical characteristic which gives high pressure systems sunny skies) brought the transported smoke towards the surface over the Midwest and Great Lakes. There the smoky airmass aged over several days. When the east coast disturbance moved northeast by May 24, west and northwest winds across the northeastern US transported the aged airmass into Maryland and other states across the northeast US leading to the aforementioned ozone exceedances on May 25 and 26, 2016 (Figure 10, #5).

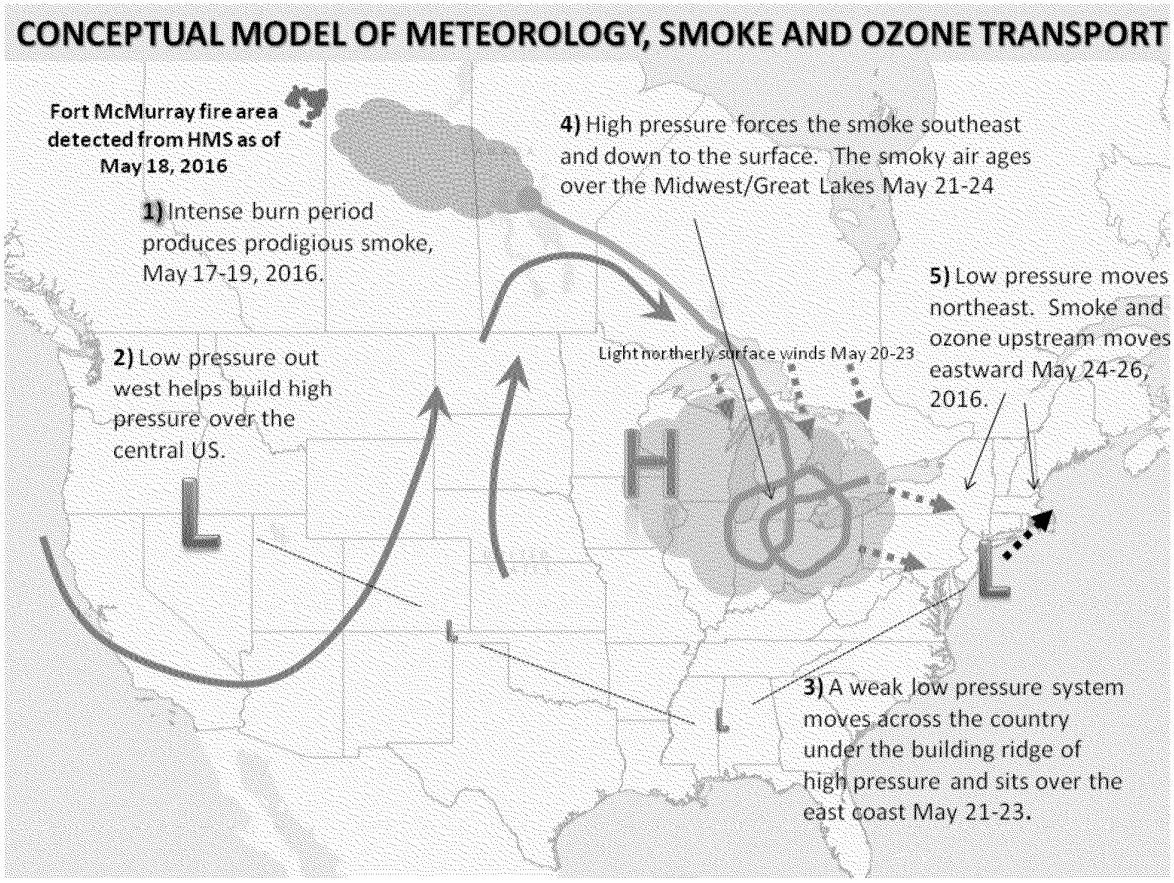

Figure 10. A simplified, illustrated, conceptual model of the May 25 and 26, 2016 wildfire influenced ozone event.

2.4.3.2. Upper Level Pattern Overview

The 850mb level (approximately 1500m above sea level) sits near the top of the planetary boundary layer, the atmospheric layer in which ozone pertinent to surface observations and human health develops. The 850mb height level can serve as a guide for the transport of pollutants. The morphology of this atmospheric level is given for May 21-26 in Figures 11-13. Initially the ridge of high pressure ("H" in the figures) was located over Minnesota and Wisconsin (Figure 11a). This allowed transport from southern Canada into the upper Midwest and Great Lakes region as the aloft winds at 850mb rotated clockwise around the ridge and

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turned southward. Ridges of high pressure are associated with subsidence (sinking vertical motions) that brings air towards the surface. Air which resides or subsides under the ridge tends to remain under the ridge since near-surface winds under the ridge are generally weak. This leads to airmass persistence beneath the ridge, which occurred over the upper Midwest at this time. Over Maryland at the same time, an area of low pressure deepened (intensified) once it reached the coast on May 22 (Figure 11b). This brought clouds and unsettled weather, along with easterly turning to north-northeasterly airmass transport, all of which was unfavorable for ozone production, through May 23.

The transport pattern remained relatively persistent on May 23 as it had on May 21 and 22 (Figure 12a) but began to break down and become transitory (changing) by May 24 (Figure 12b). The ridge of high pressure over the Midwest and Great Lakes slowly moved eastward to reside over the Illinois, Indiana, Michigan and Ohio region by May 23. There, the airmass remained stuck beneath the ridge of high pressure. Over Maryland, the coastal low persisted, keeping Maryland in unsettled (cloudy, periods of rain) weather with clean northeasterly flow. On May 24 (Figure 12b) the coastal low began to lift northeastward. This changed the transport winds in Maryland from north and northeasterly to northwesterly which started to transport the smoky, modified airmass residing across the Midwest/Great Lakes into Maryland and the Mid Atlantic.

Transport winds across the northeastern CONUS were west and northwesterly on May 25 (Figure 13a). The airmass which started to move eastward on May 24 was now fully transported to the east coast on May 25 while the ridge of high pressure flattened (de-amplified/weakened) and moved eastward. As the ridge of high pressure continued to weaken and move east, it essentially phased with the Bermuda High (a semi-permanent high pressure area off the southeast coast of North America in the summer). As the ridge of high pressure and Bermuda High phased and the previous coastal low continued its trek northeast, the transport winds turned to the southwest across Maryland (Figure 13b). These winds began to remove the airmass that had settled across the area on May 25. However, the smoke was not removed before an additional exceedance on May 26.

2.4.3.3. Surface Pattern Overview

While transport winds provide information on the transport of airmasses and weather systems, surface conditions and features dictate whether an airmass may be capable of ozone production. The surface layer (ground level) is also the layer where ozone monitors and humans reside making the layer paramount to understanding ozone morphology. A broad area of low pressure resided over the Mid-Atlantic states beginning on May 21 (Figure 14a) bringing unsettled weather to that area. At the same time, high pressure across the upper Mississippi River Valley brought fair weather to those areas. Light northerly winds from southern Canada were pushing in to the Great Lakes region (east of the High pressure center; red arrows). A weak cold front was also pushing south across this same area. Air behind cold fronts is characterized by subsidence (sinking motion) which is consistent with the features (high pressure) seen at 850mb (Figure 11a). By May 22 (Figure 14b), the cold front had lost its temperature gradient identity (removing it from the analysis over the Great Lakes in Figure 14b), though northerly winds and associated subsidence continued across the upper Midwest and Great Lakes while light surface winds existed across Iowa, Illinois, and

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Missouri under the center of high pressure. Maryland continued to receive northerly winds and cloudy, cooler conditions on May 22.

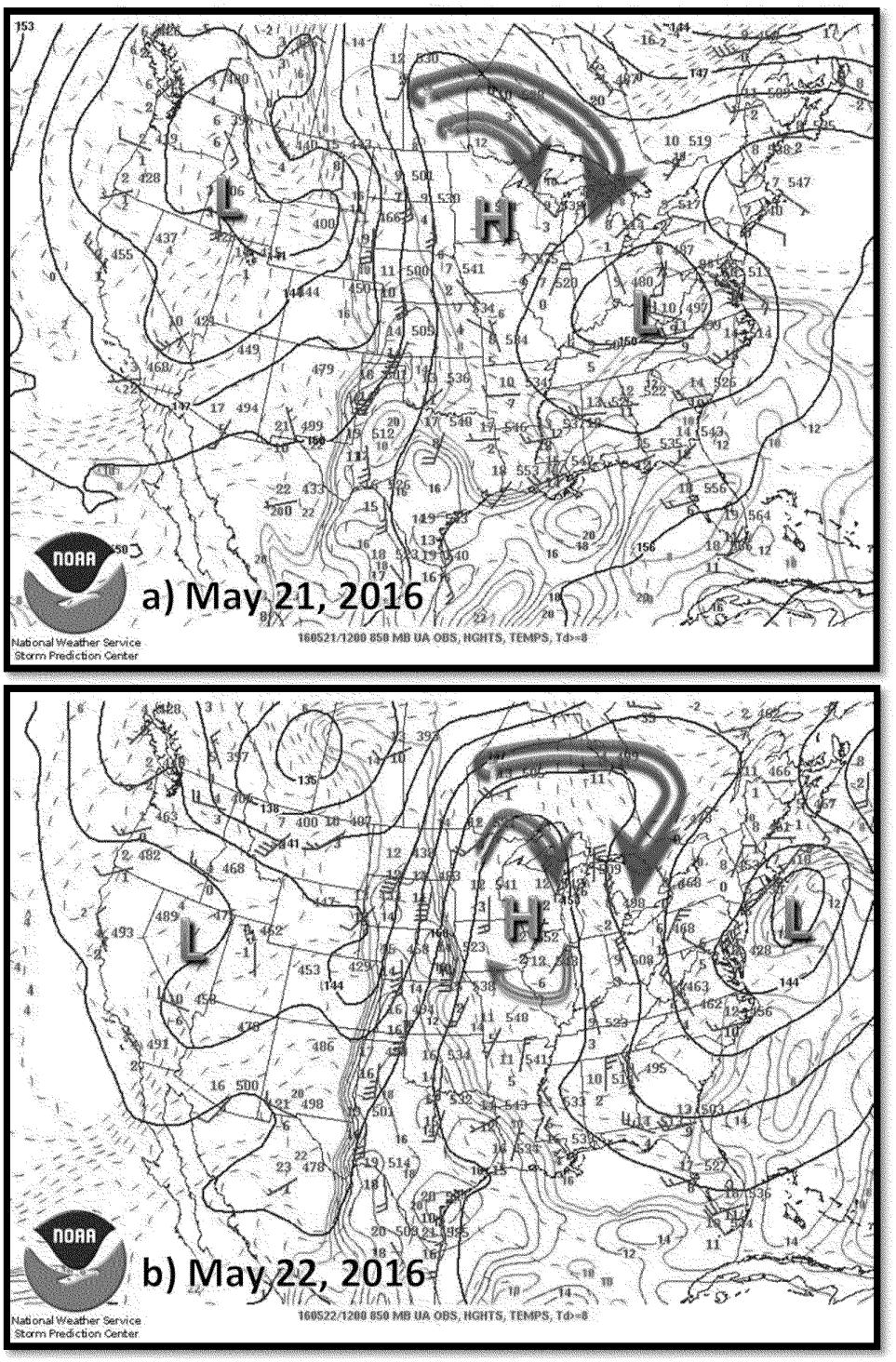

Figure 11. The 1200UTC 850mb pattern for the CONUS on a) May 21 and b) May 22, 2016.
Red arrows show the general transport pattern. Big letter "H" is high pressure , letter "L" is low pressure. Heights (black lines), temperatures (dashed red lines), dewpoint (green lines), and winds (blue barbs) are also analyzed. An omega-like pattern is apparent on May 22.

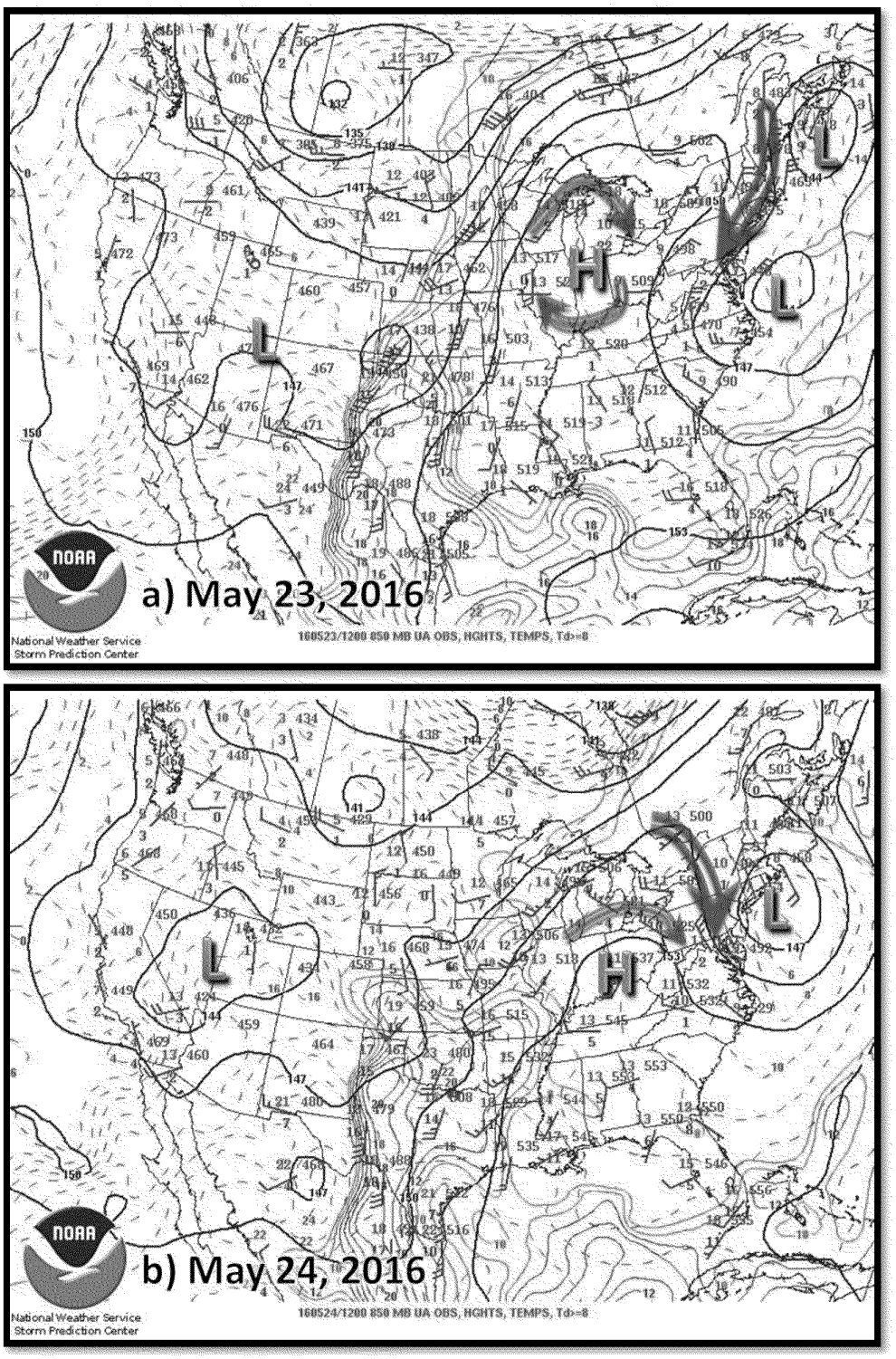

Figure 12. As in Figure 11, but for a) May 23 and b) May 24.

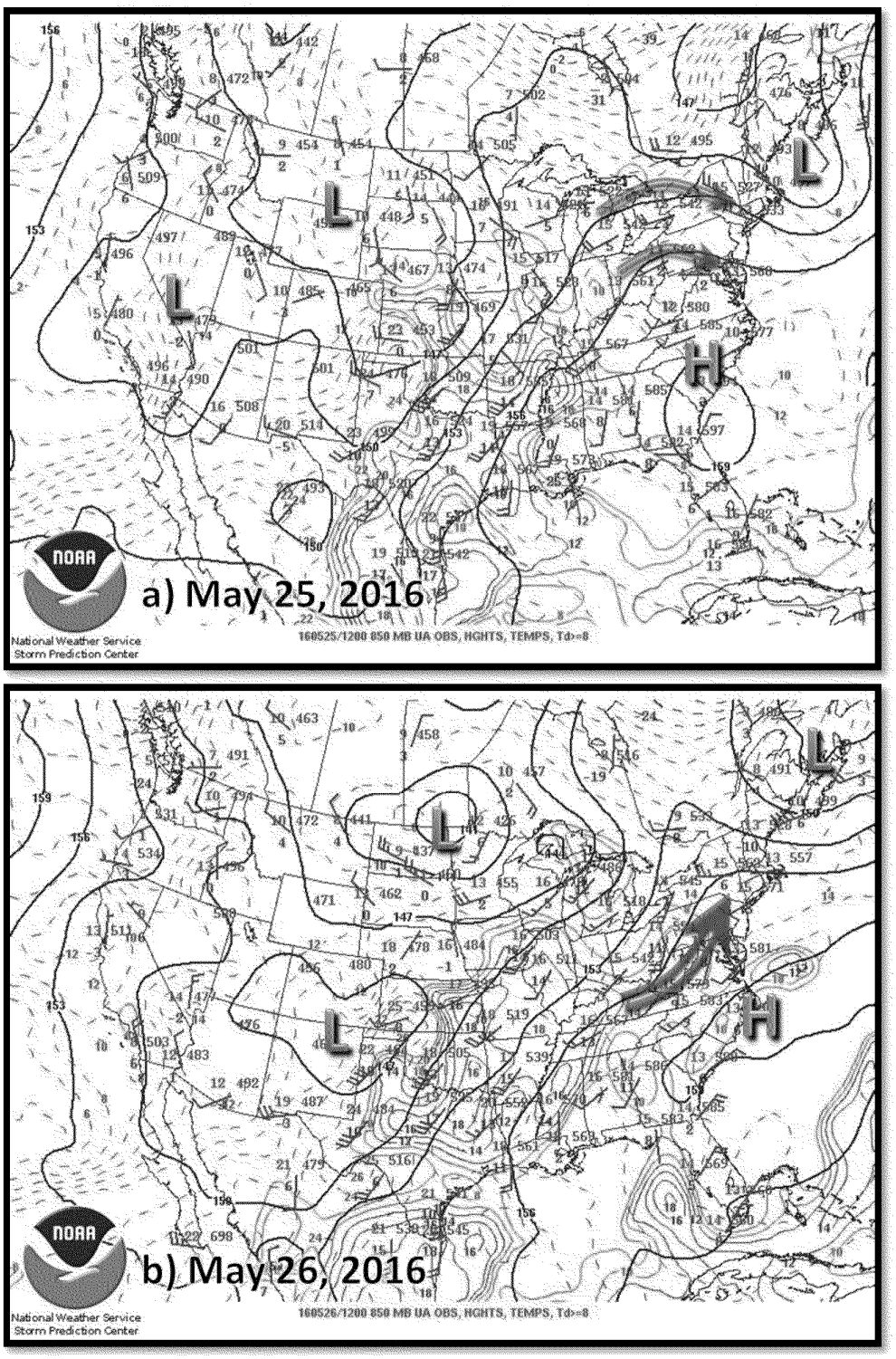

Figure 13.. As in Figure 11, but for a) May 25 and b) May 26.

By May 23, the center of high pressure over the Midwest slid eastward over Indiana and Ohio, while low pressure off the east coast continued to provide Maryland with unsettled and cooler conditions with northerly winds (Figure 15a). Light winds continued to characterize the surface conditions underneath the high pressure in the Midwest, with the airmass lingering and aging over these area. On May 24, the surface analysis showed the coastal low beginning to depart northeastward and that by 1800UTC (2pm EDT) on May 24 the surface winds in Maryland were turning to the northwest (Figure 15b). Consistent with the transport at 850mb (Figure 13a), the surface winds were beginning to move the airmass which was settled across the Midwest and Great Lakes eastward on May 24.

West and northwesterly winds at the surface continued on May 25 across the entire northeastern CONUS. This occurred as the area of surface high pressure began to "open up" and phase with the Bermuda high to the southeast while the coastal low continued to move northeast over Maine (Figure 16a). Maryland at this point was analyzed under the remaining weak surface high pressure, though it still received light west and northwesterly winds. By May 26 high pressure was centered southeast of Maryland off the coast of the US (i.e., the Bermuda High was now the dominant high pressure feature at the surface). This evolution turned the surface winds to the southwest across Maryland by May 26 (Figure 16b).

2.4.3.4. Temperature

Temperatures were above normal for the duration of the ozone exceedance event, however, above normal warmth in May is not necessarily ozone conducive nor do temperatures warmer than normal any longer mean ozone exceedances are likely. Similar to the observations of Dreessen et al. (2016), the smoke did not produce excessive ozone in May of 2016 until the smoky airmass warmed enough for ozone reactions to take place. The warmer temperatures in mid to late May 2016 were due to broad subsidence (which also mixes smoke downwards towards the surface) and warm air advection beneath the central CONUS ridge. The high temperature in Minneapolis, MN on May 21 was 9 °F warmer than normal, though only 80 °F (Table 3). At the height of the exceedance event in Indiana, the Indianapolis, Indiana airport high temperature climbed from 57 °F on May 17 to 82 °F on May 24 as the ridge of high pressure moved overhead. While 7 °F warmer than average, 82 °F is not particularly conducive to ozone formation without additional airmass support (proper photochemistry). Note that Indianapolis had an ozone exceedance with a modest surface temperature of only 78 °F on May 23. Detroit, MI at its ozone exceedance onset on May 23, had similar ozone production at an even cooler high temperature of 76 °F. Thus ozone production was intense despite low temperatures before reaching Maryland. On the days of the ozone exceedance in Maryland, maximum temperatures were 10 and 13 °F above average (Table 3). This general warming trend (i.e., temperatures incrementally greater than average as the airmass moved east) from west to east airmass indicated the airmass was modifying; polluted air is able to retain more heat.

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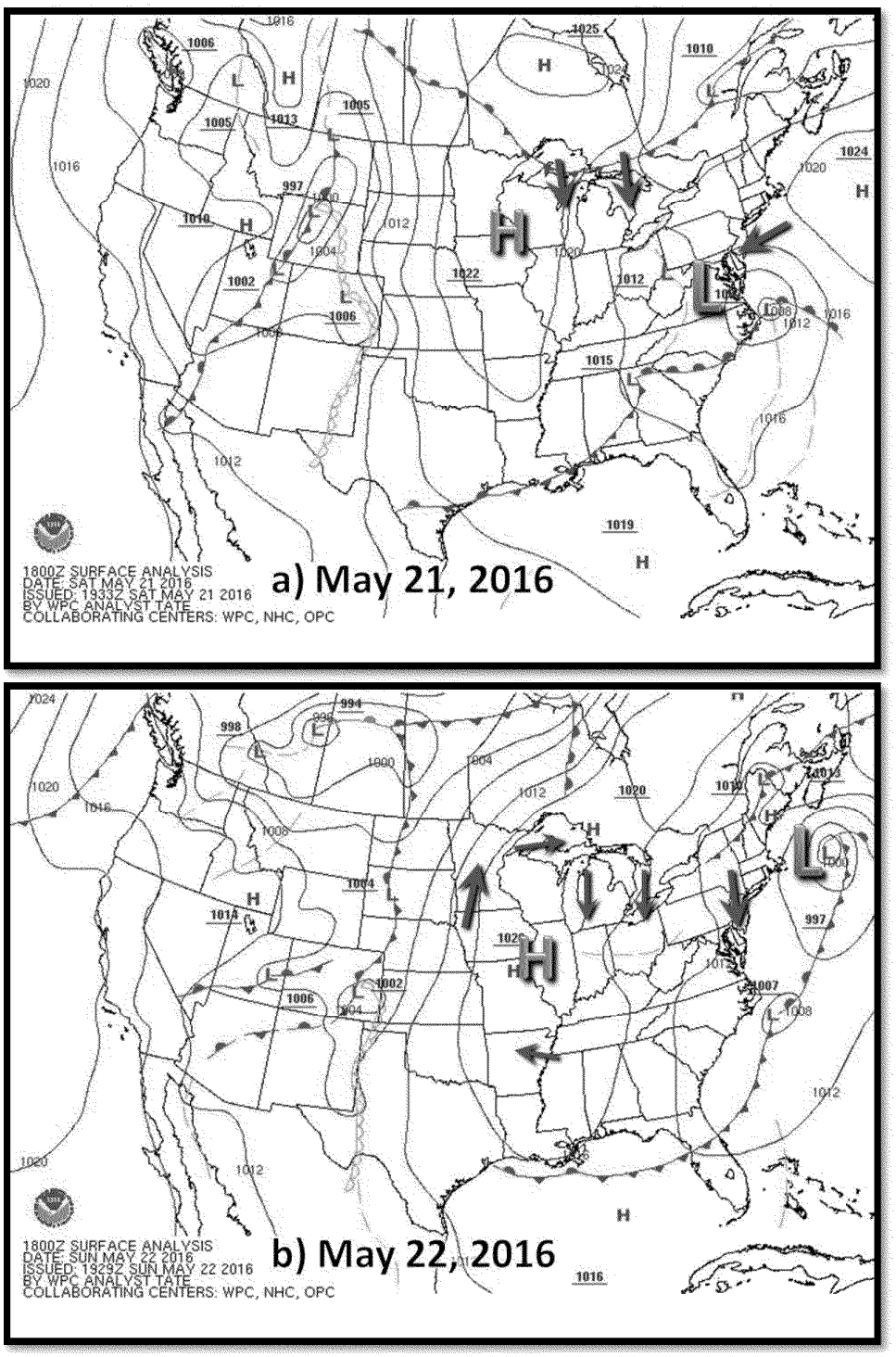

Figure 14. Surface analysis at 1800 UTC for a) May 21 and b) May 22, 2016.
Red arrows show the general pattern of surface winds. Big letter "H" is high pressure, letter "L" is low pressure. Isobars (brown lines) and fronts are also analyzed.

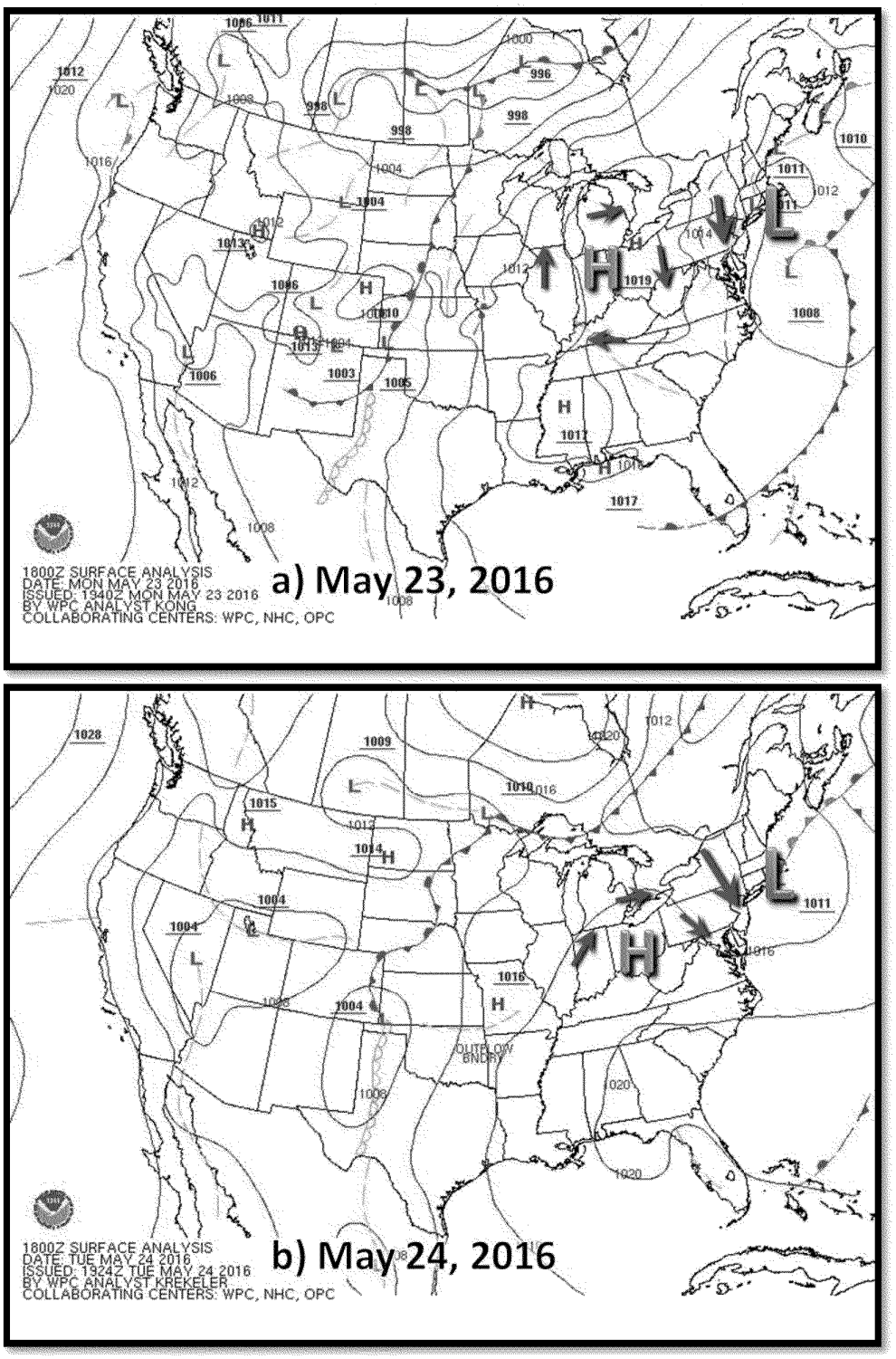

Figure 15. As in Figure 14, but for a) May 23 and b) May 24.

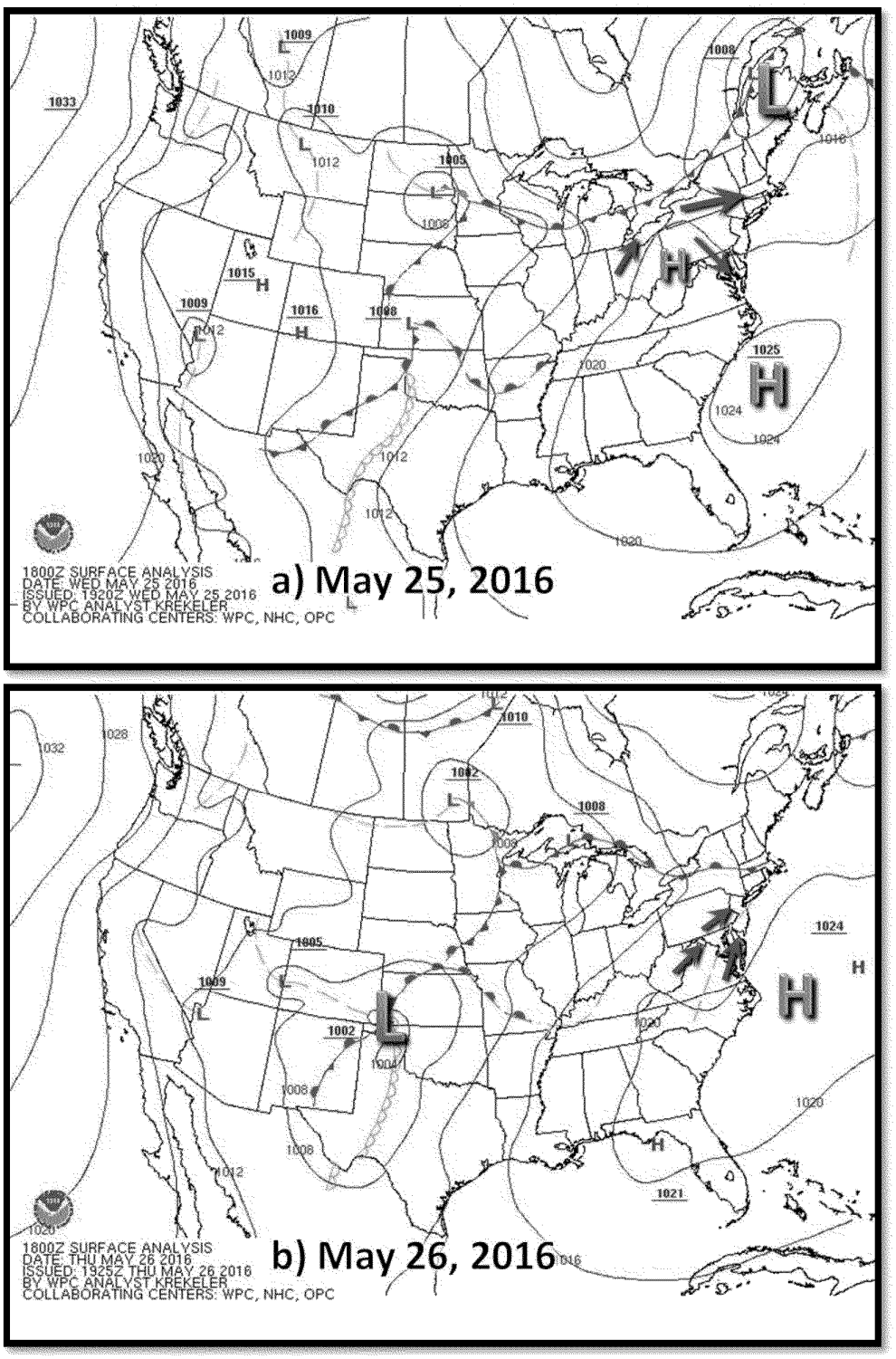

Figure 16. As in Figure 14, but for a) May 25 and b) May 26.

Table 3. Maximum daily temperature, average maximum daily temperature and depart ure from average.
Maximum daily temperature, average maximum daily temperature and departure from average (observation minus average) for various sites across the domain impacted by the smoke are provided for May 20 – May 28, 2016. All temperatures are in degrees Fahrenheit. Colored boxes show maximum daily 8-hour average ozone AQI at locations where nearby sites had ozone exceedances of 70ppb. The Columbus, OH area did not exceed during the event. However, other cities in Ohio (Cleveland, Cincinnati) did exceed on both May 24 and 25. Columbus was on the ed ge of the smoke plume both days; HMS never analyzed smoke over Columbus from May 23-28.

Date	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May
Minneapolis, MN (°F)	76	80	84	84	86	76	81	70	68
Normal (°F)	71	71	71	71	72	72	72	73	73
Departure (°F)	5	9	13	13	14	4	9	-3	-5
Indianapolis, IN (°F)	68	73	81	78	82	84	77	85	83
Normal (°F)	74	74	75	75	75	76	76	76	76
Departure (°F)	-6	-1	6	3	7	8	1	9	7
Columbus, OH (°F)	72	60	72	76	80	80	80	88	86
Normal (°F)	74	74	75	75	75	75	76	76	76
Departure (°F)	-2	-14	-3	1	5	5	4	12	10
Detroit, MI (°F)	71	73	73	76	85	86	86	82	89
Normal (°F)	71	71	72	72	72	73	73	73	74
Departure (°F)	0	2	1	4	13	13	13	9	15
Rochester, NY (°F)	73	69	71	78	83	86	85	88	91
Normal (°F)	69	69	70	70	70	70	71	71	71
Departure (°F)	4	0	1	8	13	16	14	17	20
BWI, MD (°F)	75	62	60	75	82	86	90	90	88
Normal (°F)	75	75	76	76	76	76	77	77	77
Departure (°F)	0	-13	-16	-1	6	10	13	13	11
Meriden, CT (°F)	76	69	75	82	68	88	88	87	90
Normal (°F)	71	71	71	72	72	72	72	73	73
Departure (°F)	5	-2	4	10	-4	16	16	14	17

Though temperatures were warmer than normal in May of 2016, recent data has shown that warm temperatures are no longer sufficient for ozone exceedances in Maryland (Figure 17). For example, the once steady ratio of "hot days" to ozone exceedances (from 1980 – 2003) hit an all time high in 2016 with nearly twice as many hot days as ozone exceedances at the 70ppb standard. The number of hot days to the number of ozone exceedances has been exponentially increasing since 2003 indicating that temperature alone as a factor in ozone production is an increasingly unreliable predictor of ozone in Maryland. This emphasizes the importance of smoke in this case. Previously, greater probability of ozone NAAQS exceedance in Maryland was shown with higher temperatures (Lin et al., 2001) and historically, MDE has tracked Maryland's ozone exceedance days with temperatures equal to or exceeding 90°F (MDE, 2012; Warren, 2013). It is true that ozone precursors need warm temperatures to react to produce ozone. And, indeed, Maryland had above normal temperatures near the 90 °F threshold from May 25 – May 28 (Table 3). However, Maryland also had near-record warmth throughout the 2016 ozone season but recorded a very low number of exceedances. In fact, in a year with 48 days at or above 90°F, the greatest number of days in the last 17 years, there were only 26 exceedance days, which is the lowest ratio of ozone exceedances at the 70 ppb level to hot days ever. In August of 2016, a string of several days in the mid 90s produced no ozone exceedance days. This clearly shows that though ozone production occurs best under warm temperatures, warm temperatures do not indicate substantial ozone production will occur in Maryland.

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The change in MD8AO magnitude and spatial coverage between May 25 and 26 and May 27 and 28 was driven by diminishing smoke influence. Only one monitor exceeded on May 27 and 28 as compared to 13 and 15 on May 25 and 26, respectively, with similar temperatures on all days. This illustrates that temperature was also not indicative of the scale of the ozone exceedance days in Maryland. By May 27, HMS no longer analyzed smoke across the region as the smoke-burdened airmass had largely been transported northward away from Maryland. Thus once the smoke-influenced airmass was primarily removed from the region, the constituents associated with ozone production were also removed on the regional scale. The temperature remained warm for only single monitor, isolated exceedances, but not for widespread ozone exceedances. Furthermore, there is no way to prove that the exceedances on May 27 and 28 were not also due to residual, smoke-influenced air. In fact, speciated particle data from May 27 suggests that smoke influences had not yet entirely left the area, implicating residual smoke was potentially the cause in at least another exceedance on May 27.

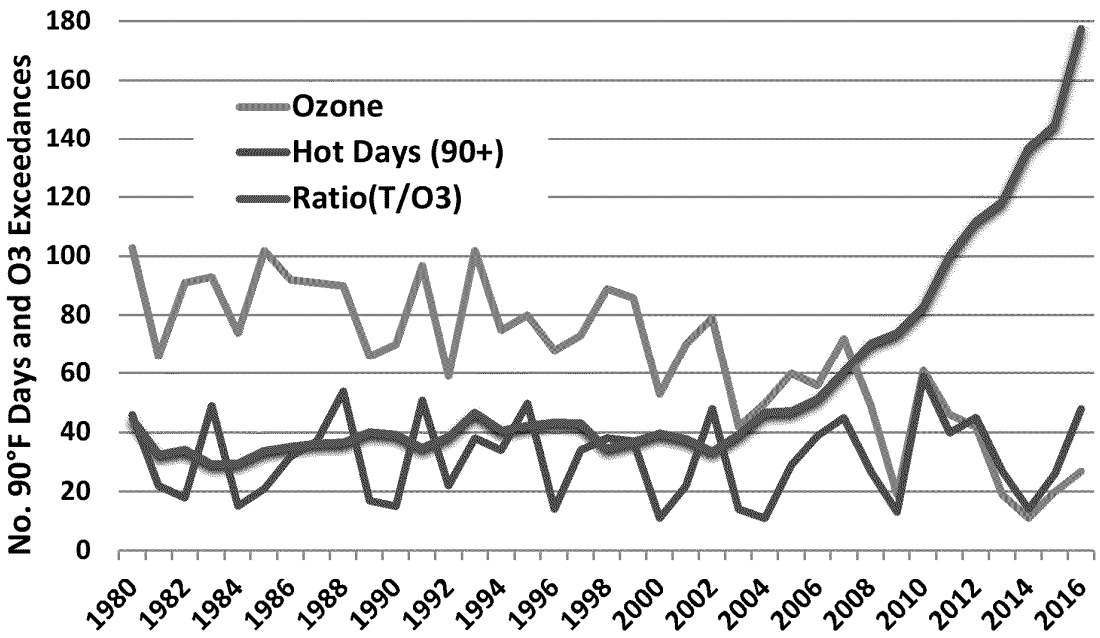

Figure 17. Ozone exceedance days to high temperature ratio.
A graph of the number of days with MD8AO in Maryland greater than 70ppb in a given ozone season (blue line), the number of days where the temperature at BWI airport reached at least 90°F in a given year (brown, thin line), and the five year moving average of the ratio of "hot days" to ozone exceedances multiplied by 100 for scale comparison (thick red, shadowed line) fro m 1980-2016. The dramatic increase in the ratio of hot days to ozone exceedances indicates the decreasing significance temperature has on ozone exceedance days in Maryland.

2.4.4. Smoke and Ozone Transport Overview

As a result of the weather pattern morphology, smoke and ozone produced due to the Fort McMurray, Alberta, Canada fire was transported to Maryland. Smoke from the Fort McMurray fire was already over the

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northern plains on May 18 and 19, 2016 (Figure 18a,b). This smoke was ineffective at producing high ozone over the Midwest and Maryland due to the developing surface low on May 20 which moved across the middle of the CONUS. Weak northerly flow across the Mississippi River Valley and northern plains returned behind this surface low and HMS again analyzed smoke on May 20 across the far northern portion of the Great Plains (Figure 18c), and then farther south on May 21, across much of the Midwest (i.e., Missouri, Illinois, Indiana, Minnesota, Wisconsin, Michigan) as northerly flow continued (Figure 18d). Concurrent with the southward drift of smoke under the ridge, subsidence brought smoke and ozone pre-cursors to the surface. Additional smoke from fires across Mexico was observed on the western side of these images (Figure 18d, e, f) but is not considered part of the plume from Fort McMurray (located over the Midwest/Great Lakes) and is not considered further within the analysis. Subsidence and meandering of the Fort McMurray smoke plume under the ridge continued and on May 22 smoke was also analyzed over all of the Great Lakes states, Midwest and southeastward to the Carolinas (Figure 18e). The northern area of smoke expanded eastward on May 23, covering nearly the entire US east of the Mississippi River, including Maryland (Figure 18f). Those areas west of the coastal low (Michigan, Indiana, Illinois, Kentucky) saw their first ozone exceedance day due to the smoke plume. Despite smoke analyzed in parts of Maryland on May 23, no impact on ozone was observed, due to the influences of the low pressure system (Compare Figures 12a and 15a with Figure 18f). Instead, the smoke plume continued slowly eastward under the slow evolution of the upper-level pattern. Ozone production continued across the Midwest through May 24 where ozone exceedances expanded and intensified (Figure 18g) as compared to May 23 as the analyzed smoke plume started to move northeast around the ridge of high pressure centered over Ohio.

Maryland was on the southern fringe of the smoke-impacted air observed over the preceding days in the Midwest as the smoke and ozone was transported into the state on May 24 and 25, 2016. Surface high pressure centered over Ohio on May 23 fostered a continuing build-up of ozone, leading to a widespread area of high ozone on May 24 upstream of Maryland (Figure 18g). Transport from this region into Maryland began on May 24 but not early enough to lead to an MD8AO in exceedance of the NAAQS. On May 25 and 26, 2016, 13 and 15 Maryland monitors, respectively, exceeded 70ppb for their respective MD8AO due to the transport of the smoke-laden, photochemically aged airmass under the ridge of high pressure across the upper Midwest and Great Lakes. HMS analyzed smoke over Maryland and many of the areas with ozone NAAQS exceedances (Figure 18h). The smoky airmass lingered in Maryland on May 26, again lining up with the placement of the highest MD8AO (Figure 18i). As surface winds shifted to the southwest on this day, the orientation of the exceedances aligned with the I-95 corridor. No smoke was analyzed on May 27 or 28 over Maryland, and only single monitor ozone exceedance days occurred in Maryland. However, the highest MD8AO concentrations had moved northeast, the direction of surface and aloft (850mb) winds from May 26 to May 27, indicating the airmass laden with smoke and ozone had been transported northeastward out of Maryland. Ozone lingered on May 28, though the spatial extent of the exceedance across the entire northeast was further decreased due to further dispersion of smoke-impacted air regionally.

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2.4.5. Smoke and Ozone Discussion and Analysis

The spatial analysis of contoured MD8AO concentrations and HMS analyzed smoke showed the smoke transport from the Fort McMurray fire across the upper Midwest and Great Lakes into the northeast CONUS and Maryland matched the movement and development of high ozone concentrations (Figure 18). Initially on May 18 and 19, the highest ozone in the country was located in proximity to smoke across the upper Mississippi River Valley (Figure 18a,b). Then, behind a surface low which traversed eastward on May 20, these same areas saw rising ozone concentrations coinciding with HMS smoke concentrations on May 20 and 21, with an exceedance of the MD8AO in Minnesota and ozone concentrations climbing above 60ppb over a wide area (Figure 18c, d). Hourly fine particle observations (not shown), which act as a primary pollutant indicator for smoke at the surface, increased on the evening of May 20 and persisted in to May 22 around Minneapolis as another southward push of smoke began. By the evening of May 21, hourly particle concentrations well in to the teens and reaching towards 30 $\mu g/m^3$ were observed from Indiana, to Michigan and lower Ontario, Canada as well. These indicate that the smoke plume had reached the surface. Speciation data from May 24 support this conclusion (shown later), showing wildfire species at the surface. Also supportive of this conclusion was the HMS spatial analysis of the smoke plume which coincided with the surface $PM_{2.5}$ increases on these days. These were the same areas where ozone was rising, further supporting the spatial correlation of smoke and ozone.

Smoke and ozone were analyzed farther south on May 22 (Figure 18e) and by May 23, HMS analyzed smoke perfectly overlapped with a broad and intensifying plume of ozone from the Gulf Coast through Michigan (Figure 18f). Isolated pockets of ozone exceedances over a broad area associated with this airmass were observed on May 23, primarily from the Missouri Boot Heel north-northeastward through the Great Lakes. Areas of the upper Midwest and Great Lakes had more intense ozone exceedances with greater coverage on May 24, expanding eastward in to New York and southern Canada where HMS tracked the northern portion of the smoke plume (Figure 18g).

Both the HMS analyzed smoke and the highest MD8AO contours moved eastward between May 24 and May 25 with wide spread ozone exceedances from Connecticut to Maryland by the 25th (Figure 18h). Spatially significant was the persistence of ozone in Maryland with the persistence of the smoke plume analyzed over the eastern half of the state of Maryland on May 26 (Figure 18i). As claimed earlier, the smoke laden air mainly left the area on May 27 and 28 (Figure 18j and k) as HMS no longer analyzed smoke over the East Coast. An isolated exceedance persisted in Maryland, however, the magnitude and spatial coherence of the MD8AO across the northeast dissolved. Potentially enough residual smoke-affected air remained over Maryland to create exceedances downwind of urban plumes. Regardless, the reduced spatial scale of ozone coverage and magnitude on May 27 and 28 highlights the significance of the departure of the smoke. The movement of the smoke plume and ozone clearly coincide, indicating the smoke and ozone are connected and dependent in this case.

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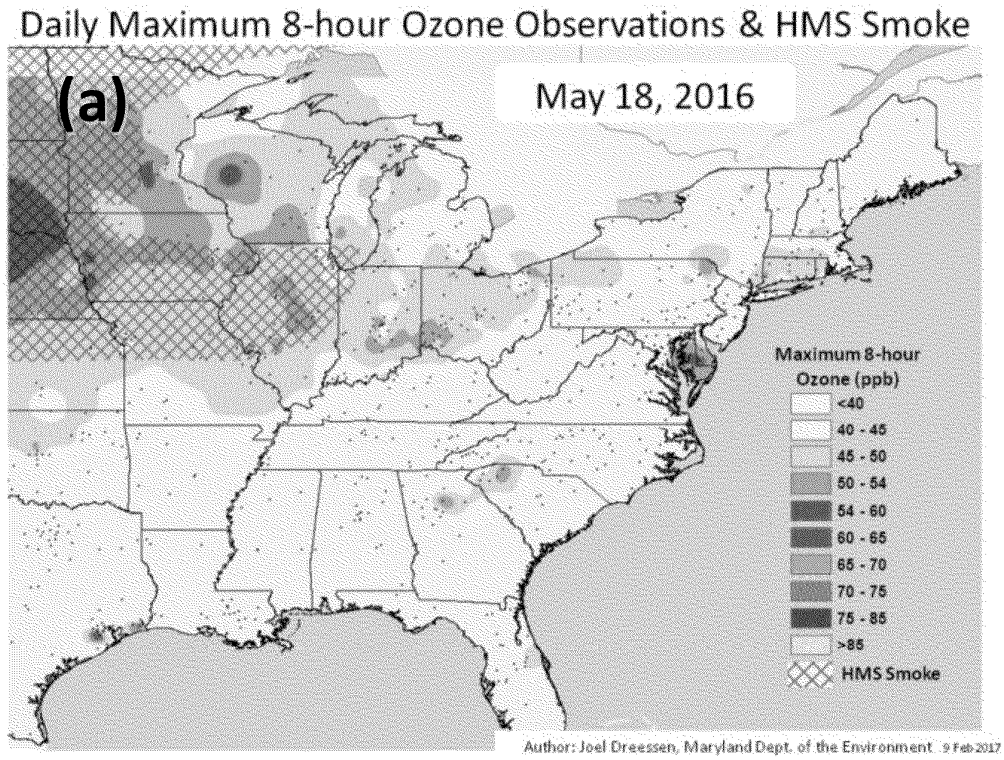
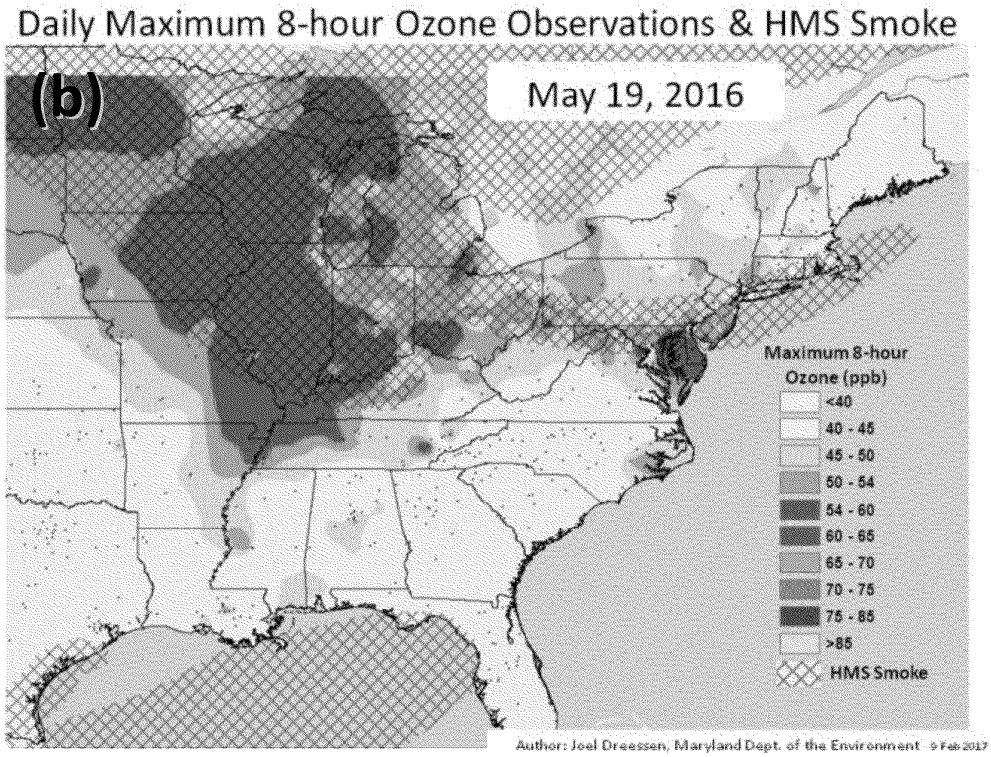
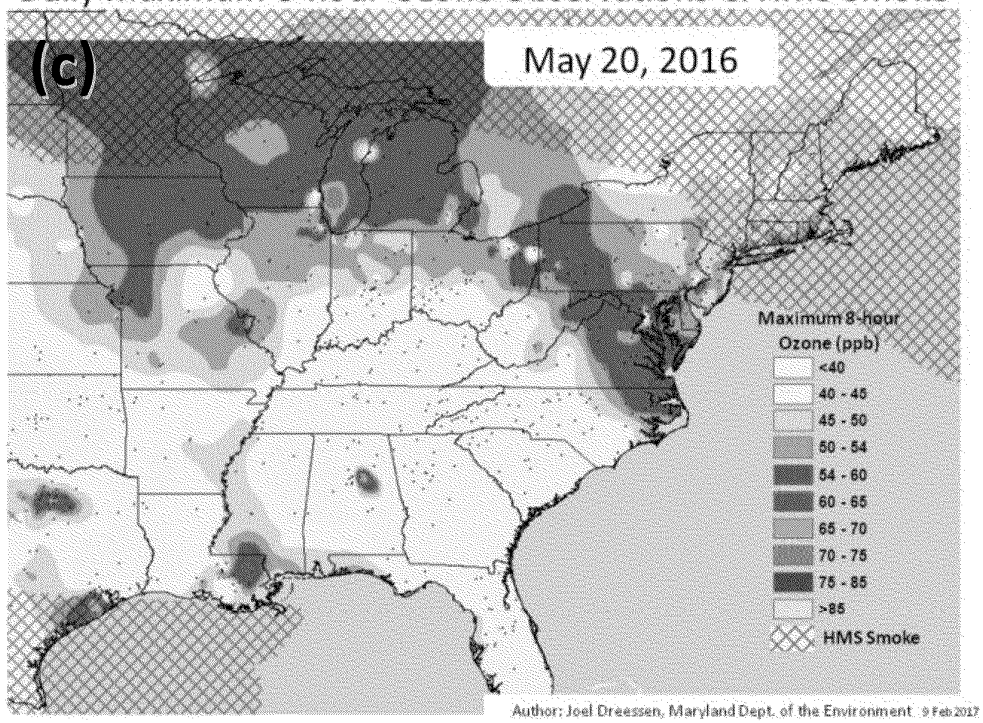
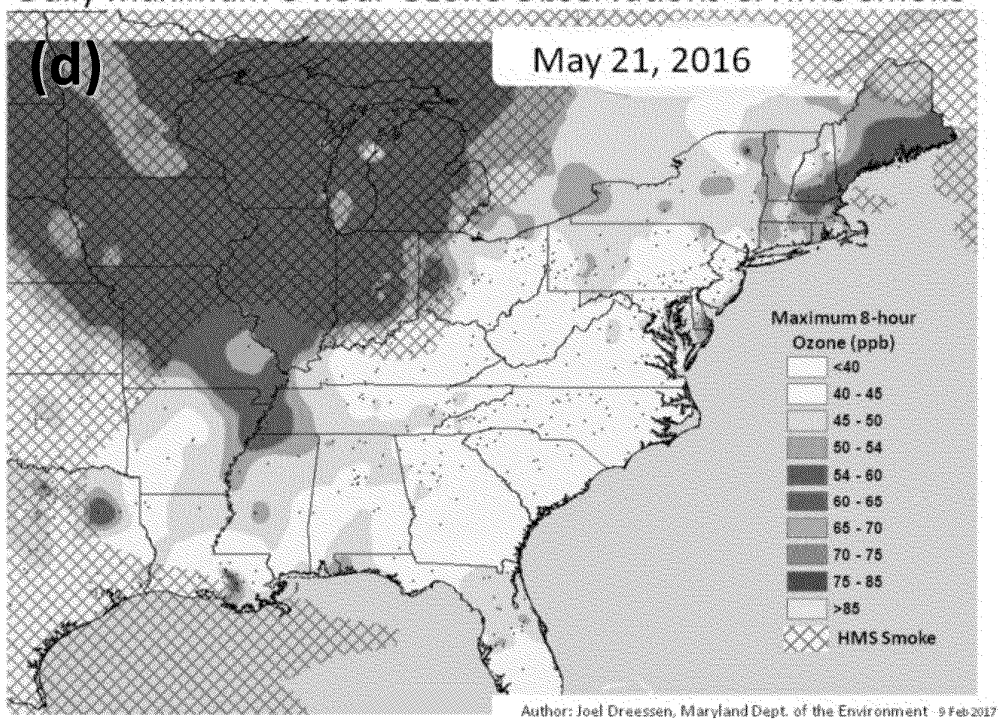

Daily Maximum 8-hour Ozone Observations & HMS Smoke
(a)
May 18, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017

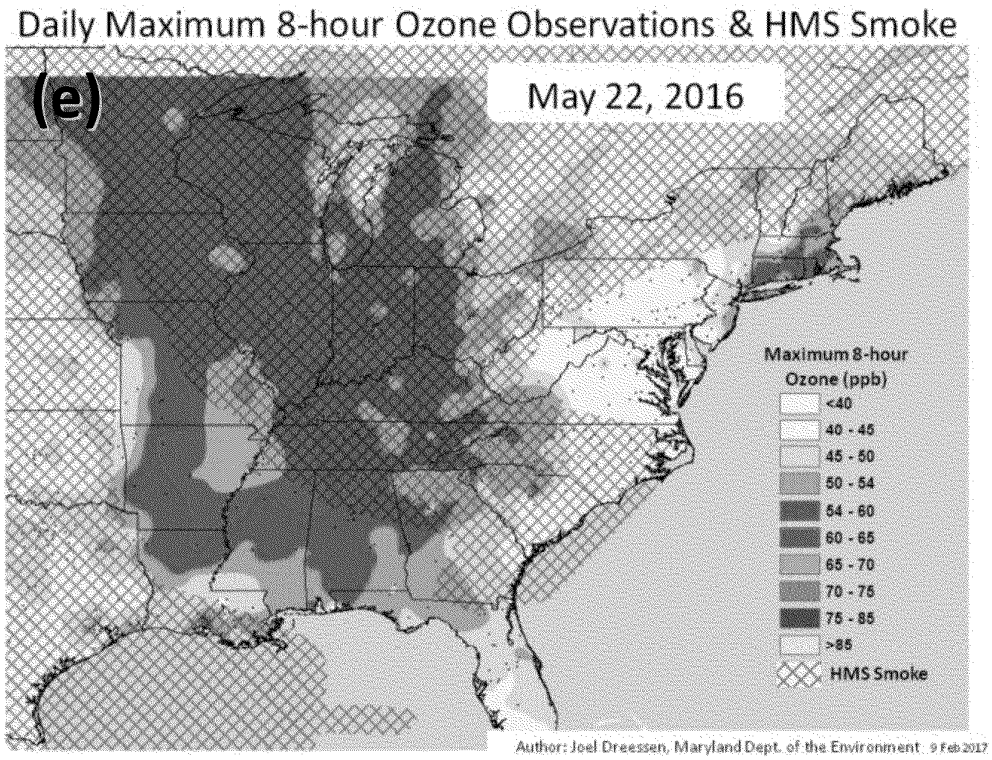

Daily Maximum 8-hour Ozone Observations & HMS Smoke
(b)
May 19, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017

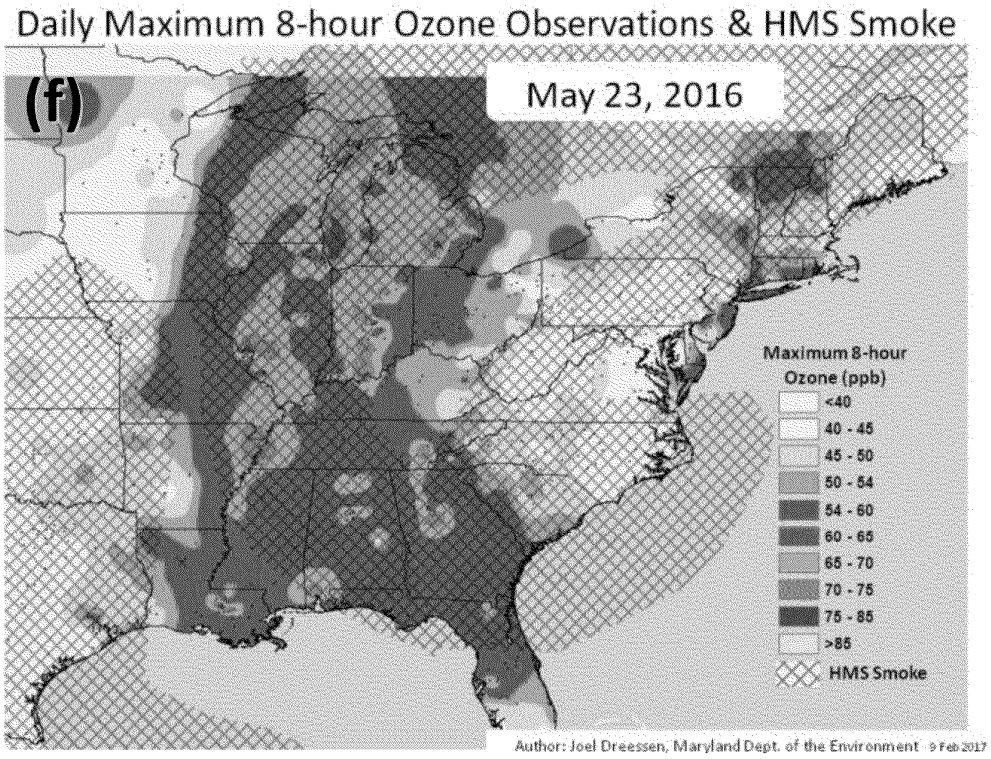
Daily Maximum 8-hour Ozone Observations & HMS Smoke

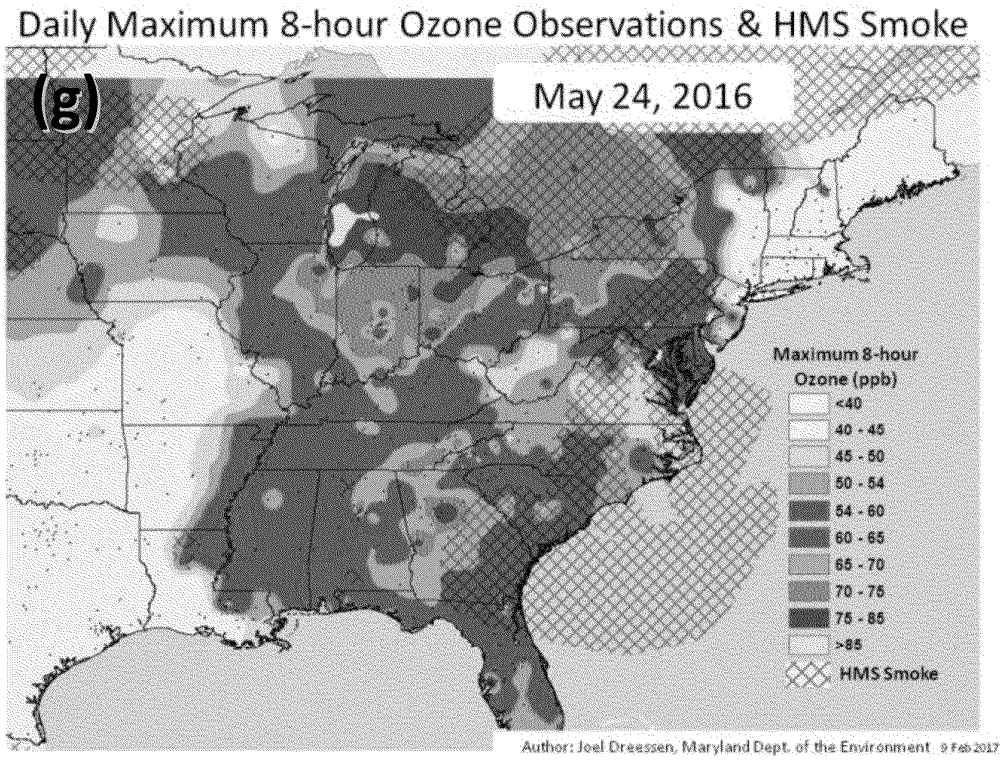


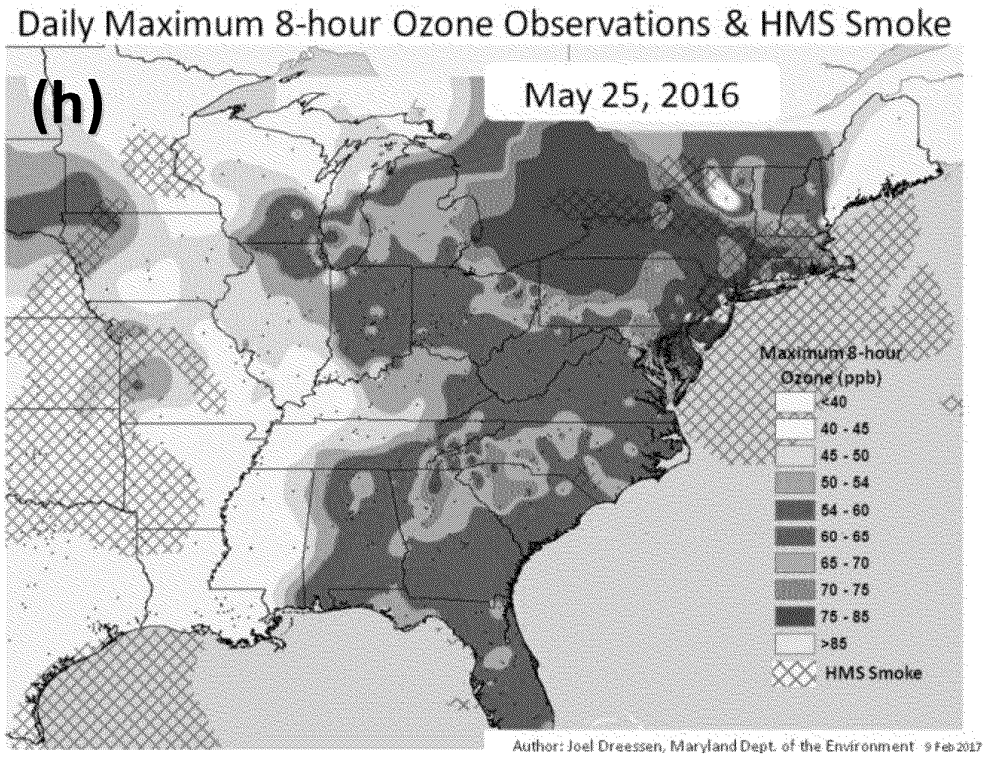
Daily Maximum 8-hour Ozone Observations & HMS Smoke

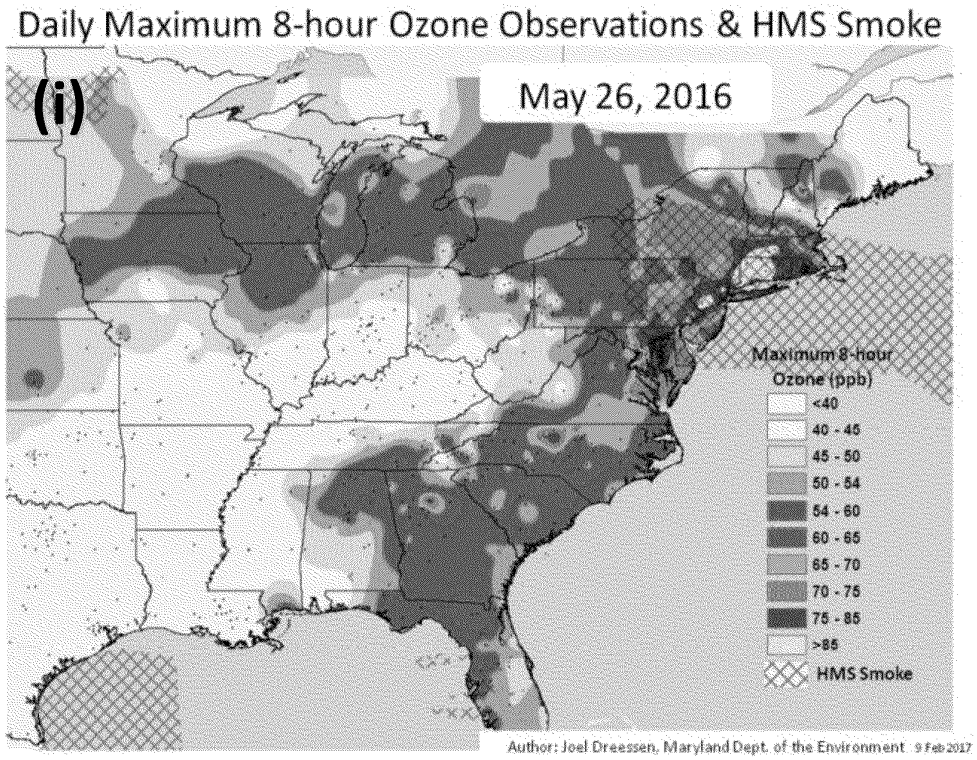


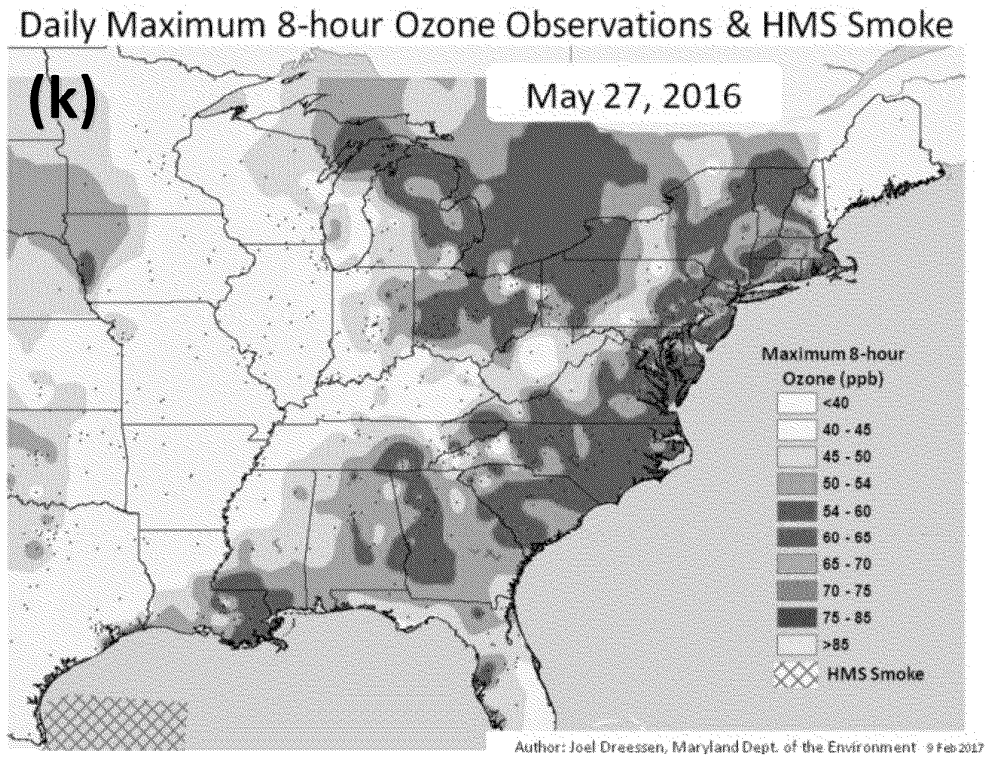

Daily Maximum 8-hour Ozone Observations & HMS Smoke
(e)
May 22, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment · 9 Feb 2017


Daily Maximum 8-hour Ozone Observations & HMS Smoke
(f)
May 23, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment · 9 Feb 2017


Daily Maximum 8-hour Ozone Observations & HMS Smoke
(g)
May 24, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017


Daily Maximum 8-hour Ozone Observations & HMS Smoke
(h)
May 25, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017


Daily Maximum 8-hour Ozone Observations & HMS Smoke
(i)
May 26, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017


Daily Maximum 8-hour Ozone Observations & HMS Smoke
(k)
May 27, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017

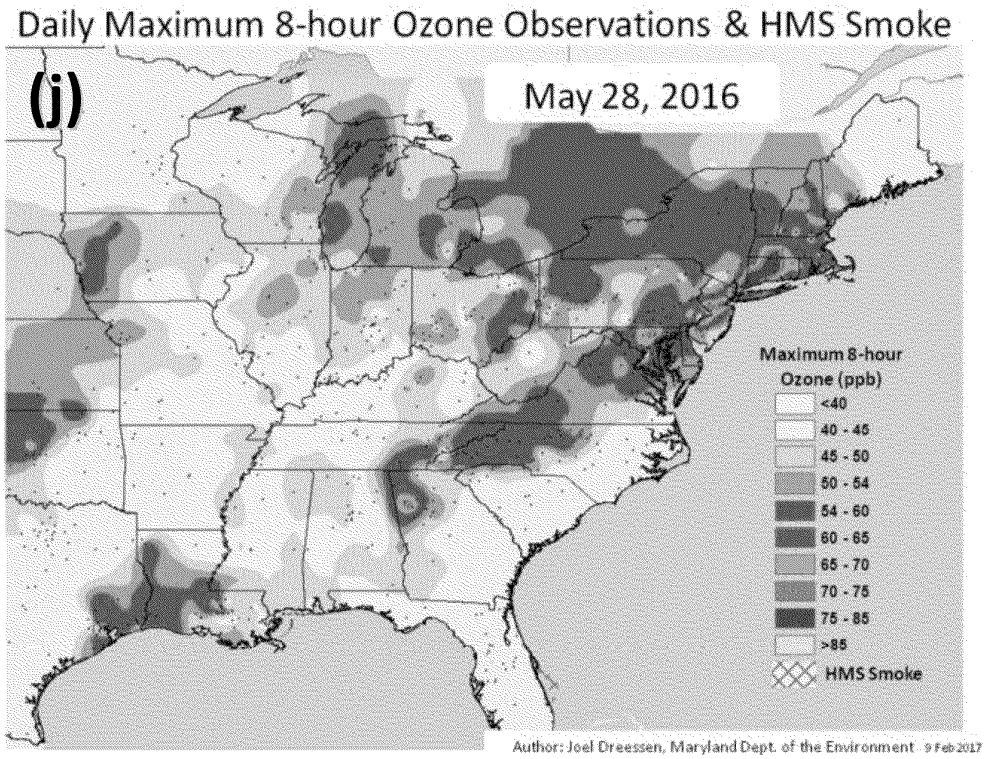


Figure 18. May 18-28 maximum daily 8-hour average ozone concentrations across the eastern CONUS.
Maximum daily 8-hour average ozone concentrations for the eastern CONUS (contoured colors) with Hazard Mapping System (HMS) analyzed smoke overlain (hatching) for May 18-28. Small black dots show the locations of ozone monitors from which the ozone isopleths were drawn. Analyzed smoke is closely associated with ozone plumes for each day up through May 26.

3. Clear Causal Relationship Between The Event and Monitored Ozone Concentrations

The case presented in this analysis illustrates an example of the impact of smoke on Maryland ozone concentrations via the transport of smoke-augmented, ozone-laden air into Maryland. MDE here presents necessary evidence to show the smoke event affected air quality in Maryland and clearly was associated with ozone concentrations beyond what otherwise is expected in the absence of smoke and that smoke caused the exceedance days. Comparisons to historical concentrations and a Q/d analysis (Tier 1 and 2 steps) are provided. While MDE believes these analyses alone show a causal relationship between the ozone and smoke, the complicated nature of the event may not clearly demonstrate a clear causal relationship. After conversations with EPA, it was deemed further analysis was necessary to further establish and demonstrate a clear causal relationship. Therefore, a weight of evidence (Tier 3) approach is used to build an irrefutable case that smoke transport was responsible for the ozone concentrations and the ozone exceedance days in Maryland.

3.1. Historical Concentrations

Scatter plots of MD8AO at Maryland monitors exceeding the 70 ppb NAAQS on May 25 and 26 showed the exceptional nature of the exceedances (Figures 19 - 34). All ozone data during the 2012-2016 ozone seasons (April 1 to September 30) were plotted for each monitor against that monitor's multi-season 99th percentile. However, recall that significant and sustained reductions in ozone precursors across the eastern US have occurred in the past 10 years. These reductions have been particularly evident in NOx. Consequently, this has lead to a noticeable decrease in ozone concentrations and exceedance days in the past three to four years. Five of lowest seasonal number of exceedance days occurred in the past 8 years, with four in the past four years, due to these NOx reductions. The May 20-31, 2016 period had the lowest late May emissions ever from 2010-2016 (Figures 4 and 5). Therefore, amplified MD8AO concentrations in 2016 represented substantially more ozone generated from available NOx than in 2012, when emissions were substantially higher. Since 2012 is within the previous five years of data that EPA requests for historical comparisons, MDE feels the data from 2012 raises the 99th percentile higher than what is otherwise now representative of Maryland's ozone. Thus MDE also offers two additional 99th percentiles to compare each monitor's MD8AO on May 25 and 26. These additional 99th percentiles are calculated using data which excludes 2012 (2013-2016) for the entire season, then another which compares only May from 2012-2016. MDE believes this increases the robustness of the historical comparison.

All monitors exceed a 99th percentile threshold on at least one of the two days and levels. Of the ozone data from the 16 monitors that MDE maintains as being influenced by an exceptional event, on May 25, 2016:

- Three (3) monitors met or exceeded the 99th percentile using all data from April 1 – September 30, 2012-2016 [Essex (240053001), Furley (245100054), Millington (240290002)].

- Nine (9) monitors met or exceeded the 99th percentile of the data when comparing only May ozone from 2012-2016 [Aldino (240259001), Beltsville CASTNET (240339991), Edgewood (240251001), Essex (240053001), Fair Hill (240150003), Furley (245100054), Millington (240290002), PG Eq Cntr (240338003), South Carroll (240130001)].

- Ten (10) monitors met or exceeded the 99th percentile of the data set when the 2012 ozone season was excluded [Aldino(240259001), Beltsville CASTNET (240339991), Essex (240053001), Fair Hill (240150003), Furley (245100054), Horn Point (240190004), HU-Beltsville (240330030), Millington (240290002), PG Eq Cntr (240338003), South Carroll (240130001)].

Of the 16 monitors that MDE is pursuing for exclusion, on May 26, 2016:

- Five (5) monitors met or exceeded the 99th percentile using all data from April 1 – September 30, 2012-2016 [Blackwater NWR (240199991), Essex (240053001), Furley (245100054), Padonia (240051007), South Carroll (240130001).

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- Twelve (12) monitors met or exceeded the 99th percentile of the data when comparing only May ozone from 2012-2016 [Aldino (240259001), Blackwater NWR (240199991), Calvert (240090011), Edgewood (240251001), Essex (240053001), Furley (245100054), Glen Burnie (240031003), Horn Point (240190004), Millington (240290002), Padonia (240051007), South Carroll (240130001), S. Maryland (240170010)].

- Twelve (12) monitors met or exceeded the 99th percentile of the data set when the 2012 ozone season was excluded [Aldino (240259001), Blackwater NWR (240199991), Calvert (240090011), Edgewood (240251001), Essex (240053001), Furley (245100054), Horn Point (240190004), HU-Beltsville (240330030), Millington (240290002), Padonia (240051007), South Carroll (240130001), S. Maryland (240170010)].

All 16 monitors that MDE contends were influenced by an exceptional event exceeded a 99th percentile. Additionally, there were only three (3) instances where the MD8AO concentrations on May 25 or 26 were NOT one of the fourth highest observations of the 2016 season at that monitor. Those three observations are Fair Hill, May 26, which was the fifth highest of the season, though would become the fourth highest if MDE's July exceptional event demonstration is concurred, Glen Burnie on May 25 (sixth highest) and PG Eq Cntr on May 25 (fifth highest). PG Eq Cntr on May 25 would also become the fourth highest observation if the July exceptional event is concurred. It is safe to say the event caused one of the highest ozone concentraitons at all monitors which exceeded the standard (and even at those that did not – see Appendix B). The following scatter plots from all 16 monitors show the above data (Figures 19-34). Along with the 70ppb NAAQS, three additional lines show the 99th percentile for all ozone season data 2012-2016, ozone season data from 2013-2016, and only ozone in May, 2012-2016.

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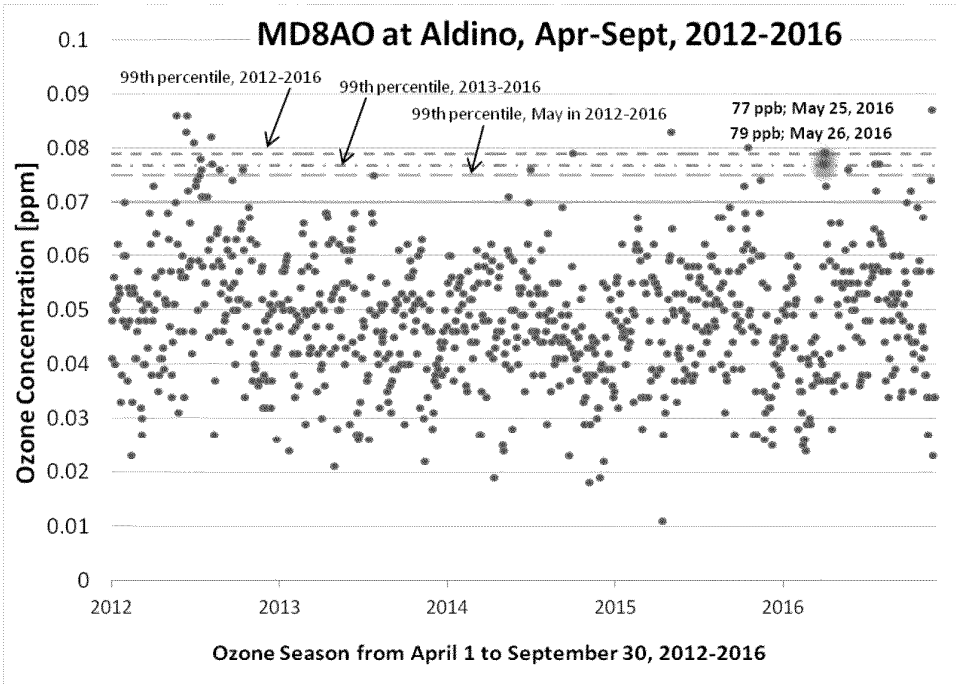

Figure 19. Scatterplot of Maximum Daily 8-hour Average Ozone (MD8AO) concentrations at Aldino (blue dots), April 1 – September 30, 2012-2016.
The days that exceeded the NAAQS on May 25 or 26 and for which MDE is seeking exclusion of the data are colored red. Textual annotations give the MD8AO for the red colored data point. Along with the NAAQS level (70ppb – red line), three 99th percentile lines are given to account for the changing NOx emissions and ozone levels in Maryland over the past 5-years. The 99th percentile for all ozone season data, 2012-2016, is given in dashed purple. All season data 2013-2016 is given in blue (dash-dot) while data only from May 2012-2016 is given in long-dashed green.

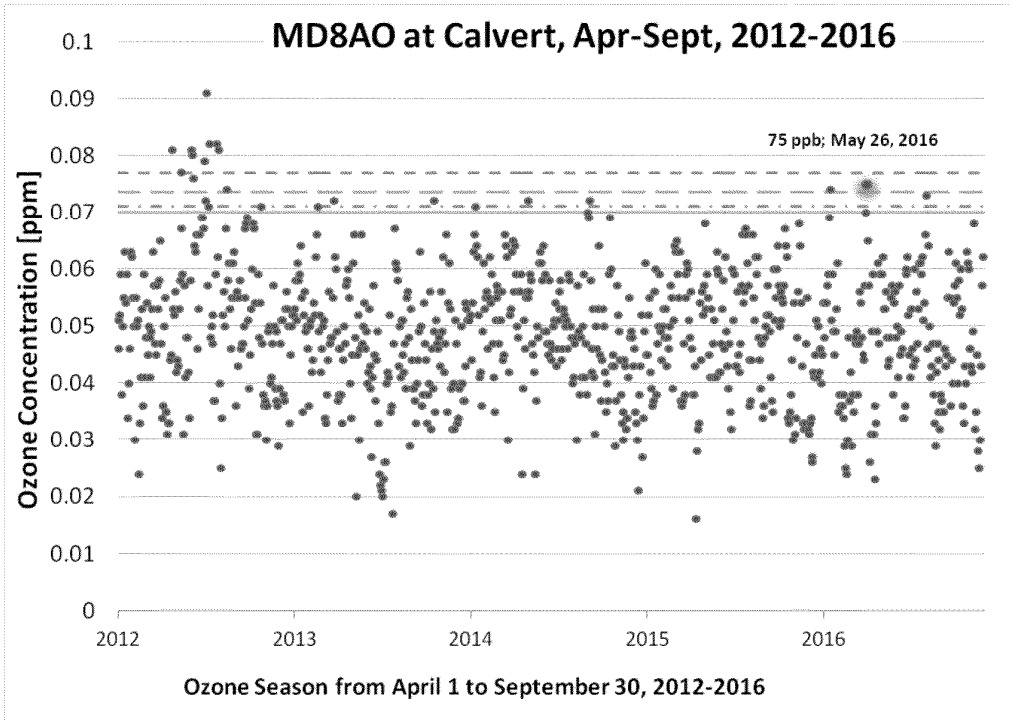

Figure 20. As in Figure 19 except for Calvert.

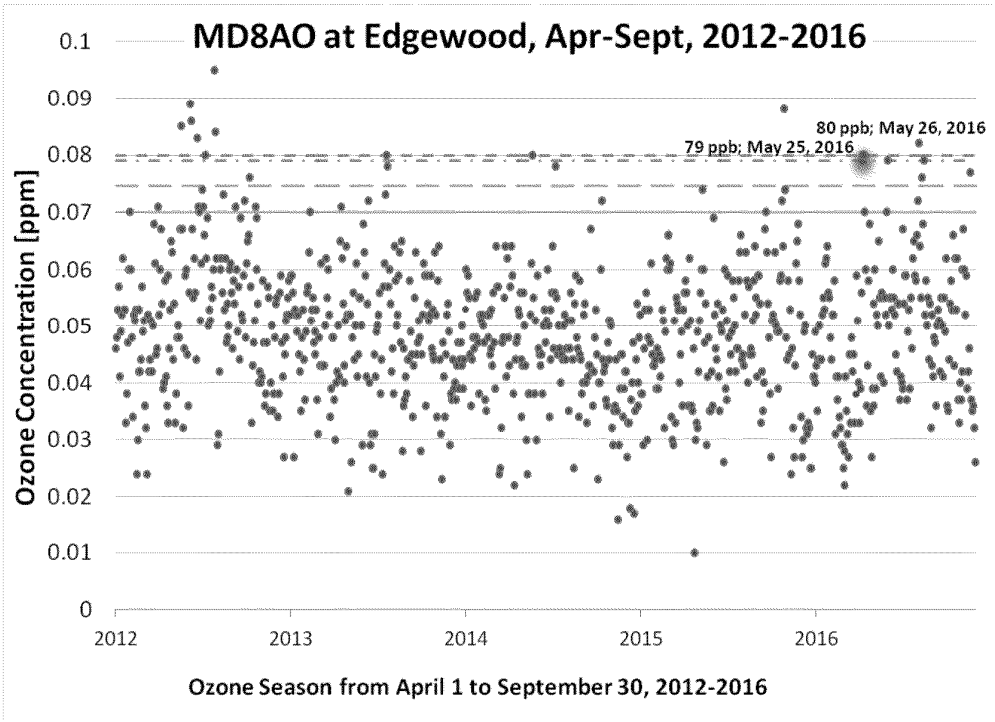

Figure 21. As in Figure 19 except for Edgewood.

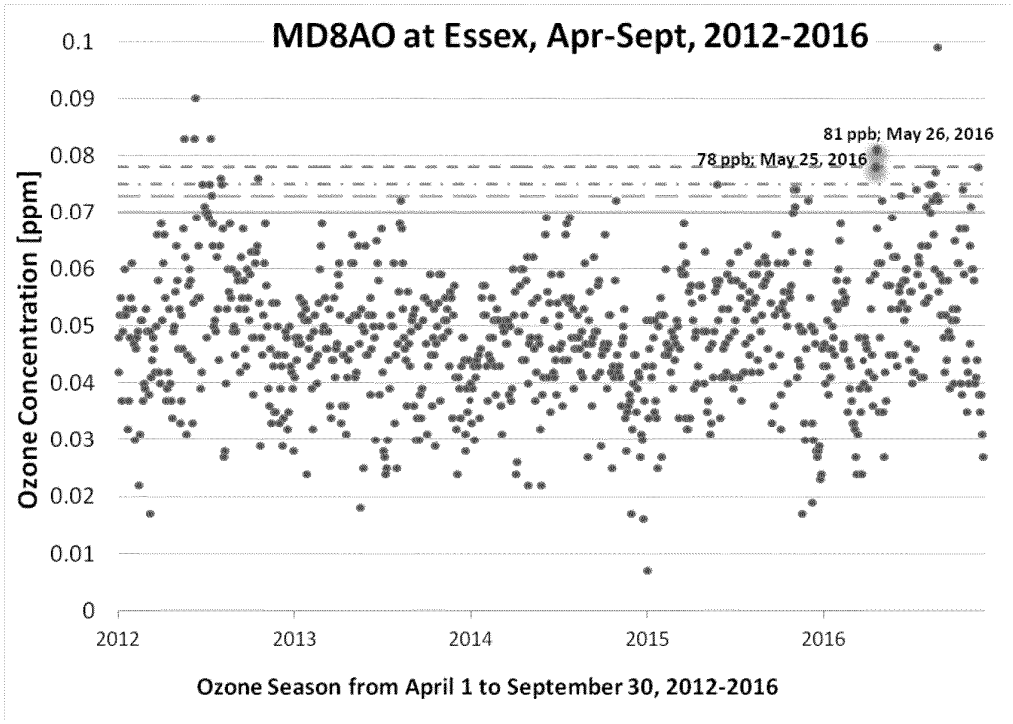

Figure 22. As in Figure 19 except for Essex.

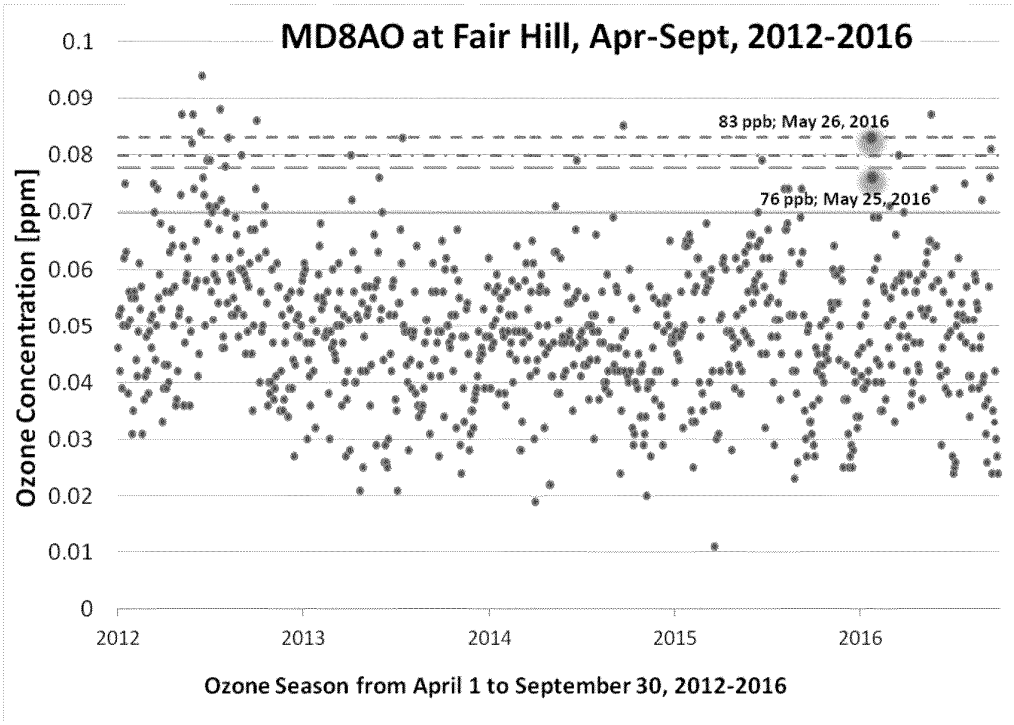

Figure 23. As in Figure 19 except for Fair Hill.

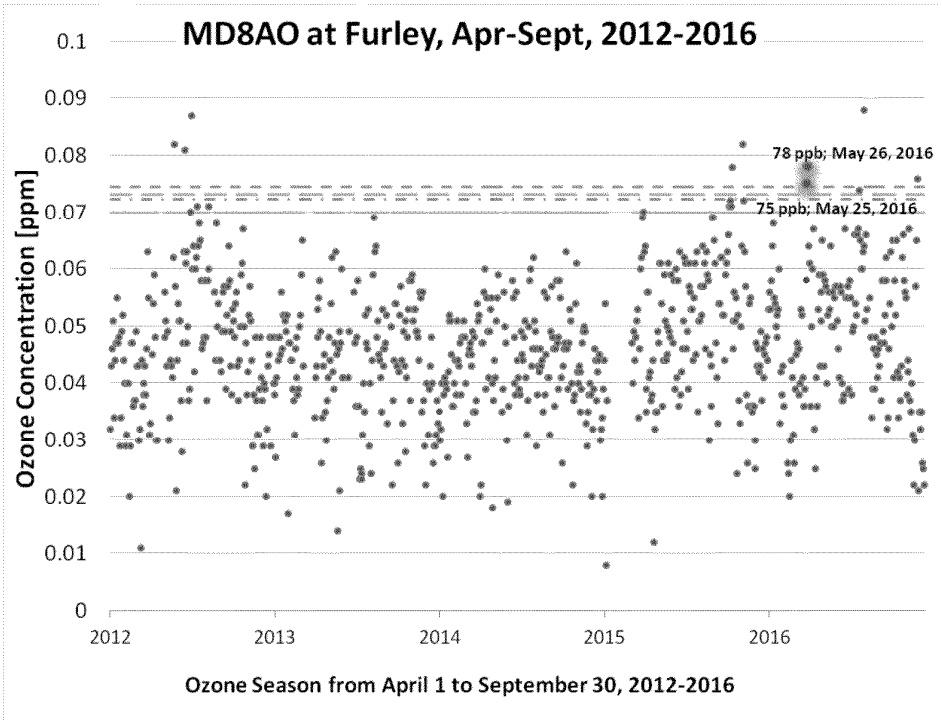

Figure 24. As in Figure 19 except for Furley.

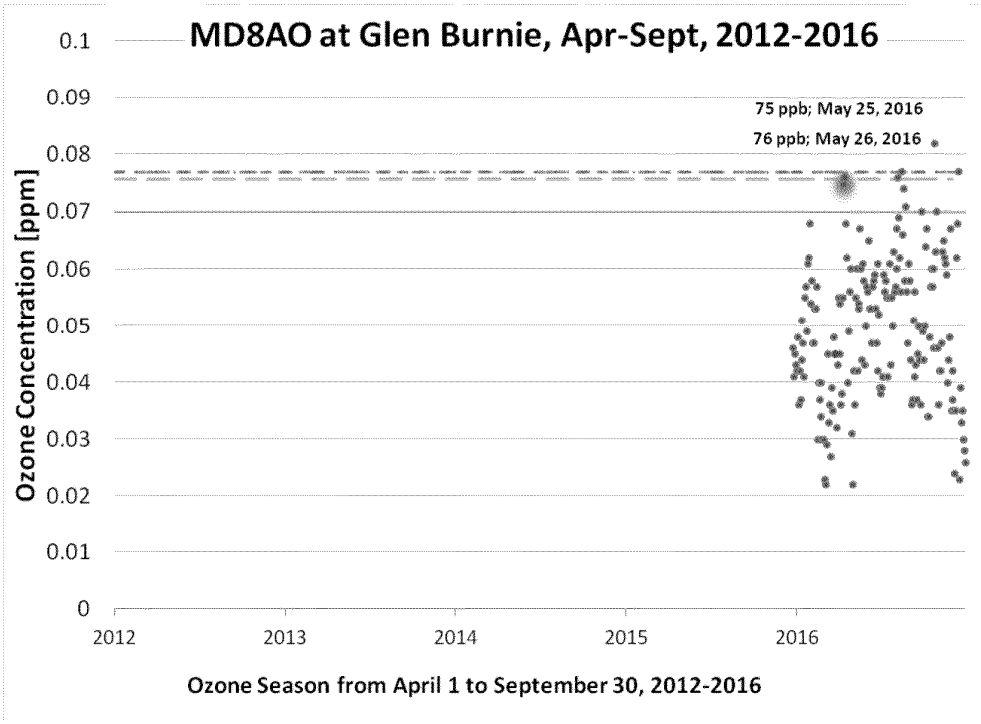

Figure 25. As in Figure 19 except for Glen Burnie. Glen Burnie became operational in 2016.

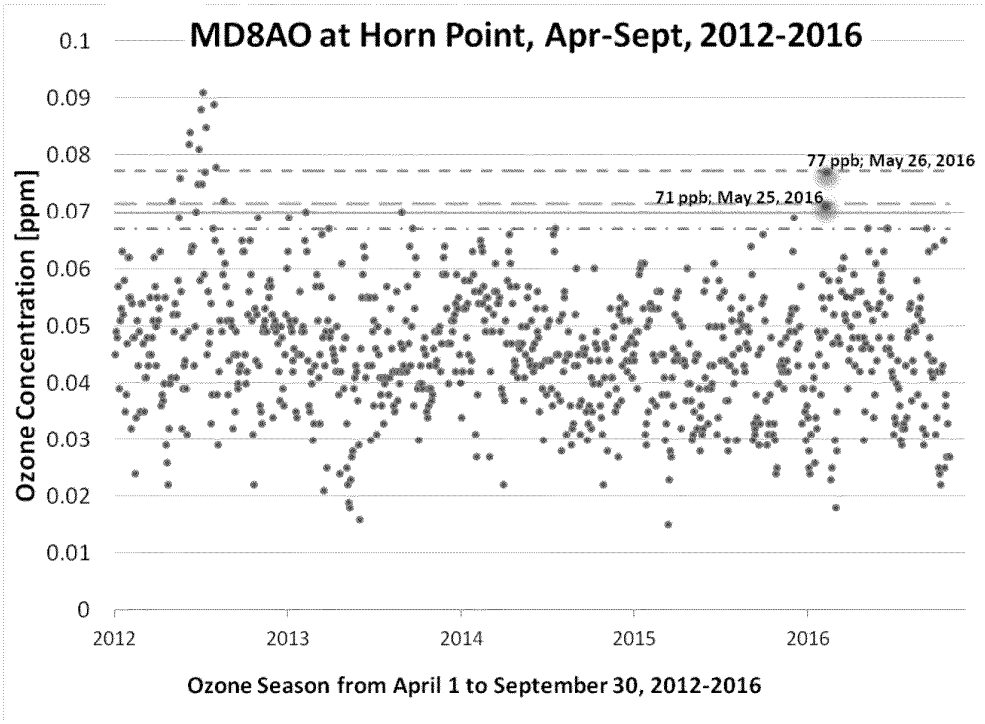

Figure 26. As in Figure 19 except for Horn Point.

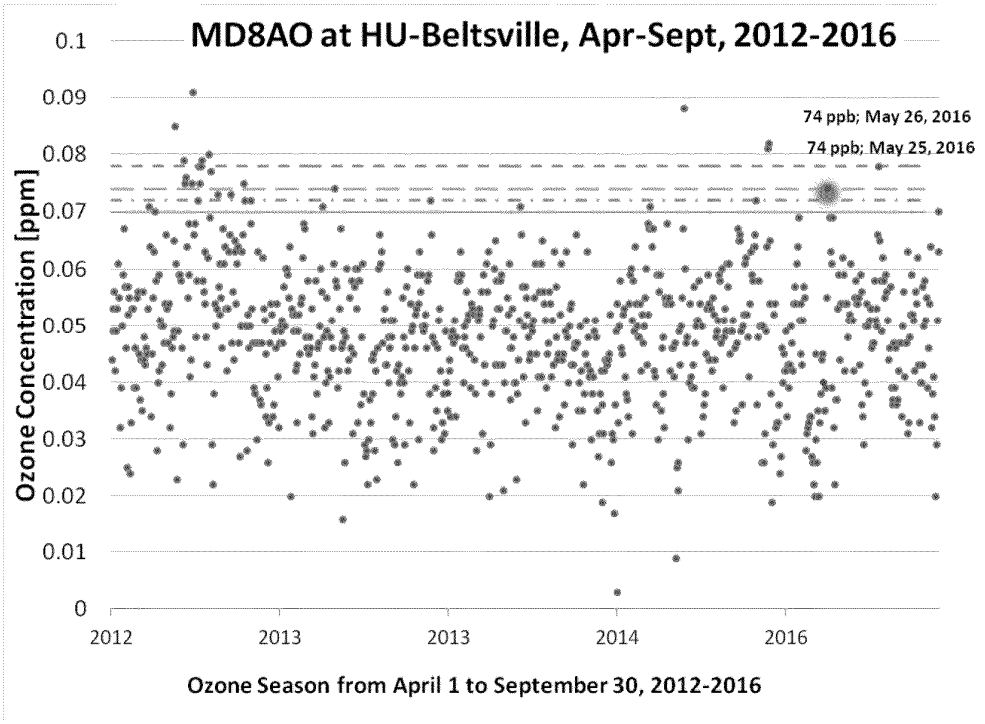

Figure 27. As in Figure 19 except for HU-Beltsville.

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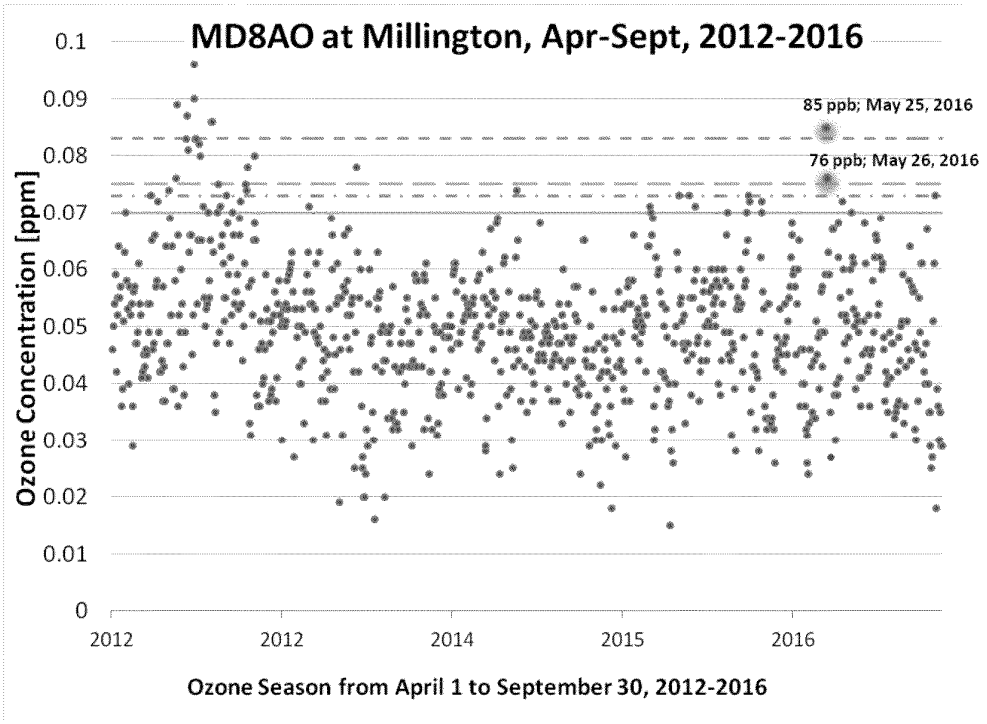

Figure 28. As in Figure 19 except for Millington.

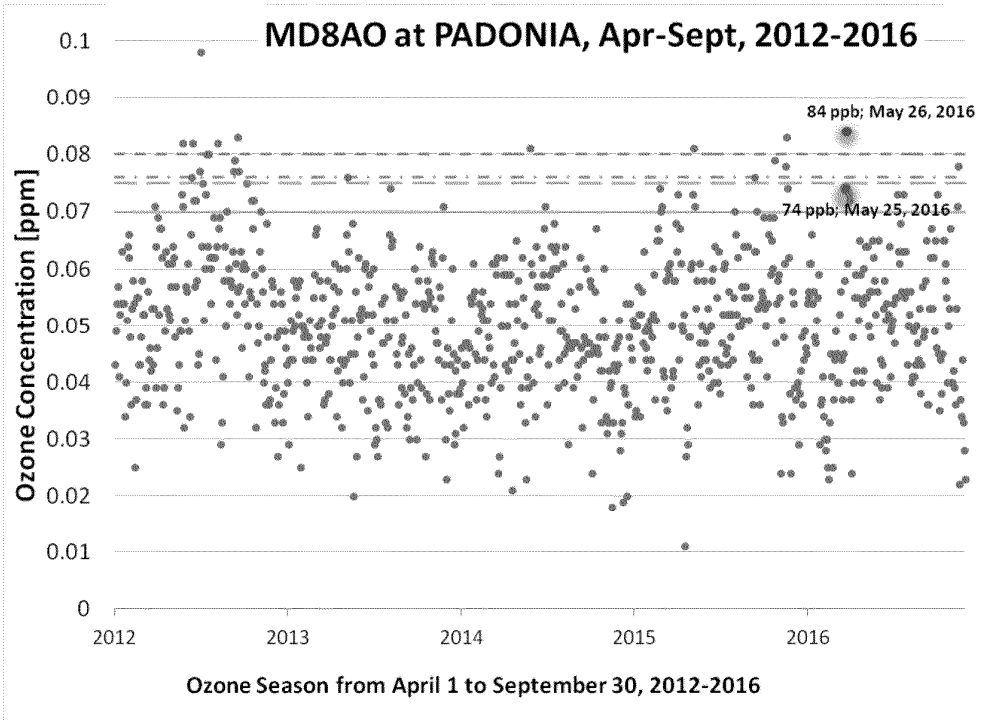

Figure 29. As in Figure 19 except for Padonia.

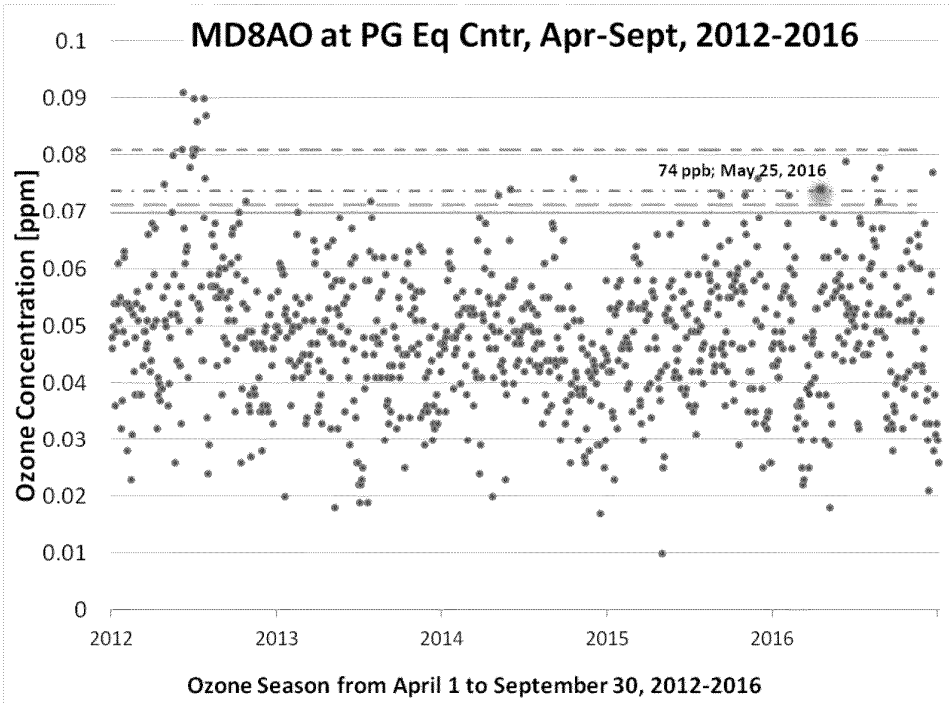

Figure 30. As in Figure 19 except for PG Eq Cntr. MDE is seeking exclusion of only May 25, 2016.

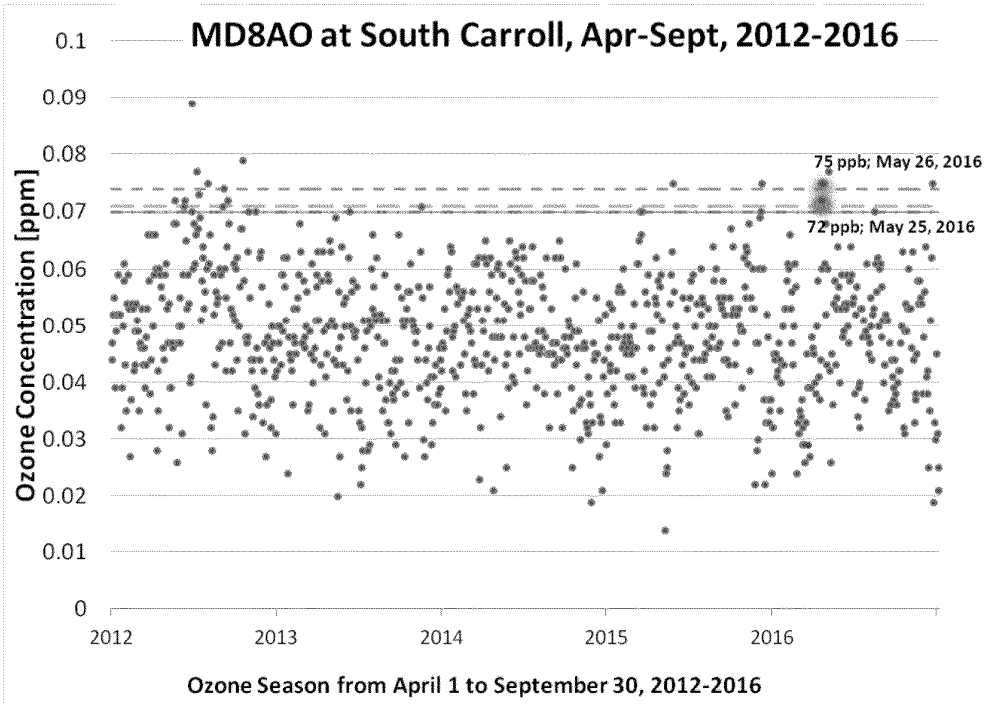

Figure 31. As in Figure 19 except for South Carroll.

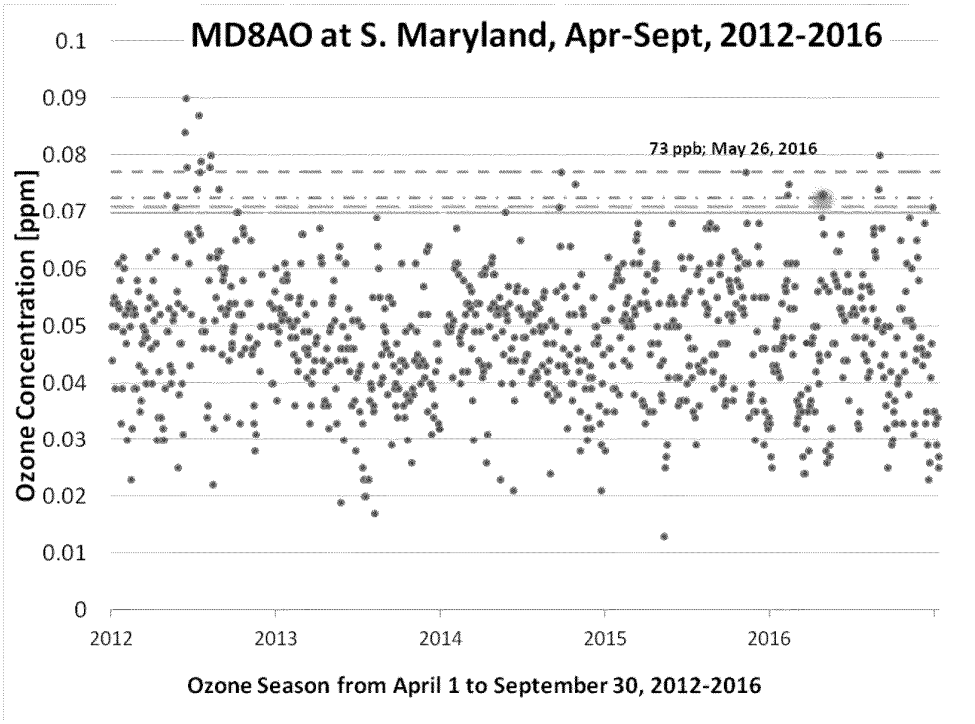

Figure 32. As in Figure 19 except for S. Maryland. MDE is seeking exclusion of only May 26, 2016.

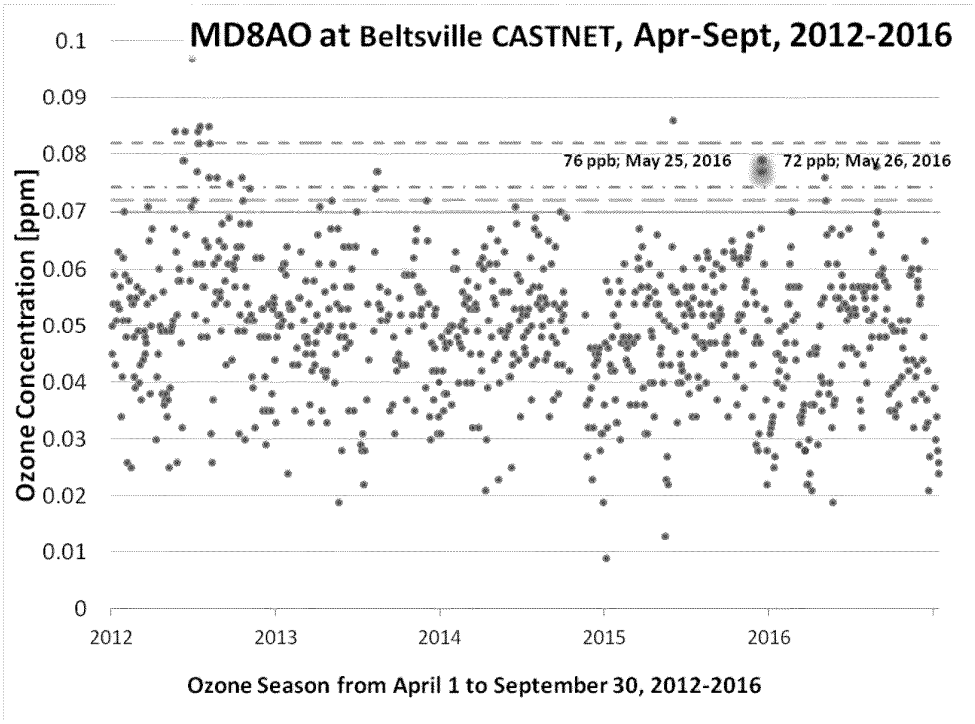

Figure 33. As in Figure 19 except for the Beltsville CASTNET monitor.

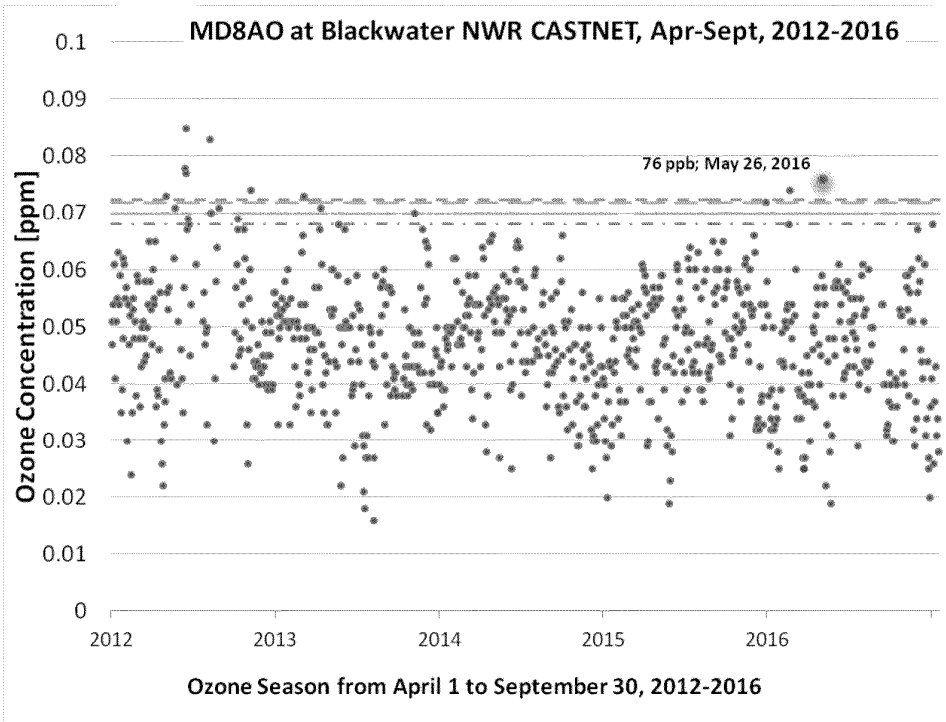

Figure 34. As in Figure 19 except for the Blackwater, NWR, CASTNET monitor. MDE is seeking exclusion of only May 26, 2016.

The preponderance of the monitors for which MDE is seeking as being influenced by an exceptional event show a "distinctive level" of monitored ozone concentration which were also within the top four highest MD8AO concentration of the 2016 season. Concentrations during the smoke influenced event exceeded the 99th percentile of not just May but also the entire mulit-seasonal dataset. Therefore, the May event is exceptional in nature. MDE has observed concentrations as those seen in May 2016 previously, such as during mid-summer of the 2012 ozone season, but with greater anthropogenic NOx emissions. The uncharacteristically high ozone concentrations early (May) in the 2016 ozone season, particularly in light of the huge precursor reductions over the past five years, and the large spatial coverage of the exceedances as compared to previous exceedances (see Figure 5), all suggest the monitors were influenced by wildfire smoke. MDE believes the evidence presented thus far indicates a clear causal relationship. Additional supportive analysis is presented below.

3.2. Evidence that Fire Emissions were Transported to Maryland

To further demonstrate that the Fort McMurray wildfire emissions were transported to Maryland, the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT; Rolph, 2015; Stein et al., 2015) model was used to approximate the movement of air parcels both forward from the fire and smoke region and backwards from Maryland. According to the conceptual model, an intense burn period from May 17-19 created a prodigious smoke plume which was transported eastward, then moved southward over the Great Lakes and Midwest around May 21, 2016. Starting from May 20, which was after the intense burn period

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and when the plume of smoke was already lofted in the atmosphere, a matrix of forward trajectories centered on the area which the HMS analyzed smoke across south central Canada were run (Figure 35a). Meteorological data driving these trajectories was the 12km North American Model (NAM). Running a matrix of trajectories (several trajectories which start from a gridded pattern over the source area) instead of a single trajectory allows the trajectories to show a spread of possible dispersion of the smoke plume while increasing the confidence in the general transport pattern of it. Due to increasing model error with time (an intrinsic occurrence when modeling the atmosphere) no single trajectory should be considered representative of the exact path of the smoke plume, and the longer the trajectory is run, the greater the error of the modeled path is likely to be. Therefore, clusters of trajectories increase confidence of the path of the smoke.

Two trajectory clusters are apparent in Figure 35a. The first is from the northern portion of the matrix, which stays north of the CONUS across Canada. The second is a cluster of trajectory members originating on the southern side of the matrix which work their way southeastward across the upper Midwest and Great Lakes. This corresponds to the forward transport of the plume observed from satellite and via ground measurements into and through the Great Lakes/Midwest and then in to the Mid-Atlantic. Three trajectories in aggregate, one red (A), one blue (B), and on Green (C), together (shaded area) represent transport to Maryland from the source region. All three trajectories take a full 4-5 days to transverse the distance to the east coast, which is consistent with heightened ozone taking until May 23/24 to develop across the Midwest/Great Lakes which led to exceedances on May 25 in Maryland. General subsidence (sinking motion) was also noted for nearly all members in the matrix (see vertical profile at bottom Figure 35a) with a majority of members at or below the original starting height of 1,500 m, supporting the assertion smoke aloft subsided to the surface under the ridge and/or behind the weak cold front on May 19.

Backward trajectories had a similar path to the southeast quadrant of forward trajectories (Figure 35b). As discussed in the conceptual model, the smoke plume was transported across the Great Lakes southward over the course of a few days while under high pressure. According to the back trajectory starting over Maryland at 1,500m on May 25 (green, Figure 35b), lofted smoke originally over 3,000m above ground level subsided to around 1,500m where it could be mixed into the boundary layer as early as May 23 over the Great Lakes area. Cross reference the path of this back-trajectory with Figure 18c to see that HMS analyzed smoke over the area of southern Canada on May 20 (where the backwards trajectory ends in Figure35b). Eventually, the smoke plume was transported east and far enough south such that Maryland was on the southern fringe of the plume. The time of transport (4-5 days) is in relatively good agreement with bringing the smoke plume analyzed on May 20 across the Northern Plains and Southern Canada southeastward to over the Great Lakes and into New England as previously discussed. Morphology in the upper levels turned transport from the north across the Midwest and Maryland to the west on May 24 and is reflected as the turn of the backwards trajectories across the Midwest to deliver the smoky and now ozone-laden airmass to Maryland.

The vertical displacement of the backwards trajectories is consistent with the increase in temperatures of the upstream airmass across the Midwest and indicates that additional smoke mixed down from a

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substantial altitude. Trajectories around 500m ending over Maryland on May 25 (Figure 35b) dropped over 2,000m during transit to Maryland. Compressional heating of ~10°C/km (adiabatic rate) over 2,000m results in an increase of 20°C. Morning analysis (12z [8am LDT]) across central Canada on May 20 showed aloft temperatures of -3°C to -4°C. This corresponds to temperatures of around 15°C after dropping 2,000m to lower heights. The subsidence creating the temperature increase also brought down ozone precursors within the smoke across the central Midwest, particularly by May 23, as identified on the vertical cross section of the backwards trajectories (Figure 35b). The subsidence explains the above normal temperatures across the duration of the event and provides evidence that the boundary layer was well mixed thermodynamically, and thus, was also mixed with smoke and ozone precursors.

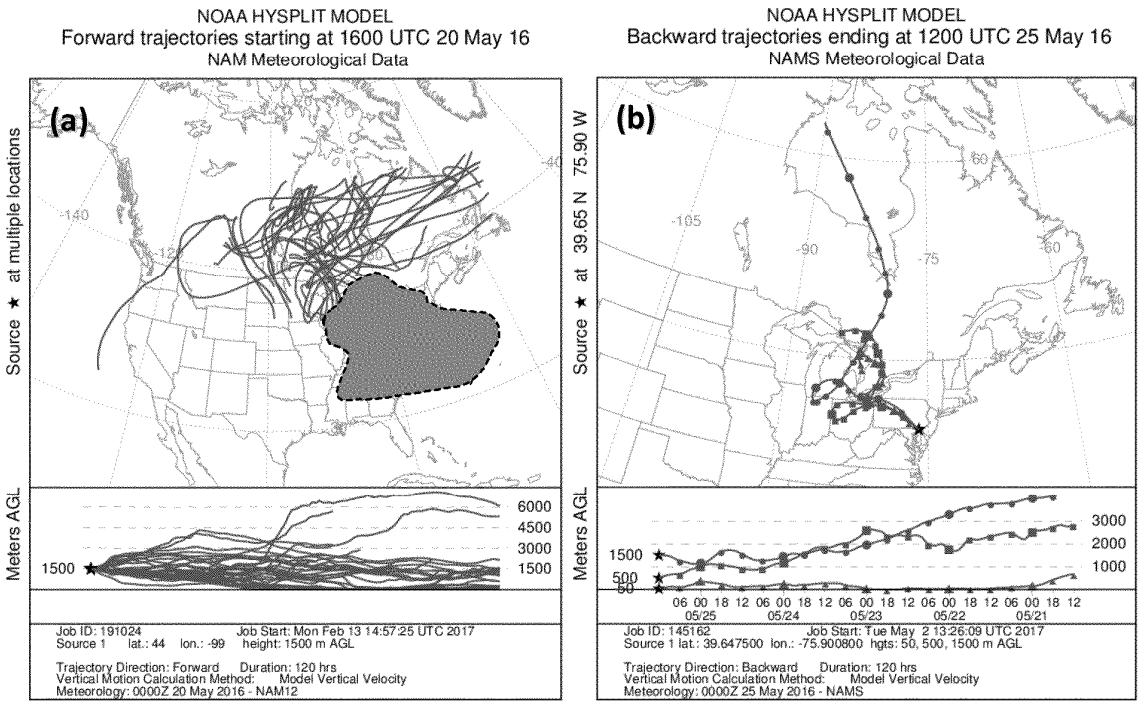

Figure 35. Forward and Backward Transport Trajectories
(a) A Matrix of 120-hour (5 day) North American Model (NAM) forward trajectories with starting points centered around the location of the smoke plume on May 20, 2016 across the upper Midwest and southern Canada. The trajectories show general clockwise transport fanning outward from the trajectory start locations. The southeastern quadrant of the trajectories (blue shading) held the relevant transport of smoke in to the upper Midwest, Northeast and Mid-Atlantic, including Maryland. (b) 120-hour back trajectories from northeast Maryland beginning on May 25 showing transport from the area of the smoke and Fort McMurray in to Maryland over the course of 4-5 days. Trajectories at 50-500m dropped over 2000m during transport to Maryland. Annotations (A), (B) and (C) mark trajectories mentioned in the text.

3.2.1. Evidence of Ozone Transport via Ozonesondes

MDE contends the ozone formation from the Fort McMurray fires occurred upstream of Maryland and the ozone was transported to Maryland as the cause of the ozone exceedances above the 99th percentile of recent historical data. With a modifying, aging and degrading airmass evident across the Midwest and Great Lakes as of May 23 and 24, MDE requested ozonesondes on be launched May 25, 26, and 27 from the Howard University (HU-)Beltsville site (see Figure 2). These ozonesondes recorded substantial ozone

concentrations within the nocturnal residual layer (i.e., pre-dawn, ozone above the surface). At night ozone is removed from the layer of air a few tens of meters from the surface as it interacts with other molecules or objects. However, the layer of air immediately above the surface at night "preserves" ozone overnight making it the "transport relevant" layer or simply known as "the residual layer." The residual layer is usually found from around 500m to 1,500-2,000m above ground level at night. Therefore, surface ozone may be at or near zero ppb at night while just a few hundred meters above the ground ozone may still be 50-80 ppb. During the pre-dawn hours of May 25 ozone concentrations within the residual layer (0.5 – 2 km) were 70-75 ppb (Figure 36). Wind direction at the time showed transport in this layer was from approximately 300 to 345°, or northwesterly.

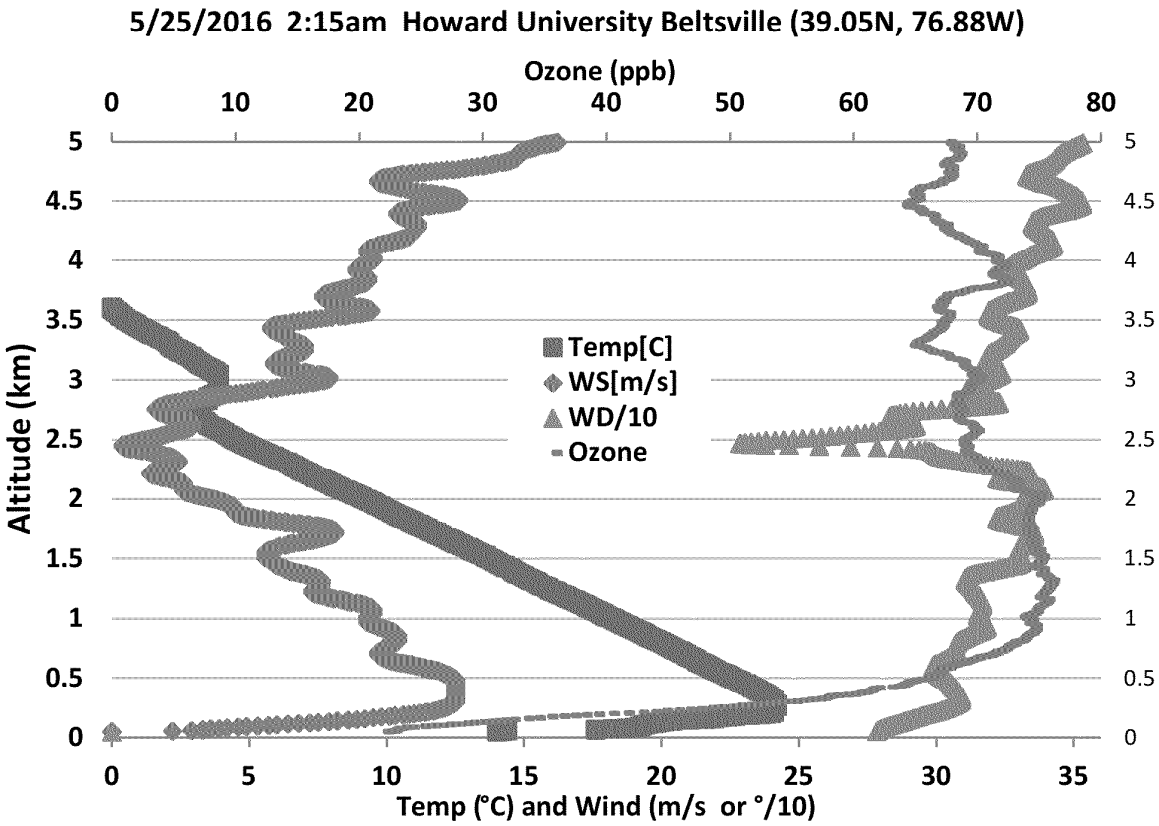

Figure 36. Ozonesonde launched from Howard University Beltsville on the morning of May 25, 2016. Temperature (red, squares), wind direction (green, triangles), wind speed (blue, diamonds), and ozone (purple, dashes) are shown from the surface through 5km AGL. Ozone concentration is given on the top horizontal axis. Temperature and winds are given by the bottom horizontal axis.

Further analysis of the origin of the air parcels transporting enhanced ozone within the residual layer showed transport from eastern OH and western PA. HYSPLIT trajectories on the morning of May 25 showed westerly transport from Ohio from May 24 and 25 to the HU-Beltsville site (Figure 37). The meteorological data driving the comparison trajectories was from the 12km resolution North American Model (NAM) and 32km resolution North American Regional Reanalysis (NARR) datasets. The trajectory levels chosen were

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based on ozonesonde features (Figure 36) which were the low-level wind maximum (jet) at approximately 400m (Figure 37: red lines, triangles), and the residual layer, which had a layer of well mixed ozone beginning at about 1,000m (Figure 37: blue, squares) and middle around 1,500m (Figure 37: green, circles). The backwards trajectories combined with the ozone concentrations measured in the residual layer by the ozonesonde (Figure 36) showed transport of modified air containing ozone greater than 70ppb from the eastern Midwest (Figure 37). Said differently, the same air containing heavy ozone concentrations over the eastern Midwest on May 24 was sampled by the ozonesonde in Maryland on the morning of May 25.

Compare the origin of the trajectories from central Ohio (Figure 37) to ozone concentrations across the same area (Figures 18f and 18g). Central and southern Ohio into Appalachia (West Virginia, eastern Tennessee) generally did not have surface ozone concentrations that exceeded the 70ppb 8-hour standard on May 23 and were on the southern fringe of the highest ozone over the Great Lakes. That same southern extent of ozone pushed east and southeastward into Maryland on May 25 and created a sharp gradient in surface ozone concentrations south of DC. Said another way, Maryland was on the southern fringe of the ozone-laden airmass on May 25 and 26, consistent with surface ozone concentrations decreasing quickly southwest of DC. Surface analysis the previous day supports the conclusion that the smoke was likely transported around southern Ohio and West Virginia but then pushed southeastward in to Maryland. The winds across Ohio were circulating around the periphery of the surface high pressure system (Figure 38). The clockwise flow may have been enough to keep smoke concentrations in Ohio slightly lower than locations just a bit farther north. Trajectories across Ohio show a slight rising (vertical) motion along their path (right side of trajectory vertical cross sections in Figure 37). It was possible that because the high pressure was weakening it no longer had strong subsidence at the high center to support an ozone exceedance of 70ppb. Still, even if not at exceedance levels, ozone concentrations were enhanced across Ohio (southern edge of degraded airmass) which was instrumental in development of a residual layer which was transported into Maryland on May 25. The ozonesonde observed ozone within the residual layer transported from areas upstream which were impacted by smoke on May 24.

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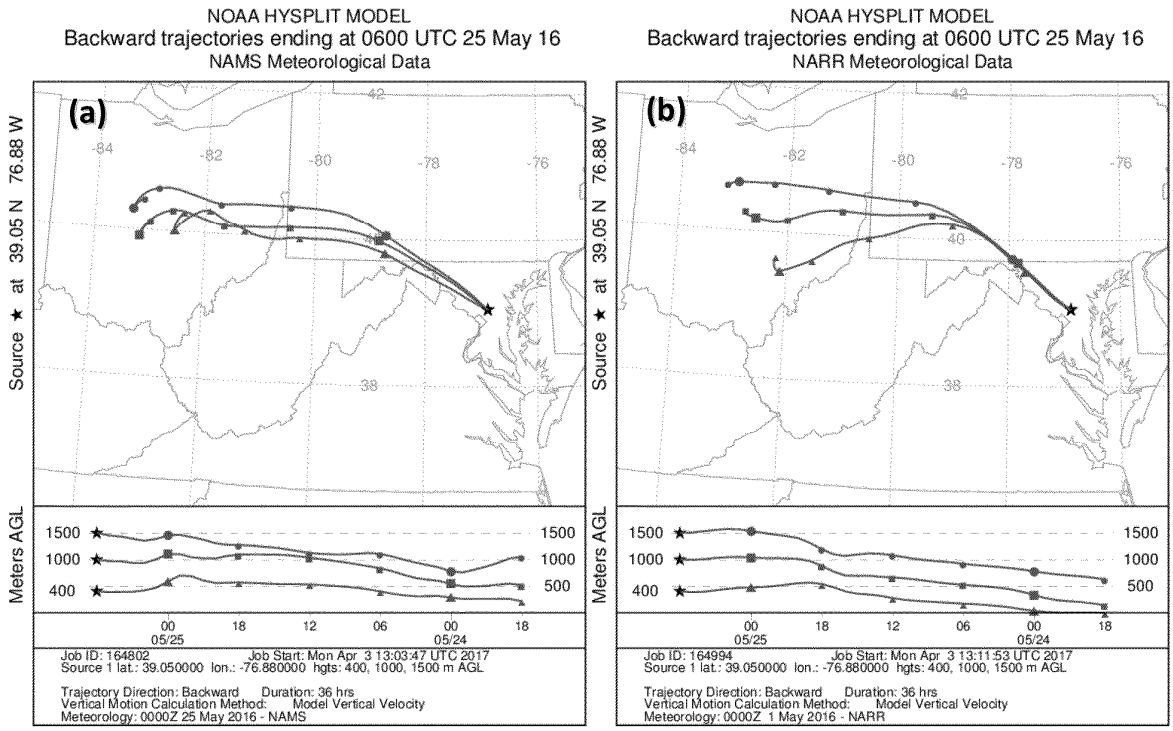

Figure 37. HYSPLIT trajectories for the ozonesondes on May 25, 2016.
The trajectories shown are 36 hour backwards trajectories beginning at the time of the ozonesondes launched at the HU - Beltsvillle site in Maryland at 2:15am (0600 UTC) on May 25 for the NAM (a) and NARR (b) meteorological datasets. The height chosen (1500m, green; 1000m, blue; 400m red) are based on features within the ozonesonde, namely the low level wind speed maximum (red), the bottom of the residual layer (blue) and the middle of the residual lay er (green). The NAM and NARR datasets are shown for comparison.

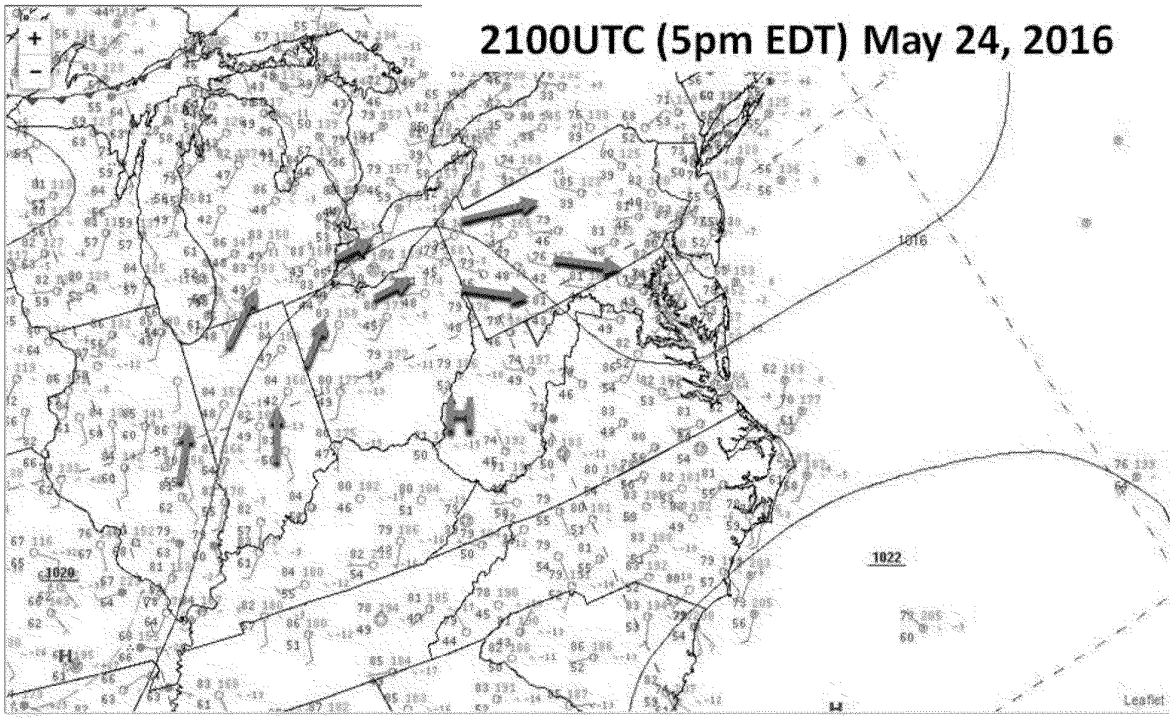

Figure 38. Surface analysis on May 24, 2016 at 5pm local time.
The blue arrows show that based on surface flow much of the smoke laden air mass was likely transported around southern Ohio and West Virginia. This is consistent with Maryland being placed on the southern fringe of the high ozone on May 25 as trans port came from the northwest.

A similar magnitude of ozone concentrations aloft was observed on the morning of May 26 as on May 25, though the ozone was not distributed as uniformly. The May 26 pre-dawn ozonesondes recorded maximum ozone above 75ppb within the residual layer between 2.5 and 3 km in height (Figure 39). Based on the inversion in the temperature profile around 2km (an inversion is where temperature no longer decreases with increasing height), this may be another layer of air with slightly different characteristics than the layer between 0.5km and 2km where ozone ranged from 60 to 70ppb. Regardless, high ozone persisted above the surface overnight from May 25 to May 26, 2016. The highest ozone concentrations between 2 and 3km were associated with winds from about 300°, slightly more westerly than May 25 but persisting from areas that on previous days recorded high ozone. Nearer the surface, particularly below 1.5km, winds were more west southwesterly (~250°). This was consistent with less smoke-influenced and ozone enhanced air being transported to the state since these regions (i.e., areas south of the Ohio River) were less impacted (though not "un-impacted") by high ozone than areas across the Great Lakes area (see Figure 18). Indeed, ozone concentrations generally decrease in the layer of transport below 1.5km to values below 70ppb as measured by the ozonesonde. The pattern of transport is similar above 3km as well where ozone decreases where winds turn towards the southwest.

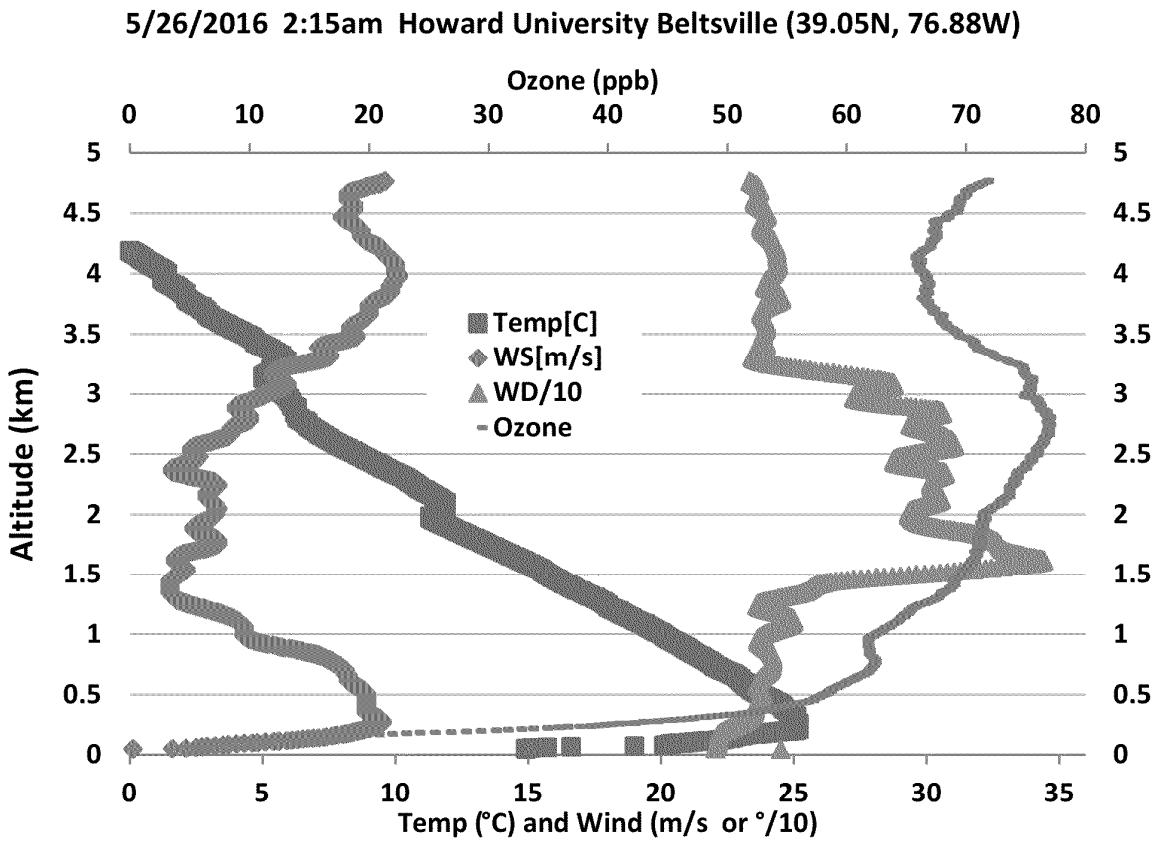

Figure 39. Ozonesonde for May 26, 2016.
Same as figure 37 but for May 26.

HYSPLIT trajectory analysis was repeated for the May 26 ozonesonde in similar fashion to the May 25 ozonesonde (Figure 40). For the May 26 ozonesonde, trajectory levels were picked at 500m, 1,500m and 2,700m to capture increased ozone concentrations within the low-level wind speed maximum, wind direction shift within the residual layer, and the peak ozone concentration within the lowest 5km, respectively. As on May 25, 36-hour back trajectories originating from HU-Beltsville were constructed for each of these heights using both the NAM (Figure 40a) and NARR (Figure 40b) meteorological datasets. Dissimilar to May 25, May 26 showed discrepancy in the trajectories between the two data sets. The discrepancy was believed to be due spatial resolution of the model attempting to capture the slowly evolving, weakly forced pattern between May 25 and 26, 2016. However, two features were consistent between the data sets. First, westerly transport was observed at 1,500m. Second, there was a trend towards southerly (cleaner) transport. The backing (counter-clockwise tendency) trend in the trajectories (as compared to May 25) was consistent with eventual southerly clean-out by May 27 (Figure 41), which resulted in the dispersal of the smoke from the region.

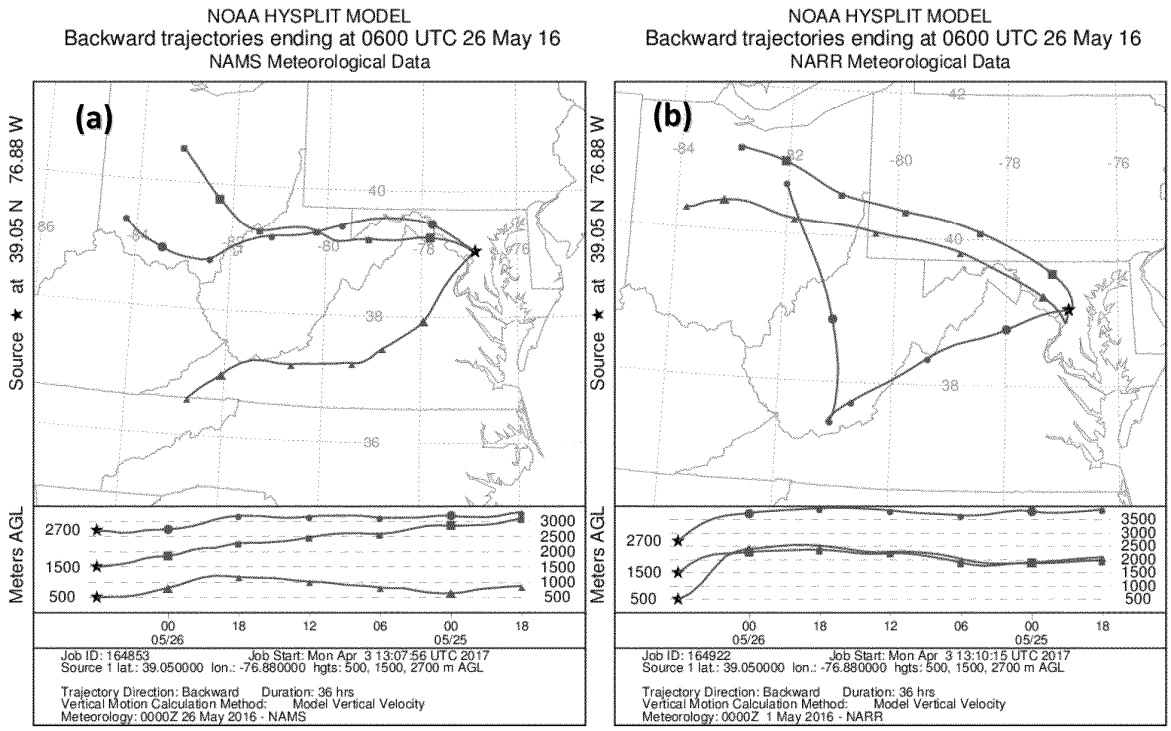

Figure 40. HYSPLIT trajectories for the ozonesondes on May 26, 2016.
The trajectories shown are 36 hour backwards trajectories beginning at the time of the ozonesondes launched at the HU -Beltsville site in Maryland at 2:15am (0600 UTC) on May 26 for the NAM (a) and NARR (b) meteorological datasets. The height chosen (2700m, green; 1500m, blue; 500m red) are based on features within the ozonesonde. Namely the low level wind speed maximum (red), the bottom of the residual layer (blue) a nd the peak in ozone concentrations seen the May 26, 2016 ozonesonde (green). Two meteorological datasets are shown for comparison.

Both ozonesondes and accompanying backwards trajectories verify that an airmass characterized by substantial ozone within the residual layer was transported into Maryland from areas (i.e., Ohio) which on previous days were on the southern periphery of the highest ozone concentrations augmented by smoke from Canada. While some ozone persisted in the residual layer on May 27, the concentration decreased in comparison to May 25 and 26, and was associated with cleaner transport from areas that had lower ozone on previous days. Winds from the southwest were apparent through a larger depth of the lower atmosphere on May 27 (Figure 41) which caused MD8AO to decrease in Maryland as compared with May 25 and 26 as ozone within the residual layer decreased (Recall that residual layer ozone will mix downwards and mix with local emissions the next day. Thus, lower concentrations in the residual layer mean less ozone is added to local ozone during the day). Ozone values were not greater than 65ppb through the depth of the atmosphere, with winds from approximately 240° (southwesterly) through that same depth. In summary, west and northwest winds were associated with enhanced ozone concentrations as measured by the ozonesonde at the onset of the smoke event in Maryland, which came from areas already influenced by the smoke plume. Once winds turned to the southwest, the smoky air cleared the area, decreasing the ozone concentrations observed in the residual layer and thereby substantially decreasing the impact on surface ozone concentrations by May 27.

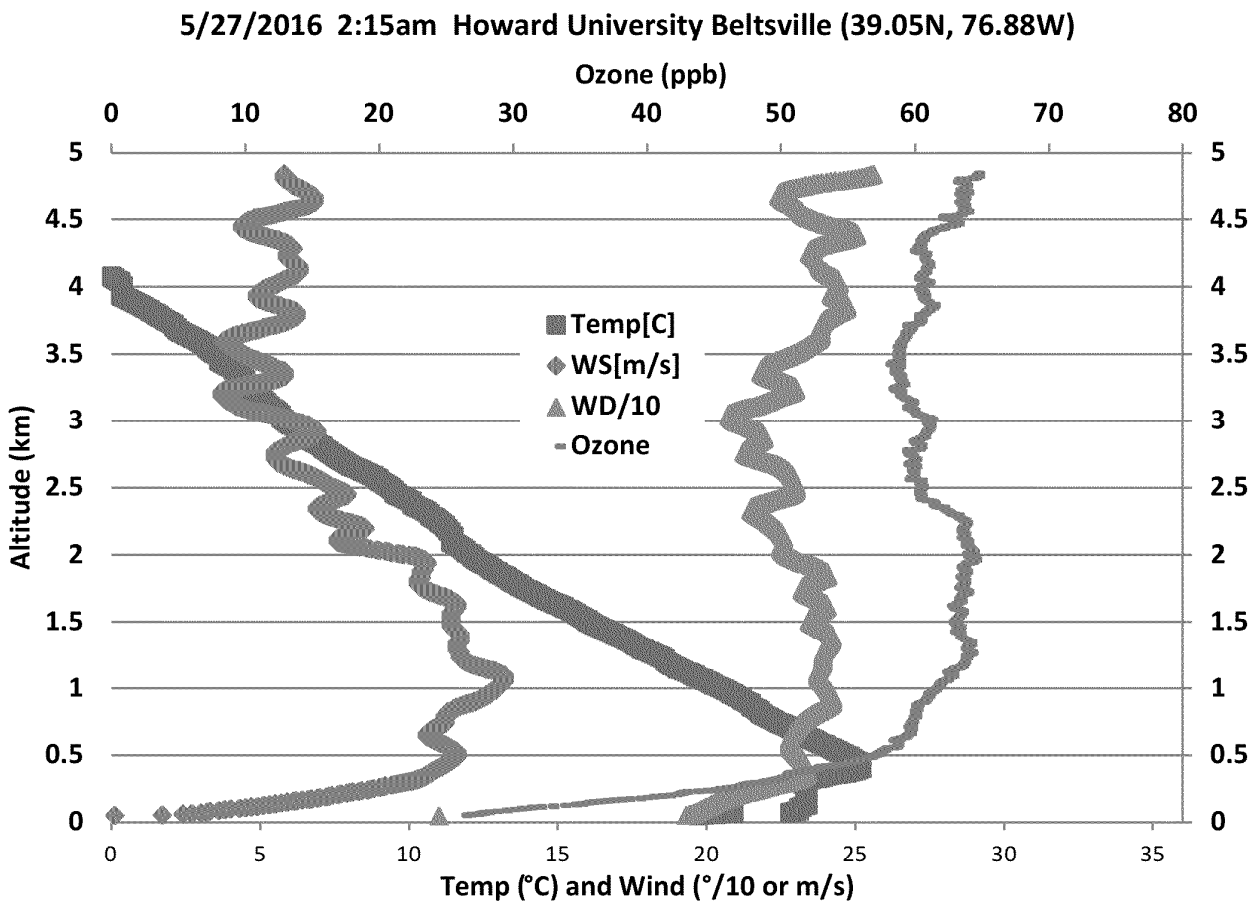

Figure 41. As in Figure 10 but for May 27, 2016.

Spatial and temporal analysis of ozone and smoke analyzed by HMS were presented in Figure 18. There MDE showed that the track and evolution of ozone which came from the northern Midwest of the CONUS was spatially correlated with analyzed smoke from May 18 through May 26. This was consistent with aloft winds observed by ozonesondes (Figures 36 and 39). In Maryland specifically, MD8AO was also greatest at the monitors directly under HMS analyzed smoke. For example, on May 25, the highest ozone concentrations were located at Fair Hill near the Pennsylvania line and at Millington on the northern eastern shore; smoke was specifically analyzed over both locations. Smoke was analyzed over the northeast portion of the state on May 26 as well where concentrations were again the highest (e.g., Padonia, Furley, Edgewood, Essex). The pattern of highest ozone under analyzed smoke was also true prior to the exceedances on May 24 in Maryland. The Piney Run, Hagerstown, and Frederick ozone monitors all had the highest MD8AO concentrations at 63, 62 and 62ppb, respectfully, on May 24, when smoke was analyzed above these western Maryland sites, which received transport of the ozone rich airmass first among Maryland monitors and therefore had the greatest time on May 24 to produce ozone before the main portion of the degraded airmass arrived in the state. Note that the Piney Run site recorded an MD8AO

concentration of 63ppb and 64ppb on May 24 and 25, respectfully. At an elevation of 766m (2,513ft), the location measures the lower portion of the residual layer. The Piney Run concentrations closely match the observed ozone concentrations on the morning of May 25 at the same altitude on the ozonesonde. Hourly observations at Piney Run at the same time as the ozonesonde on May 25 were 55 and 56ppb at 1 and 2 am EDT (not shown). Thus even the hourly concentrations observed at Piney Run were consistent with elevated ozone observed by the ozonesonde (72ppb) as shown in Figure 36. The difference in both the MD8AO and hourly observations was due to nocturnal titration (in the hourly observations) at the surface site, dry deposition during both day and night (ozone hitting nearby trees, etc.) and due to Piney Run remaining on the southwestern fringe of the highest concentrations transported in to Maryland.

3.2.2. Evidence of Wildfire Emissions via Satellite

Smoke analyses from the HMS already showed a plume of smoke being transported across the Great Lakes and Midwest towards Maryland and the northeastern CONUS. Satellites retrievals are capable of tracking wildfire species as well. When in combination with the expertly analyzed HMS smoke plume, they can together provide irrefutable evidence of the transport of wildfire ozone precursors. CO has been previously identified as a wildfire smoke indicator (Andreae and Merlet, 2001; McKeen et al., 2002, DeBell et al., 2004, Dreessen et al., 2016) and can play a role in ozone production. Total column CO (that is the sum of the CO between the ground and the satellite, most of which is near the ground unless lofted as a consequence of a large combustion source) was observed to follow a pattern of transport similar to that of the ozone exceedance conceptual model (Figure 10). Initially on May 18 (Figure 42a) a large plume emanating from the Fort McMurray area was observed across southern Canada. The plume continued eastward on May 19 (Figure 42b) though began to move southward into the CONUS. This trend continued on May 20 (Figure 42c) as additional CO was analyzed again coming from the Fort McMurray area. By May 21 (Figure 42d) the CO plume moved southward down the Mississippi River Valley area of the CONUS but otherwise consolidated over a large area from Tennessee to the Hudson Bay and over the Great Lakes area. There the plume lingered on May 22 (Figure 42e) and May 23 (Figure 42f) while slowly dissipating in intensity as CO in the plume reacted with other species in the atmosphere. By May 24 the plume had begun to slide eastward and was analyzed over Maryland (Figure 42g). Evidence of the plume persisting across the northeast CONUS is present on May 25 as well (Figure 42h), however a missing satellite overpass prevents additional conclusions for May 25. However, interpolating between May 24, 25 and where the plume was observed on May 26 (Figure 42i) strongly suggests its presence over Maryland on May 25 as well, considering the plume still was over Maryland on May 26. Note that the observation of the plume over the eastern half of the state on May 26 was consistent with the analyzed smoke by HMS on the same date. This provides further evidence that wildfire emissions were indeed transported to Maryland on the two days in question: May 25 and 26, 2016.

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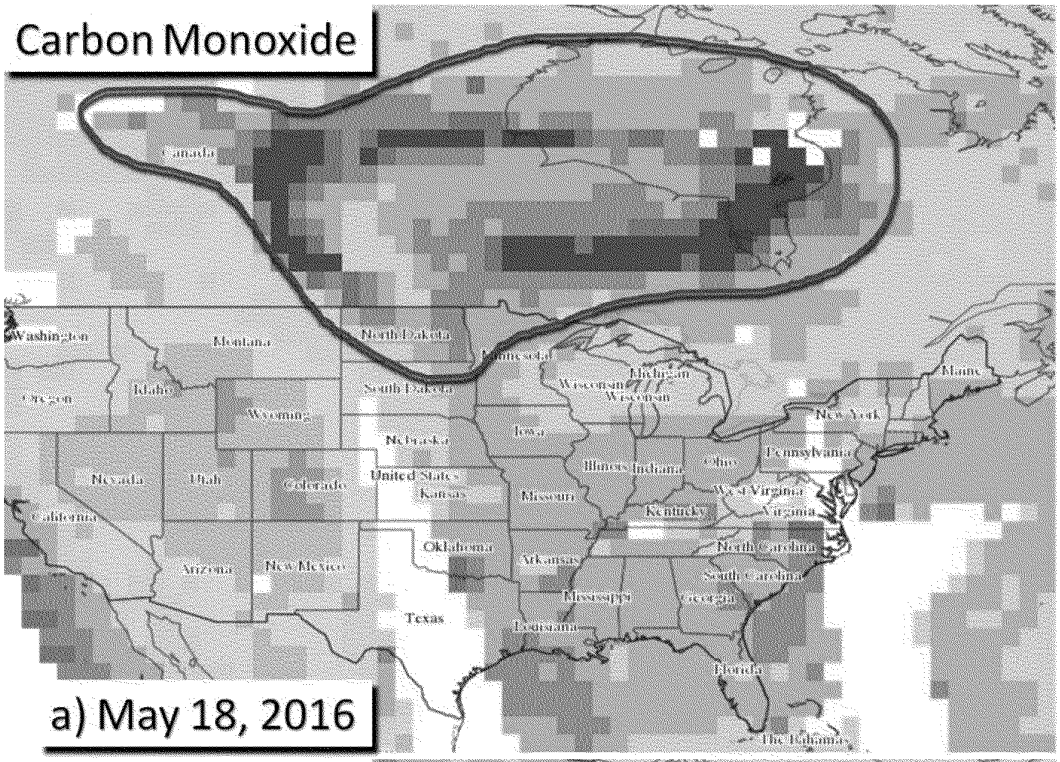

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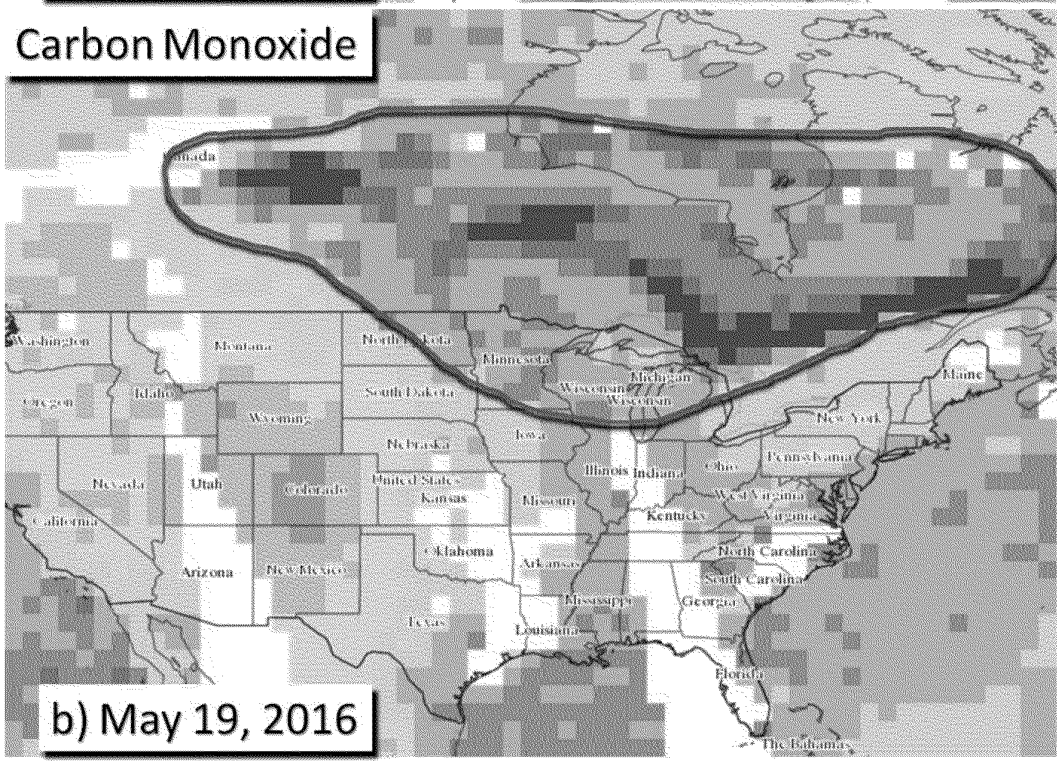

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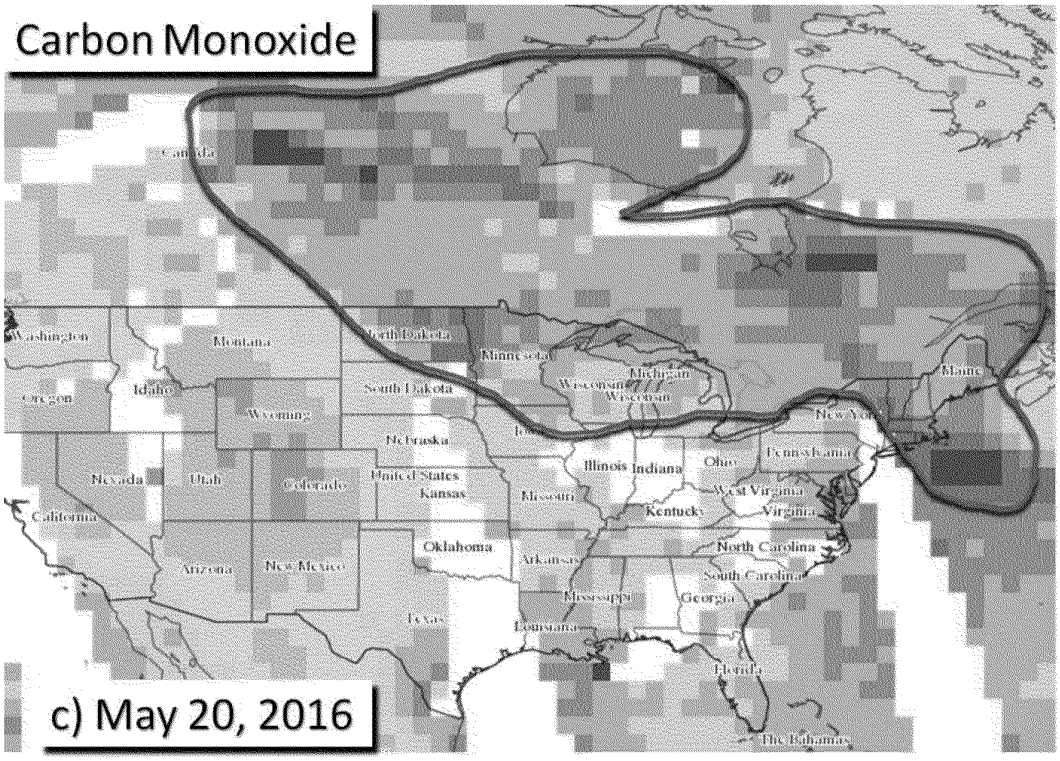
Carbon Monoxide
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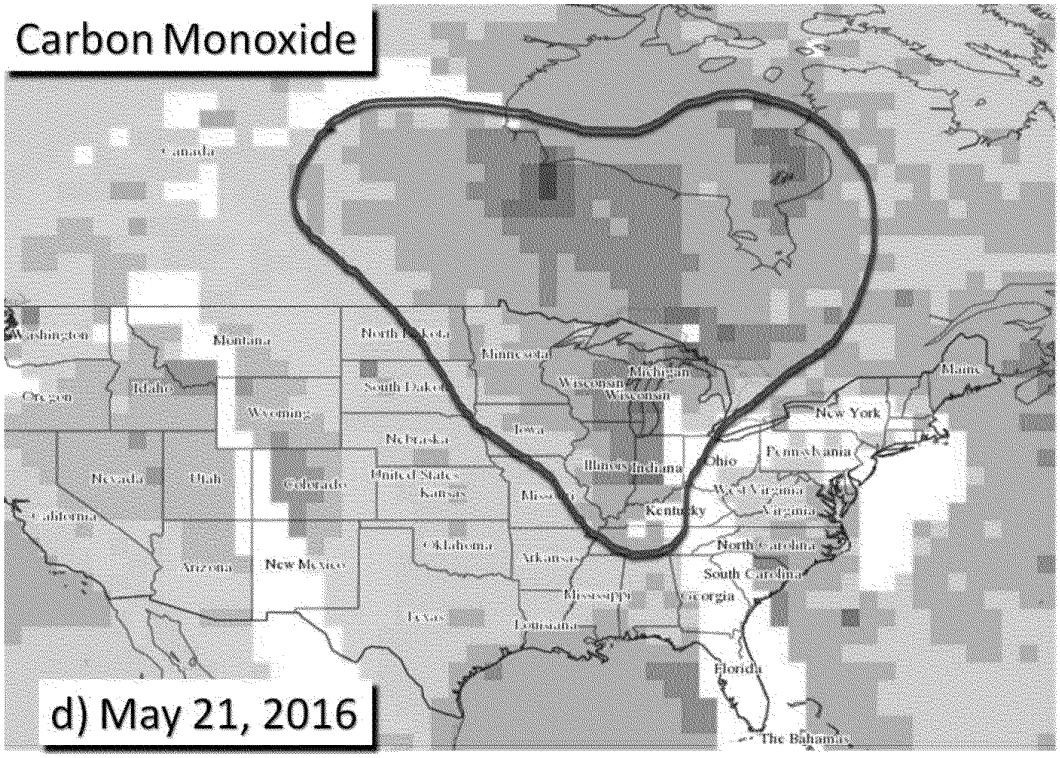
Illinois
Indiana
Ohio
Nevada
Utah
Colorado
United States
Kansas
Missouri
West Virginia
Kentucky
Virginia
California
Oklahoma
Arkansas
North Carolina
Arizona
New Mexico
South Carolina
Mississippi
Georgia
Texas
Louisiana
Florida
The Bahamas
c) May 20, 2016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Illinois
Indiana
Ohio
Nevada
Utah
Colorado
United States
Kansas
Missouri
West Virginia
Kentucky
Virginia
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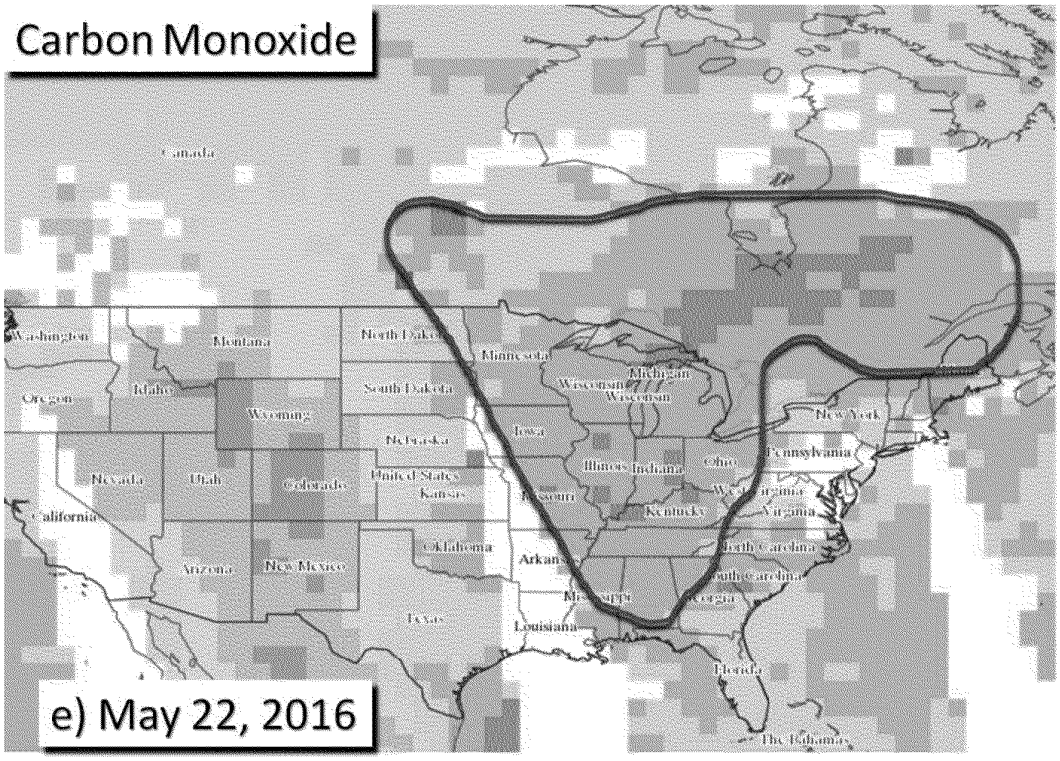
Louisiana
Florida
The Bahamas
d) May 21, 2016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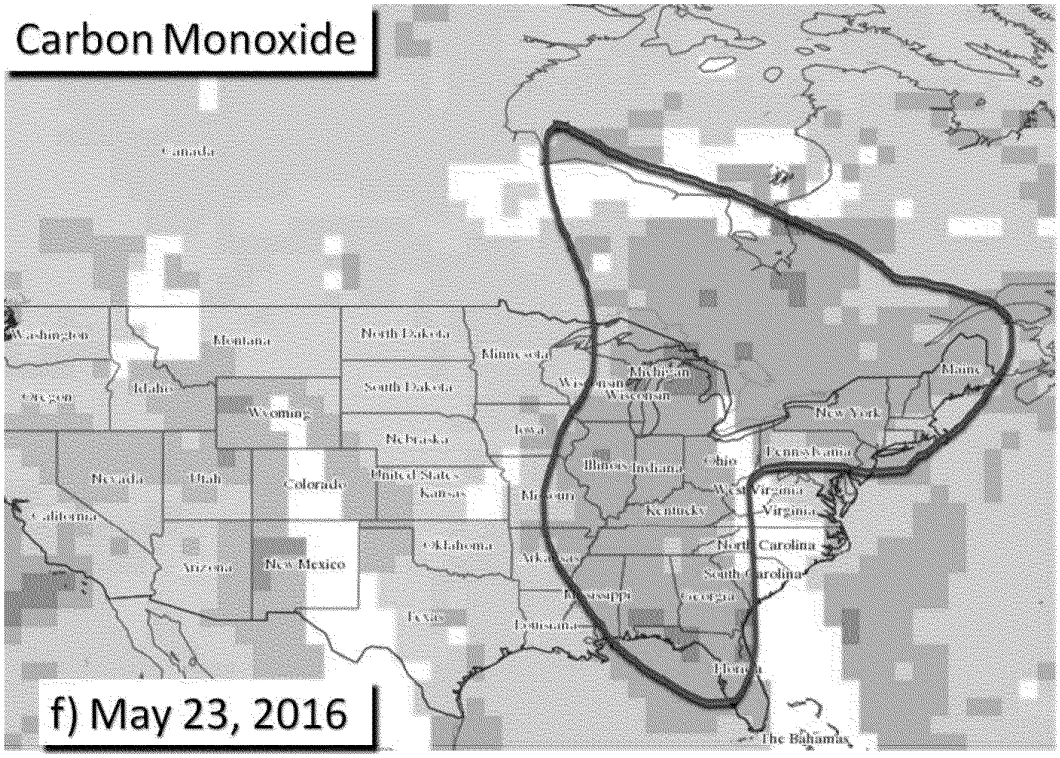
Nevada
Utah
Colorado
United States
Kansas
Illinois
Indiana
Ohio
California
Kentucky
Virginia
Oklahoma
Arkansas
North Carolina
Arizona
New Mexico
South Carolina
Texas
Louisiana
Florida
The Bahamas
e) May 22, 2016


Carbon Monoxide
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Nevada
Utah
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United States
Kansas
Illinois
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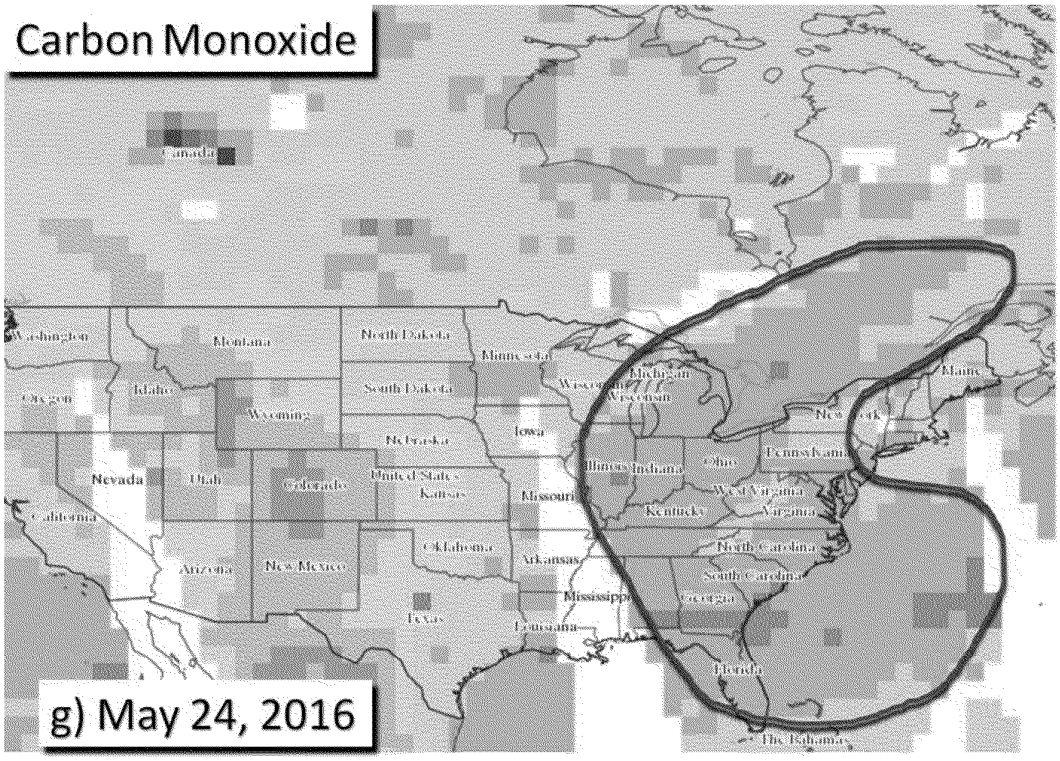
Louisiana
Florida
The Bahamas
f) May 23, 2016


Carbon Monoxide
Canada
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Minnesota
Oregon
Idaho
South Dakota
Wisconsin
Michigan
Wyoming
Nebraska
Iowa
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Colorado
United States
Kansas
Missouri
Illinois
Indiana
Ohio
Pennsylvania
Maine
West Virginia
Kentucky
Virginia
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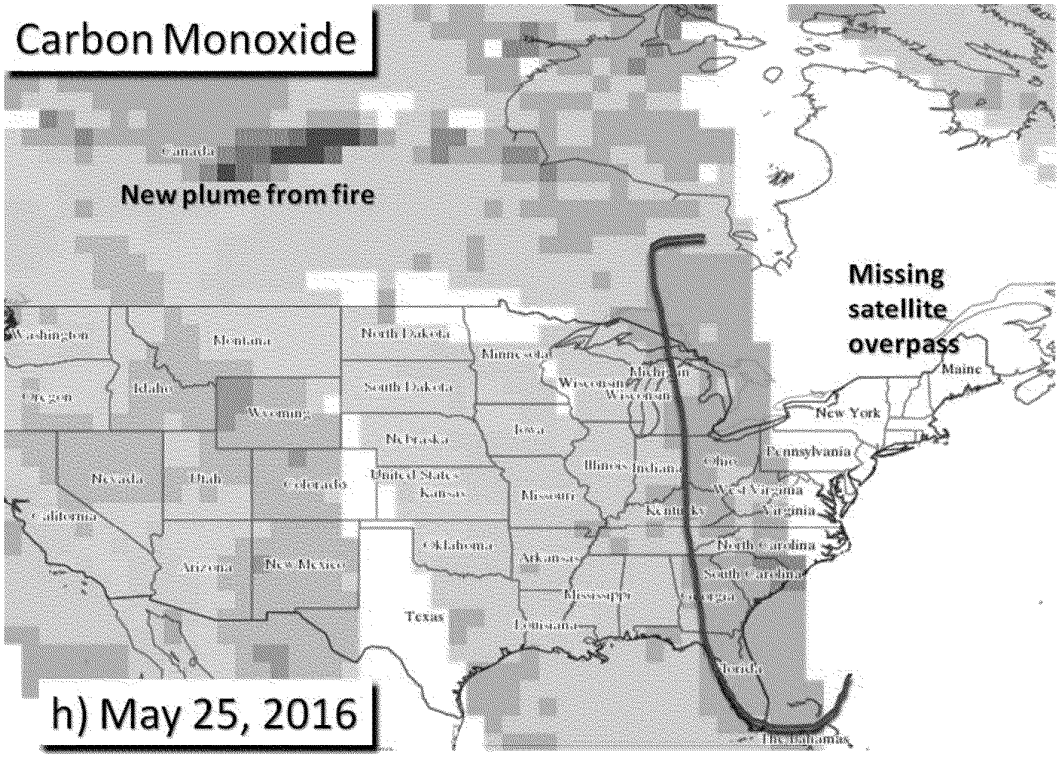
Louisiana
Florida
The Bahamas
g) May 24, 2016


Carbon Monoxide
Canada
New plume from fire
Missing satellite overpass
Washington
Montana
North Dakota
Minnesota
Oregon
Idaho
South Dakota
Wisconsin
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Iowa
New York
Nevada
Utah
Colorado
United States
Kansas
Missouri
Illinois
Indiana
Ohio
Pennsylvania
Maine
West Virginia
Kentucky
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Mississippi
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Louisiana
Florida
The Bahamas
h) May 25, 2016

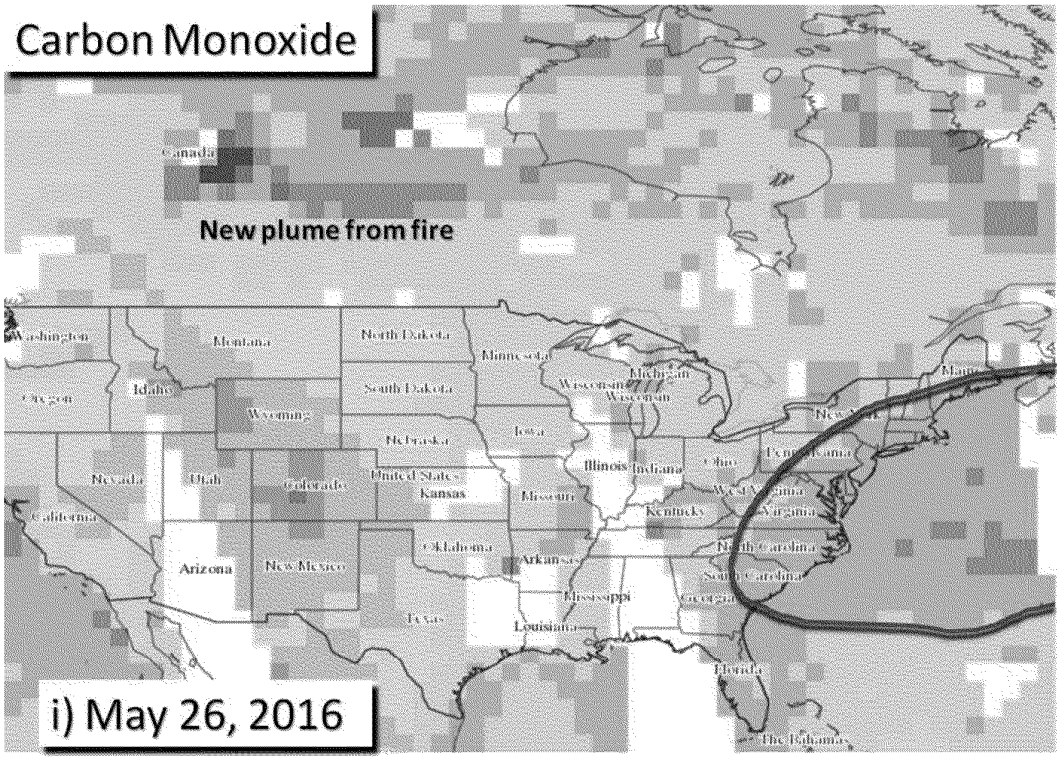

Figure 42. Carbon monoxide: total column for May 18-26, 2016.
A plume of carbon monoxide (CO) traveled from the Fort McMurray area. Darker reds indicate more CO in the atmospheric column. Greens and blues indicate low concentrations of CO in the column. The plume and its movement is identified by the bold line. NASA Giovanni data service provided access to the satellite retrievals https://giovanni.gsfc.nasa.gov/giovanni/.

3.3. Q/d Analysis

EPA guidance [Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016] recommends conducting a Q/d analysis as a rough assessment of the ability of a wildfire to cause increased ozone concentrations. The Q/d analysis is simply a comparison of the ratio of Q, the daily tons of VOC and NOx emitted from the fire, to d, the distance in kilometers from the fire to the point of concern. If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern. The comparison to other fires is a key point that will be brought up again.

EPA guidance indicates that a fire should have a Q/d in excess of 100 tons per day per kilometer (tpd/km) in order to be considered to have a clear causal impact on ozone. EPA developed this value based on analyses of four fires which occurred in 2011. Due to the large distances which Canadian wildfire plumes must travel to Maryland, the Q/d analysis will regularly fail to achieve the 100 deemed acceptable by the EPA guidance.

Therefore, MDE feels the 100 value is not representative for long-range east-coast smoke events. MDE instead presents several alternatives based on this analysis.

3.3.1. Estimate of Q

The emissions from the fire can be estimated using information from EPA's AP-42 Compilation of Air Emission Factors Section 13.1 Wildfires and Prescribed Burning. The equations given are as follows:

Fi = Pi * L (Equation 1)
Ei = Fi * A (Equation 2)

Fi = emission factor (mass of pollutant/unit area of forest consumed)
Pi = yield for pollutant "i" (mass of pollutant/unit mass of forest fuel consumed)
= 12 kg/Mg (24 lb/ton) for total hydrocarbon (as CH4)
= 2 kg/Mg (4 lb/ton) for nitrogen oxides (NOx)

L = fuel loading consumed (mass of forest fuel/unit land area burned)
A = land area burned
Ei = total emissions of pollutant "i" (mass pollutant)

Combining equations 1 and 2, we have:

Ei = Pi * L * A

Pi is given above for total hydrocarbons and for nitrogen oxides. The fuel loading is given in AP-42 for different regions of the United States and ranges from 9 to 60 tons per acre. Conservatively, we will estimate a low end emission rate using 10 tons per acre which is associated with North Central US conifer forests. Note that our results could increase by a factor of 6 were the high end of emissions expected.

The Alberta government reported that by June 10, 2016 the fire ultimately covered 589,995 hectares (1,457,909 acres) with a perimeter of 996 kilometers (618 miles). For reference, the total land area of Rhode Island is approximately 270,000 hectares.[7] The chart below indicates the total area covered by the fire as reported by the Alberta government (Figure 43)[8]. During the days prior to the smoke plume entering US space (May 17- 21) the fire grew by approximately 149,000 hectares (368,187 acres).

Therefore, ignoring the smoldering of previously burned areas AND perhaps more significantly, any additional fuels burned within the Southern Canada fires (Figure 6) the total hydrocarbon emissions from the period can be estimated to be:
Ehc = 24 lbs of HC / ton of forest fuel consumed * 10 tons fuel / acre * 368,187 acres
Ehc =88,364,880 pounds of HC

[7] Any large area estimate is more comprehensible if compared to a familiar area such as the State of Rhode Island.
[8] https://www.alberta.ca/release.cfm?xID=41701E7ECBE35-AD48-5793-1642C499FF0DE4CF [Final Update 39: 2016 Wildfires (June 10 at 4:30 p.m.), Alberta Government]

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Ehc = 44,182 tons of HC emitted during the period from May 17 to May 20

Similarly for NOx:
Enox = 4 lbs of NOx / ton of forest fuel consumed * 10 tons fuel / acre * 368,187 acres
Enox = 14,727,480 pounds of NOx
Enox = 7,364 tons of NOx emitted during the period from May 17 to May 20

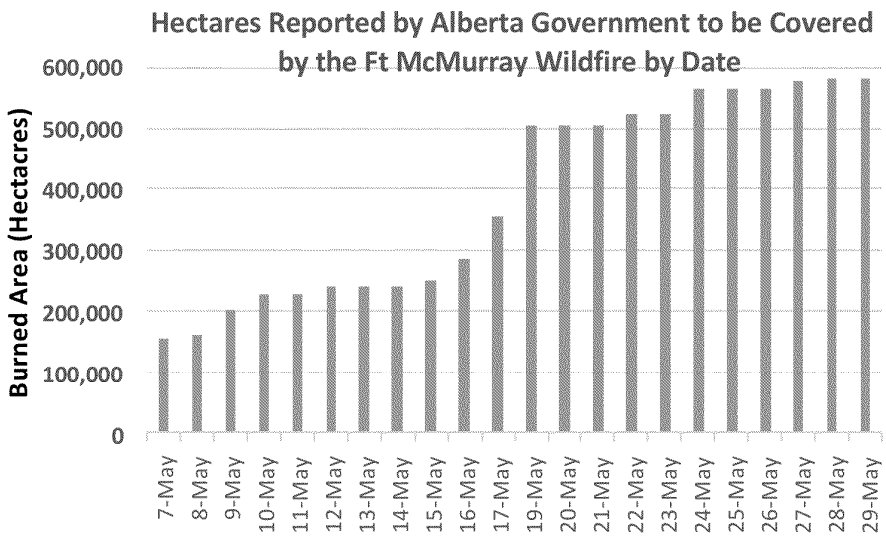

Figure 43. Hectares burned reported by Alberta Government by the Fort McMurray wildfire.
There is a sharp increase in the fire size between May 17 and May 20, leading to an increase in emissions in that time period. No data was available for May 18, 2016

Q is the total daily emission rate in tons per day of reactive hydrocarbons and nitrogen oxides. EPA recommends in the exceptional events guidance that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions become rHC = 0.6 * Ehc or 0.6 * 44,182 = 26,509 tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NOx emissions. Therefore the total rHC and NOx emissions over the period are 26,509 + 7,364, or 33,873 tons over the four days. On average this results in a daily emission rate, or Q, of 8,468 tons per day. However, data from Alberta shows that most of these emissions came over 2-3 days, (May 17 to May 19). A more reasonable estimate is 33,873/2.5 = 13,549 tons per day.*

*No fire size estimate was provided for May 18 by the Alberta Government site.

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3.3.2. Estimate of d

Based on the large distance, there will not be individual analyses completed for each monitor in Maryland but an estimate of the distance from the Fort McMurray fire to the most distant monitor in Maryland will be calculated. This will supply a conservative yet representative distance the smoke traveled to the Maryland ozone network. A value of 3,280 km was therefore used for d, the flight distance from Fort McMurray to the Blackwater NWR monitor, near Cambridge, MD on the southern eastern shore.

3.3.3. Q/d Estimate

Using the values determined above, Q/d becomes 13,549 tpd divided by 3280 km or 4.1 tpd/km (Table 4). This value is well below the EPA recommended level of 100 tpd/km indicating clear causality. If instead we aggressively assumed the out of control fire consumed most of its fuel between May 17 and May 21 in one day's time, Maryland's Q/d value climbs to 10.3. Still well below 100. This assumes, however, no contribution of other fires in Canada or from other fires in Mexico which may have also mixed in with the plume across the Mississippi River Valley.

Table 4. Q/d analysis for various scenarios.

ACRES	Ehc (tons)	Enox (tons)	Q (tons)	No. days burning	d (km)	Q/d	DESCRIPTION
368,187	44,182	7,364	33,873	2.5	3280	4.1	Standard Q/d
368,187	44,182	7,364	33,873	1.0	3280	10.3	If the entire area burned between 5/17 & 5/20 burned in one day
368,187	45,000	3,000	48,000	1.0	3280	14.6	Comparing the Wallow Fire emissions to Fort McMurray; No Ehc adjustment
368,187	265,095	44,182	203,239	2.5	3280	24.8	Fuel loading at a maximum of 60 tons/arce instead of 10
368,187	265,095	44,182	203,239	1.0	1735	117.1	Maximum fuel loading, 1-day burning, with plume impacting Minneapolis, at MN

Taking a slightly different approach MDE considered the basis for the EPA guidance and look at emissions from one of the four fires EPA relied on in developing their guidance. Appendix A2 of the EPA Exceptiona Guidance Document indicates that EPA based their conclusions on 12 km grid CMAQ modeling of four 2011 multiday fires: Wallow, Waterhole, Big Hill and Flint Hills. Emissions from the fires were based on a program called SMARTFIRE. Using information available on the Wallow Fire, MDE approximated the emissions that might be calculated for the Fort McMurray fire.

The Wallow Fire was located in eastern Arizona and western New Mexico from May 29, 2011 through July 8, 2011 and burned 841 square miles (538,240 acres) by June 26th. The maximum daily emissions from that fire were reported as approximately 15,000 tons of rVOC and 1,000 tons of NOx. [Simulating Fire Event

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Impacts on Regional ozone and $PM_{2.5}$ and Looking Forward Toward Evaluation, Kirk Baker, EPA October 5, 2015 and Using SOAS and related field study data for scientific and regulatory modeling, Kirk Baker, EPA, undated; both are slide presentations] If this fire were scaled up by a factor of three to approximate the total acreage burned in the Fort McMurray fire, then the daily emissions were as high as 45,000 tons for rVOC and 3,000 tons for NOx. These emissions produce a Q of 48,000 tpd and Q/d becomes 14.6 for Maryland – still well below EPA expectation for causality.

Taking a less conservative approach and recalling that a worst case fuel loading would increase our Q results by a factor of six, Q/d would in this case result in ~25 tpd/km; better, but not up to EPA's threshold of 100 tpd/km. While this approach might be justified by the ongoing smoldering of the peat and/or the intensity of the Fort McMurray fire, variability in the burn rate and other factors make it difficult to justify the fuel load increase without further details that may only be obtained through estimates which introduce their own error.

An ozone exceedance occurred in Minnesota on May 21, 2016. This location was only 1735 km away from the Fort McMurray fire source. It was not unreasonable to assume that 368,000 acres may have burned in approximately one day given the out of control nature of the fire. Without a size assessment on May 18, there was no way to discount this. It was also not inconceivable that the fuel load was closer to 60 tons/acre due to the ravage nature of the fire. Under these assumptions (i.e., assuming the entire area burned in one day with maximum fuel load), the Q/d value increases to 117 tpd/km in Minneapolis, MN. This would indicate that where the smoke precursors subsided to the surface with conducive local conditions (warm, sunny), ozone did respond with increased Q/d analysis over 100 tpd/km. Additionally, no contribution from sporadic but numerous wildfires across southern Saskatchewan were added to this analysis, which could bring the Q/d analysis even further above 100 tpd/km without making any liberal assumption of the emissions. The implications for Maryland are that the upstream airmass was ozone conducive and showed a clear causal relationship to the fire, meeting the EPA threshold of 100 tpd/km for Q/d analysis and was producing ozone due to the smoke before entering Maryland. Furthermore, due to the lofted nature of the smoke to the free atmosphere, it may be possible for precursors to not react as quickly as lower-level transport cases establishing the 100 tpd/km threshold such that 100 tpd/km is not representative of Canadian wildfire cases impacting the US. In Minnesota, May 21, 2016 was the highest ozone and the only exceedance for the entire 2016 season for that state. Such findings satisfy both Key Factors 1 and 2 in the EPA Exceptional Events Guidance and further suggest the smoke plume's impact on Maryland was exceptional in nature.

EPA guidance states that *"If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern."* Since 2015, at least three major Canadian wildfire episodes have impacted Maryland: June 9-12, 2015 (as thoroughly described in Dreessen et al., 2015); May 25-26, 2016; and July 20-22, 2016. Thus, by EPA's Q/d definition, MDE now has a small subset to compare other wildfire impacts on ozone within the contemporary emissions environment. A Q/d analysis for July 2016 is done in that exceptional event analysis. For June of 2015, Q/d was calculated using values in Dreessen et al., 2016, which listed 77,000

acres burned in a two (2) day period and smoke transported 3100km from central Saskatchewan. Dreessen et al., 2016, goes on to show the impact of the smoke plume as it descended on the eastern Midwest and Mid-Atlantic on June 9-11, 2015 and showed clear wildfire signatures and influences on ozone. Based on that research, Q/d for that ozone episode would have been 1.1 (Table 5). The May event demonstrated here had a Q/d four times as large (4.1). The July 2016 event had a Q/d of 1.8. Some research has noted the uncertainties in the influence of wildfire emissions in terms of strength and composition on ozone production (e.g., Hu et al., 2008). Thus it is quite plausible the value of 100 for Q/d is not relevant for long-range transport cases. It appears a more appropriate Q/d number for Canadian wildfire smoke transport cases to Maryland is closer to one (1), 100 times lower than the EPA suggested value. As the May 25-26 ozone event had a Q/d value which compared favorably with other fire events in Maryland, MDE believes this shows a clear causal relationship between the ozone and smoke.

Table 5. Q/d Analysis for three Canadian Wildfire events impacting Maryland.

ACRES	Ehc (tons)	Enox (tons)	Q (tons)	No. days burning	d (km)	Q/d	DESCRIPTION
368,187	44,182.00	7,364.00	33,873.20	2.5	3280	4.1	Fort McMurray - May 2016
271,134	32,536	5,423	24,945	4.0	3530	1.8	Northwest Territories - July 2016
77,000	5,544.00	1,540.00	7,084.00	2.0	3100	1.1	Lac La Ronge - June 2015

Noting the wide variability in emissions estimates from different approaches, and as the Q/d method does not generally satisfy the expectation of a clear causal impact, other evidence is presented demonstrating that the smoke plume from the Fort McMurray fire caused elevated ozone levels in Maryland.

3.4. 99th Percentiles

As part of demonstrating a clear causal relationship between ozone concentrations and the fire event, monitored concentrations were put in the context of historical observations. Observations at monitors falling at or above the 99th percentile in the past five years establish statistical evidence that the event was likely influenced by an exceptional event and are a "Key Factor" used to determine whether a Tier 2 application is appropriate. Following the Exceptional Events Guidance, the 99th percentile was calculated for all Maryland monitors for all days of the ozone season (April – September) from 2012-2016. Additionally the 99th percentile was calculated for all days of the ozone season excluding 2012, and all days of the month of May 2012-2016 to account for the rapid emission changes ongoing across the eastern US. These percentiles have been presented previously in scatter plots in Figures 19-34 and summarized in section 3.1 Historical Concentrations. For convenience, a summary table with comparisons of all the 99th percentiles is given in Table 6.

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Table 6. 99th percentile values and comparisons to observations on May 25 and 26, 2016.
The 16 Maryland monitors for which MDE is seeking exclusion of exceptional event influenced have their 99th percentiles presented based on data from April 1 – September 30, 2012-2016, only 2013-2016, and only May 2012-2016. The final 6 columns highlight which monitors exceed their 99th percentile level ("YES") for a given data set and day (May 25 or 26). Blanks indicate the monitor did not meet the 99th percentile for that dataset.

		99th Percentile [ppm]			May 25, 2016			May 26, 2016		
Name	AQScode	All Data	No 2012	May Only	All Data	No 2012	May Only	All Data	No 2012	May Only
Aldino	240259001	0.0790	0.0768	0.0750		YES	YES		YES	YES
Beltsville CASTNET	240339991	0.0820	0.0743	0.0720		YES	YES			
Blackwater NWR CASTNET	240199991	0.0725	0.0680	0.0719				YES	YES	YES
Calvert	240090011	0.0769	0.0710	0.0736					YES	YES
Edgewood	240251001	0.0800	0.0790	0.0747			YES		YES	YES
Essex	240053001	0.0780	0.0750	0.0728	YES	YES	YES	YES	YES	YES
Fair Hill	240150003	0.0831	0.0799	0.0778		YES	YES			
Furley	245100054	0.0744	0.0724	0.0731	YES	YES	YES	YES	YES	YES
Glen Burnie	240031003	0.0770	0.0770	0.0757						YES
Horn Point	240190004	0.0772	0.0670	0.0715		YES			YES	YES
HU-Beltsville	240330030	0.0780	0.0720	0.0740		YES			YES	
Millington	240290002	0.0830	0.0729	0.0751	YES	YES	YES		YES	YES
Padonia	240051007	0.0800	0.0760	0.0750				YES	YES	YES
PG Eq Cntr	240338003	0.0809	0.0737	0.0714		YES	YES			
S. Maryland	240170010	0.0771	0.0726	0.0709					YES	YES
South Carroll	240130001	0.0739	0.0700	0.0709		YES	YES	YES	YES	YES

3.5. Evidence that the Fire Emissions Affected the Monitors

3.5.1. Evidence of Fire Emissions in Maryland

Wildfires produce both primary and secondary pollutants which may be utilized to track the impact of smoke downstream from the fire source. While satellites may be able to track smoke plumes over wide areas and easily track their transport, they do not necessarily confirm the existence of smoke at the surface by themselves. The MDE monitoring network observes total $PM_{2.5}$ mass and speciated compounds such as ionic potassium (K+) and organic carbon (OC), as well as other pollutants like CO and NOx, which can act as tracers of wildfire emissions. Analyses of these various species which can be attributed to wildfires are here presented. The analyses show the ozone episode in Maryland was characterized by enhanced concentrations of wildfire species. Unfortunately, the specific days of interest in Maryland (May 25 and 26) did not fall on 1 in 3 run speciation days. However, enough influence of the fire was seen both upstream and lingering in Maryland on May 24 and 27, 2016 to clearly demonstrate the surface air was impacted by wildfire smoke.

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3.5.2. Particles

$PM_{2.5}$ can be both a primary pollutant and a resultant secondary pollutant of wildfire emissions downstream as photochemistry within the plume converts certain species to aerosol. The entire MDE network showed a correlated increase in $PM_{2.5}$ 24-hour averages from May 24 –29 which aligned with the onset of the smoke plume in Maryland (Figure 44). No other period of the month exhibited such a coherent increase across the entire Maryland network. Though the late May period did not possess the highest particle observations of the month, it did exhibit the highest distribution and highest-low observation for the entire month. The fine particle observations therefore provided additional evidence that along with ozone and ozone precursors, fine particles were transported within the smoke affected airmass and were a distinct indicator of wildfire emissions, particularly since speciated particles associated with wildfire emissions showed similar increases.

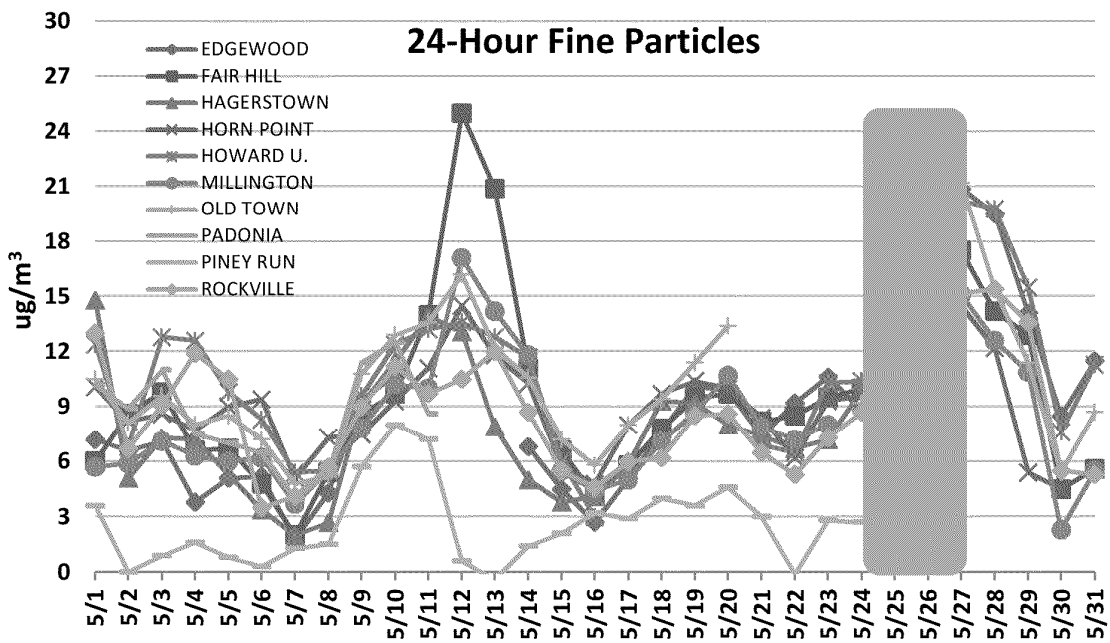

Figure 44. Daily averaged fine particle (PM2.5) concentrations for all sites available in Maryland for the month of May, 2016. The smoke influence as defined by the HMS analysis described in the conceptual model of this document is highlighted by the yellow shading from May 24-27.

3.5.2.1. Potassium Ions and Organic Carbon

Particle pollution generated from biomass burning is typically dominated by organic carbon (OC) and black carbon (BC; Martins et al., 1998), and possesses ions such as potassium (Lee et al., 2010). Ionic potassium (K+) acts as a useful tracer of wildfire smoke because there are few anthropogenic sources, and concentrations above background levels are a signature of wildfire emissions. MDE's 1 in 3 sampling days missed the exceedances on May 25 and 26 (no speciation data on the day of the exceedances). However, the speciation samples did bracket the event on May 24 and 27 and evidence presented here-in has

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displayed that some initial smoke influences began on May 24 and persisted in to May 27 in Maryland. The samples collected showed concentrations of K+ and OC were amplified in late May indicating wildfire smoke presence in the surface air across Maryland (Figure 45). K+ mass during the May ozone event was not the highest in April or May, but was still elevated and the quantity of ions were nearly identical on May 24 and May 27 at both Essex and HU-Beltsville monitoring sites clearly demonstrating a uniform pollutant load of potassium across Maryland. This is unlike other days which might have been higher but only at a single monitor. OC mass was the highest for both monitors in late May, coinciding with the smoke event which was a clear indicator of wildfire influence. The highest concentrations were on May 27, the day after the highest, most widespread ozone day in Maryland of 2016. In the present study, only the fringes of the most significantly affected air were sampled on May 24 and May 27. Additionally, transport of the photochemically aged airmass took upwards of five days to reach Maryland. Regardless, the data of these smoke tracers show a temporal maximum bracketing the ozone exceedance in Maryland. These pollutants provide a heavy weight of evidential support of the presence of smoke at the surface during this exceptional ozone event.

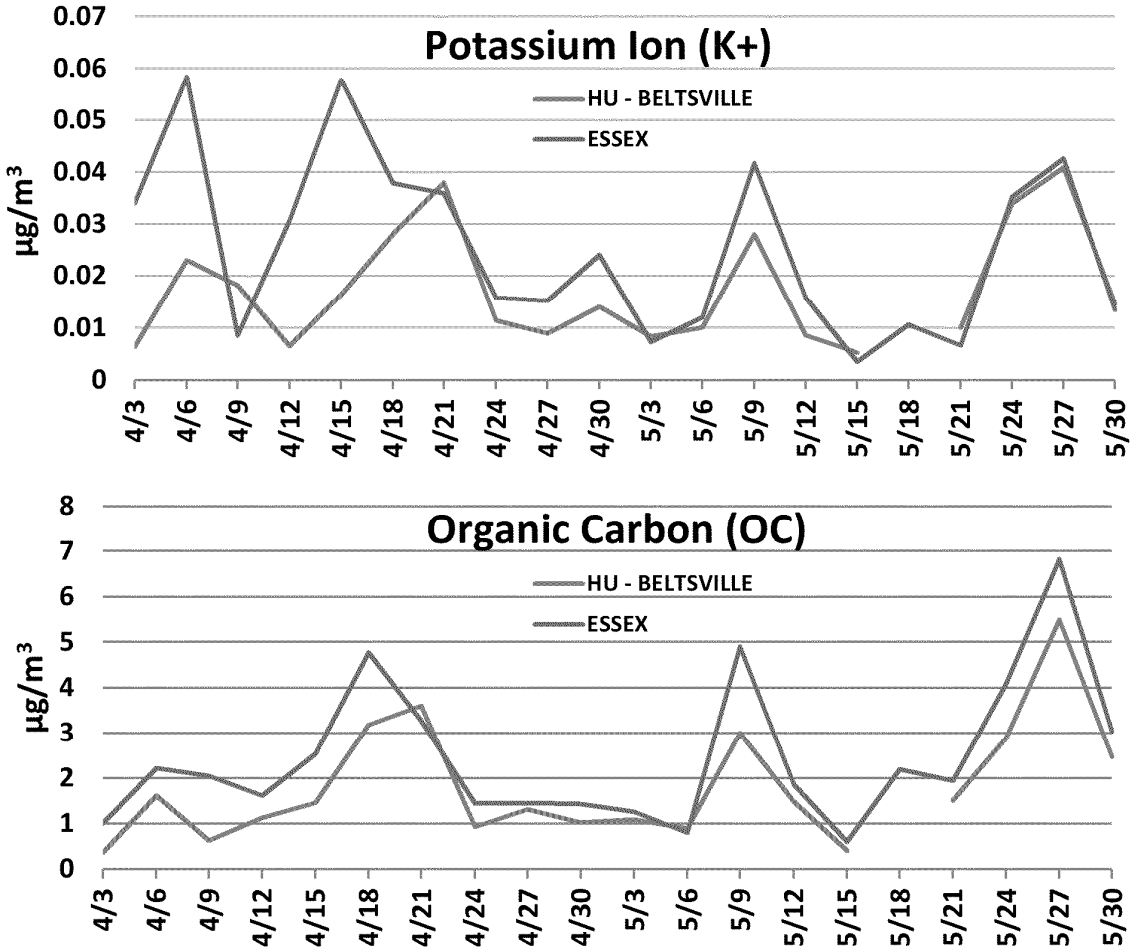

Figure 45. (a) Potassium Ion and (b) Organic Carbon, sampled every third day, from April through May of 2016.

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The two sites shown are Essex and Howard University (HU) Beltsville. Potassium Ions during the May ozone event were not the highest in the two months shown, however, the quantity of ions were nearly identical on May 24 and May 27 at both sites, suggesting uniform pollutant load of potassium across the region. Organic Carbon mass is the highest for both months in late May, coinciding with the smoke event. The highest concentrations were on May 27, the day after the highest, most widespread ozone day in Maryland of 2016.

3.5.3. Carbon Monoxide (CO)

CO has been previously identified as a wildfire smoke indicator, can play a role in ozone production, and followed similar trends to other pollutants over the lifetime of the event (Figure 46). Essex, HU-Beltsville, and the Howard County (HoCo) Near Road sites all had the highest CO concentration of the entire month of May on May 25 and 26. To a lesser extent, other monitors (Piney Run and Horn Point) showed an increase in CO as well, though recall these sites were less impacted by the smoke plume than the more northern and eastern monitors in Maryland. The increase in CO at Essex and HUB coincident with increased wildfire particle species and increased concentrations of ozone observed aloft provided irrefutable evidence for the direct impact of the smoke at the surface. Consistent with these surface observations were total column CO retrievals from satellite generated via Giovanni Data (https://disc.gsfc.nasa.gov/ Figure 42). The satellite showed a plume of enhanced CO starting over Canada meandering southeastward across the Great Lakes in line with the time frame outlined in the conceptual model (see section 2). The plume arrived over Maryland in agreement with the increased CO concentrations at Maryland surface monitors (Figure 46). Together, these observations indicated that wildfire-related ozone precursors were present to contribute to ozone production upstream across the Midwest and then moved into Maryland by May 25.

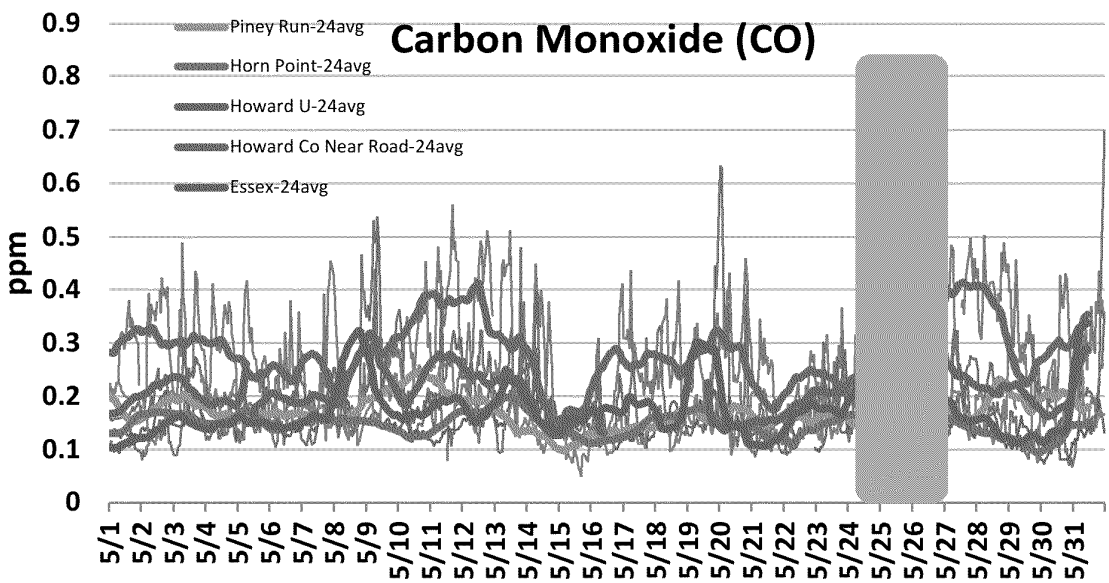

Figure 46. Hourly Carbon Monoxide (CO) overlaid with a running 24-hour average at five sites in Maryland. The smoke event is highlight in yellow. "24avg" indicates the thick lines drawn are a running 24-hour boxcar average of the underlying hourly data, given as fine lines of the same color in the time series.

3.5.4. Nitrogen Oxides

Singh et al. (2012) showed that ozone production rates from wildfires in California were dependent upon available NOx (NOx = sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2)) and that NOx from the fires themselves was relatively low. However, NOx emissions from fires can vary greatly and research has noted the uncertainties in the influence of wildfire emissions from one to another (e.g., Hu et al., 2008). In the current study, the monitors observing the highest ozone concentrations were near urbanized areas on May 21 (Minneapolis) and May 23 (Memphis, St. Louis, Indianapolis, Detroit) suggesting the local NOx contributions from these areas was partially responsible for ozone concentrations in those areas. However, it was likely that the urban areas simply augmented ozone production within the smoky airmass, since ozone concentrations within the smoke plume were already increasing in non-urban areas. Said another way, ozone would not have reached the MD8AO concentrations observed during the event without the presence of the smoke. The smoke augmentation of ozone was particularly likely and apparent given the spatial coherence on May 23 of the entire corridor of HMS analyzed smoke with enhanced ozone from the Great Lakes the Gulf Coast (Figure 18f). The reported incredible intensity (heat) of the Fort McMurray fires was likely to create NOx along with the VOCs within the smoke plume.

NOx emissions across the upstream region of Maryland were already shown to be the lowest on record in late May of 2016. However, as Dreessen et al. (2016) predicted as a result of the June 2015 case:

> "This [June 2015 smoke event] shows that the drastic NOx reductions across the [Ohio River Valley] may not be enough in future wildfire events and that future events [may impact NAAQS compliance]."

Said another way, an ozone exceedance was unlikely to occur in Maryland without the burden of smoke on the airmass. As the smoky airmass aged, photochemical reactions within the plume made it "ozone-ripe", creating an airmass easily augmented even by minimalistic NOx contributions. Then as suggested by Dreessen et al. (2016), the additional NOx, either traceable to the fire source itself or any anthropogenic source, was stored within the smoke plume via the abundance of VOCs. Hourly NOx observations from May 24 – 26 had a peak in concentrations at available monitors in Maryland which was higher than any other day in the month (Figure 47). Both near-road sites, Essex, Oldtown and Piney Run 24-hour running average concentrations rose during this time period with only Piney Run not achieving the highest running average of May 2016. Local emissions of NOx surely played a minor role in augmenting ozone concentrations in Maryland as urban pollution mixed with the smoky, ozone laden airmass, as earlier stipulated. However, CO, particle mass, and particle speciated compounds all suggest a significant wildfire presence in the dirtied upstream airmass. The ozone precursors already within the plume fostered ozone production at levels not otherwise feasible in the contemporary emissions environment.

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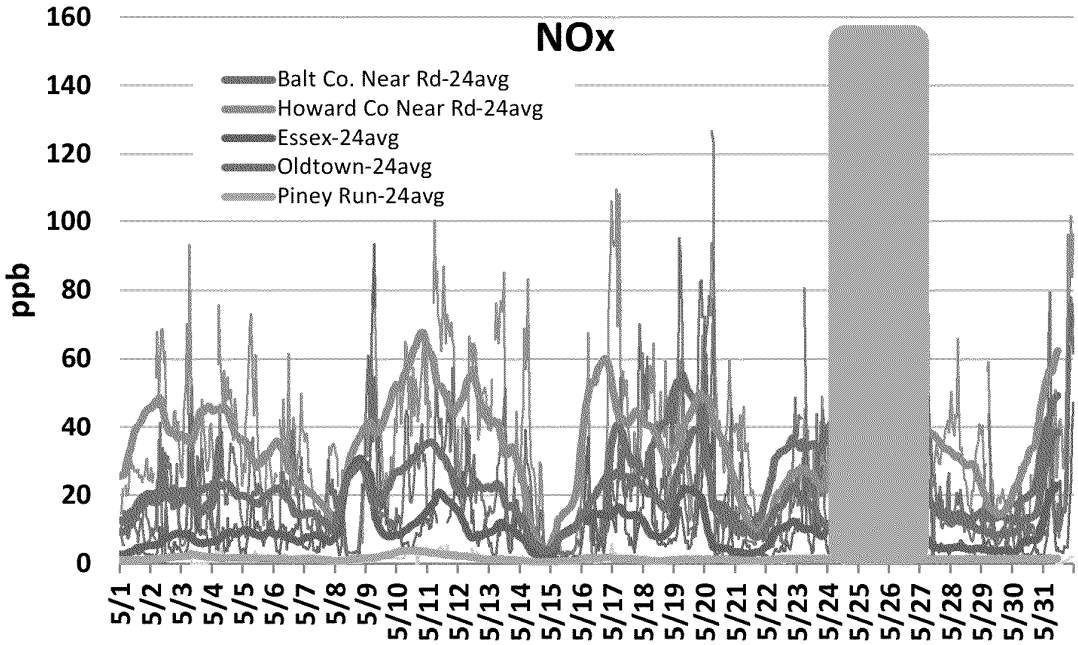

Figure 47. As in Figure 46 except for nitrogen oxides (NOx) from available Maryland monitors in May, 2016.

3.5.5. NOx Historical Context: Local May NOx, Aged Nitrogen and Total Reactive Nitrogen

If NOx was excessively stored within the smoke plume due to the abundance of VOCs as discussed in Dreessen et al (2016), strong evidence of aged NOx would be present. Further study of the composition of the Nitrogen in the airmass showed that the total active nitrogen (NOy) was both one of the largest NOy observations in May in the past five years (Figure 48a) and that total NOx in May of 2016 was the also highest among the last 5 years (Figure 48b)despite the lowest EGU NOx emissions upstream to-date (Figure 5). Daily average NOx concentrations for all May days from 2012-2016 at Maryland monitors showed that late May of 2016 had some of the highest NOx observations at many of the monitors in the network over the entire period. Total reactive nitrogen (NOy) shows similar characteristics with the highest May reading from the past 5 years in late May of 2016, consistent with the time period of the smoke influenced airmass in Maryland. HU-Beltsville reported the second highest 24-hour average during the smoke event in May of 2016 compared to the entire 2012 – 2016 period. There was no doubt the airmass was characterized by abundant NOx not seen even when upstream EGUs were emitting larger amounts of NOx prior to the 2013-2016 era.

Subjective analysis of nitrogen species allows some qualitative source attribution. Generally it is difficult to distinguish NOx sources from each other (i.e., point, mobile, wildfire). Fresh NOx emissions tend to be dominated by Nitrogen Oxide (NO) rather than Nitrogen Dioxide (NO_2) or other non-NOx speciations (NOz). NO has a shorter lifetime due to its high reactivity, thus an airmass dominated by NO_2 and NOz tends to

indicate aged nitrogen emissions. The composition of the NOx was overwhelmingly composed of older NO_2 on May 25 and 26. In fact, the Essex monitor recorded the 6th and 9th highest daily average NO_2 for the entire 2016 ozone season (151 days) on May 25 and 26 (not shown). The high levels of NO_2 were indicative of an aged airmass, NOx transport and therefore non-local ozone. Unfortunately no NOz concentration was available during this time period. However, the substantial proportion of older NO_2 at Essex and Oldtown, along with the high concentration of NOy at the HU-Beltsville site all suggests older NOx emissions, transport and older ozone. MDE therefore contends the increased NOx observed during the ozone event was a result of efficient NOx storage within the smoke plume sourced from the fire itself and diminutive regional NOx contributions, both which caused NOy to be beyond contemporary concentrations in Maryland.

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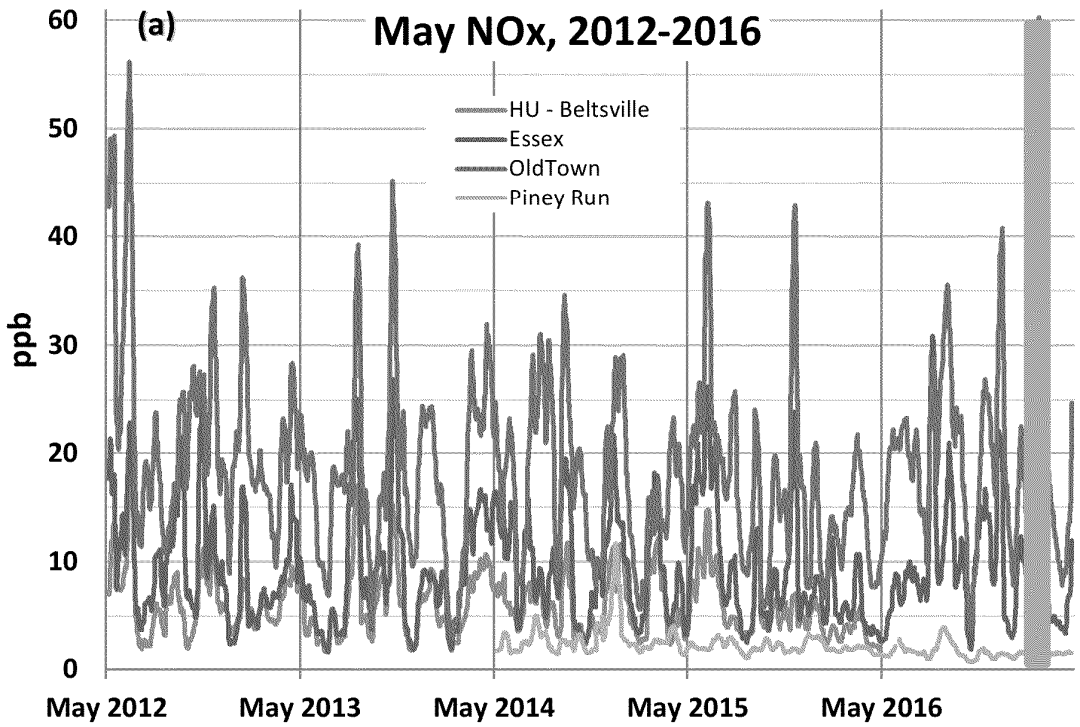

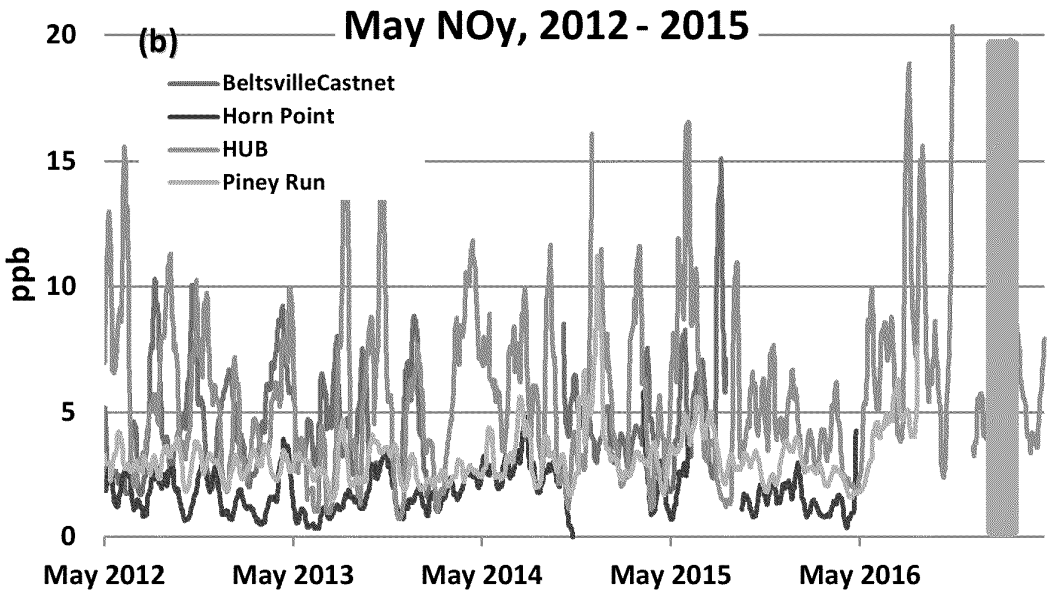

Figure 48. (a) NOx and (b) NOy for all available Maryland monitors for days in May from 2012 to 2016.
The area in yellow highlights the 2016 smoke event on May 24-26. The only available NOy in 2016 was at the Howard University, Beltsville (HUB) monitor. Both NOx and NOy were higher than each May in the previous 5 years.

3.6. Analysis Methods to Assess the Smoke Impact

3.6.1. Ozone to NOx ratio

MDE has asserted the excess NOx and NOy observed in the Maryland monitoring network was either from the fire itself or due to excessive storage of NOx within the smoke plume due to excess reactive VOCs supplied by the smoke as suggested in Dreessen et al., (2016). To further evaluate whether the increased NOx observed was carried within the smoke plume and was not simply from upstream EGUs (a typical "non-event" exceedance characteristic), MDE generated an ozone to NOx ratio for the past seven years. In a NOx limited environment, less NOx means less ozone. Thus, an airmass characterized by an abundance of ozone but also impacted by copious EGU NOx emissions will maintain a low or constant ozone to NOx ratio. A reduction in emissions leading to reductions in ozone and again the ratio would remain relatively constant. However, an airmass producing abundant ozone without substantial increases in anthropogenic NOx emissions produces a high ratio and indicates a highly efficient, ozone-productive airmass composition. Such a scenario indicates additional influences on the airmass composition.

The ozone values on May 25 and 26, 2016 reached MD8AO concentrations seen previously only in years with twice the amount of EGU NOx emitted from Maryland, Pennsylvania, West Virginia, Northern Virginia and Ohio, the states(areas) from which same-day emissions would affect the ozone concentrations on May 25, 2016 based on backwards trajectories. As a result of the lower emission from these areas, the ozone to NOx ratio (maximum statewide 8-hour average concentration divided by total NOx output across these regions) reached the highest value ever seen in Maryland on May 25 and 26, 2016, suggesting ozone production was beyond the typical exceedance event production capacity and was likely aided by other constituents (Figure 49a). This supports the assertion that VOCs are effective at storing NOx in the smoke plume for later ozone development, regardless of absolute NOx output from the fire itself or point sources along the track of the plume as discussed earlier. As NOx was stored the ozone content in the plume also increased as the smoke plume aged. Thus despite the lowest May EGU NOx emissions ever observed, ozone production rose uncharacteristically high in the early ozone season. Therefore the high ozone concentrations must be due to smoke influenced ozone production.

MDE contends that the reason for the ozone exceedances in Maryland on May 25 and 26 was the advection of an airmass which was directly impacted by smoke for several days prior to moving into Maryland. Under the same assumptions above, areas upstream of Maryland should also indicate an airmass influenced by smoke and therefore have a high ozone to NOx ratio. The first wide spread exceedance day of the extended period was on May 23 across the Midwest and Great Lakes (see Figure 18). Ozone exceedances were at first isolated to urban centers where additional NOx was available to raise concentrations above the NAAQS threshold. Since mobile emissions are assumed relatively constant between workdays, emissions from sources such as EGUs must not change significantly between days to conclude that the smoke played the integral part in these exceedances. If the EGU NOx emissions were insignificant to ozone production across the Midwest as compared to the contribution to ozone supplied by the smoke, the ozone to EGU NOx ratio

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should be quite high. If ozone production was dependent on EGU NOx output, the ratio would remain constant and/or low.

The NOx to ozone ratio in Indiana on May 23, 2016 was the second highest ever in May since 2010, and May 21-23, 2016 were three of the top 5 highest ratios of the entire data set with five of the top seven daily ratios between May 19 and 24, 2016 (Figure 49b). Using similar methodology to that used in Maryland, these ratios were calculated using emissions from Indiana, Ohio, and Michigan based on a 72-hour backward trajectory from Indianapolis, IN on May 23 (Figure 50). Interestingly, May 7, 2016, was a day also influenced by smoke (based on HMS analysis) and had the highest ratio in Indiana, though no exceedances occurred due to cool and wet conditions. This shows that the airmass developed ozone in an environment that was otherwise devoid of high levels of anthropogenic NOx relevant for abundant ozone concentrations in the absence of added smoke.

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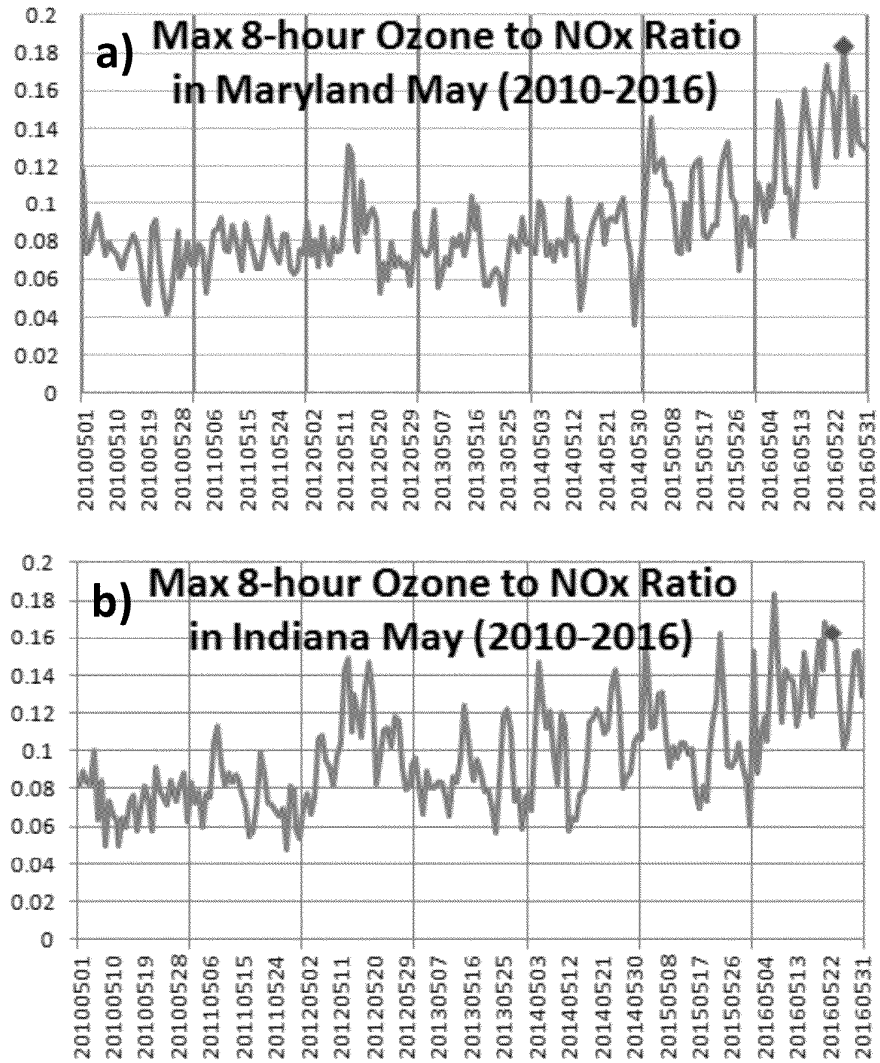


Figure 49. Ozone to NOx ratios for (a) Maryland and (b) Indiana.
The higher the ratio, the more ozone is created for a given amount of NOx output. NOx output used in each case is described in the text but is based on statewide emissions. States used were selected based on backward trajectories as described in the t ext. The red diamonds highlight the first day of an exceedance in each stat e.

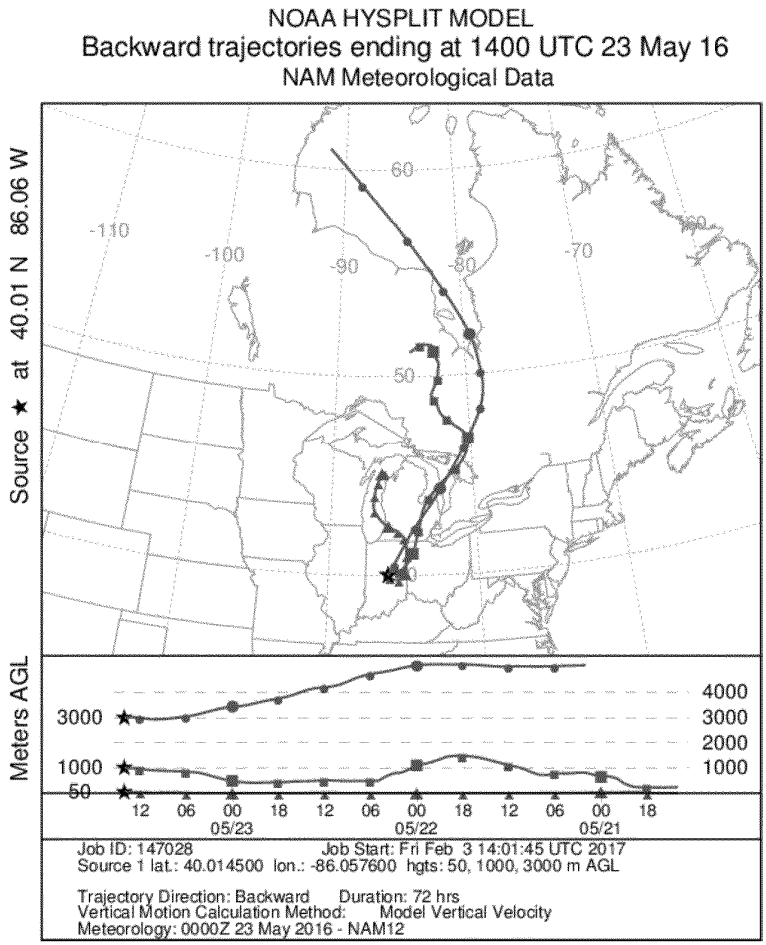


Figure 50. 72-hour backwards trajectory from Indianapolis, Indiana on May 23, 2016.

3.6.2. Model Data: CMAQ Underestimation of Ozone

The presence of smoke during the May 25 and 26, 2016 ozone exceedance days provided clear evidence that significant portions of ozone production were attributable to smoke. Given the presence of increased smoke tracers monitored at the surface and ozone values equaling or exceeding the 99th percentile when compared to ozone concentrations of the past 5 years, the impact of smoke constituents on ozone enhancement was incontrovertible. To quantify the attribution, MD8AO concentrations forecast with the operational National Ocean and Atmospheric Association (NOAA) Community Multi-scale Air Quality (CMAQ) ozone model were compared to observed MD8AO concentrations. Source information from the Fort McMurray fire as well as gas phase chemical interactions from wildfire smoke and their interactions with ozone were not included in the NOAA operational CMAQ model during 2016. Therefore, the NOAA operational CMAQ model represented a prediction of ozone in the absence of smoke and under normal conditions. The NOAA CMAQ ozone model reported approximately +7ppbv high bias and 15.1ppbv root

mean square error (RMSE) for June ozone predictions in 2010 (Chai et al., 2013) (i.e., it tends to slightly over-forecast ozone concentrations). The over prediction error has improved since 2010, but the model maintained a high bias in the Maryland area through 2016 (Figure 51). With this information in mind, the difference in the model forecast ozone to actual observations in July of 2016 provided an estimate of the increase in ozone due to smoke and the spatial extent of the influence.

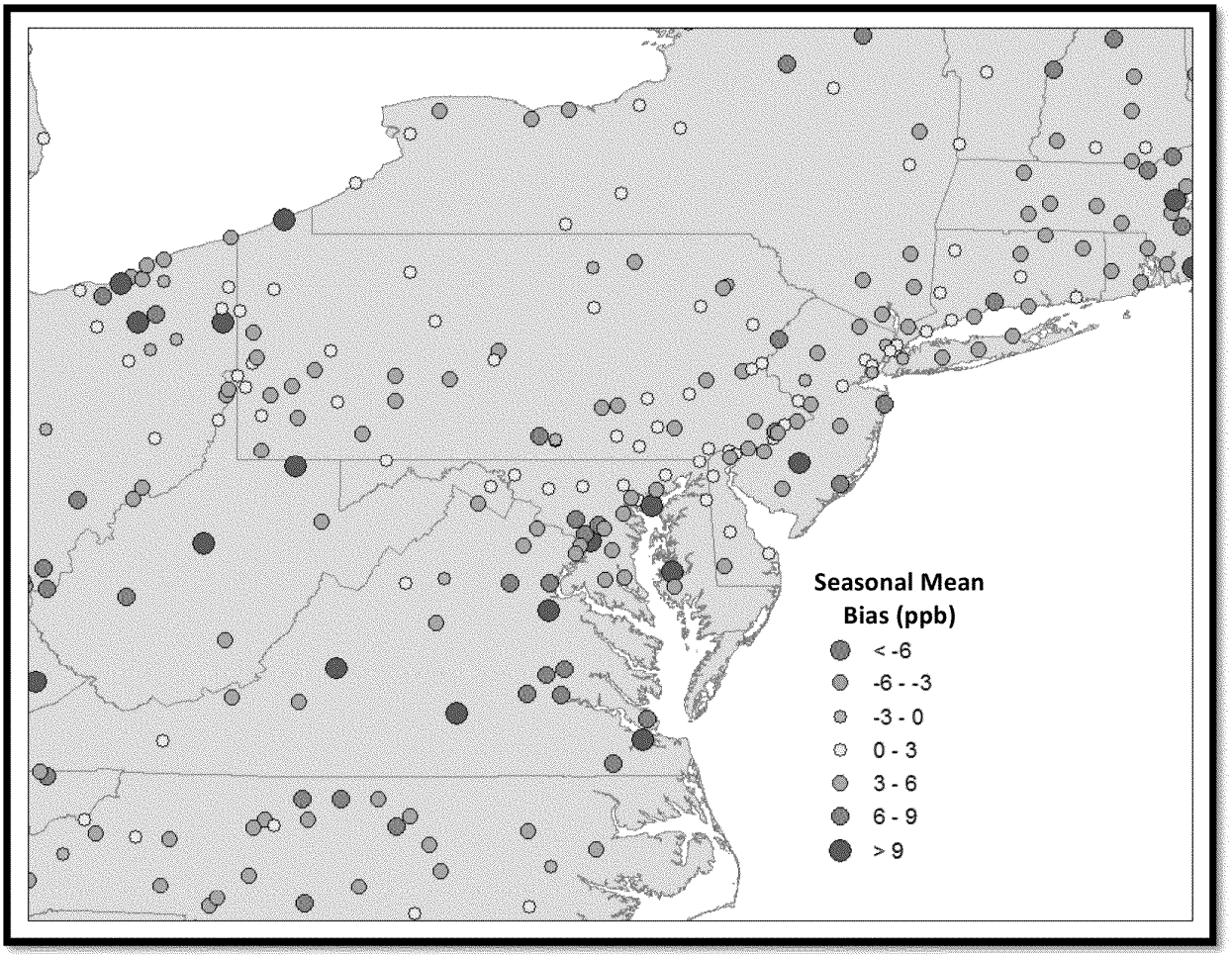
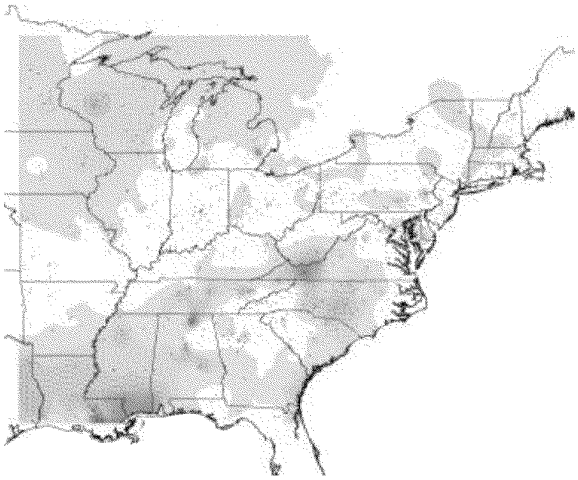


Figure 51. NOAA 2016 operational CMAQ ozone prediction errors at monitors across the northeast US.

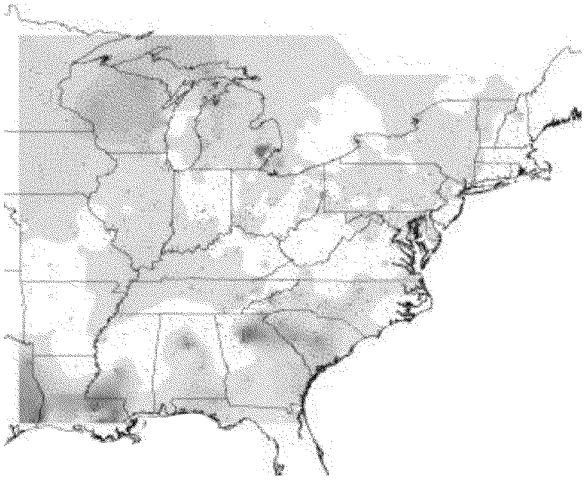
Gridded model data was extracted at observation points throughout the eastern CONUS for May 18 –28, 2016. The difference between the predicted and observed MD8AO were interpolated across the region on a daily basis and showed an area of model under prediction stretching from the upper Midwest on May 20 and 21, moving eastward to the northeast and Mid-Atlantic, to include Maryland, by May 25 (Figure 52). Cross referencing Figure 52 with Figure 18 showed similar patterns of smoke, ozone, and under-prediction by the NOAA CMAQ model. While the NOAA CMAQ model occasionally under-predicts ozone early in the season in the Mid-Atlantic, the model typically does not under predict by more than 10ppb. Since the NOAA CMAQ did not include 2016 wildfire emissions in the ozone chemical creation mechanism, under predictions

by the model were the result of fire emissions and ozone precursors which were not accounted for in the model input, leading to higher than predicted MD8AO. The underlying assumption then was that under prediction of MD8AO coincident with smoke to be caused by precursors within the smoke. It would be very coincidental for the model to under predict both quantitatively and spatially in line with the smoke plume. Sequential examination of the images reveals an area of modeled under prediction of magnitudes reaching >20ppb (dark blues) that moved through the upper Mid-West and Northeast, extending as far south as DC. The signal loses cohesiveness after May 26. The area of under prediction in the model closely correlates to the movement of ozone and HMS analyzed smoke plumes (compare Figures 52 and 18). This provides a quantitative measure of the impact of smoke during this event, suggesting the smoke provided anywhere from 5 ppb to over 20 ppb of additional ozone production on MD8AO values across the northeast US.

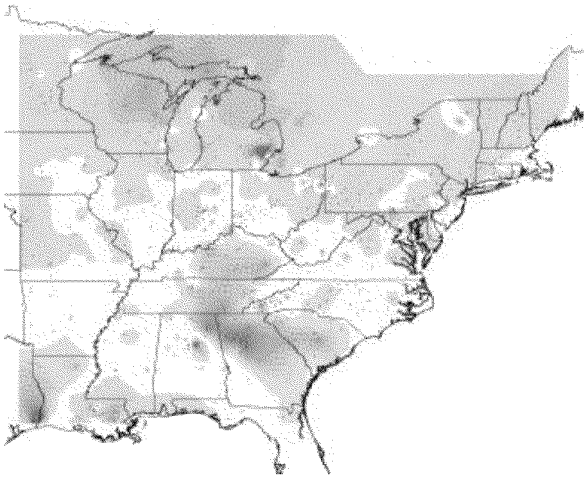
May 18, 2016



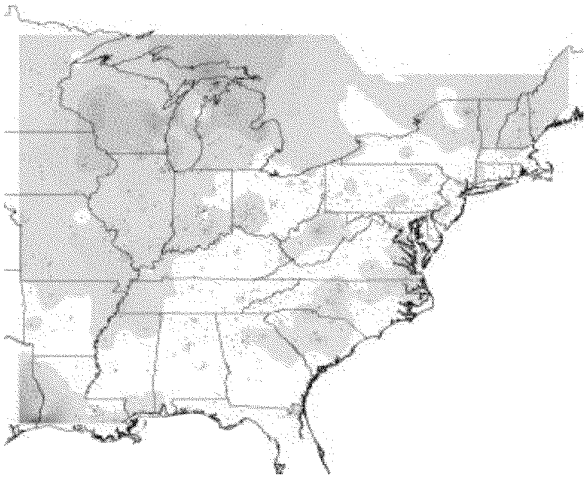
May 19, 2016



May 20, 2016



May 21, 2016



May 22, 2016

May 23, 2016

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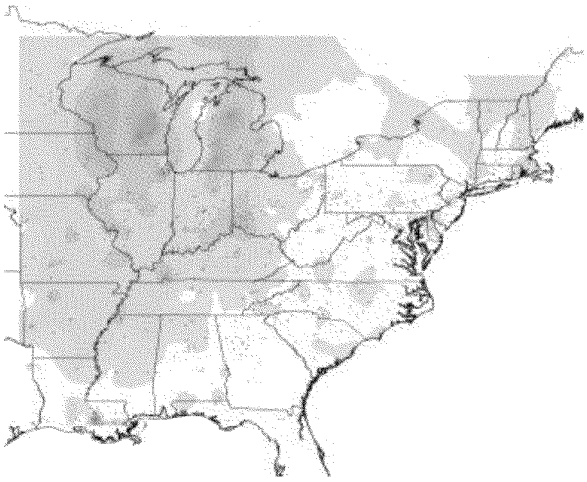
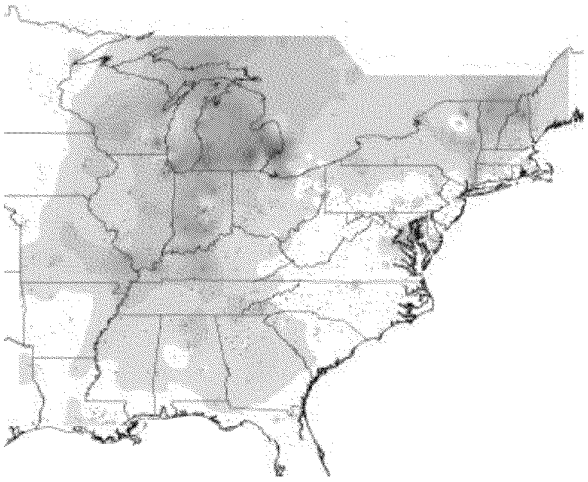
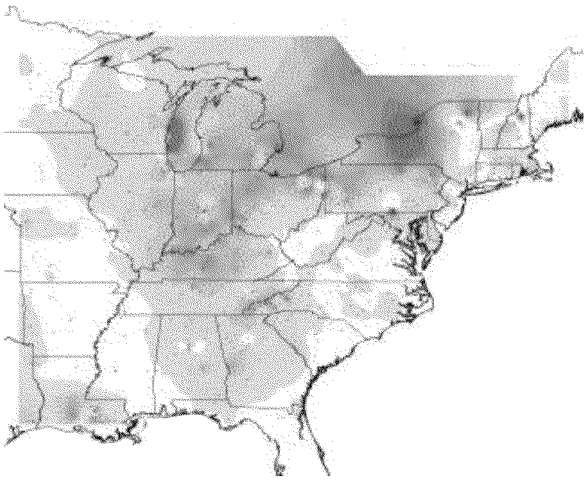


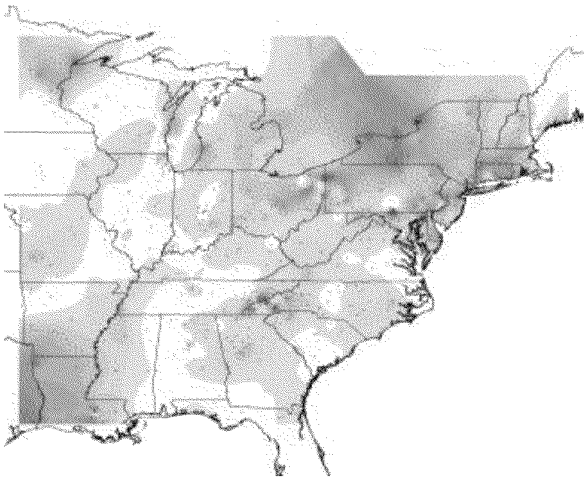
May 24, 2016



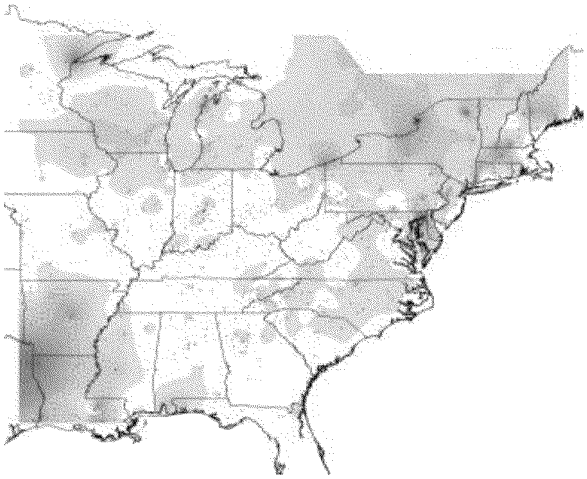
May 25, 2016



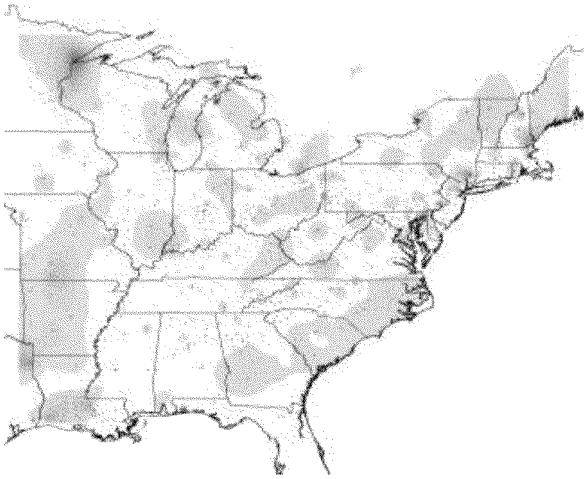
May 26, 2016



May 27, 2016



May 28, 2016



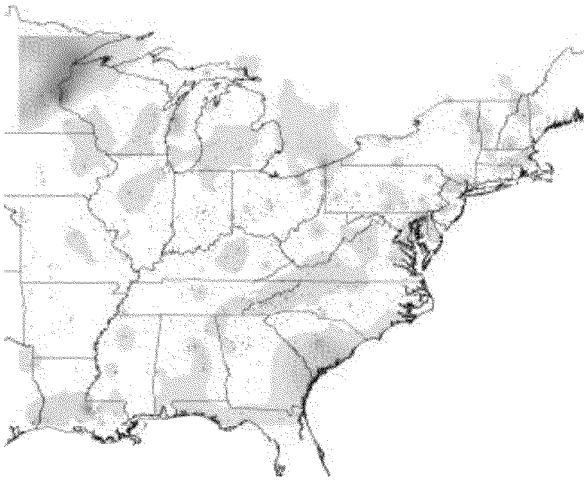


Figure 52. The NOAA CMAQ model daily maximum 8-hour ozone predictions for May 18-28, 2016 comparison to AQS observations for the entire eastern United States.
Colors represent operational NOAA CMAQ model predicted ozone minus observations contoured from May 18 -28, 2016. Darker areas of blue show more significant model under prediction, while areas of darker red show areas of model over-prediction. Colors begin at +/- 5ppb error magnitude. Small black dots are locations of ozone monitors.

3.6.3. Spatial Tracking of Organic Carbon (OC) and Potassium (K+)

OC and K+ concentrations in Maryland were previously shown to be elevated on the periphery days of the exceedance event. Speciated data (run every 3 or 6 days) retrieved from several states showed an area of increased concentrations of both species moving west to east across the upper Midwest from May 21 to May 27, consistent with the track of the smoke plume analyzed by HMS (Figure 53). Particularly on May 24, the magnitude and spatial extent of OC and K+ was greatest across the Great Lakes (the states of Michigan and New York) which was centered on the area of greatest 8-hour ozone concentrations and the area previously described as influenced by the Fort McMurray wildfire smoke. Since the K+ and OC are specific wood combustion markers these speciated $PM_{2.5}$ data provided conclusive evidence that the ozone affecting the upstream airmass of Maryland developed in areas under the heavy influence of smoke related emissions. More specifically, these wildfire markers were found in areas with high ozone production and concentrations concurrent with the intense under prediction by the NOAA CMAQ model, all which point to a wildfire smoke influence on ozone concentrations. Previous analyses demonstrated how this smoke influenced air was transported into Maryland.

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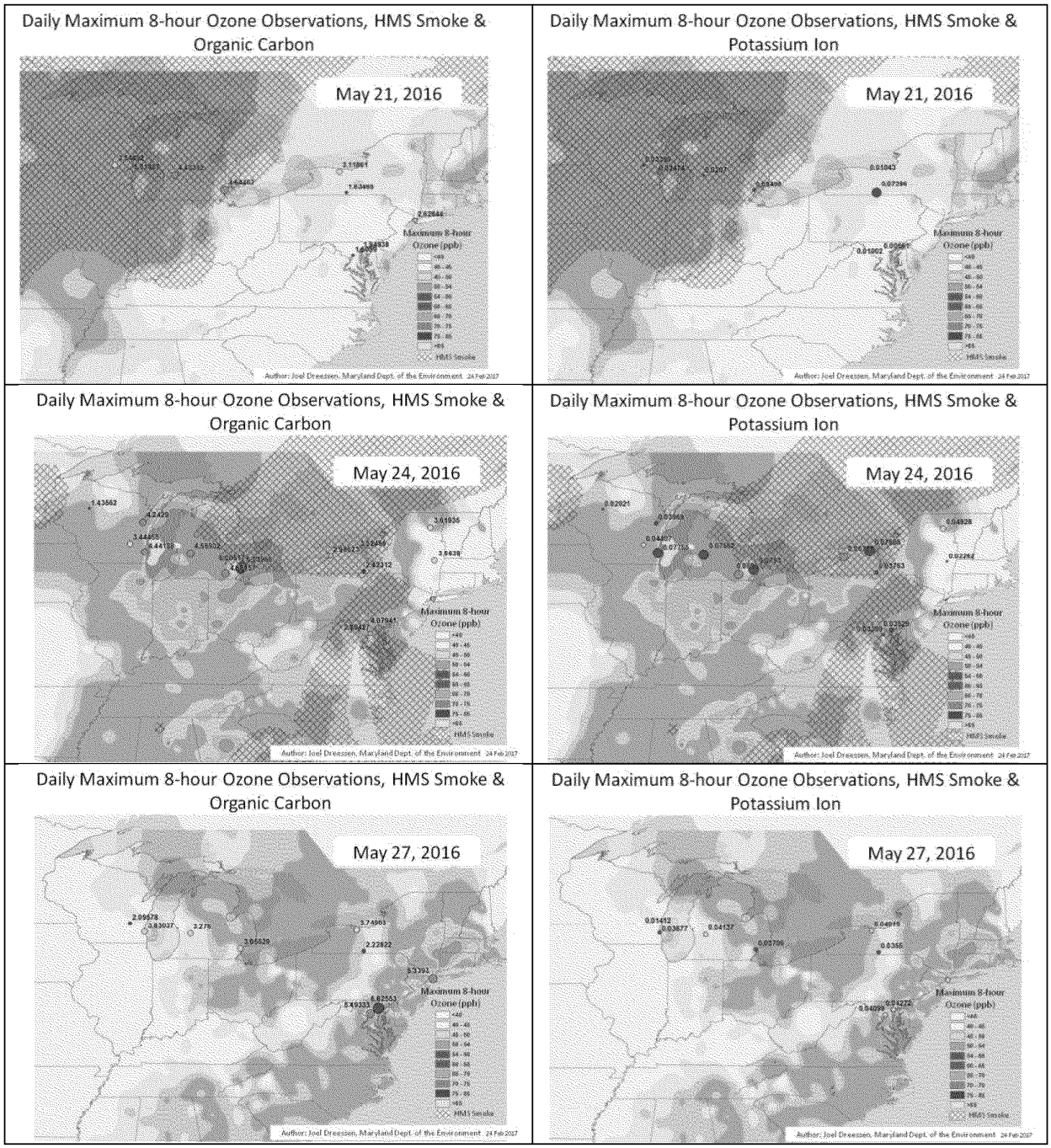

Figure 53. Geographical distribution of speciated particle data.
Data was plotted at available monitors and overlaid on contoured MD8AO concentrations and HMS analyzed smoke for May 21, 24 and 27.

3.7. Similar Day Analysis

Similar meteorology in the absence of smoke should not produce ozone exceedances in Maryland as was observed on May 25 and 26, 2016. To address this, a similar day analysis attempts to identify days which are similar in pattern and characteristics (temperatures, winds, transport regime) but without the burden of smoke on ozone production. A comparison of such days should yield substantially less ozone at monitors when not impacted by smoke.

To better establish the transport pattern for the onset of the event for a similar day analysis, the radar wind profilers (RWP) at Piney Run and Horn Point were examined (Figure 54). The RWPs showed transport leading in to the afternoon of May 25 that agreed with the ozonesonde winds launched at HU-Beltsville and the backwards trajectories portrayed in Figure 37. Thus, similar days examined would need to include northwesterly winds above the surface, surface high temperatures near 90°F and surface high pressure centered southeast of Maryland with slight ridging above the surface over Maryland.

To isolate these days from the past five years, days in May reaching at least 85°F at BWI airport were identified. On these days, those when morning aloft winds (using the 12 UTC [8am] sounding from Sterling, Virginia) were from the Northwest (>295° and <335°) at 850mb (approximately 1,500m) narrowed the group of days further. Finally, those days subjectively matching the pattern on May 25 and 26, 2016 over the eastern US determined the final group of days used for similar day comparisons. Twenty-six days in May of 2012-2016 were identified, not already connected or adjacent to the smoke event of 2016, which had high temperatures reaching at least 85°F at BWI. Of these 26, only six (6) were found which satisfied the northwest flow at 850mb criteria and of these six, only three days also matched the pattern of high pressure over the southeast US with a ridge axis extending in to the Midwest or western Mid-Atlantic, similar to the 2016 event (Table 7).

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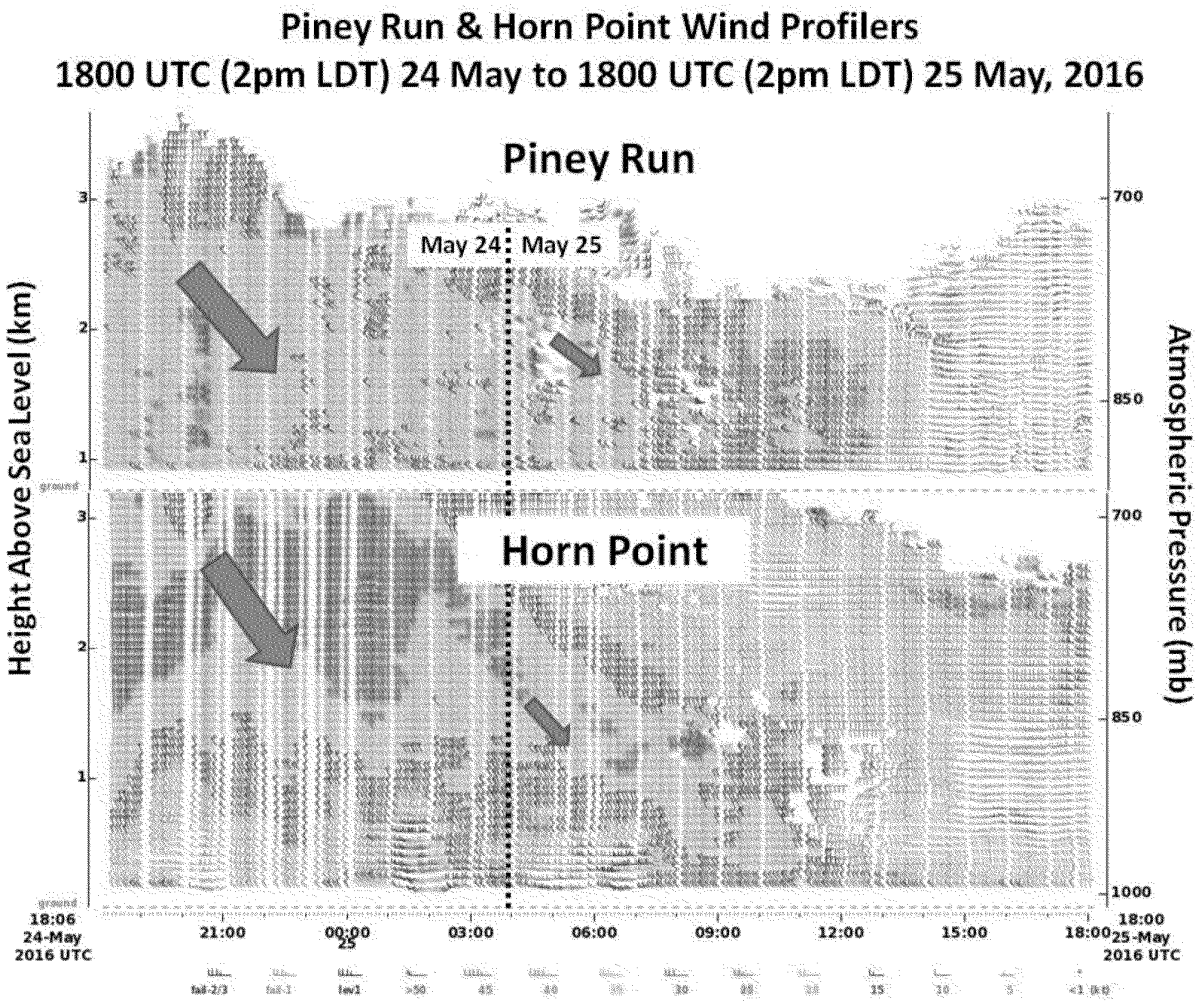
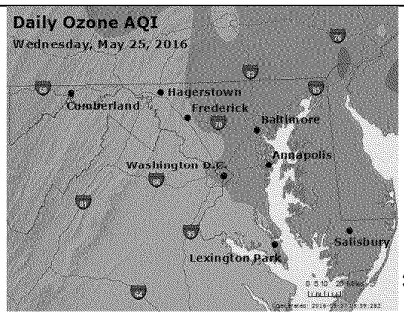
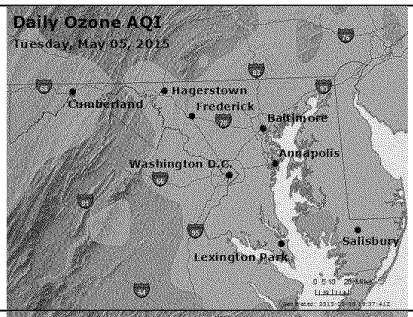
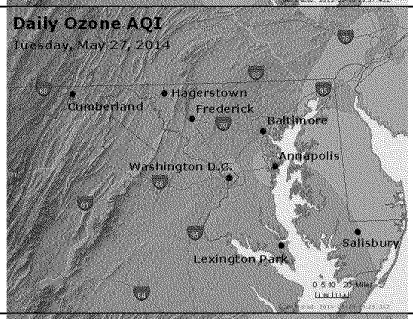
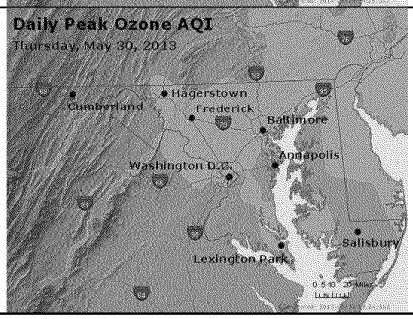


Figure 54. Radar Wind Profiler (RWP) output from 1800 UTC (2pm LDT) on May 24 through 1800 UTC (2pm LDT) May 25, 2016. The two profilers, which are on either end of the state (Piney Run is in far western Maryland and Horn Point is on the easter n shore of Maryland) both indicate robust northwest flow which is more in agreement with the ozonesondes than HYSPLIT trajectories run backwards from the afternoon on May 25, 2016.

Based on the similar day analysis, no other day in May from 2012 - 2016 which had similar meteorological characteristics produced similar levels of ozone. The highest ozone on May 25, 2016 was 85ppb, which nearly qualified as an "unhealthy" AQI day based on the 2015 standard. The next highest MD8AO concentration on a similar day was in 2013 when temperatures 6°F warmer than in 2016 produced ozone which was 11ppb lower. Spatially none of the days are comparable to the 2016 event either. More than half of the state was under code orange conditions in 2016 when in the 2013 case only four monitors were above 70ppb, in 2014, none, and in 2015 only two. This analysis reveals that similar meteorological conditions in previous years did not produce as much ozone as in 2016 despite decreasing NOx emissions over the entire period, and the lowest anthropogenic precursor emissions occurring in 2016. Thus, analog

evidence suggests the late May 2016 exceedance event was not explicable by comparing it to past may events with similar meteorology, even in cases with greater NOx emissions. The only conclusion is that the May 25 and 26, 2016 ozone exceedances were due to influences from the wildfire smoke from the Fort McMurray fire.

Table 7. Similar Day Analysis for May 25, 2016.
Three dates compared to the May 2016 ozone event were chosen by a similar maximum temperature (Tmax >=85°F) at BWI airport, 850mb winds from the northwest (>295° and <335°) on the 12 UTC (8am LDT) Sterling VA sounding and matching synoptic pattern characterized by high pressure over the southeastern US and a ridge axis across the west ern Mid-Atlantic or Midwest. * Due to the change in the ozone standard, the AQI color scale on the 2016 map is based on orange being greater than 70ppb and red greater than 85ppb for MD8AO.

DATE	Ozone (ppb)	T_{max} (°F)	Mapped AQI
May 25, 2016	85	86	 *
May 5, 2015	72	85	
May 27, 2014	69	90	
May 30, 2013	74	92	

4. The Occurrence was a Natural Event

According to the Clean Air Act (CAA) and the Exceptional Events Rule (40 CFR 50), an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location or a natural event." The EPA also believes that treating all wildfires on wildland as natural events is consistent with the CAA and Exceptional Events Rule. Based on the documentation provided in section 2 of this submittal which discusses the origin and evolution of the wildfire events, the Fort McMurrary fire qualifies as a natural event because non-prescribed human activity was suspected as the cause of the unplanned fire event which occurred on wildland. While the city of Fort McMurray itself was not wildland, ozone exceedances occurred 20 days after the fire roared through the town. Therefore wildfire emissions affecting ozone concentrations in Maryland were generated predominantly from sparely populated forested areas, meeting the definition of wildland. The EPA generally considers the emissions of ozone precursors from wildfires on wildland to meet the regulatory definition of a natural event at 40 CFR 50.1(k). Accordingly, the MDE has shown that the event is a natural event and may be considered for treatment as an exceptional event.

5. The Occurrence was Not Reasonably Controllable or Preventable

Based on the documentation provided in section 2 the fires relevant in this demonstration were likely due to human activity. Unintentional or not, these fires were considered natural wildfire events by the EPA, were outside of the United States, and were therefore neither reasonably controllable or preventable by the state of Maryland. No policy that Maryland enacted could have prevented the fire or the smoke which it caused, to enter the United States or Maryland. MDE was not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable. Therefore, emissions from these wildfires were not reasonably controllable or preventable and meet the criterion for treatment as an exceptional event.

6. Public Comment

MDE posted notice of this exceptional events demonstration on May 26 on the MDE website for a comment period of 30 days. [Number] public comments were received and have been included in [Section X] of the exceptional event demonstration, along with MDEs responses to these comments.

7. Conclusions

On May 25 and 26, 2016 smoke associated with wildfires predominantly located near Fort McMurray, Alberta, Canada occurred that generated NOx and VOC ozone precursors within the fire's smoke plume which moved across the north central CONUS and Great Lakes by May 21, 2016. This smoke plume was subsequently transported east and southeastward towards Maryland and impacted all monitoring sites across Maryland's air monitoring network. The monitored MD8AO concentrations reached 84 and 85 ppb on May 25 and 26, respectfully, and resulted in at least one of the fourth highest concentrations of 2016 at 18 of 20 sites and met or beat the 99th percentile at 16 sites on at least one or both of the days. The

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comparisons and analyses, provided in sections 2 and 3 of this demonstration support MDE's position that the Fort McMurray wildfire event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedances on May 25 and 26 and thus satisfies the clear causal relationship criterion.

The analyses provided in this demonstration support MDE's position that the Fort McMurray wildfire affected air quality in such a way that there exists a clear causal relationship between the event (Fort McMurray fire) and the monitored ozone exceedances in Maryland on May 25 and 26, 2016 and thus satisfies the clear causal relationship criterion for recognition as an exceptional event. Based on these facts, MDE requests that EPA concur that the 28 MD8AO concentrations between May 25 and 26, 2016 (Table 8), exceeding the 70ppb NAAQS at the following 16 monitors: Aldino (240259001), Calvert (240090011), Edgewood (240251001), Essex (240053001), Fair Hill (240150003), Furley (245100054), Glen Burnie (240031003), Horn Point (240190004), HU-Beltsville (240330030), Millington (240290002), Padonia (240051007), PG Eq Cntr (240338003), South Carroll (240130001), S. Maryland (240170010), and the two CASTNET sites – Beltsville (240339991) and Blackwater NWR (240199991), were impacted by an exceptional event. MDE formally requests that the data from these 16 monitors on these days be flagged as such and be excluded from use for regulatory determinations.

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Table 8. The 16 ozone monitors at which MDE is seeking EPA concurrence for data exclusion of event influence air quality data. Local names and Air Quality System (AQS) identification numbers (AQSID) identify monitors in the text. Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the season. The final columns indicate the design value with no exclusion of data (Including) and if both May 25 and 26 are excluded from design value calculations (Excluding). Sites with an asterisk indicate the site does not have a valid design value in 2016. Green highlighting indicates the monitors which MDE seeks exemption, based on the 4th high rankings. Cells showing "-" are MD8AO at sites which did not exceed 70ppb and therefore cannot seek exclusion.

		2016					
SiteName	AQSID	MD8AO [ppb] (rank)		Fourth High [ppm]		Design Value [ppm]	
		May 25	May 26	Including	Excluding	Including	Excluding
Aldino	240259001	77 (3)	79 (2)	0.077	0.076	0.073	0.073
Beltsville CASTNET	240339991	76 (2)	72 (3)	0.070	0.070	0.068	0.068
Blackwater NWR CASTNET	240199991	-	76 (1)	0.068	0.068	0.066	0.066
Calvert	240090011	-	75 (1)	0.070	0.069	0.069	0.068
Edgewood	240251001	79 (4)	80 (2)	0.079	0.079	0.073	0.073
Essex	240053001	78 (4)	81 (2)	0.078	0.077	0.072	0.072
Fair Hill	240150003	83 (2)	76 (5)	0.080	0.076	0.076	0.074
Furley	245100054	75 (4)	78 (2)	0.075	0.068	0.069	0.066
Glen Burnie	240031003	75 (6)	76 (4)	0.076	0.076	0.076*	0.076*
Horn Point	240190004	71 (2)	77 (1)	0.067	0.067	0.064	0.064
HU-Beltsville	240330030	74 (2)	74 (2)	0.070	0.069	0.069	0.068
Millington	240290002	85 (1)	76 (2)	0.072	0.069	0.070	0.069
Padonia	240051007	74 (3)	84 (1)	0.073	0.073	0.072	0.072
PG Eq Cntr	240338003	74 (5)	-	0.076	0.076	0.071	0.071
South Carroll	240130001	72 (4)	75 (2)	0.072	0.068	0.068	0.067
S. Maryland	240170010	-	73 (4)	0.073	0.073	0.070	0.070

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Andreae, M.O., and P. Merlet. 2001. Emission of trace gases and aerosols from biomass burning. Global biogeochem. Cycles 15(4): 955–66. doi:10.1029/2000GB001382

Andreae, M.O., and P. Merlet. 2001. Emission of trace gases and aerosols from biomass burning. Global biogeochem.Cycles 15(4): 955–66. doi:10.1029/2000GB001382

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Appendix: A

Letter of request to EPA CAMD to flag CASTNET monitors in Maryland.

ED_001361_00013059

Maryland
Department of
the Environment

Larry Hogan
Governor

Boyd Rutherford
Lieutenant Governor

Ben Grumbles
Secretary

May 4, 2017

Timothy Sharac
USEPA Headquarters
William Jefferson Clinton Building
1200 Pennsylvania Avenue, N.W.
Mail Code: 6204M
Washington D.C. 20460

Tim

~~Mr. Sharac~~,

MDE requests placement of RF data flags indicating the influence of Canadian wildfire smoke on air quality be placed on the two CASTNET monitors residing in Maryland. The dates and times at the following sites are as follows:

- Beltsville (240339991):

  May 25, 2016, hour 0 to May 26, 2016, hour 23
  July 21, 2016, hour 0 to July 22, 2016, hour 23

- Blackwater NWR (240199991):

  May 25, 2016, hour 0 to May 26, 2016, hour 23

Per the requirements to pursue data exclusion, the EPA requires flagging of data prior to submitting an exceptional event demonstration package to the EPA. Maryland is finalizing demonstrations showing the impact of two wild fires on the regulatory monitor sites. In May, fires near Fort McMurray, Alberta lofted a smoke plume which impacted ozone concentrations across the entire state of Maryland and much of the northeast US. In July, a large number of fires in aggregate across northwestern Canada lofted a smoke plume which again subsided over the northern Mid-Atlantic. Both instances were tied to ozone exceedances of the 70ppb NAAQS in Maryland. Maryland has determined exclusion of these data points will impact current and future design values and possibly the future attainment status of the state.

Sincerely,

David Krask
Manager, Ambient Air Monitoring Program

1800 Washington Boulevard | Baltimore, MD 21230 | 1-800-633-6101 | 410-537-3000 | TTY Users 1-800-735-2258
www.mde.maryland.gov

Appendix: B

Table 9. Ozone monitors at which MDE recognizes potential impacts on future year designations.
Table description is identical to Table 8.

		2016					
SiteName	AQSID	MD8AO [ppb] (rank)		Fourth High [ppm]		Design Value [ppm]	
		May 25	May 26	Including	Excluding	Including	Excluding
Blackwater NWR CASTNET	240199991	70 (3)	-	0.068	0.067	0.066	0.065
Calvert	240090011	70 (4)	-	0.070	0.068	0.069	0.068
Frederick	240210037	70 (4)	-	0.070	0.067	0.067	0.066
Rockville	240313001	69 (2)	-	0.068	0.068	0.068	0.068

These monitors did not exceed 70ppb on May 25 or 26, 2016. However, they observed MD8AO concentrations which were within the fourth highest of the season. Therefore, exclusion of these data points could lower future year DVs since they depend on the fourth highest over three years. Exclusion of these data points, even though they are not above 70ppb could lower these monitor's DV for the next 3 years.

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Maryland
Department of
the Environment

Larry Hogan
Governor

Boyd Rutherford
Lieutenant Governor

Ben Grumbles
Secretary

May 26, 2017

Mr. Cecil A. Rodrigues
Acting Regional Administrator
U.S. Environmental Protection Agency
Region III-Middle Atlantic Region
1650 Arch Street (3RA00)
Philadelphia, PA 19103-2029

Dear Mr. ~~Rodrigues~~ Cecil:

During the periods of May 25 & 26, 2016 and July 21 & 22, 2016, smoke plumes coming from wild fires in Fort McMurray, Alberta, Canada and Northwestern Canada, respectively, adversely affected the air quality in Maryland. Due to the influence of this extraordinary event that occurred outside of the United States, exceedances of the 8-hour ozone National Ambient Air Quality Standard (NAAQS) were measured in Maryland. According to the provisions contained in the revised Exceptional Events Rule at 40CFR50.14 and the EPA guidance document titled "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations", a state may request that monitoring data affected by natural events, such as forest fires, be excluded from being used to calculate compliance with NAAQS.

The Maryland Department of the Environment (MDE or Department) is requesting that the ozone monitoring data contained in the attached two Exceptional Events Demonstrations be excluded from calculations used to demonstrate compliance with NAAQS.

If you have any questions regarding either of these two Exceptional Events Demonstrations, please contact Tad Aburn, Director, Air and Radiation Management Administration at 410-537-3201, or by email at George.Aburn@maryland.gov.

Sincerely,

Ben Grumbles
Secretary

cc: Alice Chow, EPA Region III
Kia Long, EPA Region III

ED_001361_00013060

To: Joerger, Verena[joerger.verena@epa.gov]
From: Hence, Kia
Sent: Thur 5/18/2017 6:51:33 PM
Subject: FW: May 2016 Fort McMurray Maryland Exceptional Event Demonstration - Draft
MDE_FtMcMurray_EE_Demo.docx

MDE's draft EE Demo

From: Joel Dreessen -MDE- [mailto:joel.dreessen@maryland.gov]
Sent: Wednesday, April 05, 2017 12:05 PM
To: Hence, Kia <hence.kia@epa.gov>; joel.dreessen@maryland.gov
Cc: Hyden.lorretta@epa.gov; Chow, Alice <chow.alice@epa.gov>; Michael Woodman -MDE- <Michael.woodman@maryland.gov>; david.krask@maryland.gov; Jennifer Hains <jennifer.hains@maryland.gov>
Subject: May 2016 Fort McMurray Maryland Exceptional Event Demonstration - Draft

MDE has completed a draft demonstration of the May 2016 Fort McMurray fire's impact on ozone concentrations in Maryland on May 25 and 26, 2016. The draft is attached. Thank you for this initial informal review.

Joel

--

Joel Dreessen
Meteorologist
Air Monitoring Program
Maryland Department of the Environment
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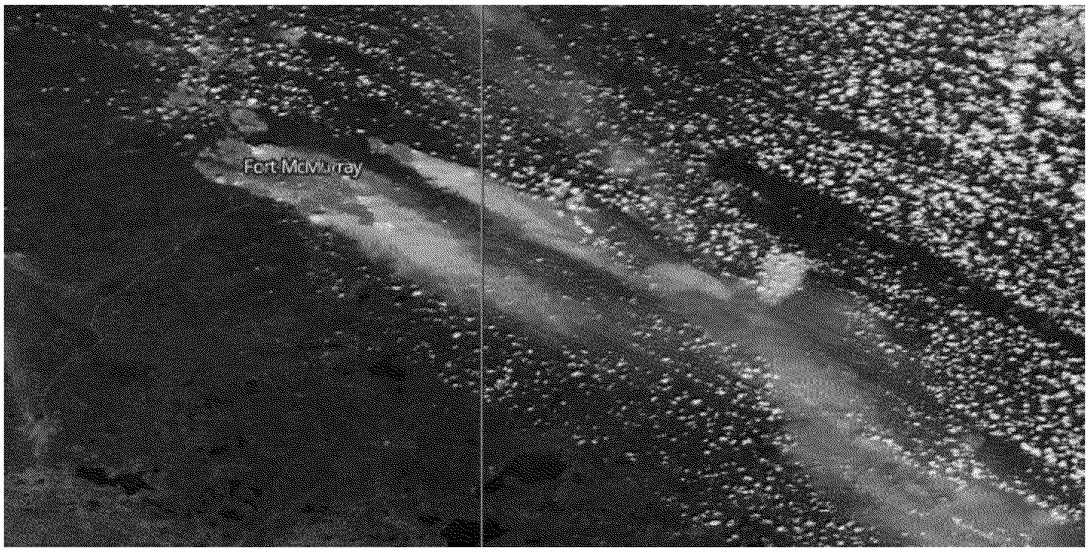
Office: (410) 537-3296
Fax: (410) 537-4243
Email: joel.dreessen@maryland.gov

Publication: June 2015 Smoke & Ozone Event

Click here to complete a three question customer experience survey.

Maryland
Department of
the Environment

State of Maryland
Exceptional Event Demonstration and Analysis of the May 2016 Fort McMurray, Alberta Wildfire and its Impact on Maryland's Air Quality on May 25 and 26, 2016



ARMA / Ambient Air Monitoring Program
Maryland Department of the Environment
1800 Washington Blvd., Suite 730
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Submitted on April 15, 2017

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i. Acknowledgements

The Maryland Department of the Environment (MDE) would like to thank the Connecticut Department of Energy and Environmental Protection (CT DEEP), Northeast States for Coordinated Air Use Management (NESCAUM) and EPA regions 1, 2 and 3 for the collaborative effort put forth in an event which impacted a wide area of the eastern United States simultaneously. Special thanks to Michael Geigert for his coordination of information and resources.

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1. Overview

1.1. Introduction

Maryland maximum daily 8-hour average ozone (MD8AO) concentrations on May 25, and 26, 2016 exceeded the 2008 and 2015 ozone National Ambient Air Quality Standards (NAAQS) due to an ozone precursor-rich airmass modified by smoke from wild fires[1] in central Canada being transported into Maryland. MD8AO concentrations reached 85 ppb at the peak of the event and were therefore in violation of the 70 and 75 ppb standards. Additionally, 90% of the Maryland ozone monitoring network observed MD8AO which ranked as at least the fourth-highest observation of the 2016 season. The purpose of this analysis is to demonstrate that Maryland's 8-hour ozone concentrations that exceeded the 2015 standard meet the requirements for having been influenced by an exceptional event as stated in the U.S. Environmental Protection Agency's (EPA) Exceptional Events Rule (71 FR 13560, March 22, 2007) and should therefore be excluded from design value (DV) calculations used to determine Maryland's ozone attainment status.

Exclusion of the MD8AO concentrations from May 25 and 26, 2016 lowers the DV for several monitors in Maryland. The EPA designates an area's attainment status of the NAAQS via the DV metric. For 8-hour ozone, each monitor's annual fourth-highest daily 8-hour maximum concentration averaged over the past three years designates attainment status for that particular area. Ozone concentrations on May 25 and 26 were within the four-highest ranked 8-hour average observations of 2016 at eighteen monitors (Table 1). Excluding the May 25 and May 26 MD8AO would reduce eight (8) monitors' DV, including the Fair Hill monitor (240150003), which would drop below the 2008 75 ppb level (from 76 to 74 ppb). Details of specific site DVs with and without exempt status along with MD8AO concentrations and rankings for the 2016 season are provided in Table 1 for all Maryland monitors. While no additional monitors would be classified as attainment of the 2015 70 ppb standard, reduction of these sites' DV would potentially be used to demonstrate compliance through 2018.

The Maryland Department of the Environment (MDE, "The Department") requests that all observed ozone data on May 25 and 26, 2016 at monitors that ranked in the top four highest MD8AO of the 2016 ozone season be flagged as impacted by an exceptional event and be excluded from regulatory use. Exclusion of the May event will impact DVs in 2017 and 2018 and MDE's July exceptional event application. A May exclusion meeting the above criteria will reduce only ten (10) monitors' fourth high MD8AO. However, exclusion of all fourth highs in the May event will impact monitors if the July event is concurred. For example, a May concurrence at Aldino (240259001) changes its fourth high from 0.077 to 0.076ppm, but does not reduce the monitor's 2016 DV. However, if the July event is concurred at Aldino, the fourth high is reduced an additional 0.02 ppm and the DV drops 0.01 ppm. MDE therefore requests all ozone monitors in the Maryland network on May 25 and 26, 2016, except Hagerstown (240430009) and PG Equestrian Center (240230002), be exempt from regulatory (Table 1).

[1]Smoke from biomass burning contains volatile organic compounds (VOCs) and nitrogen oxides (NOx), which react to form ozone.

Table 1. Maryland Ozone Monitors.
Local names and Air Quality System (AQS) identification numbers (AQSID) identify monitors in the text. Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the season. The final columns indicate the design value with no exclusion of data (Including) and if both May 25 and 26 are excluded from design value calculations (Excluding). Sites with an asterisk indicate the site does not have a valid design value in 2016. Green highlighting indicates the monitors which MDE seeks exemption, based on the 4th high rankings.

		2016					
SiteName	AQSID	MD8AO [ppb] (rank)		Fourth High [ppm]		Design Value [ppm]	
		May 25	May 26	Including	Excluding	Including	Excluding
Aldino	240259001	77 (3)	79 (2)	0.077	0.076	0.073	0.073
Beltsville CASTNET	240339991	76 (2)	72 (3)	0.070	0.070	0.068	0.068
Blackwater NWR CASTNET	240199991	70 (3)	76 (1)	0.068	0.067	0.066	0.065
Calvert	240090011	70 (4)	75 (1)	0.070	0.068	0.069	0.068
Edgewood	240251001	79 (4)	80 (2)	0.079	0.079	0.073	0.073
Essex	240053001	78 (4)	81 (2)	0.078	0.077	0.072	0.072
Fair Hill	240150003	83 (2)	76 (5)	0.080	0.076	0.076	0.074
Frederick	240210037	70 (4)	65 (8)	0.070	0.067	0.067	0.066
Furley	245100054	75 (4)	78 (2)	0.075	0.068	0.069	0.066
Glen Burnie	240031003	75 (6)	76 (4)	0.076	0.076	0.076*	0.076*
Hagerstown	240430009	68 (5)	61 (18)	0.070	0.070	0.066	0.066
Horn Point	240190004	71 (2)	77 (1)	0.067	0.067	0.064	0.064
HU-Beltsville	240330030	74 (2)	74 (2)	0.070	0.069	0.069	0.068
Millington	240290002	85 (1)	76 (2)	0.072	0.069	0.070	0.069
Padonia	240051007	74 (3)	84 (1)	0.073	0.073	0.072	0.072
PG Eq Cntr	240338003	74 (5)	69 (8)	0.076	0.076	0.071	0.071
Piney Run	240230002	64 (7)	53 (4)	0.066	0.066	0.065	0.065
Rockville	240313001	69 (2)	67 (6)	0.068	0.068	0.068	0.068
South Carroll	240130001	72 (4)	75 (2)	0.072	0.068	0.068	0.067
S. Maryland	240170010	69 (7)	73 (4)	0.073	0.073	0.070	0.070

1.2. Summary of Approach

The Exceptional Events Rule as defined in 40CFR 50.1 (j) states that an event may be excluded from regulatory use if it had the following characteristics:

1) The event was of human origins not likely to recur or was natural in origins;

2) The occurrence was not reasonably controllable or preventable; and

3) There is a clear, causal relationship between the event and the monitored exceedance that affects air quality and is beyond historical fluctuations.

In addition to these elements, the Exceptional Events Guidance Document[2] promulgated in September of 2016 states that an exceptional event demonstration should contain the following elements:

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1) A narrative conceptual model that describes the event casing the exceedance and a discussion of how emissions from the vent led to the exceedance at the affected monitors;

2) Analyses comparing the claimed event-influenced concentrations to concentrations at the same monitoring site at other times. The Administrator shall not require a State to prove a specific percentile point on the distribution of data;

3) A tiered based approach to the demonstration.

Following these guidelines, MDE contends and demonstrates here-in that the transported wildfire smoke had a direct role in amplifying ozone concentrations to a level which would not have been possible in the absence of smoke constituents and satisfies all three exceptional event criterion. This analysis is guided according to the elements suggested in the Exceptional Events Guidance Document[2] as outlined above. Based on recommendations from the EPA and the Guidance Document, Maryland used a Tier 3, weight of evidence approach for this analysis.

1.3. Summary of Findings

This report demonstrates that:

- The wildfire causing smoke was considered a natural event (Section 4);
- The smoke events in question were not reasonably preventable and are unlikely to recur (Section 5);
- There was a clear causal relationship between the smoke and the MD8AO exceedances (Section 6);
- Ozone concentrations during the event were in excess of historical norms (Section 6)

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Several analysis methods were used to develop a weight of evidence demonstration that the 8-hour ozone concentrations above 70 ppb in the May 2016 event meet the rules for data exclusion as an Exceptional Event. In summary, satellite, meteorological data, trajectory analysis, emissions data, speciated $PM_{2.5}$ data, and numerical air quality model comparisons were used to assess whether conditions were favorable for transport of smoke from the Canadian wildfires to monitors that showed 8-hour ozone concentrations above 70 ppb. The data also show that the transported smoke degraded air quality west of Maryland first, then this photochemically aging airmass was transported eastward, creating a prolonged period (May 21-28) of enhanced ozone from the Mississippi River northeastward to New England.

Substantial changes in chemistry in the eastern United States due to regional NOx emissions reductions have occurred over the last decade. The following analysis puts the 8-hour ozone concentrations in Maryland during this ozone event in the context of these reductions and in comparison to ozone in previous months of May. Comparison of emissions during late May of 2016 show Electric Generating

[2]Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016: https://www.epa.gov/sites/production/files/2016-09/documents/exceptional_events_guidance_9-16-16_final.pdf

associated with the Maryland ozone exceedances on May 25 and 26, 2016 revealed a composition characteristic of wildfires with an abundance of ozone precursors despite substantial reductions in

anthropogenic sources.

MDE's analysis strongly supports that all of the MD8AO concentrations above 70ppb in Maryland from May 25 and 26, 2016 meet the rules for exclusion as an Exceptional Event and that all monitors, regardless of MD8AO concentration, were impacted by smoke and the 18 defined previously should be excluded from DV calculations. The following documentation justifies these claims and is outlined as follows: Section 2 contains a conceptual model overview of the event including a brief synopsis of the meteorological and air quality conditions, emissions, transport and spatial characteristics defining the event. Section 3 gives an overview of the data and data sources used in this analysis. Section 4 demonstrates that this event fulfills the definition of the natural event unlikely to recur while Section 5 fulfills the requirements that demonstrate the event was not reasonably controllable or preventable. Section 6 demonstrates a clear causal relationship between the exceedance via a technical weight of evidence approach and also stipulates that the smoke event was beyond historical fluctuations.

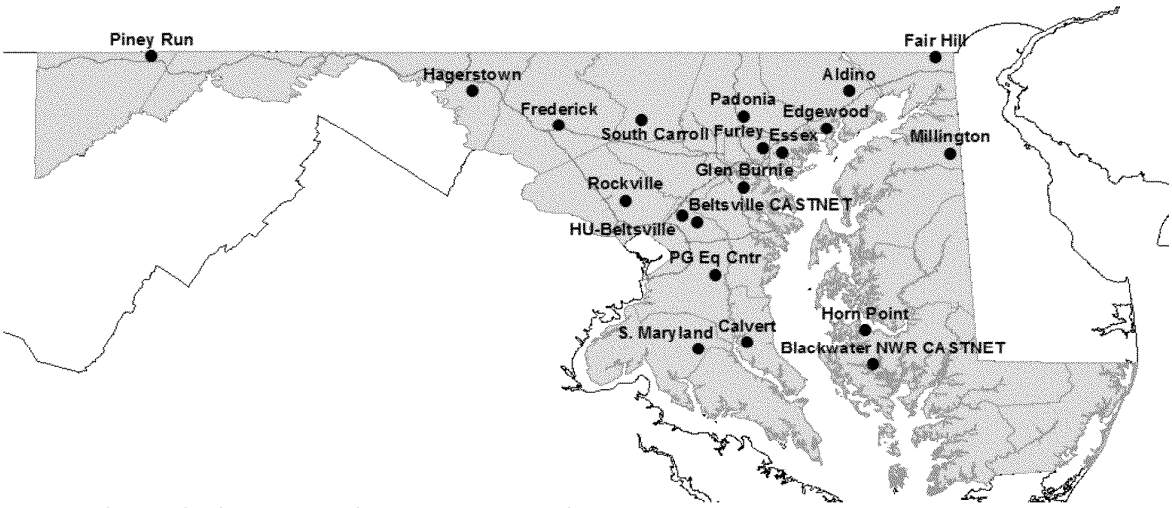

Figure 1. The Maryland ozone air quality monitoring network as of May 25, 2016. Black dots indicate the location of ozone monitors. The blue lines show interstates. Gray lines are county political boundaries within the green shading. Other lines are state borders. Only Hagerstown and PG Eq Cntr did not observe fourth highs for 2016 on May 25 and 26, even though all monitors were impacted by smoke.

2. May 21-28, 2016 Smoke and Ozone Event Overview and Conceptual Model

2.1. Regulatory Significance of the Exclusion

MDE requests that all MD8AO concentrations in Maryland on May 25 and 26, 2016 be excluded from DV calculations for 2016, 2017, and 2018. Exclusion of the MD8AO on May 25 and 26, 2016 in Maryland will decrease the DV for 2016 at eight monitors, potentially keep 18 Maryland sites' DVs lower in future years, and will bring the Fair Hill monitor (240150003, Philadelphia Non-Attainment-Area (NAA)) into

attainment of the 2008 ozone standard. Full attainment of the Philadelphia NAA of the 2008 standard is dependent on monitors outside of Maryland. All other Maryland monitors are attaining the 2008 standard currently; no monitor's attainment status of the 2015 70 ppb standard will change. However, MDE requests all ozone monitoring sites affected by this exceptional event that set a fourth highest ranked observation in 2016 be excluded from future year DV calculations. Ten ozone monitors (half of the Maryland network) will have their fourth highest values decreased by excluding May 25 and 26 with eight decreasing their 2016 DV. However, 18 sites established their fourth highest during the event and may impact future DVs if other exceptional event applications are accepted. Also, depending on future year ozone concentrations, these changes may significantly impact Maryland's attainment status in regards to the 2015 ozone NAAQS.

The Baltimore, Maryland area needs to demonstrate continued attainment of the 2008 ozone standard by 2018. This continued attainment of the 2008 ozone standard might only occur if EPA concurs with this exceptional event demonstration for May 25 and26, 2016. In addition, if EPA does not concur with this exceptional event determination the Baltimore area might be designated as a moderate and not a marginal area for the 2015 ozone NAAQS.

At this time only the Fair Hill monitor would be re-classified as attainment of the 2008 NAAQS should EPA concur with this exceptional event determination. However, the Fair Hill monitor is part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE and EPA would need to concur with the Exceptional Event demonstration submitted by Pennsylvania Department of Environmental Protection (PA DEP) for the non-attainment area to be found attaining the 2008 ozone NAAQS. In any case the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE area would still be classified as non-attainment of the 2015 ozone NAAQS. Depending on EPA concurrence or non-concurrence of the Maryland and PA DEP exceptional event the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE could potentially affect its designation status, which is due later in 2017.

2.2. Area Description

As part of the Clean Air Act (CAA), both local and state air quality agencies are required to maintain and operate ambient air quality monitoring networks. MDE complies with all EPA regulations defined in 40 CFR Part 58 and maintains a dense network of in situ and remote sensing pollution sampling platforms in Maryland. Surface monitors used for regulatory purposes include 20 ozone monitors as of May 25, 2016 (Figure 1) (including two EPA CASTNET sites, (EPA, 1997)), nine hourly fine particle ($PM_{2.5}$) Beta Attenuation Monitors (BAMs) with additional $PM_{2.5}$ hourly observations from six locations in Washington D.C. (DC) and northern Virginia, various daily $PM_{2.5}$ Federal Reference Method (FRM) filter speciations, VOC canisters and three 915 MHz radar wind profilers (RWP; Ryan, 2004; MDE, 2015). A full description of the various instrumentation used by MDE is available in the MDE Network Plan (MDE Ambient Air Monitoring Plan, 2017).

The dense MDE network exists to account for one of the most densely populated areas of the United States between DC and Baltimore. The distribution of ozone monitors across the state favors the I-95

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corridor (blue line running southwest to northeast from DC to just south of the Fair Hill ozone monitor), which stretches across the central part of the state from DC to along the northern portion of the Chesapeake Bay. Approximately 9,000,000 people reside along the I-95 corridor (including DC and northern Virginia) as of 2012. Statewide, Maryland's population was estimated to be 6,000,000 as of 2016 by the US Census Bureau. The state of Maryland also has diverse geography, with mountains greater than 2,000 ft to the west and coastal plains near sea level to the east that border the Chesapeake Bay and Atlantic Ocean. Outside of urban areas, Maryland is characterized by a mix of farmland to the east and mainly deciduous forests to the west. The dynamic interplay between the dense population and diverse geography, particularly biogenic emissions, lee side subsidence by the mountains, and land/water interaction gives Maryland distinct and variable air quality issues, previously with one of the worst monitors along the US East Coast located northeast of Baltimore (Edgewood; 240251001).

2.3. Characteristics of Non-Event Ozone Formation

Over the past two decades MDE has contracted with the University of Maryland (UMD) to conduct thorough research of air quality in Maryland. In particular this collaboration has focused on the origin of ozone in Maryland. This research was done utilizing balloon-borne ozonesondes and air plane flights to capture vertical profiles of the atmospheric composition. Computer modeling based on these observations further enhanced our understanding of the origin of ozone in Maryland. The understanding garnered from years of vertical and surface ozone measurements indicated a significant fraction of ozone and ozone precursors were due to transport by winds into Maryland from upstream states that compounded local pollution. Major legislation resulting from conclusions of this research has resulted in robust changes in the air composition in the eastern United States over the past 10 years. Full details of this ongoing collaboration may be found on the RAMMPP[3] webpage. The following describes the current understanding of ozone formation in Maryland.

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In the absence of a-typical airmass composition (e.g. exceptional events, smoke plumes), ozone formation in Maryland occurs primarily due to the photolization of volatile organic compounds (VOCs) in the presence of Nitrogen Oxides (NOx) and sunlight. The combination of high density population (pollution sources) and topography often focuses these reactions in well-defined areas that have historically created ozone issues east and northeast of DC and Baltimore. The main sources of anthropogenic emissions contributing to these issues are mobile sources (cars, trucks, boats, locomotives, non-road equipment), stationary point sources such EGUs, and area sources that include industrial processes and consumer products. The urban pollution plumes that develop along the I-95 corridor between DC and Baltimore (mobile, industrial, area) and surrounding point sources (EGUs) constitute the overwhelming percentage of NOx produced within the state which contributes to ozone formation. However, Maryland is also at the "tail pipe" end of the EGU rich Ohio River Valley (ORV) where a high density of large EGU point sources creates a regional NOx plume upstream that transports NOx in to Maryland. The majority of Maryland exceedances historically have been associated with such NOx transport. Photochemical modeling has shown that exclusive of light winds and recirculation, local emissions in Maryland are not great enough to support ozone exceedances. Thus the amount of ozone

[3] Regional Atmospheric Measurement Modeling and Prediction Program (RAMMPP): http://www.atmos.umd.edu/~rammpp/

and ozone precursors within the residual layer transported into Maryland adds to and raises local Maryland ozone concentrations to and above NAAQS thresholds.

The past four years in Maryland have seen few pollutant transport cases comparable to historical (pre-2013) norms. In recent years (2013-2016), the amount of ozone/precursors within the residual layer has declined to the lowest levels ever recorded, leading to a reduction of maximum ozone concentration on any one day in Maryland and thus a decrease in ozone exceedance days. As a consequence, this has caused local effects (meteorology, emissions) which previously were overwhelmed by regional signals to become more prominent and also made exceedances isolated spatially and infrequent. On average point source NOx emissions upstream of Maryland have dropped to record low levels each of the last three consecutive years. Said simply, EGU NOx emissions as a whole in 2016 were the lowest ever in states upstream of Maryland for each month of the ozone season, a total regional anthropogenic NOx decrease of about 50% in the past six years.

Research in Maryland has found ozone production to be a complicated mix of VOCs and NOx and that the atmospheric stoichiometry can change on a daily basis. Previously the balance of either precursor group was insignificant to their absolute measure in the atmosphere; both precursors were always in abundant supply for ozone exceedances and were strongly dependent on weather. In the NOx limited regime in which Maryland now exists due to regional NOx reductions, the stoichiometry is no longer balanced and ozone production is based on the availability of either of these precursor groups.

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VOCs relevant to ozone production in Maryland are both naturally occurring and anthropogenic. A significant but lesser decrease in anthropogenic VOCs was observed concurrent with NOx reductions. However, daily ozone production due to biogenic (naturally occurring) VOCs cannot be regulated and remain important to ozone production chemistry in Maryland. Isoprene, for example, a naturally occurring VOC, has the highest maximum incremental reactivity of VOCs tested in Maryland and is the highest VOC contributor on high ozone days. Isoprene is released by the biosphere (i.e., trees) due to environmental stresses such as heat. NOx output also increases from stationary sources on warm summer days in response to increased energy demand. (Mobile emissions are not dependent on temperature) At the same time biogenic VOCs are released into the local environment, and, in the presence of sunlight, create local ozone. When local emissions combine with ozone and ozone precursor transport into the state, Maryland exhibited its classic, fundamental non-event ozone exceedance. In the NOx limited regime, however, without additional transported ozone, VOCs and/or NOx, Maryland's local emissions provide insufficient ozone production for daily ozone exceedances.

Summertime meteorology is variable in Maryland. Occasional April ozone exceedance days are possible, but most of the ozone exceedance days occur primarily from May through September. The intra-seasonal variations of weather that occur through the ozone season therefore result in various meteorology patterns conducive to ozone formation. In no specific order, the generic patterns are lee-side troughing, airmass ozone/pre-cursor transport, and local recirculation and stagnation (to include reverse-corridor flow). Ozone production in each pattern depends on ozone conducive local weather conditions (i.e., warm, sunny conditions with light to moderate winds). The location of the Bermuda

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high ultimately determines which if any, of these scenarios develops. Average summer conditions place the Bermuda High off the southeast Atlantic coast of the US, which gives Maryland westerly (south-southwest to north-northwest depending on height) transport of upstream air. Lee-troughing is dependent on weak (<15 kts) cross-mountain flow around 850mb creating compressional heating/column stretching in the lee of the mountains. This induces a "trough" of lower pressure which often aligns with the I-95 corridor. Convergence along the trough increases ozone concentrations there that unless relieved by convection, may lead to ozone in excess of the NAAQS. Both transport and lee troughing patterns may occur simultaneously. Recirculation and stagnation can cause local pollution concentrations to increase to levels exceeding the standard. All three of these patterns are most probable during the summer months of June through August which, historically, were the climatological maximum for ozone production in Maryland. Shoulder seasons (Spring and Fall) typically are not warm enough and have active weather patterns preventing local or regional emissions from building. Winter is too cold for exceedances and Maryland's Appalachian peaks are too low for Stratospheric intrusion exceedances.

Differential heating at the land and water interface recirculates local and transported pollution near coastal areas via a thermally driven solenoidal circulation. Such circulations are believed to be the cause of high ozone DVs northeast of Baltimore. With increasing temperatures, super-regional NOx output increases from upstream EGUs in locations such as the ORV and western Pennsylvania, increasing residual layer concentrations of ozone and ozone precursors. These mix downwards at later times, combining with local sources, contributing to Maryland's ozone exceedances. This downward mixing is enhanced by the solenoidal circulation of the Chesapeake Bay Breeze (BB). Then lower mixing heights over the water "overcook" the precursors, creating greater concentrations over the Bay than nearby land sites. As a result, coastal sites achieve greater ozone concentrations as both regional and local emissions are concentrated by the land/water meteorology. It is no coincidence that the area of peak ozone in Maryland during a typical non-event ozone exceedance is northeast of Baltimore where local I-95 corridor emissions (the urban plume) are enhanced by transported regional pollution concentrated by land-water meteorology dynamics.

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2.4. Exceptional Event Wildfire Description

Abnormally warm and dry conditions across central Canada in late Spring of 2016 promoted wildfire conditions in the provinces of Alberta and Saskatchewan. On May 1, 2016 a wildfire was spotted 15 km southwest of Fort McMurray, Alberta. A Provincial State of Emergency was declared and in the next few days the fire consumed 10% of the town of Fort McMurray, forced the evacuation of 80,000+ residents and came to be known as "The Beast." The fire was still burning out of control through mid-June before it was no longer expected to grow and was not fully extinguished until July 2016. The cause of the fire is under investigation, but human activity is suspected[4]. Over 2,000 firefighters battled this and other wildfires across the province of Alberta. By May 19, 2016, the fire was estimated to have burned 505,645 hectares (1.25 million acres), was burning out of control and experienced a significant increase in size in just 48 hours. Firefighters from South Africa, the United States, and Canada assisted local teams battling the blaze. By June 10, 2016 589,995 hectares (1.46 million acres) had burned and

[4] http://www.cbc.ca/news/canada/edmonton/fort-mcmurray-wildfire-cause-investigation-rcmp-1.3635241

approximately 2500 firefighters had battled various blazes across the province[5]. Amid "The Beast" at Fort McMurray, Alberta, which was spreading eastward in to Saskatchewan, dozens of additional fires were analyzed by the NOAA Daily Hazard Mapping System (HMS) smoke analyses (McNamara, et al., 2004) in southern Saskatchewan and the north central US by May 17 and 18 (Figure 2). Fires analyzed by the Hazard Mapping System (HMS) were derived from the GOES Imager, the POES AVHRR, MODIS satellites and expert subjective analysis. Additionally, a large number of fires were ongoing across Mexico in mid-late May with a large concentration located in the Yucatan Peninsula (Figure 2). These Mexican fires were believed to be primarily agricultural in nature.

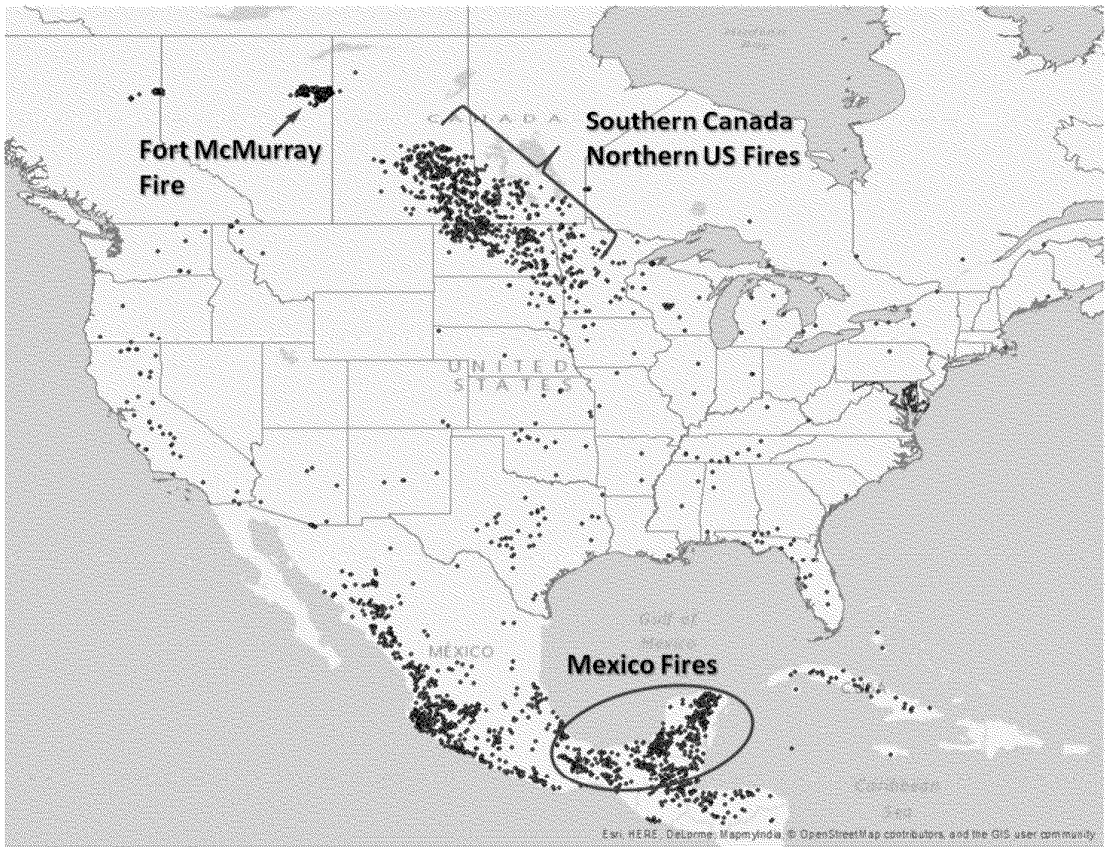

Figure 2. Hazard Mapping System Fires
Fires analyzed by the Hazard Mapping System (HMS) derived from the GOES Imager, the POES AVHRR, MODIS satellites and expert subjective analysis between May 17 and May 20. The Fort McMurray Fire, southern Canada and Mexican fires references in the text are labeled accordingly. Maryland has been colored emphasize its location compared to the fire sources.

All fires across southern Canada and Mexico were dwarfed by the size of the Fort McMurray fire. While the collection of smaller fires still produced noticeable amounts of smoke and it may have had some contribution to the plume which moved into the northeast US on May 25 and 26, their fractional impact has been essentially ignored for simplicity in this demonstration. Therefore focus will be on the

emissions from the Fort McMurray fire alone, which was extremely large, long-lasting, and produced a prolific smoke plume (Figure 3). News outlets reported impacts from the fire in New England and all the way to Spain.

Figure 3. Fort McMurray Fire.
Image showing the immense, thick and elevated smoke plume from the fires near Fort McMurray.
http://globalnews.ca/news/2685123/in-photos-the-fort-mcmurray-fire-that-displaced-80000-people/ [Source: Scott Olson/Getty Images; globalnews.ca]

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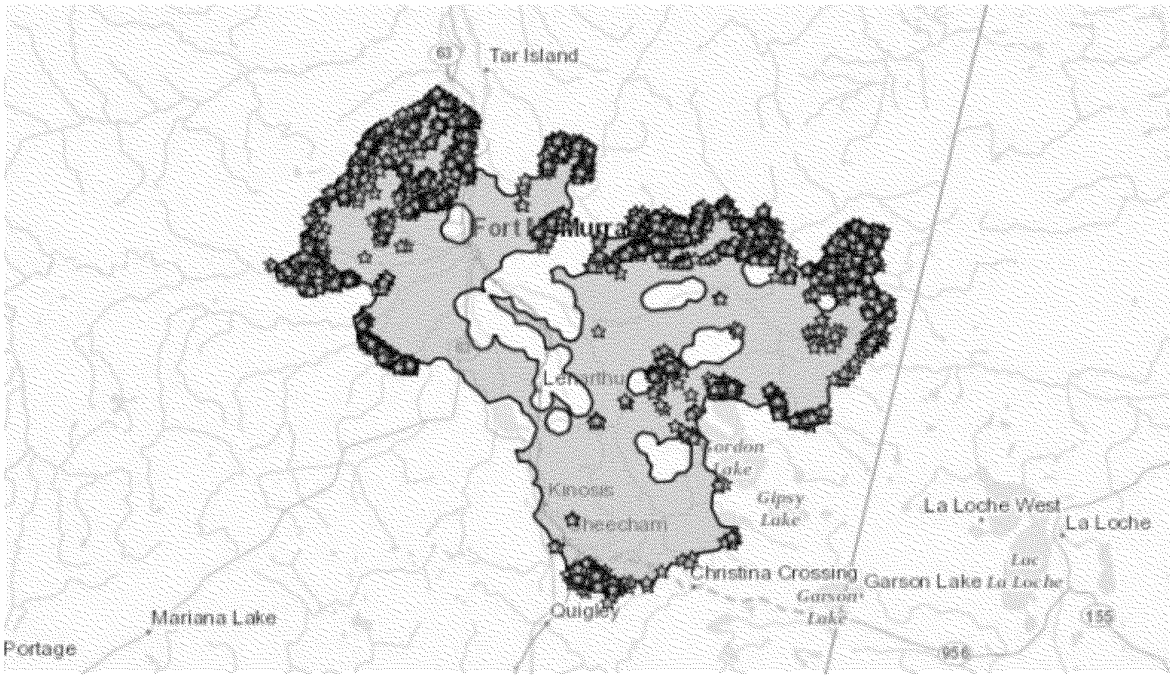

Figure 4. Fort McMurray fire extent as of May 17, 2016.
The size of the area in gray is larger than the size of state of Rhode Island. [Natural Resources Canada]

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2.5. Summary of Spatial Patterns:

Spatial analysis of contoured MD8AO concentrations and HMS analyzed smoke showed the smoke transport across the upper Midwest in to the northeast Continental United States (CONUS) and Maryland matched the movement and development of high ozone concentrations (Figure 5). Initially on May 18 and 19, the highest ozone in the country was located in proximity to smoke across the upper Mississippi River Valley (Figure 5a,b). Then, behind a surface low which traversed eastward on May 20, these same areas saw rising ozone concentrations coinciding with HMS smoke concentrations on May 20 and 21, with an exceedance of the MD8AO in Minnesota and ozone concentrations climbing above 60ppb over a wide area (Figure 5c, d). Smoke and ozone were found farther south on May 22 (Figure 5e). By May 23, HMS analyzed smoke perfectly overlapped with a broad and intensifying plume of ozone from the Gulf Coast through Michigan (Figure 5f). The first isolated exceedances of a prolonged exceedance episode associated with this airmass were observed on this day primarily from the Missouri boot heal north-northeastward through the Great Lakes. Areas of the upper Midwest and Great Lakes had larger and more intense ozone exceedances on May 24, expanding eastward in to New York and southern Canada where HMS tracked the northern portion of the smoke plume (Figure 5g).

Both the HMS analyzed smoke and the highest MD8AO contours moved eastward between May 24 and May 25 with wide spread ozone exceedances from Connecticut to Maryland by the 25th (Figure 5h). A significant spatial finding in the event at this time was the persistence of ozone in Maryland with the persistence of the smoke plume which was analyzed over the eastern half of the state of Maryland on

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May 26 (Figure 5i). Without any HMS analyzed smoke over the East Coast on May 27 and 28 (Figure 5j and k), isolated exceedances persisted, however, the magnitude and spatial coherence of the MD8AO across the northeast dissolved. That suggested that either enough residual smoke-affected air remained to create exceedances downwind of urban plumes, or that a classic, "non-event" ozone exceedance may have been occurring on these later dates. Either case highlights the significance of the departure of the smoke with the decrease in ozone coverage and magnitude on May 27 and 28.

Spatially, the key points connecting the smoke to ozone between May 20 and May 26 were the identical movement of the ozone and smoke and the persistence of one with the other. Even as early as May 18 and 19, the greatest ozone concentrations were associated with analyzed smoke (Figure 5a, b). According to hourly particle readings (not shown), which act as a primary pollutant indicator for smoke at the surface, saw an increase on the evening of May 20 and persist in to May 22 around Minneapolis as another southward push of smoke began. By the evening of May 21, hourly particle concentrations well in to the teens and reaching towards 30 were observed from Indiana, to Michigan and lower Ontario, Canada as well. These indicate that the smoke plume had reached the surface - which was supported by particle speciation data from May 24 and also coincided with the HMS spatial analysis of the smoke plume on these days. These were the same areas where ozone was rising, further supporting the spatial correlation of smoke and ozone. With the smoke plume over the East Coast, including many of the I-95 states from Connecticut to Maryland on May 25 and 26, the movement of the smoke plume and ozone clearly coincide, suggesting the smoke and ozone are connected and dependent.

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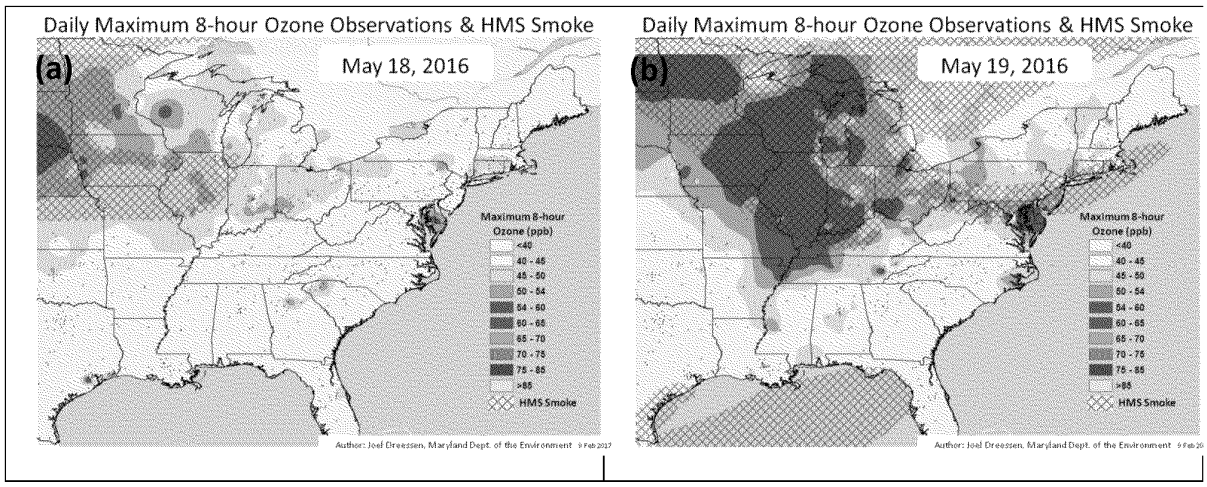
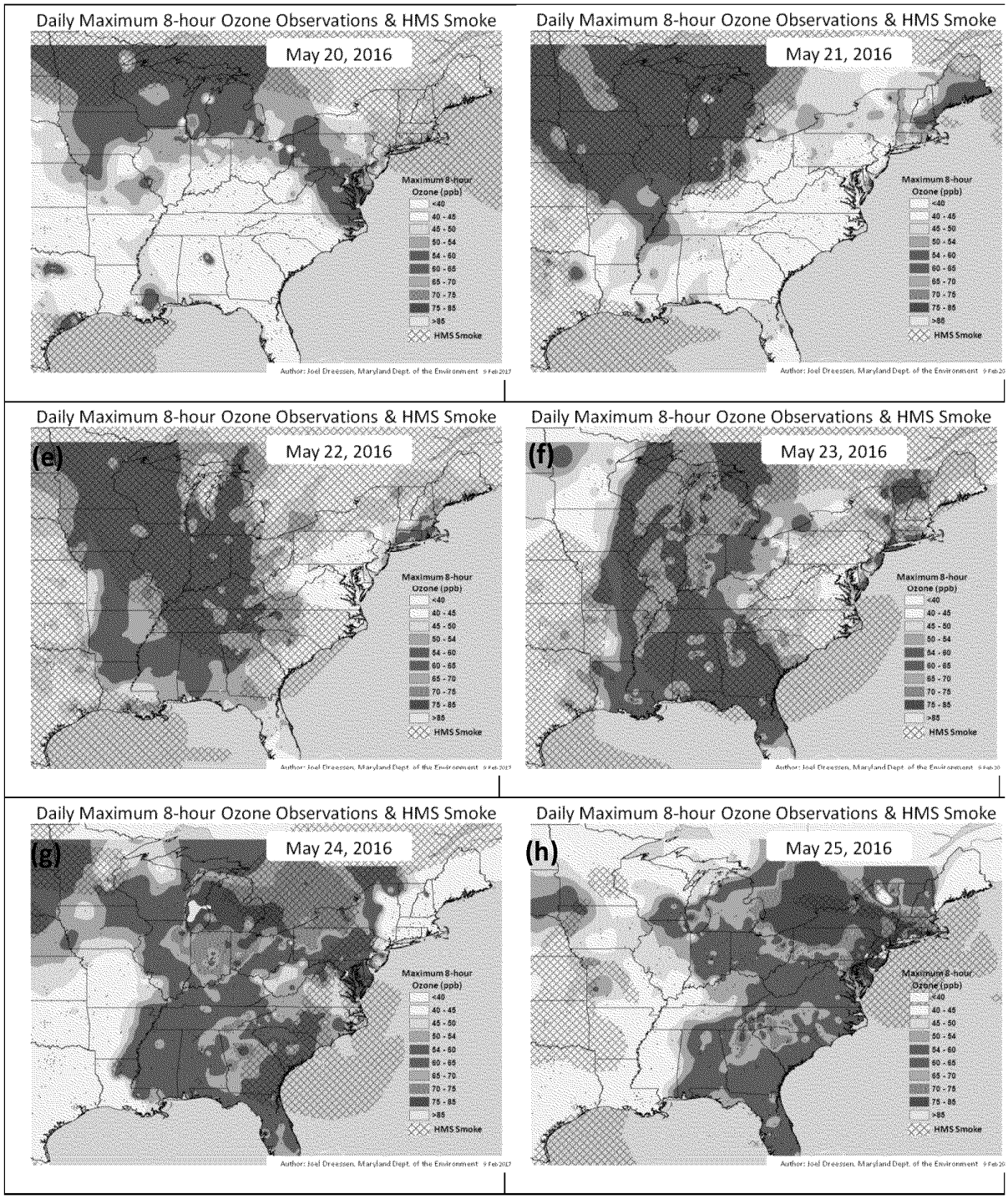


(c) **(d)**


Daily Maximum 8-hour Ozone Observations & HMS Smoke
May 20, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017
Daily Maximum 8-hour Ozone Observations & HMS Smoke
May 21, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment
Daily Maximum 8-hour Ozone Observations & HMS Smoke
(e)
May 22, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Daily Maximum 8-hour Ozone Observations & HMS Smoke
(f)
May 23, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Daily Maximum 8-hour Ozone Observations & HMS Smoke
(g)
May 24, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment 9 Feb 2017
Daily Maximum 8-hour Ozone Observations & HMS Smoke
(h)
May 25, 2016
Maximum 8-hour Ozone (ppb)
<40
40 - 45
45 - 50
50 - 54
54 - 60
60 - 65
65 - 70
70 - 75
75 - 85
>85
HMS Smoke
Author: Joel Dreessen, Maryland Dept. of the Environment

(i) **(j)**

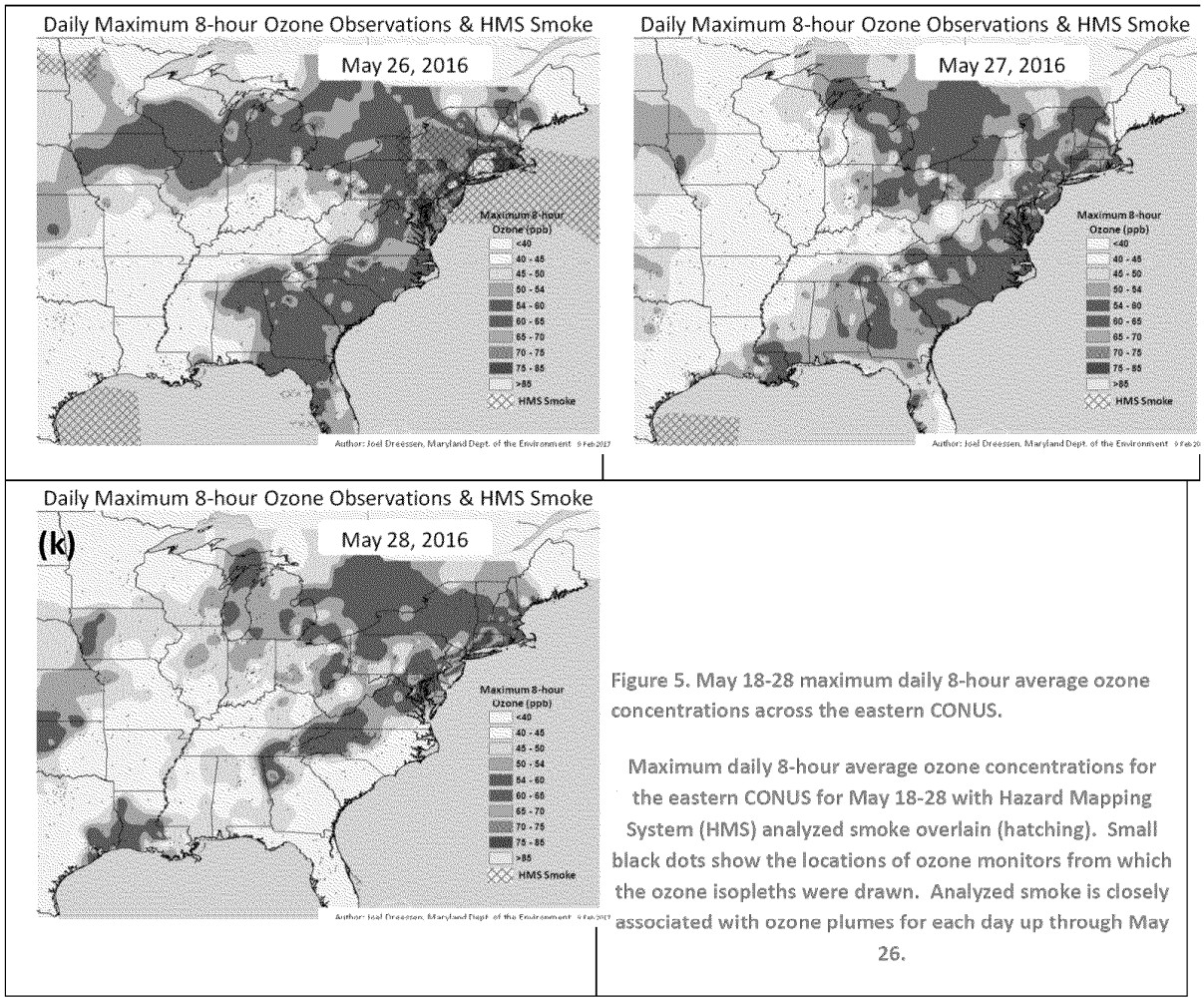


Figure 5. May 18-28 maximum daily 8-hour average ozone concentrations across the eastern CONUS.

Maximum daily 8-hour average ozone concentrations for the eastern CONUS for May 18-28 with Hazard Mapping System (HMS) analyzed smoke overlain (hatching). Small black dots show the locations of ozone monitors from which the ozone isopleths were drawn. Analyzed smoke is closely associated with ozone plumes for each day up through May 26.

2.1. Meteorological Conditions and Smoke Transport on Maryland Exceedance Days

2.1.1. Weather Pattern, Winds and Transport

An amplified atmospheric pattern developed across the CONUS characterized by a digging trough along the Northwest Coast reinforcing a central CONUS ridge building northward in to the central plains of Canada. Ahead of the high amplitude West Coast trough, a low amplitude upper level short wave moved across the interior CONUS. The trough and associated weak surface low developed from the lee of the Colorado Rockies to the lower Missouri River Valley by the morning of May 20 and moved eastward, taking clouds and associated precipitation to the east coast by May 21. There the weak upper level shortwave intensified, closed-off, and became stationary, not progressing northeastward until May 24 and providing a three day period of a trough-ridge-trough pattern in the upper levels across the CONUS (Figure 6). In the wake of the eastern low, weak northerly surface winds existed from western Ontario southward to the Louisiana Gulf Coast in the area east of the upper level ridge axis that was

aligned along the Mississippi River. A broad area of surface high pressure developed across the mid-Mississippi River Valley on the morning of May 22 and persisted across the Midwest and ORV through May 24. The eastern trough became progressive by May 24 allowing the upper level ridge axis to move eastward while its western fringes remained anchored to the stationary western trough. The associated surface high pressure meandered northeastward with the ridge axis to the Great Lakes by May 24 as the east coast surface disturbance moved northeastward and predominantly off the coast. The overall morphology of the pattern de-amplified the Midwest ridge with flow turning southwesterly in the mid and low-levels by May 26 over the eastern US.

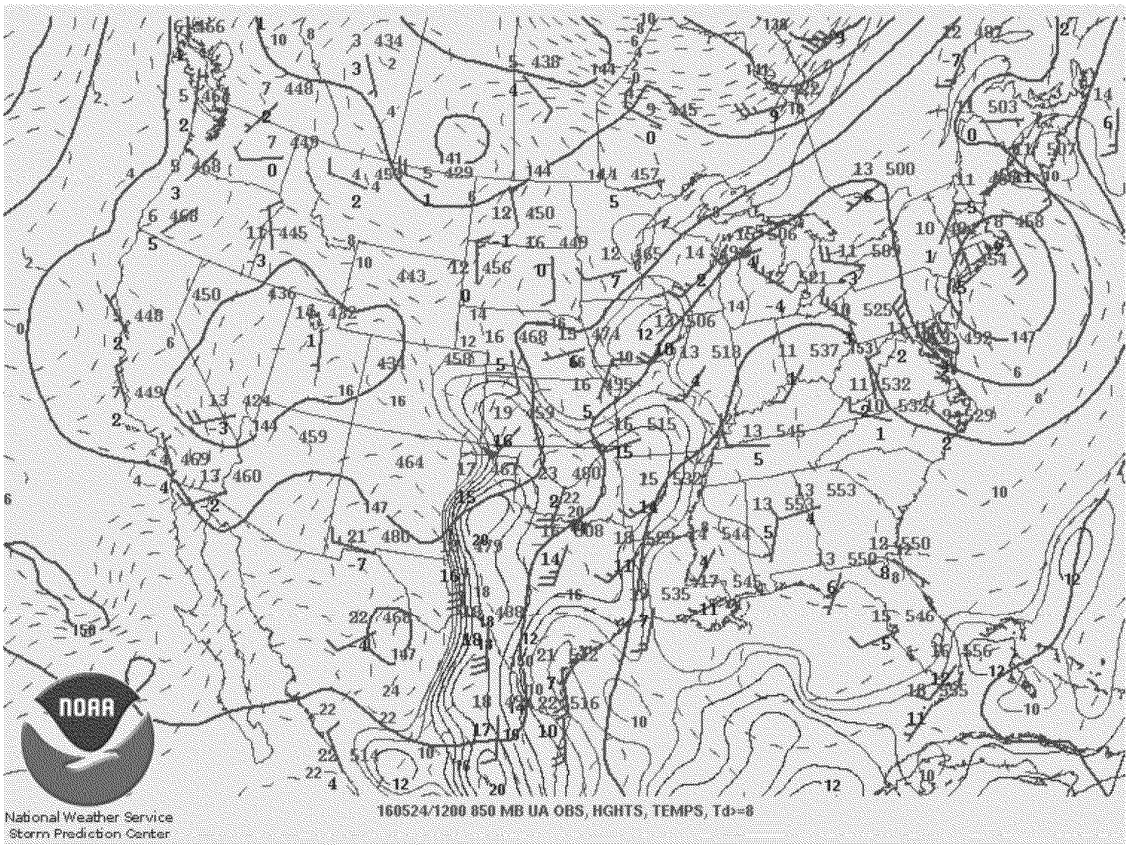


Figure 6. May 24, 1200 UTC 850mb Analysis.
Heights (black lines), temperatures (dashed lines), dewpoint (green lines), and winds (blue barbs) for the morning of May 24, 2016. The Midwest (Indiana, Ohio, Michigan) and western areas of the northeast (western Pennsylvania and New York) were underneath a ridge. The Great basin and the northeast states were both under areas of low pressure, creating a pseudo "omega" pattern that had meandered eastward but persisted since May 21.

As a result of the pattern morphology, smoke was transported to Maryland from the northwest. Smoke from a conglomeration of fires across Alberta, Saskatchewan, Manitoba and the Dakotas (Figure 2), the most prominent being the Fort McMurray fire, was already over the northern plains on May 18 and 19 (Figure 5a,b). This smoke was ineffective at producing high ozone due to the developing surface low on May 20 which moved across the lower Missouri River Valley. Weak northerly flow within the Mississippi River Valley and northern plains returned behind the transitory surface low (eastern side of

the central CONUS ridge), and HMS again analyzed smoke on May 21 across much of the Midwest (i.e., Missouri, Illinois, Indiana, Minnesota, Wisconsin, Michigan, Figure 5d). Concurrent with the southward drift of smoke under the ridge, subsidence brought smoke and ozone pre-cursors to the surface. At the same time, smoke from the Mexican fires had worked northward into the southern plains on the west side of the upper level ridge axis, combining with the northern smoke plume. The transport pattern remained relatively consistent through May 22 causing the consolidation of these two plumes into one continuous feature from Mexico northward through the northern plains on both May 21 and 22 under HMS smoke analyses (Figure 5d, e). Subsidence and meandering of the plume under the ridge continued and on May 22, smoke was also analyzed over all of the Great Lakes states, Midwest and southeastward to the Carolinas. The northern smoke expanded eastward on May 23, covering nearly the entire US east of the Mississippi River, including Maryland. Those areas west of the coastal low saw their first ozone exceedances due to the smoke plume. Despite smoke analyzed in parts of Maryland on May 23, no impact on ozone was observed, due to the low pressure system providing overcast conditions there (Figure 5f). Instead, the smoke plume continued slowly eastward under the slow evolution of the upper-level pattern. Northwesterly transport across the Midwest continued through May 24 bringing additional smoke both southeastward and to the surface.

Ozone concentrations and distribution on May 24-26 had Maryland persisting on the southern fringe of the smoke-impacted air observed over the preceding days in the Midwest. On May 25 and 26, 2016, 13 and 15 of the 20 total monitors in the state of Maryland, respectfully, exceeded 70ppb for their respective MD8AO due to the transport of smoke-laden air photochemically aged under the ridge of high pressure across the upper Midwest. Under the slow moving central CONUS upper level ridge, the Midwest (Minnesota, Wisconsin, Michigan, Illinois, Indiana, Iowa, Missouri) had northerly winds under clear skies and analyzed smoke from May 18 – May 24. The associated surface high pressure was centered over Ohio by May 23, causing sunny skies and light winds across Ohio, Michigan, Indiana and surrounding areas and fostered a build-up of ozone there. This led to ozone exceedances on May 23 that became transitory and widespread from west to east through at least May 26. Under the upper level shortwave, Maryland received clouds and/or rain from May 20 through May 23. After this period, MD8AO concentrations were significantly higher than model predicted values with exceedances of the ozone NAAQS standard on May 25 and 26, 2016. Smoke and photo-chemically aged pollutants persisted in Maryland through May 26 until surface high pressure developed to the southeast of the state and the upper level pattern shifted to southwesterly winds, leading to stronger surface winds and cleaner southerly transport.

Surface conditions in Maryland on the days of the exceedance were characterized by light winds generally 10 kts or weaker. This allowed local wind patterns to dominate, particularly the land/water breezes that develop under light synoptic wind conditions. These conditions historically support higher ozone concentrations mainly just northeast of Baltimore near the Edgewood monitor (240251001) where local pollution and meteorology are most ozone productive. Despite characteristics which would suggest localized higher ozone focused northeast of Baltimore, Edgewood was not the highest Maryland monitor during the event. Instead, the ozone was highest at monitors in the state where HMS analyzed smoke on that day. Contrary to recent ozone exceedances (2013-2015), the ozone produced on May 25

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and 26 was regional in nature and associated with analyzed smoke.

2.1.2. Temperature

Temperatures were above normal for the duration of the ozone event, but warmer than normal no longer means ozone was likely, and above normal warmth in May was not necessarily ozone conducive. Similar to the observations of Dreessen et al. (2016), the smoke did not produce excessive ozone in May 2016 until the airmass warmed. Warmer temperatures in 2016 were due to broad subsidence and warm air advection beneath the ridge. For example, the high temperature in Minneapolis, MN on May 21 was 9 °F warmer than normal (Table 2). At the Indianapolis, IN airport, the temperature climbed from a high of 57°F on May 17 to 82 °F on May 24 at the height of the exceedance event in that area. While this was 7 °F warmer than average, 82 °F is not necessarily conducive to ozone formation without the burden of wild-fire precursors. Note that Indianapolis had an ozone exceedance with a modest surface temperature of only 78 °F on May 23. Detroit, MI at its exceedance onset of May 23, had similar ozone production at an even cooler temperature of 76 °F. On the days of the ozone exceedance in Maryland, maximum temperatures were 10 and 13 °F above average (Table 2). This general warming trend (i.e., temperatures incrementally greater than average) from west to east airmass suggests the surface air was modifying as it progressed eastward.

Though temperatures were warmer than normal in 2016, recent data has shown that warm temperatures are no longer sufficient for ozone exceedances in Maryland (Figure 7). For example, the once steady ratio of "hot days" to ozone exceedances (1980 – 2003) hit an all time high in 2016 with nearly twice as many hot days as ozone exceedances at the 70ppb standard. The number of hot days to the number of ozone exceedances has been steadily increasing since 2003 indicating that temperature alone as a factor in ozone production is decreasing in importance in Maryland. This emphasizes the importance of smoke in this case. Previously, greater probability of ozone NAAQS exceedance in Maryland was shown with higher temperatures (Lin et al., 2001) and historically, MDE has tracked Maryland's ozone exceedance days with temperatures equal to or exceeding 90°F (MDE, 2012; Warren, 2013). In 2016 Maryland had above normal temperatures near the 90 °F threshold from May 25 – May 28 (Table 2). However, Maryland also had near-record warmth throughout the 2016 ozone season but recorded a very low percentage of exceedances on hot days. In fact, in a year with 48 days at or above 90°F, the greatest number of days in the last 17 years, there were only 27 exceedance days, which is the highest ratio of hot days to ozone exceedances at the 70 ppb level ever. In August of 2016, a string of several days in the mid 90s produced no ozone exceedance days. Only one monitor exceeded on either May 27 or 28 as compared to 13 and 15 on May 25 and 26 despite the latter two days being as warm as May 25 and 26 illustrating that temperature alone was not indicative of the scale of the ozone exceedance in Maryland. By May 27, HMS no longer analyzed smoke across the region as the smoke-burdened air had largely been transported northward from Maryland. Thus once the smoke-influenced airmass was removed from the region, the constituents associated with ozone production were also removed on the regional scale and local influences again dominated ozone's spatial distribution. The temperature may have remained warm enough for an exceedance at an isolated location, but not for

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widespread ozone exceedances. Additionally, there is no way to prove that the exceedances on May 27 and 28 were not also due to local, residual, smoke-impacted air. In fact, speciated particle data from May 27 suggests that smoke influences had not yet entirely left the area, implicating smoke in at least another exceedance on May 27.

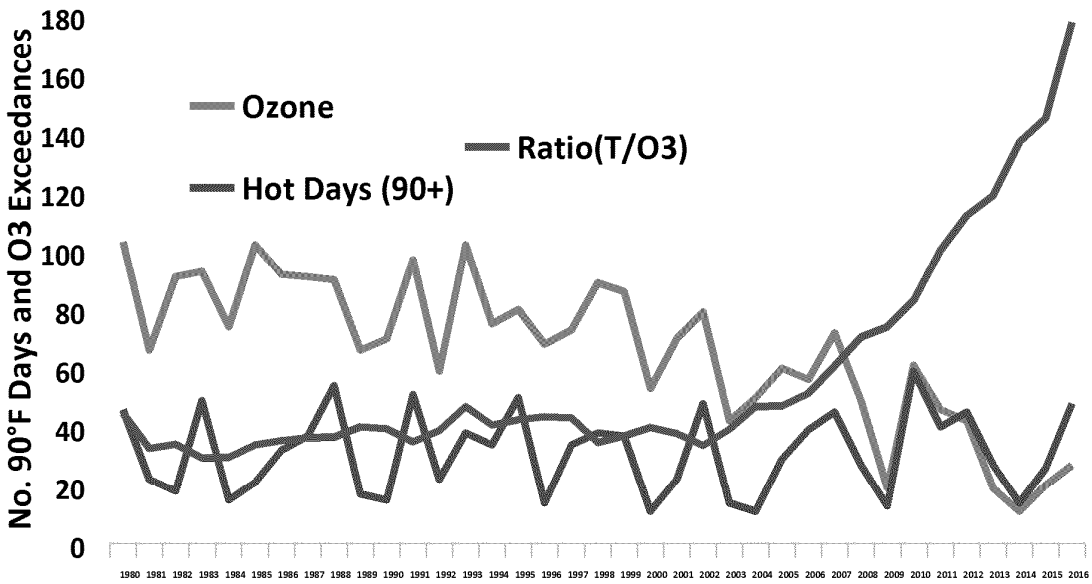

Figure 7. Ozone to temperature ratio.
A graph of the number of days with MD8AO in Maryland greater than 70ppb in a given ozone season (blue line), the number of days where the temperature at BWI airport reached at least 90°F in a given year (brown, thin line), and the five year moving average (multiplied by 100) of the ratio of "hot days" to ozone exceedances (thick red, shadowed line) from 1980-2016. The dramatic increase in the ratio of hot days to ozone exceedances indicates the decreasing significance temperature has on ozone exceedances in Maryland.

2.2. Conceptual Model of Ozone Formation from May 2016 Canadian and Mexican Fires

Dreessen et. al. (2016) previously showed that smoke plumes from Alberta and Saskatchewan are capable of transporting ozone precursors to the Mid-Atlantic. In the 2015 case study examined by Dreessen et al. (2016), it was hypothesized that once the smoke-sourced VOC rich plume interacted with anthropogenic NOx sources that copious ozone production began which was capable of being transported long distances as either ozone or within ozone reservoir species. In the present May 2016 case, sufficient amounts of NOx and VOCs were generated by fires across southern Canada in early and mid-May of 2016 for ozone production. Surface winds kept some surface precursors from dissipating, but the buoyancy of the fire plumes lofted a substantial amount of precursors. These precursors were transported long distances as they slowly subsided back to the surface under the ridge of high pressure. Diurnal mixing and additional smoke transport allowed additional wildfire precursors aloft to reach the surface between May 20 and 26 as a ridge moved eastward toward the northeastern US. This process caused the airmass associated with the smoke to photochemically age and produce copious ozone in the

Midwestern and Northeast states once the temperature warmed sufficiently for ozone reactivity.

Table 2. Maximum daily temperature, average maximum daily temperature and departure from average. Maximum daily temperature, average maximum daily temperature and departure from average (observation minus average) for various sites across the domain impacted by the smoke are provided for May 20 – May 28, 2016. All temperatures are in degrees Fahrenheit. Colored boxes show maximum daily 8-hour average ozone AQI at locations where nearby sites had ozone exceedances of 70ppb. The Columbus, OH area did not exceed during the event. However, adjacent cities in Ohio (Cleveland, Cincinnati) did exceed on both May 24 and 25. Columbus was just on the edge of the smoke plume both days. HMS never analyzed smoke over Columbus from May 23-28.

Date	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May
Minneapolis, MN (°F)	76	80	84	84	86	76	81	70	68
Normal (°F)	71	71	71	71	72	72	72	73	73
Departure (°F)	5	9	13	13	14	4	9	-3	-5
Indianapolis, IN (°F)	68	73	81	78	82	84	77	85	83
Normal (°F)	74	74	75	75	75	76	76	76	76
Departure (°F)	-6	-1	6	3	7	8	1	9	7
Columbus, OH (°F)	72	60	72	76	80	80	80	88	86
Normal (°F)	74	74	75	75	75	75	76	76	76
Departure (°F)	-2	-14	-3	1	5	5	4	12	10
Detroit, MI (°F)	71	73	73	76	85	86	86	82	89
Normal (°F)	71	71	72	72	72	73	73	73	74
Departure (°F)	0	2	1	4	13	13	13	9	15
Rochester, NY (°F)	73	69	71	78	83	86	85	88	91
Normal (°F)	69	69	70	70	70	70	71	71	71
Departure (°F)	4	0	1	8	13	16	14	17	20
BWI, MD (°F)	75	62	60	75	82	86	90	90	88
Normal (°F)	75	75	76	76	76	76	77	77	77
Departure (°F)	0	-13	-16	-1	6	10	13	13	11
Meriden, CT (°F)	76	69	75	82	68	88	88	87	90
Normal (°F)	71	71	71	72	72	72	72	73	73
Departure (°F)	5	-2	4	10	-4	16	16	14	17

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The main smoke plume and ozone precursors of interest connected to Maryland's ozone exceedances dispersed southward into the northern plains and Midwest of the US beginning on May 20-21. Across these areas upstream of Maryland, ozone production increased with the temperature, creating a photochemically aged airmass. It was postulated that the main smoke influence on ozone production in Maryland was accomplished within the photochemically aged airmass upstream, which was then transported in to the state. Ozone was elevated across Maryland beginning on May 24 as the modified airmass transport began with the departure of the coastal low, but exceedances of the NAAQS associated with the smoky airmass only occurred on May 25 and 26. Across the state, 13 and 15 of the total 20 monitors in Maryland recorded exceedances on the 25th and 26th respectfully. The HMS also analyzed a smoke plume over Maryland on these two days suggesting additional precursors were available on these exceedance days in Maryland. Regardless of the position of analyzed smoke in Maryland, however, the smoke had already heavily modified the airmass across the Upper Midwest during its residence there. This caused high ozone concentrations to be transported in to Maryland on May 25 and 26 which, while similar to, were not associated with a non-event-type transport pattern. The path, residency and meteorological setup for the smoke in this event are all consistent with a dispersing and subsiding smoke plume advected from the upper Midwest and southern Canada in to the

northern Mid-Atlantic and Northeast states.

While ozone exceedances in Maryland are not unusual during the month of May, the magnitude, location, and spatial scale of this particular exceedance was beyond historical and contemporary norms. Meteorological conditions from May 23 – May 26, 2016 (when the majority of ozone exceedances occurred) were not sufficient to cause the large spatial scale and multi-day exceedance event without the added burden of additional wildfire-related precursor emissions. Historical comparisons during the month of May show ozone values of these magnitudes are rare (fall within the 99th percentile), and are even rarer considering massive emissions reductions evident during that time period across the entire eastern US. Thus, it is unlikely such a widespread exceedance could have occurred without additional supportive atmospheric chemistry provided by the wildfire smoke.

3. Data Acquisition

Ozone concentrations in excess of the NAAQS normally occur with sunny skies, warm air temperatures, stable atmospheric conditions, and light winds. Ozone concentrations may also increase when there are unusual emissions of ozone precursors such as VOCs and NOx. Wildfires are known sources of these ozone precursors. To analyze the specific conditions on May 25-26, 2016, when 8-hour ozone concentrations above 70 ppb occurred in Maryland, fire and smoke, air quality, and meteorological data were collected from a wide variety of sources to develop both a local and regional perspective on the event (Table 3). These sources were selected because of their high standards for data quality. Combined with regional data from EPA's Air Quality System (AQS), this network provided a speciated, high resolution observational data set of a rare air quality event associated with aged Canadian smoke across the northeast CONUS. Unfortunately the worst ozone in Maryland did not fall on a speciation run day (1 in 3 day). Data were also assimilated into a Geographic Information System (GIS) to map pollutants spatially.

Table 3. Data sources used in the demonstration

CATEGORY	TYPE	SOURCE
Air Quality	Ozone	AQS
	PM2.5	Airnow
	Speciated PM2.5	MDE Lab
Meteorological	Temperature	NOAA
	Wind	NOAA
	Trajectories	ARL
Satellite	HMS	NOAA OSPO
Fire Data	Locations	NOAA OSPO
	Burn Acreage	Alberta Government

4. The Occurrence was a Natural Event

According to the CAA and the Exceptional Events Rule (40 CFR 50), an exceptional event must be "an

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event caused by human activity that is unlikely to recur at a particular location or a natural event." The EPA also believes that treating all wildfires on wildland as natural events is consistent with the CAA and Exceptional Events Rule. Based on the documentation provided in section 2 of this submittal which discusses the origin and evolution of the wildfire events, the Fort McMurrary and southern Canada fires qualify as a natural event because non-prescribed human activity was suspected as the cause of the unplanned fire event which occurred on wildland. While the city of Fort McMurray itself was not wildland, ozone exceedances occurred 20 days after the fire roared through the town. Therefore wildfire emissions affecting ozone concentrations in Maryland were generated predominantly from sparely populated forested areas, meeting the definition of wildland. The EPA generally considers the emissions of ozone precursors from wildfires on wildland to meet the regulatory definition of a natural event at 40 CFR 50.1(k). Accordingly, the MDE has shown that the event is a natural event and may be considered for treatment as an exceptional event.

5. The Occurrence was Not Reasonably Controllable or Preventable

Based on the documentation provided in section 2 the majority of the fires relevant in this demonstration were likely due to human activity. Unintentional or not, these fires were considered natural wildfire events by the EPA, were outside of the United States, and were therefore neither reasonably controllable or preventable by the state of Maryland. No policy that Maryland enacted could have prevented the fire or the smoke which it caused, to enter the United States or Maryland. The Department was not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable. Additionally Therefore, emissions from these wildfires were not reasonably controllable or preventable and meet the criterion for treatment as an exceptional event.

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6. Clear Causal Relationship Between The Event and Monitored Ozone Concentrations

6.1. Literature Review

Wildfires are known sources of emissions responsible for both primary and secondary pollutants including Carbon Monoxide (CO), $PM_{2.5}$, NOx, VOCs (Hu et al., 2008), as well as ozone (Andreae and Merlet, 2001; McKeen et al., 2002; Bytnerowicz, et al., 2010). Similar to the study presented here, Canadian wildfires have increased ozone concentrations in Houston, TX (Morris et al., 2006) and as far away as Europe (Spichtinger et al., 2001). Evidence of Canadian wildfire smoke and biomass burning affecting the Mid-Atlantic's particulate matter (PM) air quality was also previously reported (Adam et al., 2004; Colarco et al., 2004; Sapkota et al., 2005) but wildfire smoke has also been recognized in high-ozone events on the east coast (Fiore et al., 2014). DeBell et al., (2004) presented a chemical characterization of the July 2002 Quebec wildfire smoke plume and its impact on atmospheric chemistry in the northeastern US. Dreessen et. al., (2016) presented a recent case where an Alberta, Canada smoke plume caused amplified ozone in Maryland in June of 2015, similar to the applicant case presented here.

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Some have noted the uncertainties in the influence of wildfire emissions in terms of strength and composition on ozone production (e.g., Hu et al., 2008). While less frequent in the Mid-Atlantic, wildfire smoke has been an increasing fractional contribution to high-ozone days, particularly in light of increased fire frequency in a warming climate (Flannigan and Wagner, 1991; Marlon et al., 2009; Westerling et al., 2006; Spracklen et al., 2009; Pechony and Shindell, 2010), decreasing regional emissions (Gégo, et al., 2007) and tighter ozone NAAQS (http://www3.epa.gov/ozonepollution/actions.html). The case presented in this analysis illustrates an example of the impact of ozone in Maryland temporally correlated with the progression of smoke plumes. MDE here presents necessary evidence to show the smoke event affected air quality in Maryland. Tier 1 and 2 steps are provided but may not clearly demonstrate a clear causal relationship. Therefore, a weight of evidence, Tier-3 approach is used to build a convincing case that smoke transport was responsible for the high ozone concentrations in Maryland that led to ozone exceedance days.

6.2. Q/d Analysis

EPA guidance [Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016] recommends conducting a Q/d analysis as a rough assessment of the ability of a wildfire to cause increased ozone concentrations. The Q/d analysis is simply a comparison of the ratio of Q, the daily tons of VOC and NOx emitted from the fire, to d, the distance in kilometers from the fire to the point of concern. If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern. The comparison to other fires is a key point that will be brought up again.

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EPA guidance indicates that a fire should have a Q/d in excess of 100 tons per day per kilometer (tpd/km) in order to be considered to have a clear causal impact on ozone. EPA developed this value based on analyses of four fires which occurred in 2011. Due to the large distances which Canadian wildfire plumes must travel, the Q/d analysis will regularly fail to achieve the 100 deemed acceptable by the EPA guidance. Therefore, MDE feels the 100 value is not representative for long-range east-coast smoke events and the 100 value is an arbitrary value which renders this analysis immaterial to most transport events the east coast faces as was generally exemplified here.

6.2.1. Estimate of Q

The emissions from the fire can be estimated using information from EPA's AP-42 Compilation of Air Emission Factors Section 13.1 Wildfires and Prescribed Burning. The equations given are as follows:

$Fi = Pi * L$ (Equation 1)
$Ei = Fi * A$ (Equation 2)

Fi = emission factor (mass of pollutant/unit area of forest consumed)

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Pi = yield for pollutant "i" (mass of pollutant/unit mass of forest fuel consumed)
= 12 kg/Mg (24 lb/ton) for total hydrocarbon (as CH_4)
= 2 kg/Mg (4 lb/ton) for nitrogen oxides (NOx)

L = fuel loading consumed (mass of forest fuel/unit land area burned)
A = land area burned
Ei = total emissions of pollutant "i" (mass pollutant)

Combining equations 1 and 2, we have:

$$Ei = Pi * L * A$$

Pi is given above for total hydrocarbons and for nitrogen oxides. The fuel loading is given in AP-42 for different regions of the United States and ranges from 9 to 60 tons per acre. Conservatively, we will estimate a low end emission rate using 10 tons per acre which is associated with North Central US conifer forests. Note that our results could increase by a factor of 6 were we to expect the high end of emissions.

The Alberta government reported that by June 10, 2016 the fire ultimately covered 589,995 hectares (1,457,909 acres) with a perimeter of 996 kilometers (618 miles). For reference, the total land area of Rhode Island is approximately 270,000 hectares.[1] The chart below indicates the total area covered by the fire as reported by the Alberta government (Figure 8)[2]. During the days prior to the smoke plume entering US space (May 17- 21) the fire grew by approximately 149,000 hectares (368,187 acres).

Therefore, ignoring the smoldering of previously burned areas AND perhaps more significantly, any additional fuels burned within the Southern Canada fires (Figure 2) we estimate the total hydrocarbon emissions from the period to be:
Ehc = 24 lbs of HC / ton of forest fuel consumed * 10 tons fuel / acre * 368,187 acres
Ehc =88,364,880 pounds of HC
Ehc = 44,182 tons of HC emitted during the period from May 17 to May 20

Similarly for NOx:
Enox = 4 lbs of NOx / ton of forest fuel consumed * 10 tons fuel / acre * 368,187 acres
Enox = 14,727,480 pounds of NOx
Enox = 7,364 tons of NOx emitted during the period from May 17 to May 20

[1] Any large area estimate can only be considered comprehensible if compared to the State of Rhode Island.
[2] https://www.alberta.ca/release.cfm?xID=41701E7ECBE35-AD48-5793-1642C499FF0DE4CF [Final Update 39: 2016 Wildfires (June 10 at 4:30 p.m.), Alberta Government]

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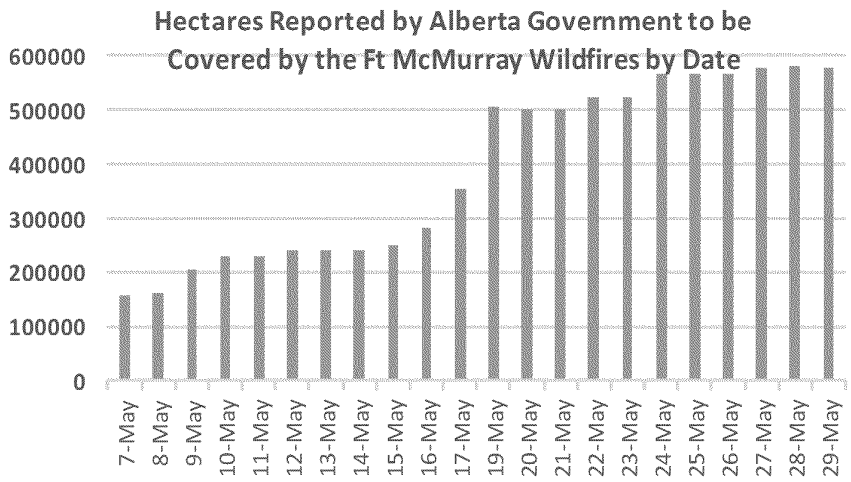

Figure 8. Hectares burned reported by Alberta Government by the Fort McMurray wildfire to date.
There is a sharp increase in the fire size between May 17 and May 20, leading to number emissions in that time period. No data was available for May 18, 2016

Q is the total daily emission rate in tons per day of reactive hydrocarbons and nitrogen oxides. EPA recommends in the exceptional events guidance that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions become rHC = 0.6 * Ehc or 0.6 * 44,182 = 26,509 tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NOx emissions. Therefore the total rHC and NOx emissions over the period are 26,509 + 7,364, or 33,873 tons over the four days. On average this results in a daily emission rate, or Q, of 8,468 tons per day. However, data from Alberta shows that most of these emissions came over 2-3 days, (May 17 to May 19). A more reasonable estimate is 33,873/2.5 = 13,549 tons per day.*

6.2.2. Estimate of d

Based on the large distance, we will not present individual analyses for each monitor in Maryland but estimate the distance from the Fort McMurray fire to the most distant point in Maryland. This will supply a conservative yet representative distance the smoke traveled to the Maryland ozone network. A value of 3280 km was therefore used for d, the flight distance from Fort McMurray to the Blackwater NWR monitor, near Cambridge, MD on the southern eastern shore.

6.2.3. Q/d Estimate

Using the values determined above, Q/d becomes 13,549 tpd divided by 3280 km or 4.1 tpd/km (Table 4). This value is well below the EPA recommended level of 100 tpd/km indicating clear causality. If instead we aggressively assumed the out of control fire consumed most of its fuel between May 17 and May 21 in one day's time, Maryland's Q/d value climbs 10.3. Still well below 100. This assumes, however, no contribution of other fires in Canada or from other fires in Mexico which may have also mixed in with the plume across the Mississippi River Valley.

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*No fire size estimate was provided for May 18 by the Alberta Government site.

Table 4. Q/d analysis for various scenarios.

ACRES	Ehc	Enox	Q	No. days burning	d	Q/d	DESCRIPTION
368,187	44,182	7,364	33,873	2.5	3280	4.1	Standard Q/d
368,187	44,182	7,364	33,873	1.0	3280	10.3	If the entire area burned between 5/17 & 5/20 burned in one day
368,187	45,000	3,000	48,000	1.0	3280	14.6	Comparing the Wallow Fire emissions to Fort McMurray; No Ehc adjustment
368,187	265,095	44,182	203,239	2.5	3280	24.8	Fuel loading at a maximum of 60 tons/arce instead of 10
368,187	265,095	44,182	203,239	1.0	1735	117.1	Maximum fuel loading, 1-day burning, with plume impacting Minneapolis, at MN

Taking a slightly different approach we consider the basis for the EPA guidance and look at emissions from one of the four fires EPA relied on in developing their guidance. Appendix A2 of the EPA guidance indicates that EPA based their conclusions on 12 km grid CMAQ modeling of four 2011 multiday fires: Wallow, Waterhole, Big Hill and Flint Hills. Emissions from the fires were based on a program called SMARTFIRE. Using information available on the Wallow Fire, we approximate the emissions that might be calculated for the Fort McMurray fire.

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The Wallow Fire was located in eastern Arizona and western New Mexico from May 29, 2011 through July 8, 2011 and burned 841 square miles (538,240 acres) by June 26th. The maximum daily emissions from that fire were reported as approximately 15,000 tons of rVOC and 1,000 tons of NOx. [Simulating Fire Event Impacts on Regional ozone and $PM_{2.5}$ and Looking Forward Toward Evaluation, Kirk Baker, EPA October 5, 2015 and Using SOAS and related field study data for scientific and regulatory modeling, Kirk Baker, EPA, undated; both are slide presentations] If we scale this fire up by a factor of three to approximate the total acreage burned in the Fort McMurray fire, then we have daily emissions as high as 45,000 tons for rVOC and 3,000 tons for NOx. These emissions produce a Q of 48,000 tpd and Q/d becomes 14.6 – still well below EPA expectation for causality.

Taking a less conservative approach and recalling that a worst case fuel loading would increase our Q results by a factor of six, Q/d would in this case result in ~25 tpd/km; better, but not up to EPA's threshold of 100 tpd/km. While this approach might be justified by the ongoing smoldering of the peat and/or the intensity of the Fort McMurray fire, variability in the burn rate and other factors make it difficult to justify the fuel load increase without further details that may only be obtained through estimates which introduce their own error.

An ozone exceedance occurred in Minnesota on May 21, 2016. This location was only 1735 km away

from the fire source. It was not unreasonable to assume that 368,000 acres may have burned in approximately one day given the out of control nature of the fire. Without a size assessment on May 18, there was no way to discount this. It was also not inconceivable that the fuel load was closer to 60 tons/acre due to the ravage nature of the fire. Under these assumptions (i.e., assuming the entire area burned in one day with maximum fuel load), the Q/d value increases to 117 tpd/km in Minneapolis, MN. This would indicate that where the smoke precursors subsided to the surface with conducive local conditions (warm, sunny), ozone did respond with increased Q/d analysis over 100 tpd/km. Additionally, no contribution from sporadic but numerous wildfires across southern Saskatchewan were added to this analysis, which could bring the Q/d analysis even further above 100 tpd/km without making any liberal assumption of the emissions. The implications for Maryland are that the upstream airmass was ozone conducive and showed a clear causal relationship to the fire, meeting the EPA threshold of 100 tpd/km for Q/d analysis and was producing ozone due to the smoke before entering Maryland. Furthermore, due to the lofted nature of the smoke to the free atmosphere, it may be possible for precursors to not react as quickly as lower-level transport cases establishing the 100 tpd/km threshold such that 100 tpd/km is not representative of Canadian wildfire cases. In Minnesota, May 21, 2016 was the highest ozone and the only exceedance for the entire 2016 season for that state. Such findings satisfy both Key Factors 1 and 2 in the EPA Exceptional Events Guidance.

EPA guidance states that *"If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern."* Since 2015, at least three major Canadian wildfire episodes have impacted Maryland: June 9-12, 2015 (as thoroughly described in Dreessen et al., 2015); May 25-26, 2016; and July 20-22, 2016. Thus, by EPA's Q/d definition, MDE now has a small subset to compare other wildfire impacts on ozone within the contemporary emissions environment. A Q/d analysis for July 2016 is done in that exceptional event analysis. For June of 2015, Q/d was calculated using values in Dreessen et al., 2016, which listed 77,000 acres burned in a 2 day period and smoke transported 3100km from central Saskatchewan. Dreessen et al., 2016, goes on to show the impact of the smoke plume as it descended on the eastern Midwest and Mid-Atlantic on June 9-11, 2015 and showed clear wildfire signatures and influences on ozone. Based on that research, Q/d for that ozone episode would have been 1.1 (Table 5). The May event demonstrated here had a Q/d four times as large (4.1). The July 2016 event had a Q/d of 1.8. It appears a more appropriate Q/d number for Canadian transport cases to Maryland is closer to one (1), 100 times lower than the EPA suggested value.

Table 5. Q/d Analysis for three Canadian Wildfire events impacting Maryland.

ACRES	Ehc	Enox	Q	No. days burning	d	Q/d	DESCRIPTION
368,187	44,182.00	7,364.00	33,873.20	2.5	3280	4.1	Fort McMurray - May 2016
271,134	32,536	5,423	24,945	4.0	3530	1.8	Northwest Territories - July 2016
77,000	5,544.00	1,540.00	7,084.00	2.0	3100	1.1	Lac La Ronge - June 2015

Noting the wide variability in emissions estimates from different approaches, and as the Q/d method

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does not generally satisfy the expectation of a clear causal impact, we present other evidence demonstrating that the plume from the Fort McMurray fire caused elevated ozone levels in Maryland.

6.3. Evidence that the Fire Emissions Affected the Monitors

6.3.1. Evidence that Fire Emissions were Transported to Maryland

Using HYSPLIT both forward trajectories constructed from the smoke plume and fire sites and backward trajectories from Maryland show transport from the fire and smoke locations to Maryland. A matrix of trajectories (Figure 7a) centered across the location of the smoke plume as of May 20 show a clockwise pattern outward from the source region. Many of the trajectory members work their way east and southward across the upper Midwest and Great Lakes. A subset of this matrix corresponds to direct forward transport of the plume into and through the Midwest and then in to the Mid-Atlantic. The farthest reaching southeast trajectories, one red (A), one blue (B), and on Green (C) together represent transport to Maryland from the source region. All three trajectories take a full 4-5 days to transverse the distance to the east coast, which is consistent with heightened ozone beginning on May 24 and exceedances on May 25. General subsidence is also noticed for nearly all members in the matrix with a majority of members at or below the original starting height of 1500 m, supporting the assertion additional smoke aloft subsided to the surface under the ridge.

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Backward trajectories had a similar path to the forward trajectories and were even more direct with the path of the smoke from the upper Great Lakes and Southern Canada (even directly from the Fort McMurray Fire itself in upper levels) in to Maryland (Figure 7b). Consistent with prior presented information, the smoke plume was transported across the Great Lakes southward over the course of a few days while under high pressure. Eventually, the plume moved east and far enough south such that Maryland reached the southern fringe of the plume. The time of transport (4-5 days) is in relatively good agreement between both bringing the smoke plume analyzed on May 20 across the Northern Plains and Southern Canada southeastward across the Great Lakes and in to New England. Morphology in the upper levels turned transport from the north across the Midwest and Maryland to the west on May 24 as seen in the inflection of the backwards trajectories across Kentucky, Virginia and North Carolina.

The vertical displacement in the trajectories is consistent with the increase in temperatures of the upstream airmass across the Midwest and indicates that smoke fell from a substantial altitude. Trajectories between 50 and 500m ending over Maryland on May 25 dropped over 2000m during transit to Maryland. Compressional heating of ~10°C/km over 2,000m results in an increase of 20°C. Morning analysis (12z) across central Canada on May 20 showed temperatures of -3°C to -4°C. This corresponds to temperatures of around 15°C after dropping to lower heights. This temperature increase also brought down ozone precursors within the smoke across the central Midwest, particularly by May 23, as identified on the vertical cross section of the backwards trajectories (Figure 7b). The subsidence also

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explains the above normal temperatures across the duration of the event and provides evidence that the boundary layer was well mixed thermodynamically, and thus, was also mixed chemically with smoke.

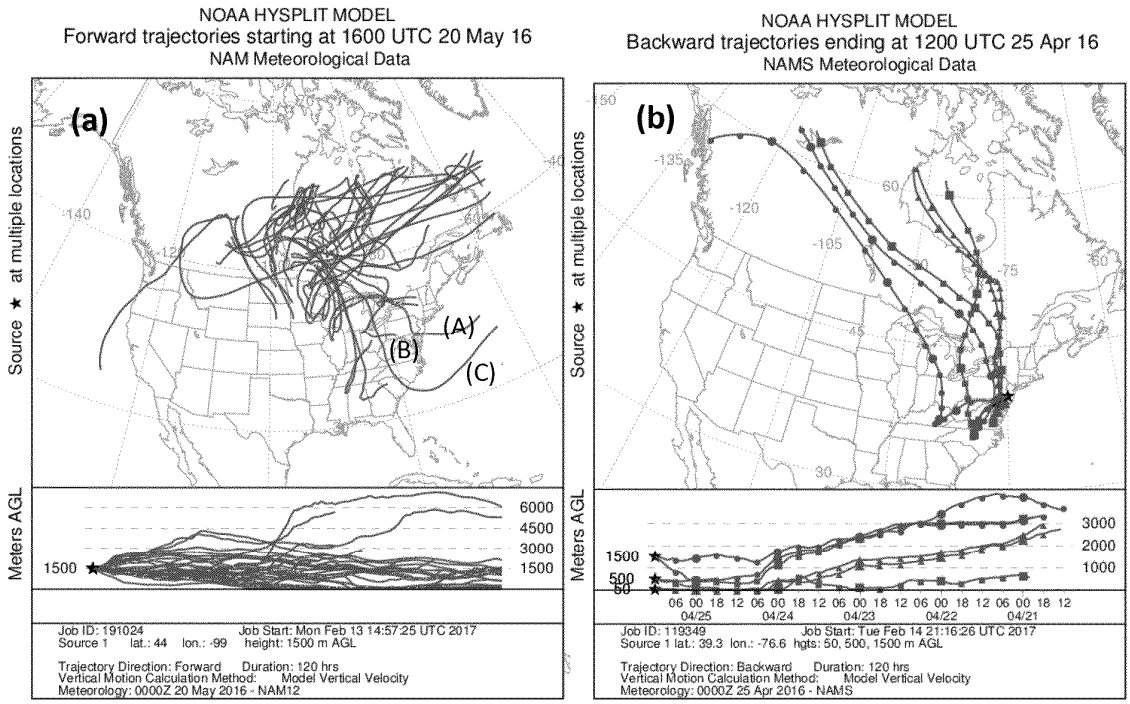

Figure 9. Trajectories
(a) A Matrix of 120-hour (5 day) North American Model (NAM) forward trajectories with starting points centered around the location of the smoke plume on May 20, 2016 across the upper Midwest and southern Canada. The trajectories show general clockwise transport fanning outward from the trajectory start locations. The southeastern quadrant of the trajectories held the relevant transport of smoke in to the upper Midwest, Northeast and Mid-Atlantic, including Maryland. (b) 120-hour back trajectories from northeast Maryland beginning on May 25 showing transport from the area of the smoke and Fort McMurray in to Maryland over the course of 4-5 days. Trajectories at 50-500m dropped over 2000m during transit to Maryland. Annotations (A), (B) and (C) mark trajectories mentioned in the text.

6.3.2. Evidence of Ozone Transport via Ozonesondes

MDE contends the ozone and impacts from fires occurred primarily upstream of Maryland and were transported to Maryland to cause an exceedance beyond historical norms. With a degrading airmass evident across the Midwest as of May 23 and 24, MDE requested ozonesondes on May 25, 26 and 27 from the Howard University Beltsville site (see Figure 1). These ozonesondes recorded substantial ozone concentrations within the nocturnal residual layer (Figure 10). During the pre-dawn morning of May 25 ozone concentrations within the residual layer (0.5 – 2 km) were 70-75 ppb (Figure 10). Wind direction at the time showed transport in this layer was from a sector approximately from 300 to 345°, or north-northwesterly. While somewhat at odds with the HYSPLIT trajectories, the ozonesondes is consistent with transport from areas of heavy ozone concentrations on May 24 (western PA and NY).

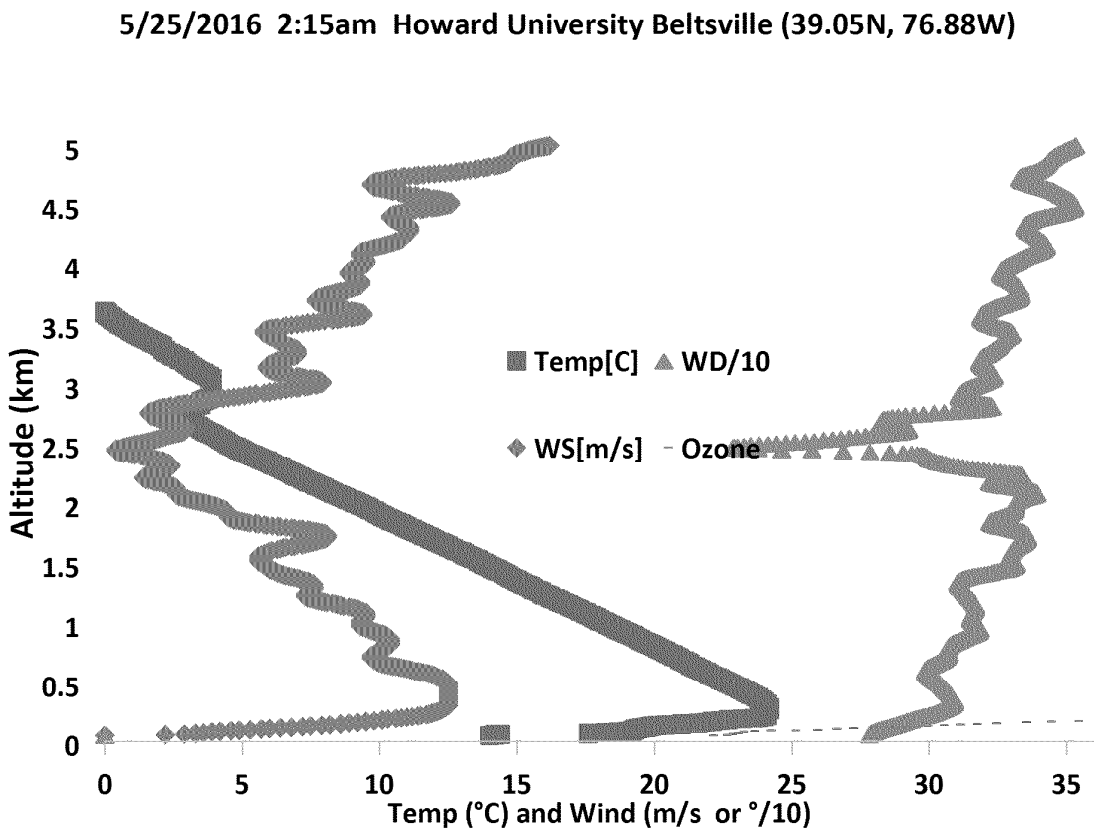

Figure 10. Ozonesonde launched from Howard University Beltsville on the morning of May 25, 2016. Temperature (red, squares), wind direction (green, triangles), wind speed (blue, diamonds), and ozone (purple, dashes) are shown from the surface through 5km AGL. Ozone is given on the top horizontal axis. Temperature and winds are given by the bottom horizontal axis. The profiles show a significant amount of ozone between 0.5 and 2km was transported into Maryland on the morning of May 25 from the north-northeast.

Further examination of the air parcels observed with the ozonesondes on the morning of May 25 using HYSPLIT showed transport from Ohio from May 23 and 24 to the Beltsville site (Figure 11). Meteorological data driving the trajectories was from the 12km resolution North American Model (NAM) and 32km resolution North American Regional Reanalysis (NARR) datasets. The trajectory levels chosen were based on features within the ozonesondes (Figure 10) which were the low-level wind maximum (jet) at approximately 400m (red lines, triangles), and the residual layer, which had a layer of well mixed ozone beginning at about 1000m (blue, squares) and middle around 1500m (green, circles). The ozone concentrations greater than 70ppb in the residual layer observed in the ozonesondes showed a clear transport of modified air from the eastern Midwest.

Compare the origin of the trajectories from central Ohio (Figure 11) to ozone concentrations across the same area (Figures 3f and 3g). Central and southern Ohio into Appalachia (West Virginia, eastern Tennessee) generally did not have surface ozone concentrations that exceeded the 70ppb 8-hour standard. That same southern extent of ozone pushed eastward into Maryland on May 25 and was consistent with a sharp gradient in surface ozone concentrations south of DC. Said another way,

Maryland was on the southern fringe of a degraded airmass on May 25 and 26, consistent with surface ozone concentrations decreasing quickly southwest of DC. Surface analysis the previous day supports the idea that the smoke was likely transported around southern Ohio and West Virginia but then pushed southeastward in to Maryland. The trajectories from Ohio (Figure 11) also show a slight rising motion along their path despite circulating around the periphery of a high pressure system. Thus the high pressure likely wasn't strong for persistence subsidence at the high center which might otherwise lead to ozone exceedances in Ohio for various reasons, including subsidence of the smoke to the surface there. The rising motion of the trajectories is also consistent with less mixing of smoke to the surface in Ohio and the development of a residual layer which was then transported in to Maryland on May 25.

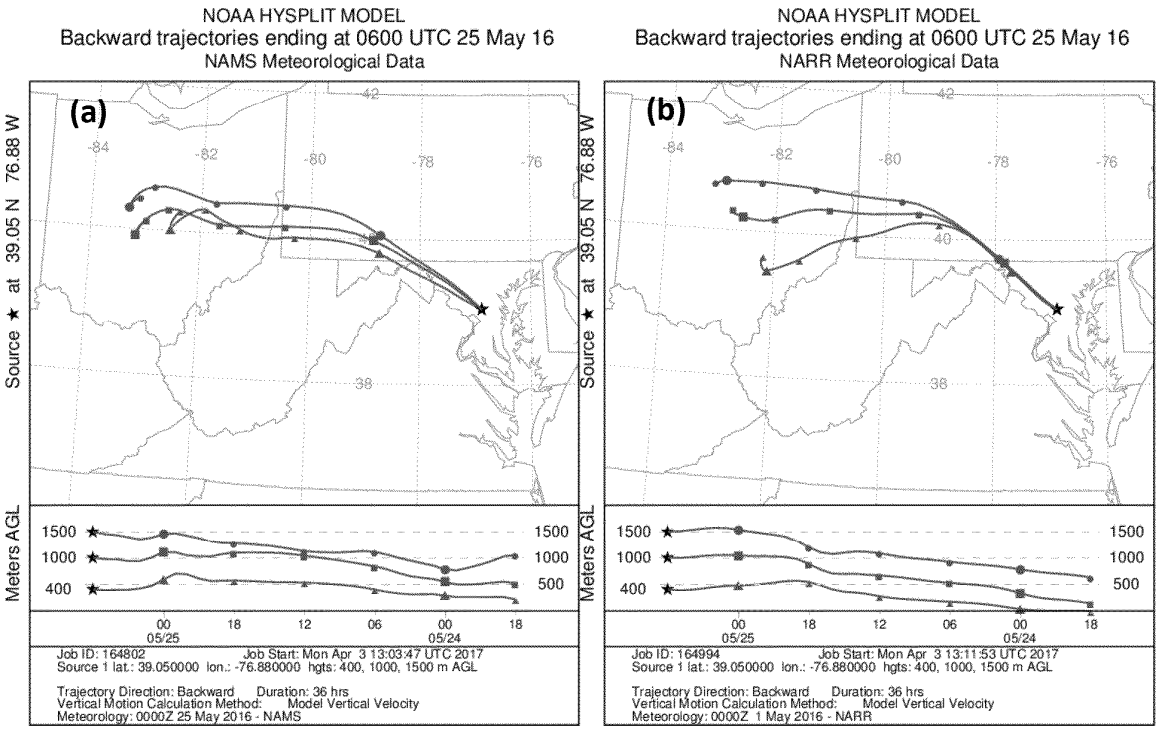

Figure 11. Hysplit trajectories for the ozonesondes on May 25, 2016.
The trajectories shown are 36 hour backwards trajectories beginning at the time of the ozonesondes launched at the HU-Beltsvillle site in Maryland at 2:15am (0600 UTC) on May 25 for the NAM (a) and NARR (b) meteorological datasets. The height chosen (1500m, green; 1000m, blue; 400m red) are based on features within the ozonesonde, namely the low level wind speed maximum (red), the bottom of the residual layer (blue) and the middle of the residual layer (green). Two meteorological datasets are shown for comparison.

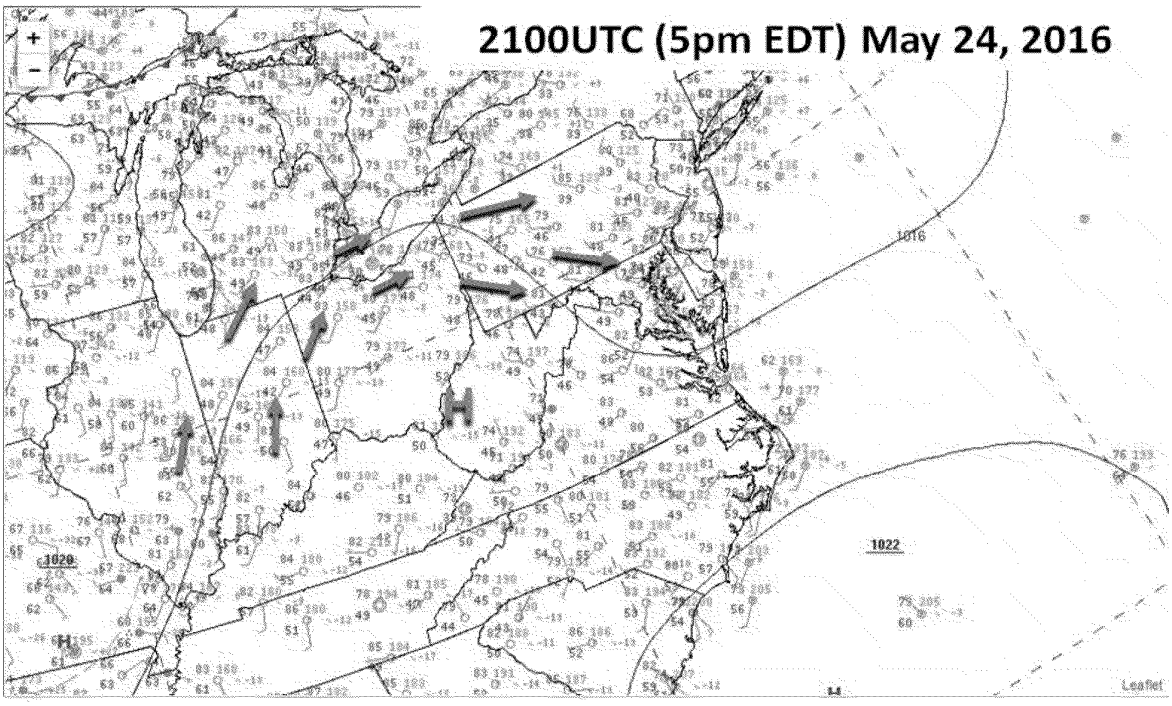

Figure 12. Surface analysis on May 24, 2016 at 5pm local time.
The blue arrows show that based on surface flow much of the smoke laden air was likely transported around southern Ohio and West Virginia. This is consistent with Maryland being placed on the southern fringe of the high ozone on May 25 as transport came from the northwest.

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Similar concentrations of ozone were observed on the morning of May 26 as well, though not distributed as evenly. The May 26 pre-dawn ozonesondes recorded maximum ozone above 75ppb within the residual layer between 2.5 and 3 km in height. Based on the inversion in the temperature profile around 2km, this may be another layer of air with slightly different characteristics than the layer between 0.5km and 2km where ozone ranged from 60 to 70ppb. Regardless, elevated ozone persisted above the surface overnight. The highest ozone concentrations between 2 and 3km were associated with winds from about 300°, slightly more westerly than May 25 but generally from areas that on previous days recorded high ozone. Nearer the surface, particularly below 1.5km, winds are more west southwesterly (~250°). This would bring in less smoke-influenced and ozone enhanced air since these regions(i.e., areas south of the Ohio River) were less impacted (though not "un-impacted") by high ozone across the Great Lakes area. Indeed, ozone concentrations generally decrease in this sector of transport to values below 70ppb. The pattern of transport is similar above 3km as well where ozone decreases where winds turn towards the southwest.

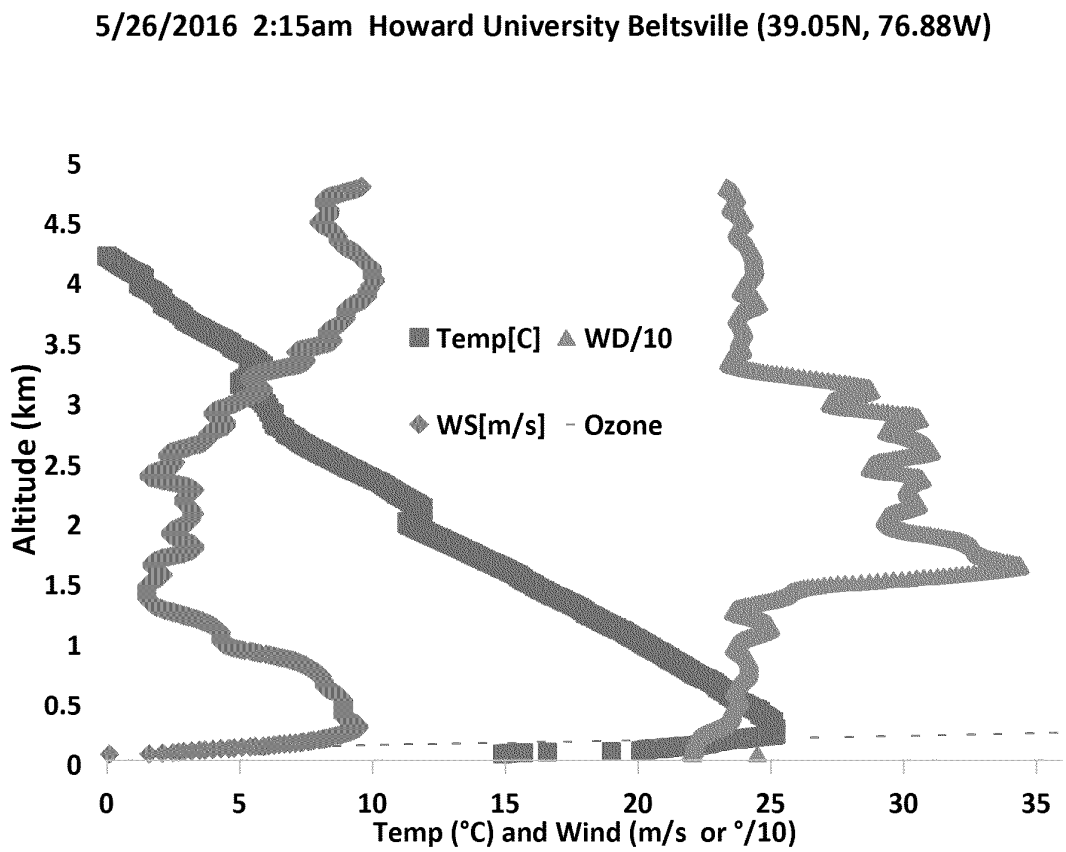

Figure 13. Ozonesonde for May 26, 2016.
Same as figure 10 but for the May 26.

HYSPLIT trajectory analysis was repeated for the May 26 ozonesonde in similar fashion to the May 25 ozonesonde. For the May 26 ozonesonde, trajectory levels were picked at 500m, 1500m and 2700m to capture increased ozone concentrations within the low-level wind speed maximum, wind direction shift within the residual layer, and the peak ozone concentration within the lowest 5km, respectfully. As on May 25, 36-hour back trajectories originating from HU-Beltsville were constructed for each of these heights using both the NAM and NARR meteorological datasets. Dissimilar to May 25, May 26 showed discrepancy in the trajectories between the two data sets. The discrepancy was believed to be due spatial resolution and the slowly evolving, weakly forced pattern between May 25 and 26, 2016. Two main features were consistent between the two data sets. First, westerly transport at least at 1500m persists and there was a trend towards southerly transport. The backing trend in the trajectories (as compared to May 25) was consistent with eventual southerly clean-out by May 27, which resulted in the removal of the smoke from the region.

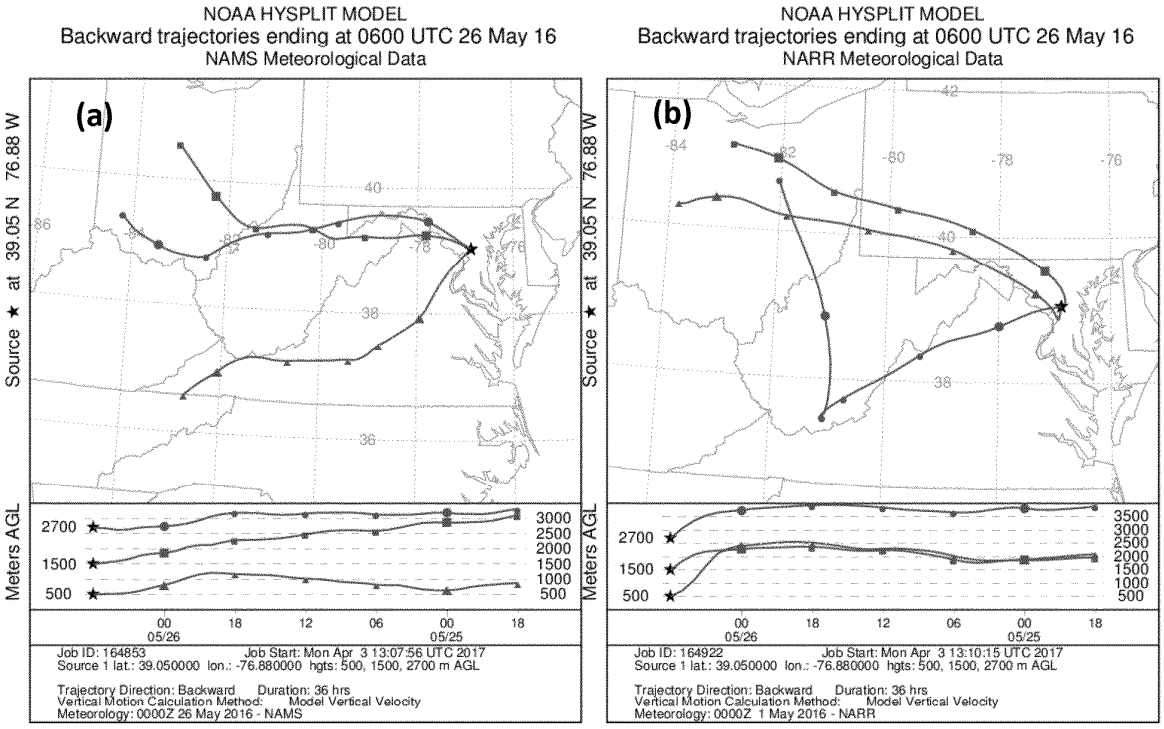

Figure 14. Hysplit trajectories for the ozonesondes on May 26, 2016.
The trajectories shown are 36 hour backwards trajectories beginning at the time of the ozonesondes launched at the HU-Beltsvillle site in Maryland at 2:15am (0600 UTC) on May 26 for the NAM (a) and NARR (b) meteorological datasets. The height chosen (2700m, green; 1500m, blue; 500m red) are based on features within the ozonesonde. Namely the low level wind speed maximum (red), the bottom of the residual layer (blue) and the peak in ozone concentrations seen the May 26, 2016 ozonesonde (green). Two meteorological datasets are shown for comparison.

Both ozonesondes and accompanying trajectories verify that an airmass characterized by substantial ozone within the residual layer was transported in to Maryland from areas which on previous days were on the southern periphery of high ozone concentrations impacted by smoke from Canada. Winds from the southwest through a larger depth of the lower atmosphere on May 27 (ozonesondes not shown) caused ozone to decrease. MD8AO was not greater than 64ppb through 3km with winds from approximately 240° through that same depth. While ozone persisted in the residual layer on May 27, its decrease associated with cleaner transport provides evidence for a smoke influenced, ozone enhanced residual layer.

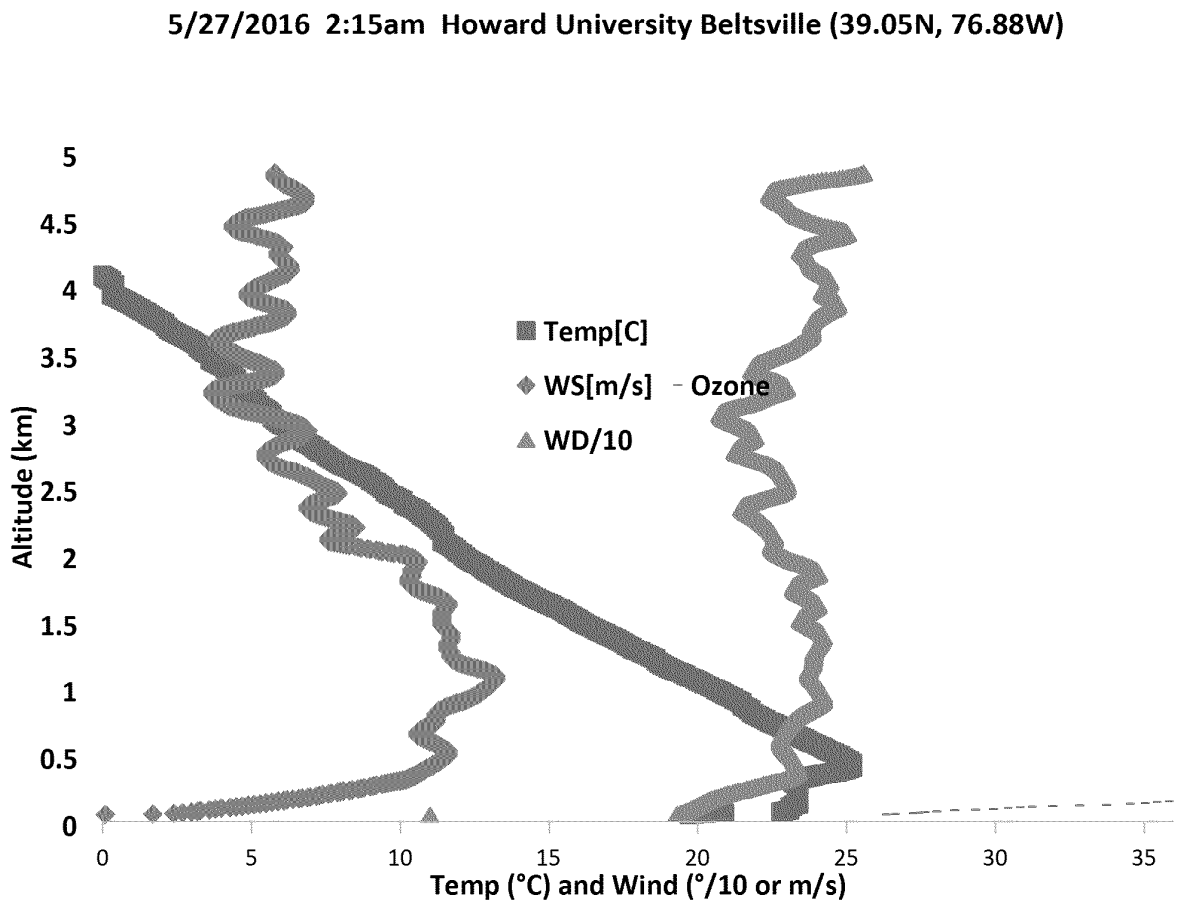

Figure 15. As in Figure 10 but for May 27, 2016.

6.3.3. Evidence of changes in spatial/temporal patterns of ozone

Spatial and temporal analysis of ozone and smoke analyzed by HMS were given in Figure 5. There MDE showed that the track and evolution of ozone which came from the northern Midwest of the CONUS was spatially correlated with analyzed smoke from May 18 through May 26. This was consistent with aloft winds observed in ozonesondes (Figures 10 and 13). In Maryland specifically, MD8AO was also greatest at the monitors directly under HMS analyzed smoke. For example, on May 25, the highest ozone concentrations were located at Fair Hill near the Pennsylvania line and at Millington on the eastern shore where smoke was analyzed at both locations. Horn Point also exceeded but a lacking urban plume (i.e., little local contribution to the site) kept the site lower than its northern counterparts. Smoke was analyzed over the northeast portion of the state on May 26 as well where concentrations were again the highest (e.g., Padonia, Furley, Edgewood, Essex). The pattern of highest ozone under analyzed smoke was also true prior to the exceedances on May 24 in Maryland. The Piney Run, Hagerstown, and Frederick ozone monitors all had the highest MD8AO concentrations at 63, 62 and

62ppb, respectfully, on May 24, when smoke was analyzed above these western Maryland sites, which received transport of the ozone rich airmass first and therefore had the greatest time on May 24 to produce ozone before the main portion of the degraded airmass arrived in the state. These sites were also rural and without an urban plume to supplement the initial ozone precursor transport. Notice that the Piney Run site recorded a concentration of 63ppb. At an elevation of 766m (2513ft), the location measures part of the residual layer. Between 1 and 2 am EDT, Piney Run measured hourly values of 55 and 56ppb. As an elevated mountain-top location, the concentrations observed at Piney Run were consistent with elevated ozone observed by the ozonesonde (72ppb) as shown in Figure 10. The difference was suspected to be due to both nocturnal titration at the surface site and due to Piney Run remaining on the southwestern fringe of the highest concentrations transported in to Maryland.

6.3.4. Evidence of Fire Emissions in Maryland

Wildfires produce both primary and secondary pollutants which may be utilized to track the impact of smoke downstream from the fire source. The MDE monitoring network observes $PM_{2.5}$ mass and speciations such as potassium (K) and organic carbon (OC), as well as CO and NOx, which act as tracers of wildfire emissions. Here we present analyses of the various species which can be attributed to wildfires. The analyses show the ozone episode in Maryland was characterized by wildfire species. Unfortunately, the specific days of interest in Maryland (May 25 and 26) did not fall on 1 in 3 run speciation days.

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6.3.4.1. Particles

$PM_{2.5}$ can be both a primary pollutant and a resultant secondary pollutant of wildfire emissions downstream as photochemistry within the plume converts certain species to aerosol. The entire MDE network showed a correlated increase in $PM_{2.5}$ 24-hour averages from May 24 –29 which aligned with the onset of the smoke plume in Maryland (Figure 16). No other period of the month exhibited such a coherent increase across the entire Maryland network. Though the late May period did not possess the highest particle observations of the month, it did exhibit the highest-low observation for the entire month. The fine particle observations therefore provided additional evidence that along with ozone and ozone precursors, fine particles were transported within the smoke affected air and were a distinct indicator of wildfire emissions, particularly since speciated particles associated with wildfire emissions showed similar increases.

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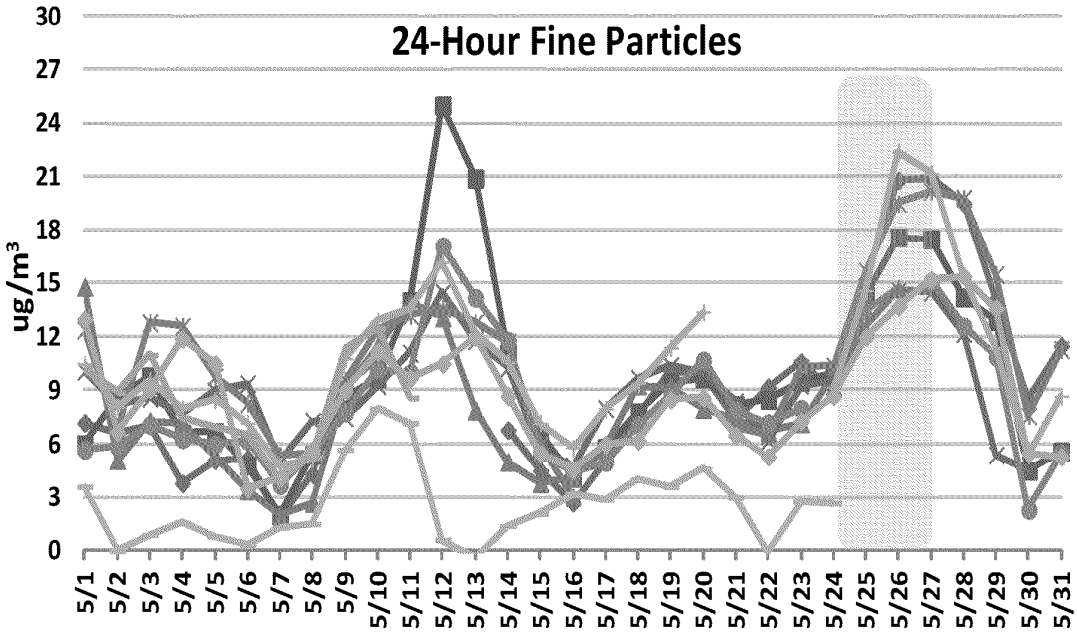

Figure 16. Daily averaged fine particle (PM2.5) concentrations for all sites available in Maryland for the month of May, 2016. The smoke influence as defined by the HMS analysis described in the conceptual model of this document is highlighted by the yellow shading from May 24-27.

6.3.4.2. Potassium Ions and Organic Carbon

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Particle pollution generated from biomass burning is typically dominated by organic carbon (OC) and black carbon (BC; Martins et al., 1998), and possesses ions such as potassium (Lee et al., 2010). Ionic potassium (K+) acts as a useful tracer of wildfire smoke because there are few anthropogenic sources, and concentrations above background levels are a signature of wildfire emissions. Unfortunately MDE's Aethalometer was not operational in late May of 2016 and the 1 in 3 sampling days missed the exceedances on May 25 and 26. However, the speciation samples did bracket the event on May 24 and 27 and evidence presented here-in has displayed that some initial smoke influences began on May 24 and persisted in to May 27. The samples collected showed concentrations of K+ and OC were amplified in late May strongly suggestive of wildfire smoke influence across Maryland (Figure 17). Potassium Ion mass during the May ozone event was not the highest in April or May, however, the quantity of ions are nearly identical on May 24 and May 27 at both Essex and HUB, suggesting uniform pollutant load of potassium across the region. Organic Carbon mass was the highest for both monitors in late May, coinciding with the smoke event which was a clear indicator of wildfire influence. The highest concentrations were on May 27, the day after the highest, most widespread ozone day in Maryland of 2016. Together these pollutants provide a heavy weight of evidence for the presence of smoke at the surface during the smoke event.

Both K+ and OC were lower than the most recently documented Canadian smoke event in Maryland in Dreessen et. al. (2016). In that study, K+ and OC were measured as high as 0.2 $\mu g/m^3$ and 11 $\mu g/m^3$ in Maryland. However, in that study a speciation 1 in 3 sample day fell on the day which was most

impacted by the smoke, giving that study a direct sample of the plume. In the present study, only the fringes of the most significantly affected air were sampled on May 24 and May 27. Additionally, transport of the photochemically aged airmass took upwards of five days to reach Maryland, potentially removing some of the tracers compared to the three days in the 2015 smoke case. Regardless, the data of these smoke tracers show a local maximum bracketing the ozone exceedance in Maryland.

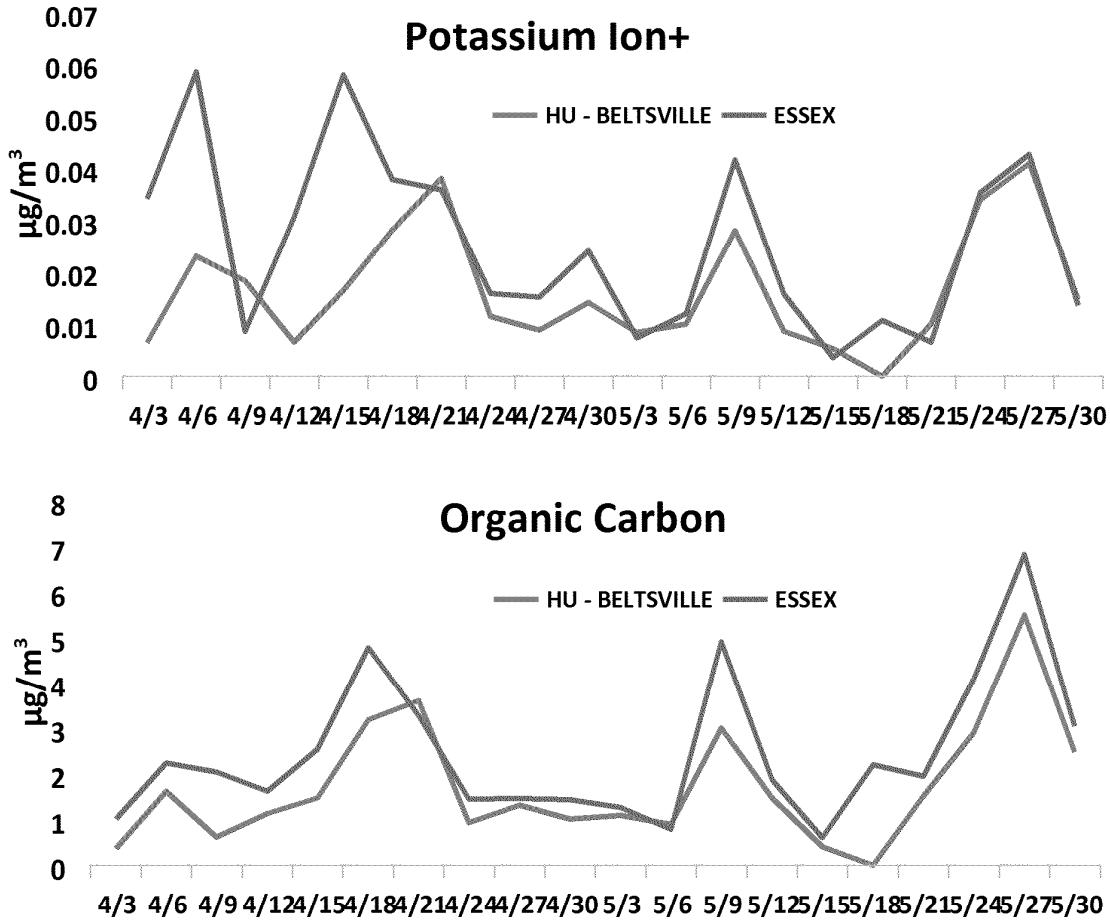

Figure 17. (a) Potassium Ion and (b) Organic Carbon, sampled every third day, from April through May of 2016. The two sites shown are Essex and Howard University (HU), Beltsville campus. Potassium Ions during the May ozone event were not the highest in the two months shown, however, the quantity of ions were nearly identical on May 24 and May 27 at both sites, suggesting uniform pollutant load of potassium across the region. Organic Carbon mass is the highest for both months in late May, coinciding with the smoke event. The highest concentrations were on May 27, the day after the highest, most widespread ozone day in Maryland of 2016.

6.3.4.3. Carbon Monoxide

Carbon monoxide (CO) has been previously identified as a wildfire smoke indicator (Andreae and Merlet, 2001; McKeen et al., 2002, DeBell et al., 2004, Dreessen et al., 2016), can play a role in ozone production, and followed similar trends to other pollutants over the event (Figure 18). Essex, HU-Beltsville and the Howard County (HoCo) Near Road sites all had the highest concentration of the entire month of May on May 25 and 26. To a lesser extent, other monitors (Piney Run and Horn Point) showed

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an increase as well. The increase in CO at Essex and HUB coincident with increased wildfire particle species and increased concentrations of ozone observed aloft provided strong evidence for the direct impact of the smoke at the surface. Together, these tracers indicated that wildfire-related ozone precursors were available to ozone production, either locally or upstream across the Midwest where trajectories first indicate the plume impacting the surface by May 23 (cf. Figure 9b). Animations of total column CO from satellite retrieval via Giovanni Data (https://disc.gsfc.nasa.gov/ not shown here) also indicate an area of enhanced CO starting over Canada meandering southeastward across the Great Lakes in line with the time frame outlined above.

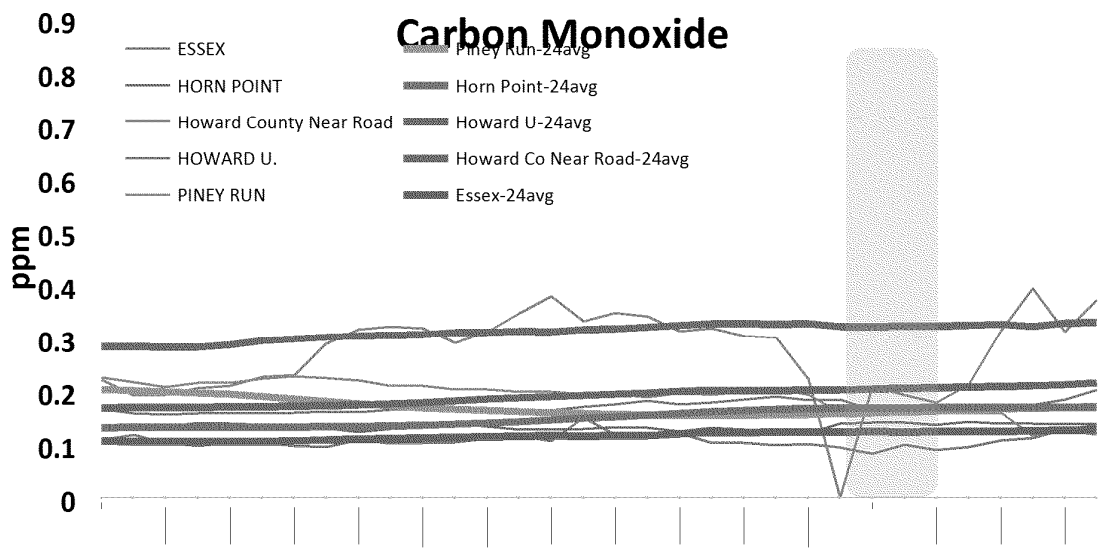

Figure 18. Hourly Carbon Monoxide (CO) overlaid with a running 24-hour average at five sites in Maryland. The smoke event is highlight in yellow. "24avg" indicates the thick lines drawn are a running 24-hour boxcar average of the underlying hourly data, given as fine lines of the same color in the time series.

6.3.4.4. Nitrogen Oxides

Singh et al. (2012) showed that ozone production rates from wildfires in California were dependent upon available nitrogen oxides (NOx = sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2)) and that NOx from the fires themselves was relatively low. In the current study, the monitors observing the highest ozone concentrations were near urbanized areas on May 21 (Minneapolis) and May 23 (Memphis, St. Louis, Indianapolis, Detroit) suggesting the local NOx contributions from these areas was partially responsible for ozone concentrations in those areas. However, it was more likely that the urban areas simply augmented ozone production within the smoky airmass, since ozone concentrations within the smoke plume were already increasing on their own. This was particularly likely given the spatial coherence on May 23 of the entire corridor of HMS analyzed smoke with enhanced ozone from the Great Lakes the Gulf Coast (Figure 5f). With the intense heat of the Fort McMurray fires, it is likely at least some NOx along with the VOCs was traveling with the plume. NOx was observed hourly at several sites across Maryland.

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May 24 – 26 observed a peak in NOx concentrations from available monitors in Maryland higher than any other day in the month (Figure 19). Both near-road sites, Essex, Oldtown and Piney Run 24-hour running average concentrations rose during this time period with only Piney Run not achieving the highest running average of May of 2016. Important questions arose from this analysis. Particularly, if the region was enveloped with a particularly large amount of NOx, can we attribute the added NOx to the fire and not from local/regional anthropogenic sources which would still be influenced by wildfire emissions, but can otherwise cause ozone exceedances exclusively? Said differently, either the additional NOx was due to local/regional NOx sources, the NOx was traceable to the fire source itself, or the NOx was stored within the smoke plume as suggested by Dreessen et al. (2016). Local emissions of NOx undoubtedly played a role in augmenting ozone concentrations in Maryland, as earlier stipulated, as urban pollution mixed with the smoke. However, CO, particles, and speciations all suggest a significant wildfire presence. Therefore we investigate regional NOx and develop an argument which showed NOx was either from the fire or was excessively stored within the plume due to the abundance of VOCs as discussed in Dreessen et al (2016), or both simultaneously.

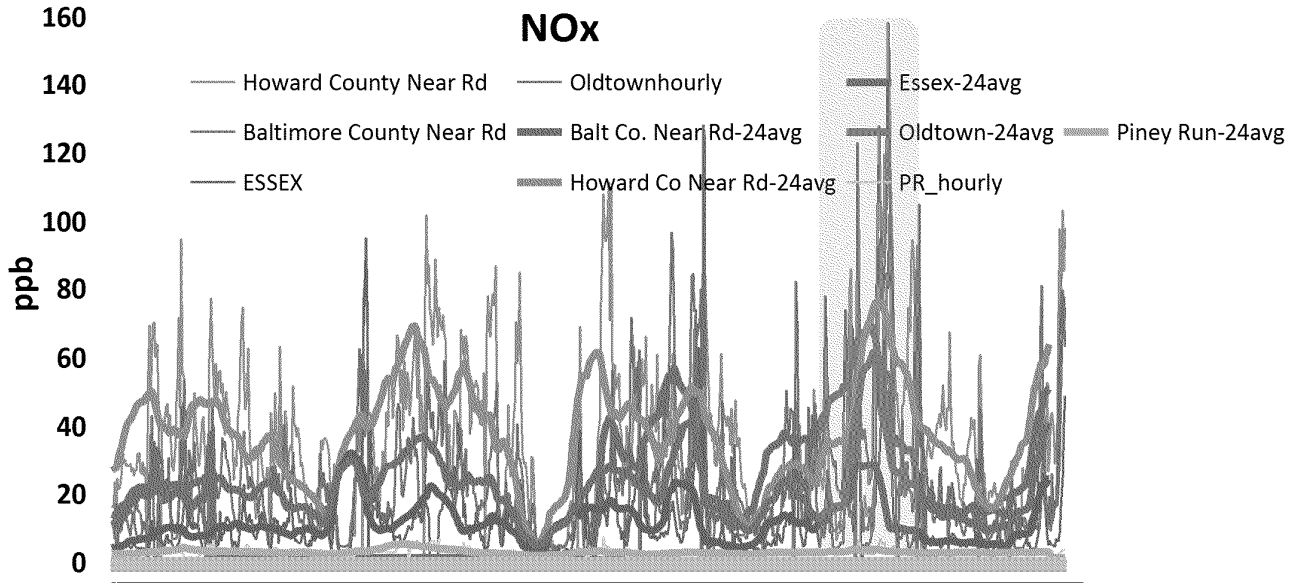

Figure 19. As in Figure 12 except for nitrogen oxides (NOx) from available Maryland monitors in May, 2016.

6.3.4.5. NOx Historical Context: Local May NOx, Aged Nitrogen and Total Reactive Nitrogen

Further study of the composition of the Nitrogen showed that the total active nitrogen (NOy) was both

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one of the largest NOy observations in May in the past five years (Figure 20a) and that total NOx in May of 2016 was the also highest among the last 5 years (Figure 20b). Daily average NOx emissions for all May days from 2012-2016 for Maryland monitors show that late May of 2016 had some of the highest NOx observations at many of the monitors in the network over the entire period. Total reactive nitrogen (NOy) shows similar characteristics with the highest May reading from the past 5 years in late May of 2016 consistent with the time period of smoke impact in Maryland. HUB reported the second highest 24-hour average during the smoke event in May of 2016 compared to the entire 2012 – 2016 period.

Subjective analysis of nitrogen species and states allows some discretion of source attribution. Generally it is difficult to distinguish NOx sources from each other (i.e., point, mobile, wildfire). Fresh NOx emissions tend to be dominated by Nitrogen Oxide (NO) rather than Nitrogen Dioxide (NO_2) or other speciations (NOz). NO has a shorter lifetime due to its high reactivity, thus an airmass dominated by NO_2 and NOz tends to indicate aged nitrogen emissions. The composition of the NOx was overwhelmingly composed of older NO_2 on May 25 and 26. In fact, the Essex monitor recorded the 6th and 9th highest daily average NO_2 for the entire 2016 ozone season (151 days) on May 25 and 26 (not shown). The high levels of NO_2 were indicative of an aged airmass, NOx transport and non-local ozone. Unfortunately no NOz calculation is available during this time period as no monitoring sites in Maryland had collocated NOy and NOx insturmentation. However, the substantial proportion of older NO_2 at Essex and Oldtown along with the high concentration of NOy at the HUB site suggests older NOx emissions and longer transport and lifetime. Maryland contends the increase NOx observed was a result of efficient NOx storage within the smoke plume sourced from both the fire itself and regional, additive NOx contributions which caused NOy to be beyond contemporary concentrations in Maryland.

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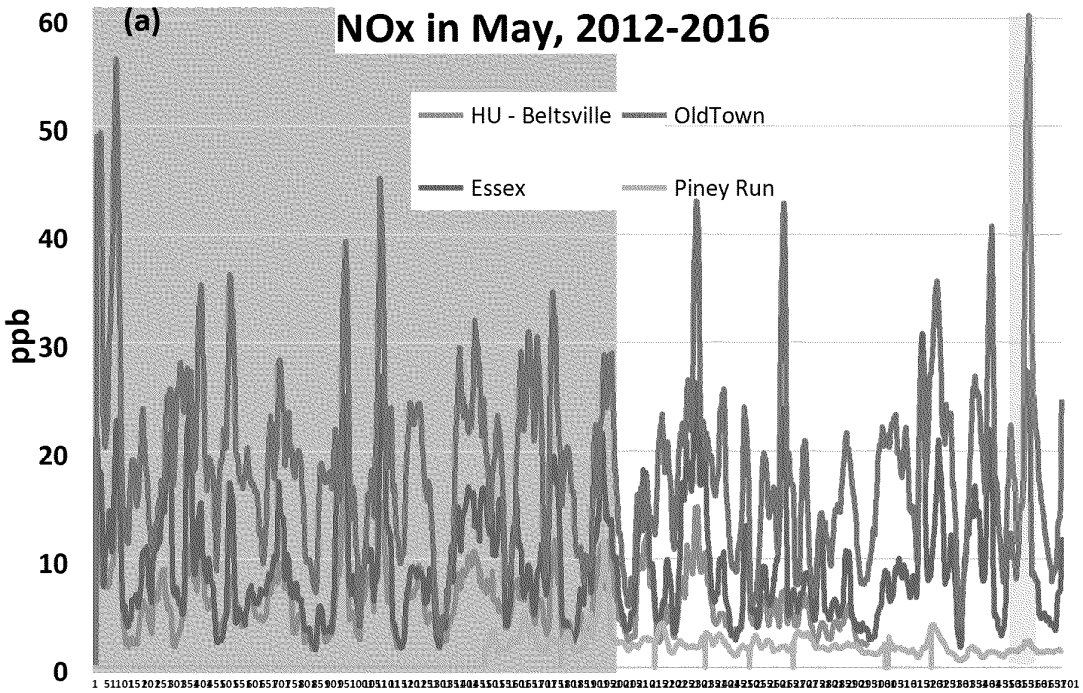

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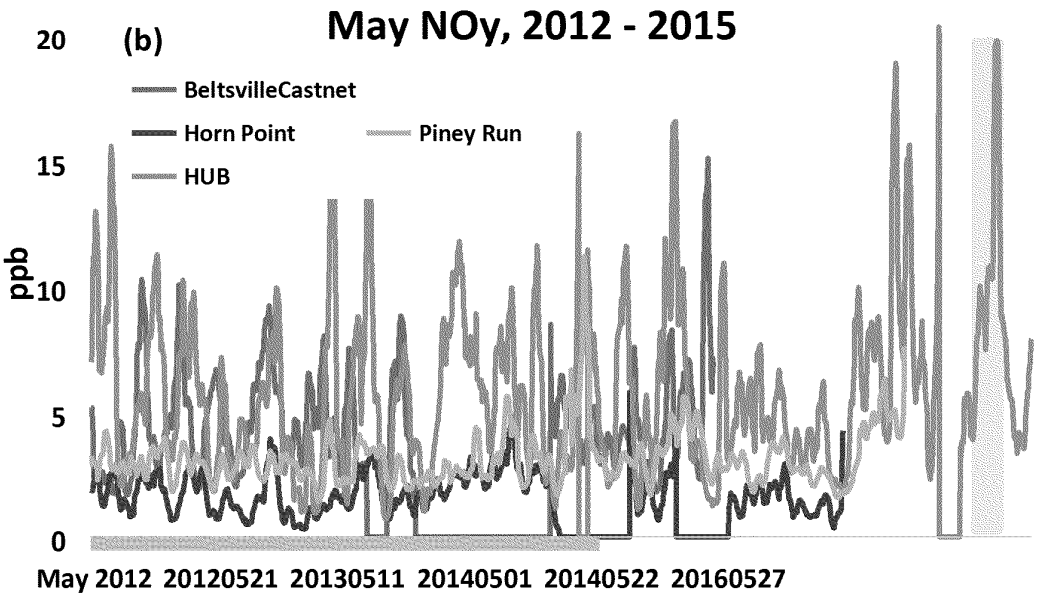

Figure 20. (a) NOx and (b) NOy for all available Maryland monitors for days in May from 2012 to 2016. The area in yellow highlights the 2016 smoke event on May 24-26. The only available NOy in 2016 was at the Howard University, Beltsville (HUB) monitor. Both NOx and NOy were higher than Mays in the previous 5 years.

6.3.4.6. Ratio of Carbon Monoxide to Nitrogen Oxide

The EPA Exceptional Events Guidance document discusses the ratio of CO to NOx as evidential support that wildfire emissions reached a monitor. The ratio of CO and NOx emissions depends on their source. Wildfire and prescribed wildland burning has a ratio of about 100 (Dennis et al., 2002), while high temperature fossil fuel combustion sources are more like 4 (Chin et al., 1994). However, EPA recognizes that changes in CO and CO ratios might be difficult to discern in urban environments. MDE had collocated CO and NOx at three sites at the time of the event in May of 2016 (Figure 21). The Howard County (HoCo) Near Road monitor had a ratio that remained below 10 for much of the month. This was likely due to its proximity to I-95 and being overwhelmed with mobile emissions. The Essex site was slightly farther away from I-95 in a neighborhood, allowing a slightly higher ratio but it too shows no change during the smoke event. The Piney Run site showed the greatest change in ratio but in the opposite direction to that expected. Inspection of the data at Piney Run revealed NOx increased with respect to CO causing the ratio to collapse. However, both CO and NOx are quite small in relation to other monitors during the event which might overwhelm the ratio and cause unexpected behavior. Despite increases in both CO and NOx at all sites (shown in figures 18 - 20), the ratio of the two monitors remains fairly consistent with the monthly average not revealing any increase as would be suggestive of a wildfire ratio. It was likely that the ratio on May 24-26 was drowned out by local urban plumes and/or nearby mobile emissions at the HoCo Near Road and Essex sites, since both were urban and near interstate I-95. Interestingly, May 14 and 15 shows a dramatic increase in the ratio. Further inspection revealed an HMS plume (not shown) over Maryland during this time period, attesting to the potential robustness of this analysis, but that period was not ozone conducive (cooler than normal). Overall, the distance the smoke plume traveled along with being in the Maryland urban environment likely criples this anlysis' ability to distinguish a wilfire influence in this case.

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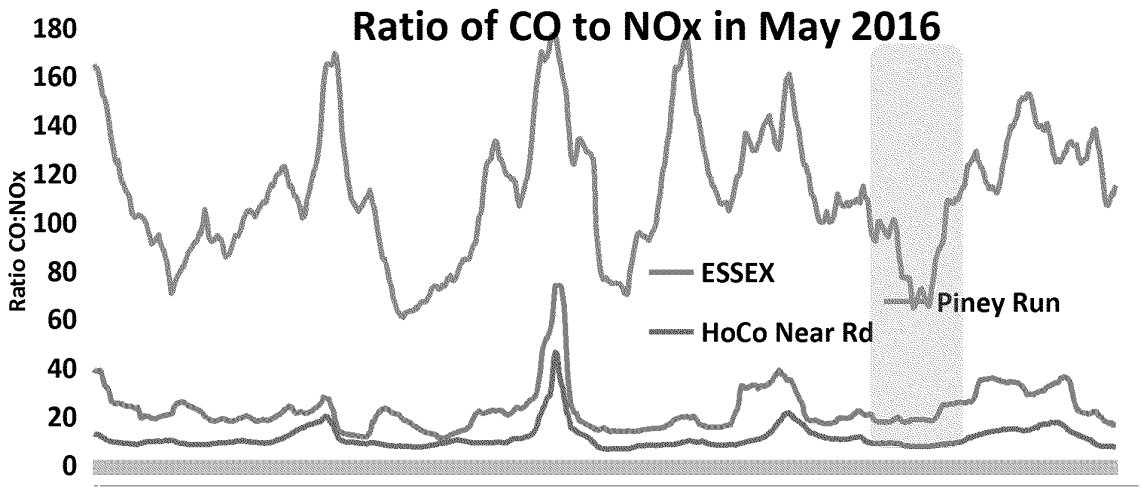

Figure 21. Time series of the 24-hour running average of the CO to NOx ratio.
Data was retrieved from the Howard County (HoCo) Near Road (Rd) site adjacent to I-95 and Essex, east of Baltimore and Piney Run in rural western Maryland. A ratio below 10 is generally indicative of mobile emissions, agricultural burning is 10-20 and wildfires on wildland can produce ratios to 100. The analysis is capable of isolating possible wildfire smoke impacts as seen on May 14 and 15, but did not identify an increased ratio on May 24 – 26.

6.4. Analysis Methods to assess impact of the SMOKE

6.4.1. Emissions Trends

MDE has asserted that the excess NOx and NOy observed in the network was either from the fire itself or was due to excessive storage of NOx within the smoke plume due to efficient storage means provided by excess reactive VOCs as suggested in Dreessen et al., (2016) and not due to excess NOx output upstream of Maryland as characterized by a non-event ozone exceedance. How was MDE sure the increased NOx associated with the ozone exceedance was from the fire and carried within the smoke plume and not mainly from EGUs (the classic transport pattern) and therefore satisfies the exceptional event criterion?

The Clean Air Markets Database (CAMD) records NOx output from EGU point sources across the country. In the conceptual (non-exceptional event) model of a Maryland ozone exceedance day, transport of NOx into the state was primarily from upwind EGU point sources which mixed down the next day to produce high concentrations of ozone and available ozone precursors. Significant and sustained reductions in ozone precursors across the eastern US have occurred in the past 10-15 years. This was particularly true for Nitrogen Oxides (NOx). Reductions in NOx have reached 75% of their pre-2003 amounts in 2016 and monthly total emissions in the 2016 ozone season (May - September) had the lowest emissions ever observed from states upwind of Maryland (Indiana, Ohio, West Virginia, Virginia, Pennsylvania, Maryland and the District of Columbia) as shown in Figure 22. The month of May alone had nearly half the amount of NOx emissions from these areas in 2016 than in 2010 and 2011.

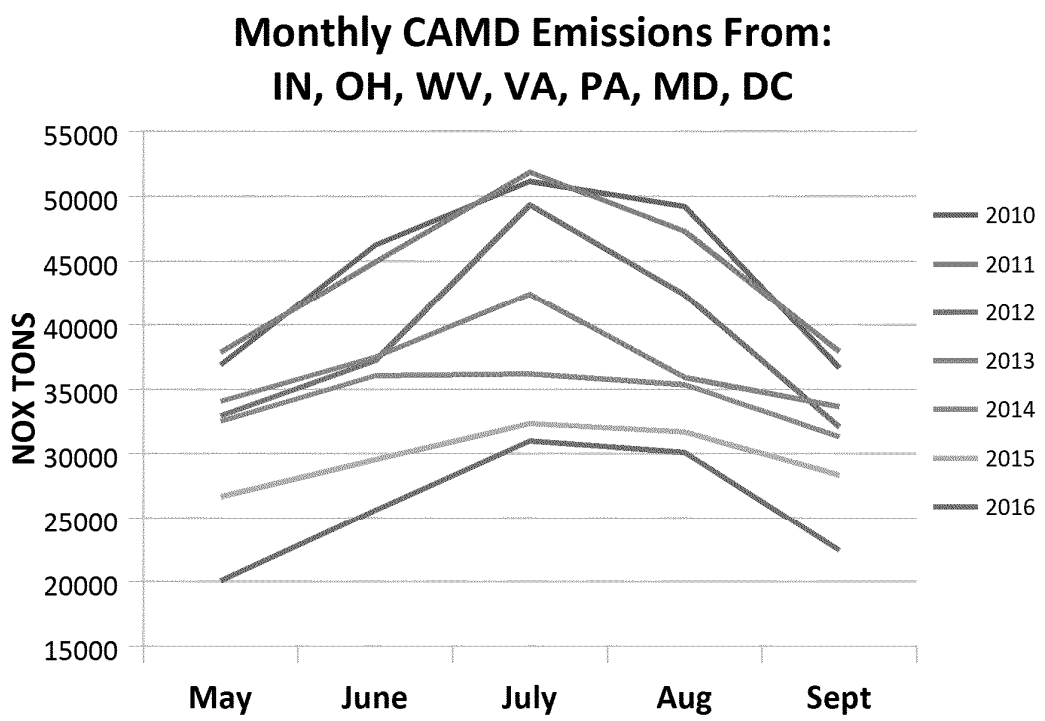

Figure 22. Monthly NOx emissions aggregated from the group of upwind states, including Maryland, by month of ozone

season.

A daily perspective on emissions for the same states showed a similar trend as the monthly annual trends. Daily emissions for the states of Indiana, Ohio, West Virginia, Virginia, Pennsylvania Maryland and the District of Columbia for only for the month of May from 2010 – 2016 pulled from CAMD showed emissions during May 2016 were the lowest ever (Figure 23). Generally there is also a downward trend, most notable in 2015 and 2016. Annually, however, each May showed an increase in emissions toward the final 10 days of the month. This was when many EGUs came online for the summer season. Even still, the late May maximum in emissions in 2016 was lower than some of the monthly minimums in the recent years of record. The fact was that even with these record low emissions in May of 2016, the smoke plume allowed any NOx emitted along the trek to be stored/joined with the abundance of reactive VOCs. That increased the ozone content in the plume and also increased the ozone production capability as the smoke plume aged. Thus despite the lowest late May NOx ever observed, ozone production was beyond historical norms. Therefore the high ozone concentrations must be due to smoke amplified ozone production. Additionally, it was very unlikely the observed near-record concentrations of NOx and NOy present at the time of the smoke event in 2016 in Maryland (Figs 13 and 14) was solely due to upstream emissions since overall emissions have decreased to the lowest levels on record. This suggests a significant contribution from the fire source (the Fort McMurray fire).

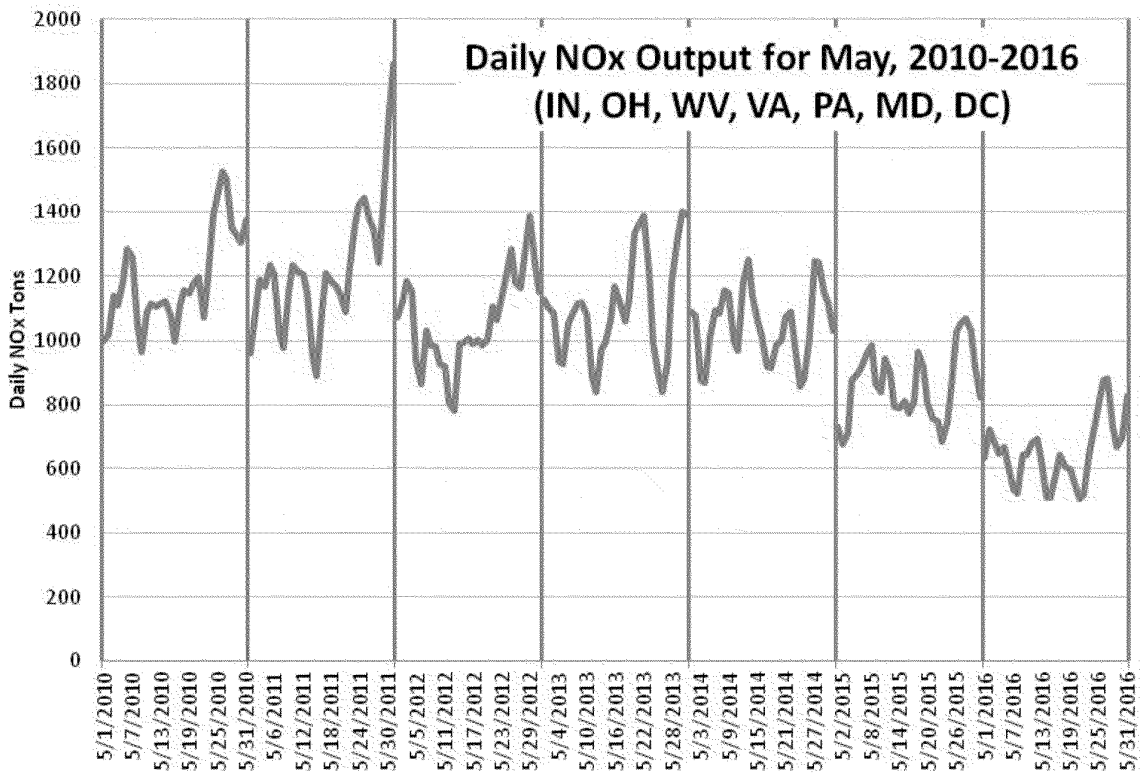

Figure 23. Daily aggregate NOx emissions from EGU point sources for states upwind of Maryland from 2010 – 2016. A downward trend is noticeable from 2014-2016. Also noticeable is the increase in NOx emissions towards the end of the month each year. 2016 has a similar late season increase but it is the smallest increase in the CAMD record. Each year/month is divided by a solid vertical line.

6.4.2. NOx to Ozone ratio

To further illustrate the amount of ozone which was generated in Maryland in the context of decreasing regional NOx concentrations, analyzing the ratio of ozone to the NOx emissions can demonstrate the ozone production efficiency of a given airmass. The ozone values on May 25 and 26 reached concentrations seen previously only in years with twice the amount of NOx in Maryland, Pennsylvania, West Virginia and Ohio (no major EGU sources in northern VA), the states from which same-day emissions would affect the ozone concentrations on May 25 based on backwards trajectories. As a result, the Ozone to NOx ratio (maximum statewide 8-hour average concentration divided by total NOx output) reached the highest value ever seen in Maryland on May 25 and 26, 2016, suggesting ozone production was beyond classic event production and was likely aided by other constituents (Figure 24a). This supports the assertion that VOCs are effective at storing all NOx in thesmoke plume for later ozone development, regardless of absolute NOx output from the fire itself or point sources along the trek of the plume as discussed in Dreessen et al, (2016).

MDE contends that the reason for the exceedance in Maryland on May 25 and 26 was the advection of an airmass which was directly impacted by smoke for several days prior to moving into Maryland. To show this, a similar analysis was done on May 23, which was the first wide spread exceedance day of the extended period across the Midwest and Great Lakes (see Figure 5). On May 23rd, ozone exceedances were at first isolated to urban centers where NOx was available for ozone production. While NOx is always available in urban areas, the added constituents within the smoke allowed for ozone production beyond typical concentrations. Mobile emissions are assumed relatively constant between workdays, so emissions changes from sources such as EGUs must be an "insignificant contributor" to conclude that the smoke played an integral part in these exceedances. If the EGU NOx emissions were insignificant, the amount of ozone produced given an amount of NOx should be quite high while within a smoke plume and a NOx to ozone ratio would also be high.

The NOx to ozone ratio in Indiana was the second highest ever in May since 2010, and May 21-23, 2016 were three of the top 5 highest ratios of the entire data set with five of the top seven daily ratios between May 19 and 24, 2016 (Figure 24b). Similar to Maryland, these ratios were calculated using emissions from Indiana, Ohio, and Michigan based on 36-hour backward trajectory from Indianapolis, IN on May 23 (not shown). Interestingly, May 7, 2016, was a day also influenced by smoke (based on HMS analysis) and had the highest ratio in Indiana, though no exceedances occurred due to cool and wet conditions. This shows that the airmass developed its ozone concentrations in an environment that was otherwise devoid of historical levels of NOx relevant for abundant ozone concentrations without the added burden of smoke.

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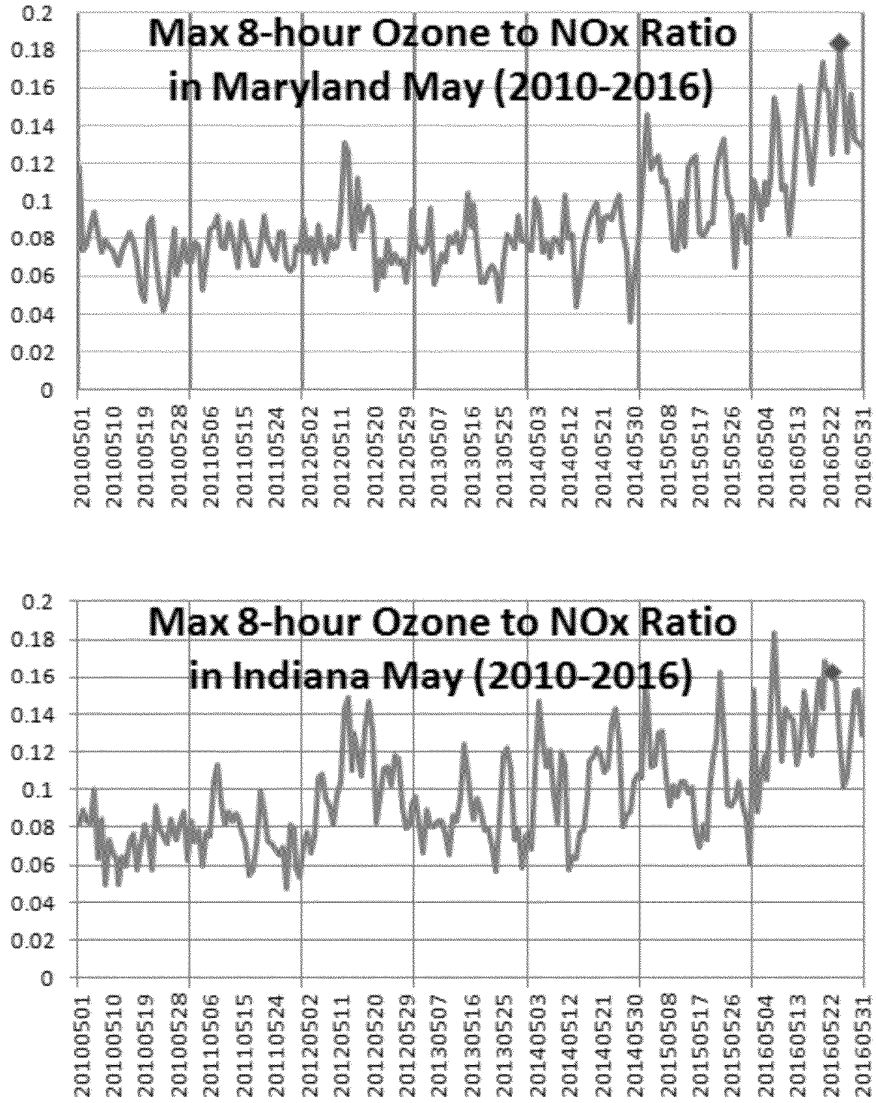

Figure 24. Ozone to NOx ratios for (a) Maryland and (b) Indiana.
The higher the ratio, the more ozone is created for a given amount of NOx output. NOx output used in each case is described in the text but is based on statewide emissions. States used were selected based on backward trajectories as described in the text. The red diamonds highlight the first day of an exceedance in each state.

6.4.3. Beyond Historical Fluctuations

Scatter plots of a few selected monitors show some exceptional qualities of the exceedances on May 25 and 26 (Figure 25 and 26). Significant and sustained reductions in ozone precursors across the eastern US have occurred in the past 10 years. This was particularly true for Nitrogen Oxides (NOx), and was most noticeable for ozone in the last 3-4 years. Five of lowest seasonal number of exceedance days occurred in the past 8 years, with four in the past four years. The trends in NOx precursors for Maryland is problematic for establishing a base year on which to statistically compare ozone values. For instance,

an 8-hour maximum ozone of 80 ppb in 2016 represents substantially more ozone generated from available NOx precursors than in 2011, thus historical contexts of 8-hour maximums must keep this in mind. The May 20-31, 2016 period was the lowest late May emissions ever from 2010-2016, over the same region affected by widespread ozone exceedances (Figure 23). The non-stationary nature of NOx across the east makes creating a baseline level for historical ozone comparisons complex. Following EPA's Exceptional Event Guidance document, MDE looked at the last five years of data across the MDE network. Ozone concentrations at the Fair Hill monitor on May 25 and 26 stand out against most data points and were near the 99th percentile level (Figure 25) with May 25 above and May 26 below the 99th percentile level. Excluding the 2012 values from comparison, which occurred during a year with much greater EGU NOx output (see Figure 23) makes May 25 and 26 more distinct. MD8AO at the Furley monitor on May 25 and 26, 2016 also present a clearly defined case of an outlier observation (Figure 26). Whereas if the Fair Hill observations on May 25 and 26 were removed from the DV calculation the 2016 DV would be reduced from 76 ppb to 74 ppb, if the same were done at Furley, the DV would be reduced 3 ppb from 69 ppb to 66 ppb. Even though Furley is attaining the 2015 ozone NAAQS prior to this analysis of the smoke event, it would be in Maryland's best interest to reference a DV of 66ppb as it better reflects the actual air quality of the Baltimore area and points to the effect of decreasing NOx emissions on ozone concentrations. Not including Furley in this analysis would unfairly increase the DV due to an event Maryland had no control over. Figures 25 and 26 show that the event in question is beyond historical fluctuations, particularly given low NOx emissions in 2016 and should be treated as an exceptional event at the very least at the Fair Hill monitor, due to its 2008 standard attainment potential influenced by the Fort McMurray fires. Statistical comparisons of other monitors were discussed in the following section.

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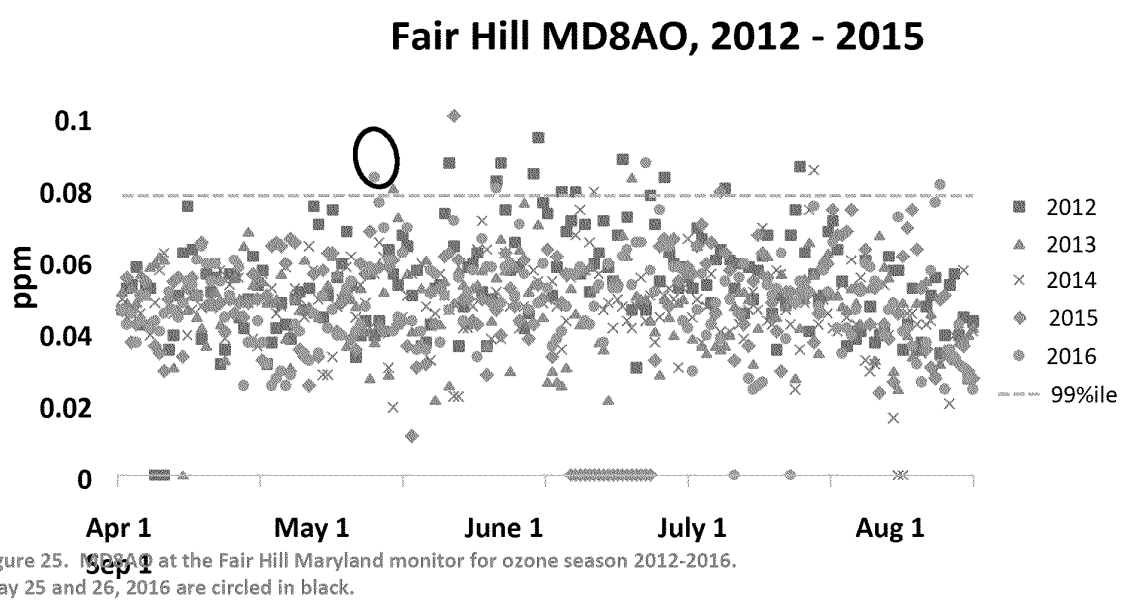

Figure 25. MD8AO at the Fair Hill Maryland monitor for ozone season 2012-2016. May 25 and 26, 2016 are circled in black.

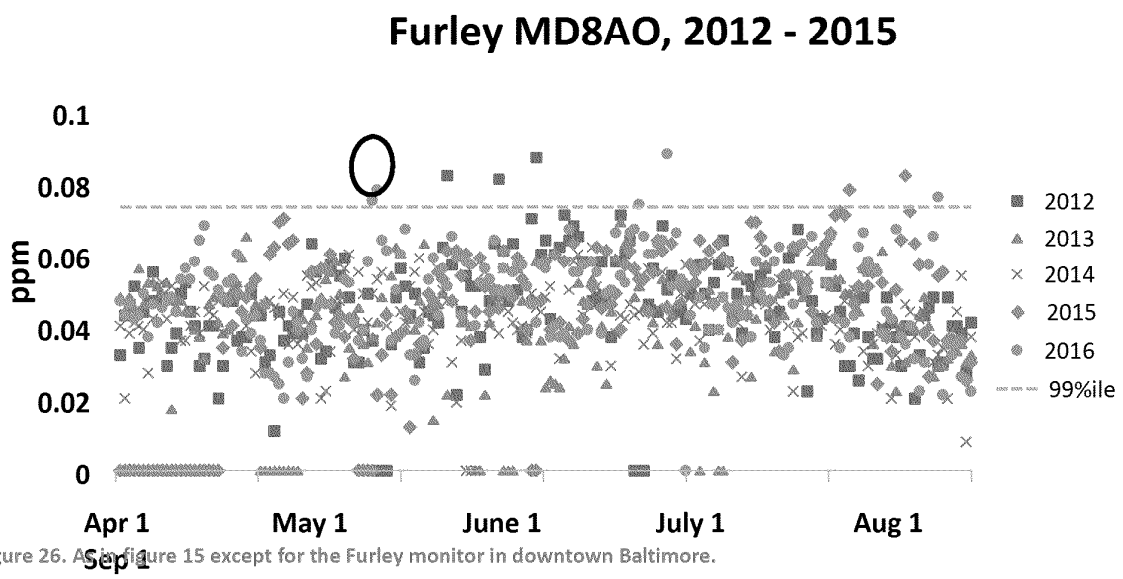

Figure 26. As in figure 15 except for the Furley monitor in downtown Baltimore.

6.4.3.1. 99th Percentiles

As part of demonstrating a clear causal relationship between ozone concentrations and the fire event, monitored concentrations were put in the context of historical observations. Following the Exceptional Events Guidance documents, the 99th percentile was calculated for all Maryland monitors (Table 6) based on all May days from 2012-2016. Observations at monitors falling at or above the 99th percentile in the past five years establish statistical evidence that the event was likely influenced by an exceptional event and can be used to determine whether a Tier 2 application is appropriate. Nine and 12 monitors fall at or above the 99th percentile out of the 20 Maryland monitors on May 25 and 26, respectfully. Most monitors were near the 99th percentiles on both days while four (Edgewood, Essex, Furley and Millington) broke the 99th percentile on both days. The regulatory implications for Fair Hill are attainment of the 2008 standard as previously discussed. At Furley and Millington, which showed 99th percentile breaks on both days, the regulatory implication would be a greater margin from violation of the 2015 standard. Despite record low emissions levels over the month of May across the country, ozone values in Maryland in late May exceeded the 99th percentile of observations within the state on both May 25 and 26, using observations from 2012 through 2016. Between the two days, 15 of the 20 ozone monitoring sites obtained an ozone concentration exceeding the 99th percentile. As previously discussed, MDE is asking for 18 monitors to be excluded from DV calculations. This analysis shows that 15 of those monitors meet statistical criteria for exclusion.

Table 6. 99th percentile values and comparisons to observations on May 25 and 26, 2016 for all Maryland monitors. Percentile is based on data from May 1 – May 31, 2012-2016. Nine monitors on May 25 and 12 on May 26 fell at or above the 99th percentile for all MD8AO concentrations in the past five year.

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Name	AQSID	99th %ile Level	May 25 (ppm)	May 26 (ppm)	Greater than 99th %ile on 5/25	Greater than 99th %ile on 5/26
Aldino	240259001	0.075	0.077	0.079	Yes	Yes
Beltsville CASTNET	240339991	0.072	0.076	0.072	Yes	
Blackwater NWR CASTNET	240199991	0.072	0.070	0.076		Yes
Calvert	240090011	0.074	0.070	0.075		Yes
Edgewood	240251001	0.075	0.079	0.080	Yes	Yes
Essex	240053001	0.073	0.078	0.081	Yes	Yes
Fair Hill	240150003	0.078	0.083	0.076	Yes	
Frederick	240210037	0.071	0.070	0.065		
Furley	245100054	0.073	0.075	0.078	Yes	Yes
Glen Burnie	240031003	0.076	0.075	0.076		Yes
Hagerstown	240430009	0.070	0.068	0.061		
Horn Point	240190004	0.071	0.071	0.077		Yes
HU-Beltsville	240330030	0.074	0.074	0.074		
Millington	240290002	0.075	0.085	0.076	Yes	Yes
Padonia	240051007	0.075	0.074	0.084		Yes
PG Eq Cntr	240338003	0.071	0.074	0.069	Yes	
Piney Run	240230002	0.073	0.064	0.053		
Rockville	240313001	0.069	0.069	0.067		
S. Maryland	240170010	0.071	0.069	0.073		Yes
South Carroll	240130001	0.071	0.072	0.075	Yes	Yes
Total					9	12

6.5. Model Data: CMAQ Underestimation of Ozone

The presence of smoke during the May 25 and 26, 2016 ozone exceedance days provided clear circumstantial evidence that significant portions of ozone production were attributable to smoke. Given the presence of increased smoke tracers monitored at the surface and ozone values equaling or exceeding the 99th percentile when compared to May ozone concentrations of the past 5 years, the impact of smoke constituents on ozone enhancement was incontrovertible. To quantify the attribution, MD8AO concentrations forecast with the operational National Ocean and Atmospheric Association (NOAA) Community Multi-scale Air Quality (CMAQ) ozone model were compared to observed MD8AO concentrations. Source information from the Canadian fires as well as gas phase chemical interactions from wildfire smoke and their interactions with ozone were not included in the NOAA operational CMAQ model during 2016. Therefore, the NOAA operational CMAQ model represented a prediction of ozone in the absence of smoke and under normal conditions. The NOAA CMAQ ozone model reported approximately +7ppbv high bias and 15.1ppbv root mean square error (RMSE) for June ozone predictions in 2010 (Chai et al., 2013). With this information in mind, the difference in the model forecast to observations in late May of 2016 provided an estimate of the increase in MD8AO concentrations due to smoke.

Gridded model data was extracted at observation points throughout the eastern CONUS for May 18 –28, 2016. The difference between the predicted and observed MD8AO were interpolated across the region on a daily basis and showed an area of under prediction stretching from the upper Midwest on May 20 and 21, moving eastward to the northeast and Mid-Atlantic, to include Maryland, by May 25 (Figure 27). Cross referencing Figure 27 with Figure 5 showed similar patterns of smoke, ozone, and under-

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prediction by the CMAQ model. While the NOAA CMAQ model traditionally under-predicts ozone early in the season in the Mid-Atlantic, the model typically does not under predict by more than 10ppb. Since the NOAA CMAQ did not include2016 wildfire emissions in the ozone chemical mechanism, under predictions by the model were the result of fire emissions and ozone precursors which were not accounted for, leading to higher than predicted MD8AO. The underlying assumption then was that under prediction of MD8AO coincident with smoke to be caused by precursors within the smoke. It would be very coincidental for the model to under predict both quantitatively and spatially in line with the smoke plume. Sequential examination of the images reveals an area of under prediction that moved through the upper Mid-West and Northeast, extending as far south as DC. The signal loses cohesiveness after May 26. The area of under prediction in the model closely correlates to the movement of ozone and HMS analyzed smoke (compare Figures 27 and 5).

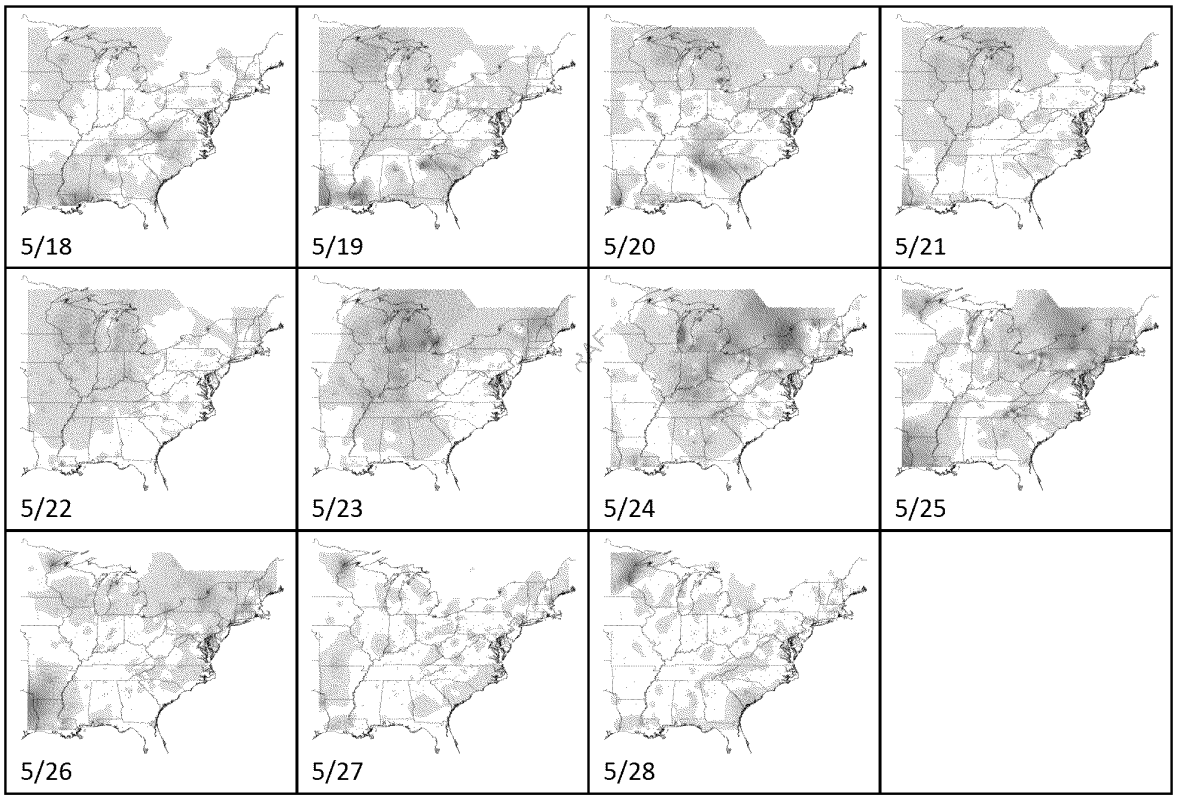

Figure 27. The NOAA CMAQ model daily maximum 8-hour ozone predictions for May 18-28, 2016 comparison to AQS observations for the entire eastern United States.
Colors represent operational NOAA CMAQ model predicted ozone minus observations contoured from May 18-28, 2016. Darker areas of blue show more significant under prediction, while areas of darker red show areas of over-prediction. Colors begin at +/- 5ppb error magnitude.

6.6. Spatial Tracking of Potassium and Organic Carbon

Ionic potassium and organic carbon concentrations in Maryland were previously shown to be elevated on the periphery days of the exceedance event. Speciated data (run every 3 or 6 days) retrieved from

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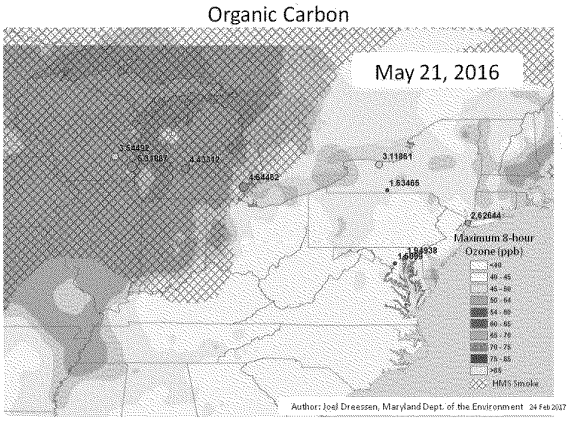
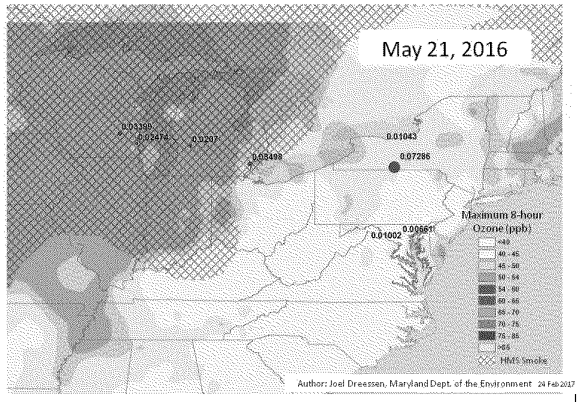
several states showed an area of increased concentrations of both species moving west to east across the upper Midwest from May 21 to May 27, consistent with the track of the smoke plume analyzed by HMS (Figure 28). Particularly on May 24, the magnitude and spatial extent of OC and ionic potassium was greatest across the Great Lakes (the states of Michigan and New York) which was centered on the area of greatest 8-hour ozone concentrations and the area previously described as influenced by the Fort McMurray wildfire smoke. Since the ionic potassium and OC are specific wood combution markers these speciated $PM_{2.5}$ data provided conclusive evidence that the ozone affecting the upstream airmass of Maryland was influenced by the smoke. More specifically, these wildfire markers were found in areas with high ozone production and concentrations concurrent with the intense under prediction by the CMAQ model, all which point to a wildfire smoke influence on ozone concentrations. Previous analyses demonstrated how this smoke influenced air was transported into Maryland.

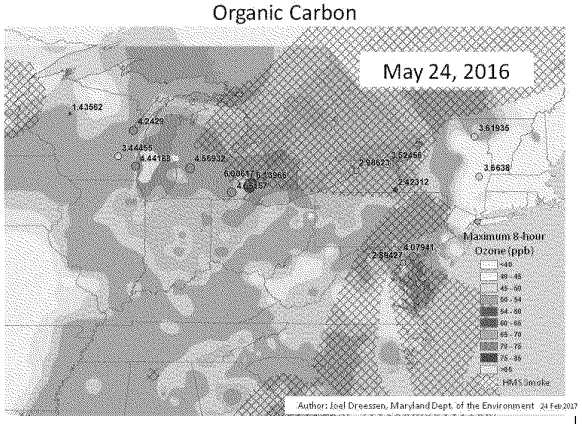
Daily Maximum 8-hour Ozone Observations, HMS Smoke & Organic Carbon



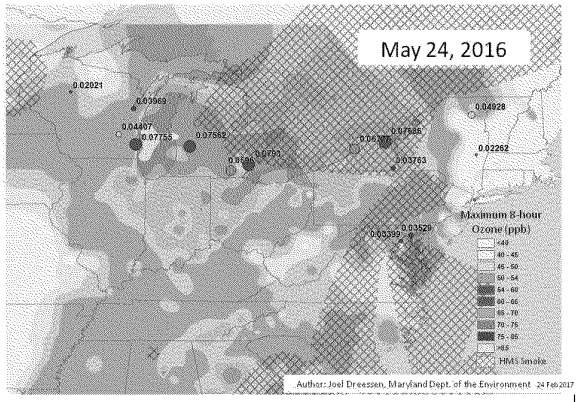
Daily Maximum 8-hour Ozone Observations, HMS Smoke & Potassium Ion



Daily Maximum 8-hour Ozone Observations, HMS Smoke & Organic Carbon



Daily Maximum 8-hour Ozone Observations, HMS Smoke & Potassium Ion



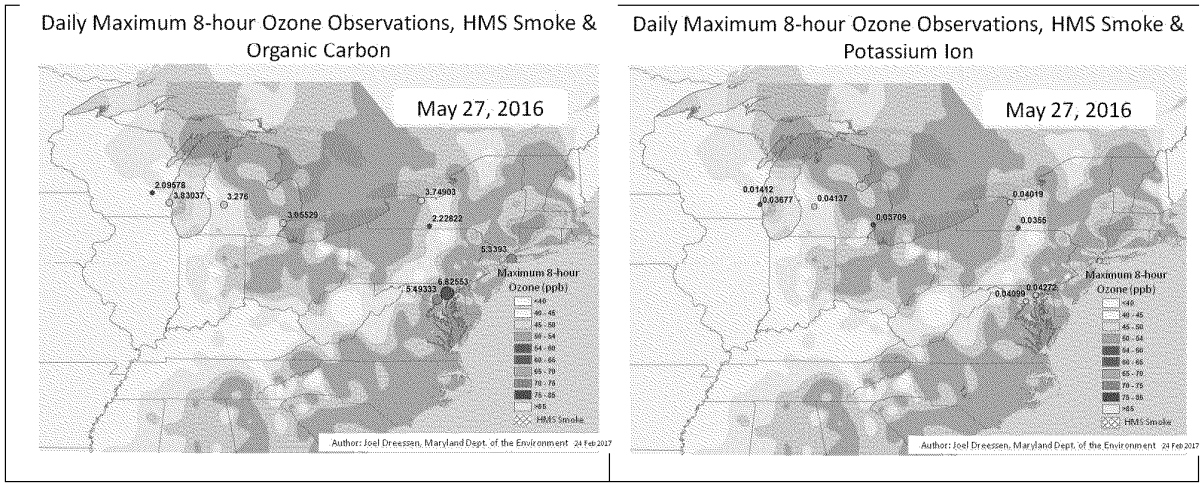


Figure 28. Geographical distribution of speciated particle data.
Data was plotted at available monitors and overlaid on contoured MD8AO concentrations and HMS analyzed smoke for May 21, 24 and 27.

6.7. Similar Day Analysis

Similar meteorology in the absence of smoke should not produce as much ozone in Maryland as observed on May 25 and 26, 2016. To address this, a similar day analysis identified days with similar weather pattern and characteristics (temperatures, winds, transport) as May 25 and 26, but without the presence of smoke. In an analog comparison of such days, affected monitors should show substantially less ozone when not impacted by smoke.

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Recall there were slight differences in the transport regime (westerly vs northerly) between the NAM HYSPLIT trajectory and HUB ozonesonde at the onset of the exceedance on May 25. To further investigate winds and better establish the transport pattern, for a similar day analysis the radar wind profilers (RWP) at Piney Run and Horn Point were examined (Figure 29). The RWPs showed transport leading in to the afternoon of May 25 that agreed more with the ozonesonde winds launched at HU-Beltsville than the westerly trajectory portrayed by the NAM. Thus, similar days examined should show a northwesterly transport and surface high temperatures near 90°F and surface high pressure centered southeast of Maryland and slight ridging aloft.

To isolate these days from the past five years, days in May reaching at least 85°F at BWI airport were identified. On these days, those when morning winds (using the 12 UTC sounding) from the Northwest (>295° and <335°) at 850mb (approximately 1500m) further refined the group. Finally, those days subjectively matching the pattern on May 25 and 26, 2016 over the eastern US determined the final group of days used for similar day comparisons. Twenty-six days in May of 2012-2016 were identified, not already connected or adjacent to the smoke event of 2016. Of these 26, only 6 were found which satisfied the northwest flow at 850mb criteria and of these 6, only 3 days also matched the pattern of high pressure over the southeast US with a ridge axis extending in to the Midwest or western Mid-Atlantic, similar to the 2016 event (Table 7).

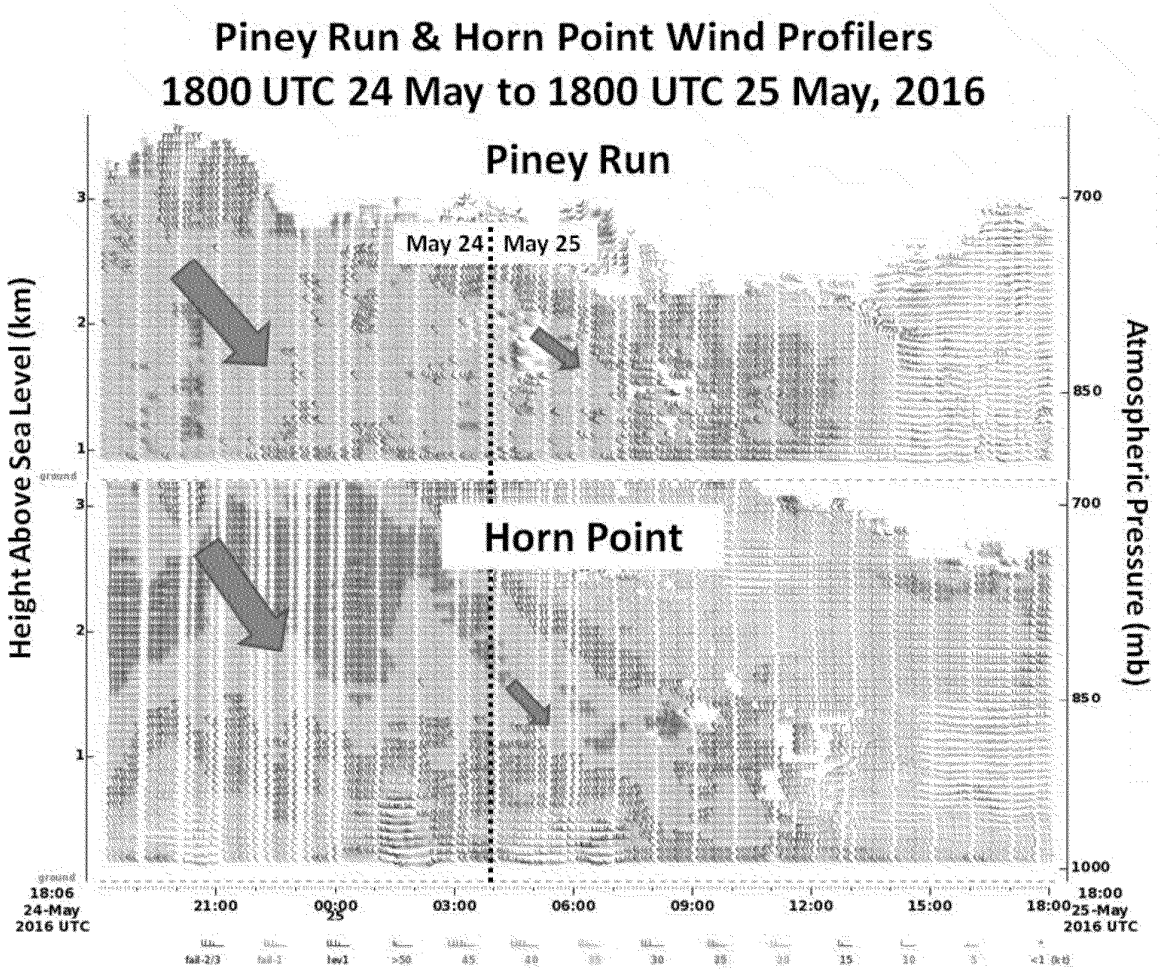
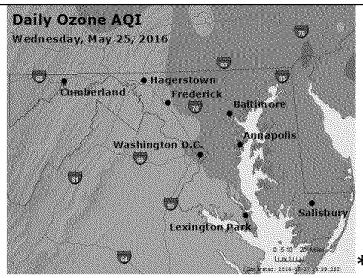
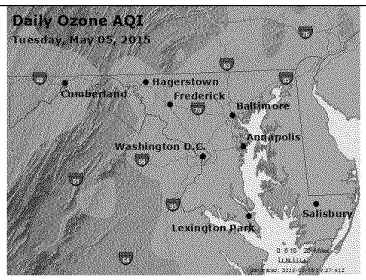
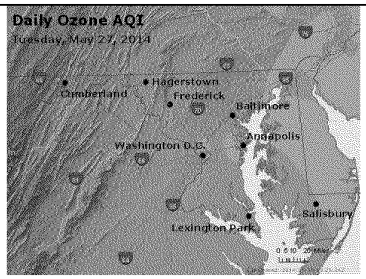
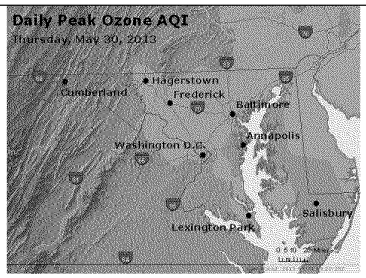


Figure 29. Radar Wind Profiler (RWP) output from 1800 UTC on May 24 through 1800 UTC May 25, 2016. The two profilers, which are on either end of the state (Piney Run is in far western Maryland and Horn Point is on the eastern shore of Maryland) both indicate robust northwest flow which is more in agreement with the ozonesondes than HYSPLIT trajectories run backwards from the afternoon on May 25, 2016.

Based on the similar day analysis, no other day in May from 2012 - 2016 which had similar meteorological characteristics produced similar levels of ozone. The highest ozone on May 25 was 85ppb, which nearly qualified as an "unhealthy" AQI day based on the 2015 standard. The next highest MD8AO concentration on a similar day was in 2013 when temperatures were 6°F warmer than in 2016 produced ozone which was 11ppb lower. Spatially none of the days are comparable to the 2016 event either. More than half of the state was under code orange conditions in 2016 when in the 2013 case only four monitors were above 70, in 2014, none, and in 2015 only two. This analysis reveals that similar meteorological conditions in previous years did not produce as much ozone as in 2016 despite decreasing emissions over the entire period, and the lowest anthropogenic precursor emissions occurring in 2016. Thus, analog evidence suggested the late May 2016 exceedance event was influenced by ozone and ozone precursors transported from an upstream airmass burdened by factors

not explained by a similarity analysis. The most likely explanation was wildfire smoke across the Midwest and Great Lakes area of the US.

Table 7. Similar Day Analysis for May 25, 2016.
Three dates compared to the May 2016 ozone event were chosen by a similar maximum temperature (Tmax >=85°F) at BWI airport, 850mb winds from the northwest (>295° and <335°) on the 12 UTC Sterling VA sounding and matching synoptic pattern characterized by high pressure over the southeastern US and a ridge axis across the western Mid-Atlantic or Midwest. ** Due to the change in the ozone standard, the AQI color scale on the 2016 map is based on orange being greater than 70ppb and red greater than 85ppb for MD8AO.

DATE	Ozone (ppb)	T_{max} (°F)	Mapped AQI
May 25, 2016	85	86	 **
May 5, 2015	72	DRAFT 85	
May 27, 2014	69	90	
May 30, 2013	74	92	

6.8. Concluding Statements

On May 25 and 26, 2016 smoke associated with wildfires predominantly located near Fort McMurray in Central and Southern Canada occurred that generated NOx and VOC ozone precursors in elevated concentrations across the northern central CONUS and Great Lakes. This pollution was subsequently transported east and southeastward towards Maryland and impacted all monitoring sites across the state's network. The monitored 8-hour ozone concentrations reaching 84 and 85ppb, respectfully, were the highest or second highest observations of the season at most sites, established at least one of the fourth highest ranking observations of 2016 at 18 of 20 sites and met or beat the 99th percentile at 15 sites on at least one or both of the days. The comparisons and analyses, provided in sections 2 and 6 of this demonstration support MDE's position that the wildfire event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation on May 25 and 26 and thus satisfies the clear causal relationship criterion.

Based on these facts, MDE requests that all observed ozone data on May 25 and 26, 2016 at monitors that ranked in the top four highest MD8AO of the 2016 ozone season be flagged as impacted by an exceptional event and be excluded from regulatory use. These monitors are highlighted in the table below. Exclusion of the May event will impact DVs in 2017 and 2018 and within MDE's July exceptional event application. A May exclusion meeting the above criteria will reduce only ten (10) monitors' fourth high MD8AO. However, exclusion of all fourth highs in the May event will impact monitors if the July event is concurred. MDE therefore requests all ozone monitors in the Maryland network on May 25 and 26, 2016, except Hagerstown (240430009) and PG Equestrian Center (240230002), be exempt from DV calculations (Table 8).

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Table 8. Maryland Ozone Monitors which MDE seeks exclusion.
Local names and Air Quality System (AQS) identification numbers (AQSID) identify monitors in the text. Also given are the maximum daily 8-hour average ozone (MD8AO) concentrations in ppb along with that day's rank in the 2016 season in parentheses. A rank of (1) indicates the MD8AO was the highest recorded at that site in the season. The final columns indicate the design value with no exclusion of data (Including) and if both May 25 and 26 are excluded from design value calculations (Excluding). Sites with an asterisk indicate the site does not have a valid design value in 2016. Green highlighting indicates the monitors which MDE seeks exemption, based on the 4th high rankings.

		2016					
SiteName	AQSID	MD8AO [ppb] (rank)		Fourth High [ppm]		Design Value [ppm]	
		May 25	May 26	Including	Excluding	Including	Excluding
Aldino	240259001	77 (3)	79 (2)	0.077	0.076	0.073	0.073
Beltsville CASTNET	240339991	76 (2)	72 (3)	0.070	0.070	0.068	0.068
Blackwater NWR CASTNET	240199991	70 (3)	76 (1)	0.068	0.067	0.066	0.065
Calvert	240090011	70 (4)	75 (1)	0.070	0.068	0.069	0.068
Edgewood	240251001	79 (4)	80 (2)	0.079	0.079	0.073	0.073
Essex	240053001	78 (4)	81 (2)	0.078	0.077	0.072	0.072
Fair Hill	240150003	83 (2)	76 (5)	0.080	0.076	0.076	0.074
Frederick	240210037	70 (4)	65 (8)	0.070	0.067	0.067	0.066
Furley	245100054	75 (4)	78 (2)	0.075	0.068	0.069	0.066
Glen Burnie	240031003	75 (6)	76 (4)	0.076	0.076	0.076*	0.076*
Hagerstown	240430009	68 (5)	61 (18)	0.070	0.070	0.066	0.066
Horn Point	240190004	71 (2)	77 (1)	0.067	0.067	0.064	0.064
HU-Beltsville	240330030	74 (2)	74 (2)	0.070	0.069	0.069	0.068
Millington	240290002	85 (1)	76 (2)	0.072	0.069	0.070	0.069
Padonia	240051007	74 (3)	84 (1)	0.073	0.073	0.072	0.072
PG Eq Cntr	240338003	74 (5)	69 (8)	0.076	0.076	0.071	0.071
Piney Run	240230002	64 (7)	53 (4)	0.066	0.066	0.065	0.065
Rockville	240313001	69 (2)	67 (6)	0.068	0.068	0.068	0.068
South Carroll	240130001	72 (4)	75 (2)	0.072	0.068	0.068	0.067
S. Maryland	240170010	69 (7)	73 (4)	0.073	0.073	0.070	0.070

7. Final Statements

MDE posted notice of this exceptional events demonstration on **[April 15]** in the following on the MDE website for a comment period of 30 days**.** [Number] public comments were received and have been included in[Section X] of the demonstration, along with [air agency's] responses to these comments.

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DRAFT

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To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
Cc: Judge, Robert[Judge.Robert@epa.gov]
From: Wortman, Eric
Sent: Mon 1/30/2017 2:46:26 PM
Subject: RE: Exceptional Event Discussion

Okay thanks. Talk to you then.

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Monday, January 30, 2017 9:30 AM
To: Wortman, Eric <Wortman.Eric@epa.gov>
Subject: RE: Exceptional Event Discussion

Eric,

Doug didn't think he and Laurie's attendance was necessary. I did pass the meeting time along to Gina, so she may be on the call.

Thanks

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

RIDEM - Office of Air Resources

235 Promenade Street, Room 230

Providence, RI 02908

(401) 222-2808 x7430

FAX: 222-2017

darren.austin@dem.ri.gov

From: Wortman, Eric [mailto:Wortman.Eric@epa.gov]
Sent: Friday, January 27, 2017 4:56 PM
To: Austin, Darren (DEM) <darren.austin@dem.ri.gov>
Subject: RE: Exceptional Event Discussion

Hey Darren,

Would you like me to extend the invite to Doug McVay, Laurie Grandchamp, Gina Friedman, and Melinda Viera? I wasn't sure if they were available and planning on joining you.

Eric

From: Wortman, Eric
Sent: Friday, January 27, 2017 2:34 PM
To: 'Austin, Darren (DEM)' <darren.austin@dem.ri.gov>
Subject: RE: Exceptional Event Discussion

Great, here's the conference line information. I'll have a few other EPA folks on the line here, please extend the invite to any others at DEM you wish to attend.

Eric

Conf. Line: 866-299-9141 / Passcode Ex. 6 - Personal Privacy

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]

Sent: Friday, January 27, 2017 2:21 PM
To: Wortman, Eric <Wortman.Eric@epa.gov>
Subject: RE: Exceptional Event Discussion

Eric,

Thanks for reaching out.

I'm available on 2/1 from 1-2pm.

Just confirm back and I'll mark my calendar.

Thanks

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

RIDEM - Office of Air Resources

235 Promenade Street, Room 230

Providence, RI 02908

(401) 222-2808 x7430

FAX: 222-2017

darren.austin@dem.ri.gov

From: Wortman, Eric [mailto:Wortman.Eric@epa.gov]
Sent: Friday, January 27, 2017 10:59 AM
To: Austin, Darren (DEM) <darren.austin@dem.ri.gov>
Subject: Exceptional Event Discussion

Hello Darren,

My name is Eric Wortman and I'm assisting with the exceptional events demonstrations from the 2016 Ft. McMurray wildfire. I'd like to set up a call between EPA and RI DEM to discuss next steps on your potential demonstration in more detail. Are you guys available next week for a quick call? Here are some available times, let me know what works for you and I'll send out a call-in number.

Wednesday, 2/1 from 1:00 – 2:00

Thursday, 2/2 from 12:00 – 1:00

Friday, 2/3 anytime midmorning or early afternoon.

Thanks,

Eric

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Monday, January 09, 2017 2:37 PM
To: Conroy, David <Conroy.Dave@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>
Cc: McVay, Doug (DEM) <doug.mcvay@dem.ri.gov>; Grandchamp, Laurie (DEM) <laurie.grandchamp@dem.ri.gov>
Subject: Exceptional Event Letter

All

See attached letter.

The hard copy of this letter was mailed today, 1/9/17 addressed to David Conroy.

Regards

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

RIDEM - Office of Air Resources

235 Promenade Street, Room 230

Providence, RI 02908

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darren.austin@dem.ri.gov

To: Downs, Tom[Tom.Downs@maine.gov]
From: Judge, Robert
Sent: Tue 6/13/2017 8:49:49 PM
Subject: RE: Next EMP in the OTR call on June 14- draft
MonitoringJudgePAMSO3 FRM.ppt.pptx

Feel free to ask tomorrow, and maybe someone from HQ could answer for certain. That said, under the 2015 ozone NAAQS, PAMS sites are required in CBSAs greater than 1,000,000 with NCORE sites. Its not directly tied to attainment/ nonattainment status.

From: Downs, Tom [mailto:Tom.Downs@maine.gov]
Sent: Tuesday, June 13, 2017 8:09 AM
To: Judge, Robert <Judge.Robert@epa.gov>
Subject: RE: Next EMP in the OTR call on June 14- draft

Bob,

The aftershock of this ozone season and the Administrator delaying designations is that areas in 3 more states will be designated nonattainment by 2019: high elevations of Acadia National Park in Maine, all of Rhode Island, SE MA and Western MA. Does this change EPA's thinking on required PAMS sites?

Tom

Tom Downs, CCM

Atmospheric Science and Analysis Section Manager

Air Quality Assessment Division

Maine DEP, Bureau of Air Quality

17 State House Station

Augusta, ME 04333-0017

Tel. (207) 287-7026; Fax. (207) 287-7641

E-mail: Tom.Downs@maine.gov

From: Judge, Robert [mailto:Judge.Robert@epa.gov]
Sent: Thursday, June 01, 2017 7:59 AM
To: Conroy, David; jeffrey.underhill@des.nh.gov; Downs, Tom; gallen@nescaum.org; swierman@marama.org; Cavender, Kevin; Lefer, Barry L. (HQ-DK000); Khan, Mazeeda; Hence, Kia; Papp, Michael; Kahn, Peter R.; Van Arsdale, Alan; michael.woodman@maryland.gov
Cc: Kipp, Katrina
Subject: Next EMP in the OTR call on June 14- draft

So I'm intending to have the next call on Enhanced Monitoring Plans in the OTR on June 14 from 11-noon. (Shooting for every other month at this time)

I had a brief discussion with Jeff Underhill of NH in setting up this Agenda, but would be interested in any additional thoughts you have before I finalize the Agenda for the call. I will send out the meeting time and Agenda either June 2, or Monday, June 5.

Thanks, Bob

****

EMPs in the OTR

June 14, 2017 11-noon EDT

Call in number 866-299-3188

Conf. code 919-541-5651#

MARAMA sharepoint site relative to this OTR Enhanced Monitoring Plans coordinating effort. This sharepoint site includes the presentations and notes thus far, along with other relevant material:

https://marama.sharefile.com/d-se76b561c76148579

1) What have we learned on these calls so far?

2) Research and Special studies:

-NASA (Barry Lefer, NASA (5 min))

3) What do we need going forward for PAMs/ EMPs?

-over water? -mountaintop? -aircraft? -"coordinated" balloon launching?

-other advanced technologies,....pandora spectrometer/ profilers?

4) Any specific thoughts on network design from individual States/ locals

5) Wrap up

To: Kelly, Bob[Kelly.Bob@epa.gov]; Wieber, Kirk[Wieber.Kirk@epa.gov]
Cc: Ruvo, Richard[Ruvo.Richard@epa.gov]; Feingersh, Henry[Feingersh.Henry@epa.gov]; Wong, Danny[Danny.Wong@dep.nj.gov]; Papalski, Ray[Ray.Papalski@dep.nj.gov]
From: Davis, Sharon
Sent: Fri 11/4/2016 7:19:56 PM
Subject: NJ's Final TSD for 2015 Ozone Designation Recommendations
NJ TSD for the size of the ozone nonattainment area under the 70 ppb NAAQS.pdf
Transmittal letter for TSD by F Steitz.pdf

Hi Bob and Kirk,

Attached to this email is the transmittal letter and technical support document for NJ's designation recommendations of the 2015, 70 ppb ozone NAAQS. If you have any questions regarding the attachment, please feel free to call me at the number below or Ray Papalski at (609) 633-7225.

Thanks and I hope you have a nice weekend.

Sharon

Sharon Davis

Section Chief

Air Quality Planning

401 East State Street

P.O. Box 420; Mail Code 401-07H

Trenton, NJ 08625

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http://www.nj.gov/dep/aqes/index.html

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From: Kelly, Bob [mailto:Kelly.Bob@epa.gov]
Sent: Thursday, November 03, 2016 2:39 PM
To: Davis, Sharon <Sharon.Davis@dep.nj.gov>
Cc: Wieber, Kirk <Wieber.Kirk@epa.gov>; Ruvo, Richard <Ruvo.Richard@epa.gov>; Feingersh, Henry <Feingersh.Henry@epa.gov>
Subject: RE: Ozone designation recommendations due Oct 1

Hi, Sharon,

Attached is a copy of the acknowledgement letter we sent to New Jersey.

We are looking forward to the technical information supporting your recommendation.

all the best,

bob

Robert (Bob) Kelly ¦ Meteorologist and Regional Air Modeler ¦

U.S. Environmental Protection Agency ¦ Region 2

290 Broadway ¦ New York, NY 10007-1866

Air Programs Branch ¦ Clean Air and Sustainability Division ¦

Voice: 212-637-3709 ¦ Fax: 212-637-3901 ¦ Email: kelly.bob@epa.gov

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY, ENERGY AND SUSTAINABILITY
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Tel: 609-292-6722
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CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

May 16, 2017

John Filippelli, Director
Clean Air and Sustainability Division
United States Environmental Protection Agency Region II
290 Broadway – 26th Floor
New York, NY 10007-1866

RE: Documentation of an Exceptional Event for Ozone on May 25 and 26, 2016

Dear Director Filippelli:

The New Jersey Department of Environmental Protection (NJDEP) observed unusual ozone exceedances on May 25 and May 26, 2016. New Jersey is providing the enclosed documentation to demonstrate that these ozone exceedances were an exceptional event due to the Fort McMurray wildfires in Alberta, Canada. New Jersey monitoring data for ozone on these days has been accordingly flagged on the United States Environmental Protection Agency's (EPA) Air Quality System.

In accordance with 40 CFR 50.14(c)(2) of the 'Exceptional Events Rule', the enclosed documentation provides the technical evidence that a clear causal relationship exists between the ozone exceedances observed in New Jersey and the Fort McMurray wildfires in Alberta, Canada. The NJDEP has coordinated with EPA Region 2, NESCAUM, and the States of Connecticut and Maryland on the technical demonstration process.

If you have any questions, please contact Sharon Davis, Section Chief, Bureau of Evaluation and Planning, at (609) 292-6722 for further discussion.

Sincerely,

Francis C. Steitz
Director, Division of Air Quality

cc: Paul Baldauf, Assistant Commissioner, NJDEP
Rick Ruvo, Region II, USEPA

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To: Ryan Eberle[Ryan.Eberle@gric.nsn.us]; christopher.horan@srpmic-nsn.gov[christopher.horan@srpmic-nsn.gov]; bball@ak-chin.nsn.us[bball@ak-chin.nsn.us]
From: McKaughan, Colleen
Sent: Thur 6/8/2017 4:43:39 PM
Subject: EPA extends deadline for 2015 ozone NAAQS designations
AZ Ducey 6-6-17.pdf

Hi, All,

Here is the letter that Administrator Pruitt sent to Governor Ducey. Designations for the 2015 ozone standard will now occur in October 2018. Let me know if you have questions.

Colleen

To: Walker.Williamson@tceq.texas.gov[Walker.Williamson@tceq.texas.gov]; Donna Huff[Donna.Huff@tceq.texas.gov]
Cc: Young, Carl[young.carl@epa.gov]
From: Paige, Carrie
Sent: Thur 6/22/2017 7:11:03 PM
Subject: FW: extension of deadline for area designations for the 2015 ozone standard

Hi Donna and Walker,

Please feel free to share this -

Yesterday Administrator Pruitt signed a Federal Register action to extend the deadline for area designations for the 2015 ozone NAAQS designations this morning. The signed action, a fact sheet, and example letter sent to Governors is posted on the ozone designations website and the link is provided below.

https://www.epa.gov/ozone-designations/extension-deadline-area-designations-2015-ozone-standards

Thank you,

Carrie Paige

Environmental Scientist

US EPA Region 6

State Implementation Section (6MM-AB)

1445 Ross Avenue, Suite 1200

Dallas, TX 75202

(214) 665-6521

POSITIONS OR VIEWS EXPRESSED DO NOT REPRESENT OFFICIAL EPA POLICY

To: Donna Huff[Donna.Huff@tceq.texas.gov]; Walker.Williamson@tceq.texas.gov[Walker.Williamson@tceq.texas.gov]; Vivian Aucoin[Vivian.Aucoin@la.gov]; Rita Bates[Rita.Bates@state.nm.us]; Ed L. Merta (emerta@cabq.gov)[emerta@cabq.gov]; treecep@adeq.state.ar.us[treecep@adeq.state.ar.us]; SPENCER@adeq.state.ar.us[SPENCER@adeq.state.ar.us]
Cc: Young, Carl[young.carl@epa.gov]; Riley, Jeffrey[riley.jeffrey@epa.gov]; Huser, Jennifer[huser.jennifer@epa.gov]; Walser, John[Walser.John@epa.gov]
From: Paige, Carrie
Sent: Wed 6/7/2017 2:05:10 PM
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

Good morning,

Please see the announcement below.

Carrie Paige

Environmental Scientist

US EPA Region 6

State Implementation Section (6MM-AB)

1445 Ross Avenue, Suite 1200

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FOR IMMEDIATE RELEASE
June 6, 2017

EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

WASHINGTON – U.S. Environmental Protection Agency (EPA) Administrator Scott Pruitt sent a letter to governors today to inform them of EPA's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. EPA is extending the deadline for promulgating initial area designations, by one year, for the 2015 ozone NAAQS.

"States have made tremendous progress and significant investment cleaning up the air. We will continue to work with states to ensure they are on a path to compliance," **said Administrator Scott Pruitt.**

The National Ambient Air Quality Standard (NAAQS) for ground-level ozone is an outdoor air regulation under the Clean Air Act. As part of the process to determine what areas of the country are able to meet the current air quality standards, states are currently submitting their proposals for area designations under the 70 parts per billion (ppb) standard, which was lowed from 75 ppb in 2015. Areas designated as being in "nonattainment" of the standard face consequences, including: increased regulatory burdens, restrictions on infrastructure investment, and increased costs to businesses.

EPA is giving states more time to develop air quality plans and EPA is looking at providing greater flexibility to states as they develop their plans. And, pursuant to the language in the recently-enacted FY2017 Omnibus funding bill, Administrator Pruitt is establishing an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

Additionally, the Agency is taking time to better understand some lingering, complicated issues so that air attainment decisions can be based on the latest and greatest information. This additional time will also provide the agency time to review the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states and localities. The Agency is evaluating these issues, primarily focused on:

- Fully understanding the role of background ozone levels;
- Appropriately accounting for international transport,
- And, timely consideration of exceptional events demonstrations.

"We share the goal of clean air, a robust economy and stronger, healthier communities. We are committed to working with states and local officials to effectively implement the ozone standard in a manner that is supportive of air quality improvement efforts without interfering with local decisions or impeding economic growth," **said Administrator Pruitt.**

Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased.

To: Foster, Melanie (melanie.foster@deq.ok.gov)[melanie.foster@deq.ok.gov]
From: Paige, Carrie
Sent: Wed 6/7/2017 1:48:08 PM
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

Please see the news release below. I haven't seen any of the other letters sent to governors.

Carrie Paige

Environmental Scientist

US EPA Region 6

State Implementation Section (6MM-AB)

1445 Ross Avenue, Suite 1200

Dallas, TX 75202

(214) 665-6521

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FOR IMMEDIATE RELEASE
June 6, 2017

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R107

Sent from my iPhone

To: Foster, Melanie (melanie.foster@deq.ok.gov)[melanie.foster@deq.ok.gov]
From: Paige, Carrie
Sent: Wed 6/7/2017 1:46:21 PM
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

Carrie Paige

Environmental Scientist

US EPA Region 6

State Implementation Section (6MM-AB)

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E. SCOTT PRUITT
ADMINISTRATOR

June 6, 2017

The Honorable Doug Ducey
Governor of Arizona
State Capitol
1700 W. Washington Street
Phoenix, AZ 85007

Dear Governor Ducey:

I am writing to update you on the status of the U.S. Environmental
efforts related to the National Ambient Air Quality Standards (NAAQS) for
October 2015. Pursuant to section 107(d)(1)(B) of the Clean Air Act (CAA
deadline for promulgating initial area designations for the 2015 ozone NAA
determined that there is insufficient information, and taking additional time
to consider completely all designation recommendations provided by state
CAA section 107(d)(1)(A) and to rely fully on the most recent air quality
time will also provide the Agency time to complete its review of the 2015 oz
taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, th
complex issues that could undermine associated compliance efforts by
regulated entities. As part of the review process, the Agency is evaluating
focusing on: fully understanding the role of background ozone levels; approp
international transport; and, timely consideration of exceptional ev
Additionally, pursuant to language in the recently-enacted FY 2017
established an Ozone Cooperative Compliance Task Force to develop addi
states to comply with the ozone standard

I appreciate the information you and your staff have shared with I
this process. I am confident this progress will continue as we work togeth
goal of clean air, a robust economy and stronger, healthier communities. If
concerns, please contact me or your staff may contact Troy Lyons, Assoc
the Office of Congressional and Intergovernmental Relations, at lyons.troy@
4987.

Respectfully yours,

E. Scott Pruitt

Clovis Steib, III

From: Donaldson, Guy
Sent: Wednesday, June 07, 2017 7:54 AM
To: R6 6MM-AA <R6_6MM-AA@epa.gov>; R6 6MM-AB <R6_6MM-AB@epa.gov>; R6 6MM-AP <R6_6MM-AP@epa.gov>; R6 6MM-AM <R6_6MM-AM@epa.gov>; Stanton, Marya <Stanton.Marya@epa.gov>; Verhalen, Frances <verhalen.frances@epa.gov>; Robinson, Jeffrey <Robinson.Jeffrey@epa.gov>; Todd, Robert <Todd.Robert@epa.gov>
Cc: Smith, Suzanne <Smith.Suzanne@epa.gov>
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

This is pretty big news.

From: Gray, David
Sent: Tuesday, June 06, 2017 5:48 PM
Subject: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

FOR IMMEDIATE RELEASE
June 6, 2017

EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

WASHINGTON – U.S. Environmental Protection Agency (EPA) Administrator Scott Pruitt sent a letter to governors today to inform them of EPA's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. EPA is extending the deadline for promulgating initial area designations, by one year, for the 2015 ozone NAAQS.

"States have made tremendous progress and significant investment cleaning up the air. We will continue to work with states to ensure they are on a path to compliance," **said Administrator Scott Pruitt.**

The National Ambient Air Quality Standard (NAAQS) for ground-level ozone is an outdoor air regulation under the Clean Air Act. As part of the process to determine what areas of the country are able to meet the current air quality standards, states are currently submitting their proposals for area designations under the 70 parts per billion (ppb) standard, which was lowed from 75 ppb in 2015. Areas designated as being in "nonattainment" of the standard face consequences, including: increased regulatory burdens, restrictions on infrastructure investment, and increased costs to businesses.

EPA is giving states more time to develop air quality plans and EPA is looking at providing greater flexibility to states as they develop their plans. And, pursuant to the language in the recently-enacted FY2017 Omnibus funding bill, Administrator Pruitt is establishing an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

Additionally, the Agency is taking time to better understand some lingering, complicated issues so that air attainment decisions can be based on the latest and greatest information. This additional time will also provide the agency time to review the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states and localities. The Agency is evaluating these issues, primarily focused on:

- Fully understanding the role of background ozone levels;
- Appropriately accounting for international transport,
- And, timely consideration of exceptional events demonstrations.

"We share the goal of clean air, a robust economy and stronger, healthier communities. We are committed to working with states and local officials to effectively implement the ozone standard in a manner that is supportive of air quality improvement efforts without interfering with local decisions or impeding economic growth," **said Administrator Pruitt.**

Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased.

R107

Sent from my iPhone

To: Palma, Elizabeth[Palma.Elizabeth@epa.gov]; Sather, Mark[sather.mark@epa.gov]
Cc: Flagg, MichaelA[Flagg.MichaelA@epa.gov]
From: Mebust, Anna
Sent: Mon 5/22/2017 2:48:43 PM
Subject: FW: Question about PM2.5/CO ratios for wildfire impacts
Laing_Enhancement_ratios.v5.pdf

FYI – this is the original email exchange I had with Jaffe, the one that I believe is cited in the materials provided by TCEQ. Sharing for transparency. (The paper is attached.)

Anna Mebust

415.972.3265

mebust.anna@epa.gov

From: Dan Jaffe [mailto:djaffe@uw.edu]
Sent: Friday, March 10, 2017 11:53 AM
To: Mebust, Anna <Mebust.Anna@epa.gov>; James Laing <Ex. 6 - Personal Privacy @gmail.com>
Cc: djaffe@u.washington.edu; Flagg, MichaelA <Flagg.MichaelA@epa.gov>
Subject: Re: Question about PM2.5/CO ratios for wildfire impacts

Hi Anna.

We submitted the attached paper a few weeks ago. We compared wildfire PM/CO and typical urban/non-wildfire periods. Its in review now, but I assume it will eventually get published. Here are key points:

Wildfire PM/CO enhancement ratio ug per m3 per ppb

Average 0.128

Min 0.057

Max 0.228

N=25

Urban-nonfire enhancement ratios		PM/CO enhancement ratio ug per m3 per ppb
Seattle - Beacon Hill	King	0.035
Seattle - 10th St	King	0.021
Portland, OR	Multnomah	0.030
Boise, ID	Ada	0.066
Denver, CO	Denver	0.021
Stockton, CA	San Joaquin	0.046
Fresno, CA	Fresno	0.041
Reno, NV	Washoe	0.029
Chico, CA	Butte	0.046
Average urban areas		0.037

For all of the urban areas except Boise, values above 50 would be unlikely

except in smoke. For Boise there is a lot of local wood burning.

So your ratios of .060-.100 ug/m3 per ppb would strongly

suggest smoke influence. The fact that the R2 drops on some days does

demonstrate mixing with the urban sources and not a pure smoke signal.

Let me know if any of this is not clear or if you have other questions.

regards

Dan

Dr. Dan Jaffe, Professor and Chair

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On Fri, Mar 10, 2017 at 11:33 AM, Mebust, Anna <Mebust.Anna@epa.gov> wrote:

Hello Dr. Jaffe,

I saw your presentation at the Denver EPA/WESTAR exceptional events workshop in November. I have a quick question about $PM_{2.5}$/CO ratios and was hoping you could help me out.

We have an agency working on a wildfire ozone demonstration and after seeing your talk, they wanted to add $PM_{2.5}$/CO correlation plots to their demonstration. Because of the nature of wildfire

ozone demonstrations, we need to be able to assess these on a daily basis, so we've asked them for plots of hourly PM2.5 and CO for each day of the demo.

I noticed from your talk that you indicate that a slope of 0.1-0.4 um m^{-3} ppb^{-1} (or 100-400 um m^{-3} ppm^{-1}) would be indicative of clear smoke impact. One of the days has a slope of 100 um m^{-3} ppm^{-1} and an R^2 of 0.75, which seems pretty solid evidence for smoke impacts. On the other two days, the slope is approximately 65-70 and the correlations are not as strong (R^2 of 0.3-0.4). I wanted to get your thoughts on the strength of this evidence as far as smoke impacts. Would these lower slopes still suggest, e.g., partial smoke impact on urban air?

For reference, EPA also made these correlation plots for several days before and after the potentially fire-impacted days. Excluding one day where some negative PM2.5 data at higher CO values skews the slope negative, the slopes range from -44 to 20, and correlation coefficients are all very low (R^2 below 0.04). To me, this would suggest that at the very least, something different is going on during those two days with higher correlations and slopes around 65-70. But as you are more familiar with this area, I was hoping you'd be willing to share your technical thoughts on this.

If you have any thoughts, or references to which you could point me, that would be very helpful.

Thanks!

Anna K. Mebust, Ph.D.

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Using ΔPM2.5/ΔCO and ΔNOy/ΔCO Enhancement Ratios to Identify Wildfire Smoke in Urban Areas

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[1]*School of Science, Technology, Engineering and Mathematics, University of Washington Bothell, Bothell, WA, USA*

[2]*Department of Atmospheric Sciences, University of Washington, Seattle, WA, USA*

**Correspondence author*: Daniel A. Jaffe (djaffe@uw.edu)

ABSTRACT

In this study we identify wildfire (WF) events using normalized enhancement ratios (NERs) of ΔPM2.5/ΔCO and ΔNOy/ΔCO. Nine urban ambient monitoring sites with adequate CO and PM2.5 measurements were selected for this study. We compare NERs for wildfires with NERs calculated using yearly ambient data, which we call the ambient enhancement ratios (AERs). The PM2.5/CO and NOy/CO AERs provide an insight into the predominant emission sources of the city. The PM2.5/CO AERs were calculated with data up to the 99th percentile of PM2.5 mass to mitigate the influence of large WF events and provide an accurate representation of typical urban emissions. All 25 WF events were distinguished because they had ΔPM2.5/ΔCO NERs that were significantly greater than the PM2.5/CO AER for each site, verifying that ΔPM2.5/ΔCO NERs are a useful tool for identifying WF events at urban monitoring sites. The ΔPM2.5/ΔCO NERs ranged from 0.057-0.228 μg m^{-3} ppbv^{-1}. ΔNOy/ΔCO NERs were only moderately successful in identifying WF events due to variable NOy urban background concentrations. Only 6 of the 17 events (17 of 25 events had NOy data) had a ΔNOy/ΔCO R^2>0.5. For those 6 events ΔNOy/ΔCO NERs ranged from 0.006-0.075 ppbv ppbv^{-1}, and all but one had a lower NER than NOy/CO AER at the site. The range of PM2.5/CO and NOy/CO AERs for all sites was 0.021-0.066 μg m^{-3} ppbv^{-1} and 0.071-0.185 ppbv ppbv^{-1}, respectively. We compare the calculated AERs with county-level emission ratios (ERs) derived from the 2011 National Emission Inventory (NEI) from the US Environmental Protection Agency (EPA). We found that PM2.5/CO AERs compared well with NEI-derived county PM2.5/CO ERs, but found most NOy/CO AERs were lower than the NEI-derived NOx/CO ERs (NOx=NO+NO_2). The discrepancy between NOy/CO AERs and NOx/CO ERs may be indicative of an overestimation of NOx in the NEI emission inventories.

Keywords: Wildfire, Normalized Enhancement Ratio, Urban AQS, PM2.5, CO, NOy

Abbreviations:

WF = Wildfire

NER = Normalized Enhancement Ratio

ER = Emission Ratio

AER = Ambient Enhancement Ratio

INTRODUCTION

Wildfire (WF) smoke in urban areas can have severe negative public health implications. Chronic respiratory diseases, cardiovascular diseases, and increased risk of mortality have been attributed to exposure to fine particulate matter (PM2.5) from WF smoke (Johnston et al., 2012; Adetona et al., 2016; Kochi et al., 2016). Long-term exposure can lead to the development of chronic diseases (Pope III et al., 2002). Due to climate change WFs are expected to increase in the US (Westerling et al., 2006; Liu et al., 2014). This increase in fires will increase public health impacts in cities. Air Quality System (AQS) monitoring stations provide real-time PM2.5 measurements at a high temporal resolution, but it is hard to directly discriminate between forest fire smoke and other smoke sources with only PM2.5 measurements. There are many tracers of WF smoke, such as acetonitrile (Andreae and Merlet, 2001; de Gouw et al., 2003), water soluble potassium (K^+) (Ramadan et al., 2000; Kim et al., 2003), levoglucosan, and other organic molecular markers (Simoneit et al., 1999; Simoneit, 2002), but these measurements either require intensive measurement techniques or have a low time resolution. In this paper we propose a simple way to determine WF smoke in urban areas based on enhancement ratios of commonly measured criteria pollutants from AQS sites.

Normalized enhancement ratios (NERs), also known as normalized excess mixing ratios, are a good way to help identify the source of a pollution plume observed at ambient monitoring sites. During a pollution or smoke event in which concentrations of two species (X and Y) increase substantially above background levels, NERs relate the excess concentrations of a target species X with that of a reference species Y (NER = $\Delta X/\Delta Y$, where Δ is the enhancement over background concentrations). The reference species Y has most commonly been carbon monoxide (CO) or carbon dioxide (CO_2), which are thought of as conserved, inert products of combustion

(Andreae and Merlet, 2001; Hobbs et al., 2003). McClure et al. (2016) showed that this is not always the case for CO_2. Vegetation uptake can deplete CO_2 in WF plumes within the boundary layer, distorting the NER. For this reason, it is typically most suitable to use CO as the Y species. There are two common ways of calculating NERs: (1) by determining the absolute enhancement above the local background concentrations $(X_{plume} - X_{bkg})/(Y_{plume} - Y_{bkg})$, and (2) by determining the regression slope of X and Y during the smoke (or pollution) event.

Emission ratios (ERs) are the ratio of two species (X and Y) at the emission source. There is a difference between ERs and NERs, which should be kept in mind throughout this paper. NERs are calculated in plumes far from the emission source and therefore represent the sources plus any atmospheric processing that has occurred, whereas ERs reflect the ratio of the species at the emission source.

One purpose of calculating the NER of a plume is to try to identify the source of the plume by relating it to known ERs. For the NER of a plume to be equal to the ER it must be assumed that (1) there is a fixed emission Y/X ratio from the source; (2) there is no chemical or physical loss of the species with transport, only dilution; and (3) there are constant background concentrations. In the real world these assumptions are rarely met. For aerosols or reactive gas species such as reactive nitrogen (NOy), the NER measured downwind of a fire may be different than the ER of the same fire due to the production or loss of the target species. In addition, Yokelson et al. (2013) has argued that the two primary methods for calculating NERs mentioned previously can be inaccurate due to changes in background concentrations during plume transport. Briggs et al. (2016) used the two primary NER methods, as well as a third method developed to address Yokelson et al. (2013)'s concerns, while studying WF plumes at the Mt. Bachelor Observatory. Briggs et al. (2016) found little difference between $\Delta\sigma_{scat}/\Delta CO$ and

ΔNOy/ΔCO NERs calculated using the three methods if the enhancement of the species in the plumes was large relative to the background concentrations (σ_{scat} is the aerosol scattering coefficient, which is well correlated to PM2.5). This result verified that if the plume concentration is significantly larger than the background the regression method for calculating NERs is acceptable. The study also showed that despite possible production or loss of the target species during transportation, NERs are useful in determining plume sources.

Review articles of WF emissions show PM2.5/CO ERs ranging from ~0.10 to 0.20 μg m^{-3} $ppbv^{-1}$ (Andreae and Merlet, 2001; Janhäll et al., 2010; Akagi et al., 2011). Although these studies primarily characterized fresh smoke emissions, there was no clear consensus whether PM mass increases (Hobbs et al., 2003; Reid et al., 2005; Yokelson et al., 2009; Vakkari et al., 2014; Briggs et al., 2016) or stays the same (Akagi et al., 2012; Jolleys et al., 2015; May et al., 2015) with plume age. Even with the complexities of plume aging on PM mass, NERs of aged WF events measured in the field mostly fit within the range of WF ERs measured at the fire source. Studies of boreal forest fire plumes observed ΔPM2.5/ΔCO of 0.13-0.15 μg m^{-3} $ppbv^{-1}$ (DeBell et al., 2004; Dutkiewicz et al., 2011). A wide range in ΔPM2.5/ΔCO NERs have been found in long-range transported WF events observed at the Mt. Bachelor Observatory in Oregon (0.18 to 0.43 μg m^{-3} $ppbv^{-1}$) (Wigder et al., 2013; Laing et al., 2016). Similar ranges have been observed in WF plume ΔOA/ΔCO (OA = organic aerosol, which makes up ~95% of PM2.5 mass) (Jolleys et al., 2012; Sakamoto et al., 2015).

Mobile emission and urban background PM2.5/CO ratios are significantly lower than WF ratios in spite of the large range of WF ΔPM2.5/ΔCO. PM2.5/CO ratios from measurements near major highways and urban background range from 0.021 to 0.045 μg m^{-3} $ppbv^{-1}$ (Dimitriou and

Kassomenos, 2014; Patton et al., 2014). The differences between the urban background ratios and ratios from WF emissions allows for the distinguishing of WF events.

NERs of ΔNOy/ΔCO may also be used to identify WF events. In urban settings vehicles are the dominant source of nitrogen oxides (NOx), which are converted to NOy through oxidation (Seinfeld and Pandis, 2006). The atmospheric lifetime of NOy is comparatively longer than that of NOx, making NOy a more conserved measure of initially emitted NOx. Both NOx and NOy have substantially shorter lifetimes than CO. NOx(y) has a lifetime of ~1 day under normal background concentrations (Seinfeld and Pandis, 2006), and hours in urban areas (Spicer, 1982; Beirle et al., 2011). Despite this difference in lifetimes between CO and NOx(y), it has previously been assumed that NOx/CO ERs are relatively conserved within the urban environment since the predominant emission sources of NOx and CO are local vehicular traffic (Hassler et al., 2016). Measurements of NOx/CO and NOy/CO in cities have similar ranges, which verifies that NOx and NOy are comparable within urban environments. Studies of urban and near-road ambient measurements observed NOy/CO ranging from 0.058 to 0.112 ppbv $ppbv^{-1}$ (Wang et al., 2003; Patton et al., 2014), and NOx/CO ranging from 0.063 to 0.150 ppbv $ppbv^{-1}$ (Kirchstetter et al., 1999; Magliano et al., 1999; Long et al., 2002). NOx(y)/CO ratios are dictated by vehicle emissions, so the ratio varies from city to city depending on the composition of their mobile fleet (e.g., gasoline vs diesel) (Hassler et al., 2016). In the past three decades CO emissions from gasoline-powered vehicles decreased faster than those of NOx, which has led to an increasing trend in urban ambient NOx/COs from the 1970s to the early 2000s (Parrish et al., 2002; Parrish, 2006; Parrish et al., 2011). The NOx/CO ratio cumulatively for 28 US cities was 0.118 ppbv $ppbv^{-1}$ in 2000, and 0.139 ppbv $ppbv^{-1}$ in 2003 (Parrish, 2006; Parrish et al., 2009).

Hassler et al. (2016) similarly found that the NOx/CO ratio measured in the LA Basin steadily increased from the 1970s until 2007, when it leveled off till present.

NOx(y)/CO ratios for WF events are significantly smaller than NOx/CO ambient ratios. From Akagi et al. (2011)'s review study of emission factors (g/kg fuel burned) for different forest types, boreal forests have a NOx/CO ER of 0.007 μg m^{-3} $ppbv^{-1}$, temperate forests an ER of 0.026 μg m^{-3} $ppbv^{-1}$, and extratropical forest an ER of 0.009 μg m^{-3} $ppbv^{-1}$. DeBell et al. (2004) found ΔNOy/ΔCOs of aged smoke events at three rural locations to range from 0.0024 to 0.0074 ppbv $ppbv^{-1}$, while the ambient NOy/CO ratios were ~0.12 ppbv $ppbv^{-1}$. WF events observed at Mt. Bachelor during the summer of 2012-2013 had ΔNOy/ΔCO NERs in a similar range (0.003-0.013 ppbv $ppbv^{-1}$) (Briggs et al., 2016).

Using the knowledge that WFs can be distinguished using ΔPM2.5/ΔCO and ΔNOy/ΔCOs, we address the following scientific questions:

- What are the characteristics of ambient urban data that make it useful for NER analysis?
- Can WF smoke events be identified in US urban AQS data using ΔPM2.5/ΔCO and ΔNOy/ΔCOs NERs)?
- How do PM2.5/CO and NOy/CO AERs fluctuate for different monitoring sites and different cities?
- How do PM2.5/CO and NOy/CO AERs compare to ERs derived from emission inventory data?

METHODS

Data Collection

For our study we chose urban AQS monitoring sites in the US with collocated hourly ambient CO and PM2.5 data available on the US Environmental Protection Agency (EPA) AQS API/Query AirData website [*https://aqs.epa.gov/api*] (Fig. 1; Table S1). Only sites with adequate CO measurements were used. CO data was deemed adequate if it was measured with an instrument whose EPA method code was greater than 500 (See EPA codes here: https://aqs.epa.gov/aqsweb/documents/codetables/methods_all.html). In this study the sites we used measured CO with EPA method codes 554, 588, and 593. These instruments report CO concentrations at a 1 ppb resolution and have an MDL of 20 ppb. Instruments with an EPA method code of less than 500 did not have enough resolution to identify WF events. These instruments measure CO concentrations at only a 100 ppb resolution and have MDLs of 500 ppb. At the Reno and Stockton sites, the CO instrumentation was changed from instruments with method codes 88 and 54 to instruments with method code 593, respectively. Due to this upgrade, we were able to use data collected after the upgrade from these sites in this paper. We highly recommend that EPA monitoring sites currently using CO instruments associated with an EPA method code less than 500 upgrade their CO instrumentation. This will result in more useful and useable CO data nationwide.

Wildfire Identification

We identified WF events by selecting time periods in the summer and fall in which there was a noticeable increase in PM2.5 and CO, and a strong correlation ($R^2 > 0.65$) between PM2.5 and CO. We have used this method of identifying WF events successfully in previous studies (Wigder et al., 2013; Baylon et al., 2015; Laing et al., 2016). We verified the fire events by one

of two ways. The first was confirming transport to the monitoring stations from known fire locations using the National Oceanic and Atmospheric Administration Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) back-trajectories (Draxler and Hess, 1997, 1998; Draxler, 1999; Stein et al., 2015). Fire locations were identified using Moderate Resolution Imaging Spectroradiometer (MODIS) satellite-derived active fire counts (Justice et al., 2002). A second way we verified WF events was to use Google News to search for local news articles pertaining to forest fire smoke in the selected cities.

Wildfire Plume Normalized Enhancement Ratios (NERs)

An NER depicts the relative enhancement of two species above background concentrations (e.g., $\Delta X/\Delta Y$; Δ is the enhancement over the background concentration) (Andreae and Merlet, 2001; Wigder et al., 2013; Laing et al., 2016). We calculated ΔPM2.5/ΔCO NERs and ΔNOy/ΔCO NERs from the slope of the Reduced Major Axis (RMA) regression. ΔPM2.5/ΔCO NERs were calculated for all WF events; ΔNOy/ΔCO NERs were calculated for 17 of the 25 events; there was a lack of NOy data at some locations.

Ambient Enhancement Ratios (AERs)

We calculated PM2.5/CO and NOy/CO AERs at each site using an RMA regression using yearly data. AERs reflect typical urban emissions at a given monitoring site. For the PM2.5/CO ratios, we used PM2.5 data up to the 99th percentile to mitigate the influence of WF events on the AERs. The NOy/CO AERs were calculated using all available data.

Emission Inventory–Derived Emission Ratios (ERs)

For comparison with AERs, we calculated PM2.5/CO and NOx/CO ERs from county emission inventories. For each site, we obtained county emission inventories for CO, PM2.5, and NOx from the US EPA 2011 National Emissions Inventory (NEI11) [*https://www.epa.gov/air-emissions-inventories/2011-national-emissions-inventory-nei-data*]. ERs were calculated for each source sector (fuel combustion, mobile sources, industrial processes, etc.), as well as in sum across all sources to compare with PM2.5/CO and NOx/CO AERs calculated from AQS measurements.

RESULTS AND DISCUSSION

Wildfire Events Identified from Urban AQS Measurements

We identified 25 WF events at nine different monitoring sites in US cities that met our criteria. All 25 had CO and PM2.5 data, and 17 of the events also had NOy data. Table 1 shows ΔPM2.5/ΔCO NERs for WF events range from 0.057-0.228 μg m^{-3} $ppbv^{-1}$, with the majority being between 0.085 and 0.170 μg m^{-3} $ppbv^{-1}$. These values are consistent with previous measurements of WF events (DeBell et al., 2004; Dutkiewicz et al., 2011; Chen and Xie, 2014), and estimates of emission factors for forest fires (Andreae and Merlet, 2001; Janhäll et al., 2010; Akagi et al., 2011).

The ΔNOy/ΔCO NERs for WF events with an R^2>0.5 (6 of 17 events) ranged from 0.006-0.075 ppbv $ppbv^{-1}$ with a mean of 0.053 ppbv $ppbv^{-1}$. These values are higher than NOx/CO ERs for forest fires (Andreae and Merlet, 2001; Akagi et al., 2011), and higher than ΔNOy/ΔCO NERs observed in WF plumes measured in rural areas (DeBell et al., 2004). This is likely caused by the variable NOy background in the urban areas in this study due to mobile

emission compared to rural background concentrations. The variable NOy background is also likely the reason only 6 of 17 events had an $R^2 > 0.5$.

The ΔPM2.5/ΔCO NERs for all of the WF events are significantly greater than the PM2.5/CO AER, and most of the ΔNOy/ΔCO NERs were significantly lower than the NOy/CO AER (Fig. 2). This suggests that ΔPM2.5/ΔCO NERs can be used to identify WF events in urban areas. ΔNOy/ΔCO NERs can be used to corroborate these events where NOy data is available but should not be used on their own to identify WF events.

The PM2.5 vs CO scatter plots for individual sites are shown in Fig. 3 and Figs. S1-S5; the NOy vs CO scatter plots are shown in Fig. 4 and Figs. S6-S7. The WF events (orange dots) are generally consistent with the ER for temperate forests (solid red line; (Akagi et al., 2011)) and significantly different than the AER (solid grey line). The AERs are site dependent; we will discuss their variance in the next section.

Urban PM2.5/CO and NOy/CO AERs

PM2.5/CO AERs were calculated using up to the 99th percentile of PM2.5 data to mitigate the influence of WF events on the AERs. The most significant differences in PM2.5/CO slope between using all data and using only the 99th percentile were seen in the Boise and Reno datasets, each of which experienced extended periods of WF smoke with very high PM2.5 concentrations. Due to the exceptional WF events at these two sites, the PM2.5/CO ratios were ~30% higher using the full dataset compared to the using up to the 99th percentile. Given that these fire events were anomalous in that they occurred during only one summer, the PM2.5/CO AERs using up to the 99th percentile of PM2.5 data provide a more accurate representation of typical concentrations.

For the sites we studied, PM2.5/CO AERs ranged from 0.021-0.066 μg m^{-3} $ppbv^{-1}$ with the majority falling between 0.030-0.046 μg m^{-3} $ppbv^{-1}$ (Table 2). These values match other studies characterizing PM2.5/CO ratios of ambient urban background concentrations (Dimitriou and Kassomenos, 2014; Patton et al., 2014). The lowest PM2.5/CO AERs were at the Seattle 10th St site and Denver (0.021 μg m^{-3} $ppbv^{-1}$). Both of these sites are in close proximity to and highly influenced by heavily trafficked highways. The highest PM2.5/CO AER was observed in Boise (0.066 μg m^{-3} $ppbv^{-1}$). PM2.5 and CO data for Boise was only available for 2015, during which extended periods of WF events were observed. This likely skewed the ratio higher despite using only data up to the 99th percentile of PM2.5.

The NOy/CO AERs using all data ranged from 0.070-0.185 ppbv $ppbv^{-1}$ (Table 3). All sites had slight diurnal differences with an increase in NOy/CO during the day and minimal seasonal differences. To try to isolate traffic emissions, we calculated NOy/CO AERs using only weekday (Monday to Friday) data during peak morning traffic (5:00 to 9:00 AM). This method has been used previously as it captures fresh vehicle emissions and minimized the effects of reactive nitrogen species produced through photochemical oxidation (Parrish et al., 2002; Parrish, 2006; Hassler et al., 2016). NOy/CO AERs calculated using the morning rush hour data were slightly higher (7-14%) for all sites compared to AERs calculated using all data. The difference may be attributed to NOy deposition and loss during the day. The high R^2 values for the NOy/CO AERs at all sites and lack of significant temporal changes in NOy/CO ratio indicates a homogenously mixed source dominated by on-road vehicle emissions. The range of observed NOy/CO AERs in this study is similar to previous studies of urban NOy/CO AERs (Wang et al., 2003; Patton et al., 2014) and urban NOx/CO AERs (Kirchstetter et al., 1999; Magliano et al., 1999; Long et al., 2002).

The differences in PM2.5/CO and NOy/CO AERs can provide insight into the emission sources within a city. To explore those differences, we compared AERs at our sites with ERs calculated from county-level emission inventories.

Comparison of AERs with EPA County ERs

To compare the PM2.5/CO and NOy/CO AERs, we calculated PM2.5/CO and NOx/CO ERs for each county using the NEI11 from the EPA. The emission inventories for CO, PM2.5, and NOx for each county broken down by source sector are provided in Tables S2, S3, and S4. CO and NOx emissions for all counties are dominated by mobile sources. The main sources of PM2.5 emissions are more county dependent. Previous studies have directly compared NERs to the corresponding ERs derived from the emissions inventory (Parrish et al., 2002; Parrish, 2006; Parrish et al., 2009; Pollack et al., 2013).

Due to the spatial inhomogeneity of the monitoring sites, the production/loss of PM2.5 and NOy after emission, and the lack of spatial and temporal resolution of the emission inventories, there are uncertainties in evaluating the EPA emission inventories from ambient measurements. Those uncertainties will be explored below.

PM2.5/CO AERs and EPA PM2.5/CO ERs

PM2.5/CO ERs were calculated using the sum of all emission sources, the sum of all sources except fires, and the sum of all sources except fires and dust to compare with the PM2.5/CO AERs (Table 2). In addition PM2.5/CO ERs were calculated for fuel combustion sources and mobile sources as they have the highest and lowest ratios, respectively (Table 2). The PM2.5/CO ER for fuel combustion is very similar in all counties except for those of Boise

and Portland. In the emission inventory, Ada County (Boise) and Multnomah County (Portland) are heavily influenced by industrial and commercial biomass combustion (~40% of fuel combustion PM2.5 emissions). Industrial and commercial biomass combustion have a large EPA PM2.5/CO ER (0.854 μg m^{-3} $ppbv^{-1}$), which skews the total fuel combustion PM2.5/CO ER higher. Most other counties' fuel combustion is dominated by residential wood combustion.

In the PM2.5 vs CO scatter plots, the mobile ER (dotted green line in Figs. 3 and S1-S5) and the Akagi et al. (2011) ER for temperate forest fires (solid red line in Figs. 3 and S1-S5) generally confine the edges of the scatter plots.

For the summed EPA PM2.5/CO ERs in Table 2**Table** , removing fire emissions produces a negligible change at all sites except for Fresno and Chico. Removing the dust source in addition changes the PM2.5/CO ER by at least 15% at all sites. The most significant change was seen at Reno, where the PM2.5/CO ER decreases by 59%. The likely reason for this large dust contribution is that Washoe County encompasses a ~6,000 square mile section of desert that extends from Reno to the Oregon border. Given this, it is most suitable to compare the urban Reno site to the PM2.5/CO ER calculated without fire or dust emissions. The range of PM2.5/CO AERs for all sites and ERs for all counties have similar trends (Fig. 5). This demonstrates that the EPA PM2.5 and CO emission inventories are relatively representative of ambient conditions in urban areas.

A caveat to this is the comparison of the two Seattle sites. The 10th St site has a significantly lower PM2.5/CO AER (0.021 μg/m^3 $ppbv^{-1}$) compared to Beacon Hill (0.035 μg/m^3 $ppbv^{-1}$), despite being in the same city. The reasons for the difference will be discussed further in Section 3.4 but underscore the fact that the location of the monitoring site can have a major influence on the AERs and therefore may not be representative of the entire city.

NOy/CO AERs and EPA NOx/CO ERs

Table 3**Table 2.** shows NOy/CO AERs measured at the monitoring sites, as well as NOx/CO ERs calculated from the EPA emission inventories for the sum of all emission sources, the sum of all sources except fires, mobile sources, and fuel combustion sources**Table 2.**. NOy is a conserved measure of emitted NOx, so NOy/CO AERs are a more accurate representation of NOx/CO ERs than NOx/CO AERs (Seinfeld and Pandis, 2006). As the principal source of NOx and CO are vehicles, the NOx/CO ERs are dominated by the mobile NOx/CO ER.

For all of sites besides Seattle - Beacon Hill, the summed county NOx/CO ERs are higher than the measured NOy/CO AERs (3). For Fresno and Portland, the NOx/CO ERs are ~2 and 4 times greater than the measured NOy/CO AERs. There are a number of possibilities as to the discrepancy between the AERs and ERs. Loss of NOy due to deposition between emission and measurement does not appear to be a large influence. As previously mentioned, the high R^2 values for NOy/CO AERs and the lack of significant diurnal variation in NOy/CO suggest a homogenously mixed source that does that substantially vary. One issue that may lead to the discrepancy is that the monitoring sites may be representative of local sources and not the entire county. An example of this is Fresno, which has a large difference between the NOy/CO AER and NOx/CO ER. Fresno County contains a ~70 mile stretch of the I-5 highway that is nearly 50 miles from the city of Fresno. The Fresno county NOx/CO total ER is very high due to heavy diesel vehicles, most likely from the I-5 corridor, which has little influence in the city of Fresno.

The difference between NOy/CO AERs and NOx/CO ERs for Fresno and Portland may also reflect problems with the emissions inventory. Pollack et al. (2013) found ambient NOx/CO ratios measured in Los Angeles to be to be half the value predicted by the California Air

Resources Board emissions inventory. In a follow-up study of Los Angeles Basin and seven other US urban areas, NOx/CO emissions ratios derived from the MACCity (Monitoring Atmospheric Composition and Climate and megacity Zoom for the Environment) global emissions inventory were found to be systematically 2-5 times higher than measured ambient NOx/CO ratios (Hassler et al., 2016). Similarly, Anderson et al. (2014) observed ΔNOy/ΔCO ratios in a flight campaign over Baltimore/Washington DC and found them to be significantly lower than NEI ERs. They attributed the difference to an overestimation of mobile NOx emissions in the NEI. Other studies have found NOx emissions to be overestimated in some emission inventories. Travis et al. (2016) found that the NOx emissions in the NEI11 were high by a factor of 2 in the Southwest US. They were unsure of the reason behind the discrepancy but concluded that there is a need to improve the accuracy of global emission inventories in assessing urban emission. Although this study lacks the spatial resolution to accurately assess the NEI11, the differences we found combined with results from previous studies signal the need for further investigation.

Seattle Case Study

The Seattle sites provide an interesting comparison of two WF events captured by two sites in close proximity to each other. As previously mentioned, the PM2.5/CO AER for the 10th St site was the lowest of all of the sites (0.021 μg m^{-3} $ppbv^{-1}$), and substantially lower than Beacon Hill (0.035 μg m^{-3} $ppbv^{-1}$), due to the heavy mobile emission influence at 10th St. We investigated how the different backgrounds at these two sites affected their WF NERs.

Fig. 6 shows the time-series of PM2.5 and CO during the WF events. We observed simultaneous increases in PM2.5 at both sites. The red boxes in show the identified WF events

for each site detailed in Table 1. Despite capturing the same WF events, the ΔPM2.5/ΔCO NERs are different for the two sites. The ΔPM2.5/ΔCO NER for Seattle 10th St was the lowest of all the WF events (0.057 μg m^{-3} $ppbv^{-1}$), and significantly lower than the ΔPM2.5/ΔCO NERs for the same event at the Beacon Hill site (0.158 μg m^{-3} $ppbv^{-1}$). The difference is due to the location of the monitoring sites. The 10th St site is located in very close proximity to a major highway (I-5) in downtown Seattle and is heavily influenced by traffic emissions. The Beacon Hill site is located in a park ~350 feet above the city and much less influenced by traffic. The background CO concentration is significantly higher at the 10th St site than the Beacon Hill site due to the influence of traffic emissions (Fig. 3). During the WF event on 8/23/2015, the maximum CO concentration at 10th St (1312 ppbv) was more than double that at Beacon Hill (568 ppbv). Due to this high and variable CO background, the correlation between PM2.5 and CO is not as strong at the 10th St site during the WF events. During the event on 8/22/2015 observed at Beacon Hill the ΔPM2.5/ΔCO R^2 was 0.920. During the same time period at 10th St there is an obvious increase in PM2.5 but the ΔPM2.5/ΔCO R^2 was only 0.332, suggesting a mix of multiple sources (mobile and fire) and making the NER a less reliable indicator of either source. During the event observed at both sites on 8/23/2015, the Beacon Hill site had a much higher R^2 (0.876) than the 10th St site (0.677).

The difference in NERs of the same fire event seen at two sites with different backgrounds substantiates Yokelson et al. (2013)'s argument that changes in background concentrations can significantly affect calculated NERs. Despite the NERs being different, at both sites the WF event NER was significantly larger than the PM2.5/CO AERs and thus the WF event could be discerned.

CONCLUSIONS

In this paper we identified 25 WF events at nine monitoring sites in US cities using NERs of commonly measured AQS criteria pollutants (PM2.5, CO, and NOy). Our main conclusions are as follows:

- Some monitoring sites had CO measurements that had a lower resolution than was necessary for the analysis in this paper. There is a need to improve CO measurements at EPA AQS monitoring sites by upgrading older CO instruments to ones with an EPA method code >500.

- For AQS sites with adequate CO data, ΔPM2.5/ΔCO NERs provide an excellent tool for identifying WF events in urban areas. If NOy data is available, it can be useful in corroborating WF events using ΔNOy/ΔCO NERs but should not be used on its own.

- ΔPM2.5/ΔCO NERs for the identified WF events ranged from 0.057-0.228 μg m^{-3} $ppbv^{-1}$. The ΔPM2.5/ΔCO NERs for WF events were significantly greater than the PM2.5/CO AERs for each site.

- ΔNOy/ΔCO NERs for WF events with an R^2>0.5 ranged from 0.006-0.075 ppbv $ppbv^{-1}$, and all but one of these events had a significantly lower ΔNOy/ΔCO NER than the NOy/CO AERs at the site. Only 6 of 17 events had R^2>0.5, likely due to high and variable NOy urban background from vehicular sources.

- Urban PM2.5/CO AERs ranged from 0.021-0.066 μg m^{-3} $ppbv^{-1}$, which compared well with PM2.5/CO ERs calculated from the NEI11 county emission inventories.

- Urban NOy/CO AERs ranged from 0.071-0.185 ppbv $ppbv^{-1}$ and were generally lower than the NOx/CO ERs derived from the NEI11 county emission inventories. This may indicate an overestimation of NOx emissions on the NEI11.

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TABLES

Table 1. Wildfire event NERs from the monitoring sites and ERs from Akagi et al. (2011) and EPA NEI11 emission inventories. NA means NOy data was not available.

		ΔPM2.5/ΔCO ($\mu g\ m^{-3}\ ppbv^{-1}$)		ΔNOy/ΔCO ($ppbv\ ppbv^{-1}$)	
Site	**Date Time (local)**	**slope**	**R^2**	**slope**	**R^2**
Seattle - Beacon Hill	8/22/15 15:00 - 8/23/15 1:00	0.108	0.920	0.088	0.161
Seattle - Beacon Hill	8/23/15 10:00 - 8/23/15 19:00	0.158	0.876	0.123	0.082
Seattle - 10th St	8/23/15 6:00 - 8/23/15 20:00	0.057	0.677	NA	NA
Portland	8/22/15 00:00 - 8/24/15 00:00	0.228	0.978	NA	NA
Boise	8/14/15 12:00 - 8/16/15 12:00	0.104	0.675	0.059	0.156
Boise	8/21/15 8:00 - 8/22/15 00:00	0.116	0.955	0.017	0.043
Boise	10/11/15 16:00- 10/12/15 18:00	0.133	0.928	0.051	0.423
Boise	10/12/15 20:00 - 10/13/15 20:00	0.129	0.731	0.076	0.322
Boise	10/13/15 20:00 - 10/14/15 14:00	0.092	0.820	0.069	0.511
Boise	10/15/15 15:00 - 10/16/15 15:00	0.107	0.776	0.078	0.372
Stockton	8/15/15 4:00 - 8/16/15 19:00	0.158	0.844	NA	NA
Denver	8/22/15 9:00 - 8/23/15 10:00	0.166	0.762	NA	NA
Fresno	8/15/15 10:00 - 8/16/15 15:00	0.087	0.815	0.047	0.707
Fresno	8/17/15 18:00 - 8/18/15 15:00	0.091	0.778	0.075	0.820
Fresno	9/11/15 15:00 - 9/11/15 20:00	0.141	0.986	0.012	0.227
Fresno	9/13/15 14:00 - 9/14/15 18:00	0.086	0.749	0.044	0.758
Reno	8/18/13 14:00 - 8/19/13 14:00	0.126	0.743	0.057	0.366
Reno	8/22/13 8:00 - 8/26/13 00:00	0.145	0.918	0.034	0.306
Reno	8/27/13 12:00 - 8/28/13 18:00	0.161	0.868	0.042	0.097
Reno	9/18/14 00:00 - 9/19/14 00:00	0.128	0.886	0.006	0.579
Reno	8/20/15 19:00 - 8/21/15 19:00	0.119	0.767	0.075	0.716
Chico	7/28/13 20:00 - 7/31/13 12:00	0.153	0.892	NA	NA
Chico	7/29/14 19:00 - 7/30/14 10:00	0.093	0.979	NA	NA
Chico	9/22/14 5:00 - 9/22/14 15:00	0.161	0.895	NA	NA
Chico	9/13/15 14:00 - 9/14/15 10:00	0.142	0.925	NA	NA
All sites mean ± SD		0.128 ± 0.036		0.053 ± 0.027[#]	
Akagi ER for boreal forests*		0.138		0.0066	
Akagi ER for temperate forests*		0.163		0.0263	
EPA WF ER range[t]		0.096 - 0.164		0.010 - 0.048	
EPA fuel combustion ER range[t]		0.155 - 0.245		0.096 - 0.669	
EPA mobile ER range[t]		0.008 - 0.014		0.178 - 0.365	

[#] Only events with an R^2>0.5 were used to calculate the mean (6 of 17 events).

*Calculated using emission factors from Akagi et al. (2011).

[t] Calculated using range of emission factors for all 8 counties from EPA emission inventories (Tables S1-S3).

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Table 2. PM2.5/CO AERs for each site and PM2.5/CO ERs calculated from the county emission inventories. The PM2.5/CO AERs were calculated using an RMA regression of all data up to the 99th percentile of PM2.5 mass. The county ERs were calculated for the mobile sources, fuel combustion sources, the sum of all sources, all sources except fires, and all sources except fires and dust. A complete listing of the county source emission inventory is provided in Table S1 for CO and Table S2 for PM2.5.

		PM2.5/CO AERs ($\mu g\ m^{-3}\ ppbv^{-1}$)*		NEI11 County PM2.5/CO ERs ($\mu g\ m^{-3}\ ppbv^{-1}$)				
Site location	**Site county**	**slope**	**R^2**	**Mobile**	**Fuel combustion**	**Sum of all sources**	**Sum except fires**	**Sum except fires and dust**
Seattle - Beacon Hill	King	0.035	0.379	0.010	0.173	0.038	0.038	0.030
Seattle - 10th St	King	0.021	0.407	0.010	0.173	0.038	0.038	0.030
Portland, OR	Multnomah	0.030	0.537	0.010	0.237	0.063	0.062	0.050
Boise, ID	Ada	0.066	0.348	0.010	0.245	0.081	0.080	0.053
Denver, CO	Denver	0.021	0.188	0.008	0.155	0.037	0.037	0.022
Stockton, CA	San Joaquin	0.046	0.351	0.013	0.157	0.050	0.046	0.036
Fresno, CA	Fresno	0.041	0.454	0.014	0.194	0.063	0.057	0.041
Reno, NV	Washoe	0.029	0.315	0.009	0.156	0.066	0.062	0.027
Chico, CA	Butte	0.046	0.565	0.011	0.170	0.075	0.061	0.051

*All data up to the 99th percentile of PM2.5 concentration used for RMA analysis.

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Table 3. NOy/CO AERs for each site and NOx/CO ERs calculated from the county emission inventories. The NOy/CO AERs are calculated using an RMA regression of all data at each site. NA means NOy data was not available. The county ERs are calculated for the mobile sources, fuel combustion sources, the sum of all sources, and the sum of all sources except fires. The county ERs are calculated for the sum of all sources, all sources except fires, and all sources except fires and dust. A complete listing of the county source emission inventory is provided in Table S1 for CO and Table S3 for NOx.

		NOy/CO AERs (ppbv ppbv^{-1})				NEI11 County NOx/CO ERs (ppbv ppbv^{-1})			
		All data		Weekday rush hour data					
Site location	**Site county**	**slope**	**R^2**	**slope**	**R^2**	**Mobile**	**Fuel combustion**	**Sum of all sources**	**Sum except fires**
Seattle - Beacon Hill	King	0.185	0.711	0.218	0.753	0.180	0.090	0.173	0.173
Seattle - 10th St	King	NA	NA	NA	NA	0.180	0.090	0.173	0.173
Portland, OR	Multnomah	0.088	0.947	0.095	0.876	0.184	0.163	0.178	0.181
Boise, ID	Ada	0.136	0.718	0.158	0.780	0.182	0.188	0.175	0.182
Denver, CO	Denver	0.145	0.801	0.160	0.831	0.166	0.625	0.195	0.195
Stockton, CA	San Joaquin	NA	NA	NA	NA	0.323	0.523	0.344	0.360
Fresno, CA	Fresno	0.070	0.918	0.079	0.812	0.340	0.376	0.306	0.349
Reno, NV	Washoe	0.130	0.858	0.141	0.910	0.169	0.201	0.147	0.157
Chico, CA	Butte	NA	NA	NA	NA	0.286	0.158	0.167	0.256

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Figure Captions

Fig. 1. Location of US Cities with sample sites used in this study.

Fig. 2. Scatter plots of PM2.5 and CO, and NOy and CO. The grey dots are all of the data points for all of the sites, and the grey line is the RMA regression line for all of the data points. The black circles represent all of the WF events and the black line are the individual event RMA regression lines.

Fig. 2. PM2.5 vs CO scatter plots for Seattle - Beacon Hill, Seattle - 10th St, Boise, and Reno. The grey dots are all of the data points at the site, and the orange dots represent the identified WF events. The lines are defined as follows. Solid dark grey line: PM2.5/CO AERs calculated (RMA slope) at each site using data up to the PM2.5 99th percentile. Dashed black line: EPA County Emission Inventory PM2.5/CO ER using all sources except fires. Dotted green line: Mobile EPA County Emission Inventory PM2.5/CO ER. Solid red line: PM2.5/CO ER for Temperate Forests (0.164 μg m^{-3} ppbv^{-1}; *Akagi et al. (2011)*).

Fig. 3. NOy vs CO scatter plots for Seattle - Beacon Hill, Fresno, Boise, and Reno. The grey dots are all of the data points at the site, and the orange dots represent the identified WF events. The lines are defined as follows. Solid dark grey line: NOy/CO AERs calculated (RMA slope) at each site. Dashed black line: EPA County Emission Inventory NOx/CO ER using all sources except fires. Dotted green line: Mobile EPA County Emission Inventory NOx/CO ER. Solid red line: NOx/CO ER for Temperate Forests (0.026 ppbv ppbv^{-1}; Akagi et al. (2011)).

Fig. 4. Scatter plot of PM2.5/CO ERs calculated from 2011 EPA county emission inventories vs PM2.5/CO AERs. The different colors represent different ways the ERs were calculated. The sum of all sources combines all CO and PM2.5 emissions from all sources in a county; the sum except fires does not include WF emissions in the ratio; the sum except fires and dust does not include WFs or dust emissions in the ratio. The dotted line is 1:1.

Fig. 5. Time series of PM2.5 and CO at the two Seattle locations during WF events in August 2015. The red boxes represent the WF events in Table 2.

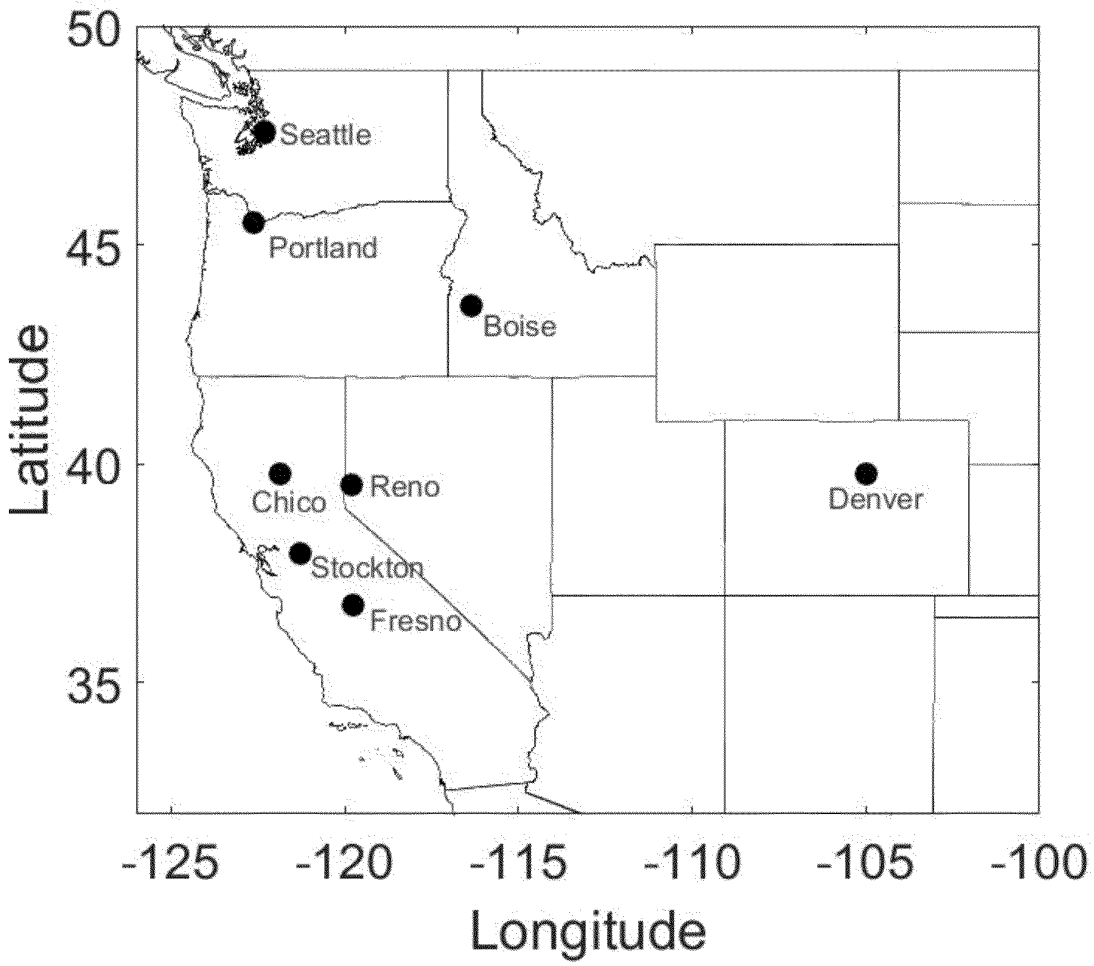
50
45
40
35
Latitude
-125
-120
-115
-110
-105
-100
Longitude
Seattle
Portland
Boise
Chico
Reno
Stockton
Fresno
Denver

Fig. 1.

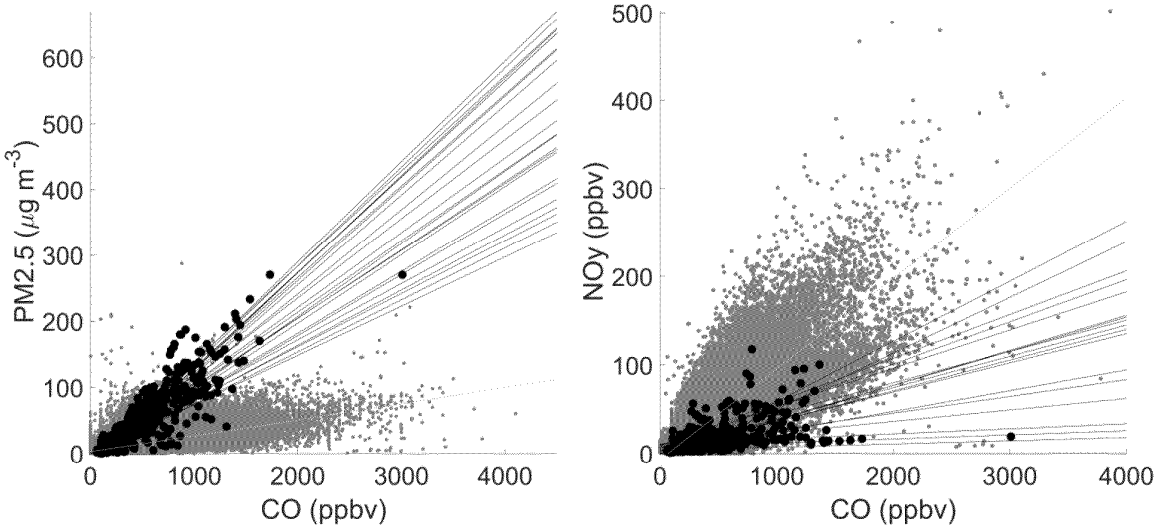

Fig. 2.

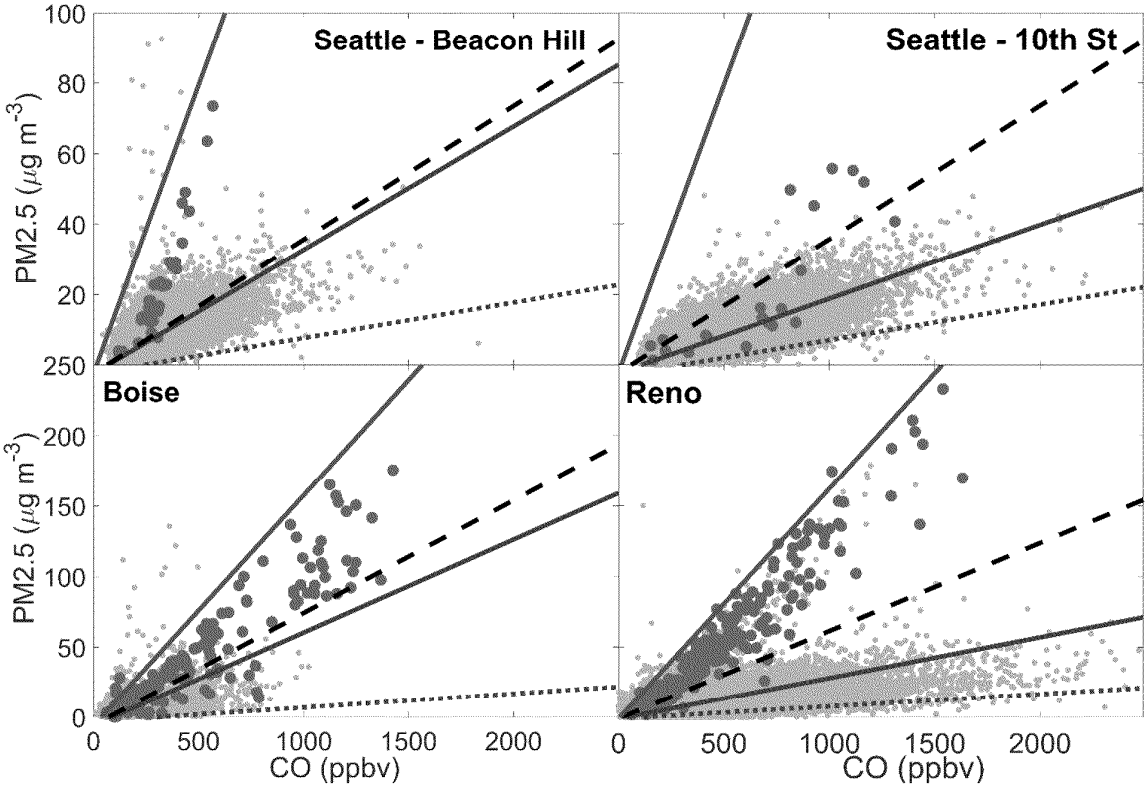
Seattle - Beacon Hill
Seattle - 10th St
Boise
Reno
PM2.5 (μg m-3)
CO (ppbv)
0
500
1000
1500
2000
20
40
60
80
100
50
150
200
250

Fig. 3.

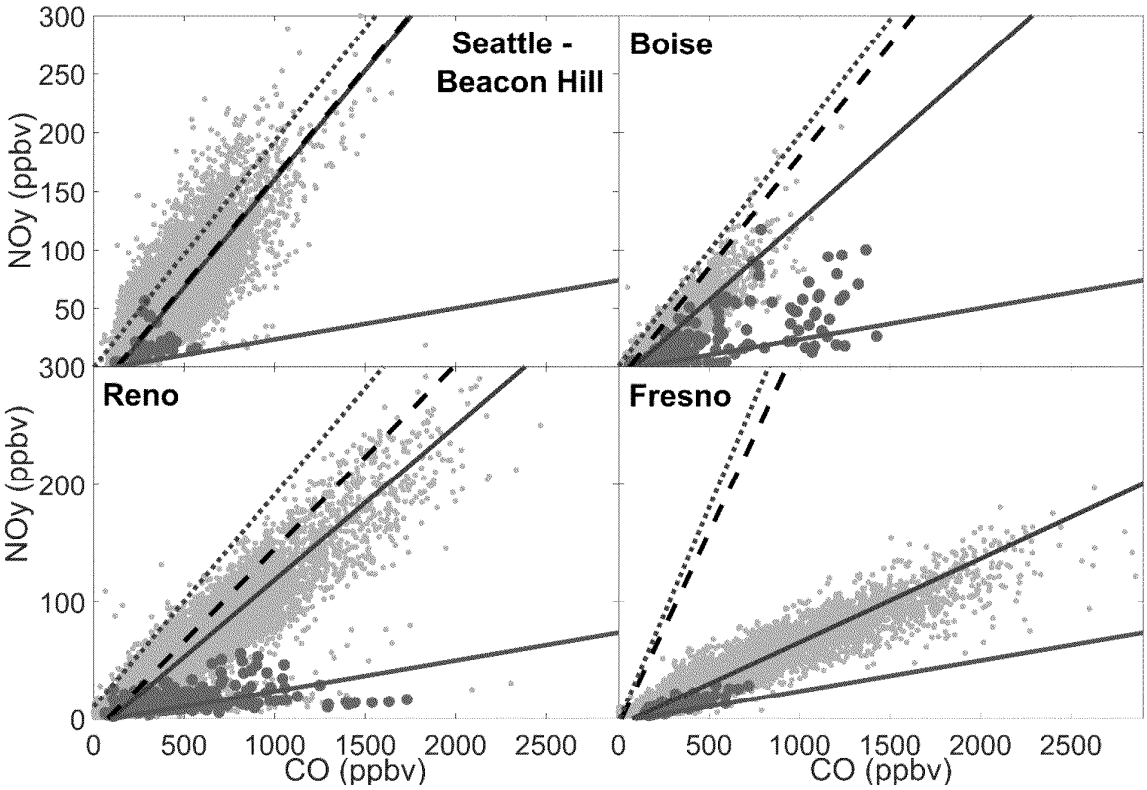
Seattle - Beacon Hill
Boise
Reno
Fresno
NOy (ppbv)
CO (ppbv)
300
250
200
150
100
50
0
500
1000
1500
2000
2500

Fig. 4.

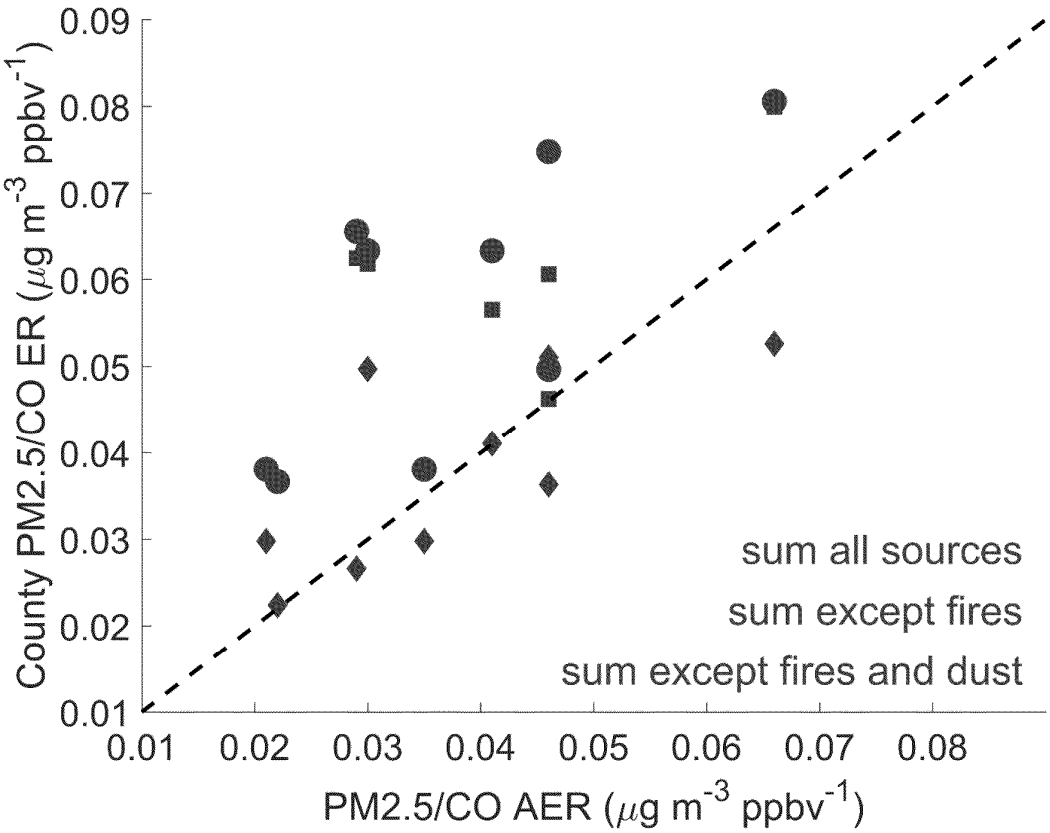
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
County PM2.5/CO ER (μg m^{-3} ppbv^{-1})
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
PM2.5/CO AER (μg m^{-3} ppbv^{-1})
sum all sources
sum except fires
sum except fires and dust

Fig. 5.

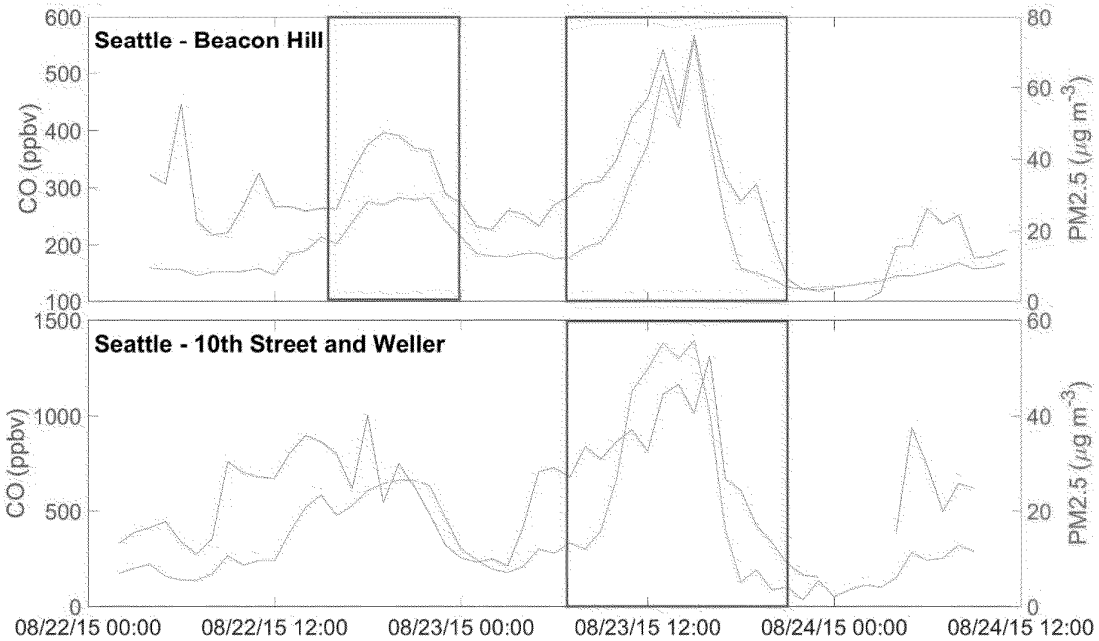
Seattle - Beacon Hill
CO (ppbv)
PM2.5 (μg m-3)
600
500
400
300
200
100
80
60
40
20
0
Seattle - 10th Street and Weller
1500
1000
500
0
60
40
20
0
08/22/15 00:00
08/22/15 12:00
08/23/15 00:00
08/23/15 12:00
08/24/15 00:00
08/24/15 12:00

Fig. 6.

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EXCEPTIONAL EVENTS UPDATES

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Air Quality Policy Division
OAQPS, U.S. EPA
AAPCA Spring Meeting
March 28, 2017

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Exceptional Events

- On September 16, 2016, the EPA finalized the **2016 Revisions to the Exceptional Events Rule**, which address issues raised by stakeholders and increase the administrative efficiency of the Exceptional Event demonstrations process
  - https://www.epa.gov/air-quality-analysis/treatment-data-influenced-exceptional-events
  - Rule effective date was September 30, 2016
  - Published in Federal Register on October 3, 2016 (81 FR 68216)
  - NRDC/Sierra Club filed a Petition for Review on December 2, 2016 (petitioners' brief due 5/17/17, EPA response due 8/17/17)

- General Exceptional Events Rule Background
  - Establishes procedures and criteria for identifying and evaluating air quality monitoring data affected by exceptional events
  - Provides a mechanism by which air quality data can be excluded from regulatory decisions and actions
  - Applies to all criteria pollutants and NAAQS and all event types to which the rule applies
  - Applies to all state air agencies, to (delegated) local air agencies, to tribal air agencies that operate air quality monitors that produce regulatory data and to federal land managers/federal agencies if agreed by the state
  - Affects design value calculations, NAAQS designation decisions, attainment determinations, and State / Tribal / Federal Implementation Plan (SIP/FIP/TIP) development

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Exceptional Events Rule Revisions

- Clarify the types of determinations and actions to which the authorizing statutory authority in Clean Air Act (CAA) section 319(b) applies
- Return to the core statutory elements of CAA section 319(b)
- Clarify “not reasonably controllable or preventable” criteria
- Clarify high wind elements currently addressed in guidance
- Codify requirements for the content and organization of exceptional events submittals
- Remove “general schedule” deadlines for data flagging and demonstration submittal

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Exceptional Events Rule Revisions and Guidance

- New fire-related rule language and preamble text
- Mitigation Regulatory Requirements
- Other provisions
  - Address who may submit a demonstration
  - Event aggregation
  - Identified in preamble intended timelines for EPA response

- Final Wildfire/Ozone Exceptional Events Implementation Guidance

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Exceptional Events Implementation: Stakeholder Feedback

- November 2016 implementation workshops for states and tribes (Denver – 11/8/16; Dallas – 11/30/16)
- General feedback
  - Participants were generally pleased with both the rule revisions and the content of the workshop
  - Participants requested further guidance and similar implementation workshops (both for exceptional events and other EPA programs) and asked for follow-up communication and outreach workshops/webinars following promulgation
  - Participants asked that EPA continue to find ways to reduce the transaction costs in exceptional events demonstrations
  - Participants called for continued EPA communication and support with more tools and examples as they become available

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Exceptional Events Implementation: Available Resources

- Exceptional Events Website at http://www2.epa.gov/air-quality-analysis/treatment-data-influenced-exceptional-events
- Quick reference guide for exceptional events demonstrations
- Examples of reviewed exceptional event submissions
- Best practices documents
- Links to publicly available support information and tools
- Links to rule and guidance resources
  - Final rule
  - Final wildfire/ozone guidance
  - Fact sheets
  - 2013 interim guidance documents

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Exceptional Events Implementation: Next Steps

- The 2016 rule revisions and final wildfire/ozone guidance were needed first steps, but efficient and coordinated implementation is critical.
- What is next?
- Additional Implementation Materials
  - Revisions to 2013 *Interim Exceptional Events Guidance Documents*
  - Stratospheric Ozone Intrusion Document
  - Alternate Paths for Data Exclusion Document
  - Prescribed Fire/Ozone Document
- Continued development of exceptional events tools
  - Templates
  - Website updates
  - AQS modifications to reflect rule revisions guided by feedback from newly created AQS workgroup
  - Standardized metrics and tracking
  - Targeted efforts with FLMs – communications and tools
  - Best practices for multi-state exceptional events demonstrations

Questions and Comments

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US surface ozone trends and extremes from 1980-2014: Quantifying the roles of rising Asian emissions, domestic controls, wildfires, and climate

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Abstract. Surface ozone (O_3) responds to varying global-to-regional precursor emissions, climate, and extreme weather, with implications for designing effective air quality control policies. We examine these conjoined processes with observations and global chemistry-climate model (GFDL-AM3) hindcasts over 1980-2014. The model captures the salient features of observed trends in daily maximum 8-hour average O_3; (1) increases over East Asia (up to 2 ppb yr^{-1}), (2) springtime increases at western US (WUS) rural sites (0.2-0.5 ppb yr^{-1}) with a 'baseline' sampling approach, (3) summertime decreases, largest at the 95th percentile, and wintertime increases in the 50th to 5th percentiles over the eastern US (EUS). Asian NO_x emissions tripled since 1990, contributing as much as 65% to modeled springtime background O_3 increases (0.3-0.5 ppb yr^{-1}) over the WUS, outpacing O_3 decreases attained via US domestic emission controls. Methane increases over this period raise WUS background O_3 by 15%. During summer, increasing Asian emissions approximately offset the effects of US emission reductions, leading to weak or insignificant observed O_3 trends at WUS rural sites. While wildfire emissions can enhance summertime monthly mean O_3 at individual sites by 2-8 ppb, high temperatures and the associated buildup of O_3 produced from regional anthropogenic emissions contribute most to elevating observed summertime O_3 throughout the USA. Rising Asian emissions and global methane under the RCP8.5 scenario increase mean springtime O_3 above the WUS by ~10 ppb from 2010 to 2030. Historical EUS O_3 trends are overwhelmingly dominated by decreases in domestic emissions, with O_3 reductions more pronounced in the Southeast with an earlier onset of biogenic isoprene emissions and NO_x-sensitive O_3 production. Regional NO_x reductions also alleviated the O_3 buildup during the recent heat waves of 2011 and 2012 relative to earlier heat waves (e.g., 1988; 1999). Without emission controls, the 95th percentile summertime O_3 in the EUS would have increased by 0.2-0.4 ppb yr^{-1} over 1988-2014 due to more frequent hot extremes and rising biogenic isoprene emissions.

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1. Introduction

Decreases in summertime O_3 were observed in parts of California and throughout the EUS (e.g., *Cooper et al., 2012; Simon et al., 2015*), following regional NO_x controls after the lowering of the US National Ambient Air Quality Standard (NAAQS) for O_3 in 1997 to 84 ppb. On the basis of health evidence, the NAAQS level for O_3 has been further lowered to 75 ppb in 2008 and to 70 ppb in 2015 (*Federal Register, 2015*). There are concerns that increases in Asian anthropogenic emissions (*Jacob et al., 1999; Lin et al., 2015b*), more frequent large wildfires in summer (e.g., *Jaffe, 2011*; *Yang et al.*, 2015; *Abatzoglou et al., 2016*), and late spring deep stratospheric O_3 intrusions (*Lin et al., 2012a*; *Langford et al., 2014; Lin et al., 2015a*) may pose challenges in attaining more stringent O_3 standards at high-elevation WUS regions. A warming climate would also offset some of air quality improvements gained from regional emission controls (see review by *Fiore et al., 2015*). Quantitative understanding on sources of O_3 variability on daily to multi-decadal time scales can provide valuable information to air quality control managers as they develop O_3 abatement strategies under the NAAQS. Here we systemically investigate the response of US surface O_3 means and extremes to changes in Asian and North American anthropogenic emissions, global methane, regional heat waves and wildfires over the course of 35 years from 1980 to 2014, using a suite of observations and chemistry-climate model (GFDL-AM3) hindcasts (*Lin et al., 2014; 2015a; 2015b*).

Rapid economic growth has led to a tripling of O_3 precursor emissions from Asia in the past 25 years (e.g., *Granier et al., 2011; Hillboll et al., 2013*). Observed 1-hour O_3 mixing ratios can frequently reach 200-400 ppb during regional pollution episodes in eastern China (*Wang T. et al.,* 2006; *Li et al., 2016*), with a seasonal peak in the late spring to early summer (*Wang Y. et al., 2008; Lin et al., 2009*). A synthesis of available observations from the mid-1990s to the 2000s indicates increases of 1-2 ppb yr^{-1} in spring to summer O_3 in China (*Ding et al., 2008; Ma et al., 2015; Sun et al., 2015*). Long-range transport of Asian pollution plumes towards western North America has been identified by aircraft and satellite measurements and in chemical transport models (e.g., *Jaffe et al., 1999; Zhang et al.,* 2008; *Fiore et al., 2009; Lin et al., 2012b; Huang et al., 2013; Verstraeten et al., 2015*). Systematic comparison of observed and modeled long-term O_3 trends over Asia is lacking in the published literature, but is needed to establish confidence in models used to assess the global impacts of rising Asian emissions.

Import of Asian pollution enhances mean WUS surface O_3 in spring by 5 ppb, and occasionally contributes 8-15 ppb during springtime pollution episodes observed at rural sites (*Lin et al., 2012b*). Stratospheric intrusions can episodically increase daily 8-hour average surface O_3 by 20-40 ppb, contributing to the highest observed O_3 events at high-elevation WUS sites (*Lin et al., 2012a; Lin et al., 2015*), in addition to pollution transport from California (e.g., *Langford et al.*, 2010). In the densely populated EUS, both changes in regional anthropogenic emissions and air pollution meteorology have the greatest impacts on summer surface O_3 during pollution episodes (*e.g., Jacob and Winner*

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2009; Rieder et al., 2015; Porter et al., 2015; Pusede et al., 2015). Discerning directly the effect of climate change on air quality from long-term observation records of O_3 would be ideal, but concurrent trends in precursor emissions impede such an effort. It is difficult to separate the impacts of changes in global-to-regional precursor emissions and different meteorological factors on O_3 at given locations without the benefit of multiple sensitivity experiments afforded by models.

On the other hand, process-oriented assessments of the models are needed to build confidence in their utility for assessing pollution control strategies, estimating tropospheric O_3 radiative forcing and projecting pollution extremes under future climate scenarios (e.g., *Monks et al., 2015*). A number of studies show that global models capture observed decreases in summertime O_3 over the EUS during 1990-2010, but have difficulty simulating O_3 increases measured at remote high-altitude sites that are believed to represent hemispheric-scale conditions with little influence from fresh local pollution (hereafter referred to as "baseline") (e.g., *Lamarque et al., 2010*; *Koumoutsaris and Bey, 2012; Parrish et al., 2014; Brown-Steiner and Hess 2014; Strode et al., 2015*). Recently, *Lin et al.* (2015b) examined the representativeness of O_3 trends derived from sparse measurements in the free troposphere over the WUS, originally reported by *Cooper et al.* (2010) and used in previous model evaluations. They found that discrepancies between observed and simulated O_3 trends reflect measurement sampling biases. Here we seek additional insights into the causes of the model-observation disagreement at the WUS rural sites with continuous, high-frequency measurements. Notably, we reconcile observed and simulated O_3 trends at these sites with a baseline sampling approach.

Our goal in this paper is twofold: first, to systematically evaluate how well our GFDL-AM3 BASE simulation represents trends and variability of surface O_3 observed at rural sites across the US; second, to examine changes in US surface O_3 means and extremes in a suite of multi-decadal hindcast simulations designed to isolate the response of O_3 to increases in Asian anthropogenic emissions, North American emission controls, rising global methane, wildfires, and interannual variability in meteorology. We examine trends across the entire probability distribution of O_3 concentration, which is crucial to assessing the ability of models to simulate the surface O_3 response under different temperature and chemical regimes depending on seasons, geographical location, and regional transport patterns. Specifically, we evaluate the trends separately for the 5th, 50th and 95th percentiles of the O_3 concentration distribution in spring (March-April-May; MAM), summer (June-July-August; JJA), and winter (December-January-February; DJF).

Section 2 briefly describes the observational records, model experiments, and analysis approach. As a first step towards assessing our understanding of the impacts of rising Asian emissions, we briefly review Asian O_3 trends from observations in recent publications and evaluate modeled trends (Sect. 3). We then focus our analysis on the US, using both observations and models to assess the response of US surface O_3 to changes in background O_3, regional anthropogenic emissions and meteorology (Sect. 4). In Section 5,

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we further separate the influence of background on WUS O_3 into components driven by rising Asian anthropogenic emissions, global methane, and wildfires. We quantify the contribution of these factors to surface O_3 in both rural areas such as national parks (Sect. 5.1 to 5.3) and in densely populated regions such as the Denver Metropolitan area (Sect. 5.4). After evaluating historical trends, we additionally draw upon two simulations following the 21st century RCP4.5 versus RCP8.5 global change scenarios to project WUS O_3 through 2050 (Sect. 5.2). Section 6 examines how the EUS summertime O_3 probability distribution and pollution extremes during heat waves respond to regional NO_x reductions in the past decades. Finally, we summarize in Section 7 the key drivers of US surface O_3 trends and extremes and discuss model skill and shortcomings.

2. Model and Observations

2.1 Chemistry-Climate Model Experiments.

(Table 1 about here: Model Experiments)

Table 1 summarizes meteorology, radiative forcing agents and emissions used in each model experiment. All hindcast simulations include interactive stratosphere-troposphere chemistry and aerosols on a cubed sphere grid with resolution of approximately 200x200 km^2 (*Donner et al., 2011*), with height-dependent nudging to the NCEP/NCAR reanalysis zonal and meridional winds (*Lin et al.*, 2012b). Biogenic isoprene emissions and lightning NO_x are tied to model meteorology (*Guenther et al.*, 2006; *Rasmussen et al.*, 2012) and thus can respond to changes in climate, whereas soil NO_x and chemical dry deposition velocities are set to a monthly climatology, with a diurnal cycle applied for O_3 dry deposition. Our **BASE** simulation and two additional simulations with modified emissions (**FIXEMIS** and **IAVFIRE**) were previously used to interpret the causes of increasing autumnal O_3 measured at Mauna Loa Observatory in Hawaii since 1974 (*Lin et al.*, 2014), interannual variability of spring time O_3 (*Lin et al.*, 2015a) and the representativeness of free tropospheric O_3 measurements over the WUS (*Lin et al.*, 2015b). Below we describe additional simulations used in this study.

With anthropogenic emissions and methane held constant (**Table 1**), the FIXEMIS and IAVFIRE simulations isolate the influence from meteorology and wildfire emissions, respectively. In the **IAVASIA** simulation, anthropogenic emissions from East Asia (15ºN-50ºN, 95ºE-160ºE) and South Asia (5ºN-35ºN, 50ºE-95ºE) are allowed to vary from year to year as in **BASE**, while anthropogenic emissions in the other regions of the world, global methane and wildfire emissions are held constant as in **FIXEMIS**. In the **IAVCH$_4$** simulation, global methane is allowed to vary over time as in **BASE**, but with anthropogenic and wildfire emissions held constant as in **FIXEMIS**. The **IAVASIA** and **IAVCH$_4$** simulations thus isolate the role of rising Asian anthropogenic emissions and global methane, respectively, by contrasting with the **FIXEMIS** simulation. Both **BASE** and **IAVCH$_4$** simulations apply observed time-varying methane concentrations as a lower boundary condition for chemistry **(Supplementary Fig.S1)**. Thus, underestimates in

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historical methane emissions reported recently by *Schwietzke et al.* (2016) do not affect our results. We quantify the total contributions to surface O_3 from meteorological variability, stratosphere-to-troposphere transport, pollution from foreign continents and O_3 produced by global methane, lightning NO_x, wildfires and biogenic emissions with the **Background** simulation, in which North American anthropogenic emissions are zeroed out relative to BASE. We additionally draw upon two simulations with the GFDL Coupled Model CM3 following the 21st century RCP global change scenarios to project changes in WUS O_3 through 2050. Details of these CM3 simulations were described in *John et al.* (2012).

2.2 Anthropogenic and Biomass Burning Emissions

(Figure 1 about here: Changes in NO_x emissions)

We first examine how well the emission inventories implemented in AM3_BASE represent changes in regional NO_x emissions over recent decades inferred from satellite measurements of tropospheric vertical column density (VCD_{trop}) of NO_2. The combined record of GOME and SCIAMACHY shows that VCD_{trop} NO_2 over the highly polluted region of eastern China almost tripled during 1996-2011 (**Fig.1a**). In contrast, VCD_{trop} NO_2 over the EUS decreased by ~50% in the 2000s (**Fig.1b**) due to NO_x State Implementation Plans (hereafter referred to as the NO_x SIP Call) and many rules that tighten emission standards for mobile sources (*McDonald et al., 2012*). Similar decreases occur in WUS cities, resulting from the NO_x control programs to achieve O_3 and regional haze planning goals. These trends are consistent with those reported by a number of recent studies (*Hilboll et al.*, 2013), including those using OMI NO_2 data (*Russell et al.*, 2012; *Duncan et al.*, 2016). For comparison with satellite data, we sample the model archived every three hours closest to the time of satellite overpass for the SCIAMACHY and GOME products we use in Figure 1 (10:00-10:30AM local time). Trends in VCD_{trop} NO_2 are similar to those in NO_x emissions (orange lines versus red triangles in **Fig.1a-1b**), indicating that any changes in NO_x chemical lifetime have negligible influence in our model, consistent with NO_2 loss against OH being minor during the morning overpasses of GOME and SCIAMACHY. The emission inventory used in AM3_BASE, from *Lamarque et al.* (2010) with annual interpolation after 2000 to RCP8.5 (*Lamarque et al.*, 2012), mimics the opposing changes in NO_x emissions over eastern China versus the EUS during 1996-2011, consistent with changes in VCD_{trop} NO_2 retrieved from the satellite instruments. For comparison, the RCP 4.5 interpolation for 2001-2010 in the historical CMIP5 simulations analyzed by *Parrish et al.* (2014) underestimates the increase in Chinese NO_x emissions by a factor of two (**Fig.1a**). We note that the levelling-off of Chinese NO_x emissions after 2011 (*Duncan et al.*, 2016) is not represented in the RCP8.5 emission inventory used in AM3.

Our BASE model applies interannually-varying monthly mean emissions from biomass burning based on the RETRO inventory (*Schultz et al.*, 2008) for 1970 to 1996 and *GFEDv3* (*van der Werf et al.*, 2010) for 1997 onwards, distributed vertically as

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recommend by *Dentener et al. (2006)*. **Supplementary Fig. S2** illustrates the interannual variability of biomass burning CO emissions from the main source regions in the Northern Hemisphere over the period 1980-2014. Boreal fire emissions in Eurasia almost doubled from 1980-1995 to 1996-2014, with large fires occurring more frequently in the recent decade as found in recent studies for the WUS (*Dennison et al.*, 2014; *Yang et al.*, 2015).

2.3 Ozone Observation Records and Uncertainties

Long-term surface O_3 observation records were obtained at 66 rural monitoring sites with 20 (1995 -2014) to 27 (1988 -2014) years of continuous hourly measurements from the US National Park Services , the US Clean Air Status and Trends Network (CASTNet), and the US EPA Air Quality System. *Cooper et al.* (2012) reported trends in daytime O_3 over 1990-2010 at 53 rural sites. We investigate trends in daily maximum 8-hour averaged (MDA8) O_3 and expand the analysis of Cooper *et al.* (2012) using additional data to 2014 and including 13 additional sites with measurements begun in 1991-1995. All sites have at least 20 years of data. If a site has less than 50% data availability in any season then that particular season is discarded. The trend is calculated separately for the 5th, 50th and 95th O_3 percentiles for each season through ordinary linear least-square regression. Statistics are derived for the slope of the linear regression in units of ppb yr^{-1}, the range of the slope with a 95% confidence limit (not adjusted for sample autocorrelation), and the p-value indicating the statistical significance of the trend based on a two-tailed *t* test.

(Figure 2 about here: Measurement uncertainties)

A cross-site consistency analysis was performed to determine robust changes in the time evolution of O_3 over the WUS during 1988-2014 (**Fig.2**). The monitor at Yellowstone National Park was moved 1.5 km from the Lake Yellowstone site to the Water Tank site in 1996. While the local transport patterns are slightly different for the two sites, using MDA8 data from the well-mixed midday period minimizes the differences (*Jaffe and Ray, 2007*). Observed O_3 interannual variations show large-scale similarity across sites over the Intermountain West except for the earlier period 1989-1990. During this period, observations at Yellowstone and Rocky Mountain National Parks show low -O_3 anomalies that do not appear at other sites but there is no change in measurement technique. *Jaffe and Ray* (2007) suggest this represents large-scale variations in background O_3 that are seen in common at these two parks. However, analysis of meteorological fields and model diagnostics does not reveal any obvious transport anomaly influencing O_3 variations at these sites in 1990 (*Lin et al.* , 2015a). Observations at Pinedale in January -February 1990 are also anomalously low relative to Grand Canyon (GRC474), Centennial (CNT169), and Gothic (GTH161). These anomalous data at the beginning of measurement records can substantially influence trends calculated from short records. For example, *Cooper et al.*, (2012) found a summertime O_3 increase of 0.42±0.30 ppb yr^{-1} at Yellowstone over 1990-2010.

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Removing 1990, we find a weaker increase of 0.28±0.27 ppb yr^{-1} (**Fig.2b**). Removing 1990 at Rocky Mountain resulted in a weaker springtime O_3 increase of 0.29±0.17 ppb yr^{-1} compared to 0.43±0.23 ppb yr^{-1} over 1990-2010 (**Fig.2c**). To assess robust O_3 changes, we thus remove these apparently uncertain measurements in 1990 from the subsequent analysis.

2.4 Model Baseline Sampling Approach

(Figure 3 about here: Influence of baseline sampling)

Springtime O_3 observations at WUS high-elevation sites (≥ 1.5 km a.s.l.) typically represent baseline conditions with little influence from fresh local pollution. In a global model with ~200x200 km^2 horizontal resolution, however, these remote sites can reside in the same grid cell that contains urban cities where NO_x emissions decreased over the analysis period. For example, Rocky Mountain National Park (2.7 km a.s.l.) is less than 100 km from the Denver Metropolitan area in Colorado. This limitation of large-scale models in resolving urban-to-rural gradients and sharp topography results in an artificial offset of increased baseline O_3 at remote sites by decreased urban pollution within the same model grid cell. Thus, coarse-resolution models are often unable to reproduce the observed O_3 increases at the high-elevation sites representative of remote baseline conditions (**Figs. 3a vs. 3b**), as found in many prior modeling analyses (e.g., *Parrish et al.*, 2014; *Strode et al.*, 2015 and references therein). This limitation can be addressed by using a baseline selection procedure to identify conditions for sampling the model to avoid model artifacts caused by poor spatial resolution, as described below.

All measurements presented in this study are unfiltered. We implement a set of regional CO-like tracers, with a 50-day exponential decay lifetime and surface emissions constant in time from each of four northern mid-latitude source regions (*Lin et al.*, 2014). We use these CO-like tracers to bin modeled O_3 according to the dominant influence from different continental air regimes. To represent observed baseline conditions at intermountain sites, we sample AM3 at 700 hPa (~3 km a.s.l.) and filter the O_3 data in the BASE simulation to remove the influence from fresh local pollution. Specifically, our filter excludes days when the North American CO tracer (NACOt) exceeds the 67th percentile for each season. This procedure yields higher calculated baseline O_3 trends (**Fig.3c**), bringing it closer to observations (**Fig.3a**). When sampled at 700 hPa without filtering (**Fig.3d**), AM3_BASE gives statistically significant O_3 increases but the rate of increase is ~0.1 ppb yr^{-1} weaker than with filtering. With North American anthropogenic emissions shut off, the model simulates significant O_3 increases that are similar at the surface (**Fig.3e**) and at 700 hPa (**Fig.3f**). This finding indicates that the BASE model underestimate of O_3 increases when sampled at the surface (**Fig.3b**) reflects an excessive offset from domestic pollution decreases in the model relative to observed conditions, as opposed to insufficient mixing of free tropospheric O_3 to the surface. As individual sites display observed trends falling in between the filtered model, and those sampled at the surface versus at altitude, we can use the model to interpret which sites are most

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frequently sampling baseline versus influenced by North American anthropogenic emissions. For consistency, in the subsequent analysis we apply the model baseline sampling approach to all WUS sites with elevations greater than 1.5 km altitude. In the EUS, where the terrain and monitor elevations are much lower than in the west and observed O_3 trends are largely controlled by regional emission changes, we always sample the model at the surface without applying data filtering.

3. Global Distribution of Lower Tropospheric O_3 Trends

3.1 Global O_3 Burden and Distribution of Trends

(Figure 4 about here: Global distribution)

We begin by examining the global distribution of lower tropospheric O_3 trends over 1988-2014 from the BASE simulation (**Fig.4**) and center our discussion on the differences between the surface and free troposphere (~700 hPa), with implications for understanding the impact of trends in hemispheric baseline O_3 on surface air quality. The model indicates that surface MDA8 O_3 levels in Asia have increased significantly by 1.5-2.5 ppb yr^{-1} in the 95th percentile (**Fig.4a-b**) and by 1-2 ppb yr^{-1} in the median values (**Fig.4c-d**), with the largest increases occurring in Southern Asia during spring and over Eastern China during summer. In contrast, there is a marked decrease in surface MDA8 O_3 in WUS cities, throughout the EUS and in central Europe, particularly at the high percentiles and during summer. The increase in surface O_3 over Asia and decreases over the US and Europe are consistent with changes in regional emissions of O_3 precursors over this period (**Fig.1**).

Over Southeast Asia (south of 30ºN) during spring, earlier springtime O_3 photochemical production at lower latitudes coupled with active frontal transport (*Liu et al.*, 2002; *Carmichael et al.*, 2003; *Lin et al.*, 2010) leads to a comparable or even greater increase of O_3 in the free troposphere than at the surface **(Figs. 4c vs. 4e).** In contrast, over Central East China during summer the simulated trends of O_3 in the free troposphere are at least a factor of three weaker than in surface air **(Fig.4d vs. 4f)**, consistent with analysis of MOZAIC aircraft data over Beijing in 1995-1999 versus 2003-2005 (*Ding et al.*, 2008). Mean O_3 at 700 hPa above parts of North America and Europe show little change in summer or even increase during spring in the model, similar to the trends at 500 hPa (**Fig.S3**), despite the significant decreases in surface air. The global tropospheric O_3 burden in the BASE simulation increases by approximately 30 Tg over the past 35 years (**Fig.5a**), attributed mainly to changes in anthropogenic emissions. Over the 2004-2015 OMI/MLS satellite era, however, meteorological variability contributes approximately half to the total simulated decadal trends of O_3 burden (**Fig.5a**).

3.2 Comparison of observed and simulated O_3 trends in Asia

(Figures 5 and 6 about here)

Long-term O_3 observations are very sparse in Asia, making it difficult to evaluate

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modeled O_3 trends. We compile available measurements from the published literature; including ozonesonde profiles at Hong Kong (2000 -2014; http:/woudc.org) and Hanoi (2005-2015; SHADOZ, *Thompson et al.*, 2007), MOZAIC aircraft profiles collected on summer afternoons in the boundary layer (below 1250 m altitude) over Beijing for 1995-2005 (*Ding et al.*, 2008), ground-based measurements at Mt. Tai (1.5 km a.s.l.) in Central Eastern China for July-August 2003-2015 (*Sun et al.*, 2016), at the GAW stations - Shangdianzi north of Beijing for 2004-2014 (*Ma et al.*, 2016) and Mt. Waliguan (3.8 km a.s.l.) in the Tibetan Plateau for 19 94-2013 (*Xu et al.*, 2016), at Taiwan for 1994-2007 (*Y-K Lin et al.*, 2010), South Korea for 1990-2010 (*Lee et al.*, 2014), Mt. Happo (1.9 km a.s.l.) in Japan for 1991-2011 (*Tanimoto*, 2009; *Parrish et al.*, 2014), and a coastal site at Hong Kong in Southern China for 1994-2007 (*T Wang et al.*, 2009).

We first evaluate observed and simulated annual trends of O_3 over 900-600 hPa at Hanoi (21°N, 106°E) and Hong Kong (22°N, 114°E) ozonesonde sites in Southeast Asia (**Fig.5b-5c**), where our model indicates the greatest free tropospheric ozone increases (**Fig.4e**). The ozonesonde frequency is 4 profiles per month at Hon g Kong and only 1-2 profiles per month at Hanoi . To determine the representativeness of O_3 trends derived from these sparse measurements, we compare observations and model results co-sampled on sonde launch days with the 'true average' determined from O_3 fields archived every three hours from the model, as in our prior work for WUS sites (*Lin et al.*, 2015a; *Lin et al.*, 2015b). The trends are generally consistent between the sonde data, model co-sampled and 'true average' results for Hong Kong, with a total increase of ~15% from 2005 to 2014. However, our analysis indicates that sampling deficiencies may influence the trends derived from ozonesondes at Hanoi recently reported by *Zhang Y. et al.* (2016). Observations at Hanoi show an apparently rapid O_3 increase of 30% from 2005 to 2014. AM3_BASE sampled sparsely as in the ozonesondes captures the observed variability (r^2 = 0.7), whereas the 'true average' over this period indicates the trend is only half of that observed. Over the short period 2005-2014, interannual variability of O_3 resulting from wildfire emissions and meteorology in IAVFIRE is as large as the total O_3 change in BASE. Over the entire 1980-2014 period, the BASE model 'true average' simulates an O_3 increase of ~30%.

Expanding the comparison to a suite of sites across East Asia (**Fig. 6),** we find that AM3_BASE captures the key features of O_3 trends in Asia, including their seasonal to regional variations, summertime increases (1-2 ppb yr^{-1}) in Central Eastern China wh ere NO_x emissions have approximately tripled since 1990 (**Fig.1a**), and springtime increases (0.5 ppb yr^{-1}) observed at Taiwan and Mt. Happo driven by pollution outflow from the Asian continent. Note that to place the trends derived from the short observational records into a broader context we show the 20 -year trends over 1995 -2014 from the model, except for South Korea (1990-2010) and Happo Japan (1991-2011). We match the time period in the model with observations at these two sites because AM3 shows weaker O_3 increases when data for the recent years are included, which likely reflects the offsetting effects from regional emission reductions in South Korea and Japan. Parrish *et*

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al. (2014) found that three chemistry-climate model simulations underestimated the observed O_3 increase at Mt. Happo by at least a factor of four. This discrepancy partly reflects the limitation of global models in resolving observed baseline conditions at Mt. Happo, as occurs at WUS sites (Sect. 2.4). Sampling our model at 700 hPa and focusing on data that are strongly influenced by outflow from the East Asian continent (Chinese CO tracer > 67th percentile), we find an O_3 increase of 0.48±0.13 ppb yr^{-1} at Mt. Happo (**Fig.6b**), approximating the observed increase of 0.76±0.35 ppb yr^{-1}. The observed and simulated trends are not statistically different given the overlapping confidence limits. The larger confidence limit (uncertainty) derived from the Happo observations reflects the measurement inconsistency before 1998 and instrumental problems after 2007 (*Tanimoto et al.*, 2016). We conclude that the ability of GFDL-AM3 to reproduce the marked increases of O_3 pollution in Asia lends confidence in its application to assess the global impacts of rising Asian emissions.

4. Regional and Seasonal Variability of US Surface O_3 Trends

We next focus our analysis on the US where dense, high-frequency, long-term, reliable measurements of surface O_3 facilitate process-oriented model evaluation. Comparisons of surface MDA8 O_3 trends over 1988-2014 at 66 rural monitoring sites across the US as observed and simulated in AM3_BASE are shown in **Figure 7** for spring, **Figure 8** for summer, and **Figure 9** for winter. The trends are calculated separately for the 5th, 50th and 95th percentiles of the O_3 concentration distribution, with larger circles on the maps indicate sites with statistically significant trends ($p<0.05$). We first discuss observations (Sect. 4.1), followed by model evaluation and trend attribution (Sect. 4.2).

4.1 Observations

(Figure 7 about here)

In spring (**Figure 7**), observations indicate spatial heterogeneity in O_3 trends across the Intermountain West, Northeast (north of 38°N), and Southeast US. At the 95th percentile (**Fig.7a**) the pattern of observed trends is homogeneous across the Northeast and Southeast US, with approximately 87% of the sites having statistically significant O_3 decreases of 0.4-0.8 ppb yr^{-1} and no sites showing a significant increase. In contrast, significant increases occur at 20% of the sites in the Intermountain West. Only Joshua Tree National Park located downwind of the Los Angeles Basin shows a significant decrease at the 95th percentile. At the 50th percentile (**Fig.7b**) there are significant O_3 decreases of 0.2-0.4 ppb yr^{-1} in the Southeast and little overall change in the Northeast, while significant increases of 0.2-0.4 ppb yr^{-1} occur at 50% of the sites in the Intermountain West. Significant springtime O_3 increases occur at all observed percentiles at Lassen Volcanic National Park in California, Great Basin National Park in Nevada, Rocky Mountain National Park and US Air Force Academy in Colorado. At the 5th percentile (**Fig.7c**) significant O_3 increases occur at most sites in the Northeast while little change and some negative trends are found in the Southeast. The observed greatest O_3

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decreases for the highest percentiles are consistent with high-temperature O_3 production being more NO_x-limited (*Pusede et al.*, 2015), and thus more responsive to the decreases in NO_x emissions over the past decade. The north-to-south gradient in springtime O_3 trends over the EUS reflects the earlier seasonal transition from NO_x-saturated to NO_x-sensitive O_3 production regimes in the Southeast, where plentiful radiation in spring enhances HO_x supply and biogenic isoprene emissions are turned on earlier than the Northeast.

(Figure 8 about here)

In summer (**Figure 8**), as radiation intensifies and isoprene emissions peak seasonally, the O_3 production becomes more NO_x-limited across both the Southeast and Northeast US where NO_x emission controls have led to significant O_3 decreases of 0.8-1.8 ppb yr^{-1} in the 95th percentile and 0.4-0.8 ppb yr^{-1} in the median value (**Fig.8a-8b**). In the Southeast, significant decreases have also occurred at the lowest percentiles during summer (**Fig.8c**), in contrast to the weak response during spring (**Fig.7c**). Despite reductions in precursor emissions in the WUS cities (**Fig.1d**), there are no significant summer O_3 decreases at the intermountain sites except at Yosemite and Joshua Tree National Parks for the 95th percentile. Instead, a significant summer increase of ~0.3 ppb yr^{-1} occurs across the entire O_3 distribution at Yellowstone National Park. Significant summer increases are found in the 5th percentile for Lassen, Mesa Verde, and Rocky Mountain National Parks.

(Figure 9 about here)

In winter (**Figure 9**), observed O_3 increases are more common than in spring and summer across the US. Notably, the wintertime O_3 increases are strongest in the lowest percentiles over the EUS, indicating the influence from weakened NO_x titration as a result of regional NO_x emission controls (see also *Gao et al.*, 2013; *Clifton et al.*, 2014; *Simon et al.*, 2015). Some decreasing O_3 trends are found in the highest percentiles over the Southeast even during winter (**Fig.9a**), similar to the Los Angeles Basin (not shown) where tropical climate and year-round active photochemistry makes O_3 most responsive to regional NO_x emission controls. Despite the greatest NO_x emission reductions over the past decade in the central and northeast US regions, observed O_3 reductions have been most pronounced in the Southeast, particularly in spring and winter.

4.2 Model Evaluation and Attribution of Observed O_3 Trends

The BASE simulation with GFDL -AM3 captures the salient features of observed O_3 trends over 1988-2014 at rural sites across the US: (1) the overall springtime increases and the lack of significant trends in summer over the Intermountain West, (2) the north-to-south gradients in O_3 trends during spring and the largest decreases in the 95th percentile during summer over the EUS, (3) wintertime increases in the 5th and 50th percentiles (left vs right panels in **Figs. 7 to 9**). AM3 also simulates the median

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springtime O_3 increase of 0.32±0.11 ppb yr^{-1} over 1988-2014 (0.64±0.50 ppb yr^{-1} over 2004-2014) at Mount Bachelor Observatory in Oregon, consistent with the positive trends (0.63±0.41 ppb yr^{-1}) observed over the shorter 2004-2015 period (*Gratz et al.*, 2014). These analyses imply that GFDL-AM3 represents the underlying chemical and physical processes controlling the response of US surface O_3 means and extremes to changes in global-to-regional precursor emissions and climate, despite mean state biases (**Figs. S4-S5**).

The filtered model shows greater 95th percentile O_3 increases than observed at some WUS sites (e.g., Yosemite; Grand Canyon; Canyonlands) for both spring and summer (**Figs.7a,d and Fig.8a,d**), reflecting that observations at these sites sometimes can be influenced by transport of photochemically aged plumes from nearby urban areas and from southern California during late spring and summer. When sampled at the surface, AM3 simulates small summertime O_3 decreases in the 95th and 50th percentiles over the Intermountain West (**Fig.4b,d),** consistent with observations at Yosemite, Grand Canyon, and Canyonlands (**Fig.8a,b**). As illustrated in **Fig.3** for spring and discussed in Sect. 2.4, individual sites in the west display observed trends falling in between the filtered model and those sampled at the surface versus aloft.

(Figures 10 and 11 about here)

We examine how US surface O_3 responds to changes in regional anthropogenic emissions, hemispheric background, and meteorology by comparing O_3 trends in the BASE, Background, and FIXEMIS experiments (**Figs. 10-11**). With North American anthropogenic emissions shut off in the Background simulation, little difference is discernable from the BASE simulation for the WUS O_3 trends during spring (first vs. second rows in **Fig.10**), indicating the key role of hemispheric background driving increases in springtime O_3 over the WUS. With anthropogenic emissions held constant in time, FIXEMIS still shows statistically significant spring O_3 increases in the 95th percentile (**Fig.10c**), approximately half of the trends simulated in BASE, for Grand Canyon, Canyonlands, Mesa Verde and Rocky Mountain National Parks. Prior work shows that deep stratospheric intrusions contribute to the highest observed and simulated surface O_3 events at these sites (*Langford et al.*, 2009; *Lin et al.*, 2012a). Strong year-to-year variability of such intrusion events (*Lin et al.*, 2015a) can confound the attribution of springtime O_3 changes over the WUS to anthropogenic emission trends, particularly in the highest percentile and over a short record length. Summer avoids this confounding influence when stratospheric intrusions are at their seasonal minimum, as evidenced by little O_3 change in FIXEMIS over the WUS (**Figs. 11c,f**). In contrast to spring, the model shows larger differences in WUS O_3 trends between BASE and Background during summer when the influence of North American pollution peaks seasonally (**Figs.10a,d vs. 10b,e** compared to **Figs.11a,d vs. 11b,e**). There are significant increases of 0.2-0.5 ppb yr^{-1} in the 95th and 50th percentile summer background O_3 at more than 50% of the western sites (**Fig.11b,e**), offsetting the O_3 decreases resulting from

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US NO_x reductions and leading to little overall change in total observed and simulated O_3 at WUS rural sites during summer (**Fig.8**).

Over the EUS, AM3 also simulates background O_3 increases, occurring in both the 95th and 50th percentiles, with a rate of 0.1-0.3 ppb yr^{-1} during spring (**Fig.10b,e**) and 0.2-0.5 ppb yr^{-1} during summer (**Fig.11b,e**). Rising biogenic isoprene emissions contribute to the EUS background O_3 increase in summer (**Fig.12a**). Based on prior model estimates that springtime background O_3 is greater in the Northeast than the Southeast (*Lin et al.*, 2012a; *Lin et al.*, 2012b; *Fiore et al.*, 2014), one might assume that the springtime O_3 increases in the 5th percentile observed over the Northeast (**Fig.7c**) have been influenced by a rising background. However, AM3 simulates homogeneous background O_3 trends across the entire EUS (**Fig.10b,e**), indicating that the observed north-to-south gradient in O_3 trends reflects an earlier onset of NO_x-sensitive photochemistry in the Southeast as opposed to the background influence.

(Figure 12 about here).

A warming climate is most likely to worsen the highest O_3 events in polluted regions (e.g., *Schnell et al.*, 2016; *Shen et al., 2016*). With anthropogenic emissions held constant in time over 1988-2014, FIXEMIS suggests significant increases of 0.2-0.4 ppb yr^{-1} in the 95th percentile summertime O_3 over the EUS (**Fig.11c**). Using self-organizing map cluster analysis, Horton *et al*. (2015) identified robust increases in the occurrence of summer and autumn anticyclonic circulations over eastern North America since 1990. We find that biogenic isoprene emissions over this period increase significantly by 1-2% yr^{-1} (10 to 20 mg C m^{-2} $summer^{-1}$) throughout the EUS in the model, consistent with simulated increases in the 90th percentile JJA daily maximum temperature (**Fig. 12a-12b**). We further analyze the Global Land-Based Datasets for Monitoring Climate Extremes (GHCNDEX; Donat et al., 2013) and find increases in the number of warm days above the 90th percentile and maximum temperature over the central and southeast US in August (**Fig.12c-12d**). The trends in temperature extremes are similar between June and August, but there is no significant trend in July (not shown). While changes in regional temperature extremes on 20 to 30-year time series may merely reflect internal climate variability (*Shepherd, 2015*), we suggest that the increased frequency of hot extremes and rising isoprene emissions over the last two decades may have offset some of air quality improvements in the EUS gained from regional NO_x reductions.

5. Impacts of rising Asian emissions, methane and wildfires on western US O_3

5.1 Historical western US O_3 trends in spring

(Figure 13 about here: Time series analysis)

Further indications of the factors driving baseline O_3 changes over the WUS can be inferred by examining the time series at several high-elevation sites, which are most frequently sampling baseline O_3 in the free troposphere during spring (Sect. 2.4). **Figure**

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13 shows the results, both observed and simulated, for six such monitoring sites: Great Basin National Park in Nevada (2.1 km a.s.l.), Rocky Mountain National Park (2.7 km a.s.l.) in Colorado, US Air Force Academy (1.9 km a.s.l.) in Colorado Springs, Yellowstone National Park (2.4 km a.s.l.) and Pinedale (2.4 km a.s.l .) in Wyoming, and Mesa Verde National Park (2.2 km a.s.l.) in the Colorado -New Mexico -Arizona-Utah four corner region. The observed median values of springtime MDA8 O_3 have increased significantly at a rate of 0.2 -0.5 ppb yr^{-1} over the past 20 -27 years at these sites, except Pinedale, where the increase in background O_3 is likely offset by the O_3 decrease due to recent emission control for the large oil and gas production fields in this area (http://deq.wyoming.gov/aqd/winter-ozone/resources/technical-documents/). When filtered to remove the influence from fresh local pollution (Sect.2.4), AM3_BASE captures the long-term trends of O_3 observed at these sites.

Correlating AM3 Background directly with the observations indicates that most of the observed variability reflects changes in the background, with fluctuations in stratospheric influence contributing to anomalies on interannual time scales (e.g., the 1999 anomaly, *Lin et al., 2015a*), whereas Asian influence dominates the decadal trends as discussed below. The O_3 reduction resulting from US anthropogenic emission controls is less than 0.1 ppb yr^{-1} (BASE minus Background) at these baseline sites. We show model results for the entire 1980 -2014 period for Great Basin, Rocky Mountain, and US Air Force Academy to provide context for observed trends in the two most recent decades (**Fig.13a**). In the 1980s when Chin ese NO_x emissions (~4 Tg/yr NO) were much low er than US NO_x emissions (~15 Tg/yr NO) (*Granier et al.*, 2011), there was little overall O_3 change over the WUS in the model. From the mid-1990s onwards, with NO_x emissions in China rising steeply (**Fig.1a**) and surpassing US emissions in the 2000s, we find that the O_3 trends at remote WUS sites appear to be dominated by trends of background, reflecting rising emissions outside the US . Supporting the Asian influence, the regions experiencing the largest springtime O_3 increases from 1981 -1990 to 2003 -2012 at 700 hPa extend from Southeast Asia to the subtropical North Pacific Ocean to the southwestern US (**Fig.S6a**).

(Table 2 about here: Trend attribution)

Table 2 contains a summary of the drivers of O_3 trends in the model at seven CASTNet sites with a significant springtime O_3 increase observed over the period 1988-2012. Here we focus our attribution analysis on the period 1988-2012 (instead of 1988-2014) because the IAVASIA and IAVCH_4 simulations only extend to 2012. Meteorology varies from year to year in all experiments. Thus, we quantify the contributions from rising Asian emissions in IAVASIA, global methane in IAVCH_4, and wildfire emissions in IAVFIRE by subtracting out the slope of the linear regression of seasonal O_3 means in FIXEMIS. Simulated O_3 with anthropogenic emissions varying in both South and East Asia (red boxes in **Fig.1c**) but held constant elsewhere gives statistically significant increases of 0.1-0.2 ppb yr^{-1} ($p \leq 0.01$; IAVASIA minusFIXEMIS in **Table 2**), consistent with trends of

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0.2 ppb yr^{-1} estimated from HTAP phase 1 multi-model sensitivity experiments in which Asian emissions were reduced by 20% (*Riedmiller et al., 2009*). This Asian influence can explain 50-65% of the total background O_3 increases in spring (Background in **Table 2**).

With only methane varying, the model trends are less than 0.1 ppb yr^{-1} ($IAVCH_4$ minus FIXEMIS), accounting for an average of 15 % of the total background increases. The contribution from wildfire emissions during spring is of minor importance, as evidenced by the small differences between FIXEMIS and IAVFIRE (**Table 2**). A stratospheric O_3 tracer (O_3Strat) in AM3 (*Lin et al.*, 2012a; *Lin et al.*, 2015a) demonstrates a positive but insignificant trend in stratospheric O_3 transport to the sites. We examine the trends of lower tropospheric O_3 at these sites when transport conditions favor the import of Asian pollution into western North America, as diagnosed by East Asian CO tracer (EACOt) exceeding the 67 th percentile for each spring. Similar to the conclusion of *Lin et al.*, (2015b), we find that the rate of O_3 increase under strong transport from Asia is greater by 0.05-0.1 ppb yr^{-1} than without filtering in the Background simulation. Filtering the IAVASIAsimulation for Asian influence also results in greater O_3 increases than filtering for baseline conditions (**Table 2**).

Increasing O_3 from rising Asian emissions can also influence trends of O_3 downwind of the Los Angeles Basin during spring. For instance, Cooper *et al*. (2012) found that O_3 measured in Joshua Tree National Park shows an increase of 0.31±0.25 ppb yr^{-1} in spring over 1990-2010, despite significant improvements in O_3 air quality in the Los Angeles Basin (*Warneke et al.*, 2012). An extended O_3 record to 2014 shows a decline in the 95th percentile O_3 in Joshua Tree National Park for both spring and summer (**Figs. 7-8**), whereas the 5th percentile continues to increase in spring and there is no significant trend in the median. Sampling the model background simulation at this site indicates rising background (0.31±0.14 ppb yr^{-1}). Aircraft measurements in May-June 2010 indicate the presence of Asian pollution layers 2 km above Joshua Tree National Park with distinct sulfate enhancements coincident with low organic mass (*Lin et al.*, 2012b), supporting the conclusion that rising Asian emissions can contribute to trends of O_3 observed in this region. Yosemite National Park (1.6 km a.s.l.) and Chiricahua National Monument (1.5 km a.s.l.) are also influenced by increases in Asian emissions and concurrent decreases in California. Ozone observed at Yosemite show an increase from 1995 to around 2012 (0.37±0.32 ppb yr^{-1}; **Fig.S7**), which the model attributes to rising background (primarily from trends of Asian emissions; **Table 2**), but observations have remained constant since then, reflecting an offset by O_3 decreases in California (**Fig.4**).

5.2 Projecting western US springtime O_3 for the 21st Century

(Figure 14 about here: Future Projections).

Under the RCP8.5 scenario, Chinese NO_x emissions are projected to peak in 2020-2030, reflecting an increase from year 2010 by ~50% (**Fig.1a),** and global methane increases by

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~60% from 2010 to 2050 (**Fig.S1**). Under the RCP4.5 scenario, in contrast, NO_x emissions in China change little over 2010-2030 and global methane remains almost constant from 2010 to 2050. NO_x emissions in the US decrease through 2050 under both RCP4.5 and RCP8.5, by ~40% from 2010. We examine the extent to which these changes influence trends of springtime O_3 over the WUS. A number of studies have examined future US O_3 changes under the RCPs (e.g., *Gao et al.*, 2013; *Clifton et al.*, 2014; *Pfister et al.*, 2014; *Fiore et al.*, 2015; *Barnes et al.*, 2016). However, as discussed earlier in this study the trends of O_3 in the model when sampled near the surface are overwhelmingly dominated by the trends of US anthropogenic emissions. Thus, the future O_3 changes estimated by these prior studies do not represent baseline conditions, particularly the response to rising Asian emissions. In **Fig. 14** we show changes of free tropospheric (700 hPa) O_3 relative to 2010 over the WUS in the CM3 future simulations under RCP8.5 versus RCP4.5. Historical hindcasts and observations averaged from Lassen, Great Basin, and Rocky Mountain are also shown for context. Under RCP4.5, springtime O_3 over the WUS shows little overall change over 2010-2050. Under RCP8.5, in contrast, springtime O_3 over the WUS increases by ~10 ppb from 2010 to 2030 and remains almost constant from 2030 to 2050, consistent with the projected trend in Asian anthropogenic emissions and global methane.

5.3 Trends and variability of western US O_3 in summer

(Figure 15 about here: Yellowstone)

Yellowstone National Park is the only site with statistically significant summer O_3 increases observed across all percentiles (**Fig.8a-8c**). The 1988-2012 trends for the median from observations and model simulations are summarized in **Figure 15a**. Observations show an increase of 0.32±0.18 ppb yr^{-1} for JJA, with a greater rate of increase in June (0.38±0.25 ppb yr^{-1}) than in July-August (0.26±0.18 ppb yr^{-1}). AM3_BASE sampled at 700 hPa and filtered for baseline conditions (hatched pink bar in **Fig.15a**) captures the observed increase. Without baseline filtering (solid pink bar), North American emission reductions offset almost 50% of the O_3 increase at Yellowstone in the model, causing the model to underestimate the observed O_3 trend. The model attributes much of the observed summertime O_3 increase at Yellowstone to rising Asian emissions, with IAVASIA simulating an O_3 increase of 0.31±0.19 ppb yr^{-1} under baseline conditions, increasing to 0.42±0.23 ppb yr^{-1} when under conditions of Asian influence (EACOt ≥ 67th percentile). The stronger increase measured in June than in July-August is consistent with the seasonality of pollution transport from Asia. In contrast, changes in methane, wildfires and meteorology over this period are of minor importance for the decadal O_3 trends at Yellowstone.

Enhanced wildfire activity in hot and dry weather is thought to be a key driver of interannual variability of surface O_3 in the Intermountain West from summer into fall (*Jaffe et al.*, 2008; *Pfister et al.*, 2008; *Jaffe*, 2011). However, hot and dry conditions also

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facilitate the buildup of O_3 produced from regional anthropogenic emissions, which can complicate the unambiguous attribution of observed O_3 enhancements. Using August data at Yellowstone as an example, we isolate the relative contribution of these two processes to observed O_3 with the IAVFIRE versus FIXEMIS experiments (**Fig.15b**; note that here we sample AM3 at the surface to account for any influence from boundary layer mixing depths). Even with wildfire emissions held constant in time, FIXEMIS captures much of the observed year-to-year variability of August mean O_3 at Yellowstone (r=0.67). IAVFIRE with time-varying fire emissions only moderately improves the correlations (r = 0.75). FIXEMIS also captures the observed O_3 increase from the early 1990s to around 2002, likely reflecting warmer temperature and deeper mixing depths pulling down more baseline O_3 to the surface. Over the entire 1988-2014 (or 1980-2014) period, IAVFIRE gives ~0.1 ppb yr^{-1} greater O_3 trends in August than FIXEMIS, consistent with an overall increase in boreal wildfire activity **(Fig.S2 and Fig.S6b).**

(Figure 16 about here: Wildfires)

Figure 16 shows year-to-year variability in surface MDA8 O_3 enhancements from wildfires during summer, as diagnosed by the differences between IAVFIRE and FIXEMIS. The results are shown for individual months, since fires are highly episodic. During the summers of 1998, 2002, and 2003, biomass fires burned a large area of Siberia and parts of the North American boreal forests, raising carbon monoxide burden across the Northern Hemisphere as detected from space (*Jaffe et al.*, 2004; *van der Werf et al.*, 2010; *Yurganov et al.*, 2005). Long-range transport of the Siberian fire plumes resulted in 2-6 ppb enhancements in surface MDA8 O_3 at the US west coast and in parts of the Intermountain West according to AM3. The model calculates enhancements in monthly mean MDA8 O_3 of up to 8 ppb from the intense wildfire events in Northern California during July 2008 (*Huang et al.*, 2013; *Pfister et al.*, 2013), over Texas-Mexico during June 2011 (*Y Wang et al.*, 2015), and in Wyoming-Utah during August 2012 (*Jaffe et al.*, 2013). The AM3 estimates are roughly consistent with analysis of boundary layer aircraft data with and without fire influences (as diagnosed by CH_3CN) during June 2008 over California (*Pfister et al.*, 2013).

While fires during hot and dry summers clearly result in enhanced O_3 at individual sites for some summers, the ability of AM3 with constant fire emissions to simulate variability of O_3 (±8 ppb) for a high (e.g., 1988; 2002; 2006) versus low (e.g., 1997; 2009) fire activity year (**Fig.15b**) indicates that biomass burning is not the primary driver of summer O_3 interannual variability. Year-to-year variability of JJA mean MDA8 O_3 observed at Yellowstone is strongly correlated ($r > 0.6$) with observed large-scale variations in JJA mean daily maximum temperature across the Intermountain West and the Great Plains (**Fig.15c**). Correlations for other ground stations show a similar large-scale feature. Similar to the conclusion from *Zhang L. et al.* (2014), our analysis indicates that the correlation between O_3 and biomass burned reported by *Jaffe et al.* (2008, 2011) at rural sites reflects common underlying correlations with temperature

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rather than a causal relationship of fire on O_3. At remote mountain sites (e.g., Yellowstone), warmer surface temperatures lead to deeper mixed layers that facilitate mixing of free tropospheric air with higher O_3 concentrations down to the surface (*Brown-Steiner and Hess*, 2011). At sites nearby sources of air pollution, hot conditions enhance regional O_3 production and orographic lifting of urban pollution to mountain-top sites during daytime, as occurs at Rocky Mountain National Park located downwind of the Denver Metropolitan area during summer (**Sect. 5.4**). Baker et al. (2016) found that reactive volatile organic compound (VOC) emissions from fires can enhance O_3 production in NO_x-rich urban areas. Evaluating these impacts needs high-resolution models and better treatment of fire plumes.

5.4 Ozone Trends in the Denver Metropolitan Area

(Figure 17 about here: Denver)

Efforts to improve air quality have led to a marked decrease in high-O_3 events in the Los Angeles Basin as illustrated with annual 4th highest MDA8 O_3 at Crestline – a regionally representative monitor operated continuously from 1980 to present (**Fig.17a**). In striking contrast, the 4th highest MDA8 O_3 in the Denver Metropolitan area shows little change over the past decades, despite significant reductions in NO_x (**Fig.1**) and CO emissions (-80% from 1990-2010; *Cooper et al.*, 2012). Recent field measurements indicates that VOC emissions from increasing oil and natural gas operations are an important source of O_3 precursors in the Denver-Julesberg Basin (*Gilman et al.*, 2013; *Halliday et al.*, 2016; *McDuffie et al.*, 2016). However, total VOC emissions in Denver may not be increasing over time due to the marked reductions in VOC emissions from vehicles (*Bishop and Stedman*, 2008; 2015). We seek insights into the causes of the lack of significant O_3 responses to emission controls in Denver by separately analyzing trends in spring and summer (**Fig.17b-17c**).

The ~200x200 km^2 AM3 simulations are not expected to resolve the urban-to-rural differences between Rocky Mountain National Park and the Denver Metropolitan area. However, if observed O_3 variability in Denver correlates with that at remote sites in the Intermountain West, then model attribution for the remote sites can be used to infer sources of observed O_3 in Denver. This is demonstrated in **Fig.17b** for spring using data at three representative sites in Denver: Rocky Flats North, National Renewable Energy Lab (NREL), and Welby with continuous measurements since the early 1990s. Year-to-year variability of median MDA8 O_3 at these sites during spring correlates strongly with that in Great Basin National Park ($r = 0.7$) - a fairly remote site in Nevada not influenced by urban emissions in Denver. Median spring O_3 observations in Denver increased significantly by ~0.3 ppb yr^{-1} similar to the rate of increase in Great Basin National Park which the model attributes to rising background (**Fig.13a**), implying that the tripling of Asian emissions since 1990 also raised mean springtime O_3 in the Denver Metropolitan area. Trends in the 95th percentile are statistically insignificant.

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During summer, changes in regional emissions and temperature have the greatest impacts on the highest observed O_3 concentrations in polluted environments. **Fig.17c** shows times series of July-August 95th percentile MDA8 O_3 in Denver, together with the distribution of daily maximum temperature. In every year since 1993 the highest summer MDA8 O_3 observed at these sites exceeds the 70 ppb NAAQS level. There is a small negative trend that is swamped by large interannual variability. The summers with the highest observed O_3 coincide with those with the highest observed temperatures, such as 1998, 2003, 2007, 2011 and 2012. During these summers, enhancements of MDA8 O_3 were also recorded at Rocky Mountain National Park, reflecting enhanced lifting of pollution from Denver under warmer conditions (*Brodin et al.*, 2010). Appling quantile regression (e.g., *Porter et al.*, 2015) to daily observations at Rocky Flats North over 1993-2015, we find a 2 ppb °C^{-1} sensitivity of 95th percentile July-August O_3 to changes in maximum daily temperature. We suggest that the substantial increases in extreme heat occurrence over central North America over the last two decades, as found by *Horton et al.* (2015), contribute to raising summer O_3 in Denver, which offsets O_3 reductions that otherwise would have occurred due to emission controls in Denver. Potential shifts in the O_3 photochemistry regime can also contribute to trends of summer O_3 in Denver, although advancing this knowledge would require a high-resolution air quality model.

6. Summer O_3 pollution extremes over the eastern US

(Figure 18 about here: Interannual Variability)

We discuss in this section interannual variability and long-term changes in summer O_3 over the EUS, where air stagnation and high temperatures typically yield the highest O_3 observed in surface air (e.g., *Jacob and Winner 2009*). Evaluating the ability of models to simulate the high-O_3 anomalies during large-scale heat waves is crucial to establishing confidence in the model projection of pollution extremes under a warming climate. **Figure 18** shows comparisons of July mean MDA8 O_3 at one regionally representative site – the Pennsylvania State CASTNet site - as observed and simulated by the model. With time-varying emissions, the BASE model simulates an O_3 decrease (-0.45±0.32 ppb yr^{-1}) consistent with observations (-0.67±0.33 ppb yr^{-1}), and captures the observed July mean O_3 interannual variability (r = 0.82) that is correlated with large-scale variations in daily maximum temperature (r = 0.57). In particular, the O_3 pollution extremes are successfully simulated during the EUS summer heat waves of 1988, 1999, 2002, 2011 and 2012 (*Leibensperger et al.*, 2008; *Fiore et al.*, 2015; *Jia et al.*, 2016). Year-to-year variations in such air stagnation events can explain 30% of the total observed O_3 variability (r = 0.55), as inferred by FIXEMIS with constant anthropogenic emissions. If US anthropogenic emissions remained at 1990s levels (as in FIXEMIS), then anomalies in July mean MDA8 O_3 would have been 10 ppb greater during the 2011 and 2012 heat waves. *Loughner et al.* (2014) found that half of the days in July 2011 would have been classified as O_3 exceedance days for much of the mid-Atlantic region if emissions had not

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declined.

(Figure 19 about here: Changes in O_3 distribution)

Figure 19a compares the probability density functions of MDA8 O_3 at 40 EUS surface sites for JJA in the pre-NO_x SIP Call (1988-2002) versus post-NO_x SIP Call (2003-2014) periods and during the extreme heat waves of 1988 versus 2012. Following the NO_x SIP Call, observed JJA MDA8 O_3 over the EUS manifested a downward shift in the probability distribution (black vs. gray lines in **Fig.19a**), with the median value declining by 9 ppb and the largest decreases occurring in the upper tails, leading to weaker day-to-day O_3 variability and a narrower O_3 range (standard deviation σ decreased from 16.4 to 12.9 ppb). Using fewer data in 1995-1998 vs. 2002-2005, *Rieder et al.* (2015) also noted a shift in the O_3 distribution. These observed O_3 changes driven by regional NO_x reductions are even more prominent when comparing the heat waves of 1988 versus 2012 (red vs. brown lines in **Fig.19a**): σ = 22.3 vs. 13.4 ppb and median value μ= 68.6 vs. 52.2 ppb. Regional emission reductions significantly alleviated the O_3 buildup during the 2012 heat wave relative to earlier heat waves.

Fig.19b shows the corresponding comparisons using the results from AM3 BASE. Despite the high mean model bias (~20 ppb), AM3 captures the overall structure of the changes in the surface O_3 distributions and thus the response of surface O_3 to the NO_x SIP Call, including the reductions of high-O_3 events during the heat wave of 2012 compared to 1988. Nevertheless, there is a noticeable difference between the observations and simulations in the shape of MDA8 O_3 probability distributions for summer 1988, particularly in the upper tail of the distribution (red lines in **Figs.19a vs. 19b**). One possible explanation for this bias is that the 1988 heat wave coincided with severe drought conditions (*Seager and Hoerling*, 2014), which can effectively "turn off" the O_3 deposition sink to vegetation, leading to a substantial increase in surface O_3 concentrations as found during the 2003 European heat wave (*Solberg et al.*, 2008; *Emberson et al.*, 2013), whereas AM3 does not include interannually varying dry deposition velocities for O_3. Quantile mapping can be applied to correct systematic distributional biases in surface O_3 compared to observations (*Rieder et al., 2015*), but this approach has limitations if there are structural biases in the O_3 distribution due to missing physical processes in the model.

Travis et al. (2016) suggest that the National Emission Inventory (NEI) for NO_x from the US EPA is too high nationally by 50% and that decreasing US NO_x emissions by this amount corrects their model bias for boundary layer O_3 by 12 ppb in the Southeast for summer 2013, while surface MDA8 O_3 in their model is still biased high by 8±13 ppb, which the authors attribute to excessive boundary layer mixing. US NO_x emissions in the emission inventory used in AM3 (Sect. 2.2) are approximately 15% lower than those from the NEI. The 35% decrease in NO_x emissions from the pre-NO_x SIP Call to the post-NO_x SIP Call in the model reduces mean O_3 by 8 ppb in the EUS, implying that the NO_x emission bias could correct 40% of our model mean bias of ~20 ppb. These

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estimates support the idea that the common model biases in simulating surface O_3 over the Southeast US (e.g., *Fiore et al.*, 2009) may partly reflect excessive NO_x emissions. Some of the positive O_3 biases could be also due to the averaging over a deep vertical box in the model surface layer that can't resolve near-surface gradients.

7. Conclusions

(Figure 20 about here: 2003-2012 minus 1981-1990)

Through a comprehensive analysis of interannual variability and long-term trends in sources of O_3 over the past 35 years, we have discussed the key factors controlling US O_3 pollution. In **Fig.20**, we summarize the overall statistics, drawing upon the decadal mean MDA8 O_3 changes from 1981-1990 to 2003-2012 in the AM3 BASE and sensitivity simulations. The changes in BASE are: over the WUS 4.3±1.8 ppb for spring and 1.6±1.2 ppb for summer; over the Northeast -1.8±1.7 ppb for spring and -6.0±2.0 ppb for summer; over the Southeast -3.9±1.4 ppb for spring and -7.5±1.6 ppb for summer. Increasing O_3 under BASE for the WUS coincides with an increase of background O_3 by 6.3±1.9 ppb for spring and 4.2 ±2.0 ppb for summer. Under conditions of strong transport from Asia, the background trend rose to 7.6±2.2 ppb for spring and 6.0 ±2.1 ppb for summer (green dots in **Fig.20**). The background O_3 increase in the WUS reflects the contribution from increases in Asian anthropogenic emissions (accounting for 50% of background increase in spring; 52% in summer), rising global methane (13% in spring; 23% in summer), and variability in biomass burning (6% in spring; 12% in summer; with the meteorological influence subtracted out). We conclude that rising Asian anthropogenic emissions are the major driver of increasing background O_3 over the WUS for both spring and summer. Methane increases contribute to a much lesser extent than rising Asian emissions.

As a first step towards assessing the impacts of rising Asian emissions, we evaluated trends of surface and free tropospheric O_3 over Asia. Our synthesis of available observations and model simulations indicates that O_3 over East Asia has increased by 1-2 ppb yr^{-1} since 1990 (i.e., 25-50 ppb over 25 years), with significant implications for regional air quality and global tropospheric O_3 burden (**Figs.4-6**). We find 0.2 -0.5 ppb yr^{-1} increases in median springtime MDA8 O_3 measured at 50% of sixteen WUS rural sites, with 25% of the sites showing increases across the entire O_3 concentration distribution (**Fig. 7**). With a novel baseline sampling approach, we show that the GFDL-AM3 model captures these increases (Fig.13). The tripling of Asian NO_x emissions since 1990 contributes to as much as 65% of modelled springtime background O_3 increases (0.3-0.5 ppb yr^{-1}) over the WUS, outpacing O_3 decreases resulting from U.S. domestic emission controls (**Table 2 and Fig.10**). Springtime O_3 observed in the Denver and Colorado Springs metropolitan areas has increased at a rate similar to those at remote rural sites (**Fig. 17b**). We further show that mean springtime O_3 above the WUS would increase by ~10 ppb from 2010 to 2030 under the RCP8.5 global change scenario but would remain constant throughout 2010 to 2050 under the RCP4.5 scenario (**Fig.14**).

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During summer, rising Asian anthropogenic emissions over 1988-2014 approximately offset the effects of US domestic emission controls, leading to weak or insignificant O_3 trends observed at most WUS rural sites (**Figs.8 and 11**). Rising Asian emissions contribute to observed increases (0.3 ppb yr^{-1}) in summertime O_3 at Yellowstone National Park. While wildfire emissions can result in 2-8 ppb enhancements to monthly mean O_3 at individual sites in some summers, they are not the primary driver of observed O_3 interannual variability over the Intermountain West (**Figs.15 and 16**). Instead, boundary layer depth, high temperatures and the associated buildup of O_3 produced from regional anthropogenic emissions contribute most to observed year-to-year variability of O_3 in summer. We find that summertime O_3 measured in the Denver Metropolitan area frequently exceeds the 70 ppb NAAQS level during pollution episodes, with little overall trend despite stringent precursor emission controls (**Fig.17c**), which likely reflects the influence from more frequent occurrences of hot extremes in the last decade.

In contrast to the WUS, the observed trends of surface O_3 in the EUS are overwhelmingly dominated by decreases in regional anthropogenic emissions. Following the NO_x SIP Call, surface O_3 over the EUS manifested a downward shift in the probability distribution, with the largest decreases occurring in the highest percentiles during summer (-0.8 to -1.8 ppb yr^{-1}; **Fig.8**). Spatially, the O_3 decreases are most pronounced in the Southeast with an earlier onset of biogenic isoprene emissions and NO_x-sensitive O_3 production. Regional NO_x controls also alleviated the O_3 buildup during the recent heat waves of 2011 and 2012 relative to earlier heat waves (Figs. 18 and 19). Despite high mean state biases, the model captures the salient features of observed O_3 trends over the EUS, including the largest summertime decreases in the 95th percentile, the north-to-south gradient in springtime O_3 trends, as well as wintertime increases in the 5th and 50th percentiles. The model also captures enhancements in monthly mean O_3 due to large-scale heat waves. Without anthropogenic emission controls, the 95th percentile summertime O_3 over the EUS would have increased by 0.2-0.4 ppb yr^{-1} over 1988-2014 (**Fig.11c**), due to more frequent hot summer extremes and increases in biogenic isoprene emissions over this period **(Fig.12),** which may have offset some of air quality improvements gained from regional NO_x reductions.

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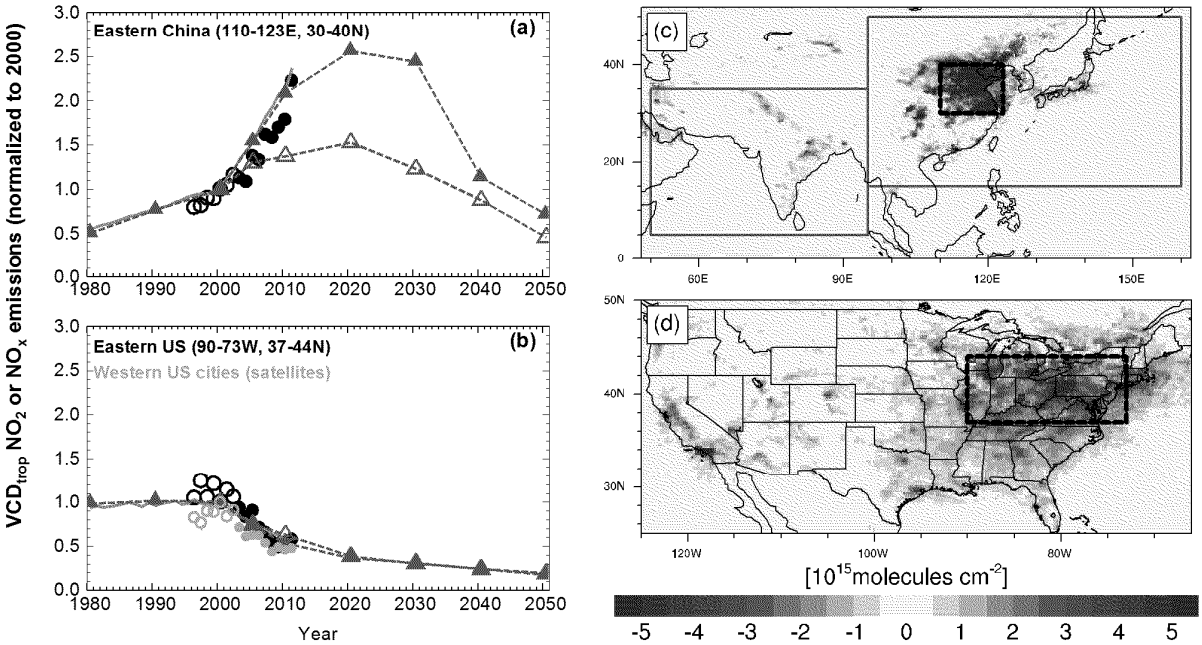

Figure 1. Changes in NO_x emissions. (a-b) Mean annual vertical column densities of tropospheric (VCD_{trop}) NO_2 normalized to year 2000 for the Eastern China and Eastern US domains (black boxes on map) from GOME (1996-2002, open circles) and SCIAMACHY (2003-2011, closed circles) measurements and AM3_BASE simulations (orange lines). Triangles indicate trends in NO_x emissions (normalized to 2000) from Lamarque et al. (2010) with annual interpolation after 2000 to RCP8.5 (red) versus RCP4.5 (blue). (c-d) Differences in annual mean SCIAMACHY VCD_{trop} NO_2 from 2003-2005 to 2009-2011. The red boxes denote the regions where emissions vary over time in the IAVASIAsimulation (Table 1). Satellite NO_2 data are from www.temis.nl, with retrieval technique described in Boersma et al.(2004).

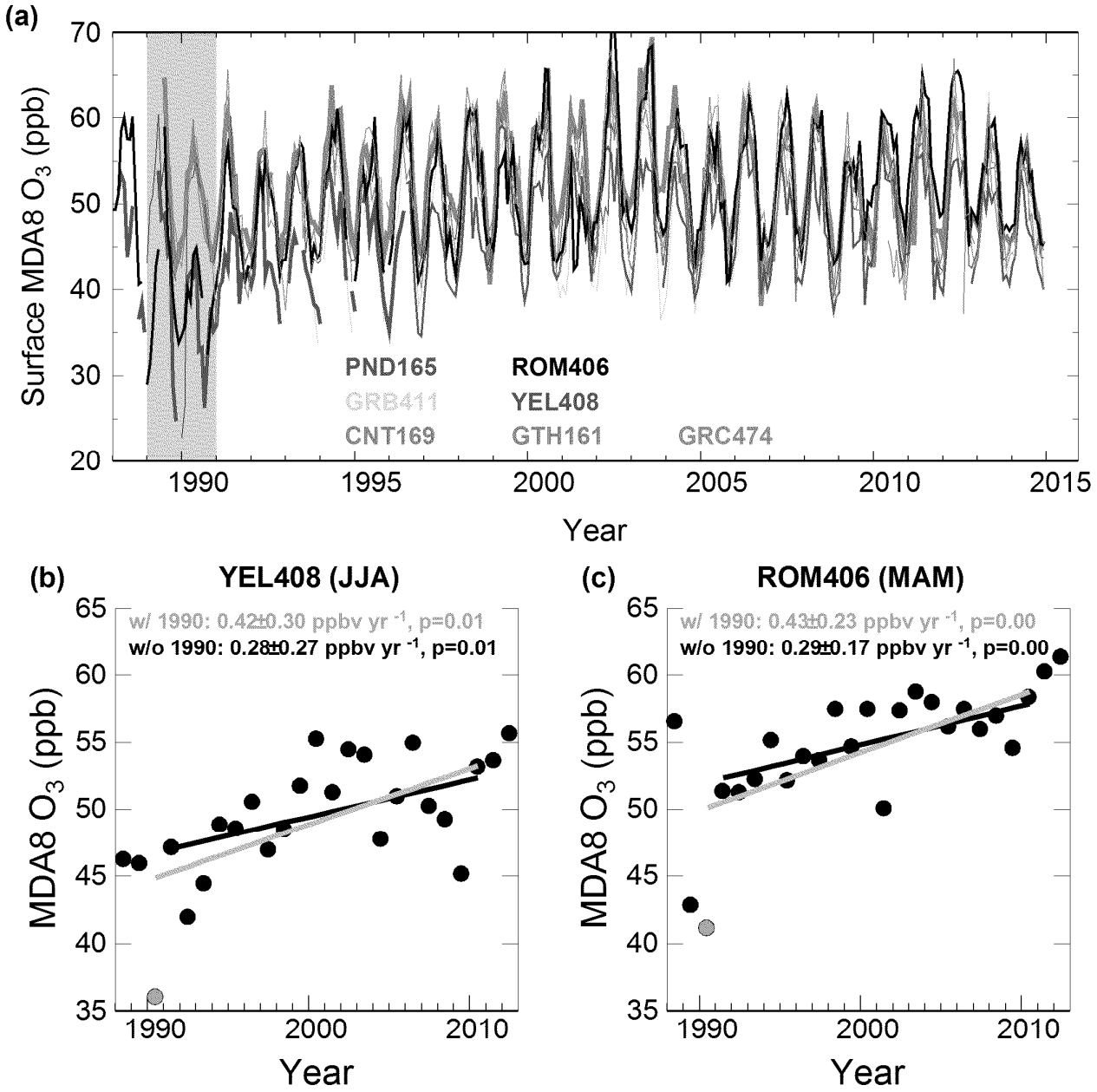

Figure 2. Measurement uncertainties. (a) Comparison of observed monthly mean MDA8 O_3 at WUS CASTNet sites. All sites have more than 90% data availability in every month shown. The grey shading denotes the period when data at Yellowstone (red) and Rocky Mountain (black) were inconsistent with the other sites. (b-c) The 1990-2010 trends of median JJA MDA8 O_3 at Yellowstone and median MAM MDA8 O_3 at Rocky Mountain with and without data in 1990.

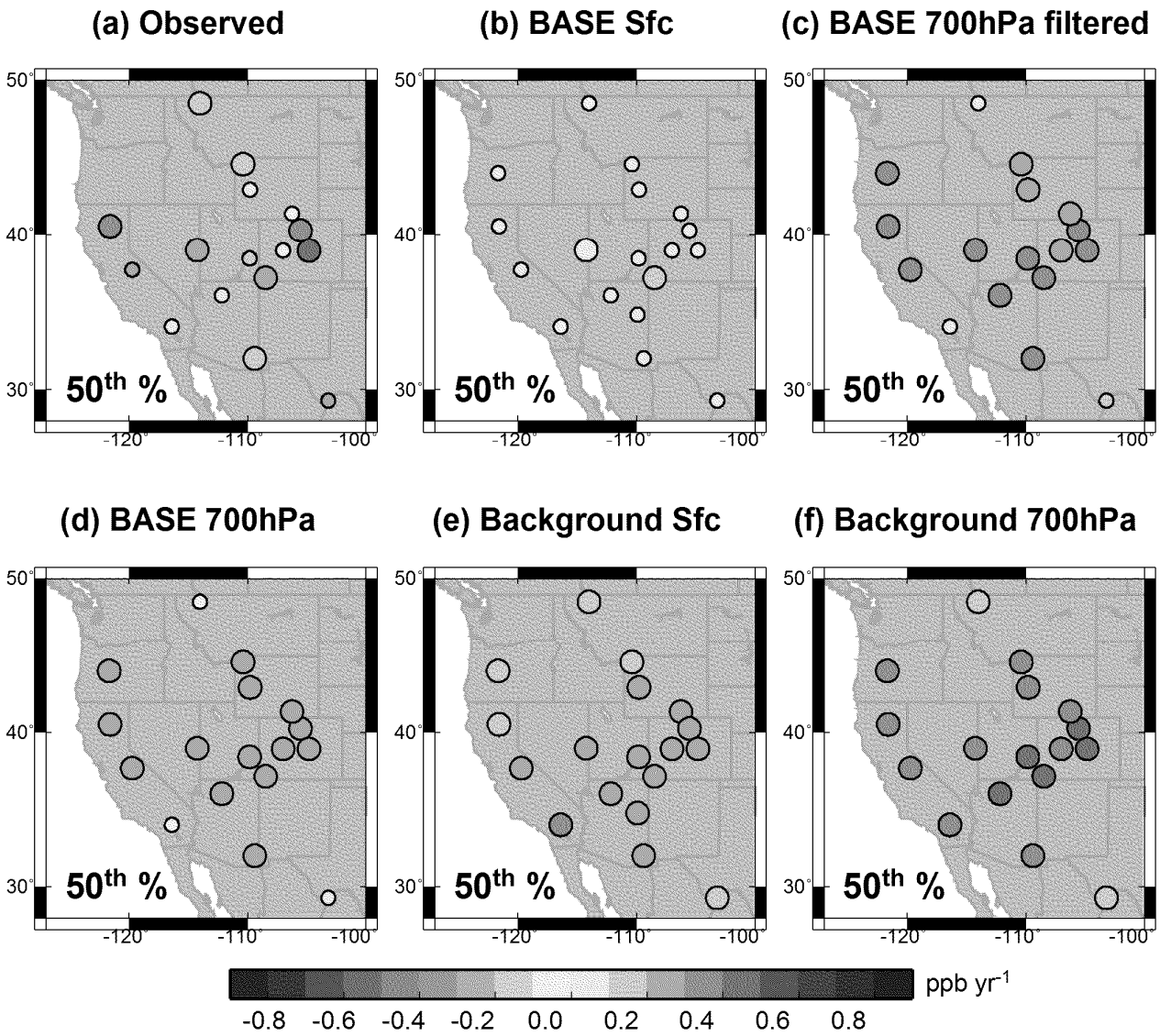

Figure 3. Influence of baseline sampling. Median spring MDA8 O_3 trends over 1988-2014 at WUS sites from: (a) Observations; (b) BASE model sampled at the surface; (c) BASE sampled at 700 hPa and filtered to remove the influence from fresh local pollution (see Sect. 2.4); (d) BASE sampled at 700 hPa without filtering; and (e-f) Background (with North American anthropogenic emissions shut off) sampled at the surface versus at 700 hPa. Note that three low-elevation (<1.5 km) sites Joshua Tree, Big Bend and Glacier National Parks are always sampled at the surface. Larger circles indicate sites with statistically signficant trends ($p<0.05$).

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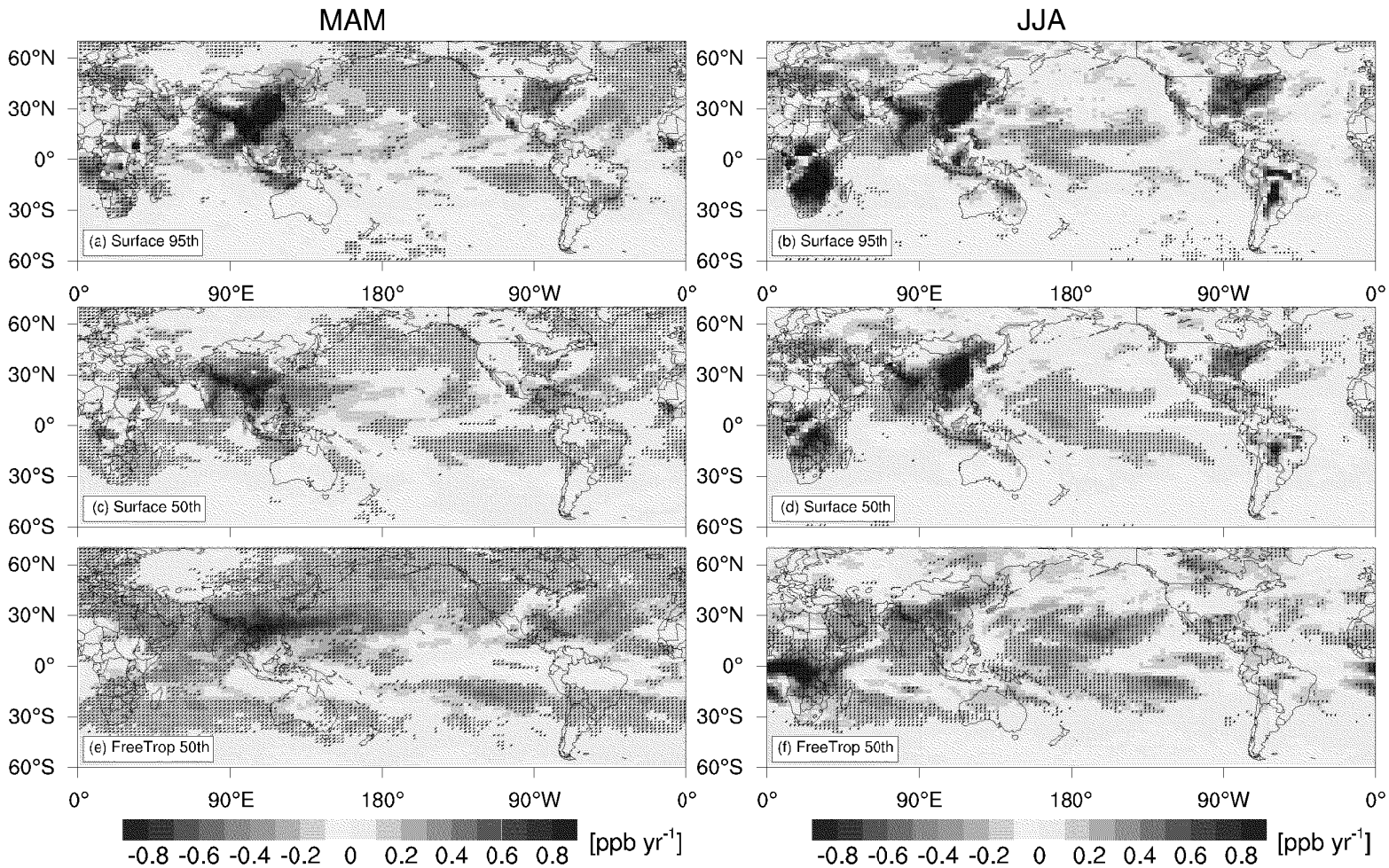

Figure 4. Global distribution of MDA8 O_3 trends from AM3_BASE over 1988-2014 for boreal spring (left) and summer (right) for the 95th percentile at the surface (a-b), median at the surface (c-d), and median in the free troposphere (700 hPa; e-f). Stippling indicates areas where the trend is statistically significant ($p<0.05$). The color scale is designed to resolve regional features rather than extreme values and saturates. The range of trends is -1 to +2.5 ppb yr^{-1}.

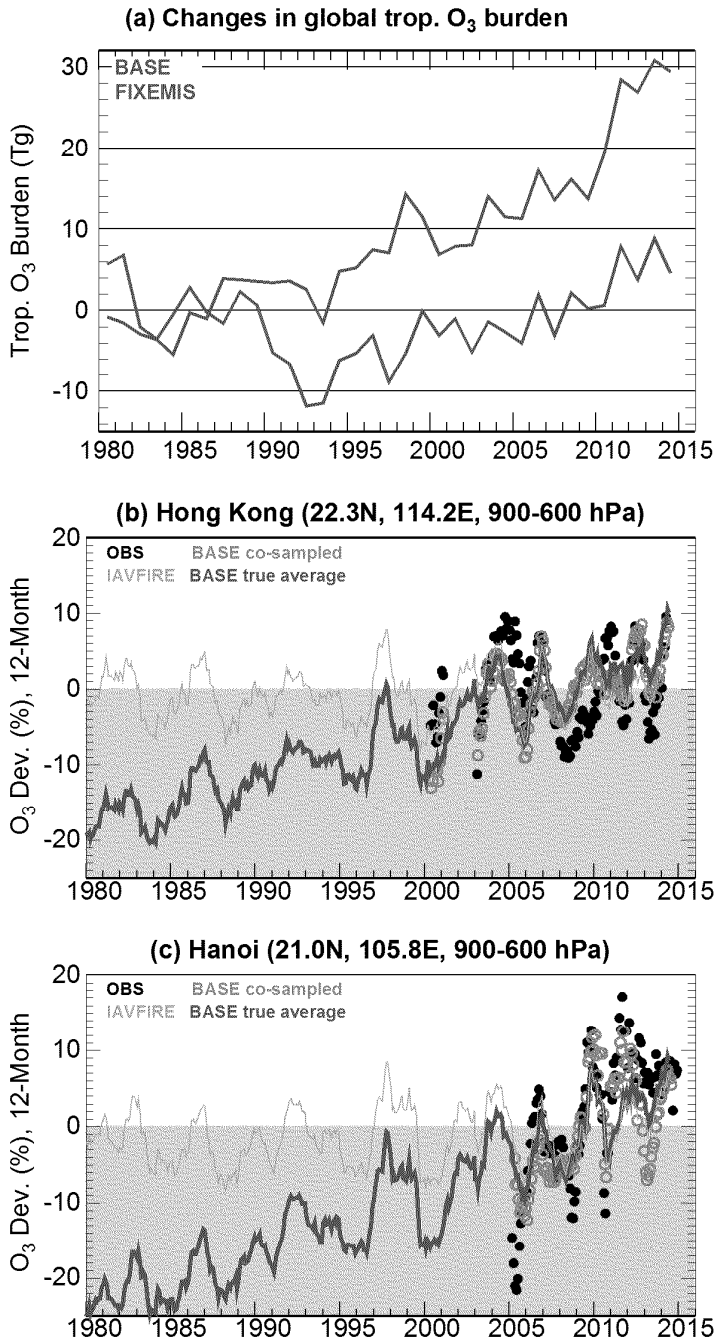

Figure 5. (a) Time series of changes in global tropospheric O_3 burden relative to the 1981-1990 mean from BASE and FIXEMIS simulations (Table 1). (b) Time series of 12-month running mean anomalies (in percent relative to the 2005-2014 mean) of O_3 averaged over 900-600 hPa at Hong Kong from: the averages of ozonesonde samples (black circles) and BASE model co-sampled on sonde launch days (orange circles) versus the true average from BASE and IAVFIRE with continuous daily sampling (solid lines). (c) Same as (b) but for Hanoi.

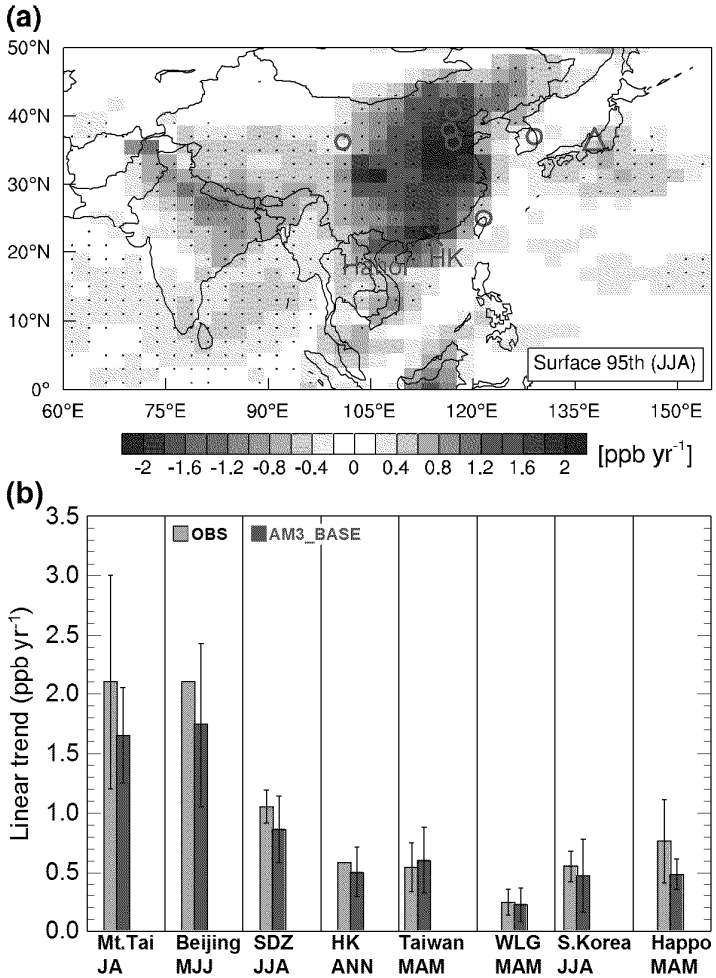

Figure 6. Surface O_3 trends in Asia. (a) Observation sites superimposed on a map of the 95th percentile summer MDA8 O_3 trends over 1995-2014 from AM3_BASE. (b) Comparison of median O_3 trends from AM3 (1995-2014) with observations (see text for periods): in Central Eastern China at Mt. Tai (July-August, Sun et al. 2016), Beijing (May-June-July, Ding et al. 2008) and Shangdianzi (SDZ) (JJA, Ma et al. 2016); in South China at Hong Kong (HK) (annual average, Wang et al. 2009) and Taiwan (MAM, Lin YK et al. 2010); at Mt. Waliguan (WLG) in western China (MAM, Xu et al. 2016); at South Korea (JJA, Lee et al. 2013) and Mt. Happo Japan (MAM, Tanimoto 2009). For Mt. Happo (triangle on map) AM3 is sampled at 700 hPa and filtered for the influence from Asian continental air - more representative of observed baseline conditions.

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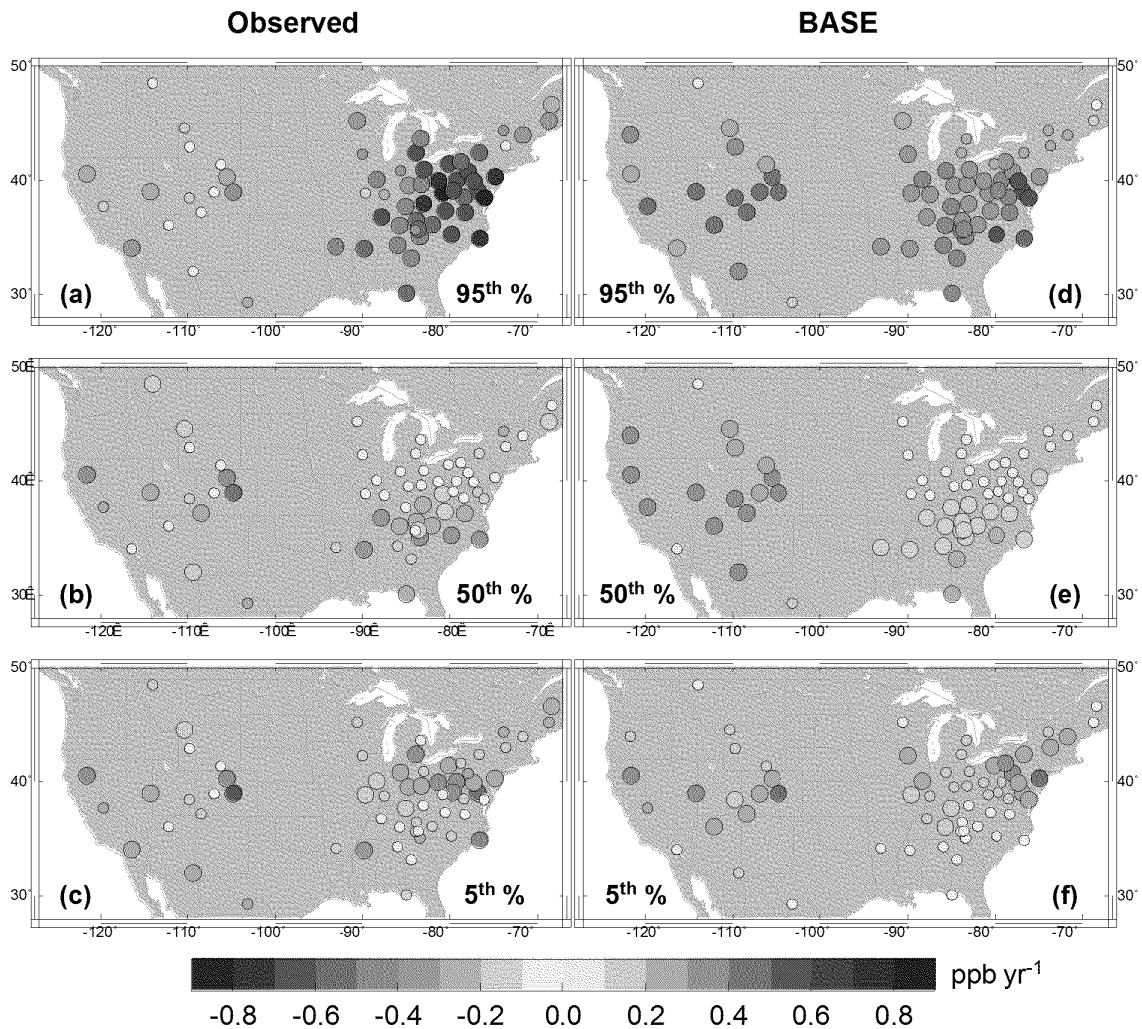

Figure 7. Linear trends in spring (MAM) MDA8 O_3 over 1988-2014 at US rural sites for the 95th, 50th, and 5th percentiles as observed (left) and simulated (right) in AM3 BASE. Larger circles indicate sites with statistically significant trends ($p<0.05$). For WUS high-elevation sites, the model is sampled at 700 hPa and filtered to remove local influence (see text in Sect. 2.4).

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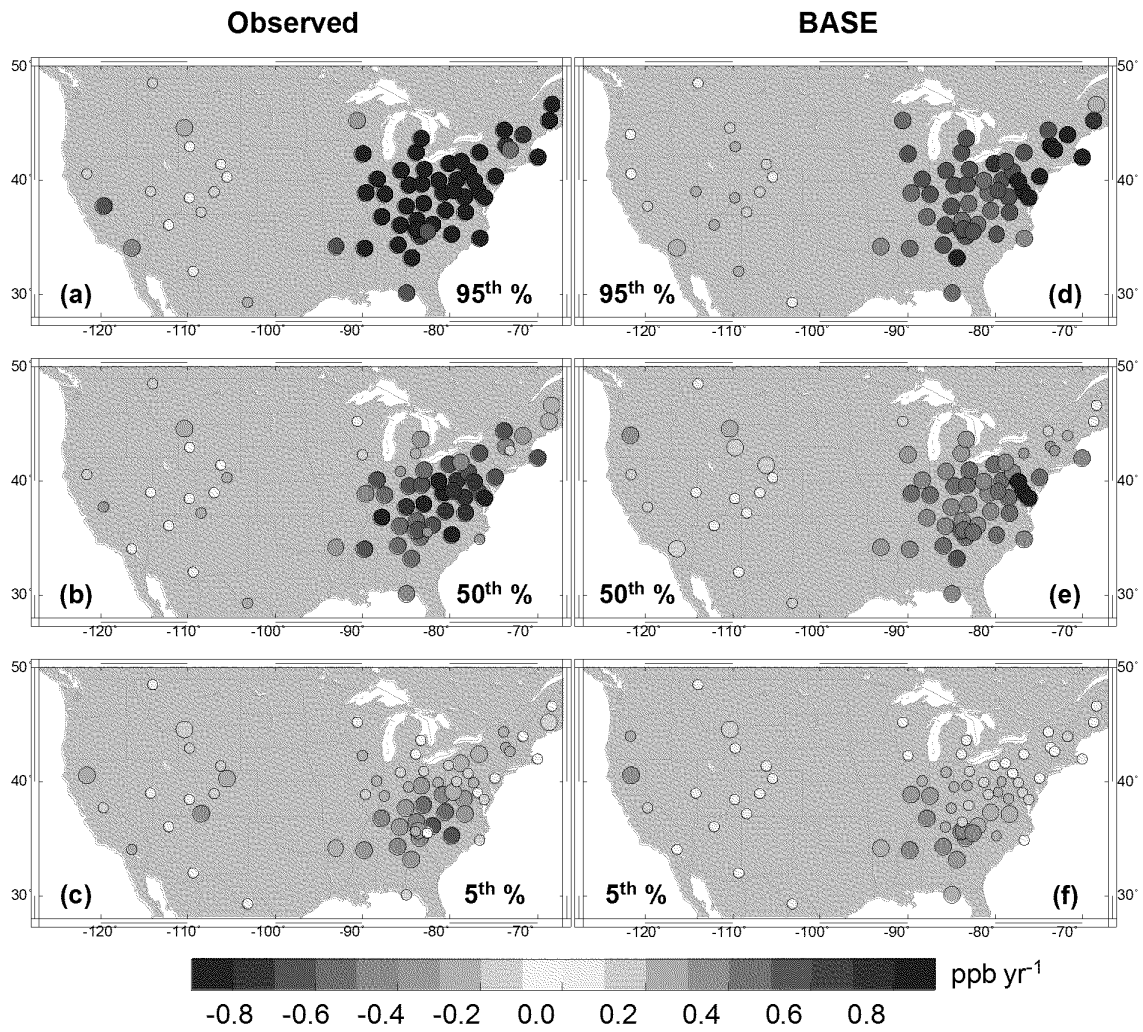

Figure 8. As in Figure 7, but for summer (JJA). Note that the colorbar saturates at -0.8.

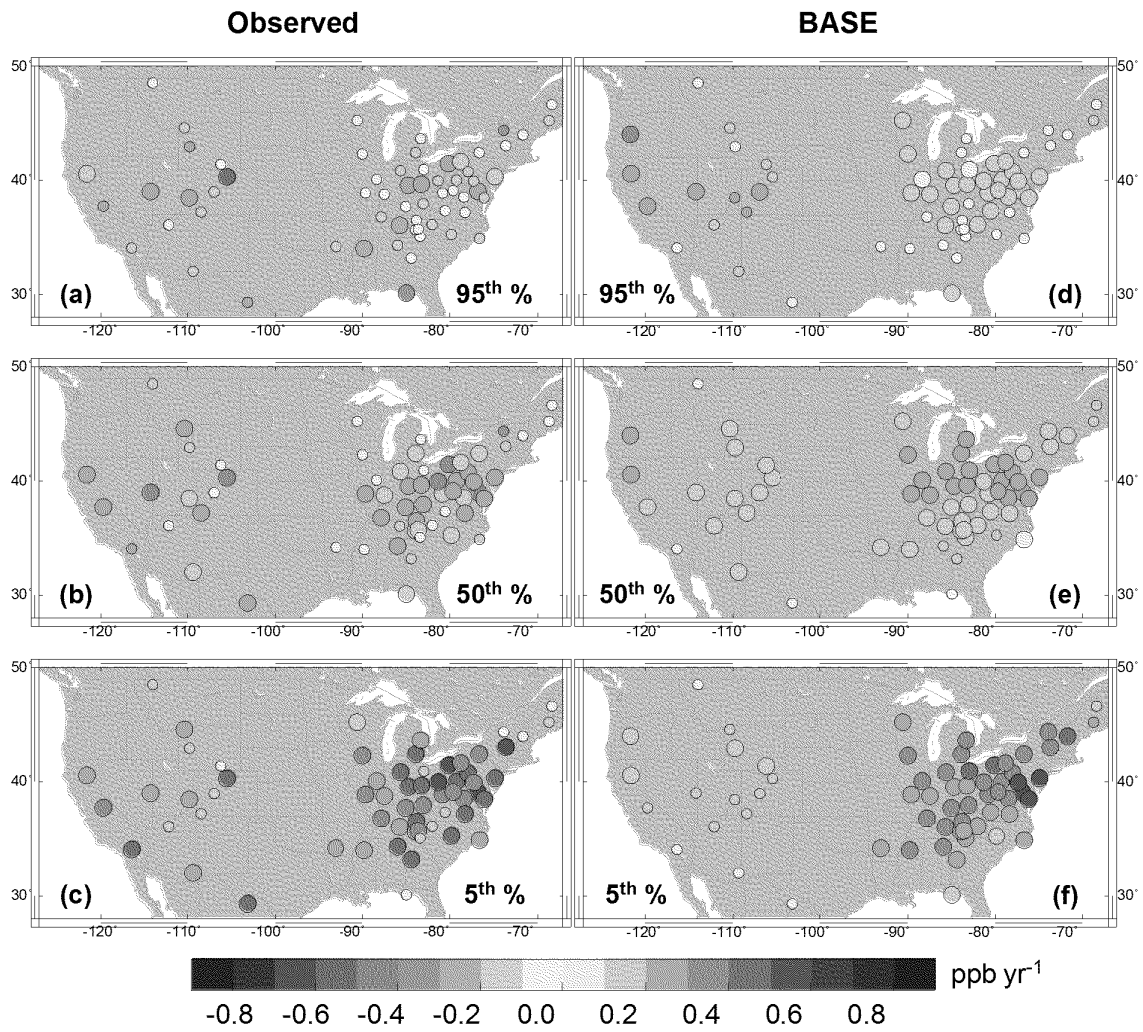

Figure 9. As in Figure 7, but for winter (DJF).

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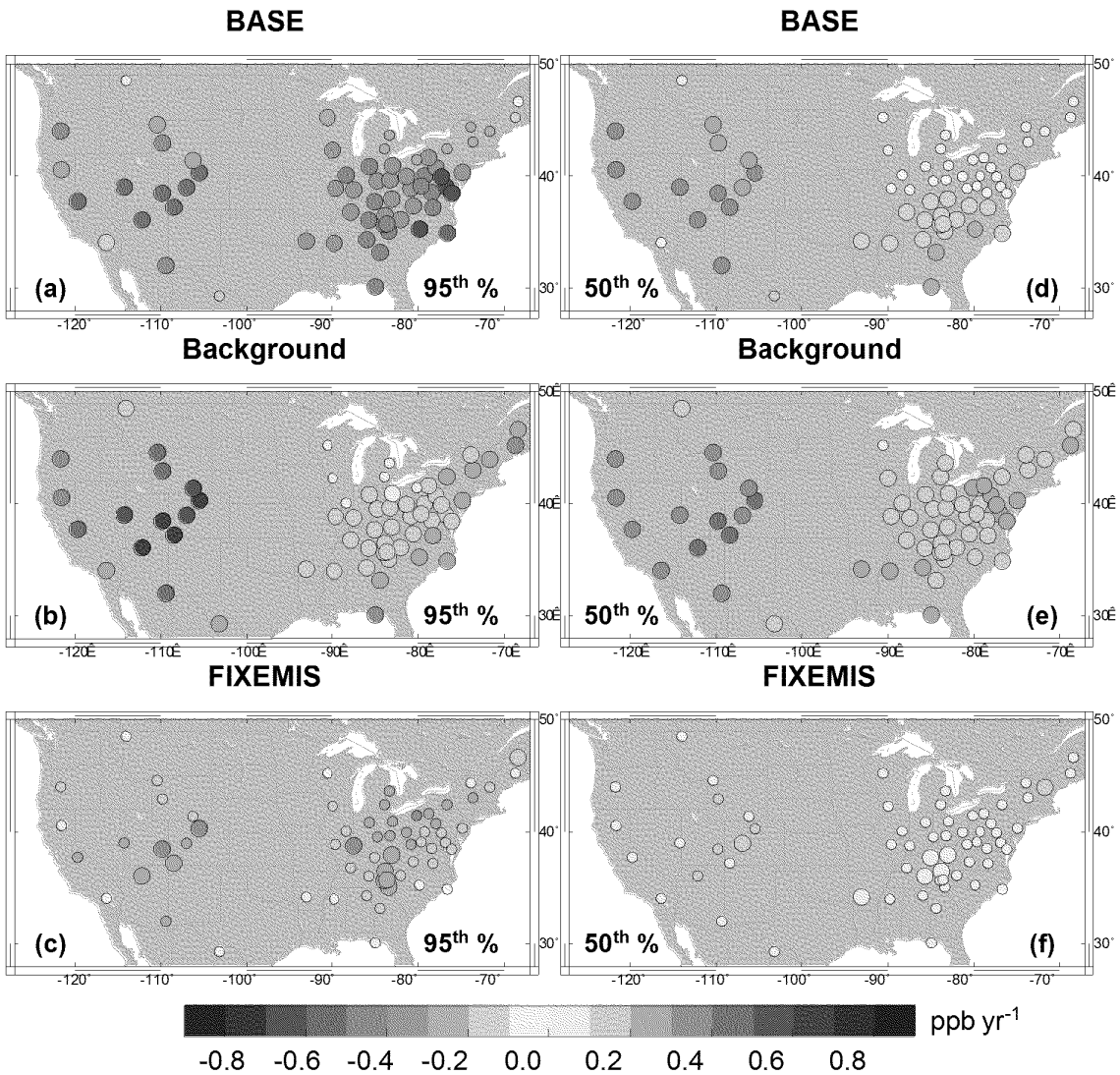

Figure 10. Linear trends in the 95th (left) and 50th (right) percentile springtime MDA8 O_3 over 1988-2014 at US rural sites from BASE (top), Background (middle) and FIXEMIS simulations (bottom). Larger circles indicate sites with statistically significant trends ($p<0.05$). Top panels are repeated from Fig.7d,e. Note that the 95th (50th) percentile is sampled seperately from the Background and FIXEMIS simulations without depending on the times when the BASE simulation is experiencing the 95th (50th) percentile days.

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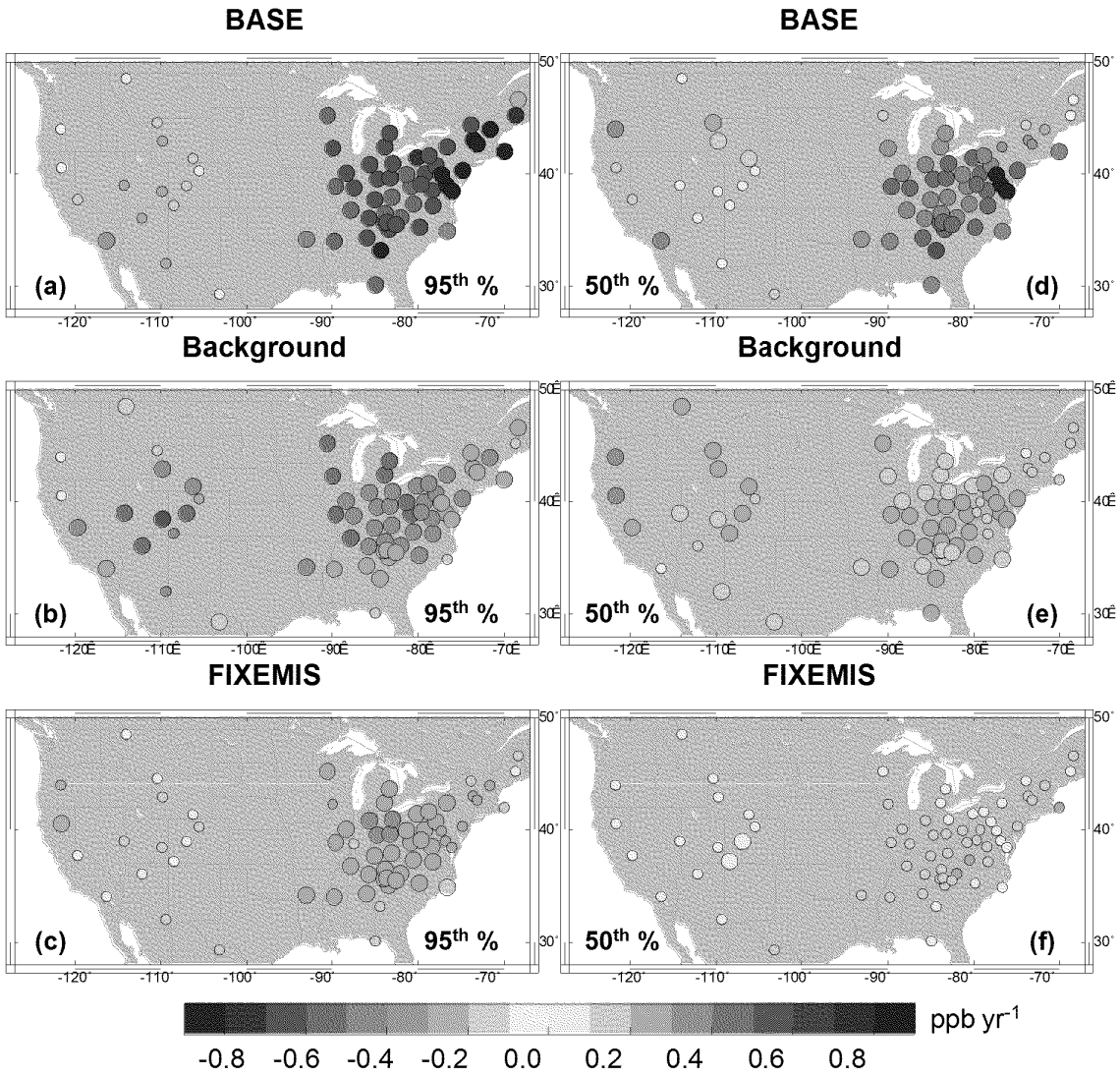

Figure 11. As in Figure 10, but for summer. Top panels are repeated from Fig. 8d,e.

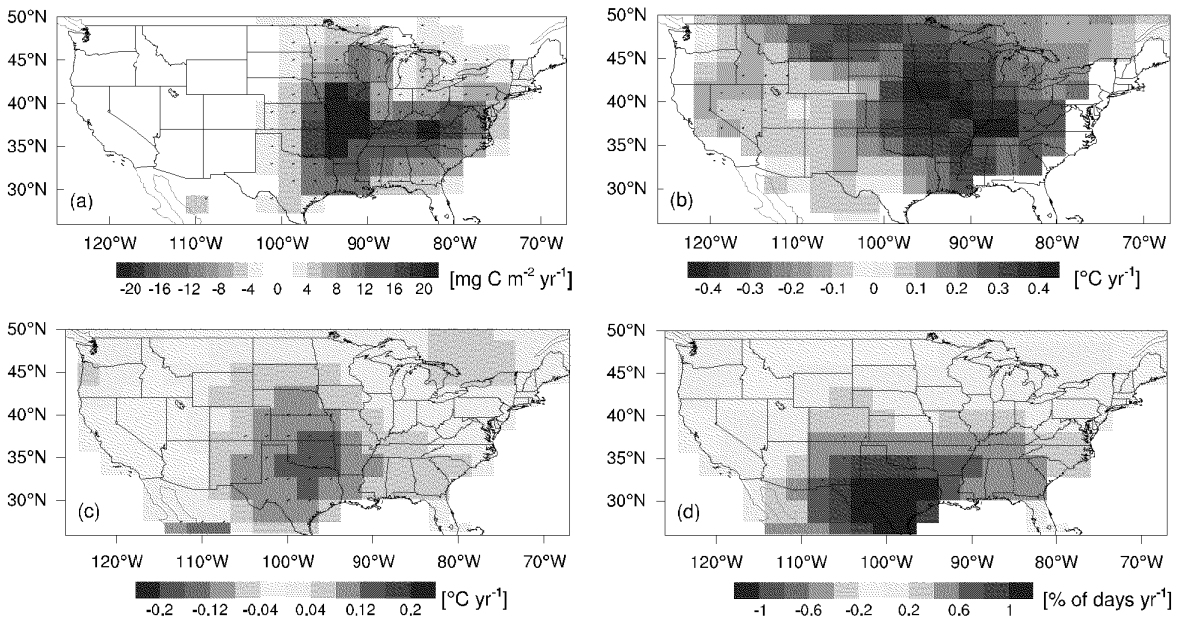

Figure 12. The 1990-2012 trends in: (a) model JJA total biogenic isoprene emissions; (b) model 90th percentile JJA daily maximum temperature; (c) the warmest daily maximum temperature and (d) the frequency of warm days (i.e., those above the 90th percentile for the base period 1961-90) for August obtained from GHCNDEX dataset (Donat et al., 2013; available at http://www.climdex.org/view_download.html). Stippling denotes areas where the change is statistically significant ($p<0.05$). Note that the trends are calculated for the 1990-2012 period, instead of 1988-2014, to avoid the influence from hot extremes in 1988 and cold conditions in 2014 (Sect. 6). When these years are included, the trends in (c) and (d) are swamped by the anomalies. The trends in (a) and (b) are similar between 1990-2012 and 1988-2014.

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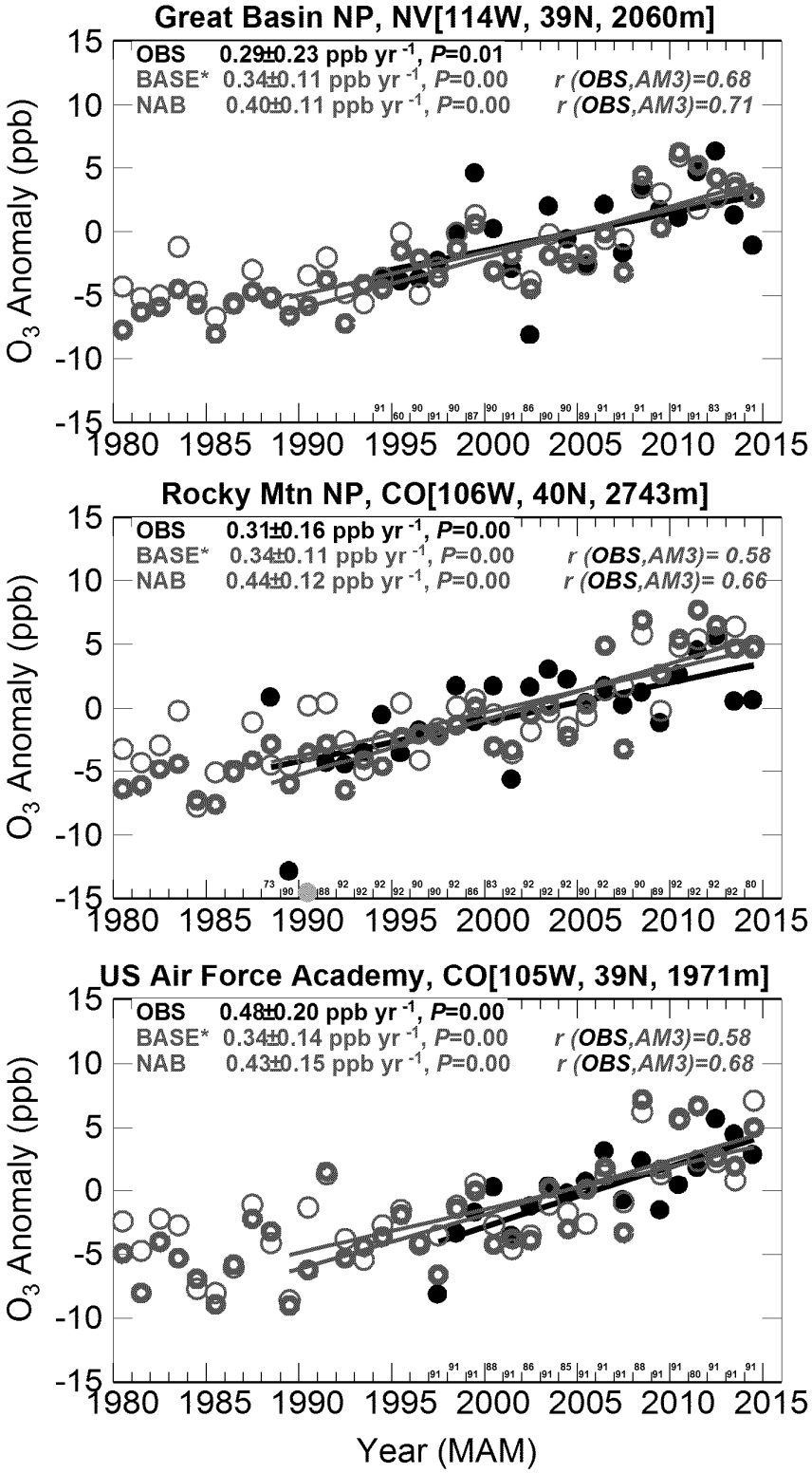

Figure 13a. Time series of median spring MDA8 O_3 anomalies (relative to the 1995-2014 mean) at Great Basin, Rocky Mountain, and US Air Force Academy as observed (black) and simulated in AM3_BASE filtered for baseline conditions (red, see Sect.2.4) and in Background with North American anthropogenic emissions zeroed out (NAB; green). Presented on the top of the graph are statistics from the linear fit and correlations between observations and simulations. Numbers on the bottom of the graph denote the sample size of observations for each year. Grey dots indicate uncertain observations that are removed from the linear fit (see Sect. 2.3).

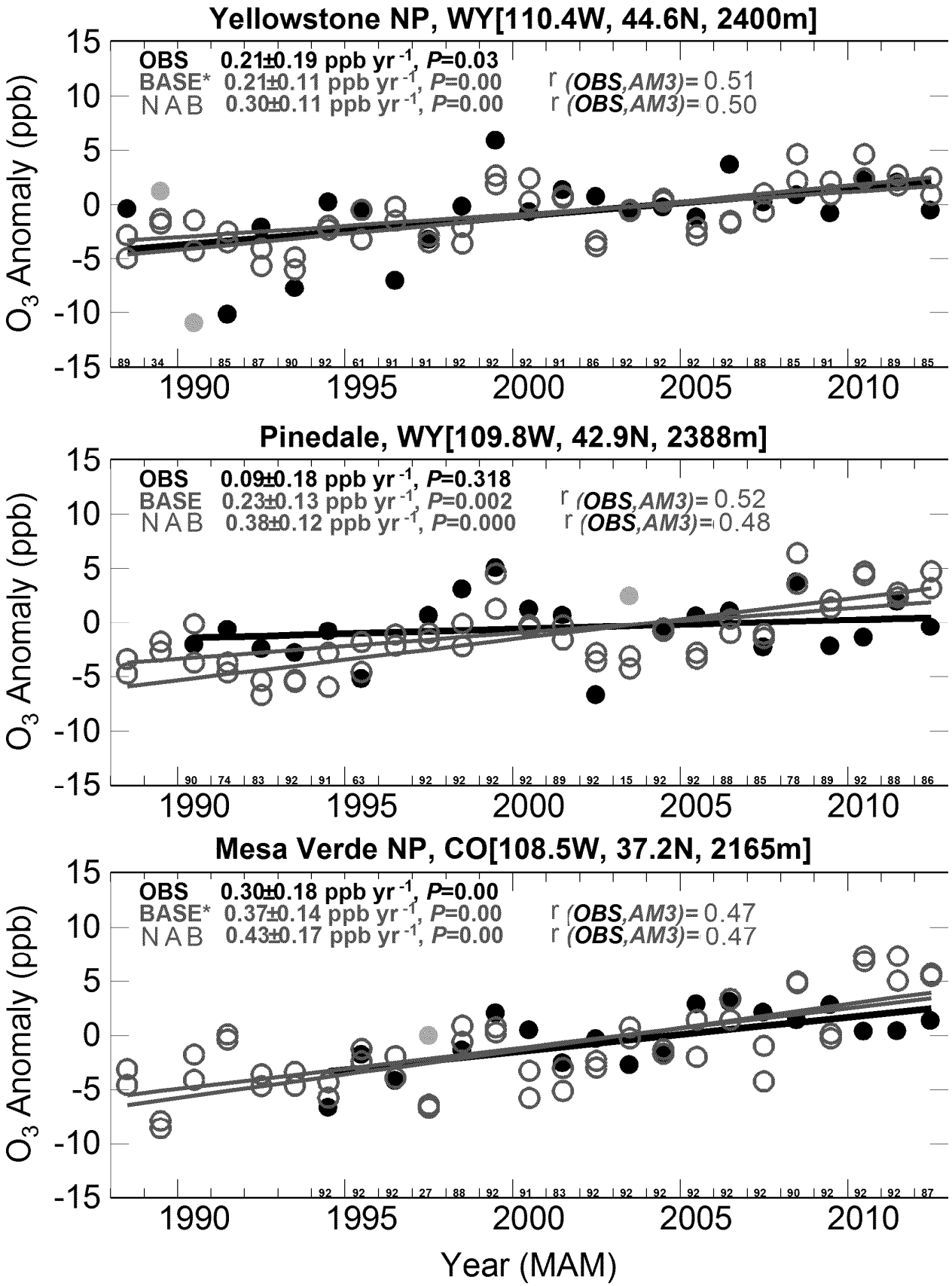

Figure 13b. Same as Figure 13a, but for Yellowstone, Pinedale, and Mesa Verde over the period 1988-2012.

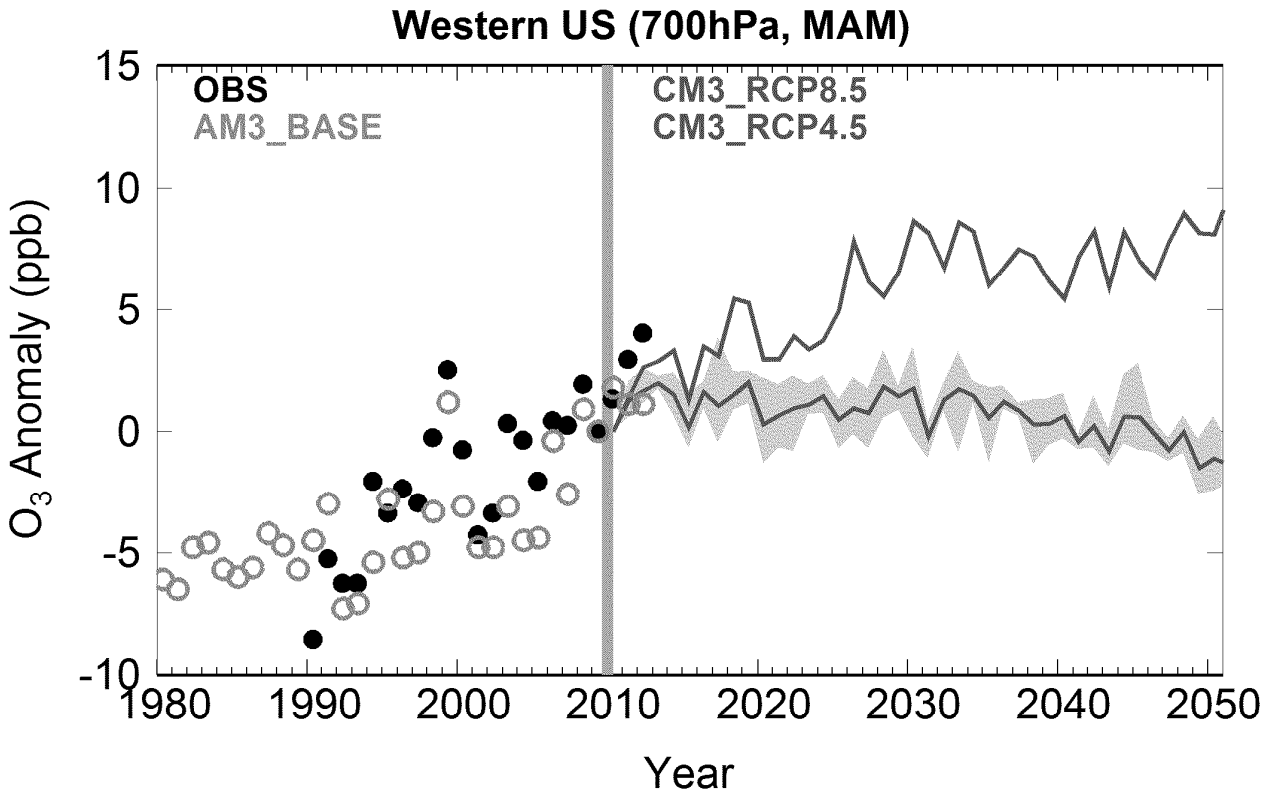

Figure 14. Future projections. Time series of median springtime O_3 changes relative to 2010 over the WUS (35-45N,120-105W) in GFDL AM3 hindcast (orange circles) and CM3 future simulations for RCP8.5 (red) and RCP4.5 (blue; shading represents the range of three ensemble members). Black circles indicate observed changes averaged from Lassen, Great Basin, and Rocky Mountain National Parks.

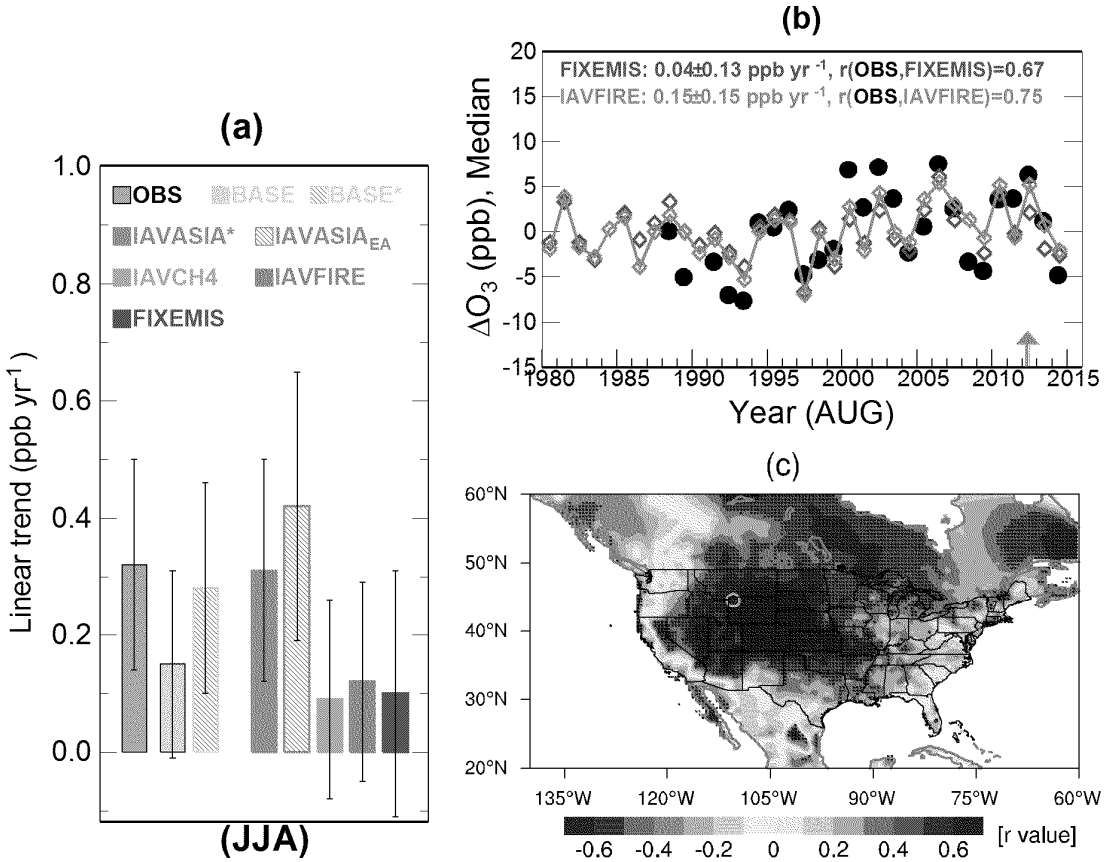

Figure 15. Variability and trends of summertime O_3 at Yellowstone National Park. (a) Median JJA MDA8 O_3 trends over 1988-2012 at Yellowstone from observations (black) and simulations sampled at 700 hPa for BASE without filtering (pink), BASE filtered for baseline conditions (hatched pink), IAVASIA (solid purple, baseline), IAVASIA filtered for Asian influence (EACOt≥67th, hatched purple), IAVCH$_4$ (cyan), IAVFIRE (orange) and FIXEMIS (red). (b) Time series of anomalies in August median MDA8 O_3 at Yellowstone as observed (black) and simulated by the model sampled at the surface, with constant (red) and time-varying wildfire emissions (orange). Trends in (b) are reported for the 1988-2014 period. (c) Interannual correlations of JJA mean MDA8 O_3 observed at Yellowstone with JJA mean daily maximum temperature from observations (Harris et al., 2014).

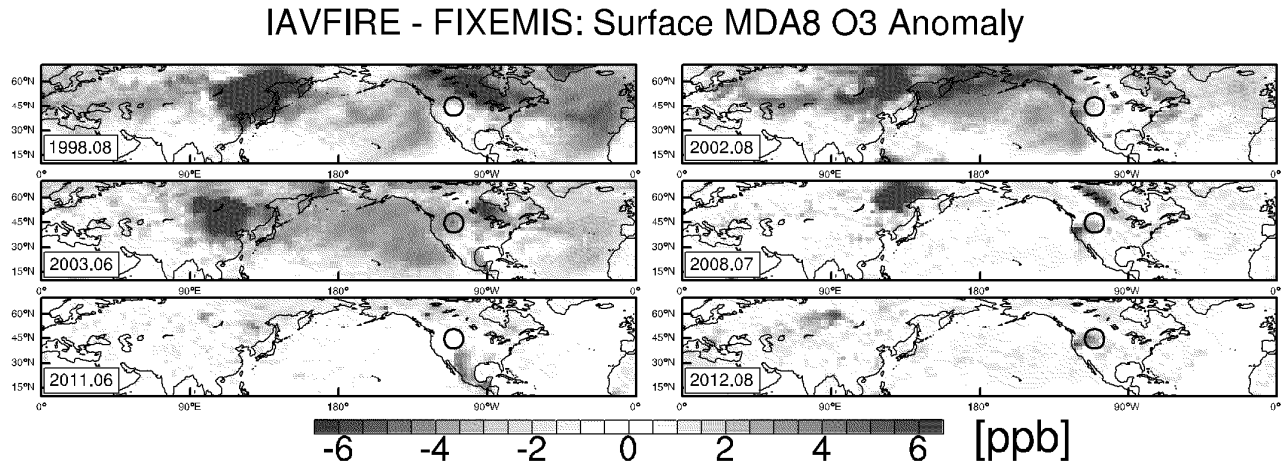

Figure 16. Surface MDA8 O_3 enhancements from wildfire emissions for individual months in the years with large biomass burning in boreal regions (1998, 2002, 2003) and over the WUS (2008, 2011, 2012), as diagnosed by the differences between IAVFIRE and FIXEMIS. The black circle denotes the location of Yellowstone National Park.

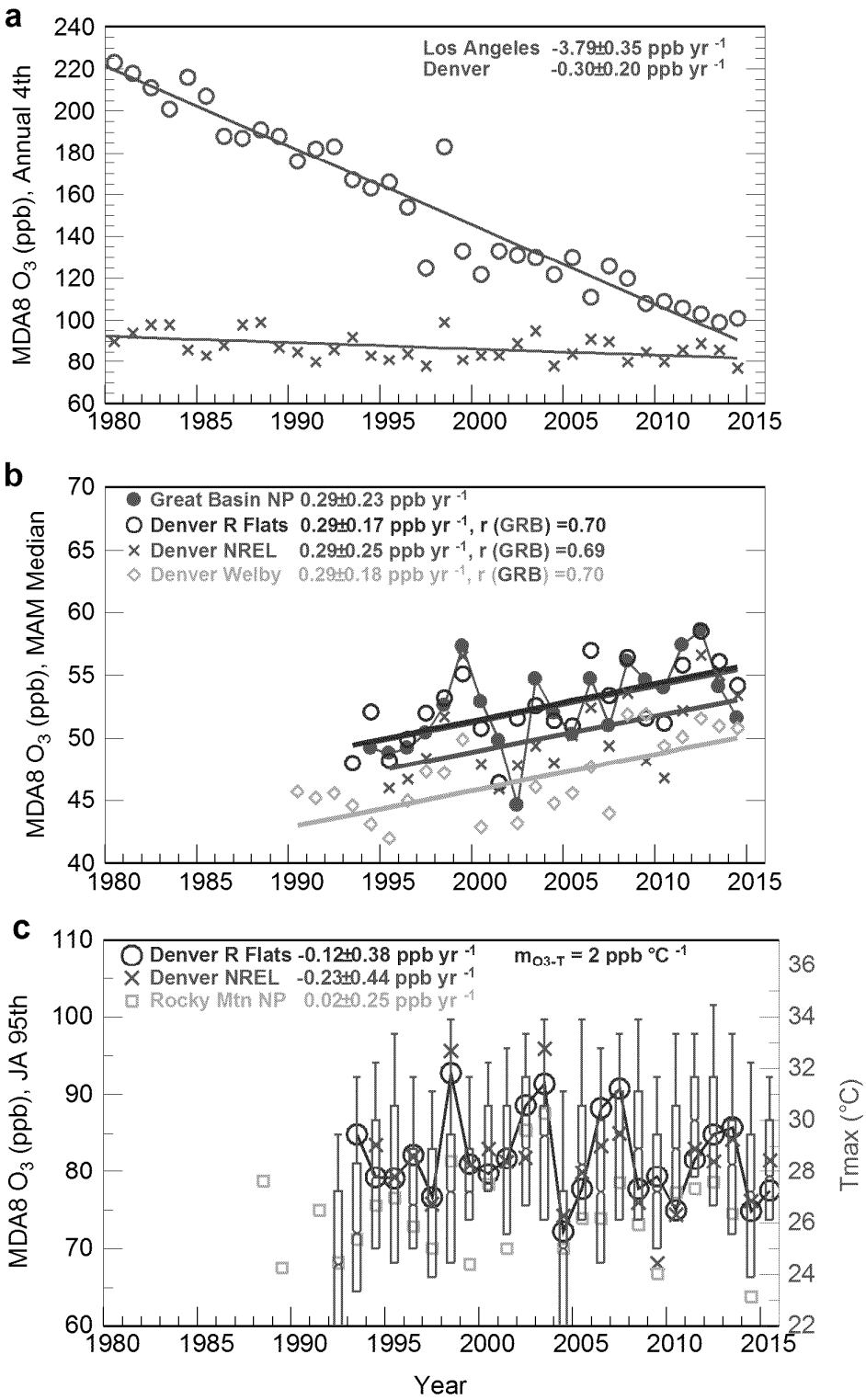

Figure 17. Surface O_3 trends in Denver. (a) Comparison of observed trends in annual 4th highest MDA8 O_3 at Crestline Los Angeles (brown) and in Denver (blue, computed from all monitors available in Denver non-attainment counties). (b) Time series of observed median MAM MDA8 O_3 at Great Basin National Park (red), in comparison with three monitors in Denver. (c) Time series of observed 95th percentile July-August MDA8 O_3 in Denver, together with statistics (25th, 50th, 75th, 95th) of observed July-August daily maximum temperature at Rocky Flats (red, right axis).

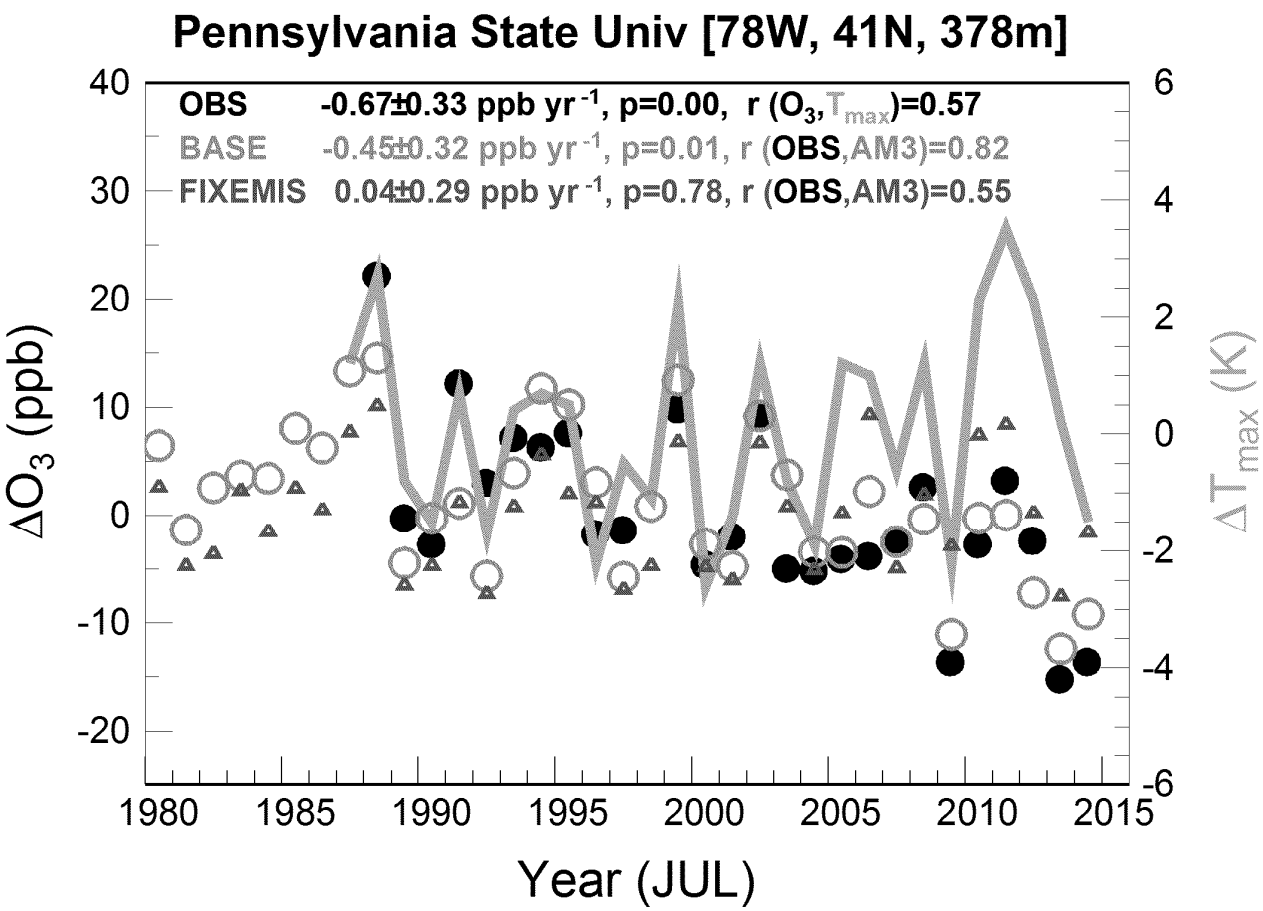

Figure 18. Anomalies in July mean MDA8 O_3 at the Pennsylvania State CASTNET site as observed (black) and simulated by the GFDL-AM3 model with time-varying (purple) and constant anthropogenic emissions (red). Observed anomalies in July mean daily maximum temperature are shown in gray using right axis.

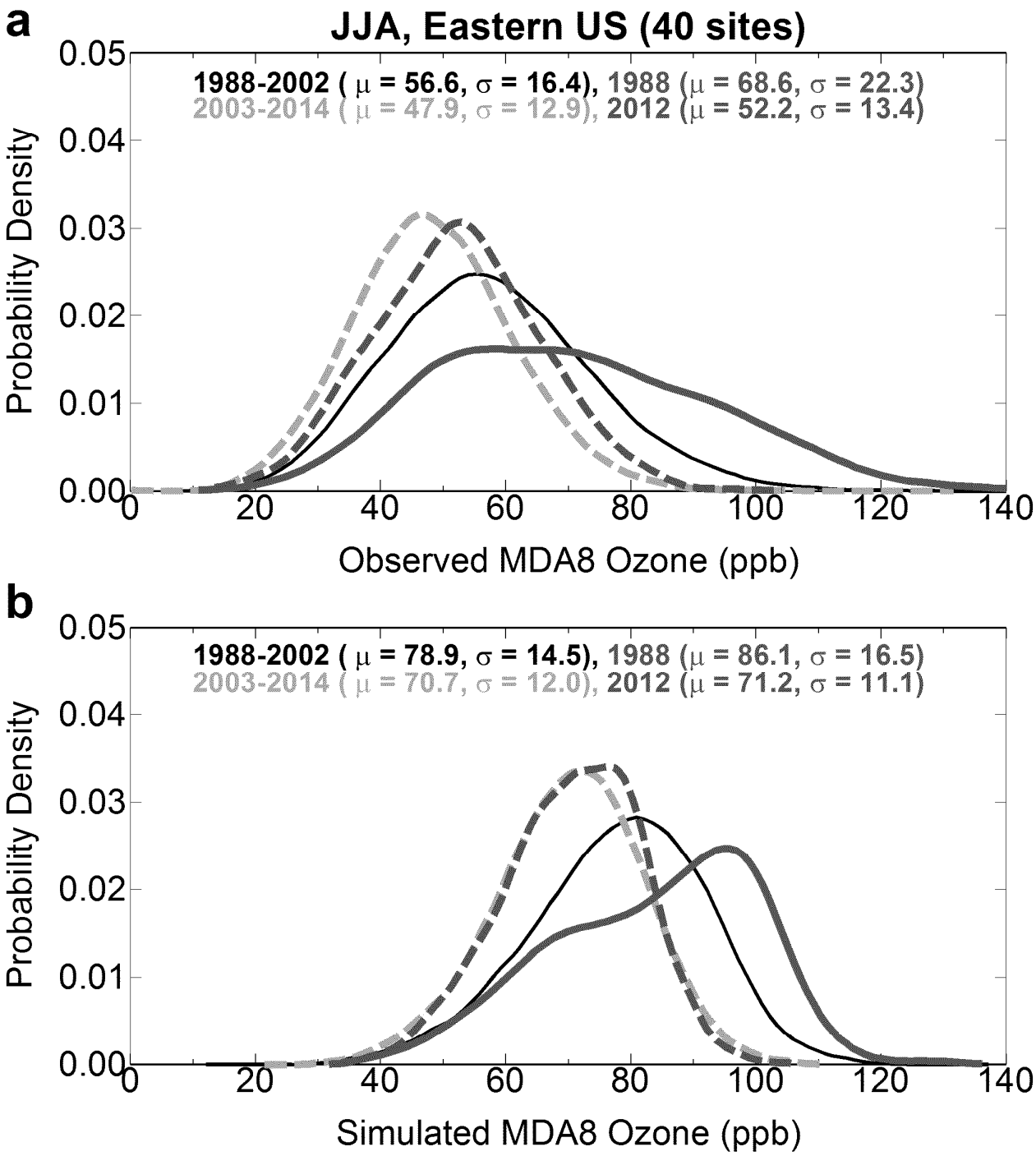

Figure 19. (a) Comparisons of probability distributions of summertime MDA8 O_3 from CASTNet over the EUS domain for the pre-NO_x SIP Call (1988-2002; solid black lines) versus post-NO_x SIP Call (2003-2014; dashed gray lines) periods and during the extreme heat waves of 1988 (solid red lines) versus 2012 (dashed brown lines). (b) Same as (a) but from AM3_BASE. The median (μ) and standard deviation (←) are shown (ppb).

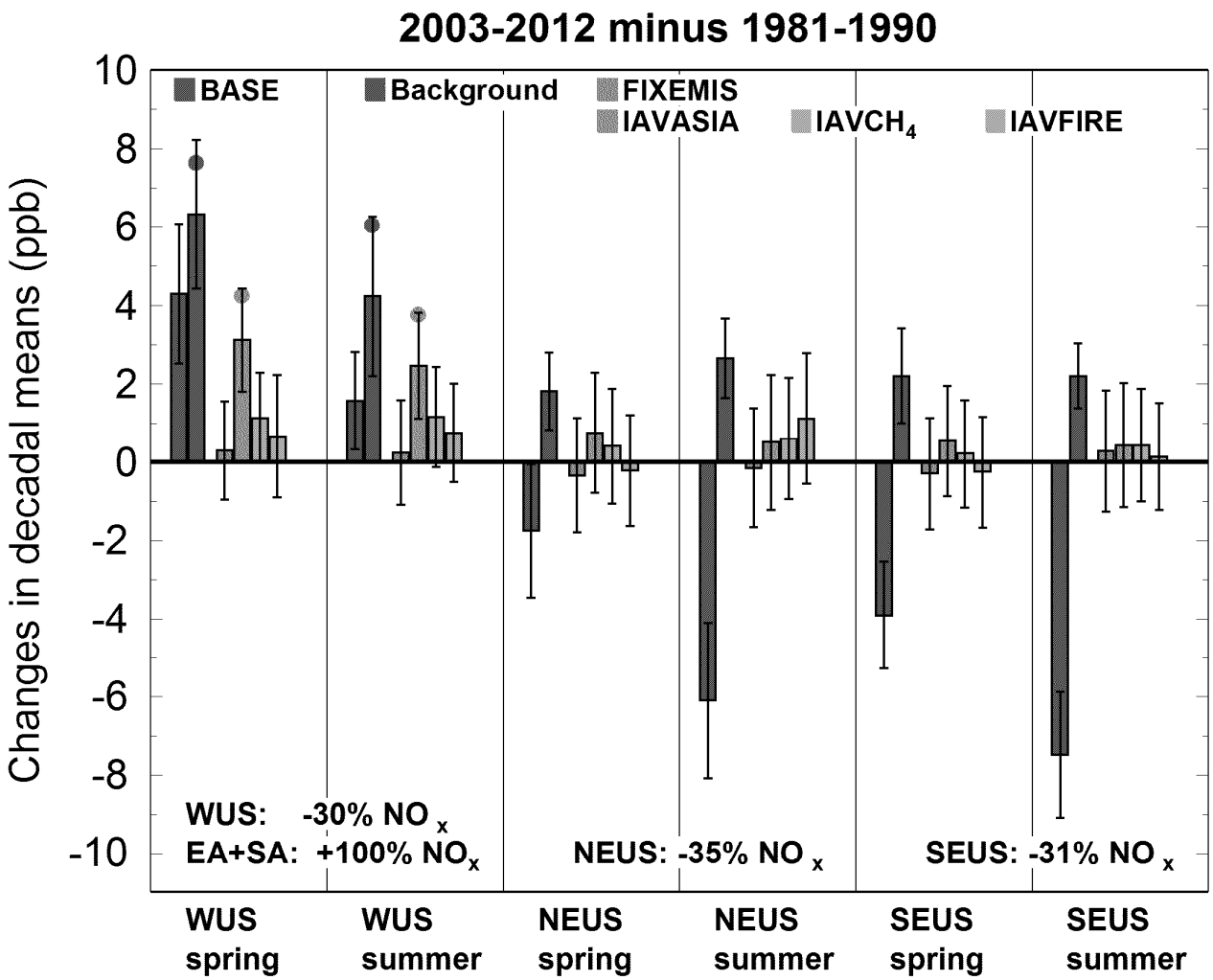

Figure 20. Summary of US surface O_3 trends and drivers. Changes in decadal mean MDA8 O_3 from 1981-1990 to 2003-2012 simulated in a suite of GFDL-AM3 experiments for spring and summer for the western (32N-46N and 123W-102W), Northeast (37N-45N and 90W-65W) and Southeast (30N-36N and 95W-77W) US domains. Experiments are color-coded with the error bars indicating the range of the mean change at the 95% confidence level. Filled circles represent the changes under Background (green) and IAVASIA (purple) when filtered for Asian influence (EACOt≥67th%), while other results are from the unfiltered models. The text near the bottom of the plot provides the change in NO_x emissions over the same period for each region.

Table 1 Summary of forcings and emissions used in AM3 hindcasts and CM3 projections

Experiment	Time Periods	Meteorology	Radiative forcings	CH_4 (chemistry)	Anthropogenic emissions of aerosol and O_3 precursors	Fire Emissions
BASE	1979-2014	Nudged to NCEP	Historical	Historical	Historical	Historical
Background	1979-2014	as BASE	Historical	Historical	Switched off in North America; As BASE elsewhere	Historical
FIXEMIS	1979-2014	as BASE	Historical	2000	Constant*	Constant*
IAVFIRE	1979-2014	as BASE	Historical	2000	Constant*	Historical
IAVASIA	1979-2012+	as BASE	Historical	2000	Varying in Asia as BASE; as in FIXEMIS elsewhere	Constant*
IAVCH4	1979-2012+	as BASE	Historical	Historical	Constant*	Constant*
CM3_RCP4.5	2005-2050	Free running	RCP4.5	RCP4.5	RCP4.5	RCP4.5
CM3_RCP8.5	2005-2050	Free running	RCP8.5	RCP8.5	RCP8.5	RCP8.5

*Averaged over the whole 1970-2010 period.

+Note that the IAVASIA and IAVCH4 simulations only extend to 2012 (see also the attribution analysis in Table 2 and Fig.20).

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Table 2. Summary of linear trends in spring MDA8 O_3 for 1988 to 2012 (ppb yr^{-1}) observed at seven western U .S. sites and as simulated in the AM3 experiments. Trends with the 95% confidence intervals and levels of significance (**bold**: <1%; *italic*, 1-5%; , ≥5%) were estimated by the two-tailed *t*-test.

Experiment[a]	Lassen	Great Basin	Rocky Mountain	Mesa Verde	Yellowstone	Yosemite	Chiricahua
			Spring (MAM)				
Observed	**0.38±0.14**	**0.38±0.26**	**0.37±0.18**	**0.30±0.18**	*0.21±0.19*	*0.37±0.32*	**0.17±0.10**
BASE*	**0.33±0.11**	**0.34±0.12**	**0.32±0.13**	**0.37±0.14**	**0.21±0.11**	**0.35±0.17**	*0.25±0.19*
Background	**0.31±0.12**	**0.40±0.13**	**0.45±0.13**	**0.43±0.17**	**0.30±0.11**	**0.41±0.16**	**0.32±0.21**
$Background_{EA}$	**0.41±0.12**	**0.39±0.18**	**0.50±0.15**	**0.52±0.20**	**0.40±0.16**	**0.47±0.17**	**0.47±0.21**
IAVASIA*	**0.29±0.13**	**0.31±0.11**	**0.25±0.11**	**0.27±0.11**	**0.19±0.11**	**0.24±0.14**	0.15±0.15
$IAVASIA_{EA}$	**0.26±0.16**	**0.26±0.16**	**0.35±0.13**	**0.32±0.13**	**0.27±0.16**	**0.31±0.18**	**0.25±0.15**
$IAVCH_4$*	*0.18±0.12*	**0.20±0.11**	*0.12±0.09*	*0.16±0.12*	0.09±0.12	0.15±0.16	0.04±0.15
IAVFIRE	0.10±0.12	*0.14±0.12*	*0.17±0.14*	*0.16±0.14*	0.11±0.13	0.15±0.16	0.08±0.17
FIXEMIS	0.08±0.12	*0.12±0.12*	*0.16±0.12*	*0.13±0.12*	0.09±0.13	0.12±0.16	0.04±0.16
O_3Strat	0.18±0.18	0.20±0.25	0.18±0.18	*0.25±0.23*	0.15±0.18	0.27±0.30	0.07±0.24

a. The * mask indicates data filtered to represent baseline conditions (NACOt ≤67th). The EA subscript indicates that data were filtered to represent transport conditions favoring the import of Asian pollution (EACOt ≥ 67th).

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To: Jackson, Scott[jackson.scott@epa.gov]; Daly, Carl[Daly.Carl@epa.gov]
Cc: Ostendorf, Jody[ostendorf.jody@epa.gov]; Rickard, Joshua[rickard.joshua@epa.gov]
From: Payton, Richard
Sent: Fri 9/30/2016 7:58:43 PM
Subject: FW: Ute Indian Tribe designation recommendation for the recently revised NAAQS for Ozone attached
16 9 29 UTBC - EPA re designation recommendation for the recently revised National Ambient Air Quality Standards for Ozone.pdf

Tribe recommends attainment, assuming our concurrence on the June 2015 SI EE request results in attaining data; if we do not concur, tribe recommends only the area around Ouray be designated nonattainment; they promise a legal description of that area, but, it is not included. They do not include any monitoring data or design values.

From AQS, using all valid data, 2013-2015 and 2014-2016 DVs, with and without EPA concurrence on EE flags for June 8-9, 2015:

Site	2013-2015 w/out Concurrence	2013-2015 w/concurrence	2014-2016 W/O	2014-2016 With
Ouray	79	79	81	80
Redwash	71	71	70	70
Myton	74	73	72	72
Whiterocks	68	68	71	71
Dinosaur			68	68
Roosevelt	75	75	67	67
Rangely	73	73	63	63

Rangely and Dinosaur have EE flags for SI in 2015, but, we have no request for concurrence, and concurrence would not change those design values.

Bottom line, all 4 tribal monitors violate the NAAQS either in 2015 or 2016, with or without concurrence, and Ouray and Myton violate both design values. At a minimum, the area must be Nonattainment, and the area will have to include the 2016 violating monitors (Whiterocks, Myton and Ouray).

Richard

From: Monique Douville [mailto:MDouville@ndnlaw.com]
Sent: Friday, September 30, 2016 1:07 PM
To: Ostendorf, Jody <ostendorf.jody@epa.gov>
Cc: Jeremy Patterson <JPatterson@ndnlaw.com>; Fallon, Gail <fallon.gail@epa.gov>; Payton, Richard <Payton.Richard@epa.gov>; minnieg@utetribe.com
Subject: Ute Indian Tribe designation recommendation for the recently revised NAAQS for Ozone attached
Importance: High

Ms. Ostendorf,

Attached please find the Ute Indian Tribe's designation recommendation for the recently revised National Ambient Air Quality Standards for Ozone. We are also filing this electronically as well as sending a hard copy, certified return receipt.

Thank you.

Respectfully,

Monique Douville

Assistant to Tom Fredericks and Jeremy Patterson

Fredericks Peebles & Morgan LLP

1900 Plaza Drive

Louisville, Colorado 80027

(303)673-9600

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To: Pino, Maria[Pino.Maria@epa.gov]
Cc: Gentry, Penny J. (DNREC)[Penny.Gentry@state.de.us]; Amirikian, Ronald A. (DNREC)[Ronald.Amirikian@state.de.us]; Fees, David F. (DNREC)[David.Fees@state.de.us]
From: Mirzakhalili, Ali (DNREC)
Sent: Wed 10/12/2016 8:34:11 PM
Subject: DE Designation Recommendation
DE 2015 O3 Designation Recommendation 9-23-16.pdf

Hi Maria,

Attached is Delaware's recommendation letter which was sent out a while ago. I noticed that we had not copied you on the transmittal but I hope that you can find it in the office. We will track the submittal from this end as well.

Thanks,

Ali

Ali Mirzakhalili, P.E.

Director

Division of Air Quality

State Street Commons

100 W. Water Street, Suite 6A

Dover, DE 19904

(302) 739-9402

To: Fernandez, Cristina[Fernandez.Cristina@epa.gov]
Cc: Pino, Maria[Pino.Maria@epa.gov]; Ramamurthy, Krishnan[kramamurth@pa.gov]; Trowbridge, Brian[britrowbri@pa.gov]
From: Dalal, Kirit
Sent: Mon 10/3/2016 8:16:02 PM
Subject: 2015 ozone area recommendations for the Commonwealth of Pennsylvania - No. 2
PADEP 2015 Ozone NAAQS Proposed Designations - Appendix D.pdf
PADEP 2015 Ozone NAAQS Proposed Designations - Appendix E.pdf
PADEP 2015 Ozone NAAQS Proposed Designations - Appendix C.pdf

Hello Cristina,

Here are the rest of the files.

If you have any questions, please feel free to contact me.

Thank you. – Kirit

Kirit Dalal P.E.| Environmental Program Manager
Department of Environmental Protection
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3436| Fax: 717.772.2303
www.depweb.state.pa.us

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To: Rehn, Brian[rehn.brian@epa.gov]
Cc: Pino, Maria[Pino.Maria@epa.gov];
george.aburn@maryland.gov[george.aburn@maryland.gov];
roger.thunell@maryland.gov[roger.thunell@maryland.gov]
From: Brian Hug -MDE-
Sent: Thur 3/16/2017 5:02:14 PM
Subject: Re: 75 and 70 ppb standards

How about 130 I give you a call?

On Wed, Mar 15, 2017 at 4:27 PM Rehn, Brian <rehn.brian@epa.gov> wrote:

Brian.

Apologies for the delay in responding. Our office was closed for the weather yesterday. Cristina asked me to get back to you on your question below regarding options for revocation of the 2008 ozone NAAQS and their implications.

At this point we don't know what revocation option will be selected, but if you'd like to talk about the potential impacts under our Option 2, we can do so on a short call outside the normal MDE monthly call. Option 2 would revoke the 2008 ozone NAAQS for all purposes in an area only when designated attainment for that NAAQS, no sooner than 1 year after the effective date of the designations for the 2015 ozone NAAQS.

Maria and I could possibly talk tomorrow at 1:00, but I'm pretty busy otherwise. If that doesn't work for you, perhaps we could set something up for next week.

Brian Rehn

Acting Associate Director

Office of Air Program Planning

Air Protection Division

EPA Region III

(215) 814-2176

From: Brian Hug -MDE- [mailto:brian.hug@maryland.gov]
Sent: Friday, March 10, 2017 11:17 AM
To: Fernandez, Cristina <Fernandez.Cristina@epa.gov>; Rehn, Brian <rehn.brian@epa.gov>
Cc: George Aburn -MDE- <george.aburn@maryland.gov>; Roger Thunell -MDE- <roger.thunell@maryland.gov>
Subject: 75 and 70 ppb standards

Talking to staff here and our guess is EPA will likely move ahead with option 2 on the 75ppb standard - meaning dueling standards for Cecil County in Maryland as well as Baltimore

I would like to set up a short call next week if you have time to talk this through

Brian

--

Brian J. Hug
Program Manager
Air Quality Planning Program
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230
410 537 4125

Click here to complete a three question customer experience survey.

--
Brian J. Hug
Program Manager
Air Quality Planning Program
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230
410 537 4125

Click here to complete a three question customer experience survey.

To: brian.hug@maryland.gov[brian.hug@maryland.gov]
Cc: roger.thunell@maryland.gov[roger.thunell@maryland.gov]; george.aburn@maryland.gov[george.aburn@maryland.gov]; Pino, Maria[Pino.Maria@epa.gov]
From: Rehn, Brian
Sent: Wed 3/15/2017 8:27:09 PM
Subject: RE: 75 and 70 ppb standards

Brian.

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At this point we don't know what revocation option will be selected, but if you'd like to talk about the potential impacts under our Option 2, we can do so on a short call outside the normal MDE monthly call. Option 2 would revoke the 2008 ozone NAAQS for all purposes in an area only when designated attainment for that NAAQS, no sooner than 1 year after the effective date of the designations for the 2015 ozone NAAQS.

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Program Manager
Air Quality Planning Program
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230
410 537 4125

Click here to complete a three question customer experience survey.

To: Fernandez, Cristina[Fernandez.Cristina@epa.gov]
Cc: Pino, Maria[Pino.Maria@epa.gov]; Ramamurthy, Krishnan[kramamurth@pa.gov]; Trowbridge, Brian[britrowbri@pa.gov]
From: Dalal, Kirit
Sent: Mon 10/3/2016 8:08:59 PM
Subject: 2015 ozone area recommendations for the Commonwealth of Pennsylvania - No 1
PADEP 2015 Ozone NAAQS - Final Designation Letter.pdf
PADEP 2015 Ozone NAAQS - Final Designation Recommendations.pdf
PADEP 2015 Ozone NAAQS - Appendix A.pdf
PADEP 2015 Ozone NAAQS - Appendix B.pdf

Hello Cristina,

Please find attached the final 2015 ozone area recommendations for the Commonwealth of Pennsylvania.

The documents will be sent in multiple emails due the file size. If you have any questions, please feel free to contact me.

Thank you. – Kirit

Kirit Dalal P.E.| Environmental Program Manager
Department of Environmental Protection
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3436| Fax: 717.772.2303
www.depweb.state.pa.us

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To: R3 RA[R3_RA@epa.gov]; Fernandez, Cristina[Fernandez.Cristina@epa.gov]; Pino, Maria[Pino.Maria@epa.gov]
Cc: Dowd, Michael (DEQ)[Michael.Dowd@deq.virginia.gov]; Franklin, Elsie (DEQ)[Elsie.Franklin@deq.virginia.gov]
From: Ballou, Thomas (DEQ)
Sent: Mon 10/3/2016 7:05:07 PM
Subject: 2015 Ozone Recommendations for Virginia
Virginia 2015 Ozone Designation Recommendations.pdf
Enclosure I VA 2013-2015 8-Hour Ozone Certified Data.pdf
Enclosure II_technical background.pdf
Enclosure III_2015 VA Ozone Designations table.pdf

As required by Section 107(d) of the Clean Air Act and on behalf of David K. Paylor, Director of the Virginia Department of Environmental Quality, the purpose of this email message is to transmit the initial area designation recommendations of the Commonwealth of Virginia for the 2015 8-hour Ozone National Ambient Air Quality Standard.

Any questions concerning these recommendations should be directed to Michael Dowd (michael.dowd@deq.virginia.gov) or Tom Ballou (thomas.ballou@deq.virginia.gov). Thank you for the opportunity to provide input to this important process.

Thomas R. Ballou
Air Data Analysis & Planning Manager
VA Department of Environmental Quality

629 E. Main Street, Richmond, VA 23219
(804) 698-4406

thomas.ballou@deq.virginia.gov

www.deq.virginia.gov

To: kdalal@pa.gov[kdalal@pa.gov]
Cc: Pino, Maria[Pino.Maria@epa.gov]
From: Khadr, Asrah
Sent: Wed 9/28/2016 12:49:51 PM
Subject: RE: PA Monthly Call
09_28_16_agenda.docx

Hi Kirit,

Attached is the agenda for our call today.

Thanks,

Asrah

From: Dalal, Kirit [mailto:kdalal@pa.gov]
Sent: Wednesday, September 28, 2016 8:47 AM
To: Khadr, Asrah <Khadr.Asrah@epa.gov>
Cc: Pino, Maria <Pino.Maria@epa.gov>
Subject: RE: PA Monthly Call

Hello Asrah,

What is the telephone number that we should call you at? Thank you. – Kirit

Kirit Dalal P.E.| Environmental Program Manager
Department of Environmental Protection
400 Market Street | Harrisburg, PA 17101
Phone: 717.772.3436| Fax: 717.772.2303
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information other than by the intended recipient is prohibited. If you receive this message in error, please send a reply e-mail to the sender and delete the material from any and all computers.

From: Khadr, Asrah [mailto:Khadr.Asrah@epa.gov]
Sent: Tuesday, September 27, 2016 4:23 PM
To: Dalal, Kirit
Cc: Pino, Maria
Subject: RE: PA Monthly Call

Yes….There are items from our end. I was told that Tim (our modeler) will be attending the call tomorrow to answer SO2 questions. The items are below

1) Beaver Co SO2 attainment demo modeling & Shell

2) Ozone designation recommendations & exceptional events

3) NOx RACT/ Brunner Island

I will send out the formal agenda tomorrow morning.

Asrah

From: Dalal, Kirit [mailto:kdalal@pa.gov]
Sent: Tuesday, September 27, 2016 4:10 PM
To: Khadr, Asrah <Khadr.Asrah@epa.gov>
Cc: Pino, Maria <Pino.Maria@epa.gov>
Subject: RE: PA Monthly Call

Hi Asrah,

1) SO2 SIP (planning, modeling, inventory) related questions. – PA DEP

2) Status of clean data determination for the Delaware County area for the 2012 annual PM2.5 NAAQS. Is it going to be proposed or direct final, and the timing of it. – EPA

3) Any RACT2/RACT certification related questions or any 2008 ozone attainment related questions.

These are some of the items for discussions. Did you have anything from your end.

Thank you. – Kirit

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Department of Environmental Protection
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From: Khadr, Asrah [mailto:Khadr.Asrah@epa.gov]
Sent: Tuesday, September 27, 2016 2:44 PM

To: Dalal, Kirit
Cc: Pino, Maria
Subject: FW: PA Monthly Call

Hi Kirit,

Please let me know if PADEP has any agenda items by close of business today.

Thanks,

Asrah

From: Khadr, Asrah
Sent: Monday, September 26, 2016 9:31 AM
To: kdalal@pa.gov
Cc: Pino, Maria <pino.maria@epa.gov>
Subject: PA Monthly Call

Hi Kirit,

Just touching base with you about the agenda items we spoke about on Thursday. Please let me know if PADEP has any agenda items by mid-day tomorrow.

Thanks,

Asrah Khadr, Environmental Engineer, EIT

WISE SE-Program Manager

U.S. Environmental Protection Agency, Region III

Air Protection Division

Office of Air Program Planning

1650 Arch Street

Philadelphia, PA 19103

Phone: 215-814-2071

To: kdalal@pa.gov[kdalal@pa.gov]
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Thanks,

Asrah Khadr, Environmental Engineer, EIT

WISE SE-Program Manager

U.S. Environmental Protection Agency, Region III

Air Protection Division

Office of Air Program Planning

1650 Arch Street

Philadelphia, PA 19103

Phone: 215-814-2071

STATE OF DELAWARE
OFFICE OF THE GOVERNOR
TATNALL BUILDING, SECOND FLOOR
WILLIAM PENN STREET, DOVER, DE 19901

JACK A. MARKELL
GOVERNOR

PHONE: 302-744-4101
FAX: 302-739-2775

September 23, 2016

Shawn M. Garvin
Regional Administrator
Region III
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Dear Administrator Garvin:

On October 1, 2015, the EPA strengthened the primary and secondary National Ambient Air Quality Standards (NAAQS) for ground-level ozone from the current 0.075 parts per million (ppm) over an 8-hour period to a new 0.070 ppm. Section 107(d) of the Clean Air Act (CAA) requires the Governor of each State to submit to the EPA a list of all areas (or portions thereof) in the State, designating each as nonattainment, attainment, or unclassifiable. This letter fulfills Delaware's obligations under Section 107(d) of the CAA.

Emissions cause ozone nonattainment and Delaware believes it is necessary to establish nonattainment boundaries that encompass enough of these emissions to make attainment a feasible and possible goal for the area. To this end Delaware hereby recommends that the nonattainment area borders associated with New Castle County be the borders of the States of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin, as shown in Figure 1 in the attached Executive Summary, due to EPA's analysis that these states significantly impact Delaware as part of the CSAPR and CSAPR Update. If the EPA again rejects establishing a nonattainment area that is consistent with science to solve the problem, Delaware requests EPA establish New Castle County as a stand-alone nonattainment area under the 2015 8-hour ozone NAAQS. The attached five factor analysis supports this recommendation.

Thank you for your consideration of the above recommendations. If you have any questions concerning this submittal or would like to discuss it further, please contact Mr. Ali Mirzakhalili, the Director of the Division of Air Quality, at (302)739-9402.

Sincerely,

Jack A. Markell
Governor

Attachment
pc: David Small
Ali Mirzakhalili
Cristina Fernandez, EPA Region III

Executive Summary

Area Description and Attainment/Nonattainment Status

Delaware is composed of three counties, namely New Castle, Kent, and Sussex, laying from north to south. The northern portion of New Castle County lies above the Chesapeake and Delaware Canal (C&D Canal), a waterway that connects the Chesapeake Bay with the Delaware Bay. The remainder of Delaware lies south of the Canal and is connected to the north primarily by the Route 1 Bridge. The portion of New Castle County located above the C&D Canal is more metropolitan and industrialized than the remainder of Delaware; however this area has experienced a significant decline in heavy industrial sources over the last two decades. Delaware is geographically situated, along with portions of Maryland and Virginia, on a land mass known as the Delmarva Peninsula. This land mass is separated from the Continental U.S. by the Chesapeake Bay on the west and from the State of New Jersey by the Delaware Bay on the east. These large water bodies surrounding the relatively large, flat Peninsula, plus the Atlantic Ocean, situate Delaware in an area that is geographically unlike any other. Further, these large water bodies create complex meteorological mountains and valleys that at times funnel transported emissions around the Peninsula and up the I-95 corridor, and at other times trap upwind emissions such that those emissions are recirculated by ocean and bay breezes, and impact Delaware multiple times.

Delaware operates a dense ozone monitoring network that includes ambient ozone monitors in each of its counties (four monitors in New Castle, one monitor in Kent, and two monitors in Sussex). Based on certified 2013 through 2015 ozone monitoring data (i.e., the most recent, certified three years), the 8-hour ozone design values for New Castle, Kent, and Sussex counties are 0.069 ppm, 0.065 ppm, and 0.069 ppm, respectively. However, 2016 ozone monitoring data shows that these three counties have 8-hour ozone design values based upon 2014 through 2016 ozone monitoring data of 0.072 ppm, 0.066 ppm, and 0.069 ppm, respectively. Based on 2014 through 2016 data Delaware recommends that Kent and Sussex County be designated as attainment, and that New Castle County be designated as nonattainment for both the primary and secondary 0.070 ppm 8-hour ozone NAAQS.

Nonattainment Area Boundaries associated with New Castle County

Over the past 40+ years, and in particular since 1990, Delaware's local sources of ozone precursor emissions have all been well controlled, yet Delaware's air quality remains nonattainment relative to ozone. Emission controls have been established and implemented in Delaware at a great economic cost to Delaware citizens and industry. Both large and small, new and modified, sources have been subject to costly nonattainment New Source Review control and offset requirements for more than two decades. Power plants, industrial boilers, consumer products, and paints are regulated in Delaware at levels far below national levels – and the list goes on. After many rounds of regulation[1], Delaware's sources that cause and contribute to ozone formation (i.e., volatile organic compound (VOC) and nitrogen oxides (NOx) emitting sources) are well controlled. Delaware's

[1] For example, all Delaware electric generating units (EGUs) have been subject to reasonably available control requirements (RACT) in 1995, the OTC NOx Budget Program in 1998, the EPA NOx SIP Call in 2002, the EPA CAIR in 2006, and 7 DE Admin Code 1146 in 2008. All Delaware EGUs are now subject to unit specific best available control technology (BACT) controls that were installed at a cost of between $1,200 and $11,000 per ton of NOx reduced.

emissions are likely controlled to a greater level than any other state that impacts Delaware's air quality – yet Delaware's air quality remains unhealthy because of high ozone concentrations. Many studies have shown that the health benefits of clean air far outweigh the cost of controls needed to clean the air; typically by more than 10:1. Delaware citizens and industry have endured the cost of controls, and despite this, have not reaped the economic benefit of clean air because of uncontrolled emissions generated outside of Delaware's borders. As such, Delaware suffers from this dual malfeasance.

The establishment of nonattainment boundaries is critical because it is within these boundaries that the nonattainment provisions of the CAA are applied. If the EPA again establishes small, metropolitan based nonattainment areas, Delaware's well controlled sources will undergo another round of costly regulation, and any additional emission reductions will come at a high cost, with control strategies generally being technology forcing. In contrast, very cost effective emissions reduction opportunities outside this small nonattainment area will not be realized, and the uncontrolled sources that are contributing to the problem will remain uncontrolled. This is unfair, and contrary to the CAA.

Emissions cause ozone nonattainment and Delaware believes it is necessary to establish nonattainment boundaries that encompass enough of these emissions to make attainment a feasible and possible goal for the area. To this end Delaware hereby recommends that the nonattainment area borders associated with New Castle County be the borders of the States of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin, as shown in Figure 1, due to EPA's analysis that these states significantly impact Delaware as part of the CSAPR and CSAPR Update. Delaware has made this same recommendation in the past and the EPA has provided the following rationale for rejecting this recommendation in the past. Delaware asks EPA to reconsider its position for the following reasons.

- EPA has indicated that Section 107(d) of the CAA requires EPA to designate as nonattainment all areas violating the ozone NAAQS and any nearby areas that are contributing to a violation in another area. U nder the designation provision, only "nearby" areas that contribute to the violation must be included as part of the nonattainment area. The issue here is that the term nearby must be interpreted consistent with the scale of the problem. The Courts have ruled that EPA has discretion on how it interprets the term nearby, and that interpreting nearby as a large area is a feasible construct of the statutory language.

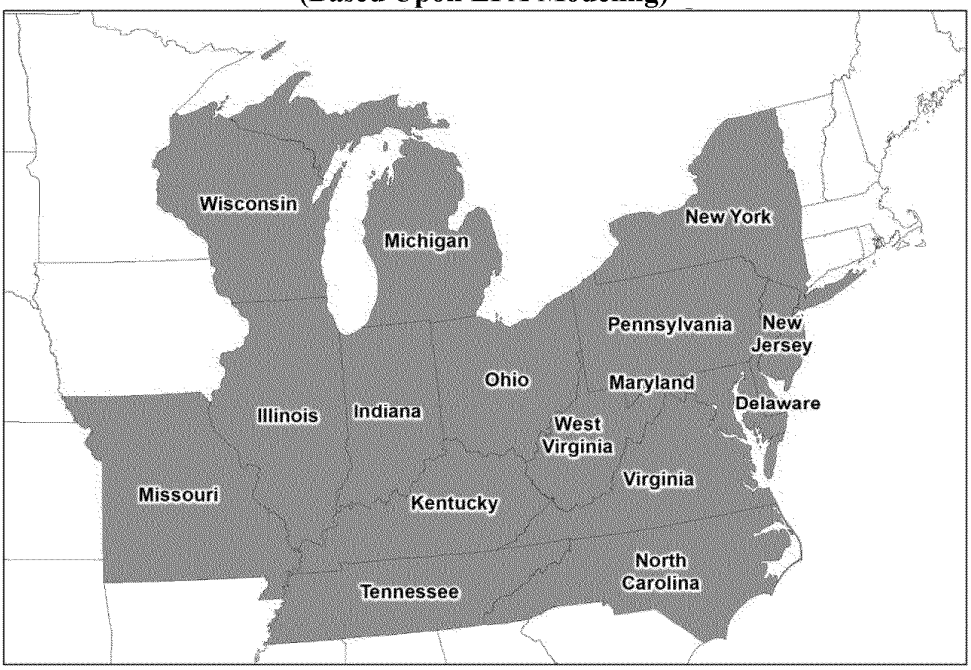
- EPA has indicated that there are other provisions of the CAA that address longer range transport of ozone pollution, such as sections 110(a)(2)(D), 126, and 176A. The phenomenon of ozone transport must be balanced against the need to have smaller areas that can focus on local control measures. Delaware has and continues to take action under these CAA provisions, but notes the dates for EPA to take action come and go and EPA fails to act. EPA has effectively made these provisions of no effect. Further, given that this would be the 4th round of applying the CAA ozone requirements to the Phila delphia area since 1990 there are few local control measures that remain for this area to focus on. It is not reasonable for EPA to knowingly establish nonattainment area boundaries that task the areas within the boundaries to achieve a goal that they can not achieve, that requires these

areas to make demonstrations and implement costly controls that cannot lead to attainment, and point to solutions that lead to other discretionary processes that are also outside the control of these areas. EPA ignoring th e scale of the problem during the designation process does nothing more than penalize these areas with unhealthy air quality.

- EPA in the past has noted that most of the states that Delaware seeks to include as part of this large nonattainment area did not make a similar request. EPA indicated that in the absence of broad agreement among a large group of states to create such a large nonattainment area, demonstrating a commitment to work together to address both long - range and local transport of emissions, they do not intend to designate a large nonattainment area as suggested by Delaware. Seeking broad agreement makes no sense and will not happen. Agreement was sought through the State Collaborative On Ozone Transport (SCOOT) process, but did not occur. Due to the upwind/downwind nature and the false perception that almost all of the potential benefits of reducing emissions lie in the Northeastern states while all costs lie in the Midwestern states. EPA alone has the authority to designate areas and fed eral intervention is necessary to require the area to work together and resolve the problem.

Figure 1 - Delaware Recommended Large Nonattainment Area

(Based Upon EPA Modeling)



Attachment 1

Delaware's Five Factor Analysis
For Establishment of Nonattainment Area Boundaries
For the 0.070 ppm 8-Hour Ozone NAAQS

As a framework for area-specific analyses, the EPA has recommended that states and tribes base their boundary recommendations on an evaluation of the following five factors[1]: Air Quality Data, Emissions and Emissions -Related Data , Meteorology, Geography/Topography, and Jurisdictional Boundaries. This EPA guidance indicates that states and tribes may identify and evaluate other relevant factors or circumstances specific to a particular area.

Delaware's primary boundary recommendation is to include New Castle County as part of a large multi-state nonattainment area. The information and analysis that Delaware submitted to the EPA in its nonattainment boundary recommendations for the 2008 8-hour ozone NAAQS still stand as justification for recommending a large nonattainment area. This recommendation is in line with current science and the Courts have ruled that EPA has sufficient authority under the CAA to adopt it. In the event that EPA does not accept Delaware's recommendation for the establishment of a large nonattainment area, Delaware hereby provides the following detailed discussion and analyses on each of the five factors, which indicate New Castle County should be established as a stand-alone nonattainment area. This alternate recommendation follows EPA guidance but not science.

Delaware considers in this analysis all counties considered by the EPA in their factor assessment associated with the Area Designations for Delaware under the 2008 Ozone National Ambient Air Quality Standards.[2] These counties are identified in Table 1 and are represented in Figure 1.

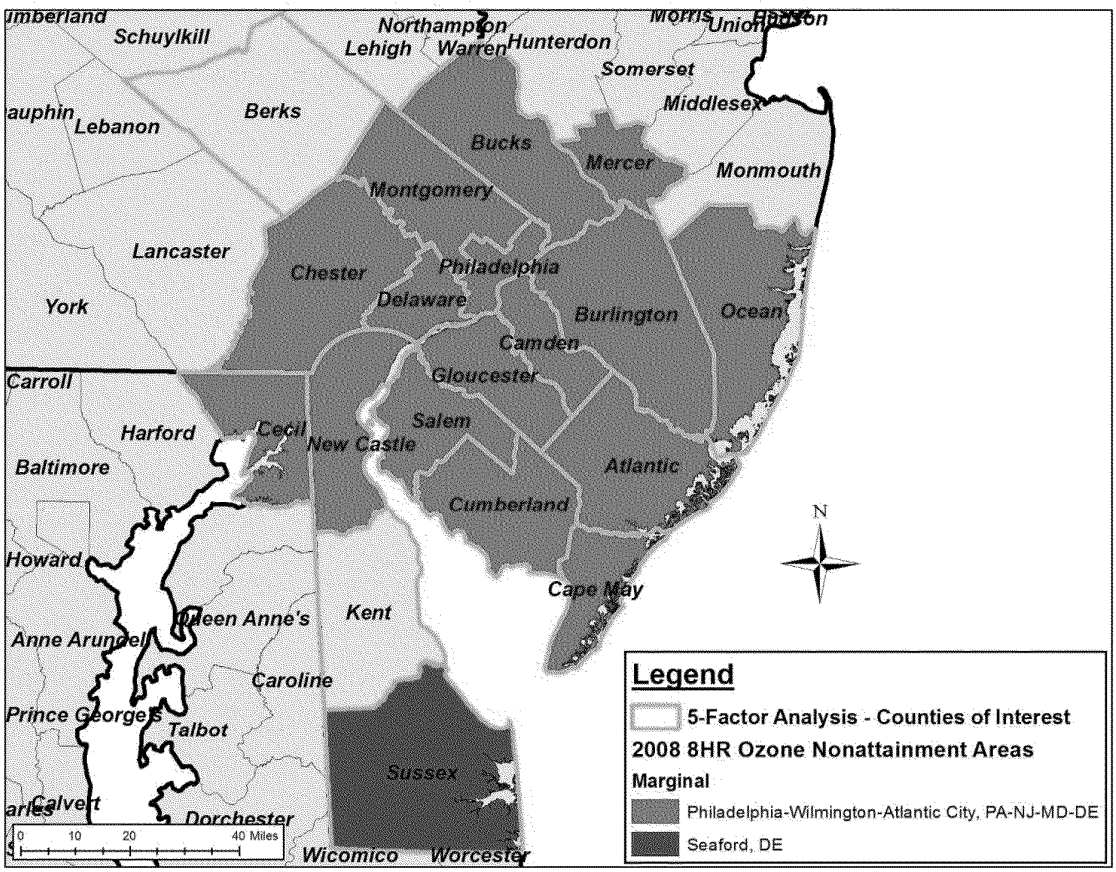
Table 1 - Counties of Interest

FIPS Code	State	County
10001	DE	Kent County, Delaware
10003	DE	New Castle County, Delaware
10005	DE	Sussex County, Delaware
24015	MD	Cecil County, Maryland
34001	NJ	Atlantic County, New Jersey
34005	NJ	Burlington County, New Jersey
34007	NJ	Camden County, New Jersey
34009	NJ	Cape May County, New Jersey
34011	NJ	Cumberland County, New Jersey
34015	NJ	Gloucester County, New Jersey
34021	NJ	Mercer County, New Jersey
34029	NJ	Ocean County, New Jersey

[1] Memorandum: Area Designations for the 2015 Ozone National Ambient Air Quality Standards; Janet G. McCabe, Acting Assistant Administrator, US EPA, February 25, 2016.
[2] https://archive.epa.gov/ozonedesignations/web/html/region3r.html

FIPS Code	State	County
34033	NJ	Salem County, New Jersey
42011	PA	Berks County, Pennsylvania
42017	PA	Bucks County, Pennsylvania
42029	PA	Chester County, Pennsylvania
42045	PA	Delaware County, Pennsylvania
42091	PA	Montgomery County, Pennsylvania
42101	PA	Philadelphia County, Pennsylvania

Figure 1 - Counties of Interest



Factor 1: Air Quality Data

For this factor Delaware evaluated 8-hour ozone design values (DV, in parts per million (ppm)) for air quality monitors in the counties of interest . A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2015 8-hour ozone NAAQS is met when the annual fourth -highest daily maximum 8 -hour average concentration, averaged over 3 years, is 0.070 ppm or less. Where several monitors are located in a county (or a

ED_001361_00018546

designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest value. Delaware considered monitoring data for the 2014-2016. This is the 2 most recent years of certified air quality data, plus uncertified 2016 data through 9/14/16. Delaware believes it is important to consider 2016 data at this time because 1) EPA has indicated they will consider it when they make final designations in 2017, and 2) ozone concentrations were low in 2015 due to abnormal meteorological conditions.

Table 2 and Figure 2 below detail the draft 2016 DVs for the counties of interest, as well as the violating monitors in these counties. While all monitors in Delaware were monitoring attainment with the 2015 8-hour ozone NAAQS based upon 2015 DVs, it is only with the most recent, uncertified 2016 data that New Castle County's northern-most monitor located in the Brandywine Creek State Park (Site ID 10003 1010) exceeds the 2015 8-hour ozone NAAQS. The closest monitor to the Brandywine monitor is Delaware's Bellefonte monitor (Site ID 100031013), which is monitoring attainment just 4.6 miles away to the southeast, while the second closest monitor is the Chester monitor (Site ID 420450002) in Delaware County, Pennsylvania, which is monitoring nonattainment 10.3 miles away to the east.

Table 2 - Counties of Interest – 2016 Design Values

County	2016 8-hour Ozone DV (ppm)
Atlantic, NJ	0.064
Berks, PA	0.071
Bucks, PA	0.077
Burlington, NJ	--
Camden, NJ	0.074
Cape May, NJ	--
Cecil, MD	0.074
Chester, PA	0.070
Cumberland, NJ	0.067
Delaware, PA	0.072
Gloucester, NJ	0.073
Kent, DE	0.066
Mercer, NJ	0.073
Montgomery, PA	0.072
New Castle, DE	0.072
Ocean, NJ	0.072
Philadelphia, PA	0.076
Salem, NJ	--
Sussex, DE	0.069

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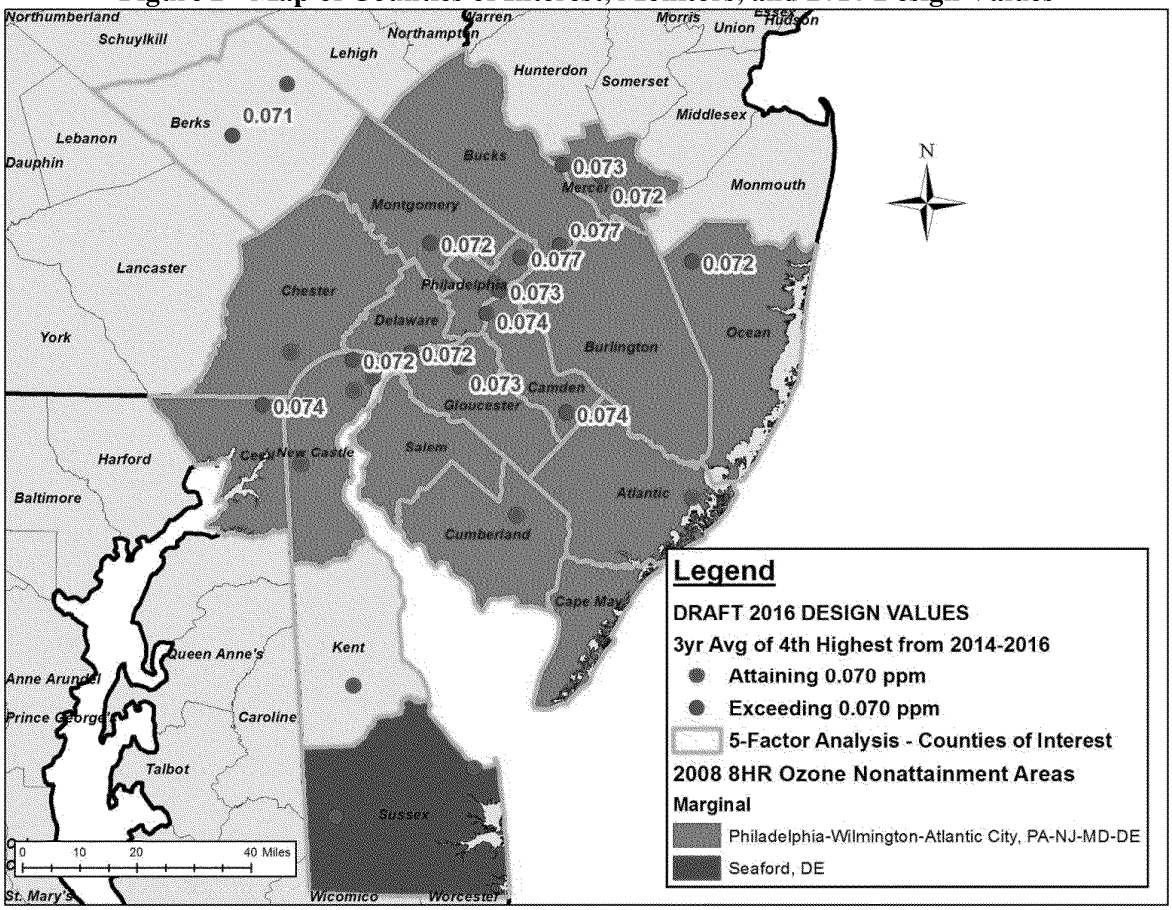
Figure 2 - Map of Counties of Interest, Monitors, and 2016 Design Values



In accordance with section 107(d) of the Clean Air Act, EPA must designate an area nonattainment if it is violating the 2015 8-hour ozone NAAQS. New Castle County in Delaware is violating the 2015 8-hour ozone NAAQS.

Factor 2: Emissions and Emissions-Related Data

Emissions

Table 3 and Table 4 show the emissions of NOx and VOC (in tons per year) for the counties of interest. The emissions were provided by EPA and are from the 2011 NEI V3 dataset.[3]

[3] https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data

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Table 3 - 2011 NEI V3 NOx Emissions

FIPS	State	County	NOX Fires (tpy)	NOX Nonpoint[4] (tpy)	NOX Nonroad (tpy)	NOX Onroad (tpy)	NOX Point (tpy)	NOX Total (tpy)
42101	PA	Philadelphia County	-	5,791	2,480	10,201	2,568	**21,041**
42045	PA	Delaware County	21	2,839	1,124	5,643	7,642	**17,270**
42091	PA	Montgomery County	-	2,369	3,076	9,533	1,456	**16,435**
42011	PA	Berks County	15	1,766	1,529	7,665	3,140	**14,114**
10003	DE	New Castle County	7	2,889	1,748	6,459	2,755	**13,859**
42017	PA	Bucks County	1	1,631	2,196	7,680	1,271	**12,779**
42029	PA	Chester County	1	1,208	2,214	6,841	1,530	**11,794**
10005	DE	Sussex County	11	2,109	1,721	4,399	2,457	**10,697**
34007	NJ	Camden County	9	2,441	1,150	5,353	433	**9,386**
34005	NJ	Burlington County	30	1,365	1,512	5,936	286	**9,128**
34021	NJ	Mercer County	7	1,323	1,433	4,659	639	**8,061**
34015	NJ	Gloucester County	2	1,734	871	3,576	1,758	**7,942**
34029	NJ	Ocean County	30	1,388	2,264	3,969	255	**7,905**
34001	NJ	Atlantic County	7	936	1,161	2,808	202	**5,115**
10001	DE	Kent County	4	1,026	878	2,583	412	**4,902**
34009	NJ	Cape May County	-	1,022	1,227	1,193	602	**4,045**
34011	NJ	Cumberland County	29	1,106	766	1,394	723	**4,017**
24015	MD	Cecil County	0	494	529	2,757	77	**3,858**
34033	NJ	Salem County	1	345	311	1,078	1,540	**3,276**

[4] EPA's 2011 NEI V3 Emissi ons data included biogenic emissions within the nonpoint emissions data. The nonpoint NOx emissions in Table 3 exclude the biogenics emissions which EPA had added for each county.

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Table 4 - 2011 NEI V3 VOC Emissions

FIPS	State	County	VOC Fires (tpy)	VOC Nonpoint[5] (tpy)	VOC Nonroad (tpy)	VOC Onroad (tpy)	VOC Point (tpy)	VOC Total (tpy)
42101	PA	Philadelphia County	-	11,129	2,518	5,641	1,598	**20,886**
42091	PA	Montgomery County	-	8,756	4,211	5,016	729	**18,712**
42017	PA	Bucks County	14	7,382	3,206	4,025	524	**15,150**
34029	NJ	Ocean County	1,002	4,968	4,416	2,636	73	**13,095**
42011	PA	Berks County	168	5,845	1,651	3,831	1,224	**12,719**
42029	PA	Chester County	14	4,766	2,646	3,223	799	**11,448**
42045	PA	Delaware County	491	4,715	1,788	3,000	1,393	**11,387**
10003	DE	New Castle County	15	4,626	1,931	3,051	848	**10,470**
34005	NJ	Burlington County	969	4,424	2,036	2,518	237	**10,183**
34007	NJ	Camden County	259	4,756	1,433	2,450	219	**9,117**
34015	NJ	Gloucester County	25	5,129	1,240	1,499	939	**8,832**
10005	DE	Sussex County	88	2,315	2,589	2,856	817	**8,665**
34021	NJ	Mercer County	75	4,168	1,185	1,964	135	**7,528**
34001	NJ	Atlantic County	204	3,245	2,230	1,261	98	**7,038**
34011	NJ	Cumberland County	889	2,613	780	676	70	**5,028**
34009	NJ	Cape May County	-	1,534	2,943	517	21	**5,014**
10001	DE	Kent County	80	1,578	1,127	1,010	85	**3,878**
24015	MD	Cecil County	4	951	1,055	853	20	**2,883**
34033	NJ	Salem County	13	1,024	525	387	199	**2,148**

[5] EPA's 2011 NEI V3 Emissions data included biogenic emissions within the nonpoint emissions data. The nonpoint VOC emissions in Table 4 exclude the biogenics emissions which EPA had added for each county.

Philadelphia County has the highest individual NOx or VOC emissions of the counties of interest and the highest combined emissions (NOx + VOC emissions). New Castle County's combined emissions are about half of Philadelphia County's combined emissions. New Castle County's emissions beyond 2011 have decreased, and continue to decline, in part due to enforceable coal to gas fuel switching; adoption and implementation of NOx measures which significantly reduce refinery emissions and VOC measures such as the updated AIM and Consumer Products rules; and adoption of CA LEV III.

During the designations process for the 2008 8-hour ozone NAAQS , the EPA's factor assessment characterized Berks County emissions as "moderate," and excluded Berks County from the 2008 Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE nonattainment area (2008 Philadelphia NAA). Berks County's total 2008 NOx and VOC emissions were similar to New Castle County's total 2008 NOx and VOC emissions, as well as Chester County 's (which separates Berks County and New Castle County) , both of which were included within the 2008 Philadelphia NAA. Berks County's 2011 NOx and VOC emissions are higher than New Castle County's emissions. For this reason, emissions indicate New Castle County is separate from the other counties of interest.

Population and Degree of Urbanization

Table 5 contains various demographic information for the counties of interest, to include each county's land area (in square miles), 2014 population, population density, and the percent of the population which reside in an urban area. These demographic data were obtained from the U.S. Census Bureau website at www.census.gov.[6]

Table 5 - 2014 Population and Density

FIPS	State	County	Land Area (SQ MI, US 2014 Gazeteer)	2014 Population (5yr ACS)	2014 Population/ Sq. Mile (people/mile^2)	% Urban Population (2010 Census)
42101	PA	Philadelphia County	134.11	**1,546,920**	11,535	100.0%
42091	PA	Montgomery County	483.04	**809,372**	1,676	97.1%
42017	PA	Bucks County	604.32	**626,205**	1,036	91.2%
34029	NJ	Ocean County	628.83	**581,413**	925	97.1%
42045	PA	Delaware County	183.84	**560,775**	3,050	99.5%
10003	DE	New Castle County	426.29	**545,846**	1,280	95.4%
34007	NJ	Camden County	221.27	**512,632**	2,317	98.4%
42029	PA	Chester County	750.51	**506,422**	675	86.7%
34005	NJ	Burlington County	798.58	**450,155**	564	93.3%
42011	PA	Berks County	856.48	**413,016**	482	76.3%

[6] Land Area obtained from US Census Bureau, 2014 U.S. Gazetteer Files, http://www.census.gov/geo/maps-data/data/gazetteer2014.htm. Population estimates are from the U.S. Census Bureau, American Community Survey, 5 year estimates. http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.

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34021	NJ	Mercer County	224.57	**369,526**	1,645	96.5%
34015	NJ	Gloucester County	322.02	**289,705**	900	91.7%
34001	NJ	Atlantic County	555.71	**275,325**	495	87.3%
10005	DE	Sussex County	936.09	**203,737**	218	58.7%
10001	DE	Kent County	586.32	**167,477**	286	73.0%
34011	NJ	Cumberland County	483.76	**157,429**	325	77.0%
24015	MD	Cecil County	346.28	**101,803**	294	57.9%
34009	NJ	Cape May County	251.43	**96,286**	383	82.5%
34033	NJ	Salem County	331.99	**65,501**	197	54.7%

Philadelphia County has the highest population and population density among the counties of interest. Bucks, Chester, Delaware, and Montgomery Counties, in Pennsylvania; Burlington, Camden, and Ocean Counties in New Jersey; and New Castle County in Delaware have somewhat large populations compared to Kent and Sussex Counties in Delaware. Although Cecil County in Maryland and several counties in New Jersey that were included in the 2008 Philadelphia NAA have comparatively small populations and population densities, they have lower populations and population densities than Berks County, which was excluded from the 2008 Philadelphia NAA. Although New Castle County's population and population density are higher than those of Berks County, these values are more alike than the values between New Castle County and Philadelphia County. In the factor assessment for Berks County for the 2008 8-hour ozone NAAQS, EPA states that it considers these demographic factors as indicators of the probable location and magnitude of nonpoint source emissions. For the factor assessment of Berks County EPA stated, "*...non-point source emissions from Lebanon or Schuylkill Counties are not likely to contribute to ozone violations in Berks County*" since Berks County's population was nearly three times higher than the other two counties. By this reasoning, it would suggest that nonpoint source emissions from New Castle County are not likely to contribute to ozone violations in Philadelphia County.

Traffic and Commuting Patterns

Traffic and commuting patterns usually show similarities in cities and counties with similar rural or urban patterns, such as within a CBSA/CSA. Their relations with local onroad mobile emissions seem to be more apparent or more easily identified on a local scale. As shown in Table 6, New Castle County's vehicle miles traveled (VMT) in 2011 are similar to that of the counties in and around Philadelphia County.[7]

Table 6 - 2011 VMT

FIPS	State	County	Vehicle Miles Traveled (VMT)
42091	PA	Montgomery County	**6,505,446,421**
42101	PA	Philadelphia County	**5,344,508,760**

[7] 2011 Vehicle Miles Traveled provided by EPA at https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data

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FIPS	State	County	Vehicle Miles Traveled (VMT)
10003	DE	New Castle County	**5,201,246,605**
42017	PA	Bucks County	**4,727,709,143**
34029	NJ	Ocean County	**4,617,759,793**
34005	NJ	Burlington County	**4,477,567,355**
42029	PA	Chester County	**4,277,236,066**
34007	NJ	Camden County	**3,848,560,437**
42011	PA	Berks County	**3,381,679,887**
42045	PA	Delaware County	**3,336,446,326**
34021	NJ	Mercer County	**3,325,914,191**
34015	NJ	Gloucester County	**2,713,227,986**
34001	NJ	Atlantic County	**2,676,389,714**
10005	DE	Sussex County	**2,224,310,996**
10001	DE	Kent County	**1,601,985,389**
24015	MD	Cecil County	**1,356,020,045**
34011	NJ	Cumberland County	**1,122,284,008**
34009	NJ	Cape May County	**1,043,389,878**
34033	NJ	Salem County	**779,668,486**

National, regional, and local emission inventory data have shown for many years that the onroad mobile source emissions remain a major portion of an area's or county's total emission inventory. The emissions data in Table 3 and Table 4 show that onroad emissions contribute between one third to two thirds of the NOx emissions in the counties of interest, while onroad emissions contribute no more than a third of the VOC emissions. While onroad emissions contribute to less than half of the NOx emissions in New Castle County, onroad emissions contribute to well more than half of the NOx emissions in some counties surrounding Delaware. Not surprisingly, onroad contributions of NOx and VOC emissions from the onroad sector, compared to emissions in total, are more prevalent in counties along the I-95 corridor. However, Berks County is an exception to this statement, which is not near the I-95 corridor, and has relatively fewer VMT in 2011 than New Castle County. Yet, 54% and 30% of Berks County's total 2011 NOx and VOC emissions, respectively, are onroad emissions (both of which are greater percentages than New Castle County's onroad emissions contributions).

Table 7 contains the "Commuting (Journey to Work) Worker Flows" for the counties of interest.[8] From the data it can be seen that most Delaware commuters work within Delaware. This makes sense as most commuters work in the same county in which they live, and is true for most of the counties shown. For New Castle County, over 26,000 commuters travel into Pennsylvania to work in one of the counties of interest, with over 24,000 traveling specifically to either Chester County, Delaware County, or Philadelphia County. Cecil County has many commuters who

[8] Commuting (Journey to Work) Worker Flows are from US, Census Bureau, American Community Survey, 5 year estimates 2009-2013. http://www.census.gov/hhes/commuting/data/commutingflows.html

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work in the same county, but about 10,000 of its commuters travel to Delaware, primarily in New Castle County. In Pennsylvania, only a small percentage of commuters travel into Delaware, but the total commuters to Delaware just from the 5 counties of interest in Pennsylvania are almost the same as all Delaware c ommuters which travel into Pennsylvania. The same can be said about the counties of interest in New Jersey, in that the number of commuters from those counties is nearly the same as all Delaware commuters which travel into New Jersey. In regards to New C astle County specifically, more commuters travel into the county from the counties of interest (about 47,000, excluding Kent and Sussex Counties in Delaware), than commuters from New Castle County travel to counties of interest of the surrounding states (a bout 36 ,000, excluding Kent and Sussex Counties in Delaware). By this metric, more onroad emissions are coming into New Castle County from out of state commuters than from Delaware workers commuting to the surrounding states.

In the factor assessment for Delaware for the 2008 8-hour ozone NAAQS, Berks County is shown to have as many workers commuting into Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania as New Castle County (based upon commuting work flows from the 2000 Census). E PA excluded Berks County from the 2008 Philadelphia NAA despite this data. The latest worker flow data below confirms that both New Castle County and Berks County still have about the same number of workers which commute into one of the four previously named counties in Pennsylvania.

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Table 7 - County to County Commuting Flows- ACS 2009-2013

COMMUTING FROM...

COMMUTING TO		10001	10003	10005	24015	34001	34005	34007	34009	34011	34015	34021	34029	34033	42017	42017	42029	42045	42091	42101
FIPS	County Name	Kent	New Castle	Sussex	Cecil	Atlantic	Burlington	Camden	Cape May	Cumberland	Gloucester	Mercer	Ocean	Salem	Berks	Bucks	Chester	Delaware	Montgomery	Philadelphia
10001	Kent	**52,320**	3,529	**6,208**	345	20	18	25		22	4		28	38			77	48	49	99
10003	New Castle	**9,460**	**211,593**	**1,133**	**10,409**	149	702	1,447	23	298	2,376	87	69	**2,428**	184	492	**14,602**	9,451	1,431	2,712
10005	Sussex	**5,819**	464	**65,614**	12						10		30		13			120	48	
24015	Cecil	553	4,384	28	**21,722**		36			2	4			94		38	1,215	157		43
34001	Atlantic	6	148	12		**102,097**	1,920	4,846	**5,622**	**4,105**	3,041	141	**4,405**	252		111	91	588	151	587
34005	Burlington	64	625	3		2,083	**121,646**	**34,850**	415	574	**9,378**	**4,969**	**4,209**	468	29	5,919	441	1,423	2,128	6,054
34007	Camden	98	777	66	36	**3,492**	**25,242**	**119,946**	471	1,350	**23,078**	985	789	1,266	62	1,989	470	2,322	1,947	8,352
34009	Cape May		48	14		**3,890**	292	343	**32,131**	1,898	404		406	40	23	110	169	326	259	305
34011	Cumberland		211	45	10	**3,769**	441	1,760	**974**	**43,792**	4,209	62	138	**2,909**		87	16	77	65	480
34015	Gloucester	91	1,312	19	40	1,619	3,203	**17,249**	215	**3,120**	**63,519**	234	212	**4,833**		397	376	1,765	407	3,066
34021	Mercer	38	153	3		256	**22,362**	4,210	186	333	1,265	**117,053**	**6,964**	114	26	**19,632**	271	394	1,682	3,075
34029	Ocean		31	8		1,298	2,127	512	137	46	223	899	**141,719**	44		335	6	62	47	150
34033	Salem	159	1,601	23	105	222	264	991	60	**2,214**	2,874	46	45	**13,443**	29	34	201	321	115	185
42011	Berks		13	20	59	59		22	4		7	10			**142,041**	308	2,545	204	4,313	195
42017	Bucks	60	332		54	246	4,328	1,857	159	19	961	**4,753**	340	84	1,090	**175,586**	1,386	1,838	**25,722**	**24,860**
42029	Chester	155	**6,466**	141	**1,168**	202	502	689	113	126	939	134	47	86	**7,499**	2,741	**158,395**	**19,107**	**25,083**	7,479
42045	Delaware	294	**9,318**	120	482	225	1,244	2,642	219	114	3,455	202	112	600	550	2,457	**19,784**	**137,377**	12,435	**17,181**
42091	Montgomery	31	2,036	126	96	236	3,205	3,356	287	185	2,321	896	304	151	**14,822**	**45,800**	**29,813**	**28,263**	**258,752**	**59,146**
42101	Philadelphia	465	**8,290**	**161**	396	1,602	**16,425**	**33,685**	**777**	754	**16,075**	1,776	564	862	1,039	**34,856**	12,577	**51,283**	**59,910**	**460,086**

BOLD YELLOW - Represents destination counties with commuters within the top 25% of commuters to counties of interest from a single county.

Sonoma Technologies Inc. (STi) conducted air quality modeling using the Comprehensive Air Quality Model with extensions (CAMx) Ozone Source Apportionment Technology (OSAT) , and its results indicates that mobile emissions significantly impact monitors in and around Delaware.[9] The maximum impact to any monito r in the area, from onroad emissions in a single state, is shown in Table 8.

Table 8 – Maximum Impacts from State Onroad Emissions, To Monitors In and Around Delaware

State	Maximum Impact from State (ppb)
Pennsylvania	20.76
Maryland	17.65
New Jersey	10.74
Virginia	7.52
Ohio	4.93
Delaware	4.82
Michigan	4.11
New York – Downstate	3.51
New York – Upstate	3.42
Indiana	2.86
Connecticut	1.58
Illinois	1.57
District of Columbia	1.04
West Virginia	0.99

Mobile emissions from Pennsylvania and Maryland impact the area the most, followed by New Jersey, Virginia, Ohio, and then Delaware. The large impacts from Maryland onroad emissions are likely from the Baltimore area and not from Cecil County. The maximum impact of Delaware onroad mobile emissions on the area are about 45% less than the impacts of Virginia onroad mobile emissions, and are on par with the onroad mobile impacts of Ohio, Mi chigan, and throughout New York.

Mobile sources are regulated at the federal level through tailpipe emissions standards, and at the state level through vehicle inspection/maintenance programs, transportation conformity, and adoption of California Low Em ission Vehicles. Each of the counties in the Philadelphia area have these programs in place. Transportation conformity is implemented at the county level – each county in the area has established and demonstrates compliance with its own conformity budget separate from the other parts of the CBSA. This means that mobile emissions and planning do not, and have not , historically tie the area together. The lack of interstate planning, to include transportation conformity coordination, indicates that mobile emissions should not be a significant consideration in establishing small, local scale nonattainment area boundaries

[9]Ozone Impacts from Brunner Island Power Plant in 2011, Sonoma Technology Inc., August 6, 2015, https://content.sierraclub.org/coal/sites/content.sierraclub.org.coal/files/docs/Sonoma_8-6-15_Brunner_Memo_1.pdf.

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around the Philadelphia area. Similarly, while the impact of mobile emissions to the area is significant, modeling shows that most of the mobile source impact is due to emissions outside of the area immediately surrounding Philadelphia; and the impact of Delaware onroad mobile emissions are more like the areas further away from the Philadelphia area.

Evaluation of Factor 2 indicates New Castle County be established as a stand alone nonattainment area, separate from the other counties of interest.

Factor 3: Meteorology

There are many components in meteorology which affect ozone formation and transport, such as precipitation, cloud coverage, solar radiation, temperature gradients, and wind. Extensive studies have been done on effects of meteorological components on ozone formation and transport, and the results consistently support the regional nature of the ozone problem (see "The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description," Final Report by NESCAUM, October 2006; "A conceptual Model for Ozone Transport," by Dr. Robert Hudson, University of Maryland, January, 2006; and "A Guide to Mid-Atlantic Regional Air Quality," by MARAMA, October 2005.).

In brief, a number of meteorological processes affect local ozone levels within the Ozone Transport Region (OTR). Transport within the OTR can be divided into three principle components: ground level transport at the surface, transport by the nocturnal low level jet, and transport aloft. All three modes of transport depend on the location of the high pressure system. Ground level transport is the result of interaction between the synoptic flow and local effects, such as the sea breeze and the Appalachian lee side trough. Transport within the OTR can occur by the nocturnal low level jet that forms late at night or in the very early morning hours. This phenomenon is a result of the differential heating of the air between the Appalachian Mountains and the Atlantic Ocean. It has been observed from Georgia to Maine. The nocturnal low level jet can transport ozone that formed within the OTR or was transported into the OTR from outside the region. Transport aloft is dominated by the anti-cyclonic flow around a high pressure system, which can lead to transport of an ozone reservoir, created by emissions in areas that lie outside the OTR, into the OTR. Local emissions within the OTR add to the polluted air mixing down from above that arrived from more distant locations. A number of modeling studies indicate that pollution sources in the Ohio River Valley and the Southeast significantly contribute to ozone nonattainment problems in various portions of the OTR. In fact, meteorology and its impact on ozone and ozone precursor transport, and its impact on the formation of ozone in the atmosphere, make this a main factor that sets ozone part from other criteria pollutants. Delaware believes that the meteorology factor strongly supports the establishment of large nonattainment boundaries due its wide-range impacts.

Despite the fact that science supports establishment of large nonattainment area boundaries, an evaluation of the local Philadelphia area indicates meteorology in New Castle County is different than other parts of the Philadelphia area. Table 9 below shows the days in 2013 through 2016 which were forecast to be Air Quality Action Days (AQAD) for ozone in Delaware and the

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"Greater Philadelphia Region," as forecast by the Department of Meteorology of The Pennsylvania State University.[10]

Table 9 - Air Quality Action Days Forecast in Delaware and the Greater Philadelphia Region for Ozone for 2013 through 2016

2016		
Date	Greater Philadelphia Region	Delaware
5/25/2016	Code Orange	Code Orange
5/26/2016	Code Red	Code Red
5/27/2016	Code Orange	Code Orange
6/11/2016	Code Yellow	Code Orange
6/18/2016	Code Orange	Code Yellow
6/19/2016	Code Orange	Code Yellow
6/20/2016	Code Orange	Code Orange
6/26/2016	Code Orange	Code Yellow
7/6/2016	Code Orange	Code Orange
7/7/2016	Code Orange	Code Orange
7/17/2016	Code Orange	Code Yellow
7/22/2016	Code Orange	Code Orange
7/28/2016	Code Orange	Code Yellow
# of AQADs	12	8

2015		
Date	Greater Philadelphia Region	Delaware
6/11/2015	Code Orange	Code Orange
6/12/2015	Code Orange	Code Orange
7/12/2015	Code Orange	Code Yellow
7/19/2015	Code Orange	Code Orange
7/29/2015	Code Orange	Code Orange
8/15/2015	Code Orange	Code Yellow
8/16/2015	Code Orange	Code Yellow
8/17/2015	Code Orange	Code Yellow
9/1/2015	Code Orange	Code Yellow
9/3/2015	Code Orange	Code Orange
9/17/2015	Code Orange	Code Orange
9/18/2015	Code Orange	Code Orange
# of AQADs	12	7

2014		
Date	Greater Philadelphia Region	Delaware
6/17/2014	Code Orange	Code Orange
7/12/2014	Code Orange	Code Orange
7/22/2014	Code Orange	Code Yellow
8/5/2014	Code Orange	Code Orange
8/27/2014	Code Orange	Code Orange
# of AQADs	5	4

2013		
Date	Greater Philadelphia Region	Delaware
5/30/2013	Code Orange	Code Orange
5/31/2013	Code Orange	Code Orange
6/22/2013	Code Orange	Code Yellow
6/23/2013	Code Orange	Code Green
6/25/2013	Code Orange	Code Orange
7/17/2013	Code Orange	Code Orange
7/18/2013	Code Orange	Code Orange
7/19/2013	Code Orange	Code Yellow
8/20/2013	Code Orange	Code Yellow
8/21/2013	Code Orange	Code Yellow
# of AQADs	10	5

This data shows that there have been more AQADs forecast in Delaware and the Greater Philadelphia Region in the last two years,[11] but there have been fewer AQADs forecast for Delaware than the Greater Philadelphia Region. Additionally, the daily ozone forecast values for Delaware (of which the Air Quality Index and AQADs are based) were typically lower than the daily forecast values for the Greater Philadelphia Region. During the months of May through

[10] AQAD data is summarized from daily emails received by DAQ staff regarding the ground level ozone forecasts received either directly from Penn State University or from the Enviroflash listserve emails in recent years.
[11] Beginning in 2016, AQADs were based on forecasts which exceeded the new 0.070 ppm standard, whereas AQADs in 2013, 2014, and 2015 were based on forecasts which exceeded the previous 0.075 ppm standard.

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September, from May 2013 until the end of July 2016, the daily ozone forecast for Delaware has been lower than that of the Greater Philadelphia Region 65% of the time.[12] On average, the Delaware daily ozone forecast values have been 1.5 parts per billion (ppb) lower than those of the Greater Philadelphia region (see Table 10). When averaging the values by month, over the same time period, it can be seen from Table 10 that the Delaware forecast values vary between 0.64 ppb to 2.24 ppb lower than Greater Philadelphia region forecast values.

Table 10 -Average Difference in Daily Ozone Forecast Values 5/1/13 – 7/30/16 (Greater Philadelphia Region – Delaware)

	(ppb)
Overall Average Difference	**1.50**
Average Difference in May	0.64
Average Difference in June	1.42
Average Difference in July	1.65
Average Difference in August	2.24
Average Difference in September	1.74

This is in part due to the different weather patterns that Delaware sees versus those of the Philadelphia area. During 2013 to 2015, hot weather was seen to still be necessary for high ozone concentrations, but it is no longer sufficient to solely cause high ozone concentrations. Temperatures during June, July, and August 2015 were about average compared to 1981-2010, which would suggest an average ozone season, which indeed it was. However, 2015, like 2013-2014, was marked by an atypical weather pattern that limited the development of heat waves in June-August and inhibited the frequency of westerly transport aloft. In a study for Delaware that analyzed air mass transport patterns in the Northeast, STi looked at ozone data and back trajectories for 2008 through 2015. In comparing the ozone data from all days in the ozone season to days with high ozone (the top 10% daily 8-hr max), STi found discernable trajectory patterns between high ozone days and all days. As shown in Figure 3 there are differences in transport patterns in 2011 and 2015 compared to all other years. Specifically in 2015, the study confirms a more persistent westerly and northwesterly flow inhibited southerly transport. This shift in weather patterns in 2015 likely contributed to the recent "step-down" in observed ozone levels in Delaware, although the effects are minor compared to ongoing reductions on ozone precursor emissions, of which Delaware has made huge strides.[13]

[12] Daily ozone forecast data obtained from Dr. Amy K. Huff, Department of Meteorology, The Pennsylvania State University, via email on 8/7/16. Analysis performed on days when there were forecasts for both Delaware and the Greater Philadelphia Region – 507 days out of 557 days.

[13] "State of Delaware Final Report: Ozone Observations and Forecasts in 2015," A Report Prepared for the Delaware Department of Natural Resources and Environment, by Dr. Amy K. Huff and William F. Ryan, Department of Meteorology, The Pennsylvania State University, February 29, 2016

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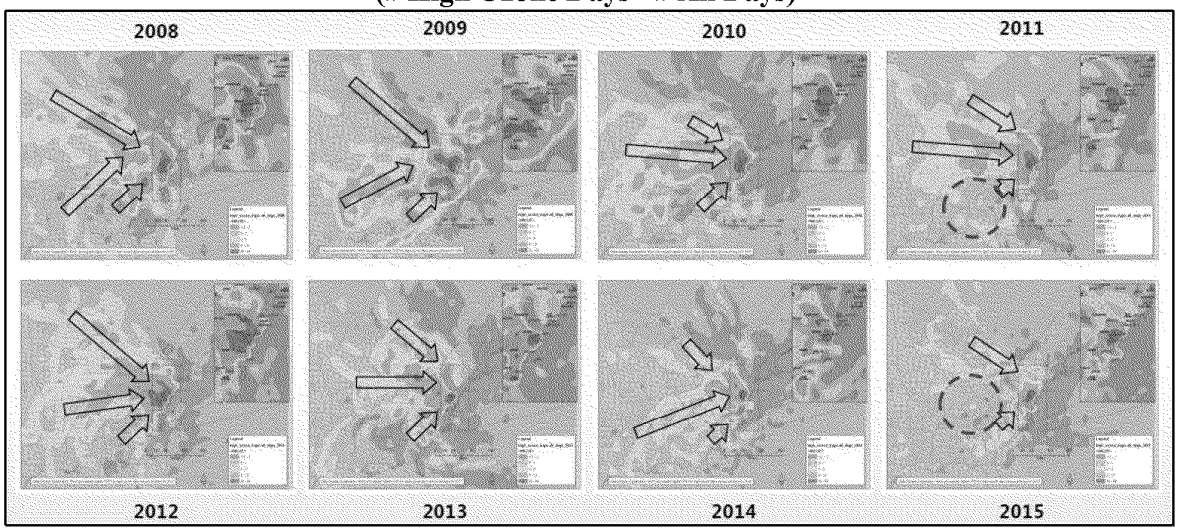
Figure 3 - Difference Comparisons
(# High Ozone Days - # All Days)



Factor 4: Geography/Topography

Delaware is on a level plain, with the lowest mean elevation of any state in the nation. It is bounded to the north by Pennsylvania; to the east by the Delaware River, Delaware Bay, part of New Jersey, and the Atlantic Ocean; and to the west and south by Maryland. Beyond Maryland to the west of Delaware is the Chesapeake Bay. The distance between the Chesapeake Bay and the Delaware River is less than 20 miles across Maryland and Delaware at the narrowest land area around the Chesapeake & Delaware Canal (C&D Canal). New Castle County is separated from New Jersey by about 1 mile of water at its closest and about 5 miles of water at its furthest (at the southern most boundary of New Castle County). Together, Delaware's geography and the land, water, and air interactions discussed below play an important part in Delaware's air quality. The two bays on either side of Delaware potentially segregate local and transported emissions, by both blocking some emissions yet concentrating other emissions. Delaware is unique i n this aspect, in that it is the only state which is almost entirely surrounded by water , thus making it geographically different from the Philadelphia region.

In the OTR, land and sea breezes, and mountain and valley breezes , can have an important influence on local air quality. These local winds are driven by a difference in temperature that produces a difference in pressure. The sea breeze forms in the afternoon when the land is considerably hotter than the ocean or bay. Air then flows from the high pressure over the ocean toward the low pressure over land. At night, the opposite may happen as the land cools to below the ocean's temperature, and a land breeze blows out to sea. Because the nighttime land and water temperature differences are usually much smaller than in the day, the land breeze is weaker

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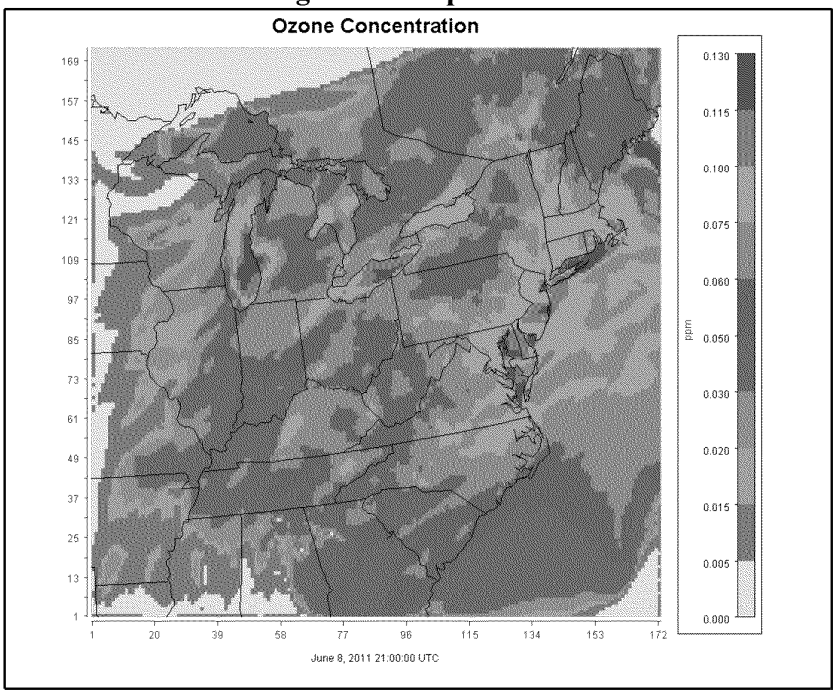
than the sea breeze. Sea breezes typically only penetrate a few kilometers inland because they are driven by temperature contrasts that disappear inland.[14]

Along coastlines, such as coastal Delaware, sea breezes bring in air pollution transported near the surface over water from urban locations located to the southwest. These sites are located many miles away from the coast, and receive ozone transported over water from the sea up through the coastal bays and rivers. In other cases, sea breezes can affect air quality in coastal cities because, under stagnant synoptic-scale winds, a city's emissions may be recirculated or pushed back over land after having drifted out over the sea earlier. Before sea breeze circulation begins, air pollution from a coastal city can move out over the water. In the absence of a shift in winds due to a sea breeze, the city's air pollution will be blown away. When a sea breeze circulation sets up, however, the polluted air is pushed back toward the city. The sea breeze only pushes a few miles inland, which is where the barrier to mixing lies. Later in the day, the air may be quite clean on the ocean side of the city, but the air is usually quite dirty on the inland side. The city suffers from its own recirculated pollution, and also from the sea breeze that does not allow pollution from the city to flow away from it. Depending on the exact conditions (time of day, meteorology, local emissions, etc.), the pollution may even be more concentrated off the coast, as shown in Figure 4, which represents modeled ozone concentrations for the high-ozone episode of 6/8/2011.

Figure 4 – Modeled Ozone Concentrations (ppm)
For the High-Ozone Episode of 6/8/2011



[14] "The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description" Prepared by NESCAUM, October 2006. www.nescaum.org/documents/2006-1013b-o3-conceptual-model-draft-final-all.pdf/

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The bay breeze is a shallow circulation over large inland bays, and may only extend a couple hundred meters above the surface. For example, bay breezes from the Chesapeake Bay often make Baltimore's summertime air quality particularly poor. Air from the city cannot escape directly across the Bay. On the other hand, a few miles closer to the Bay, conditions a re often considerably cleaner, since no fresh emissions have gotten into the air there since earlier that morning. Polluted air from the west side of the Bay can still mix upward, where it meets the stronger winds aloft, pass over the Bay breeze circulation and come back down on the east side of the Bay. In a recent study, results from meteorological and air -quality model simulations, airborne and shipborne in situ air -quality observations, and routine air -quality and meteorological observations from grou nd-based monitoring stations were used to investigate how the Chesapeake Bay breeze affects air quality.[15] The study's results show that a strong and prolonged bay breeze on July 11, 2011 caused locally high surface ozone concentrations near the bay breeze convergence zone, which penetrated into the urban corridor. An extended period of convergence of air pollution at the bay breeze front resulted in a significant amount of air pollution being transported up and into the free troposphere. This elevated layer of air pollution aloft was transported far downwind into New England by early the following morning where it likely mixed down to the surface, affecting air quality in that region.

Factor 5: Jurisdictional Boundaries

Jurisdictional boundaries limits the authority of a nonattainment area (a county or state within a CBSA/CSA) to address upwind impacts on its nonattainment problems. Sections 110 and 126 of the Clean Air Act provide states a mechanism to petition to EPA for controls on upwind emission sources, and although Delaware has petitioned EPA under th ese provisions, EPA has not responded effectively. As part of EPA's reasoning for incorporating New Castle County in a multi-state nonattainment area under the 2008 8-hour ozone NAAQS, EPA states:

> "New Castle County has historically been part of the Philadelphia nonattainment area for ozone (1 -hour and 8 -hour) and fine particulate matter (PM2.5). New Castle County is part of the Wilmington, DE -MD-NJ Metropolitan Division of the Philadelphi a-Camden-Wilmington Metropolitan Statistical Area (MSA) in the Philadelphia -Camden-Vineland CSA. Being part of a statistical area indicates that counties are linked through employment and commuting. According to the Office of Management and Budget's "Standards for Defining Metropolitan and Micropolitan Statistical Areas," published in the Federal Register on December 27, 2000 (65 FR 82228), the "general concept of a Metropolitan Statistical Area or a Micropolitan Statistical Area is that of an area containing a recognized population nucleus and adjacent communities that have a high degree of integration with that nucleus." Delaware, Pennsylvania, Maryland and New Jersey have a long history of working cooperatively through the Ozone Transport Commission (OTC) and the Mid -Atlantic Northeast Visibility Union (MANE -VU) with

[15] Christopher P. Loughner, Maria Tzortziou, Melanie Follette -Cook, Kenneth E. Pickering, Daniel Goldberg, Chinmay Satam, Andrew Weinheimer, James H. Crawford, David J. Knapp, Denise D. Montzka, Glenn S. Diskin, and Russell R. Dickerson. " Impact of Bay -Breeze Circulations on Surface Air Quality and Boundary Layer Export." Journal Of Applied Meteorology And Climatol ogy, vol. 53, July 2014, pp. 1697 -1713. DOI: 10.1175/JAMC-D-13-0323.1

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ozone attainment planning. Furthermore, the two local MPOs, DVRPC and WILMAPCO, have worked together for decades."

While it is true that New Castle County has historically been part of a Philadelphia based nonattainment area and statistical area, it is not logical to keep the county in future Philadelphia based nonattainment areas simply to keep the "status quo." EPA's logic that Delaware's cooperation with its immediately neighboring states as part of the OTC or MANE-VU as a basis for including it in a multi-state nonattainment area does not make sense. The OTR and OTC were created under the Clean Air Act to advise EPA on transport issues and to develop and implement regional solutions to ground-level ozone in the OTR. These entities are established and operate separate from nonattainment designations. Using EPA's logic, each state, in whole, in the OTR should be incorporated into a single multi-state nonattainment area as every state in the OTR works cooperatively at ozone attainment planning. Delaware has petitioned EPA to expand the OTR to include all of the States that science indicates should be included and the EPA has not yet acted on this petition despite the statuary deadline for action having passed more than 15 months ago. Also, EPA was incorrect that local MPOs support including New Castle County, Delaware as part of the Philadelphia area in the 2008 designations, and that rationale remains incorrect now. Transportation conformity is implemented at the county level – each county in the area has established and demonstrates compliance with its own conformity budget separate from the other parts of the CBSA. This means that mobile emissions and planning do not, and have not, historically tie the area together. The lack of interstate planning, to include transportation conformity coordination, indicates that mobile emissions should not be a significant consideration in establishing small, local scale nonattainment area boundaries around the Philadelphia area. Thus, unless Delaware's primary recommendation of a large nonattainment area is accepted by EPA, Delaware believes evaluation of this factor supports establishment of a nonattainment boundary for New Castle County that follows the jurisdictional boundaries of the county.

Summary

The above five factor analysis in determining the nonattainment boundary that would include New Castle County is summarized as follows:

- Delaware air quality, based on 2014-2016 monitoring data, indicates nonattainment of the 2015 8-hour ozone NAAQS in New Castle County.
- In New Castle County, ozone exceedances are generally associated with two general scenarios: long-range transport from the southwest or west, and local circulation along the I-95 corridor which runs from southwest to northeast. Differences in daily ozone forecast values between Delaware and southeastern counties in Pennsylvania suggest that meteorological differences between the areas are an important part of the differences in ozone values in each area.
- New Castle County's emissions of VOC and NOx are similar, yet lower, than many other counties surrounding it. Its 2011 emissions are lower than those of Berks County, which was excluded from the 2008 Philadelphia NAA despite having similar 2008 emissions as New Castle County.

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- The population, population density, and level of urbanization of New Castle County are relatively similar to those of the counties of interest. By EPA's reasoning that such demographic data is an indicator of nonpoint emissions, New Castle County's nonpoint emissions have no greater impact on ground -level ozone than most other counties surrounding it. Philadelphia County's high population, population density, and high 2011 nonpoint emissions reflect EPA's rationale.
- The numbers of vehicle miles traveled in New Castle County is similar to that in other counties surrounding it, though more workers commute into New Castle County than workers which commute out of the cou nty. Its VMT and worker flow data is similar to Berks County, which was excluded from the 2008 Philadelphia NAA , despite Berks County having just as much impact to the Philadelphia "urban core" as New Castle County. In fact, New Castle County's 2011 onroad emissions are less than Berks County's 2011 onroad emissions.
- Delaware is geographically in an area that is unlike any other. The large water bodies which practically surround the state create complex meteorological mountains and valleys that at times funnel transported emissions around the Delmarva Peninsula and up the I-95 corridor, and at other times trap upwind emissions such that those emissions are recirculated by ocean and bay breezes, and impact Delaware multiple times.

Based on the data and analysis presented above , Delaware recommends a standalone nonattainment area be established for New Castle County. Also, Based upon EPA's rationale for segregating Berks County as its own nonattainment area in the previous assessment, New Castle County should be segregated into its own nonattainment area in the current assessment. New Castle County has lower emissions than Berks County, similar demographics to Berks County, and similar commuting patterns to Berks County. Delaware's unique geography and meteorology (due to the land, water, and air interactions) make New Castle County even more unique than Berks County.

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APPENDIX C

24-Hour HYSPLIT Back Trajectories for Exceedances of the 70 ppb Standard at Ozone Monitors for Calendar Years 2013-2015

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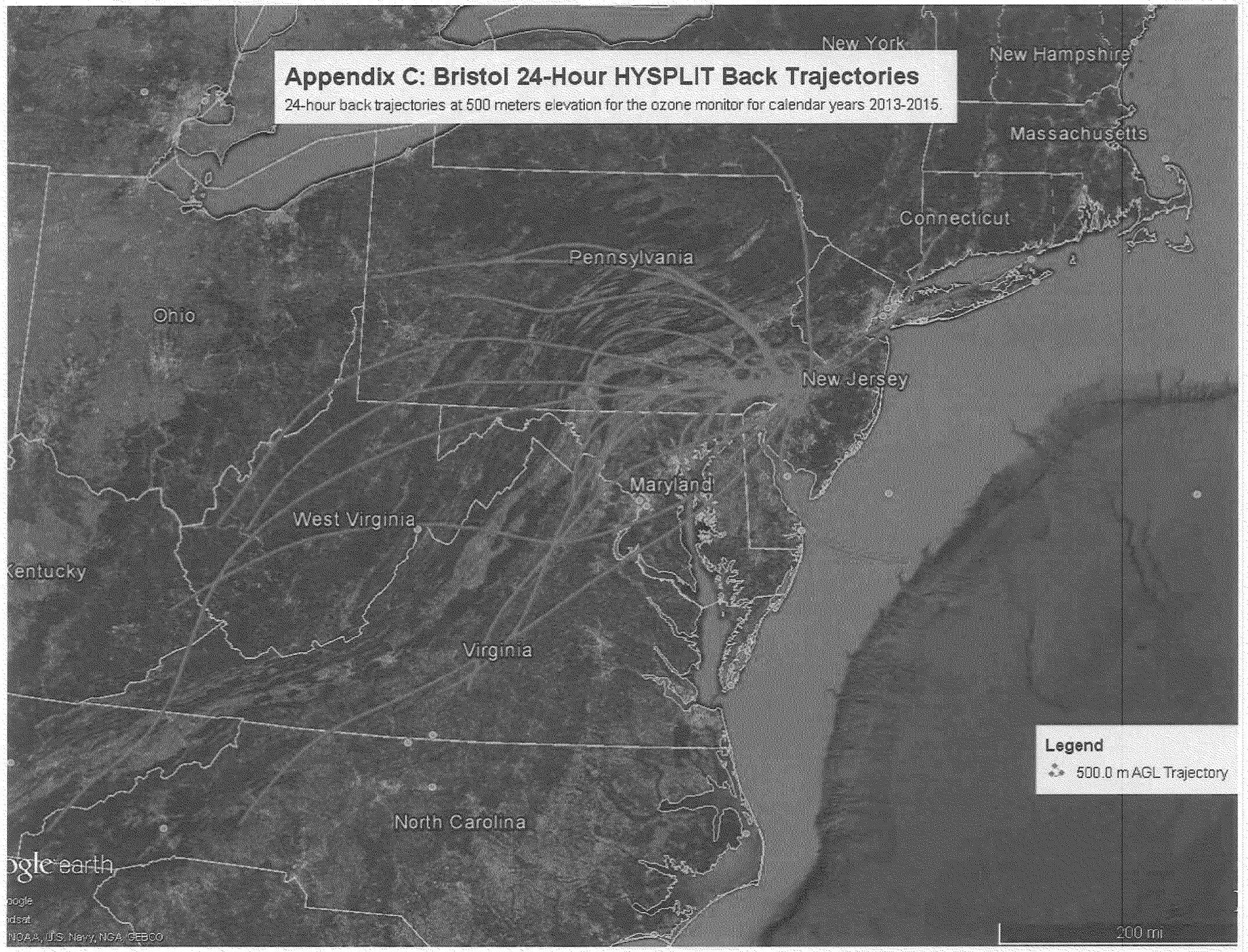
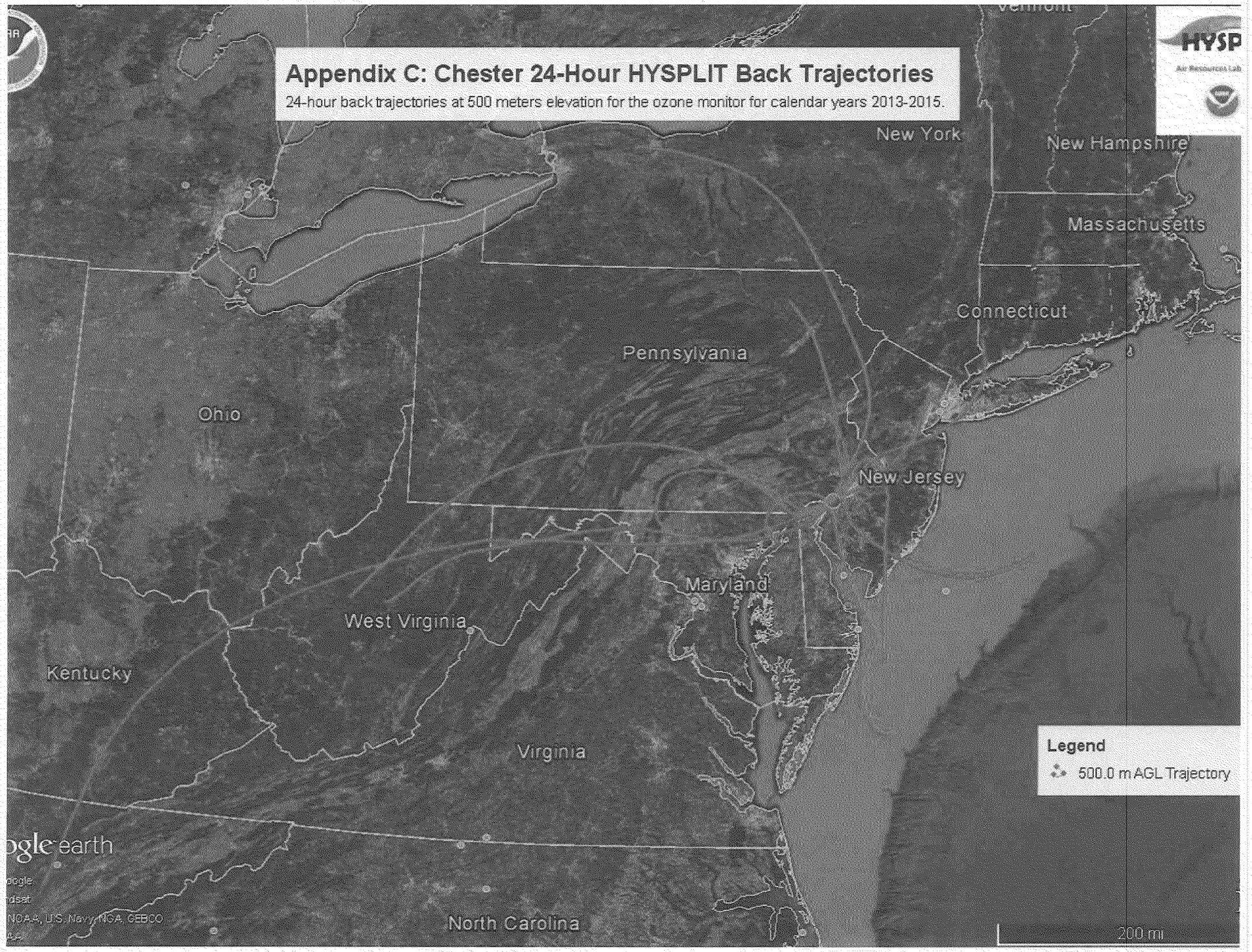


Appendix C: Bristol 24-Hour HYSPLIT Back Trajectories

24-hour back trajectories at 500 meters elevation for the ozone monitor for calendar years 2013-2015.



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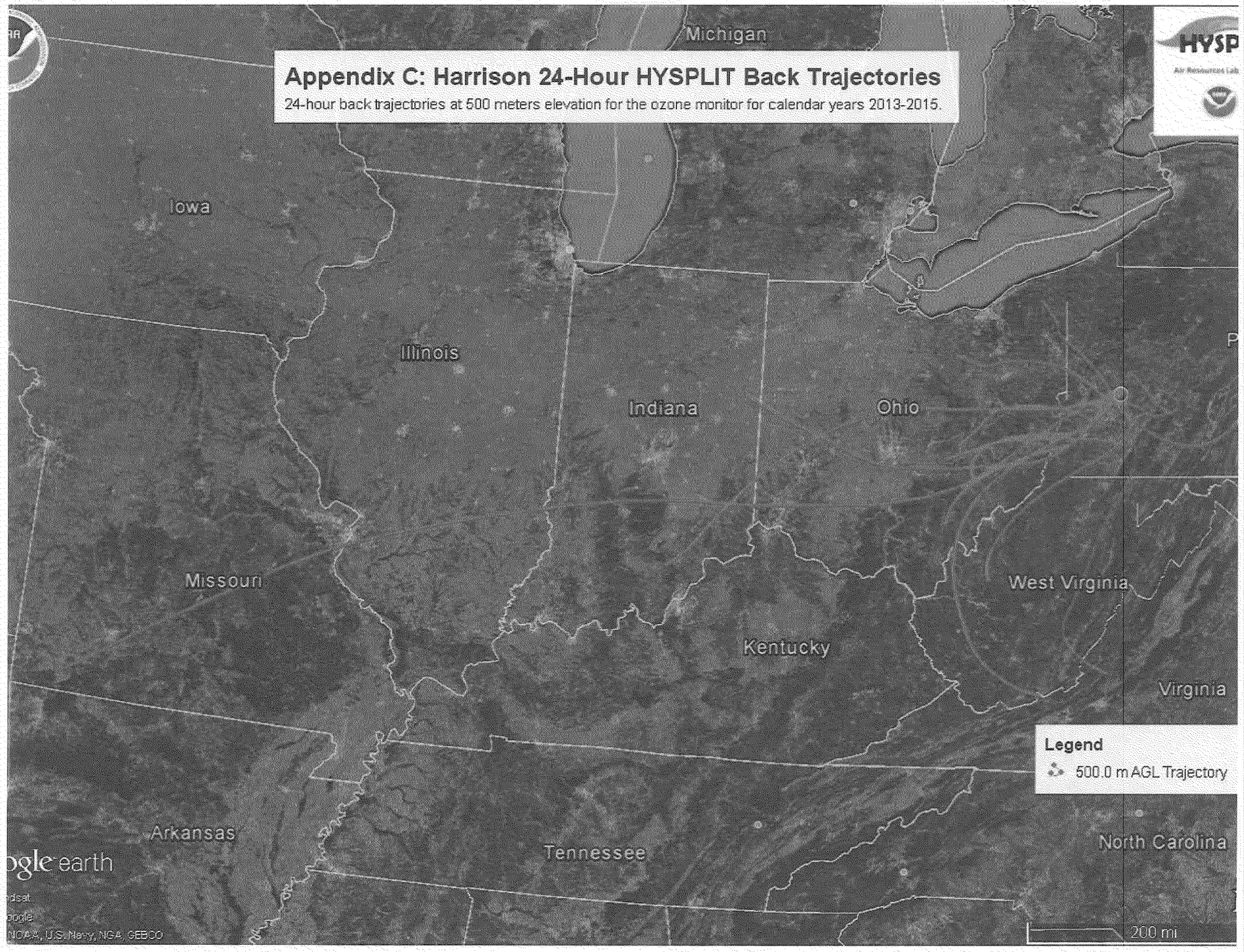
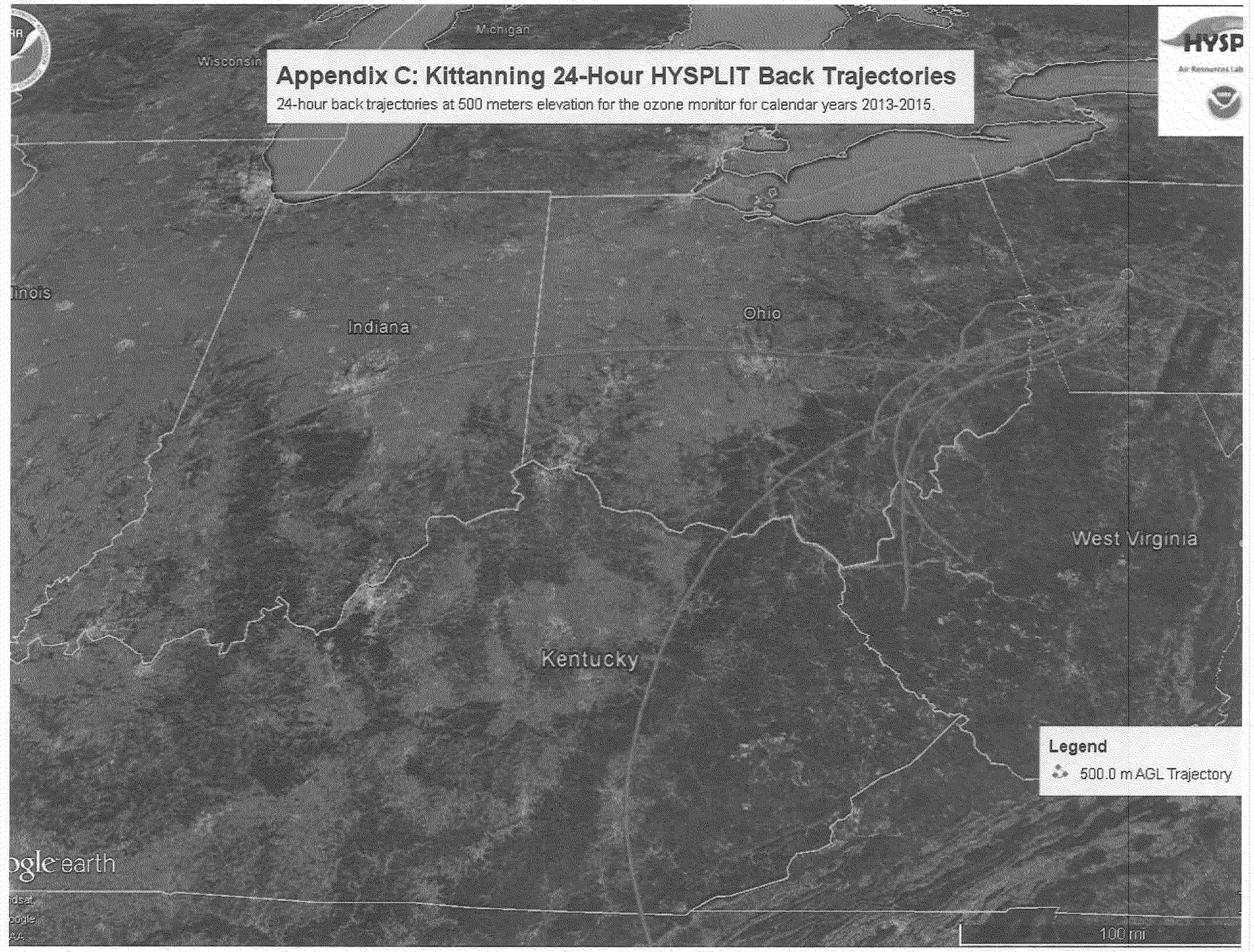

Appendix C: Harrison 24-Hour HYSPLIT Back Trajectories
24-hour back trajectories at 500 meters elevation for the ozone monitor for calendar years 2013-2015.
HYSP
Michigan
Iowa
Illinois
Indiana
Ohio
Missouri
West Virginia
Kentucky
Virginia
Arkansas
Tennessee
North Carolina
Legend
500.0 m AGL Trajectory
200 mi
ogle earth
NOAA, U.S. Navy, NGA, GEBCO


Appendix C: Kittanning 24-Hour HYSPLIT Back Trajectories
24-hour back trajectories at 500 meters elevation for the ozone monitor for calendar years 2013-2015.
HYSP
Air Resources Lab
Michigan
Wisconsin
Illinois
Indiana
Ohio
West Virginia
Kentucky
Legend
500.0 m AGL Trajectory
100 mi
ogle earth

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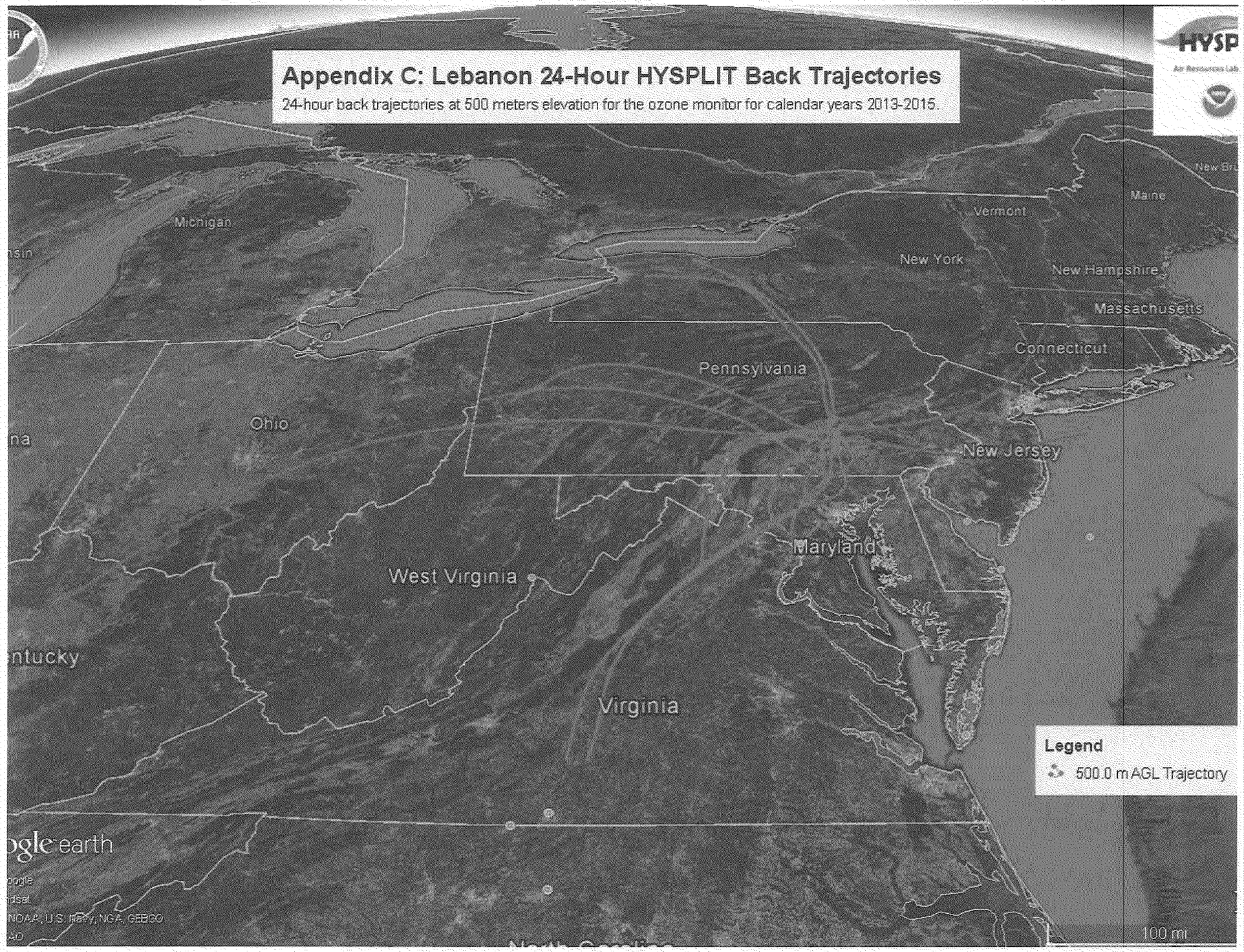
Appendix C: Lebanon 24-Hour HYSPLIT Back Trajectories

24-hour back trajectories at 500 meters elevation for the ozone monitor for calendar years 2013-2015.



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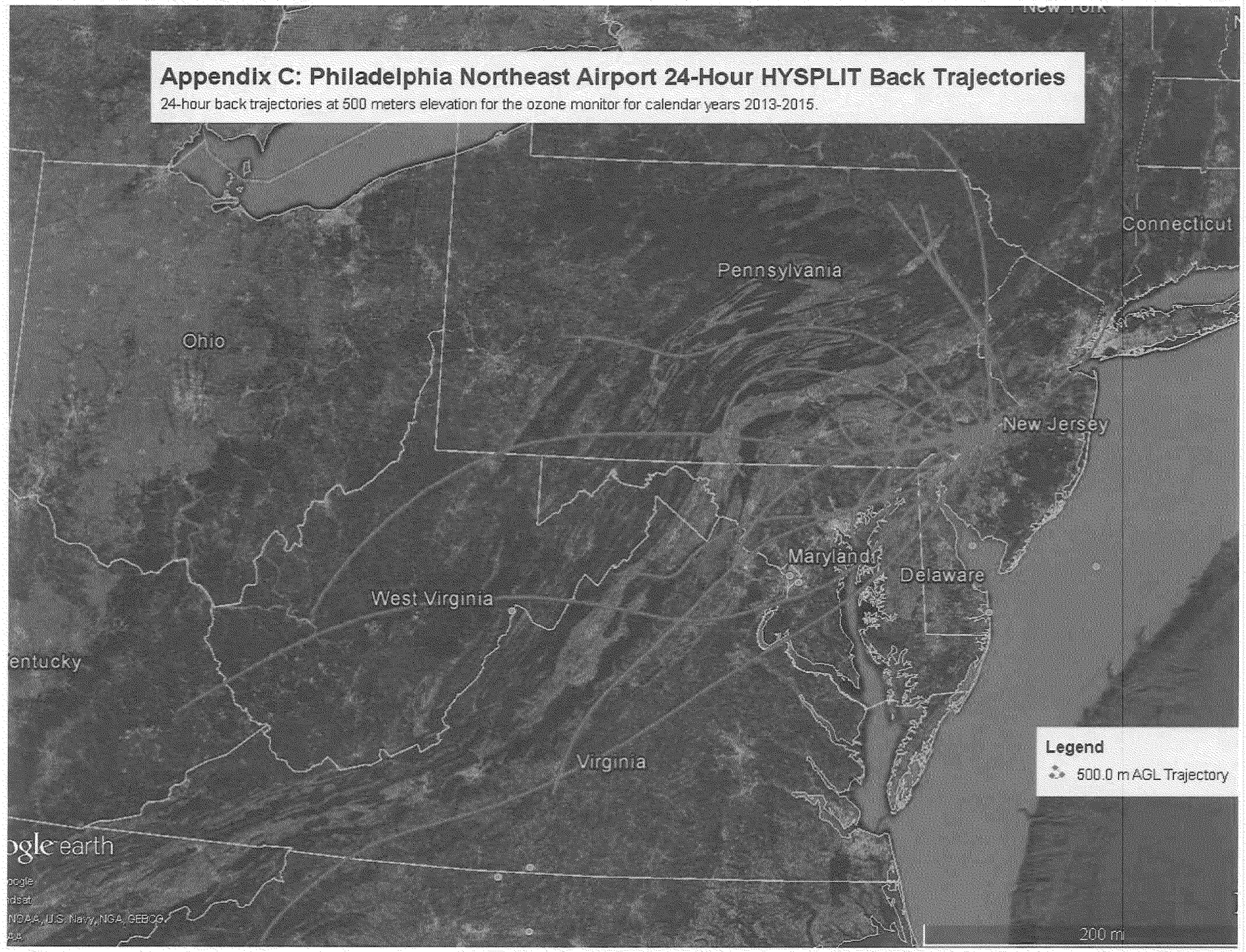
Appendix C: Philadelphia Northeast Airport 24-Hour HYSPLIT Back Trajectories

24-hour back trajectories at 500 meters elevation for the ozone monitor for calendar years 2013-2015.



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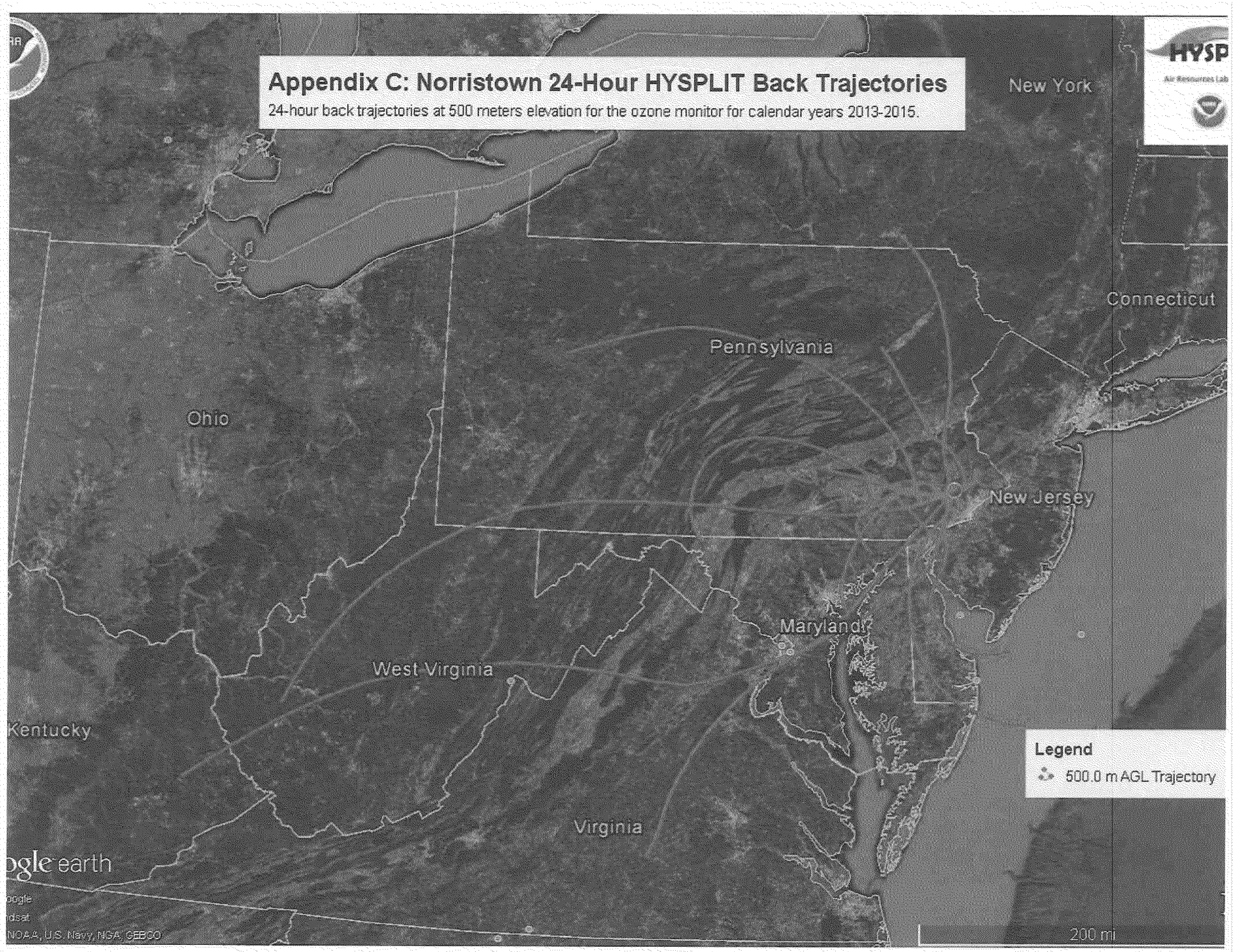
Appendix C: Norristown 24-Hour HYSPLIT Back Trajectories

24-hour back trajectories at 500 meters elevation for the ozone monitor for calendar years 2013-2015.



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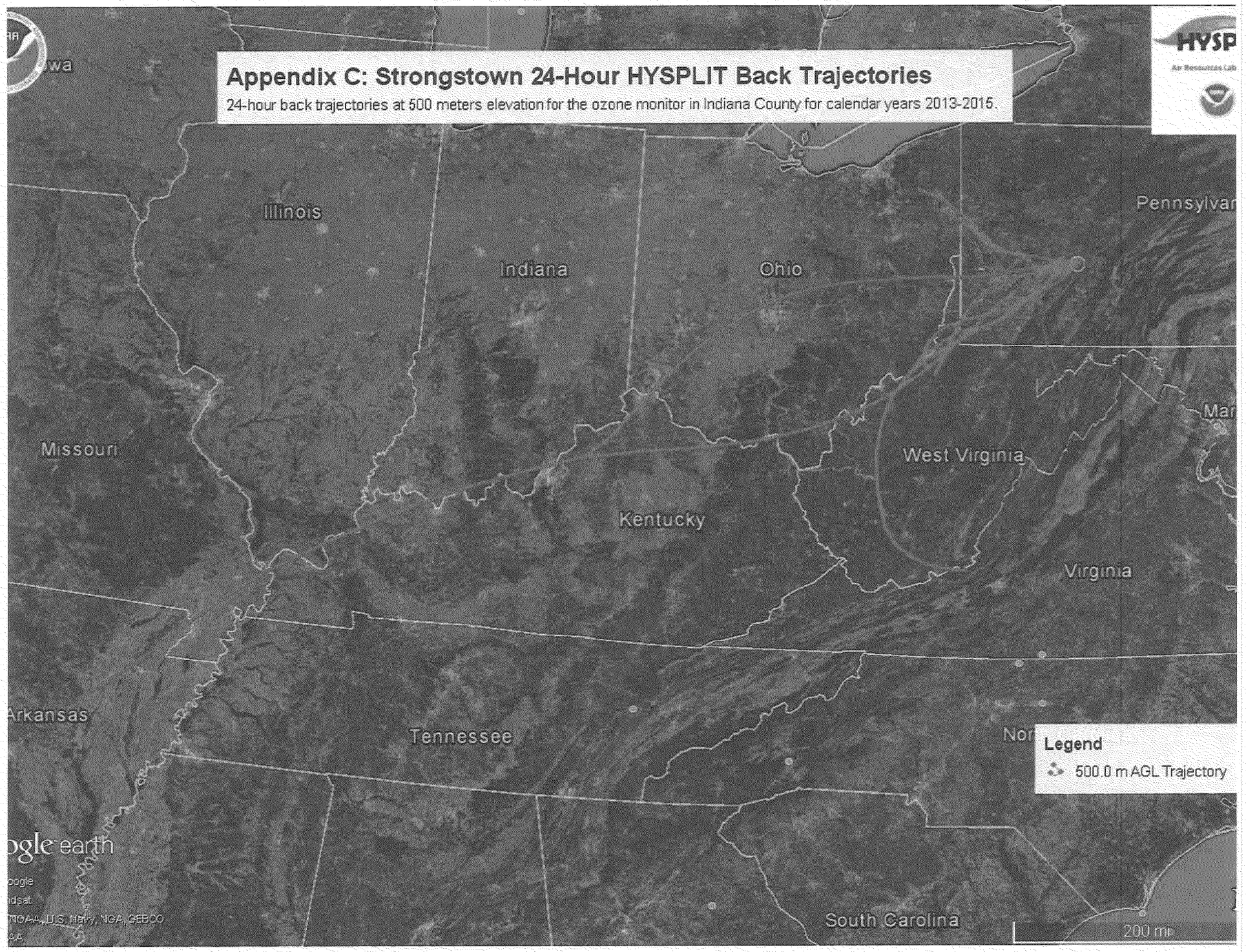
Appendix C: Strongstown 24-Hour HYSPLIT Back Trajectories

24-hour back trajectories at 500 meters elevation for the ozone monitor in Indiana County for calendar years 2013-2015.



APPENDIX D

Commuting Patterns for Selected Counties within Metropolitan Statistical Areas

Allegheny County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Allegheny County, PA	445,081	**80.90%**	**Allegheny County, PA**	445,081	**66.90%**
Westmoreland County, PA	18,534	**3.40%**	Westmoreland County, PA	53,125	**8.00%**
Washington County, PA	17,703	**3.20%**	Washington County, PA	30,630	**4.60%**
Butler County, PA	13,970	**2.50%**	Butler County, PA	26,128	**3.90%**
Beaver County, PA	7,081	**1.30%**	Beaver County, PA	25,538	**3.80%**
Philadelphia County, PA	3,065	**0.60%**	Armstrong County, PA	6,586	**1.00%**
Montgomery County, PA	2,632	**0.50%**	Fayette County, PA	6,080	**0.90%**
Cumberland County, PA	2,169	**0.40%**	Lawrence County, PA	4,470	**0.70%**
Dauphin County, PA	2,000	**0.40%**	Erie County, PA	3,575	**0.50%**
Erie County, PA	1,927	**0.40%**	Indiana County, PA	3,276	**0.50%**
Fayette County, PA	1,742	**0.30%**	Mercer County, PA	2,950	**0.40%**
Lawrence County, PA	1,594	**0.30%**	Cambria County, PA	2,723	**0.40%**
Mercer County, PA	1,470	**0.30%**	Philadelphia County, PA	2,398	**0.40%**
Cambria County, PA	1,302	**0.20%**	Hancock County, WV	2,257	**0.30%**
Indiana County, PA	1,278	**0.20%**	Montgomery County, PA	2,222	**0.30%**
Armstrong County, PA	1,086	**0.20%**	Greene County, PA	2,059	**0.30%**
Blair County, PA	1,049	**0.20%**	Blair County, PA	1,761	**0.30%**
Lancaster County, PA	1,019	**0.20%**	Chester County, PA	1,634	**0.20%**
York County, PA	998	**0.20%**	York County, PA	1,548	**0.20%**
Delaware County, PA	994	**0.20%**	Somerset County, PA	1,541	**0.20%**
Chester County, PA	979	**0.20%**	Bucks County, PA	1,531	**0.20%**
Centre County, PA	856	**0.20%**	Dauphin County, PA	1,461	**0.20%**
Bucks County, PA	818	**0.10%**	Lancaster County, PA	1,432	**0.20%**
Lehigh County, PA	752	**0.10%**	Columbiana County, OH	1,387	**0.20%**
Greene County, PA	692	**0.10%**	Cumberland County, PA	1,273	**0.20%**
All Other Locations	19,426	**3.50%**	All Other Locations	32,368	**4.90%**

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Armstrong County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Armstrong County, PA	8,741	**29.60%**	**Armstrong County, PA**	8,741	**53.30%**
Allegheny County, PA	6,586	**22.30%**	Westmoreland County, PA	1,594	**9.70%**
Westmoreland County, PA	3,632	**12.30%**	Butler County, PA	1,483	**9.00%**
Butler County, PA	3,320	**11.30%**	Allegheny County, PA	1,086	**6.60%**
Indiana County, PA	1,655	**5.60%**	Indiana County, PA	915	**5.60%**
Clarion County, PA	847	**2.90%**	Clarion County, PA	449	**2.70%**
Jefferson County, PA	399	**1.40%**	Clearfield County, PA	174	**1.10%**
Cambria County, PA	388	**1.30%**	Cambria County, PA	160	**1.00%**
Washington County, PA	290	**1.00%**	Venango County, PA	157	**1.00%**
Clearfield County, PA	257	**0.90%**	Jefferson County, PA	151	**0.90%**
Blair County, PA	231	**0.80%**	Washington County, PA	109	**0.70%**
Cumberland County, PA	213	**0.70%**	Beaver County, PA	96	**0.60%**
Beaver County, PA	195	**0.70%**	Erie County, PA	94	**0.60%**
Erie County, PA	154	**0.50%**	Mercer County, PA	86	**0.50%**
Fayette County, PA	150	**0.50%**	Somerset County, PA	81	**0.50%**
Dauphin County, PA	142	**0.50%**	Fayette County, PA	74	**0.50%**
Somerset County, PA	124	**0.40%**	Blair County, PA	61	**0.40%**
Mercer County, PA	118	**0.40%**	Lawrence County, PA	60	**0.40%**
Centre County, PA	116	**0.40%**	Crawford County, PA	35	**0.20%**
Venango County, PA	115	**0.40%**	Centre County, PA	31	**0.20%**
Lancaster County, PA	96	**0.30%**	Elk County, PA	30	**0.20%**
Lycoming County, PA	79	**0.30%**	Bedford County, PA	28	**0.20%**
York County, PA	79	**0.30%**	Huntingdon County, PA	27	**0.20%**
Greene County, PA	75	**0.30%**	McKean County, PA	26	**0.20%**
Montgomery County, PA	70	**0.20%**	Potter County, PA	18	**0.10%**
All Other Locations	1,436	**4.90%**	All Other Locations	644	**3.90%**

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Beaver County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Beaver County, PA	28,705	**39.30%**	**Beaver County, PA**	28,705	**55.00%**
Allegheny County, PA	25,538	**34.90%**	Allegheny County, PA	7,081	**13.60%**
Butler County, PA	5,826	**8.00%**	Lawrence County, PA	3,193	**6.10%**
Lawrence County, PA	2,032	**2.80%**	Butler County, PA	2,720	**5.20%**
Washington County, PA	1,325	**1.80%**	Columbiana County, OH	2,090	**4.00%**
Westmoreland County, PA	1,113	**1.50%**	Westmoreland County, PA	1,200	**2.30%**
Erie County, PA	531	**0.70%**	Washington County, PA	1,047	**2.00%**
Mercer County, PA	527	**0.70%**	Hancock County, WV	625	**1.20%**
Cumberland County, PA	497	**0.70%**	Mercer County, PA	392	**0.80%**
Columbiana County, OH	365	**0.50%**	Fayette County, PA	380	**0.70%**
Philadelphia County, PA	342	**0.50%**	Erie County, PA	343	**0.70%**
Montgomery County, PA	316	**0.40%**	Mahoning County, OH	254	**0.50%**
Dauphin County, PA	305	**0.40%**	Indiana County, PA	211	**0.40%**
Indiana County, PA	232	**0.30%**	Armstrong County, PA	195	**0.40%**
Hancock County, WV	227	**0.30%**	Trumbull County, OH	169	**0.30%**
Mahoning County, OH	222	**0.30%**	Ohio County, WV	146	**0.30%**
Fayette County, PA	218	**0.30%**	Jefferson County, OH	137	**0.30%**
Blair County, PA	198	**0.30%**	Venango County, PA	133	**0.30%**
Cambria County, PA	193	**0.30%**	Brooke County, WV	125	**0.20%**
Delaware County, PA	157	**0.20%**	Cambria County, PA	121	**0.20%**
Centre County, PA	153	**0.20%**	Crawford County, PA	112	**0.20%**
York County, PA	148	**0.20%**	Clarion County, PA	106	**0.20%**
Crawford County, PA	142	**0.20%**	York County, PA	103	**0.20%**
Clearfield County, PA	137	**0.20%**	Berks County, PA	100	**0.20%**
Venango County, PA	133	**0.20%**	Clearfield County, PA	98	**0.20%**
All Other Locations	3,502	**4.80%**	All Other Locations	2,445	**4.70%**

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Butler County, PA

Live in County - Work Locations

County	Job Count	Share
Butler County, PA	35,525	**44.20%**
Allegheny County, PA	26,128	**32.50%**
Beaver County, PA	2,720	**3.40%**
Westmoreland County, PA	1,948	**2.40%**
Mercer County, PA	1,857	**2.30%**
Armstrong County, PA	1,483	**1.80%**
Lawrence County, PA	1,445	**1.80%**
Washington County, PA	1,071	**1.30%**
Erie County, PA	581	**0.70%**
Cumberland County, PA	535	**0.70%**
Venango County, PA	464	**0.60%**
Montgomery County, PA	382	**0.50%**
Clarion County, PA	377	**0.50%**
Philadelphia County, PA	374	**0.50%**
Indiana County, PA	305	**0.40%**
Dauphin County, PA	289	**0.40%**
Fayette County, PA	237	**0.30%**
Cambria County, PA	214	**0.30%**
Blair County, PA	206	**0.30%**
Centre County, PA	206	**0.30%**
Crawford County, PA	204	**0.30%**
Cuyahoga County, OH	173	**0.20%**
York County, PA	166	**0.20%**
Delaware County, PA	165	**0.20%**
Bucks County, PA	132	**0.20%**
All Other Locations	3,246	**4.00%**

Work In County - Home Locations

County	Job Count	Share
Butler County, PA	35,525	**45.90%**
Allegheny County, PA	13,970	**18.00%**
Beaver County, PA	5,826	**7.50%**
Armstrong County, PA	3,320	**4.30%**
Lawrence County, PA	3,271	**4.20%**
Westmoreland County, PA	3,097	**4.00%**
Mercer County, PA	1,559	**2.00%**
Washington County, PA	1,074	**1.40%**
Clarion County, PA	1,038	**1.30%**
Venango County, PA	786	**1.00%**
Indiana County, PA	726	**0.90%**
Erie County, PA	646	**0.80%**
Fayette County, PA	427	**0.60%**
Crawford County, PA	310	**0.40%**
Cambria County, PA	262	**0.30%**
Mahoning County, OH	234	**0.30%**
York County, PA	219	**0.30%**
Clearfield County, PA	217	**0.30%**
Bucks County, PA	183	**0.20%**
Trumbull County, OH	172	**0.20%**
Columbiana County, OH	171	**0.20%**
Lancaster County, PA	169	**0.20%**
Blair County, PA	157	**0.20%**
Somerset County, PA	143	**0.20%**
Dauphin County, PA	138	**0.20%**
All Other Locations	3,799	**4.90%**

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Fayette County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Fayette County, PA	22,091	**43.40%**	**Fayette County, PA**	22,091	**62.60%**
Westmoreland County, PA	7,172	**14.10%**	Westmoreland County, PA	3,304	**9.40%**
Allegheny County, PA	6,080	**12.00%**	Washington County, PA	1,840	**5.20%**
Washington County, PA	3,786	**7.40%**	Allegheny County, PA	1,742	**4.90%**
Monongalia County, WV	2,619	**5.10%**	Greene County, PA	756	**2.10%**
Greene County, PA	1,859	**3.70%**	Somerset County, PA	596	**1.70%**
Somerset County, PA	611	**1.20%**	Monongalia County, WV	368	**1.00%**
Butler County, PA	427	**0.80%**	Cambria County, PA	314	**0.90%**
Beaver County, PA	380	**0.70%**	Butler County, PA	237	**0.70%**
Cambria County, PA	358	**0.70%**	Blair County, PA	230	**0.70%**
Indiana County, PA	341	**0.70%**	Beaver County, PA	218	**0.60%**
Cumberland County, PA	301	**0.60%**	Indiana County, PA	189	**0.50%**
Dauphin County, PA	251	**0.50%**	Clearfield County, PA	161	**0.50%**
Blair County, PA	248	**0.50%**	Preston County, WV	161	**0.50%**
Philadelphia County, PA	216	**0.40%**	Erie County, PA	159	**0.50%**
Erie County, PA	195	**0.40%**	Armstrong County, PA	150	**0.40%**
Montgomery County, PA	187	**0.40%**	York County, PA	112	**0.30%**
Mercer County, PA	168	**0.30%**	Lawrence County, PA	96	**0.30%**
Preston County, WV	166	**0.30%**	Ohio County, WV	95	**0.30%**
Centre County, PA	150	**0.30%**	Mercer County, PA	84	**0.20%**
Clearfield County, PA	148	**0.30%**	Jefferson County, PA	83	**0.20%**
York County, PA	133	**0.30%**	Venango County, PA	77	**0.20%**
Garrett County, MD	108	**0.20%**	Garrett County, MD	76	**0.20%**
Lancaster County, PA	106	**0.20%**	Lancaster County, PA	71	**0.20%**
Lawrence County, PA	104	**0.20%**	Centre County, PA	64	**0.20%**
All Other Locations	2,659	**5.20%**	All Other Locations	2,027	**5.70%**

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Washington County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Washington County, PA	38,445	**43.50%**	**Washington County, PA**	38,445	**47.50%**
Allegheny County, PA	30,630	**34.60%**	Allegheny County, PA	17,703	**21.90%**
Westmoreland County, PA	3,152	**3.60%**	Westmoreland County, PA	4,713	**5.80%**
Greene County, PA	1,845	**2.10%**	Fayette County, PA	3,786	**4.70%**
Fayette County, PA	1,840	**2.10%**	Greene County, PA	2,422	**3.00%**
Butler County, PA	1,074	**1.20%**	Beaver County, PA	1,325	**1.60%**
Beaver County, PA	1,047	**1.20%**	Butler County, PA	1,071	**1.30%**
Philadelphia County, PA	735	**0.80%**	Ohio County, WV	806	**1.00%**
Ohio County, WV	714	**0.80%**	Brooke County, WV	586	**0.70%**
Monongalia County, WV	587	**0.70%**	Hancock County, WV	548	**0.70%**
Montgomery County, PA	457	**0.50%**	Jefferson County, OH	547	**0.70%**
Cumberland County, PA	425	**0.50%**	Belmont County, OH	494	**0.60%**
Indiana County, PA	326	**0.40%**	Erie County, PA	397	**0.50%**
Dauphin County, PA	317	**0.40%**	Lawrence County, PA	392	**0.50%**
Erie County, PA	313	**0.40%**	Marshall County, WV	366	**0.50%**
Marshall County, WV	259	**0.30%**	Indiana County, PA	351	**0.40%**
Hancock County, WV	248	**0.30%**	Mercer County, PA	315	**0.40%**
Mercer County, PA	245	**0.30%**	Armstrong County, PA	290	**0.40%**
Cambria County, PA	236	**0.30%**	Cambria County, PA	277	**0.30%**
Jefferson County, OH	221	**0.20%**	Monongalia County, WV	276	**0.30%**
Brooke County, WV	215	**0.20%**	York County, PA	203	**0.30%**
Lawrence County, PA	208	**0.20%**	Columbiana County, OH	193	**0.20%**
Belmont County, OH	199	**0.20%**	Clearfield County, PA	190	**0.20%**
Chester County, PA	185	**0.20%**	Blair County, PA	184	**0.20%**
Blair County, PA	178	**0.20%**	Venango County, PA	167	**0.20%**
All Other Locations	4,338	**4.90%**	All Other Locations	4,869	**6.00%**

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Westmoreland County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Westmoreland County, PA	72,003	**45.70%**	**Westmoreland County, PA**	72,003	**57.20%**
Allegheny County, PA	53,125	**33.70%**	Allegheny County, PA	18,534	**14.70%**
Washington County, PA	4,713	**3.00%**	Fayette County, PA	7,172	**5.70%**
Fayette County, PA	3,304	**2.10%**	Armstrong County, PA	3,632	**2.90%**
Butler County, PA	3,097	**2.00%**	Washington County, PA	3,152	**2.50%**
Indiana County, PA	2,712	**1.70%**	Indiana County, PA	3,146	**2.50%**
Cambria County, PA	1,748	**1.10%**	Butler County, PA	1,948	**1.50%**
Armstrong County, PA	1,594	**1.00%**	Cambria County, PA	1,729	**1.40%**
Beaver County, PA	1,200	**0.80%**	Somerset County, PA	1,443	**1.10%**
Somerset County, PA	889	**0.60%**	Beaver County, PA	1,113	**0.90%**
Cumberland County, PA	765	**0.50%**	Blair County, PA	632	**0.50%**
Blair County, PA	720	**0.50%**	Erie County, PA	616	**0.50%**
Dauphin County, PA	677	**0.40%**	Lawrence County, PA	501	**0.40%**
Philadelphia County, PA	533	**0.30%**	Greene County, PA	500	**0.40%**
Erie County, PA	514	**0.30%**	Clearfield County, PA	488	**0.40%**
Centre County, PA	477	**0.30%**	Mercer County, PA	474	**0.40%**
Montgomery County, PA	457	**0.30%**	York County, PA	372	**0.30%**
Mercer County, PA	409	**0.30%**	Venango County, PA	335	**0.30%**
York County, PA	382	**0.20%**	Berks County, PA	296	**0.20%**
Greene County, PA	379	**0.20%**	Lancaster County, PA	289	**0.20%**
Clearfield County, PA	374	**0.20%**	Centre County, PA	278	**0.20%**
Lancaster County, PA	354	**0.20%**	Bedford County, PA	260	**0.20%**
Chester County, PA	293	**0.20%**	Dauphin County, PA	255	**0.20%**
Lawrence County, PA	287	**0.20%**	Jefferson County, PA	253	**0.20%**
Bedford County, PA	260	**0.20%**	Cumberland County, PA	244	**0.20%**
All Other Locations	6,292	**4.00%**	All Other Locations	6,192	**4.90%**

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Lawrence County

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Lawrence County, PA	16,198	**43.60%**	**Lawrence County, PA**	16,198	**57.40%**
Allegheny County, PA	4,470	**12.00%**	Mercer County, PA	2,522	**8.90%**
Butler County, PA	3,271	**8.80%**	Beaver County, PA	2,032	**7.20%**
Beaver County, PA	3,193	**8.60%**	Allegheny County, PA	1,594	**5.60%**
Mercer County, PA	3,092	**8.30%**	Butler County, PA	1,445	**5.10%**
Mahoning County, OH	1,532	**4.10%**	Mahoning County, OH	746	**2.60%**
Westmoreland County, PA	501	**1.30%**	Trumbull County, OH	502	**1.80%**
Trumbull County, OH	407	**1.10%**	Westmoreland County, PA	287	**1.00%**
Washington County, PA	392	**1.10%**	Erie County, PA	258	**0.90%**
Erie County, PA	265	**0.70%**	Washington County, PA	208	**0.70%**
Cumberland County, PA	253	**0.70%**	Columbiana County, OH	200	**0.70%**
Columbiana County, OH	205	**0.60%**	Crawford County, PA	174	**0.60%**
Philadelphia County, PA	200	**0.50%**	Venango County, PA	113	**0.40%**
Montgomery County, PA	181	**0.50%**	Fayette County, PA	104	**0.40%**
Dauphin County, PA	151	**0.40%**	Indiana County, PA	95	**0.30%**
Venango County, PA	148	**0.40%**	Clarion County, PA	79	**0.30%**
Indiana County, PA	145	**0.40%**	Clearfield County, PA	76	**0.30%**
Crawford County, PA	140	**0.40%**	Warren County, PA	67	**0.20%**
Cambria County, PA	103	**0.30%**	Cambria County, PA	65	**0.20%**
Blair County, PA	100	**0.30%**	Armstrong County, PA	61	**0.20%**
Fayette County, PA	96	**0.30%**	York County, PA	51	**0.20%**
Centre County, PA	94	**0.30%**	Blair County, PA	49	**0.20%**
Cuyahoga County, OH	83	**0.20%**	Dauphin County, PA	45	**0.20%**
York County, PA	82	**0.20%**	Cumberland County, PA	43	**0.20%**
Delaware County, PA	80	**0.20%**	Jefferson County, PA	43	**0.20%**
All Other Locations	1,786	**4.80%**	All Other Locations	1,156	**4.10%**

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Indiana County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Indiana County, PA	15,425	**48.00%**	**Indiana County, PA**	15,425	**49.10%**
Allegheny County, PA	3,276	**10.20%**	Westmoreland County, PA	2,712	**8.60%**
Westmoreland County, PA	3,146	**9.80%**	Cambria County, PA	2,479	**7.90%**
Cambria County, PA	2,060	**6.40%**	Armstrong County, PA	1,655	**5.30%**
Armstrong County, PA	915	**2.80%**	Allegheny County, PA	1,278	**4.10%**
Jefferson County, PA	818	**2.50%**	Clearfield County, PA	945	**3.00%**
Butler County, PA	726	**2.30%**	Jefferson County, PA	834	**2.70%**
Clearfield County, PA	505	**1.60%**	Somerset County, PA	482	**1.50%**
Washington County, PA	351	**1.10%**	Fayette County, PA	341	**1.10%**
Blair County, PA	315	**1.00%**	Blair County, PA	327	**1.00%**
Cumberland County, PA	297	**0.90%**	Washington County, PA	326	**1.00%**
Clarion County, PA	273	**0.80%**	Butler County, PA	305	**1.00%**
Somerset County, PA	254	**0.80%**	Erie County, PA	254	**0.80%**
Erie County, PA	220	**0.70%**	Beaver County, PA	232	**0.70%**
Dauphin County, PA	215	**0.70%**	Venango County, PA	184	**0.60%**
Beaver County, PA	211	**0.70%**	Centre County, PA	183	**0.60%**
Fayette County, PA	189	**0.60%**	Mercer County, PA	181	**0.60%**
Centre County, PA	170	**0.50%**	Clarion County, PA	163	**0.50%**
Mercer County, PA	163	**0.50%**	Lawrence County, PA	145	**0.50%**
Venango County, PA	134	**0.40%**	York County, PA	145	**0.50%**
York County, PA	112	**0.30%**	Bedford County, PA	137	**0.40%**
Lancaster County, PA	97	**0.30%**	Berks County, PA	107	**0.30%**
Lawrence County, PA	95	**0.30%**	Lancaster County, PA	107	**0.30%**
Berks County, PA	89	**0.30%**	Greene County, PA	94	**0.30%**
Lycoming County, PA	89	**0.30%**	Huntingdon County, PA	94	**0.30%**
All Other Locations	1,999	**6.20%**	All Other Locations	2,287	**7.30%**

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Cumberland County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Cumberland County, PA	47,524	**46.40%**	**Cumberland County, PA**	47,524	**36.30%**
Dauphin County, PA	22,356	**21.80%**	Dauphin County, PA	17,279	**13.20%**
York County, PA	6,355	**6.20%**	York County, PA	12,958	**9.90%**
Franklin County, PA	3,402	**3.30%**	Perry County, PA	5,622	**4.30%**
Lancaster County, PA	2,437	**2.40%**	Franklin County, PA	4,314	**3.30%**
Montgomery County, PA	1,649	**1.60%**	Lancaster County, PA	3,976	**3.00%**
Philadelphia County, PA	1,409	**1.40%**	Adams County, PA	2,681	**2.00%**
Allegheny County, PA	1,273	**1.20%**	Allegheny County, PA	2,169	**1.70%**
Berks County, PA	1,153	**1.10%**	Lebanon County, PA	1,875	**1.40%**
Adams County, PA	1,084	**1.10%**	Bucks County, PA	1,779	**1.40%**
Chester County, PA	994	**1.00%**	Berks County, PA	1,698	**1.30%**
Lehigh County, PA	972	**0.90%**	Montgomery County, PA	1,686	**1.30%**
Perry County, PA	857	**0.80%**	Chester County, PA	1,435	**1.10%**
Lebanon County, PA	840	**0.80%**	Philadelphia County, PA	1,241	**0.90%**
Delaware County, PA	700	**0.70%**	Lehigh County, PA	1,088	**0.80%**
Bucks County, PA	667	**0.70%**	Luzerne County, PA	1,084	**0.80%**
Centre County, PA	655	**0.60%**	Northampton County, PA	922	**0.70%**
Luzerne County, PA	620	**0.60%**	Juniata County, PA	881	**0.70%**
Lycoming County, PA	361	**0.40%**	Schuylkill County, PA	858	**0.70%**
Northampton County, PA	354	**0.30%**	Delaware County, PA	793	**0.60%**
Schuylkill County, PA	336	**0.30%**	Westmoreland County, PA	765	**0.60%**
Blair County, PA	298	**0.30%**	Mifflin County, PA	762	**0.60%**
Lackawanna County, PA	271	**0.30%**	Lackawanna County, PA	754	**0.60%**
Mifflin County, PA	244	**0.20%**	Northumberland County, PA	707	**0.50%**
Westmoreland County, PA	244	**0.20%**	Centre County, PA	677	**0.50%**
All Other Locations	5,311	**5.20%**	All Other Locations	15,266	**11.70%**

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Dauphin County, PA

Live in County - Work Locations	Job Count	Share	Work In County - Home Locations	Job Count	Share
Dauphin County, PA	63,736	**54.90%**	**Dauphin County, PA**	63,736	**37.70%**
Cumberland County, PA	17,279	**14.90%**	Cumberland County, PA	22,356	**13.20%**
York County, PA	4,971	**4.30%**	York County, PA	12,537	**7.40%**
Lancaster County, PA	4,867	**4.20%**	Lebanon County, PA	12,165	**7.20%**
Lebanon County, PA	2,939	**2.50%**	Lancaster County, PA	10,874	**6.40%**
Montgomery County, PA	1,925	**1.70%**	Perry County, PA	5,166	**3.10%**
Philadelphia County, PA	1,613	**1.40%**	Schuylkill County, PA	2,757	**1.60%**
Berks County, PA	1,575	**1.40%**	Berks County, PA	2,531	**1.50%**
Allegheny County, PA	1,461	**1.30%**	Philadelphia County, PA	2,355	**1.40%**
Chester County, PA	1,078	**0.90%**	Montgomery County, PA	2,030	**1.20%**
Schuylkill County, PA	1,060	**0.90%**	Allegheny County, PA	2,000	**1.20%**
Lehigh County, PA	998	**0.90%**	Luzerne County, PA	1,618	**1.00%**
Centre County, PA	851	**0.70%**	Chester County, PA	1,592	**0.90%**
Delaware County, PA	784	**0.70%**	Northumberland County, PA	1,551	**0.90%**
Bucks County, PA	760	**0.70%**	Juniata County, PA	1,462	**0.90%**
Luzerne County, PA	743	**0.60%**	Franklin County, PA	1,437	**0.80%**
Perry County, PA	713	**0.60%**	Bucks County, PA	1,275	**0.80%**
Franklin County, PA	651	**0.60%**	Lehigh County, PA	1,231	**0.70%**
Northumberland County, PA	519	**0.40%**	Adams County, PA	1,175	**0.70%**
Lycoming County, PA	409	**0.40%**	Delaware County, PA	1,147	**0.70%**
Northampton County, PA	394	**0.30%**	Lackawanna County, PA	1,060	**0.60%**
Blair County, PA	299	**0.30%**	Northampton County, PA	1,040	**0.60%**
Lackawanna County, PA	282	**0.20%**	Centre County, PA	1,026	**0.60%**
Snyder County, PA	282	**0.20%**	Mifflin County, PA	950	**0.60%**
Adams County, PA	278	**0.20%**	Snyder County, PA	905	**0.50%**
All Other Locations	5,556	**4.80%**	All Other Locations	13,250	**7.80%**

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Lebanon County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Lebanon County, PA	24,504	**41.20%**	**Lebanon County, PA**	24,504	**53.30%**
Dauphin County, PA	12,165	**20.40%**	Lancaster County, PA	4,751	**10.30%**
Lancaster County, PA	6,762	**11.40%**	Berks County, PA	3,450	**7.50%**
Berks County, PA	3,423	**5.70%**	Dauphin County, PA	2,939	**6.40%**
Cumberland County, PA	1,875	**3.10%**	Schuylkill County, PA	1,659	**3.60%**
York County, PA	1,255	**2.10%**	York County, PA	1,102	**2.40%**
Montgomery County, PA	946	**1.60%**	Cumberland County, PA	840	**1.80%**
Philadelphia County, PA	770	**1.30%**	Philadelphia County, PA	448	**1.00%**
Allegheny County, PA	730	**1.20%**	Montgomery County, PA	415	**0.90%**
Chester County, PA	655	**1.10%**	Chester County, PA	386	**0.80%**
Schuylkill County, PA	545	**0.90%**	Luzerne County, PA	325	**0.70%**
Lehigh County, PA	515	**0.90%**	Lehigh County, PA	264	**0.60%**
Luzerne County, PA	374	**0.60%**	Franklin County, PA	246	**0.50%**
Delaware County, PA	365	**0.60%**	Bucks County, PA	239	**0.50%**
Bucks County, PA	356	**0.60%**	Perry County, PA	217	**0.50%**
Centre County, PA	274	**0.50%**	Lackawanna County, PA	214	**0.50%**
Franklin County, PA	214	**0.40%**	Northumberland County, PA	209	**0.50%**
Northampton County, PA	210	**0.40%**	Northampton County, PA	205	**0.40%**
Blair County, PA	164	**0.30%**	Mifflin County, PA	195	**0.40%**
Adams County, PA	163	**0.30%**	Delaware County, PA	188	**0.40%**
Lycoming County, PA	156	**0.30%**	Adams County, PA	169	**0.40%**
Northumberland County, PA	152	**0.30%**	Allegheny County, PA	143	**0.30%**
Lackawanna County, PA	150	**0.30%**	Juniata County, PA	136	**0.30%**
Westmoreland County, PA	127	**0.20%**	Snyder County, PA	136	**0.30%**
Monroe County, PA	91	**0.20%**	Monroe County, PA	130	**0.30%**
All Other Locations	2,598	**4.40%**	All Other Locations	2,454	**5.30%**

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Cumberland County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Cumberland County, PA	5,622	**27.50%**	**Perry County, PA**	3,688	**48.90%**
Dauphin County, PA	5,166	**25.20%**	Cumberland County, PA	857	**11.40%**
Perry County, PA	**3,688**	**18.00%**	Dauphin County, PA	713	**9.50%**
York County, PA	932	**4.60%**	Juniata County, PA	381	**5.10%**
Lancaster County, PA	468	**2.30%**	York County, PA	241	**3.20%**
Montgomery County, PA	316	**1.50%**	Lancaster County, PA	139	**1.80%**
Franklin County, PA	310	**1.50%**	Snyder County, PA	124	**1.60%**
Juniata County, PA	301	**1.50%**	Mifflin County, PA	107	**1.40%**
Philadelphia County, PA	289	**1.40%**	Lebanon County, PA	82	**1.10%**
Allegheny County, PA	224	**1.10%**	Union County, PA	73	**1.00%**
Berks County, PA	224	**1.10%**	Bucks County, PA	62	**0.80%**
Lebanon County, PA	217	**1.10%**	Franklin County, PA	62	**0.80%**
Lehigh County, PA	210	**1.00%**	Centre County, PA	55	**0.70%**
Chester County, PA	179	**0.90%**	Northumberland County, PA	50	**0.70%**
Mifflin County, PA	160	**0.80%**	Adams County, PA	47	**0.60%**
Luzerne County, PA	152	**0.70%**	Berks County, PA	46	**0.60%**
Centre County, PA	143	**0.70%**	Luzerne County, PA	45	**0.60%**
Adams County, PA	127	**0.60%**	Schuylkill County, PA	44	**0.60%**
Delaware County, PA	126	**0.60%**	Lycoming County, PA	43	**0.60%**
Bucks County, PA	114	**0.60%**	Blair County, PA	31	**0.40%**
Snyder County, PA	86	**0.40%**	Huntingdon County, PA	30	**0.40%**
Schuylkill County, PA	81	**0.40%**	Westmoreland County, PA	30	**0.40%**
Lycoming County, PA	72	**0.40%**	Cambria County, PA	27	**0.40%**
Northumberland County, PA	64	**0.30%**	Allegheny County, PA	24	**0.30%**
Northampton County, PA	63	**0.30%**	Clinton County, PA	22	**0.30%**
All Other Locations	1,132	**5.50%**	All Other Locations	520	**6.90%**

ED_001361_00018559

York County, PA

Live in County - Work Locations

County	Job Count	Share
York County, PA	105,693	**52.90%**
Cumberland County, PA	12,958	**6.50%**
Dauphin County, PA	12,537	**6.30%**
Lancaster County, PA	11,115	**5.60%**
Baltimore County, MD	10,582	**5.30%**
Adams County, PA	6,296	**3.20%**
Baltimore city, MD	4,028	**2.00%**
Carroll County, MD	2,656	**1.30%**
Harford County, MD	2,545	**1.30%**
Montgomery County, PA	2,147	**1.10%**
Berks County, PA	1,989	**1.00%**
Philadelphia County, PA	1,754	**0.90%**
Chester County, PA	1,617	**0.80%**
Allegheny County, PA	1,548	**0.80%**
Anne Arundel County, MD	1,398	**0.70%**
Franklin County, PA	1,248	**0.60%**
Lehigh County, PA	1,159	**0.60%**
Montgomery County, MD	1,112	**0.60%**
Lebanon County, PA	1,102	**0.60%**
Bucks County, PA	1,007	**0.50%**
Howard County, MD	973	**0.50%**
Delaware County, PA	931	**0.50%**
Prince George's County, MD	747	**0.40%**
Centre County, PA	745	**0.40%**
Luzerne County, PA	671	**0.30%**
All Other Locations	11,201	**5.60%**

Work In County - Home Locations

County	Job Count	Share
York County, PA	105,693	**63.90%**
Adams County, PA	10,285	**6.20%**
Lancaster County, PA	9,270	**5.60%**
Cumberland County, PA	6,355	**3.80%**
Dauphin County, PA	4,971	**3.00%**
Berks County, PA	1,786	**1.10%**
Franklin County, PA	1,710	**1.00%**
Philadelphia County, PA	1,316	**0.80%**
Montgomery County, PA	1,265	**0.80%**
Chester County, PA	1,264	**0.80%**
Lebanon County, PA	1,255	**0.80%**
Baltimore County, MD	1,115	**0.70%**
Allegheny County, PA	998	**0.60%**
Perry County, PA	932	**0.60%**
Lehigh County, PA	911	**0.60%**
Bucks County, PA	903	**0.50%**
Carroll County, MD	777	**0.50%**
Delaware County, PA	754	**0.50%**
Northampton County, PA	731	**0.40%**
Schuylkill County, PA	700	**0.40%**
Luzerne County, PA	695	**0.40%**
Harford County, MD	512	**0.30%**
Lackawanna County, PA	464	**0.30%**
Centre County, PA	436	**0.30%**
Cambria County, PA	423	**0.30%**
All Other Locations	9,841	**6.00%**

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Bucks County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Bucks County, PA	120,791	**40.70%**	**Bucks County, PA**	120,791	**50.60%**
Montgomery County, PA	51,513	**17.30%**	Montgomery County, PA	32,075	**13.40%**
Philadelphia County, PA	35,096	**11.80%**	Philadelphia County, PA	30,451	**12.80%**
Mercer County, NJ	19,261	**6.50%**	Lehigh County, PA	5,781	**2.40%**
Chester County, PA	6,944	**2.30%**	Burlington County, NJ	5,024	**2.10%**
Lehigh County, PA	6,795	**2.30%**	Delaware County, PA	4,855	**2.00%**
Delaware County, PA	5,757	**1.90%**	Mercer County, NJ	4,290	**1.80%**
Burlington County, NJ	5,663	**1.90%**	Chester County, PA	4,043	**1.70%**
Middlesex County, NJ	4,226	**1.40%**	Northampton County, PA	3,786	**1.60%**
Northampton County, PA	3,394	**1.10%**	Berks County, PA	2,711	**1.10%**
Somerset County, NJ	2,861	**1.00%**	Camden County, NJ	2,154	**0.90%**
Camden County, NJ	2,359	**0.80%**	Lancaster County, PA	1,607	**0.70%**
New York County, NY	2,236	**0.80%**	Hunterdon County, NJ	1,122	**0.50%**
Hunterdon County, NJ	2,162	**0.70%**	York County, PA	1,007	**0.40%**
Berks County, PA	2,106	**0.70%**	Luzerne County, PA	972	**0.40%**
Cumberland County, PA	1,779	**0.60%**	Gloucester County, NJ	905	**0.40%**
Allegheny County, PA	1,531	**0.50%**	Allegheny County, PA	818	**0.30%**
Lancaster County, PA	1,442	**0.50%**	Dauphin County, PA	760	**0.30%**
Dauphin County, PA	1,275	**0.40%**	Lackawanna County, PA	681	**0.30%**
Essex County, NJ	1,158	**0.40%**	Schuylkill County, PA	671	**0.30%**
Morris County, NJ	1,101	**0.40%**	Cumberland County, PA	667	**0.30%**
Union County, NJ	985	**0.30%**	Monroe County, PA	647	**0.30%**
Monmouth County, NJ	979	**0.30%**	New Castle County, DE	605	**0.30%**
Luzerne County, PA	927	**0.30%**	Carbon County, PA	576	**0.20%**
Bergen County, NJ	921	**0.30%**	Middlesex County, NJ	543	**0.20%**
All Other Locations	13,826	**4.70%**	All Other Locations	11,115	**4.70%**

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Chester County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Chester County, PA	104,908	**45.40%**	**Chester County, PA**	104,908	**45.50%**
Montgomery County, PA	33,874	**14.70%**	Montgomery County, PA	31,028	**13.50%**
Delaware County, PA	22,149	**9.60%**	Delaware County, PA	21,750	**9.40%**
Philadelphia County, PA	16,592	**7.20%**	Philadelphia County, PA	11,107	**4.80%**
New Castle County, DE	15,536	**6.70%**	Lancaster County, PA	9,869	**4.30%**
Lancaster County, PA	5,311	**2.30%**	Berks County, PA	9,319	**4.00%**
Berks County, PA	4,270	**1.80%**	New Castle County, DE	7,384	**3.20%**
Bucks County, PA	4,043	**1.80%**	Bucks County, PA	6,944	**3.00%**
Lehigh County, PA	1,828	**0.80%**	Lehigh County, PA	2,136	**0.90%**
Allegheny County, PA	1,634	**0.70%**	York County, PA	1,617	**0.70%**
Dauphin County, PA	1,592	**0.70%**	Northampton County, PA	1,570	**0.70%**
Cumberland County, PA	1,435	**0.60%**	Gloucester County, NJ	1,358	**0.60%**
York County, PA	1,264	**0.50%**	Cecil County, MD	1,312	**0.60%**
Cecil County, MD	1,238	**0.50%**	Camden County, NJ	1,210	**0.50%**
New York County, NY	871	**0.40%**	Dauphin County, PA	1,078	**0.50%**
Northampton County, PA	852	**0.40%**	Cumberland County, PA	994	**0.40%**
Luzerne County, PA	652	**0.30%**	Allegheny County, PA	979	**0.40%**
Lackawanna County, PA	506	**0.20%**	Burlington County, NJ	883	**0.40%**
Camden County, NJ	494	**0.20%**	Luzerne County, PA	817	**0.40%**
Gloucester County, NJ	480	**0.20%**	Lebanon County, PA	655	**0.30%**
Burlington County, NJ	395	**0.20%**	Monroe County, PA	635	**0.30%**
Lebanon County, PA	386	**0.20%**	Schuylkill County, PA	618	**0.30%**
Mercer County, NJ	352	**0.20%**	Lackawanna County, PA	557	**0.20%**
Centre County, PA	346	**0.10%**	Salem County, NJ	474	**0.20%**
Middlesex County, NJ	342	**0.10%**	Carbon County, PA	394	**0.20%**
All Other Locations	9,665	**4.20%**	All Other Locations	10,779	**4.70%**

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Delaware County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Delaware County, PA	95,676	**38.90%**	**Delaware County, PA**	95,676	**45.00%**
Philadelphia County, PA	55,683	**22.60%**	Philadelphia County, PA	28,804	**13.50%**
Montgomery County, PA	32,019	**13.00%**	Chester County, PA	22,149	**10.40%**
Chester County, PA	21,750	**8.80%**	Montgomery County, PA	18,198	**8.60%**
New Castle County, DE	10,703	**4.40%**	New Castle County, DE	8,954	**4.20%**
Bucks County, PA	4,855	**2.00%**	Bucks County, PA	5,757	**2.70%**
Camden County, NJ	2,254	**0.90%**	Gloucester County, NJ	4,420	**2.10%**
Gloucester County, NJ	1,998	**0.80%**	Camden County, NJ	3,247	**1.50%**
Berks County, PA	1,259	**0.50%**	Lancaster County, PA	2,718	**1.30%**
Lehigh County, PA	1,228	**0.50%**	Berks County, PA	2,057	**1.00%**
Allegheny County, PA	1,165	**0.50%**	Lehigh County, PA	1,512	**0.70%**
Dauphin County, PA	1,147	**0.50%**	Burlington County, NJ	1,485	**0.70%**
Burlington County, NJ	1,146	**0.50%**	Northampton County, PA	1,163	**0.50%**
Lancaster County, PA	1,141	**0.50%**	Allegheny County, PA	994	**0.50%**
New York County, NY	921	**0.40%**	Salem County, NJ	956	**0.40%**
Cumberland County, PA	793	**0.30%**	York County, PA	931	**0.40%**
York County, PA	754	**0.30%**	Dauphin County, PA	784	**0.40%**
Northampton County, PA	623	**0.30%**	Cumberland County, PA	700	**0.30%**
Luzerne County, PA	533	**0.20%**	Luzerne County, PA	648	**0.30%**
Mercer County, NJ	481	**0.20%**	Cecil County, MD	444	**0.20%**
Middlesex County, NJ	450	**0.20%**	Lackawanna County, PA	442	**0.20%**
Lackawanna County, PA	325	**0.10%**	Schuylkill County, PA	420	**0.20%**
Salem County, NJ	319	**0.10%**	Lebanon County, PA	365	**0.20%**
Kent County, DE	281	**0.10%**	Carbon County, PA	303	**0.10%**
Bergen County, NJ	256	**0.10%**	Mercer County, NJ	296	**0.10%**
All Other Locations	8,239	**3.30%**	All Other Locations	9,387	**4.40%**

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Montgomery County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Montgomery County, PA	181,224	**47.80%**	**Montgomery County, PA**	181,224	**40.00%**
Philadelphia County, PA	65,316	**17.20%**	Philadelphia County, PA	67,007	**14.80%**
Bucks County, PA	32,075	**8.50%**	Bucks County, PA	51,513	**11.40%**
Chester County, PA	31,028	**8.20%**	Chester County, PA	33,874	**7.50%**
Delaware County, PA	18,198	**4.80%**	Delaware County, PA	32,019	**7.10%**
Berks County, PA	7,396	**2.00%**	Berks County, PA	16,689	**3.70%**
Lehigh County, PA	5,691	**1.50%**	Lehigh County, PA	8,625	**1.90%**
Lancaster County, PA	2,270	**0.60%**	Lancaster County, PA	4,948	**1.10%**
Allegheny County, PA	2,222	**0.60%**	Northampton County, PA	4,568	**1.00%**
Northampton County, PA	2,155	**0.60%**	Burlington County, NJ	4,263	**0.90%**
Camden County, NJ	2,059	**0.50%**	Camden County, NJ	4,155	**0.90%**
Dauphin County, PA	2,030	**0.50%**	New Castle County, DE	2,768	**0.60%**
Burlington County, NJ	1,965	**0.50%**	Allegheny County, PA	2,632	**0.60%**
New Castle County, DE	1,925	**0.50%**	Gloucester County, NJ	2,583	**0.60%**
Cumberland County, PA	1,686	**0.40%**	Luzerne County, PA	2,278	**0.50%**
Mercer County, NJ	1,662	**0.40%**	York County, PA	2,147	**0.50%**
New York County, NY	1,637	**0.40%**	Dauphin County, PA	1,925	**0.40%**
York County, PA	1,265	**0.30%**	Cumberland County, PA	1,649	**0.40%**
Luzerne County, PA	1,043	**0.30%**	Lackawanna County, PA	1,540	**0.30%**
Middlesex County, NJ	1,014	**0.30%**	Monroe County, PA	1,515	**0.30%**
Lackawanna County, PA	686	**0.20%**	Schuylkill County, PA	1,356	**0.30%**
Somerset County, NJ	574	**0.20%**	Mercer County, NJ	1,232	**0.30%**
Gloucester County, NJ	553	**0.10%**	Carbon County, PA	1,149	**0.30%**
Monroe County, PA	551	**0.10%**	Lebanon County, PA	946	**0.20%**
Schuylkill County, PA	524	**0.10%**	Franklin County, PA	707	**0.20%**
All Other Locations	12,165	**3.20%**	All Other Locations	20,223	**4.50%**

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Philadelphia County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Philadelphia County, PA	322,240	**61.10%**	**Philadelphia County, PA**	322,240	**52.30%**
Montgomery County, PA	67,007	**12.70%**	Montgomery County, PA	65,316	**10.60%**
Bucks County, PA	30,451	**5.80%**	Delaware County, PA	55,683	**9.00%**
Delaware County, PA	28,804	**5.50%**	Bucks County, PA	35,096	**5.70%**
Chester County, PA	11,107	**2.10%**	Camden County, NJ	28,198	**4.60%**
Camden County, NJ	9,999	**1.90%**	Burlington County, NJ	17,707	**2.90%**
Burlington County, NJ	7,038	**1.30%**	Chester County, PA	16,592	**2.70%**
New Castle County, DE	3,340	**0.60%**	Gloucester County, NJ	14,310	**2.30%**
Lehigh County, PA	2,812	**0.50%**	New Castle County, DE	6,482	**1.10%**
Gloucester County, NJ	2,810	**0.50%**	Lehigh County, PA	3,687	**0.60%**
Mercer County, NJ	2,611	**0.50%**	Lancaster County, PA	3,138	**0.50%**
New York County, NY	2,550	**0.50%**	Allegheny County, PA	3,065	**0.50%**
Allegheny County, PA	2,398	**0.50%**	Berks County, PA	2,824	**0.50%**
Dauphin County, PA	2,355	**0.40%**	Northampton County, PA	2,709	**0.40%**
Berks County, PA	2,195	**0.40%**	York County, PA	1,754	**0.30%**
Lancaster County, PA	1,842	**0.30%**	Mercer County, NJ	1,738	**0.30%**
Middlesex County, NJ	1,496	**0.30%**	Luzerne County, PA	1,717	**0.30%**
Northampton County, PA	1,480	**0.30%**	Dauphin County, PA	1,613	**0.30%**
York County, PA	1,316	**0.20%**	Salem County, NJ	1,433	**0.20%**
Luzerne County, PA	1,256	**0.20%**	Cumberland County, PA	1,409	**0.20%**
Cumberland County, PA	1,241	**0.20%**	Atlantic County, NJ	1,351	**0.20%**
Lackawanna County, PA	758	**0.10%**	Lackawanna County, PA	1,158	**0.20%**
Bergen County, NJ	738	**0.10%**	Schuylkill County, PA	1,004	**0.20%**
Essex County, NJ	686	**0.10%**	New York County, NY	835	**0.10%**
Kings County, NY	640	**0.10%**	Middlesex County, NJ	791	**0.10%**
All Other Locations	18,319	**3.50%**	All Other Locations	24,541	**4.00%**

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Berks County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Berks County, PA	104,622	**57.20%**	**Berks County, PA**	104,622	**63.70%**
Montgomery County, PA	16,689	**9.10%**	Lancaster County, PA	7,532	**4.60%**
Lehigh County, PA	9,837	**5.40%**	Montgomery County, PA	7,396	**4.50%**
Chester County, PA	9,319	**5.10%**	Schuylkill County, PA	6,282	**3.80%**
Lancaster County, PA	8,703	**4.80%**	Lehigh County, PA	5,191	**3.20%**
Lebanon County, PA	3,450	**1.90%**	Chester County, PA	4,270	**2.60%**
Philadelphia County, PA	2,824	**1.50%**	Lebanon County, PA	3,423	**2.10%**
Bucks County, PA	2,711	**1.50%**	Philadelphia County, PA	2,195	**1.30%**
Dauphin County, PA	2,531	**1.40%**	Bucks County, PA	2,106	**1.30%**
Delaware County, PA	2,057	**1.10%**	York County, PA	1,989	**1.20%**
Northampton County, PA	1,956	**1.10%**	Northampton County, PA	1,914	**1.20%**
Schuylkill County, PA	1,954	**1.10%**	Dauphin County, PA	1,575	**1.00%**
York County, PA	1,786	**1.00%**	Luzerne County, PA	1,291	**0.80%**
Cumberland County, PA	1,698	**0.90%**	Delaware County, PA	1,259	**0.80%**
Luzerne County, PA	1,271	**0.70%**	Cumberland County, PA	1,153	**0.70%**
Allegheny County, PA	953	**0.50%**	Carbon County, PA	763	**0.50%**
Lackawanna County, PA	634	**0.30%**	Lackawanna County, PA	763	**0.50%**
Centre County, PA	580	**0.30%**	Monroe County, PA	681	**0.40%**
Monroe County, PA	481	**0.30%**	Northumberland County, PA	524	**0.30%**
New York County, NY	406	**0.20%**	Allegheny County, PA	424	**0.30%**
Franklin County, PA	333	**0.20%**	Franklin County, PA	409	**0.20%**
Northumberland County, PA	308	**0.20%**	Lycoming County, PA	407	**0.20%**
Lycoming County, PA	299	**0.20%**	Columbia County, PA	393	**0.20%**
Westmoreland County, PA	296	**0.20%**	Adams County, PA	276	**0.20%**
Carbon County, PA	264	**0.10%**	Centre County, PA	252	**0.20%**
All Other Locations	6,811	**3.70%**	All Other Locations	7,033	**4.30%**

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Lancaster County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Lancaster County, PA	150,729	**66.20%**	**Lancaster County, PA**	150,729	**69.70%**
Dauphin County, PA	10,874	**4.80%**	York County, PA	11,115	**5.10%**
Chester County, PA	9,869	**4.30%**	Berks County, PA	8,703	**4.00%**
York County, PA	9,270	**4.10%**	Lebanon County, PA	6,762	**3.10%**
Berks County, PA	7,532	**3.30%**	Chester County, PA	5,311	**2.50%**
Montgomery County, PA	4,948	**2.20%**	Dauphin County, PA	4,867	**2.20%**
Lebanon County, PA	4,751	**2.10%**	Cumberland County, PA	2,437	**1.10%**
Cumberland County, PA	3,976	**1.70%**	Montgomery County, PA	2,270	**1.00%**
Philadelphia County, PA	3,138	**1.40%**	Philadelphia County, PA	1,842	**0.90%**
Delaware County, PA	2,718	**1.20%**	Bucks County, PA	1,442	**0.70%**
Lehigh County, PA	1,953	**0.90%**	Lehigh County, PA	1,264	**0.60%**
Bucks County, PA	1,607	**0.70%**	Delaware County, PA	1,141	**0.50%**
Allegheny County, PA	1,432	**0.60%**	Northampton County, PA	1,055	**0.50%**
Luzerne County, PA	842	**0.40%**	Schuylkill County, PA	1,033	**0.50%**
New Castle County, DE	771	**0.30%**	Allegheny County, PA	1,019	**0.50%**
Northampton County, PA	681	**0.30%**	Luzerne County, PA	953	**0.40%**
Franklin County, PA	569	**0.20%**	Franklin County, PA	845	**0.40%**
Schuylkill County, PA	508	**0.20%**	Adams County, PA	683	**0.30%**
Centre County, PA	496	**0.20%**	Northumberland County, PA	606	**0.30%**
Lycoming County, PA	402	**0.20%**	Lackawanna County, PA	592	**0.30%**
Lackawanna County, PA	384	**0.20%**	Monroe County, PA	559	**0.30%**
Cecil County, MD	369	**0.20%**	Lycoming County, PA	539	**0.20%**
Baltimore County, MD	367	**0.20%**	Centre County, PA	533	**0.20%**
New York County, NY	345	**0.20%**	Perry County, PA	468	**0.20%**
Monroe County, PA	331	**0.10%**	Westmoreland County, PA	354	**0.20%**
All Other Locations	8,849	**3.90%**	All Other Locations	9,238	**4.30%**

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Cumberland County, PA

Live in County - Work Locations

County	Job Count	Share
Cumberland County, PA	47,524	**46.40%**
Dauphin County, PA	22,356	**21.80%**
York County, PA	6,355	**6.20%**
Franklin County, PA	3,402	**3.30%**
Lancaster County, PA	2,437	**2.40%**
Montgomery County, PA	1,649	**1.60%**
Philadelphia County, PA	1,409	**1.40%**
Allegheny County, PA	1,273	**1.20%**
Berks County, PA	1,153	**1.10%**
Adams County, PA	1,084	**1.10%**
Chester County, PA	994	**1.00%**
Lehigh County, PA	972	**0.90%**
Perry County, PA	857	**0.80%**
Lebanon County, PA	840	**0.80%**
Delaware County, PA	700	**0.70%**
Bucks County, PA	667	**0.70%**
Centre County, PA	655	**0.60%**
Luzerne County, PA	620	**0.60%**
Lycoming County, PA	361	**0.40%**
Northampton County, PA	354	**0.30%**
Schuylkill County, PA	336	**0.30%**
Blair County, PA	298	**0.30%**
Lackawanna County, PA	271	**0.30%**
Mifflin County, PA	244	**0.20%**
Westmoreland County, PA	244	**0.20%**
All Other Locations	5,311	**5.20%**

Work In County - Home Locations

County	Job Count	Share
Cumberland County, PA	47,524	**36.30%**
Dauphin County, PA	17,279	**13.20%**
York County, PA	12,958	**9.90%**
Perry County, PA	5,622	**4.30%**
Franklin County, PA	4,314	**3.30%**
Lancaster County, PA	3,976	**3.00%**
Adams County, PA	2,681	**2.00%**
Allegheny County, PA	2,169	**1.70%**
Lebanon County, PA	1,875	**1.40%**
Bucks County, PA	1,779	**1.40%**
Berks County, PA	1,698	**1.30%**
Montgomery County, PA	1,686	**1.30%**
Chester County, PA	1,435	**1.10%**
Philadelphia County, PA	1,241	**0.90%**
Lehigh County, PA	1,088	**0.80%**
Luzerne County, PA	1,084	**0.80%**
Northampton County, PA	922	**0.70%**
Juniata County, PA	881	**0.70%**
Schuylkill County, PA	858	**0.70%**
Delaware County, PA	793	**0.60%**
Westmoreland County, PA	765	**0.60%**
Mifflin County, PA	762	**0.60%**
Lackawanna County, PA	754	**0.60%**
Northumberland County, PA	707	**0.50%**
Centre County, PA	677	**0.50%**
All Other Locations	15,266	**11.70%**

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Dauphin County, PA

Live in County - Work Locations

County	Job Count	Share
Dauphin County, PA	63,736	**54.90%**
Cumberland County, PA	17,279	**14.90%**
York County, PA	4,971	**4.30%**
Lancaster County, PA	4,867	**4.20%**
Lebanon County, PA	2,939	**2.50%**
Montgomery County, PA	1,925	**1.70%**
Philadelphia County, PA	1,613	**1.40%**
Berks County, PA	1,575	**1.40%**
Allegheny County, PA	1,461	**1.30%**
Chester County, PA	1,078	**0.90%**
Schuylkill County, PA	1,060	**0.90%**
Lehigh County, PA	998	**0.90%**
Centre County, PA	851	**0.70%**
Delaware County, PA	784	**0.70%**
Bucks County, PA	760	**0.70%**
Luzerne County, PA	743	**0.60%**
Perry County, PA	713	**0.60%**
Franklin County, PA	651	**0.60%**
Northumberland County, PA	519	**0.40%**
Lycoming County, PA	409	**0.40%**
Northampton County, PA	394	**0.30%**
Blair County, PA	299	**0.30%**
Lackawanna County, PA	282	**0.20%**
Snyder County, PA	282	**0.20%**
Adams County, PA	278	**0.20%**
All Other Locations	5,556	**4.80%**

Work In County - Home Locations

County	Job Count	Share
Dauphin County, PA	63,736	**37.70%**
Cumberland County, PA	22,356	**13.20%**
York County, PA	12,537	**7.40%**
Lebanon County, PA	12,165	**7.20%**
Lancaster County, PA	10,874	**6.40%**
Perry County, PA	5,166	**3.10%**
Schuylkill County, PA	2,757	**1.60%**
Berks County, PA	2,531	**1.50%**
Philadelphia County, PA	2,355	**1.40%**
Montgomery County, PA	2,030	**1.20%**
Allegheny County, PA	2,000	**1.20%**
Luzerne County, PA	1,618	**1.00%**
Chester County, PA	1,592	**0.90%**
Northumberland County, PA	1,551	**0.90%**
Juniata County, PA	1,462	**0.90%**
Franklin County, PA	1,437	**0.80%**
Bucks County, PA	1,275	**0.80%**
Lehigh County, PA	1,231	**0.70%**
Adams County, PA	1,175	**0.70%**
Delaware County, PA	1,147	**0.70%**
Lackawanna County, PA	1,060	**0.60%**
Northampton County, PA	1,040	**0.60%**
Centre County, PA	1,026	**0.60%**
Mifflin County, PA	950	**0.60%**
Snyder County, PA	905	**0.50%**
All Other Locations	13,250	**7.80%**

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Lebanon County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Lebanon County, PA	24,504	**41.20%**	**Lebanon County, PA**	24,504	**53.30%**
Dauphin County, PA	12,165	**20.40%**	Lancaster County, PA	4,751	**10.30%**
Lancaster County, PA	6,762	**11.40%**	Berks County, PA	3,450	**7.50%**
Berks County, PA	3,423	**5.70%**	Dauphin County, PA	2,939	**6.40%**
Cumberland County, PA	1,875	**3.10%**	Schuylkill County, PA	1,659	**3.60%**
York County, PA	1,255	**2.10%**	York County, PA	1,102	**2.40%**
Montgomery County, PA	946	**1.60%**	Cumberland County, PA	840	**1.80%**
Philadelphia County, PA	770	**1.30%**	Philadelphia County, PA	448	**1.00%**
Allegheny County, PA	730	**1.20%**	Montgomery County, PA	415	**0.90%**
Chester County, PA	655	**1.10%**	Chester County, PA	386	**0.80%**
Schuylkill County, PA	545	**0.90%**	Luzerne County, PA	325	**0.70%**
Lehigh County, PA	515	**0.90%**	Lehigh County, PA	264	**0.60%**
Luzerne County, PA	374	**0.60%**	Franklin County, PA	246	**0.50%**
Delaware County, PA	365	**0.60%**	Bucks County, PA	239	**0.50%**
Bucks County, PA	356	**0.60%**	Perry County, PA	217	**0.50%**
Centre County, PA	274	**0.50%**	Lackawanna County, PA	214	**0.50%**
Franklin County, PA	214	**0.40%**	Northumberland County, PA	209	**0.50%**
Northampton County, PA	210	**0.40%**	Northampton County, PA	205	**0.40%**
Blair County, PA	164	**0.30%**	Mifflin County, PA	195	**0.40%**
Adams County, PA	163	**0.30%**	Delaware County, PA	188	**0.40%**
Lycoming County, PA	156	**0.30%**	Adams County, PA	169	**0.40%**
Northumberland County, PA	152	**0.30%**	Allegheny County, PA	143	**0.30%**
Lackawanna County, PA	150	**0.30%**	Juniata County, PA	136	**0.30%**
Westmoreland County, PA	127	**0.20%**	Snyder County, PA	136	**0.30%**
Monroe County, PA	91	**0.20%**	Monroe County, PA	130	**0.30%**
All Other Locations	2,598	**4.40%**	All Other Locations	2,454	**5.30%**

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Cumberland County, PA

Live in County - Work Locations			Work In County - Home Locations		
County	Job Count	Share	County	Job Count	Share
Cumberland County, PA	5,622	**27.50%**	**Perry County, PA**	3,688	**48.90%**
Dauphin County, PA	5,166	**25.20%**	Cumberland County, PA	857	**11.40%**
Perry County, PA	**3,688**	**18.00%**	Dauphin County, PA	713	**9.50%**
York County, PA	932	**4.60%**	Juniata County, PA	381	**5.10%**
Lancaster County, PA	468	**2.30%**	York County, PA	241	**3.20%**
Montgomery County, PA	316	**1.50%**	Lancaster County, PA	139	**1.80%**
Franklin County, PA	310	**1.50%**	Snyder County, PA	124	**1.60%**
Juniata County, PA	301	**1.50%**	Mifflin County, PA	107	**1.40%**
Philadelphia County, PA	289	**1.40%**	Lebanon County, PA	82	**1.10%**
Allegheny County, PA	224	**1.10%**	Union County, PA	73	**1.00%**
Berks County, PA	224	**1.10%**	Bucks County, PA	62	**0.80%**
Lebanon County, PA	217	**1.10%**	Franklin County, PA	62	**0.80%**
Lehigh County, PA	210	**1.00%**	Centre County, PA	55	**0.70%**
Chester County, PA	179	**0.90%**	Northumberland County, PA	50	**0.70%**
Mifflin County, PA	160	**0.80%**	Adams County, PA	47	**0.60%**
Luzerne County, PA	152	**0.70%**	Berks County, PA	46	**0.60%**
Centre County, PA	143	**0.70%**	Luzerne County, PA	45	**0.60%**
Adams County, PA	127	**0.60%**	Schuylkill County, PA	44	**0.60%**
Delaware County, PA	126	**0.60%**	Lycoming County, PA	43	**0.60%**
Bucks County, PA	114	**0.60%**	Blair County, PA	31	**0.40%**
Snyder County, PA	86	**0.40%**	Huntingdon County, PA	30	**0.40%**
Schuylkill County, PA	81	**0.40%**	Westmoreland County, PA	30	**0.40%**
Lycoming County, PA	72	**0.40%**	Cambria County, PA	27	**0.40%**
Northumberland County, PA	64	**0.30%**	Allegheny County, PA	24	**0.30%**
Northampton County, PA	63	**0.30%**	Clinton County, PA	22	**0.30%**
All Other Locations	1,132	**5.50%**	All Other Locations	520	**6.90%**

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York County, PA

Live in County - Work Locations

County	Job Count	Share
York County, PA	105,693	**52.90%**
Cumberland County, PA	12,958	**6.50%**
Dauphin County, PA	12,537	**6.30%**
Lancaster County, PA	11,115	**5.60%**
Baltimore County, MD	10,582	**5.30%**
Adams County, PA	6,296	**3.20%**
Baltimore city, MD	4,028	**2.00%**
Carroll County, MD	2,656	**1.30%**
Harford County, MD	2,545	**1.30%**
Montgomery County, PA	2,147	**1.10%**
Berks County, PA	1,989	**1.00%**
Philadelphia County, PA	1,754	**0.90%**
Chester County, PA	1,617	**0.80%**
Allegheny County, PA	1,548	**0.80%**
Anne Arundel County, MD	1,398	**0.70%**
Franklin County, PA	1,248	**0.60%**
Lehigh County, PA	1,159	**0.60%**
Montgomery County, MD	1,112	**0.60%**
Lebanon County, PA	1,102	**0.60%**
Bucks County, PA	1,007	**0.50%**
Howard County, MD	973	**0.50%**
Delaware County, PA	931	**0.50%**
Prince George's County, MD	747	**0.40%**
Centre County, PA	745	**0.40%**
Luzerne County, PA	671	**0.30%**
All Other Locations	11,201	**5.60%**

Work In County - Home Locations

County	Job Count	Share
York County, PA	105,693	**63.90%**
Adams County, PA	10,285	**6.20%**
Lancaster County, PA	9,270	**5.60%**
Cumberland County, PA	6,355	**3.80%**
Dauphin County, PA	4,971	**3.00%**
Berks County, PA	1,786	**1.10%**
Franklin County, PA	1,710	**1.00%**
Philadelphia County, PA	1,316	**0.80%**
Montgomery County, PA	1,265	**0.80%**
Chester County, PA	1,264	**0.80%**
Lebanon County, PA	1,255	**0.80%**
Baltimore County, MD	1,115	**0.70%**
Allegheny County, PA	998	**0.60%**
Perry County, PA	932	**0.60%**
Lehigh County, PA	911	**0.60%**
Bucks County, PA	903	**0.50%**
Carroll County, MD	777	**0.50%**
Delaware County, PA	754	**0.50%**
Northampton County, PA	731	**0.40%**
Schuylkill County, PA	700	**0.40%**
Luzerne County, PA	695	**0.40%**
Harford County, MD	512	**0.30%**
Lackawanna County, PA	464	**0.30%**
Centre County, PA	436	**0.30%**
Cambria County, PA	423	**0.30%**
All Other Locations	9,841	**6.00%**

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APPENDIX E
Comment and Response Documents

Document E-1: *Pennsylvania Bulletin* Notice for Public Comment Period and Public Meetings

Document E-2: Comment and Response Document

NOTICES

Proposed Designation Recommendations for the 2015 Ozone Standards; Public Meetings

[46 Pa.B. 5162]
[Saturday, August 20, 2016]

Ground-level ozone concentrations above the Federal health-based standard are a serious threat to human health. Ozone also causes damage to crops, forests and wildlife. On October 1, 2015, the United States Environmental Protection Agency (EPA) promulgated revised primary and secondary National Ambient Air Quality Standards (NAAQS) for ozone, which were published at 80 FR 65292 (October 26, 2015). The revised primary ozone NAAQS of 70 parts per billion (ppb) will provide increased protection of public health when compared to the 2008 primary NAAQS of 75 ppb. The revised secondary 8-hour ozone NAAQS of 70 ppb is also expected to provide increased protection of forests, crop yield, plants and wildlife when compared to the 2008 secondary 8-hour NAAQS of 75 ppb.

In accordance with section 107(d)(1) of the Clean Air Act (CAA) (42 U.S.C.A. § 7407 (d)(1)), the governor of each state must now submit designation recommendations to the EPA by October 1, 2016, within 1 year of the promulgation of a new or revised NAAQS for any pollutant under section 109 of the CAA (42 U.S.C.A. § 7409). The Commonwealth's designation recommendations for the 2015 8-hour ozone NAAQS are based on air quality monitoring data for 2013—2015, demographic information and other criteria, as recommended by the EPA in its February 25, 2016, memorandum pertaining to "Area Designations for the 2015 Revised Ozone National Ambient Air Quality Standards." The EPA expects to make final designations by October 1, 2017.

The Department of Environmental Protection (Department) is seeking public input on the proposed designation recommendations for the 2015 ozone NAAQS. Based on air quality, demographic information and political boundary factors, the Department is proposing to recommend that:

- Allegheny, Armstrong, Beaver, Butler, Washington, Fayette and Westmoreland Counties be designated as a multicounty nonattainment area.

- Indiana County be designated as a single county nonattainment area.

- Lebanon County be designated as a single county nonattainment area.

- Bucks, Chester, Delaware, Montgomery and Philadelphia Counties be designated as a multicounty interstate nonattainment area.

The Department is proposing to recommend that the remainder of this Commonwealth be designated as unclassifiable/attainment as described in the EPA guidance.

This proposal is available on the Department's web site at http://www.dep.pa.gov/ or through the following list of contact persons. The Department will hold public informational meetings as follows:

August 24, 2016	August 25, 2016	August 26, 2016
11 a.m.	11 a.m.	11 a.m.
Juniata River Room	Waterfront A	Delaware River Room
909 Elmerton Avenue	500 Waterfront Drive	2 East Main Street
Harrisburg, PA	Pittsburgh, PA	Norristown, PA

For more information on the public meetings, contact Roma Monteiro at (717) 787-9702 or rmonteiro@pa.gov. Persons with disabilities who wish to attend a meeting and require an auxiliary aid, service or other accommodation to participate in the proceeding should also contact Roma Monteiro. TDD users may contact the Pennsylvania AT&T Relay Service at (800) 654-5984 to discuss how the Department can best accommodate their needs.

The Department must receive all comments on or by Friday, September 2, 2016. Electronic comments should be submitted using the Department's eComment site at www.ahs.dep.pa.gov/eComment. Written comments can be submitted by e-mail to ecomment@pa.gov or by mail to the Policy Office, Department of Environmental Protection, Rachel Carson State Office Building, P.O. Box 2063, Harrisburg, PA 17105-2063.

PATRICK McDONNELL,
Acting Secretary

[Pa.B. Doc. No. 16-1438. Filed for public inspection August 19, 2016, 9:00 a.m.]

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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

COMMENT AND RESPONSE DOCUMENT CONCERNING

Designation Recommendations for the 2015 Eight-Hour Ozone National Ambient Air Quality Standards

September 2016

On August 20, 2016, the Pennsylvania Department of Environmental Protection ("DEP" or "Department") requested public comment on its proposed designation recommendations for Nonattainment/Attainment Areas for the revised primary and secondary 2015 8-hour ozone National Ambient Air Quality Standards (NAAQS). (46 Pa. B. 5162). EPA published the 2015 ozone NAAQS on October 26, 2015. (80 FR 65292). The Department has developed designation recommendations in accordance with section 107(d)(1) of the Clean Air Act (CAA), 42 U.S.C. § 7407(d)(1). The public comment period on the proposed designation recommendations closed on September 2, 2016. The DEP held three public informational meetings as follows:

August 24, 2016 11:00 am	Department of Environmental Protection Juniata River Room 909 Elmerton Avenue Harrisburg, PA 17110
August 25, 2016 11:00 am	Department of Environmental Protection Waterfront A 500 Waterfront Drive Pittsburgh, PA 15222
August 26, 2016 11:00 am	Department of Environmental Protection Delaware River Room 2 East Main Street Norristown, PA 19401

This Comment and Response Document summarizes the comments received from the public during the public comment period. Each comment is listed with its corresponding commentator number. The list of commentators, including name and affiliation, can be found below.

COMMENTATORS:

1. Vincent Brisini
   Director of Environmental Affairs
   Olympus Power, LLC
   67 Park Place East

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Morristown, NJ 07960

2. Kevin Sunday
   Director, Government Affairs
   PA Chamber of Business and Industry
   417 Walnut Street
   Harrisburg, PA 17101

3. Dennis Yablonsky
   Greater Pittsburgh Chamber of Commerce
   11 Stanwix Street, 17th Floor
   Pittsburgh, PA 15222-1312

4. John Shimshock
   Sr. Air Environmental Specialist
   NRG Energy
   121 Champion Way
   Canonsburg, PA 15317

5. Judy Morgan
   Philadelphia Neighborhood Networks Environmental Committee
   121 South Broad Street
   Suite 800
   Philadelphia, PA 19107

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COMMENTS AND RESPONSES

1. **COMMENT:** The proposed classifications of the majority of Pennsylvania are flawed because of the measured design values of the three year 2013-2015 period. The "vast majority" of monitors in this period measured attainment of the 2015 ozone NAAQS and were measured prior to the 2017 implementation of the Pennsylvania Reasonable Available Control Technology II (RACT II) regulation and the introduction of federal Tier 3 gasoline. (1)

   RESPONSE: The Department disagrees with the commentator's assertion that the recommendations are flawed because the measured design values in the three year period from 2013 to 2015 were used. Section 107(d)(1) of the CAA, 42 U.S.C. § 7407(d)(1), requires the EPA to designate an area as "nonattainment" if it is violating the NAAQS or if it is contributing to a violation of a NAAQS in a nearby area. Monitor design values are the numerical values used for determining compliance with the NAAQS. There is no legal provision for the EPA to designate an area as attainment if only a "vast majority", but not all, of the monitors in the area show no violation of the NAAQS or no contribution to a violation of the NAAQS. EPA explained in its guidance issued February 25, 2016 by Janet McCabe, Acting Assistant Administrator for the EPA's Office of Air Radiation, entitled "Area Designations for the 2015 Ozone National Ambient Air Quality Standards," (hereinafter "Designation Guidance") that States should base their recommendations on air quality data from the three most recent years of quality assured, certified monitoring data available at the time. Designation Guidance, pp. 2, 3. For Pennsylvania's recommendations, the Department has used monitoring data collected from EPA Federal Equivalent Method (FEM) monitors for 2013 to 2015, and certified in accordance with federal regulations (40 C.F.R. § 58.15).

   Pennsylvania's RACT II and EPA's Tier 3 gasoline programs will not take effect until 2017. EPA indicates in its Designation Guidance that it intends to promulgate final ozone area designations for the 2015 ozone NAAQS by October 1, 2017. Designation Guidance, p. 3. This deadline would preclude the inclusion of monitoring data from 2017 for the purposes of designation. The EPA Designation Guidance indicates that EPA will use "the most recent complete three consecutive calendar years of quality assured, *certified* air quality data" (emphasis added) in making their designations. As complete 2017 monitoring data would not be available until after January 1, 2018, EPA would be unable to use monitoring data reflecting these potential benefits. EPA expects promulgation of final designations no later than October 1, 2017. However, any emissions benefits achieved from the programs identified by the commentator, while not likely to influence area designations, will nonetheless help the areas attain and maintain the NAAQS, and may be reflected in later State Implementation Plan (SIP) revisions, such as attainment plans and maintenance plans, for Pennsylvania's ozone nonattainment areas.

2. **COMMENT:** The Department should not propose that Allegheny, Armstrong, Beaver, Butler, Washington, Fayette, and Westmoreland Counties be designated as a multi-county nonattainment area because only one Allegheny monitor and the Armstrong

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County monitor have design values greater than the 2015 eight-hour ozone NAAQS. (1,2)

RESPONSE: The Department disagrees with the comment to not recommend the designation of the seven county Pittsburgh-Beaver Valley area as in nonattainment of the 2015 ozone NAAQS.

As described in the proposed recommendations, the Department used a multi-factor analysis consistent with the EPA Designation Guidance. That guidance states that EPA will consider five factors in designating new areas under the 2015 ozone NAAQS: 1) Air quality data; 2) Emissions data and emissions-related data; 3) Meteorology; 4) Geography and topography; and 5) Jurisdictional boundaries, including political boundaries, transportation planning organizations and existing nonattainment areas.

In addition to air quality data indicating two monitors with design values greater than the 2015 ozone NAAQS, a large part of the Department's recommendation is based upon the seven counties being part of a Core Based Statistical Area (CBSA) that includes both Metropolitan and Micropolitan Statistical Areas with a high degree of both historic and current social and economic integration. This is evidenced by commuting patterns between the outlying counties surrounding the core of the City of Pittsburgh in Allegheny County. Furthermore, other factors described in the proposal, including monitoring, emissions and meteorological data, topography, jurisdictional boundaries and past designation history, were considered to make the final recommendation.

HYSPLIT trajectory analysis, showing contributions of transport into the seven-county area and provided in Appendices C & D of the proposal, further support the Department's recommendation to designate the seven-county Pittsburgh-Beaver Valley area as nonattainment for the 2015 Ozone NAAQS. Section 107(d)(1) of the Clean Air Act requires that the EPA designate an area as "nonattainment" if it is violating the NAAQS *or if it is contributing to a violation of a NAAQS in a nearby area* (emphasis added).

3. **COMMENT:** Linking counties into a single multi-county nonattainment area results in the entire area remaining classified as nonattainment, even if only one monitor in one county is actually measuring nonattainment of the standard. (1)

   RESPONSE: The commentator appears concerned that counties, once linked together as a nonattainment area, will remain that way for future NAAQS revisions. While the Department is sensitive to this concern, the Department has developed the Pennsylvania recommendations based on the CAA and EPA guidance. When making designation recommendations for the 2015 ozone NAAQS and determining whether to link counties into a single county nonattainment area, EPA indicates in its Designation Guidance that it will consider five factors: 1) Air quality data; 2) Emissions data and emissions-related data; 3) Meteorology; 4) Geography and topography; and 5) Jurisdictional boundaries, including political boundaries, transportation planning organizations and existing nonattainment areas.

4. **COMMENT:** Because the Commonwealth is located in a Clean Air Act defined Ozone Transport Region (OTR), it is not necessary for the Department to create separate

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"internal ozone transport regions" by recommending multi-county areas for EPA designation as nonattainment. (1)

RESPONSE: The Department disagrees with the commentator's premise that recommending a multi-county area for designation as nonattainment creates an "internal ozone transport region", or that the Department's recommendation of a multi-county area is unnecessary.

The OTR was created by operation of law in Section 184 of the CAA, 42 U.S.C. § 7511c(a), to facilitate the coordinated control of interstate ozone transport. It is already the Department's responsibility under the CAA, Pennsylvania Air Pollution Control Act (APCA), 35 P.S. §§ 4001 *et seq.*, and regulations adopted under APCA (25 Pa. Code §§121-145) to regulate intrastate transport of pollution. Furthermore, the APCA mandates in Section 4(1) that the Department implement the CAA in Pennsylvania. 35 P.S. § 4004(1).

Consistent with Section 107 of the CAA, and applying the EPA Designation Guidance, the Department is recommending a multi-county nonattainment area in the five county Philadelphia area (Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties), as the specified factors indicate that intrastate emissions likely contribute significantly to the exceedances at a monitor within the multi-county area. This approach is consistent with Section 107 of the CAA, prior Department designation recommendations, previous and current EPA NAAQS designation guidance, and final EPA designations for previous ozone NAAQS.

5. **COMMENT:** It is ultimately in the best interests of businesses to be located in areas which have a formal county specific designation of attainment. (1)

   RESPONSE: The Department agrees, since there are fewer restrictions on businesses in areas that are not designated nonattainment. That is not, however, a primary factor in making area designation recommendations. The Department is following the CAA and EPA's Designation Guidance, which are designed to ensure that all areas in the United States attain the 2015 ozone NAAQS, in making its recommendations. It is in the best interest of all Pennsylvanians to breathe air that attains the human health and welfare based NAAQS. Residents in areas of Pennsylvania that attain the NAAQS will enjoy both reduced hospital admissions and other long-term health benefits. Areas with clean air that meets ambient health and welfare standards are generally more attractive places to live and visit, thus encouraging economic growth in sectors related to that development.

6. **COMMENT:** An ultimate classification by EPA of attainment of the 2015 ozone NAAQS would show that reductions that have already been achieved have resulted in attainment of the NAAQS which is important to be shared with citizens of the state. (1)

   RESPONSE: The Department agrees. EPA's final designations for the 2015 ozone NAAQS should reflect the progress already made by Pennsylvania in achieving attainment of the previous ozone NAAQS.

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7. **COMMENT:** A county specific designation of attainment over a multi-county designation would have no negative effect on the availability and use of Emissions Reduction Credits (ERCs) necessary for the operation of new or modified sources major sources of ozone precursors and each county would only be obligated to obtain ERCs at a ratio that is consistent with the county specific classification rather than at a higher level of nonattainment designation that could be made for an entire multi-county nonattainment area due to the ozone concentrations measured in a different county. (1)

   RESPONSE: The Department appreciates the commentator's concern, but the Department has developed its recommendations consistent with the CAA and EPA's Designation Guidance, which lead to the conclusion that the Pittsburgh–Beaver Valley area should include the seven listed counties in Pennsylvania's final designation recommendations.

8. **COMMENT:** Designating individual counties based upon the measured design values could be quite important in the very near future, because if the PA RACT II and the Tier 3 gasoline implementation result in measured attainment of the 2015 ozone NAAQS in all counties, then the current PA RACT II regulation could be determined to be adequate for Pennsylvania and no revision to that regulation would be required. (1)

   RESPONSE: The RACT II regulations in Pennsylvania will take effect in 2017. RACT II was ultimately developed as a requirement to consider RACT as a result of the 2008 8-hr ozone NAAQS. (46 *Pa. B.* 2036-2064; April 23, 2016). Section 182 of the CAA (42 U.S.C. § 7511a) requires a state to develop and implement a program that requires owners and operators of sources in ozone nonattainment areas to implement RACT for sources that are subject to Control Techniques Guidelines (CTG) issued by EPA and for "major sources" of VOC and NOx, which are precursors to ozone.

   After EPA promulgates its final designations for the 2015 ozone NAAQS in 2017, the Department is legally obligated to evaluate existing RACT requirements to either certify that the existing RACT II regulation presumptively meets the requirements of RACT under the new 2015 ozone NAAQS, or, after evaluation, require owners and operators of sources in nonattainment areas to implement additional RACT.

   According to EPA's preamble to its final rule establishing the 2015 ozone NAAQS, EPA intends to promulgate a 2015 ozone NAAQS implementation rule that will address RACT for major sources and RACT VOC CTGs. (80 FR 65292, 65437; October 26, 2015.) EPA has indicated that the implementation rule will be similar to the 2008 ozone NAAQS implementation rule (80 FR 12264; March 6, 2015). Following receipt of the anticipated implementation rule for the 2015 ozone NAAQS and following EPA's determination of final area designations for the 2015 ozone NAAQS in 2017, the Department will determine if the existing RACT II regulation will need to be evaluated to determine if it meets the requirements to be considered presumptive RACT for the 2015 ozone NAAQS.

   See also the response to Comment #2.

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9. **COMMENT:** If the design values for the 2014-2016 ozone season period show measured attainment of the 2015 ozone NAAQS for those monitors that currently show violations for the 2013-2015 ozone season period, then the designation for those counties should be revised to attainment of the 2015 ozone NAAQS prior to EPA finalizing the designations on October 1, 2017. (1,2,3,4)

   RESPONSE: The Department will revise its recommendations if the 2014-2016 quality assured, certified monitoring data demonstrates attainment of the NAAQS in accordance with 40 C.F.R. § 50.19 and EPA's implementing guidance for demonstrating attainment of the NAAQS, in time for EPA's final determinations. In EPA's Designation Guidance, the EPA has anticipated notifying Pennsylvania of its intended modifications to the Department's recommendations by June 2, 2017. EPA has stated that it will allow states sixty (60) days from the date of the EPA letter's issuance to submit additional information, including 2016 certified monitoring data, for EPA's consideration in making its final designations. Given the existing EPA requirement to provide certified monitoring data for 2016 no later than May 1, 2017, the Department anticipates that certified 2016 monitoring data will be available for EPA to use in determining if areas initially recommended for nonattainment would actually be in attainment of the 2015 ozone NAAQS.

10. **COMMENT:** Chester County should not be designated as a nonattainment area or as part of a Bucks, Chester, Delaware, Montgomery and Philadelphia multi-county nonattainment area. The monitor located in that county has a measured design value for the 2013-2015 time period that demonstrates attainment of the 2015 ozone NAAQS. Further, the PA RACT II regulation and Tier 3 gasoline will result in additional significant reductions in ozone precursors further reducing the ambient ozone concentrations at that location. (1)

    RESPONSE: The Department disagrees. Chester County is included in the interstate Philadelphia-Reading-Camden Combined Statistical Area (CSA) and is included in the Southeast Pennsylvania air basin as defined in 25 Pa. Code § 121.1. The area's transportation planning organization includes the five counties and all five counties have been part of the multi-state ozone nonattainment area since the first ozone designations were made under the federal CAA. Because of this historic inclusion as part of a five county nonattainment area, Chester County already shares a number of air pollution control strategies reflecting the area nature of ozone formation and transport.

    Section 107(d)(1) of the Clean Air Act requires that the EPA designate an area as "nonattainment" if it is violating the NAAQS or if it is contributing to a violation of a NAAQS in a nearby area. As indicated in Appendix D of the Department's proposed and final designation recommendations, the inter-county commuting ties remain strong and further reinforce the five county nonattainment area recommendation. Importantly, the entire five-county area relies heavily on the U.S. Interstate 95 corridor and the corridor's interconnecting network of feeder highways. The I-95 corridor has often been cited as one of the leading contributing factors to regional ozone nonattainment in the nation.

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See also the response to Comment #2.

11. **COMMENT:** Indiana and Lebanon Counties should initially be designated as individual county nonattainment areas of the 2015 ozone NAAQS, however, if the design values for the 2014-2016 ozone season period show measured attainment of the 2015 ozone NAAQS in either or both of those counties, then the designation for either or both of those counties should be revised to attainment of the 2015 ozone NAAQS prior to EPA finalizing the designations on October 1, 2017. (1)

    RESPONSE: The Department agrees. See also response to Comment #9.

12. **COMMENT:** PADEP should not designate the bulk of Pennsylvania as unclassifiable/attainment. The remainder of the state should be designated as being in attainment of the 2015 ozone NAAQS. (1)

    RESPONSE: The Department can submit a recommendation that areas be classified as "attainment" as opposed to the historical designation category of "unclassifiable/attainment". However, EPA indicates in the Designation Guidance that the agency likely will continue to use the "unclassifiable/attainment" designation. This would be done to recognize the difference between an area that has demonstrated attainment with area specific monitoring ("attainment") and those areas without monitors that EPA believes are likely in attainment and do not contribute to nearby violations ("unclassifiable").

13. **COMMENT:** Given the economic ramifications of the increased regulatory burden that will fall on sources located within counties designated as non-attainment for criteria pollutants, the commentator recommends DEP pursue standalone county non-attainment designation recommendations to the greatest extent possible, in part by contemplating the additional reductions expected from the implementation of various federal and state air quality regulations. (2)

    RESPONSE: The Department has recommended both Indiana and Lebanon Counties for stand-alone county designation as nonattainment. However, the Department cannot recommend attainment based on future emissions control programs (for example, federal Tier 3 rules or Pennsylvania RACT II regulations) as EPA designations must be based on certified monitored ozone data in accordance with the CAA.

    See also the responses to Comment #1 and Comment #8 regarding the inclusion of future emissions control programs in designations by EPA.

    See also the response to Comment #2.

14. **COMMENT:** DEP should have provided more time for public comment on this matter of significant public policy. It is imperative that DEP allow for a sufficient comment

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period on matters of great interest to the regulated community and stakeholders writ large. The comment period on this matter was announced on August 20 and will close September 2. Ten business days is an inadequate amount of time to gather meaningful stakeholder input. The implementation of the newly revised ozone NAAQS has significant implications for businesses and industries and a robust public comment period and stakeholder involvement is necessary. (2)

RESPONSE: The Department appreciates the concern but disagrees that inadequate time was provided for public input. The comment period and the three public meetings held during that period were sufficient to gather public input on the Department's recommendations to EPA for designations under the 2015 ozone NAAQS. It is EPA that has the authority to make the area designations under the Section 107(d) of the CAA. EPA states on page 3 of its Designation Guidance that it plans to provide a thirty (30) day public comment period when it publishes notice of its modifications, if any, to states' recommended designations.

It is important to note that, unlike the legal requirement for public comment for regulatory and State Implementation Plan (SIP) actions by the Department, neither states nor the EPA are required to provide a public comment period or public meetings as part of the area designation process.

An EPA designation begins a process of planning by a state to bring the nonattainment areas into attainment of the NAAQS by a set date. As regulations and/or revisions to the state's SIP are developed, they are subject to statutorily-required public comment periods and additional public outreach across the state. The public will have ample opportunity to review and comment on Department actions in this regard.

15. **COMMENT:** The proposed designations were not discussed in any great detail with the Air Quality Technical Advisory Committee (AQTAC), whose meetings have on numerous occasions been cancelled this year. (2)

    RESPONSE: The Department disagrees. Both the 2008 and 2015 ozone NAAQS and the then-current ozone monitoring design values were presented at the December 10, 2015 meeting of AQTAC. The implications of the monitors with design values greater than the 2015 ozone NAAQS were presented. In addition, the Department's proposed recommendations for nonattainment areas were stated in the Regulatory and SIP Update presentation at the August 4, 2016 AQTAC meeting. The AQTAC members held a brief discussion on the proposed recommendations. The Department explained the public comment process the Department would undertake prior to submitting the final designation recommendations.

    However, recognizing that AQTAC meetings in April and June 2016 were canceled due to resource and scheduling limitations, the Department believes that even had meetings been scheduled, the time constraints for submittal of the recommendations to EPA would have precluded a presentation of final draft recommendations to AQTAC.

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The final designation recommendations will be presented to AQTAC as committee scheduling allow.

16. **COMMENT:** EPA's guidance on designation suggests states group counties based on Core-Based or Combined Statistical Areas. However, as DEP makes clear in its discussion of designating Indiana and Lebanon Counties, there is the option afforded to states to recommend individual county designations. For these reasons, DEP should recommend a non-attainment designation only for counties in which a monitor is demonstrating ozone values (for years 2013-15) of greater than 70 ppb, and DEP should also ensure that EPA recognize monitoring data from 2016 as soon as it is available before finalizing nonattainment designations next year. (2)

    RESPONSE: As stated above, a monitor's design value is an important factor in considering whether an area is in nonattainment, but it is only one of several factors that DEP and EPA must consider to meet the requirements of the Clean Air Act.

    See also the responses to Comments #2, #3, #8, #10, #11 and #13.

17. **COMMENT:** Both DEP and EPA should set a course with respect to securing statewide attainment of the 2015 ozone standard in a manner that does not result in further job loss and economic disadvantage to the state. (2)

    RESPONSE: The Department agrees with this goal and is mindful of it when developing plans to attain a NAAQS. The document under review at the moment, however, is the area designation recommendations, and not the methods that will be used to bring areas into attainment.

    The Department's planning actions are guided in part by the Declaration of Policy in Section 2 of Pennsylvania's Air Pollution Control Act. That provision calls for the Commonwealth to balance the protection of Pennsylvania's air resources to the degree necessary for protection of public health, safety and well-being of its citizens with, among other factors, the development, attraction and expansion of industry, commerce and agriculture. (35 P.S. § 4002)

    The 2015 ozone NAAQS, while estimated to cost $1.4 billion nationally (except California), is estimated to result in $2.9 to $5.9 billion in health benefits nationally (except California). In California, the standard is estimated to cost $0.8 billion with a $1.2 to $2.1 billion health benefit. In Pennsylvania, the health benefits will be more pronounced in the most densely populated areas already affected negatively by ambient ozone levels.

18. **COMMENT:** While the Pittsburgh region continues to deal with the challenges of transport and the typical emissions associated with a thriving urban economy, the steady reduction in average ozone levels as well as incidences of exceeding standards indicate that existing emission control strategies are working. As evidence of our improving air quality, the ozone monitor in Harrison, historically Pittsburgh's highest reading location,

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has shown a decrease in design values of nearly 11 percent over just the past four years and 16 percent in the past decade. Over the same period of time, ozone exceedances in Allegheny County have dropped from 19 in 2012, to just 2 in 2015. (3)

RESPONSE: The Department agrees that the historical downward trend of average ozone levels and number of exceedance days in the Pittsburgh-Beaver Valley area demonstrate the effectiveness of Pennsylvania's long-time efforts to improve ambient air quality.

HYSPLIT trajectory analysis, which shows contributions of transport into the seven-county area as provided in Appendices C and D of the proposal, indicate that long-range transport of ozone and ozone precursors, while still significant, is becoming more regional in nature, further supporting the efficacy of existing plans.

19. **COMMENT:** We are optimistic that both DEP and EPA will acknowledge the air quality improvements that have resulted from existing control measures and will allow the current strategies to continue in the Pittsburgh region without adding additional unnecessary regulatory actions prematurely. (3)

    RESPONSE: The Department has long acknowledged the effectiveness of existing air quality management and pollution control programs in reducing ambient concentrations of unhealthful criteria pollutants. The Department will consider and implement new regulatory initiatives for further reducing air pollution in the Commonwealth, as necessary and appropriate, consistent with legal requirements of the CAA, the APCA and the regulations thereunder and DEP's existing policy to ensure that any new program is necessary and effective.

20. **COMMENT:** The Pittsburgh region has made tremendous strides in improving all measures of air quality, including ozone. Previously implemented measures are resulting in better air quality for everyone and will continue to do so. We look forward to working with DEP on this issue as it progresses and urge the Department to allow for appropriate public comment periods and engagement opportunities. (3)

    RESPONSE: The Department recognizes the efforts and progress made by the Pittsburgh-Beaver Valley area in improving air quality. DEP will continue to provide appropriate opportunities for input in the development of, and comment on, proposed Department actions.

21. **COMMENT:** The ozone design values ultimately calculated from the air quality monitoring data for 2014-2016 may be less than the 70 ppbv (part per billion by volume) ozone NAAQS, perhaps due in part of the significant decrease in nitrogen oxide (NOx) emissions. According to the National Emissions Inventory 2012-2014, NOx emissions in PA from the top three source categories decreased from 2012 to 2014 calendar years (CY) as follows:

	State-Wide NOx Emissions (1000 tons)

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Source Category *	CY 2012	CY 2013	CY 2014
Highway Vehicles	188.40	172.73	157.06
Fuel Combustion Electric Utilities	122.36	130.40	118.99
Off-Highway	71.63	66.86	62.09

Likewise NOx emissions from the electric utility industry as reported to the US EPA

State	Year	NOx Emissions (1000 tons)	Heat Input (MMBtu)	Gross Load (MW-h)	Average NOx Emission Rate (lb/MMBtu)	Average NOx Emission Rate (lb/MW-h)
PA	2013	133.82	1.28E+09	1.34E+08	0.21	1.99
	2014	122.70	1.21E+09	1.26E+08	0.20	1.95
	2015	96.82	1.13E+09	1.18E+08	0.17	1.64
	2016 Jan-Jun	39.15	4.92E+08	5.05E+07	0.16	1.55

Clean Air Markets Division show a similar trend. (4)

RESPONSE: The Department agrees that certified 2014-2016 monitoring may indicate attainment for monitors where 2013-2015 monitoring does not. Further, the Department agrees that a potential reduction in overall 2016 NOx emissions, among other factors, may contribute to an ultimate lowering of 2016 monitored design values. See also the response to Comment #9.

22. **COMMENT:** Additional statewide NOx emission reductions are expected beginning in 2017 in response to both the EPA Tier 3 Vehicle Emission and Fuel Standards Program and the Department's NOx and VOC RACT II rule. (4)

    RESPONSE: The Department agrees that both the EPA Tier 3 and Pennsylvania RACT II rule will provide NOx reductions following their implementation in 2017. The reductions are described in the programs' respective rulemaking documents.

    See also the responses to Comment #1 and Comment #8.

23. **COMMENT:** Commentator supports the designation of Philadelphia County as a nonattainment area as Philadelphia has exceptionally high rates of asthma, especially among minorities and the poor. (5)

    RESPONSE: The Department thanks the commentator for the support of its recommendation and recognizes the challenges faced by urban centers such as Philadelphia.

24. **COMMENT:** We urge the DEP to request of EPA a further lowering of the ozone standard, dropping it from 70 to 65 ppb or lower, to provide additional protection from the harmful effects of ozone. (5)

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RESPONSE: The Department will continue to participate in the periodic EPA review and update process of all NAAQS, in accordance with the CAA. This process ensures that EPA uses the latest available scientific data to determine whether a new or revised NAAQS is needed.

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APPENDIX A
Area Designations

Table 1: Recommended Area Designations for the 2015 Ozone Standards

Figure A-1: Recommended Area Designations for the 2015 Ozone Standards

Figure A-2: Final Area Designations for the 2008 Ozone Standards

Table 1. Recommended Area Designations for the 2015 Ozone Standards

Pennsylvania Areas	County Design Values (2015)	Recommended Designation
DEP's Southeast Region		
Philadelphia-Reading-Camden PA-NJ-DE-MD Combined Statistical Area		
Philadelphia-Camden-Wilmington PA-NJ-DE-MD Metropolitan Statistical Area		
Bucks County	75 ppb	Nonattainment
Chester County	69 ppb	Nonattainment
Delaware County	72 ppb	Nonattainment
Montgomery County	71 ppb	Nonattainment
Philadelphia County	73 ppb	Nonattainment
Reading Metropolitan Statistical Area		
Berks County (Part of DEP's Southcentral Region)	69 ppb	Unclassifiable/Attainment
DEP's Southcentral Region		
Altoona Metropolitan Statistical Area		
Blair County	64 ppb	Unclassifiable/Attainment
Harrisburg-York-Lebanon Combined Statistical Area		
Harrisburg-Carlisle Metropolitan Statistical Area		
Cumberland County	No monitor	Unclassifiable/Attainment
Dauphin County	66 ppb	Unclassifiable/Attainment
Perry County	No monitor	Unclassifiable/Attainment
York-Hanover Statistical Area		
York County	68 ppb	Unclassifiable/Attainment
Lebanon Metropolitan Statistical Area		
Lebanon County	71 ppb	Nonattainment
Gettysburg Metropolitan Statistical Area		
Adams County	65 ppb	Unclassifiable/Attainment
Lancaster Metropolitan Statistical Area		
Lancaster County	67 ppb	Unclassifiable/Attainment

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Table 1. Recommended Area Designations for the 2015 Ozone Standards

Pennsylvania Areas	County Design Values (2015)	Recommended Designation
Washington-Baltimore-Arlington, DC-MD-VA-WV-PA Combined Statistical Area		
Chambersburg-Waynesboro Metropolitan Statistical Area		
Franklin County	64 ppb	Unclassifiable/Attainment
Huntingdon Micropolitan Statistical Area		
Huntingdon County	No monitor	Unclassifiable/Attainment
Lewistown Micropolitan Statistical Area		
Mifflin County	No monitor	Unclassifiable/Attainment
Remaining Counties in DEP's Southcentral Region		
Bedford County	No monitor	Unclassifiable/Attainment
Fulton County	No monitor	Unclassifiable/Attainment
Juniata County	No monitor	Unclassifiable/Attainment
DEP's Southwest Region		
Pittsburgh-New Castle-Weirton PA-OH-WV Combined Statistical Area		
Pittsburgh Metropolitan Statistical Area		
Allegheny County	73 ppb	Nonattainment
Armstrong County	72 ppb	Nonattainment
Beaver County	70 ppb	Nonattainment
Butler County (Part of DEP's Northwest Region)	No monitor	Nonattainment
Fayette County	No monitor	Nonattainment
Washington County	68 ppb	Nonattainment
Westmoreland County	67 ppb	Nonattainment
Indiana Micropolitan Statistical Area		
Indiana County	71 ppb	Nonattainment

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Table 1. Recommended Area Designations for the 2015 Ozone Standards

Pennsylvania Areas	County Design Values (2015)	Recommended Designation
New Castle Micropolitan Statistical Area		
Lawrence County (Part of DEP's Northwest Region)	68 ppb	Unclassifiable/Attainment
Johnstown-Somerset Combined Statistical Area		
Johnstown Metropolitan Statistical Area		
Cambria County	63 ppb	Unclassifiable/Attainment
Somerset Micropolitan Statistical Area		
Somerset County	60 ppb	Unclassifiable/Attainment
Remaining Counties in DEP's Southwest Region		
Greene County	67 ppb	Unclassifiable/Attainment
DEPs Northwest Region		
Erie-Meadville Combined Statistical Area		
Erie Metropolitan Statistical Area		
Erie County	66 ppb	Unclassifiable/Attainment
Meadville Micropolitan Statistical Area		
Crawford County	No monitor	Unclassifiable/Attainment
Youngstown-Warren, OH-PA Combined Statistical Area		
Youngstown-Warren-Boardman Metropolitan Statistical Area		
Mercer County	68 ppb	Unclassifiable/Attainment
St. Mary's Micropolitan Statistical Area		
Elk County	No monitor	Unclassifiable/Attainment
Bradford Micropolitan Statistical Area		
McKean County	No monitor	Unclassifiable/Attainment

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Table 1. Recommended Area Designations for the 2015 Ozone Standards

Pennsylvania Areas	County Design Values (2015)	Recommended Designation
Oil City Micropolitan Statistical Area		
Venango County	No monitor	Unclassifiable/Attainment
Warren Micropolitan Statistical Area		
Warren County	No monitor	Unclassifiable/Attainment
Remaining Counties in DEP's Northwest Region		
Clarion County	No monitor	Unclassifiable/Attainment
Jefferson County	No monitor	Unclassifiable/Attainment
Forest County	No monitor	Unclassifiable/Attainment
DEP's Northcentral Region		
State College-DuBois Combined Statistical Area		
State College Metropolitan Statistical Area		
Centre County	65 ppb	Unclassifiable/Attainment
DuBois Micropolitan Statistical Area		
Clearfield County	65 ppb	Unclassifiable/Attainment
Williamsport-Lock Haven Combined Statistical Area		
Williamsport Metropolitan Statistical Area		
Lycoming County	64 ppb	Unclassifiable/Attainment
Lock Haven Micropolitan Statistical Area		
Clinton County	No monitor	Unclassifiable/Attainment
Bloomsburg-Berwick-Sunbury Combined Metropolitan Statistical Area		
Bloomsburg-Berwick Metropolitan Statistical Area		
Columbia County	No monitor	Unclassifiable/Attainment
Montour County	No monitor	Unclassifiable/Attainment
Lewisburg Micropolitan Statistical Area		
Union County	No monitor	Unclassifiable/Attainment
Selinsgrove Micropolitan Statistical Area		
Snyder County	No monitor	Unclassifiable/Attainment
Sunbury Micropolitan Statistical Area		
Northumberland County	No monitor	Unclassifiable/Attainment

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Table 1. Recommended Area Designations for the 2015 Ozone Standards

Pennsylvania Areas	County Design Values	Recommended Designation
Sayre Micropolitan Statistical Area		
Bradford County	No monitor	Unclassifiable/Attainment
Remaining Counties in Northcentral Region		
Cameron County	No monitor	Unclassifiable/Attainment
Potter County	No monitor	Unclassifiable/Attainment
Sullivan County	No monitor	Unclassifiable/Attainment
Tioga County	63 ppb	Unclassifiable/Attainment
DEP's Northeast Region		
New York-Newark, NY-NJ-CT-PA Combined Statistical Area		
Allentown-Bethlehem-Easton PA-NJ Metropolitan Statistical Area		
Carbon County	No monitor	Unclassifiable/Attainment
Lehigh County	68 ppb	Unclassifiable/Attainment
Northampton County	67 ppb	Unclassifiable/Attainment
Scranton-Wilkes-Barre-Hazleton Metropolitan Statistical Area		
Lackawanna County	65 ppb	Unclassifiable/Attainment
Luzerne County	63 ppb	Unclassifiable/Attainment
Wyoming	No monitor	Unclassifiable/Attainment
East Stroudsburg Metropolitan Statistical Area		
Monroe County	63 ppb	Unclassifiable/Attainment
Remaining Counties in Northeast Region		
New York-Newark-Edison Metropolitan Statistical Area		
Pike County	No monitor	Unclassifiable/Attainment
Schuylkill County	No monitor	Unclassifiable/Attainment
Susquehanna County	No monitor	Unclassifiable/Attainment
Wayne County	No monitor	Unclassifiable/Attainment

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Figure A-1: Recommended Area Designations for the 2015 Ozone Standards

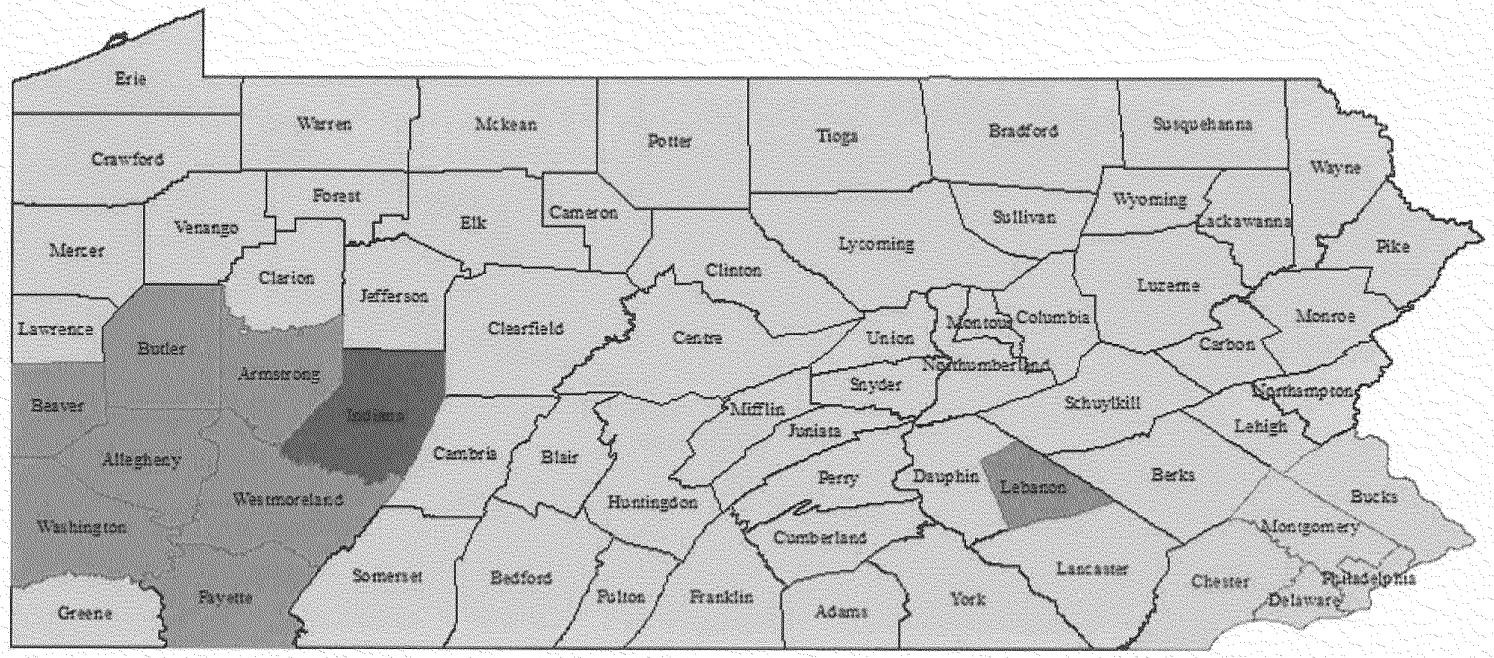

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Figure A-2: Final Area Designations for the 2008 Ozone Standards

- Lancaster Marginal Nonattainment Area
- Lehigh Valley Marginal Nonattainment Area
- Philadelphia Area Marginal Nonattainment Area
- Pittsburgh-Beaver Valley Area Marginal Nonattainment Area
- Reading Marginal Nonattinment Area
- Unclassifiable/Attainment

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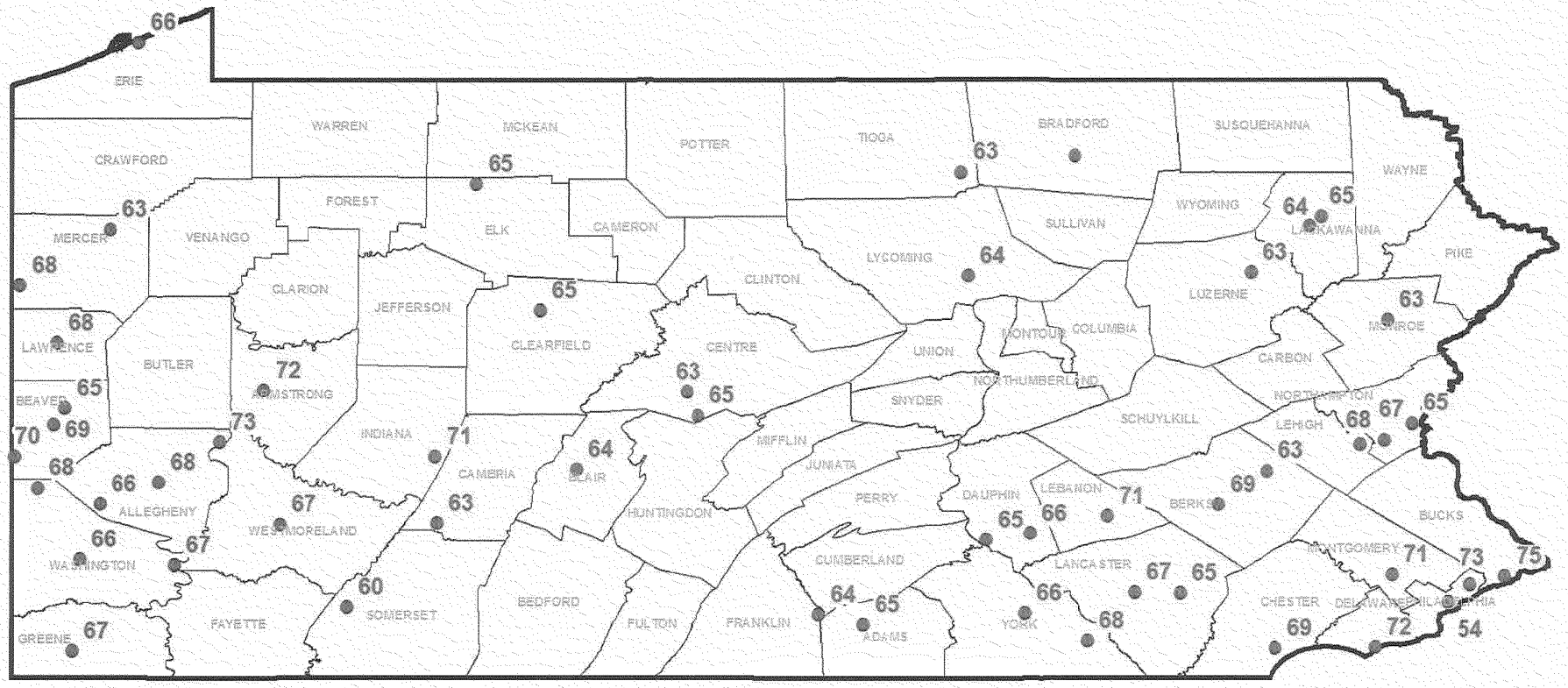
APPENDIX B

Supporting Documentation

Figure B-1: Pennsylvania's 2015 Ozone Design Values
Figure B-2: NOx Emissions Density by County
Figure B-3: VOC Emissions Density by County
Figure B-4: Population Density by County
Figure B-5: Population Growth by County
Figure B-6: Pennsylvania's Core-Based Statistical Areas
Figure B-7: Combined Statistical Areas
Table 2: 2011 Annual Emissions and Emission Densities by County

Figure B-1: Pennsylvania's 2015 Ozone Design Values



Appearing in Red - 2015 Ozone Design Value is Exceeding 2015 Ozone Standard

Appearing in Blue - 2015 Ozone Design Value in Attainment of 2015 Ozone Standard

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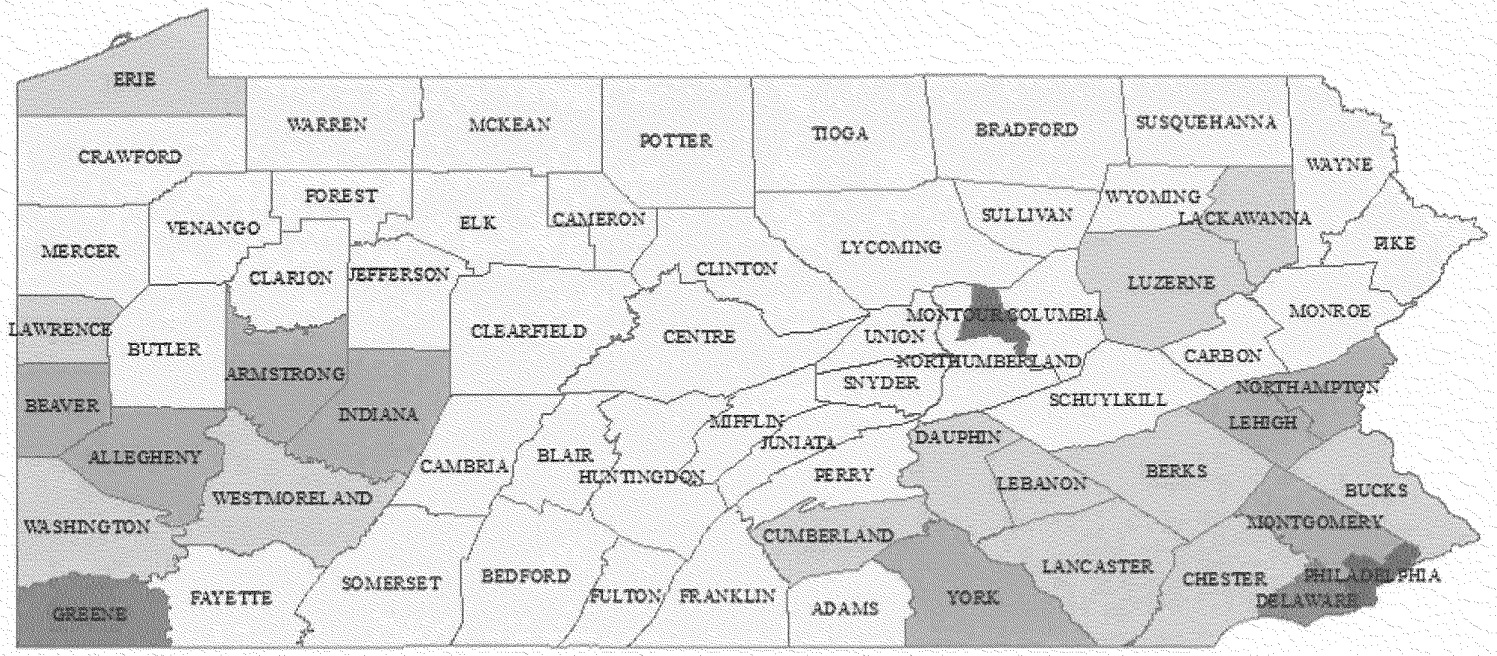
Figure B-2: NOx Emissions Density by County

Emissions Based on 2011 NEI Data



NOx Emissions Density (tons per year per square mile)

0 - 10.0 | 10 - 25.0 | 25.0 - 50.0 | 50.0 - 100.0 | 100.0 - 160.0

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Figure B-3: VOC Emission Density by County

Emissions Based on 2011 NEI Data

VOC Emissions Density (tons per year per square mile)

0 - 10 | 10 - 25 | 25 - 50 | 50 - 75 | 75 - 165

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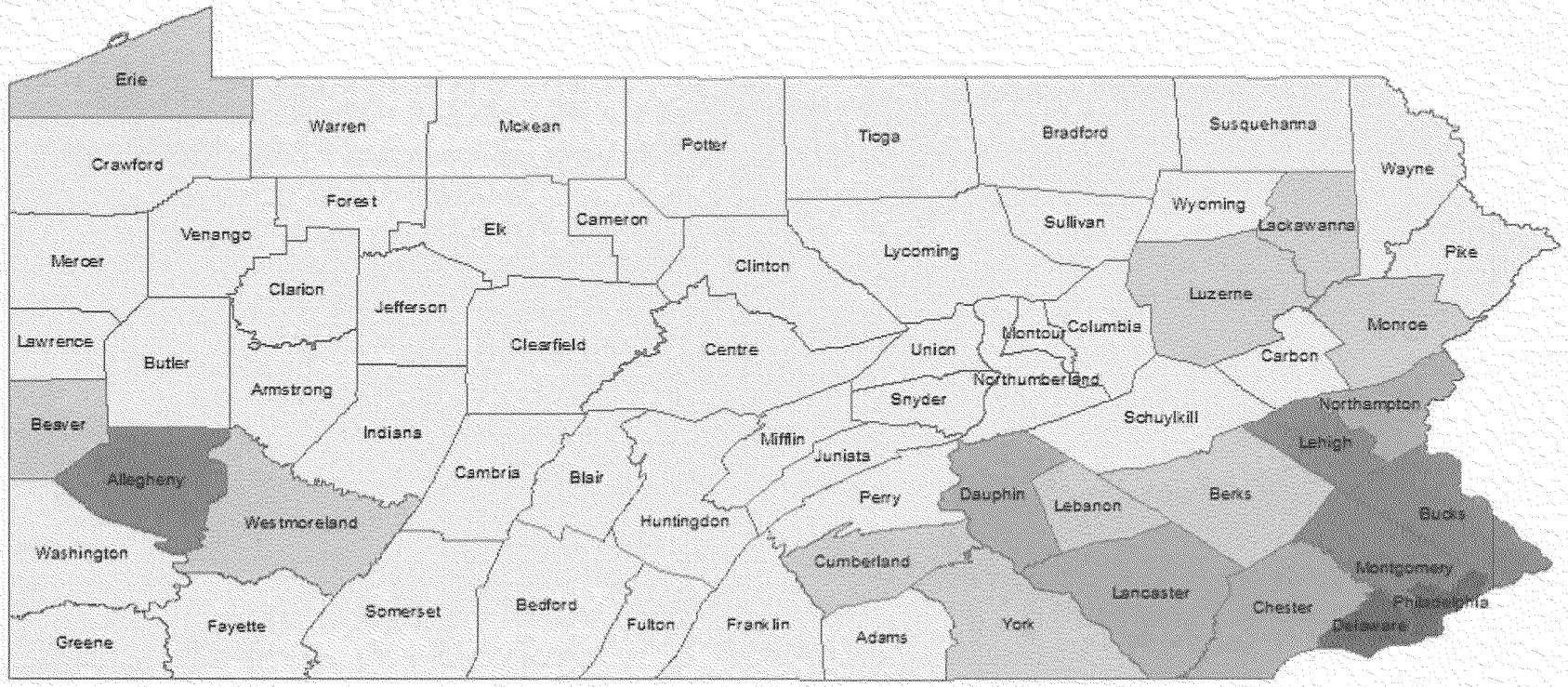
Fig B-4: Population Density by County

Population Based on 2015 US Census Estimates



Population Density (Persons per Square Mile)

0 - 250 | 250 - 500 | 500 - 1000 | 1000 - 3000 | 3000 - 11688

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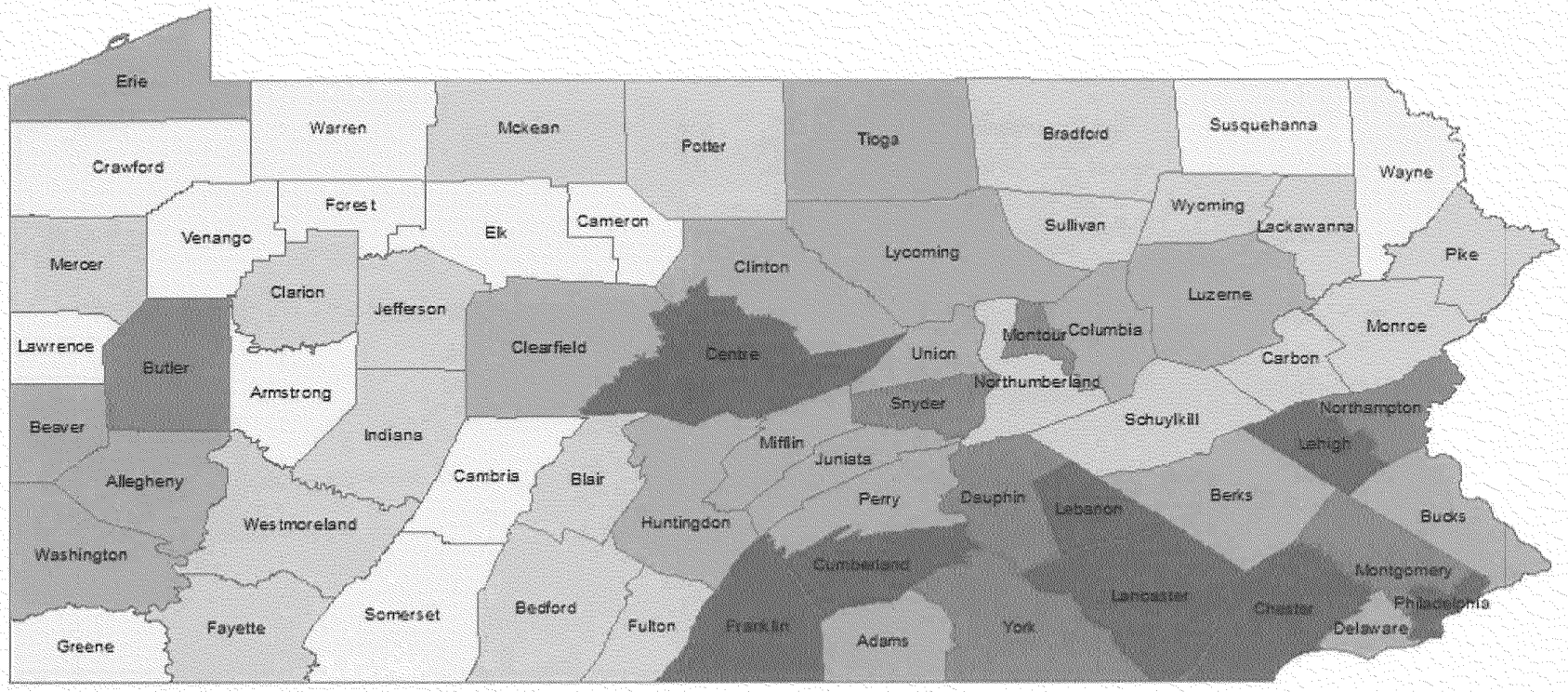
Figure B-5: Population Growth by County

Population Trends Based on 2010 and 2015 US Census Results



Population Growth (% Change: 2010 to 2015)

-7.0 - -2.5 | -2.50 - -1.0 | -1.0 - 1.0 | 1.0 - 2.5 | 2.5 - 4.65

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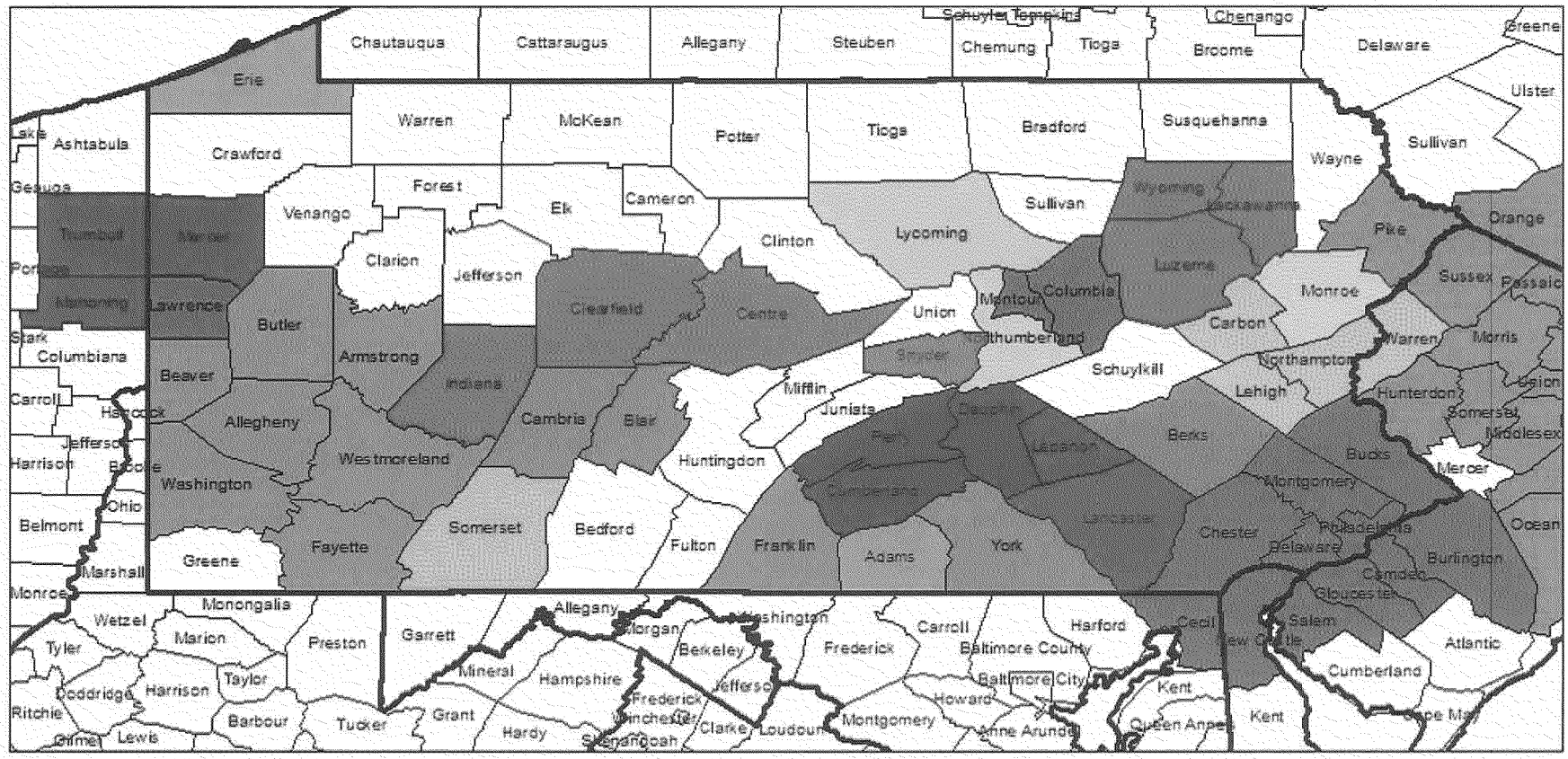
Figure B-6: Pennsylvania's Core-Based Statistical Areas



- Allentown-Bethlehem-Easton, PA-NJ
- Altoona, PA
- Bloomsburg-Berwick, PA
- Chambersburg-Waynesboro, PA
- DuBois, PA
- East Stroudsburg, PA
- Erie, PA
- Gettysburg, PA
- Harrisburg-Carlisle, PA
- Indiana, PA
- Johnstown, PA
- Lancaster, PA
- Lebanon, PA
- New Castle, PA
- New York-Newark-Jersey City, NY-NJ-PA
- Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
- Pittsburgh, PA
- Reading, PA
- Scranton–Wilkes-Barre–Hazleton, PA
- Selinsgrove, PA
- Somerset, PA
- State College, PA
- Sunbury, PA
- Williamsport, PA
- York-Hanover, PA
- Youngstown-Warren-Boardman, OH-PA

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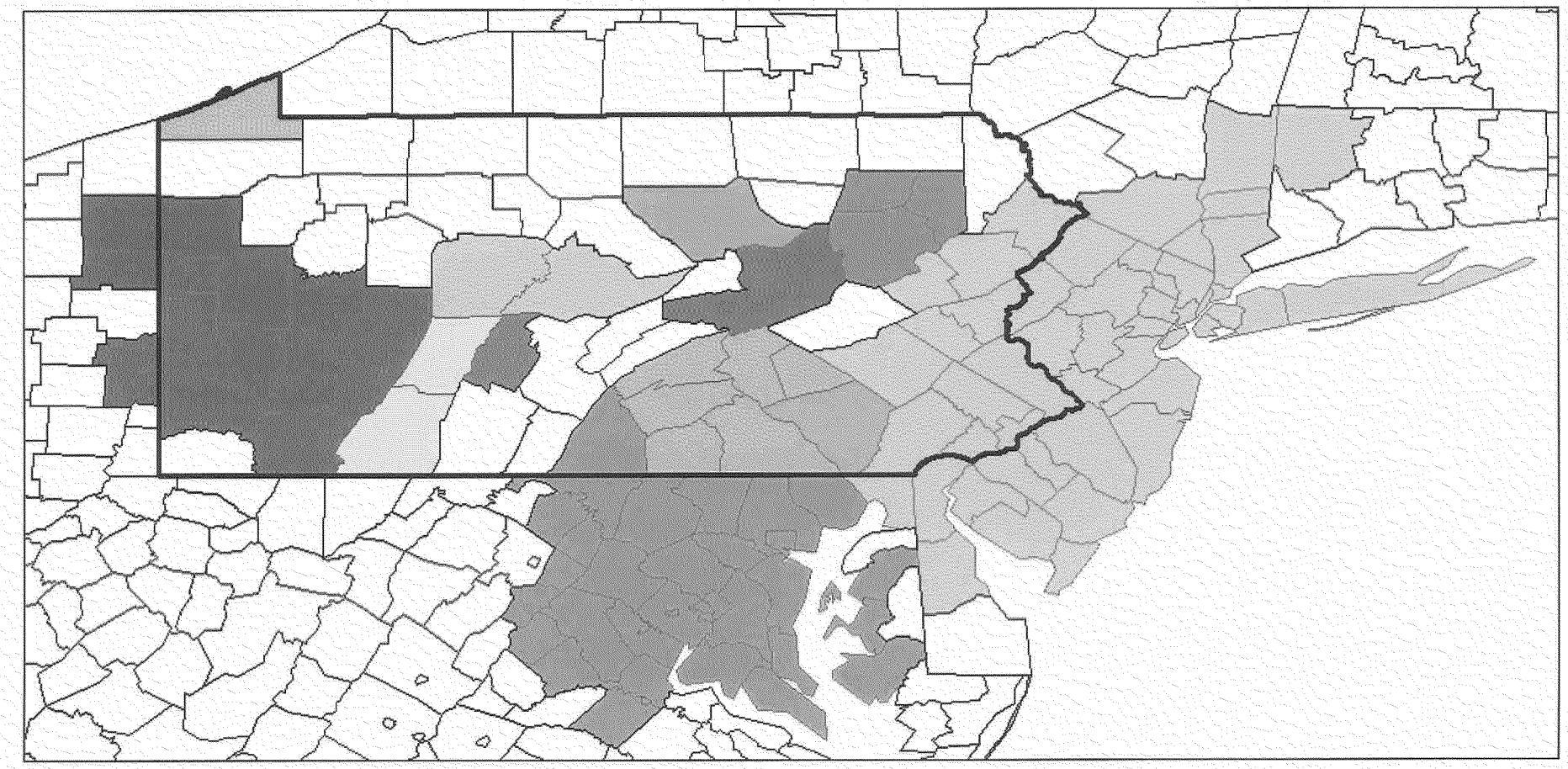
Figure B-7: Combined Statistical Areas

Office of Management and Budget, 2010



- Altoona, PA
- Bloomsburg-Berwick-Sunbury, PA
- Erie-Meadville, PA
- Harrisburg-York-Lebanon, PA
- Johnstown-Somerset, PA
- Lancaster, PA
- New York-Newark, NY-NJ-CT-PA
- Philadelphia-Reading-Camden, PA-NJ-DE-MD
- Pittsburgh-New Castle-Weirton, PA-OH-WV
- Scranton--Wilkes-Barre--Hazleton, PA
- State College-DuBois, PA
- Washington-Baltimore-Arlington, DC-MD-VA-WV-PA
- Williamsport-Lock Haven, PA
- Youngstown-Warren, OH-PA

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Table 2. 2011 Annual Emissions and Emission Densities by County

COUNTY	VOC EMISSIONS (tons per year)	NOx EMISSIONS (tons per year)	LAND AREA (square miles)	NOx Emissions Density (tons per square mile per year)	VOC Emissions Density (tons per square mile per year)
Adams	9654.48	3345.34	518.67	6.45	18.61
Allegheny	29972.96	35455.11	730.08	48.56	41.05
Armstrong	9429.85	29517.69	653.20	45.19	14.44
Beaver	8556.56	21166.68	434.71	48.69	19.68
Bedford	14678.76	2841.60	1012.30	2.81	14.50
Berks	20059.17	14403.92	856.51	16.82	23.42
Blair	10715.38	4851.27	525.80	9.23	20.38
Bradford	12338.87	5310.53	1147.40	4.63	10.75
Bucks	20381.56	12925.42	604.31	21.39	33.73
Butler	13233.76	6617.13	788.60	8.39	16.78
Cambria	10147.11	6243.75	688.35	9.07	14.74
Cameron	7082.60	380.33	396.23	0.96	17.87
Carbon	8631.36	2817.42	381.46	7.39	22.63
Centre	19058.50	6743.25	1109.92	6.08	17.17
Chester	17579.34	12031.82	750.51	16.03	23.42
Clarion	8413.73	4001.87	600.83	6.66	14.00
Clearfield	15158.80	9789.46	1144.72	8.55	13.24
Clinton	15890.55	3381.46	887.98	3.81	17.90
Columbia	8245.08	2747.46	483.11	5.69	17.07
Crawford	11818.85	6058.58	1012.30	5.98	11.68
Cumberland	13561.34	13243.86	545.46	24.28	24.86
Dauphin	15609.40	9715.01	525.05	18.50	29.73
Delaware	13451.12	17306.44	183.84	94.14	73.17
Elk	9365.78	3206.12	827.36	3.88	11.32
Erie	15001.84	11373.23	799.15	14.23	18.77
Fayette	12430.46	5775.22	790.34	7.31	15.73
Forest	7784.27	912.56	427.19	2.14	18.22
Franklin	11984.25	4970.71	772.22	6.44	15.52
Fulton	8138.25	1174.52	437.55	2.68	18.60
Greene	7893.87	30873.94	575.95	53.61	13.71
Huntingdon	14216.07	2287.11	874.64	2.61	16.25
Indiana	11466.01	36017.65	827.03	43.55	13.86
Jefferson	8427.49	5591.84	652.43	8.57	12.92
Juniata	7238.10	1847.57	391.35	4.72	18.50
Lackawanna	10584.77	5839.90	459.08	12.72	23.06
Lancaster	23579.50	13810.48	943.81	14.63	24.98
Lawrence	6238.99	4423.39	358.18	12.35	17.42

Table 2. 2011 Annual Emissions and Emission Densities by County

Lebanon	8156.48	5116.34	361.83	14.14	22.54
Lehigh	12764.82	8694.80	345.17	25.19	36.98
Luzerne	19325.78	9134.50	890.33	10.26	21.71
Lycoming	18582.84	5458.60	1228.59	4.44	15.13
McKean	9841.46	4090.39	979.20	4.18	10.05
Mercer	10789.76	6398.93	672.58	9.51	16.04
Mifflin	8489.99	2061.74	411.03	5.02	20.66
Monroe	13244.53	5236.00	608.29	8.61	21.77
Montgomery	22710.07	16546.00	483.04	34.25	47.01
Montour	3244.87	13952.98	130.24	107.13	24.91
Northampton	10741.36	14071.76	369.67	38.07	29.06
Northumberland	8202.80	3582.07	458.37	7.81	17.90
Perry	9887.61	2454.40	551.45	4.45	17.93
Philadelphia	22045.18	21064.62	134.10	157.08	164.39
Pike	11826.15	2225.94	544.96	4.08	21.70
Potter	8875.26	1883.71	1081.32	1.74	8.21
Schuylkill	16405.10	5967.22	778.63	7.66	21.07
Snyder	5924.59	3055.46	328.71	9.30	18.02
Somerset	12642.56	3452.80	1074.37	3.21	11.77
Sullivan	6012.39	610.94	449.94	1.36	13.36
Susquehanna	8432.27	4746.72	823.44	5.76	10.24
Tioga	11209.98	4094.38	1133.79	3.61	9.89
Union	6085.94	1958.20	315.98	6.20	19.26
Venango	10779.01	3885.06	674.28	5.76	15.99
Warren	11475.06	3722.89	884.14	4.21	12.98
Washington	11552.93	10067.33	856.99	11.75	13.48
Wayne	9607.42	1776.37	725.60	2.45	13.24
Westmoreland	17391.75	12939.02	1027.55	12.59	16.93
Wyoming	6177.44	2343.01	397.32	5.90	15.55
York	22085.76	33738.79	904.18	37.31	24.43

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SECRETARY

October 3, 2016

Mr. Shawn M. Garvin
Regional Administrator
U.S. Environmental Protection Agency, Region III
1650 Arch Street, (Mail Code: 3RA00)
Philadelphia, PA 19103-2029

Dear Mr. Garvin:

Pursuant to Section 107 of the Clean Air Act (CAA), enclosed please find the Commonwealth of Pennsylvania's designation recommendations pertinent to the 2015 National Ambient Air Quality Standards for ozone, 70 parts per billion as set by the U.S. Environmental Protection Agency (EPA) on October 1, 2015 and published in the *Federal Register* on October 26, 2015 (80 FR 65292). The recommended geographical boundaries for ozone unclassifiable/attainment and nonattainment areas within the Commonwealth's borders were determined in accordance with the guidance set forth in the EPA memorandum issued by Janet McCabe on February 25, 2016 pertaining to the "Area Designations for the 2015 Revised Ozone National Ambient Air Quality Standards."

Prior to finalizing the Commonwealth's ozone designation recommendations, notice announcing three public meetings and an opportunity for public comment were published by the Pennsylvania Department of Environmental Protection (DEP) in the *Pennsylvania Bulletin* on August 20, 2016 (46 Pa.B. 5162). The public meetings on the proposed recommendations were held in Pittsburgh, Harrisburg, and Philadelphia on August 24, 25, and 26, 2016, respectively. A 13-day public comment period was held from August 20 to September 2, 2016. A summary of comments received and DEP's responses are included with the recommendations.

We understand that EPA will provide notice of any modifications to our ozone designation recommendations at least 120 days prior to issuing the final designations in accordance with Section 107(d)(B)(ii) of the CAA (42 U.S.C.A. § 7407(d)(B)(ii)). We fully intend to take advantage of the opportunities prescribed under the CAA to comment on any proposed modifications to our recommendations. We look forward to collaborating with your staff during the development of final eight-hour ozone designations for the Commonwealth.

Thank you in advance for your favorable consideration of Pennsylvania's ozone designation recommendations. Should you have any questions or need additional information during the ozone designation process, please contact Krishnan Ramamurthy, Acting Director, Bureau of Air Quality, by e-mail at kramamurth@pa.gov or by telephone at 717.787.9702.

Sincerely,

Patrick McDonnell
Acting Secretary

Commonwealth of Pennsylvania

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

FINAL
DESIGNATION RECOMMENDATIONS FOR THE 2015 EIGHT-HOUR OZONE NATIONAL AMBIENT AIR QUALITY STANDARDS

OCTOBER 2016

Bureau of Air Quality
Pennsylvania Department of Environmental Protection
P.O. Box 8468
Harrisburg, PA 17105-8468
717-787-9495

www.dep.pa.gov

Patrick McDonnell
Acting Secretary

Tom Wolf
Governor

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Designation Recommendations
For the 2015 Eight-Hour Ozone
National Ambient Air Quality Standards

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APPENDIX A. Recommended Designations

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Figure A-2: Final Area Designations for the 2008 the Ozone Standards (EPA, 2012)

APPENDIX B. Supporting Documentation

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APPENDIX C. 24-Hour HYSPLIT Back Trajectories for Exceedances at Ozone Monitors for Calendar Years 2013-2015

APPENDIX D. County Commuting Patterns for the Recommended Area Designations

APPENDIX E. Public Comment and Department Response Document for Proposed Recommendations for Designation

What is this document?

Section 107 of the Clean Air Act (CAA), 42 U.S.C. § 7407, provides a mechanism for states to make recommendations to the United States Environmental Protection Agency (EPA) on the designation of areas attaining and not attaining the National Ambient Air Quality Standards (NAAQS).

In this document, the Commonwealth of Pennsylvania (Commonwealth) is making recommendations to EPA concerning the designation of Unclassifiable/Attainment and Nonattainment areas in Pennsylvania for the primary and secondary 8-hour ozone NAAQS revised by EPA on October 1, 2015 (80 FR 65292; October 26, 2015). The designation recommendations for the 2015 ozone NAAQS are based on air quality monitoring data for 2013-2015 and other available information, including ozone-forming emissions and emissions-related data, meteorological data, geography and topography and jurisdictional boundaries. In addition, the Commonwealth may use other factors as part of a weight-of-evidence approach in recommending attainment and nonattainment areas. A full list of the recommendations by area and county and a map are contained in Appendix A.

Since EPA anticipates making final designations by October 1, 2017, using air quality monitoring data that may include 2016, the Pennsylvania Department of Environmental Protection (DEP) will continue to work with EPA during the designation process leading to the promulgation of the final designations.

What is ground-level ozone?

Ozone is not emitted directly to the atmosphere, but is formed by photochemical reactions between volatile organic compounds (VOCs) and oxides of nitrogen (NO_x) in the presence of sunlight. The long, hot, humid days of summer are particularly conducive to ozone formation, so ozone levels are of concern primarily during the months of April through September.

The primary sources of anthropogenic VOCs and NO_x, the ozone precursors, are the evaporation of fuels and solvents (gasoline and consumer products), the combustion of fuels (motor vehicles, power plants and non-road engines), and industrial processes. Biogenic sources of emissions also contribute to ozone formation.

Health effects. Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present in low levels, inhaling it triggers a variety of health problems including chest pains, coughing, nausea, throat irritation, and congestion. Exposure to ozone can also worsen symptoms of bronchitis, heart disease, emphysema, and asthma, and reduce lung capacity. Asthma is a significant and growing health threat to children and adults. Ozone can aggravate asthma, causing more asthma attacks, increased use of medication, more medical treatment and more frequent visits to hospital emergency clinics.

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Healthy people also experience difficulty in breathing when exposed to ozone pollution. Because ozone pollution usually forms in hot weather, normally healthy individuals who spend time outdoors in the summer may be affected, particularly children, mature adults, considered individuals older than 64 years of age, outdoor workers and people exercising. Children are most at risk from exposure to ozone because they are active outside, playing and exercising, during the summertime, when ozone concentrations are at their highest. Several million Pennsylvanians live in areas and near areas where the ozone health-based standards are exceeded.

EPA estimates that revising the primary NAAQS for ozone will yield national public health benefits valued between $2.9 billion and $5.9 billion versus an estimated cost to comply with the regulation of $1.4 billion. These national benefits and costs exclude the State of California. Benefits include preventing cases of bronchitis, aggravated asthma, hospital and emergency room visits, nonfatal heart attacks and premature death, among others.

Welfare effects. Ground-level ozone damages plant life and is responsible for hundreds of millions of dollars in reduced crop production in the United States each year. Ozone interferes with the ability of plants to produce and store food, making them more susceptible to disease, insects, other pollutants, and harsh weather. It also damages the foliage of trees and other plants, ruining the landscape of cities, parks and forests, and recreation areas. One of the key components of ozone, NOx, contributes to fish kills and algae blooms in sensitive waterways, such as the Chesapeake Bay.

What is the NAAQS for ozone?

EPA sets the primary and secondary NAAQS based on its review of existing scientific knowledge about the adverse health and welfare effects of a pollutant. Section 109(d) of the CAA (42 U.S.C. § 7409(d)) requires EPA to review and periodically update, if necessary, the NAAQS to "protect public health with an adequate margin of safety" based on the latest, best-available science.

An ozone standard averaged over eight hours (8-hour standard) was first established in 1997, replacing a 1-hour standard established in 1979 to account for health impacts over longer periods of daily ozone exposure (62 FR 38856, July 18,1997). The 1997 standard, set at 0.08 parts per million (ppm), effectively became 0.084 ppm because of rounding methods. In 2008, the EPA revised the primary and secondary ozone NAAQS to 0.075 ppm or equivalent to 75 parts per billion (ppb) (73 FR 16436, March 27, 2008).

After evaluating the results of scientific studies available for the 2015 ozone NAAQS review, which included epidemiological, controlled human exposure, and animal toxicological studies, EPA concluded that ozone causes adverse health effects at levels below the primary 2008 ozone NAAQS. Moreover, the human exposure studies were performed with healthy individuals, which means those with existing respiratory illness are even more affected by higher levels of ozone. The more protective primary (health-

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based) 2015 NAAQS is set at 0.070 ppm or 70 ppb. EPA also strengthened the secondary (welfare-based) 2015 ozone NAAQS to the level of 70 ppb, making it identical in all respects to the revised primary ozone standard.

What is the process for designating areas?

Section 107(d)(1)(B) of the CAA (42 U.S.C. § 7407 (d)(1)(B)) requires EPA to designate areas as nonattainment, attainment or unclassifiable after promulgating a new or revised NAAQS under Section 109 of the CAA (42 U.S.C. § 7409). Following promulgation of new or revised air NAAQS, governors are given the opportunity under Section 107(d)(1)(A) of the CAA, 42 U.S.C. § 7407(d)(1)(A), to submit recommendations for the designation of attainment and nonattainment areas, supported by the most recent quality-assured monitoring data. EPA provides criteria for states' recommendations for designating areas.

EPA has requested that governors' recommendations for ozone attainment and nonattainment designations be submitted by October 1, 2016, one year after the promulgation of the revised primary and secondary NAAQS. EPA may make modifications and promulgate all or part of a Governor's recommendations. If EPA determines that a modification to the recommendation is necessary, EPA will notify the state no later than 120 days prior to promulgating the designation, and must give the state an opportunity to demonstrate why the potential modification is inappropriate.

The CAA in section 107(d)(1)(B), 42 U.S.C. § 7407(d)(1)(B), requires EPA to make final ozone designations within two years of promulgation of a new or revised NAAQS unless there is insufficient information. Therefore, EPA anticipates promulgating designations by October 1, 2017, based on the most recent quality-assured data available at the time.

The anticipated schedule for the recommendations of designation and development of SIPs is as follows:

September 2, 2016	Close comment period on ozone designation recommendations
October 1, 2016	State recommendations due to EPA
June 3, 2017	EPA notifies Pennsylvania if EPA intends to modify recommendations
July 3, 2017	EPA public comment period on draft designations
August 2, 2017	Deadline for states to submit additional information
October 1, 2017	EPA's final designations

The DEP held public informational meetings in the DEP regional offices in Harrisburg on August 24, 2016 in Harrisburg, in Norristown on August 25, 2016 and in Pittsburgh on August 25, 2016 to explain the proposed ozone designation recommendations. DEP accepted public comment on the proposed ozone designation recommendations through September 2, 2016. Notice of the public meetings and the opportunity for public comment was published in the Pennsylvania Bulletin on August 19, 2016.

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Five commentators submitted twenty four comments that the Department considered when finalizing its recommendations (See Appendix E). The changes from proposed to final are detailed in the section *Pennsylvania's Ozone Designation Recommendations*.

The ozone State Implementation Plan (SIP) revisions, outlining how each nonattainment area will reduce pollution to meet the 2015 8-hour ozone NAAQS, will be due to the EPA in October 1, 2020, three years after final designations are expected to be effective. The EPA is expected to classify areas in accordance with CAA § 181(a)(1) at the same time it makes final designations; requirements and attainment dates may vary based on the severity of the problem in the area, as indicated by the area's classification.

What would be the effects of designation as nonattainment?

The CAA contains different regulatory requirements for new or modified stationary sources in areas designated as nonattainment for a NAAQS. In addition, the "conformity" provisions of the CAA apply only in nonattainment and maintenance areas; transportation plans and federally funded actions and projects must conform to the SIP in order not to interfere with NAAQS attainment and maintenance.

However, because ground-level ozone and ozone precursor emissions are pervasive and easily transported, Congress established an Ozone Transport Region (OTR), consisting of 13 states and the District of Columbia, stretching from Northern Virginia to Maine. Section 184 of the CAA, 42 U.S.C. § 7511c(a). As a result of Pennsylvania's inclusion in the OTR, the entire Commonwealth is considered a "moderate" nonattainment area for purposes of regulating stationary sources and for the specific requirements in the OTR-related portions of the CAA. Pennsylvania has already fulfilled these requirements in its development of the SIPs for the 1979 1-hour ozone NAAQS and the 1997 8-hour ozone NAAQS. Pennsylvania has also adopted many regulations that are in effect at both the local and state level that ensure attainment and maintenance both within its borders and to help reduce its contribution to ozone pollution in downwind areas. The Commonwealth is also included in the Cross State Air Pollution Rule (CSAPR) currently being administered by EPA. According to EPA, CSAPR will reduce emissions of ozone precursors by 54 percent from 2005 levels in the eastern United States. The EPA has approved redesignation requests (to attainment status) and maintenance plans for most of those counties that were designated as nonattainment under the 1997 primary and secondary ozone NAAQS; these maintenance plans include specific permanent and enforceable control measures. Most measures in effect in an area previously designated as nonattainment of a prior ozone NAAQS will continue to stay in effect even if the area has attained the prior ozone NAAQS or is designated as attainment for the 2015 ozone NAAQS. For the 2008 ozone NAAQS, five areas (Figure A-2) in the Commonwealth were designated nonattainment. Three of those areas have received clean data determinations for the 2008 ozone NAAQS from EPA, while two areas, the Pittsburgh-Beaver Valley Area and the Philadelphia Area, have received 1-year extensions to attain the NAAQS.

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To the extent additional state measures are required to attain the revised primary and secondary 2015 8-hour ozone NAAQS, new measures will be developed by Pennsylvania through a public process. The Commonwealth will also work with states in areas that affect and are affected by Pennsylvania's air quality to develop cost-effective measures that will not disadvantage Pennsylvania economically.

Pennsylvania's Ozone Designation Recommendations

EPA guidance for ozone designation boundaries. On February 25, 2016, Janet McCabe, Acting Assistant Administrator for the EPA's Office of Air Radiation, issued a general guidance memorandum entitled, "Area Designations for the 2015 Ozone National Ambient Air Quality Standards." (Designation Guidance.) The Designation Guidance describes criteria that EPA suggests states should examine when determining their recommended nonattainment area boundaries.

EPA recommends that a state use the statistical areas defined by the U.S. Office of Management and Budget (OMB) as a starting point for its recommendations. In addition, EPA recommends analysis of five factors for area-specific recommendations (some of which are similar to the criteria OMB uses to establish statistical areas), particularly if the state is recommending deviations from the boundaries of the statistical areas. The five factors are:

- Air quality data
- Emissions data and emissions-related data
- Meteorology
- Geography and topography
- Jurisdictional boundaries, including political boundaries, transportation planning organizations and existing nonattainment areas

The EPA recommended nine factors for the 2008 ozone NAAQS designations. The four factors previously recommended by EPA that have not been included as part of the five factors for the 2015 ozone NAAQS are population density and degree of urbanization, traffic and commuting patterns, population growth rates and patterns, and level of control on emissions sources. EPA still includes population and degree of urbanization and traffic commuting patterns under one of the five factors: emissions and emissions-related data. States may still consider other relevant data to determine nonattainment boundaries for the 2015 8-hour ozone NAAQS designations. Pennsylvania will still consider other factors outside of the five factors.

Pennsylvania will consider population growth rates, population density, emissions density and other factors in addition to the five factors given by EPA in order to establish similarities and differences between neighboring counties and multi-county areas. This will allow Pennsylvania to determine the appropriateness of including a county or area with another area for the purpose of developing recommendations for ozone designations.

Discussion about statistical areas. Section 107(d)(1) of the CAA defines an area as nonattainment if it is violating the NAAQS or if it is contributing to a violation in a

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nearby area. 42 U.S.C. § 7407(d)(1). Ozone and ozone precursors are readily transported, so EPA believes it is important to examine emissions across a relatively broad geographic area. EPA recommends using the Core-Based Statistical Area (CBSA) where appropriate or Combined Statistical Area (CSA) (which includes two or more adjacent CBSAs) associated with the violating monitor(s) as a starting point. A CBSA consists of a county or counties containing at least one urban core plus adjacent counties that have a high degree of social and economic integration with the urban core as measured by commuting ties. If a violating monitor is not located in a CBSA or CSA, EPA recommends using the boundary of the county as the starting point for defining a nonattainment area. EPA used the same conceptual approach in the designation process for the 1997 and 2008 ozone NAAQS.

The OMB defines statistical areas. The criteria on which statistical areas are based are contained in a notice of decision, *Standards for Defining Metropolitan and Micropolitan Statistical Areas* (75 FR 37246; June 28, 2010). DEP based its nonattainment area boundary recommendations in this document on OMB Bulletin No. 13-01 (February 2013), *Revised Delineations of Metropolitan Statistical Areas, Micropolitan Statistical Areas, and Combined Statistical Areas, and Guidance and Uses of These Areas,* containing the lists of counties in each statistical area. The updated list of statistical areas is available at the following website: http://www.census.gov/population/metro/.

A metropolitan statistical area is a CBSA that has an urban area with a population of at least 50,000. It may or may not include outlying counties. A micropolitan statistical area is a CBSA that has an urban area with a population of at least 10,000, but less than 50,000 (with or without outlying counties). A map of relevant CBSAs can be found in Appendix B, Figure B-6. CSAs are formed automatically if two or more adjacent CBSAs have an employment interchange of 25 percent. A map of relevant CSAs can be found in Appendix B, Figure B-7. If the employment interchange is between 15 percent and 25 percent between two or more adjacent CBSAs, a CSA could be formed if local opinion favors the idea. Counties or groups of counties form metropolitan divisions if they have a core population of at least 2.5 million and have commuting ties to adjacent counties.

A county may appear in only one CBSA. If a county is a central county in one CBSA and an outlying county in another, it falls within the CBSA where it is a central county. If a county is an outlying county in two or more CBSAs, the county falls in the CBSA where it has the greatest employment interchange measure.

Example of a Pennsylvania statistical area. The Harrisburg-York-Lebanon CSA is comprised of four metropolitan statistical areas (MSA). Dauphin, Cumberland, and Perry counties comprise one MSA, Harrisburg-Carlisle. All three counties have very strong economic and commuting links with each other so that the area comprises both an MSA and a CBSA. Lebanon County is also one MSA. It is a stand-alone adjacent county that has a core and a separate CBSA. Lebanon County is not as integrated with Dauphin, Cumberland, and Perry Counties as those three counties are with each other. Also, York-Hanover is an MSA within the Harrisburg-York-Lebanon CSA. The Gettysburg MSA is

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the fourth MSA in the Harrisburg-York-Lebanon CSA. A map of the OMB core-based statistical areas is provided as Figure B-6 in Appendix B.

Discussion by factor. DEP, on behalf of the Commonwealth, and per EPA guidance, has considered these five factors in order to determine Pennsylvania's designation recommendations for the 2015 ozone NAAQS:

Air Quality

The Commonwealth's recommendations are based on the 2015 ozone design values (using the 2013, 2014, and 2015 quality assured ozone monitor data). Figure B-1 in Appendix B is a map of the 2015 ozone design values for all of the ozone monitors. The monitors exceeding the 70 ppb standard are displayed in red. Two areas that were designated nonattainment for the 2008 ozone NAAQS in 2010, specifically the Pittsburgh-Beaver Valley Area and the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Area, have monitors that still exceed the revised 2015 ozone NAAQS. The Allentown-Bethlehem-Easton Area, Lancaster Area, and the Reading Area were designated nonattainment for the 2008 ozone NAAQS, but are now monitoring attainment for the 2015 ozone NAAQS. The Harrisburg-York-Lebanon Area was designated attainment for the 2008 ozone NAAQS, but a portion of this area is monitoring nonattainment for the 2015 ozone NAAQS. Counties in which the ozone monitors do not exceed the 2015 ozone NAAQS are Adams, Beaver, Berks, Blair, Bradford, Cambria, Centre, Clearfield, Dauphin, Elk, Erie, Franklin, Greene, Lackawanna, Lancaster, Lawrence, Lehigh, Lycoming, Luzerne, Mercer, Monroe, Northampton, Somerset, Tioga, Washington, Westmoreland, and York,.

Emissions and Emissions-Related Data

An emissions inventory is an estimate of the emissions from sources in a particular area. The inventory consists of sources in five sectors: stationary point sources, stationary area sources, highway vehicle sources, nonroad sources and biogenic sources.

Table 2 in Appendix B shows the ozone precursor emissions of NO_x and VOC by county. Figures B-2, B-3 and Table 2 in Appendix B show the tons of emissions of NO_x and VOC emitted per square mile. These emissions come from the following sources:

- "Stationary sources" (or "point" sources), which are sources for which the DEP collects individual emissions-related information. Generally, stationary sources are "major" stationary sources for purposes of permitting, but may also include some smaller stationary sources.

- "Stationary area sources," which are industrial, commercial, and residential sources too small or too numerous to be handled individually, such as commercial and residential open burning, architectural and industrial maintenance coatings application and clean-up, consumer product use, and vehicle refueling at service stations.

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- "Highway vehicles," which include passenger cars and light-duty trucks, other trucks, buses and motorcycles.

- "Nonroad sources," which include a diverse collection of engines and vehicles, including outdoor power equipment, recreational vehicles, farm and construction machinery, lawn and garden equipment, industrial equipment, recreational marine vessels, commercial marine vessels, locomotives, ships, aircraft and many other engines and vehicles.

- "Biogenic Source," include mostly VOC emissions from natural sources such as plants, crops, and trees.

As recommended by EPA in its Designation Guidance, these emissions are based on the last complete three-year National Emissions Inventory (NEI) available, which is the 2011 NEI version 2. Emissions for the 2014 NEI version 1, which was submitted by Pennsylvania to EPA in December 2015 and under EPA review, are significantly less than the emissions in the 2011 NEI version 2.

Population, Urbanization, Traffic, Commuting, and Growth

Population, urbanization, traffic, commuting, and growth are related factors that are the primary determinates of the OMB's designation of metropolitan and micropolitan statistical areas; therefore, consideration of the statistical area boundary associated with the violating monitor as a starting point for the nonattainment area boundary inherently includes consideration of these factors. This approach is consistent with EPA's Designation Guidance and with the approach used in the designation process for the ozone standard.

Although the factor of population growth is considered in this analysis, a high rate of growth does not necessarily mean a high absolute increase in emissions. For example, while Pike County has a high rate of growth, its population is small when compared to the New York City area and, therefore, emissions from Pike County are expected to remain an insignificant contribution to the New York City area. Therefore, Pike County should be designated Unclassifiable/Attainment.

Commuting patterns were obtained from the U.S. Census, U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2014). In a county-by-county breakdown, the commuting patterns data indicate both the percentage of people who reside inside a specified county who commute to another county and what percentage of the people who reside outside a specified county commute to the specified county. Updated commuting patterns were examined to determine the relative strength of the commuting patterns between counties within a MSA or CSA.

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Meteorology

Ozone is a photochemical pollutant, which means sunlight is needed in order to start the chemical transformation of VOCs and NO_x into ozone. For this reason, meteorology plays a very important factor in the formation of ozone. Significant reductions in the monitored ozone values have occurred from when the 1997 8-hour ozone designations were made in 2004 until today. This reduction in ozone levels is due to many factors which include the reduction in transport of NO_x emissions from upwind point sources, and lower sulfur levels in transportation fuels along with better emission controls on highway vehicles and nonroad equipment. This region-wide reduction in NO_x has helped to limit the level of NO_x transported into the Commonwealth from other states. This can be seen in monitoring data recorded at the Methodist Hill and Tioga monitors (high elevation monitors), which measure ozone values well below the 2015 revised ozone standard. However, ozone transport from other states is still occurring (see the 24-hour Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) back trajectories) at the monitors in the Pittsburgh-Beaver Valley area, Indiana County, Lebanon County and Philadelphia area. General wind flow through the entire Commonwealth is from west to east. Wind flow across the eastern portion of the Commonwealth is generally from southwest to northeast. Therefore, the Commonwealth continues to see transport of ozone and its precursors primarily from states to Pennsylvania's south and west.

Topography and Geography

Pennsylvania contains numerous topographically and geographically distinct regions, most of which form a series of curved bands that run from the northeastern to the southwestern portion of the state. Starting from the eastern part of the state, a narrow coastal zone belt that is slightly above sea level occupies the southeastern portion of the state. Next, a zone of rolling hills defines the Piedmont Plateau. Going west, some of the regions are the Great Valley, Pocono Plateau, Appalachian Mountains, Allegheny High Plateau, and the Erie Plain. Intermixed within these regions, a few small topographical regions exist. All of these regions exert its own specific influence on the formation of ozone. The topography of the region will be considered when metropolitan and micropolitan statistical areas are combined to form one ozone Unclassifiable/Attainment or Nonattainment Areas. A discussion of the topography and geography will be included in each recommendation.

Jurisdictional Boundaries Including Political Boundaries, Transportation Planning Organizations and Existing Nonattainment Areas

Following county boundaries has a natural advantage in that county boundaries are also used by the Commonwealth's regional transportation planning organizations (which are often economic planning organizations, as well). Inventory data for non-point sources is more readily available on the county level and is more accurate because county populations are easily obtained and estimated. When a monitor is not located in a CBSA or CSA, the EPA intends to review relevant information associated with the county containing the monitor and, if appropriate, other adjacent nearby counties. The EPA

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indicates that it will determine the nonattainment area boundaries through a weight-of-evidence analysis for the area based on the five-factor analysis. Regional transportation planning organizations (metropolitan and rural planning organizations) established in Pennsylvania often, but do not always, follow OMB's statistical area framework. Continuity of planning for ozone nonattainment areas may provide an important factor for planning, but keeping nonattainment areas constant is probably less important currently since the Commonwealth has no maintenance plans for the 2008 ozone NAAQS, the 1997 ozone NAAQS is now almost 20 years old and second 10-year maintenance plans for the 1997 ozone NAAQS will not be required to be submitted to EPA. This will increase flexibility for the Commonwealth to form new nonattainment areas that correspond to relevant criteria associated with current transport of ozone precursors and other data examined in the five factor analysis.

Other Factors that Pennsylvania Will Consider

Because of the pervasive nature of ozone and the effects of transport of ozone and its precursors into and out of the Commonwealth, Pennsylvania will consider the current level of emission controls, which will likely keep some areas attaining the 2015 revised ozone NAAQS. Most emission controls in Pennsylvania have been adopted for areas larger than single nonattainment areas. There are exceptions, though, primarily for the Pittsburgh-Beaver Valley Nonattainment Area[1] and the Philadelphia Nonattainment Area[2]. Level of emission control is a factor for recommending nonattainment boundaries primarily in those two areas.

Highway and nonroad emissions of NO_x and VOC have been declining and will continue to decline as national and state controls on new highway vehicles, and national controls on nonroad equipment and motor vehicle fuels, come into effect, and as older vehicles are replaced.

Starting in 1997, Pennsylvania and other states adopted regional NO_x control programs in the form of regulations for large industrial boilers, internal combustion engines, electric generating units, and cement plants. The federal CSAPR Program governs large electric generating units in the Commonwealth. CSAPR requires reductions in NO_x emissions from these electric generating units. The federal and state New Source Review programs and standards for hazardous air pollutants also reduce emissions to provide continued improvements. Pennsylvania has also adopted statewide controls for emissions of VOCs from sources such as consumer products, adhesives, solvent degreasing, printing, large appliances and metal furniture finishing, and architectural and industrial maintenance coatings. Finally, the low cost of natural gas has provided incentive for utility companies to shutdown older, more polluting, coal-fired power plants.

Additional discussion of the five factors is included below.

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[1] Recommended to include Allegheny, Armstrong, Beaver, Butler, Fayette, Washington and Westmoreland counties.

[2] Recommended to include Bucks, Chester, Delaware, Montgomery and Philadelphia Counties.

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Discussion by Area.

Recommended Nonattainment Areas

The Commonwealth is making the following ozone nonattainment area designation recommendations based upon air quality monitoring data for 2013-2015, the other information described above regarding the five factors in the EPA's Designation Guidance, and the additional information described below. Please see Appendix A, Figure A-1, for a full list of designation recommendations for each Pennsylvania county for the 2015 ozone NAAQS.

Southwest Pennsylvania:

This region of Pennsylvania is dominated by relatively high terrain cut by numerous river valleys. These valleys tend to trap the precursor pollutants necessary to form ozone. During an ozone generating event, the sun begins to heat the surface in the late morning. With an abundance of NO_x and VOC due to the local traffic and regional source production, the sun reacts well with the air mass over the region to form ozone.

Pittsburgh-Beaver Valley Nonattainment Area:
The Pittsburgh-Beaver Valley Nonattainment Area for the 2008 ozone NAAQS consists of Allegheny, Armstrong, Beaver, Butler, Fayette, Washington and Westmoreland Counties. Two monitors in the Pittsburgh-Beaver Valley Area have monitored a 2015 design value above the 2015 ozone NAAQS level of 70 ppb. These monitors are Harrison in Allegheny County, at 72 ppb and Kittanning in Armstrong County, at 73 ppb.

These seven counties have historically been part of the same MSA as they are today. The seven counties have been grouped together for the purposes of air quality planning, emission control programs, state implementation plans, and area designations for many years. The relatively low population growth and types of economic activity that the seven counties experience are similar (Appendix B, Figures B-4 and B-5). In addition, commuting patterns shown in Appendix D indicate that between 35 to 40 percent of commuters in the six counties surrounding Allegheny County travel to workplace destinations inside the seven county area. Finally, in the Pittsburgh-Beaver Valley Area and in nearby upwind states, natural gas prices have either led to the shutdown of coal-fired power plants or the conversion of these power plants to natural gas. Consequently, ozone forming pollutants and ozone concentrations have been greatly reduced in the area and beyond.

The 24-hour HYSPLIT trajectory analysis for the Pittsburgh-Beaver Valley Area, Appendix D, for the calendar years 2013 through 2015 years shows that the same problems affect the area as was the case a decade ago, such as ozone transport, although transport is not coming from as far away on average. Also, exceedances of the ozone standards for 2013 through 2015 occur less often when compared to ozone exceedances from 2003 through 2005. Regional transport of pollution from states to the south and west of Pennsylvania into the Pittsburgh-Beaver Valley Area still occurs. Slightly over half of the ozone exceedances resulted from regional transport during calendar years

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2013 through 2015. The rest of the ozone exceedances appear to be a result of more local sources.

All of these elements taken together indicate why it is appropriate to designate the 7-county Pittsburgh-Beaver Valley Area as one nonattainment area.

Indiana County Nonattainment Area:

DEP recommends that Indiana County be designated as a stand-alone nonattainment area for the 2015 ozone NAAQS. Twelve years ago, Indiana County was designated as a nonattainment area with Clearfield County for the 1997 ozone NAAQS, but Indiana County was designated as Unclassifiable/Attainment for the 2008 ozone NAAQS. Indiana County is a single county micropolitan statistical area in Pennsylvania included in the Pittsburgh-New Castle-Weirton PA-OH-WV, CSA. It is adjacent to the 7-county Pittsburgh-Beaver Valley MSA. The ozone monitor located in Strongstown, Indiana County, measures a 2015 design value of 71 ppb. Indiana County does not share some important factors with the Pittsburgh-Beaver Valley area. For instance, only about 25 percent of all Indiana County residents commute to the 7-county Pittsburgh-Beaver Valley area while upward of 40 percent of residents in counties in the 7-county Pittsburgh-Beaver Valley area commute to other counties in the area. In addition, Indiana County has never been included in the Pittsburgh-Beaver Valley nonattainment area and, thus, has never been included in the larger region for air quality planning or regional emission control planning.

One factor could indicate that Indiana County should be grouped with the Pittsburgh-Beaver Valley area. The HYSPLIT back trajectories, which can represent wind speed and direction before an ozone exceedance, indicate that 7 out of 10 24-hour HYSPLIT scenarios analyzed local pollution sources in the 7-county Pittsburgh-Beaver Valley area probably had a role in affecting air quality in Indiana County. The 7 back trajectories indicate that the ozone transport started closer to Indiana County from either within the 7-county Pittsburgh-Beaver Valley area or just across the border in Ohio, West Virginia, or Maryland, but because the DEP is recommending that both Indiana County and the Pittsburgh-Beaver Valley areas be designated nonattainment, the DEP sees no reason or air quality benefit to include Indiana County in the larger Pittsburgh-Beaver Valley Area.

All of these elements taken together indicate that it is appropriate to designate Indiana County as a single nonattainment area.

Southcentral Pennsylvania:

This region of Pennsylvania is comprised of the Piedmont Plateau and the Great Valley. The region lies south of Blue Mountain, a mountain that marks the southern border of the Allegheny Mountains. This physical boundary influences regional wind patterns and often poses a barrier to maritime air masses originating from the Atlantic Ocean. Several broad valleys stretch across the region comprising the topography feature called the Great Valley, mainly aligned from east to west. These valleys are separated by a mountain range to the north and west. Population, population density and population growth are

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higher than in other areas in the Commonwealth and relatively consistent across the region.

Lebanon Nonattainment Area:

All monitors in the southcentral region, except the Lebanon monitor, are meeting the ozone standard. The 2015 ozone design value for the Lebanon monitor is 71 ppb. The DEP recommends that Lebanon County be designated as a single nonattainment area for the 2015 ozone NAAQS.

Cumberland, Dauphin, Perry, and Lebanon Counties were designated as one nonattainment area for the 1997 ozone NAAQS and EPA has redesignated the area to attainment and approved a maintenance plan for the area for the 1997 ozone NAAQS. All four of these counties were designated Unclassifiable/Attainment for the 2008 NAAQS. Circumstances have changed since the designations for the 1997 and 2008 ozone NAAQS in that most, but not all, of the area is meeting the revised 2015 ozone NAAQS consistently.

Cumberland, Dauphin, and Perry Counties comprise the Harrisburg-Carlisle MSA. Lebanon County by itself comprises the Lebanon MSA. York County comprises the York-Hanover MSA. Adams County comprises the Gettysburg MSA. These four MSAs comprise the Harrisburg-York-Lebanon CSA.

The 24-hour HYSPLIT back trajectories shown in Appendix C indicate that the wind patterns at 500 meters altitude transport pollution toward the Lebanon monitor from all directions.

Consequently, DEP recommends that Lebanon County be designated as a nonattainment area for the 2015 ozone NAAQS.

Cumberland, Dauphin, and Perry Counties:

The Commonwealth recommends that Cumberland, Dauphin and Perry Counties be designated Unclassifiable/Attainment. Although Cumberland County does not have an ozone monitor, the county is surrounded by other counties (Adams, Franklin, Dauphin and York) that do have ozone monitors, and all of those monitors are meeting the 2015 ozone NAAQS. The examination of commuting patterns in Appendix D illustrates that Cumberland County does not have many commuters who travel to Lebanon County for work. Unlike Cumberland County, Dauphin County has two ozone monitors, each of which is attaining the 2015 ozone NAAQS. As with Cumberland County, a small percentage (about 2%) of Dauphin County residents travels to Lebanon County for work. Perry County neither contains any significant sources of industrial emissions nor produces much in the way of highway emissions that contribute to ozone concentrations at the Lebanon monitor. Vehicles in Perry County contribute a very small percentage of the vehicle miles travelled within its MSA: about 7 percent. In addition, commuting volumes, found in Appendix D, indicate that vehicle traffic between Perry County and

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the other five counties in the CSA are low. For these reasons, the Commonwealth recommends that Cumberland, Dauphin and Perry Counties be designated Unclassifiable/Attainment.

York County:

The Commonwealth recommends that York County be designated Unclassifiable/Attainment. York County is considered part of the Harrisburg-York-Lebanon CSA because these counties have established economic and commuting ties with each other. Regardless, York County has two ozone monitors, each of which is meeting the 2015 ozone NAAQS. All of these counties have higher population growth rates (See Figure B-5) on average than most other areas of the Commonwealth and similar population densities (Figure B-4). Although York County has the highest NO_x emission density of any county in the Harrisburg-York-Lebanon CSA, NO_x emissions within York County are anticipated to continue to decline greatly over the next several years. Pennsylvania's implementation of the Reasonably Available Control Technology for Major Sources of NOx and VOCs rule (25 *Pa. Code* § 129.96) will greatly lower emissions from large sources of emissions in York County and across the Commonwealth. Also, with the changing landscape in the price of fossil fuels (currently, it is cheaper to produce electricity by combusting natural gas than coal), the forecast is for electric utilities to use natural gas, which produces less NOx than coal; a major NO_x emitter in York County, Talen Energy's Brunner Island, is expected to produce much less NOx. In addition, commuting patterns, illustrated in Appendix D, show that only slightly more than 2 percent of York County residents travel to Lebanon County for work. The same patterns hold for those commuters traveling from Lebanon County to York County.

Adams County:

The Commonwealth recommends that Adams County be designated Unclassifiable /Attainment. Adams County is part of the Harrisburg-York-Lebanon CSA and the Gettysburg MSA, but Adams County's economic association with other counties in the Harrisburg-York-Lebanon CSA has always been the weakest of all of the counties in the CSA. Furthermore, the NOx emissions density (Figure B-2) of Adams County is lower than that of all the other counties in the region. Also, population density and population growth are lower than the other counties in the CSA (Figure B-4 and B-5). In addition, ozone monitors in Adams County measure design values of 51 ppb and 65 ppb and no major industrial sources of pollution exist in Adams County. For these reasons, the Commonwealth recommends that Adams County be designated Unclassifiable /Attainment.

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Eastern Pennsylvania

Philadelphia Nonattainment Area:

The Pennsylvania portion of the nonattainment area for the 2008 ozone NAAQS consists of Bucks, Chester, Delaware, Montgomery and Philadelphia Counties. The Commonwealth is recommending that these five counties be designated as nonattainment for the 2015 ozone NAAQS, as well. The monitor with the highest design value in the 5-county area is located in Bucks County and has a 2015 design value of 75 ppb.

There are no major topographic features to restrict airflow present in this region of the state as this region of the state is in a band of coastal zone. Some small hills separate this region from the Lehigh Valley area to the north. Emissions and population density are, with the exception of Philadelphia County, relatively uniform across the 5-county area and eastward into New Jersey.

All of these five counties are included in the interstate Philadelphia-Reading-Camden CSA. The transportation planning agency for the area covers the five Pennsylvania counties as well as a number of counties in New Jersey. The nonattainment area includes the Southeast Pennsylvania air basin, as defined in 25 *Pa. Code* § 121.1. These five counties have been included in a Philadelphia multi-state nonattainment area since ozone designations were first made under the CAA. The Commonwealth has no objection to these five counties being included in the same interstate nonattainment area as in the past.

Population density throughout the 5-county area is high but shows a relatively homogenous growth increase within the five counties that ranges from 0.9 percent to 2.7 percent between the years 2010 and 2015. Philadelphia has reversed a long-term trend of losing population to become the fastest growing county in the 5-county area. As indicated by the area's MSA status, commuting and economic ties throughout the area are strong. According to U.S. Census data, Appendix D, about one-third of all commuters from these counties travel from their home county to another county within the 5-county area.

There are a number of emission control strategies that differentiate the 5-county area from other surrounding nonattainment areas, including Berks and Lancaster Counties. These primarily arise from the area's former designation as "severe" under the 1979 1-hour ozone standard and include:

- a more stringent major source definition for new source review and permitting;
- a requirement for federal reformulated gasoline, as mandated by federal statute;
- a requirement for Stage II gasoline pumps;
- requirements for NOx controls on smaller sources not required in other areas; and
- a more stringent vehicle emission inspection/maintenance program

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Additional Areas Recommended As Unclassifiable/Attainment

Pike County:

The area does not have a monitor, but is part of the New York City CSA. Historically, the county has not been included as part of the New York City nonattainment area. While population in Pike County is growing, population is still very low. Pike County is now, and is likely to remain, an insignificant contributor to New York City ozone nonattainment. The Commonwealth, therefore, recommends that Pike County remain designated as Unclassifiable/Attainment and not be included in any designation of the New York City area as nonattainment for the revised 2015 ozone NAAQS.

Scranton-Wilkes-Barre Area:

The Commonwealth is recommending designation of Lackawanna, Luzerne, and Wyoming Counties as Unclassifiable/Attainment for the 2015 ozone NAAQS. The Scranton-Wilkes-Barre metropolitan area consists of Lackawanna, Luzerne, and Wyoming Counties. The three monitors in these counties are measuring ozone levels that meet the 2015 ozone NAAQS at design values of 63, 64 and 65 ppb.

Allentown-Bethlehem-Easton Area:

The Commonwealth recommends designating Carbon, Lehigh and Northampton Counties as Unclassifiable/Attainment for the 2015 ozone NAAQS. The highest design value monitored in the area is 68 ppb. The Allentown-Bethlehem-Easton area historically has strong planning and economic ties and is designated by OMB as an MSA.

The region shares a common topography and geography. The region is bounded on the north by Blue Mountain, providing a significant physical barrier. A broad valley runs from east to west connecting both Lehigh and Northampton Counties.

Lehigh and Northampton Counties are covered by a single metropolitan transportation planning organization, while Carbon County is part of a 5-county rural planning organization.

The Allentown, Bethlehem, Easton air basin defined in 25 *Pa. Code* § 121.1 covers portions of Lehigh and Northampton Counties.

Lancaster County:

The Commonwealth recommends that Lancaster County be designated Unclassifiable/Attainment for the 2015 ozone NAAQS. Monitors in the Lancaster Area are measuring attainment for the 2015 ozone NAAQS with the highest design value of any monitor certified at 67 ppb. Although the HYSPLIT back trajectories show that ozone plumes travel over western Lancaster County on their way to the Lebanon monitor, Lancaster County has a lower NO_x emission density than surrounding counties and no

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major point sources of NO_x emissions that can contribute significantly to ozone exceedances at the Lebanon monitor. In addition, Lancaster County is not part of the Harrisburg-York-Lebanon MSA, has traditionally been separate from all other surrounding MSAs and has remained its own distinct area. While there are some commuting ties to other MSAs in Southcentral Pennsylvania, Lancaster County has a political and cultural identity of its own.

Lawrence County:

The Commonwealth recommends designating Lawrence County Unclassifiable/Attainment and not including Lawrence County in the Pittsburgh-Beaver Valley nonattainment area (discussed above). Although included in the larger Pittsburgh-New Castle CSA, Lawrence County is a single county micropolitan statistical area. Lawrence County has traditionally been a stand-alone planning area. The monitor located in New Castle indicates ambient air quality that attains the standard with a design value of 68 ppb, and Lawrence County's micropolitan statistical area status indicates a lower level of social and economic ties to the Pittsburgh metropolitan area counties than the ties of the counties included in the MSA.

Reading Nonattainment Area:

The Commonwealth recommends that Berks County be designated as an Unclassifiable/Attainment area for the 2015 ozone NAAQS based on current ozone monitoring data.

The OMB defines a Reading MSA that consists of only Berks County. Although the OMB added Berks County to the Philadelphia CSA in 2006 because of increasing commuting ties to the larger area, Berks traditionally has its own planning functions, including its own metropolitan planning organization. In addition, the Reading air basin is defined in 25 *Pa. Code* §121.1 as including portions of Berks County and no other county.

Berks County has a lower VOC and NO_x emissions density than any of the other five counties in the Philadelphia area. As shown in Figures B-4 and B-5, Berks County has a relatively lower population density and lower population growth than the five counties in the Philadelphia area. In addition, Berks County commuting patterns, shown in Appendix D, with the Philadelphia area are not as linked as the commuting patterns in the counties within the 5-county Philadelphia region.

Finally, Berks County was designated as a single nonattainment area for the 2008 ozone NAAQS; it subsequently attained the standard, and currently, the highest design for an ozone monitor in Berks County is below the 2015 standard at 69 ppb.

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Additional Information

Appendix A includes a table and a map that describe the recommendations for the 2015 ozone NAAQS nonattainment areas, and a map of the designations for the 2008 ozone NAAQS. The list of nonattainment and unclassifiable/attainment areas in Table 1 includes all 67 Pennsylvania counties.

Appendices B and C include documenting data and material that address the EPA's five factor designation criteria pertaining to air quality, emissions and population factors, a map of the OMB statistical areas in Pennsylvania, and the HYSPLIT back trajectories.

Appendix D includes commuting patterns of residents in counties relevant to this analysis.

Appendix E is a summary of comments received by the Department during the public comment period and the Department's responses to those comments.

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ACRONYMS AND TERMS

CAA	Clean Air Act
CSA	Combined Statistical Area
CSAPR	Cross State Air Pollution Rule
DEP	Department of Environmental Protection (Pennsylvania)
EPA	Environmental Protection Agency (United States)
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
NAAQS	National Ambient Air Quality Standards
NEI	National Emission Inventory
NO_x	oxides of nitrogen
OMB	Office of Management and Budget (United States)
PM	particulate matter
ppb	parts per billion
ppm	parts per million
SIP	State Implementation Plan
VOC	volatile organic compounds

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ENCLOSURE I

Virginia Department of Environmental Quality

2013-2015 Fourth Highest Daily Maximum Ozone 8-hour Averages

Units, ppb

Certified as of March 1, 2016

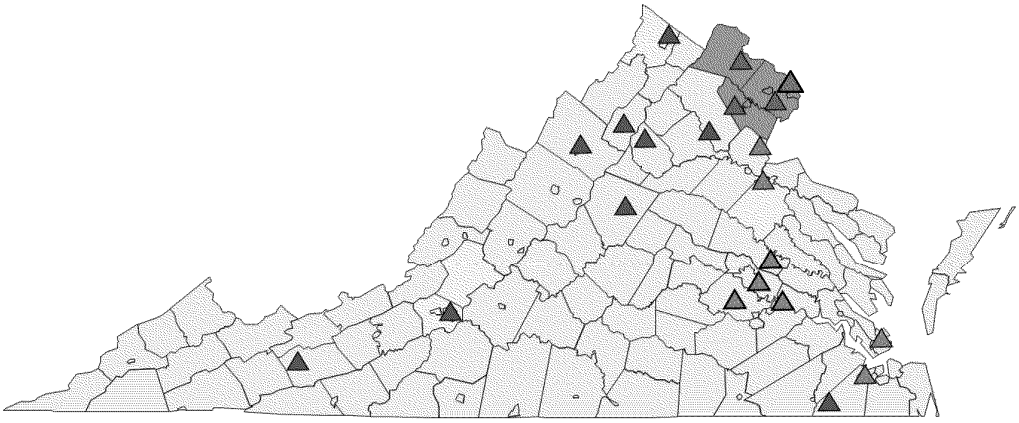
Monitoring Sites	AIRS ID	2013	2014	2015	3-year average	Complete
Wythe Co.	511970002	59	64	58	60	Y
Rockbridge Co.	511630003	58	58	56	57	Y
Page Co.	511390004	60	58	59	59	Y
Fauquier Co.	510610002	59	59	56	58	Y
Caroline Co.	510330001	65	61	62	62	N
Rockingham Co.	511650003	58	58	60	58	Y
Albemarle Co.	510030001	60	59	58	59	N
Roanoke Area:						
Roanoke Co.	511611004	57	60	62	59	Y
Frederick County Area:						
Frederick Co.	510690010	60	59	61	60	Y
Richmond Area:						
Chesterfield Co.	510410004	63	61	63	62	Y
Henrico Co.	510870014	65	62	64	63	N
Hanover Co.	510850003	66	62	61	63	Y
Charles City Co.	510360002	61	66	59	62	Y
Hampton Roads Area:						
Hampton	516500008	68	61	65	64	Y
Suffolk - TCC	518000004	65	58	61	61	Y
Suffolk - Holland	518000005	65	63	60	62	Y
Fredericksburg Area:						
Stafford Co.	511790001	64	62	63	63	Y
Northern Virginia Area:						
Loudoun Co.	511071005	66	63	71	66	Y
Prince William Co.	511530009	66	62	67	65	Y
Arlington Co.	510130020	67	71	73	70	Y
Fairfax Co. - Lee Park	510590030	67	65	72	68	Y
Shenandoah National Park - Madison Co. (Site operated by the National Park Service)	511130003	63	62	63	62	Y
Giles Co. CASTNET	510719991	61	62	63	62	Y
Prince Edward Co. CASTNET	511479991	60	63	57	60	Y

Sites in italics exceeded the 8-hour ozone standard for 2013-2015

ENCLOSURE II

COMMONWEALTH OF VIRGINIA AREA DESIGNATION RECOMMENDATIONS UNDER THE 2015 8-HOUR OZONE NATIONAL AMBIENT AIR QUALITY STANDARD (NAAQS)

TECHNICAL SUPPORT DOCUMENT



VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

BACKGROUND

On October 1, 2015, the U.S. Environmental Protection Agency (EPA) strengthened the National Ambient Air Quality Standard (NAAQS) for ground level ozone from 0.075 parts per million to 0.070 parts per million (ppm). This action was taken by EPA in light of new and compelling scientific evidence that a lower standard was needed to protect human health and welfare.

One of the first actions required when a new air quality standard is established is to designate areas in regard to compliance with the standard. Those areas that are not in compliance with the standard are designated as "nonattainment" areas, while areas in compliance are designated "attainment". Areas where insufficient data is available to make a determination are designated as "unclassifiable".

On February 25, 2015, the Acting Assistant Administrator, Janet G. McCabe, issued guidance to EPA and the states on the process and factors to consider when designating areas under the new ozone standard. In general, this guidance recommended the use of census bureau areas such as Core Based Statistical Areas (CBSA) or Combined Statistical Areas (CSA) as the starting point for nonattainment area designations when a violating ozone air quality monitor is present. However, EPA also allows states the flexibility to make area specific designations based on five ozone related factors that are listed below:

- Ozone air quality data,
- Emissions and emissions-related data (location of sources and contribution to ozone),
- Meteorology (weather/transport patterns),
- Geography/topography, and
- Jurisdictional boundaries.

The approach taken to making individual jurisdiction determinations is further based on the following hierarchy of criteria:

- Does the jurisdiction have a violating ozone monitor?
- Is the jurisdiction part of a current ozone nonattainment or maintenance area?
- Would exclusion of the jurisdiction create an illogical result, such as an attainment area within a larger nonattainment area?
- Does the jurisdiction significantly contribute to ozone formation in a nearby recommended nonattainment area?

For any areas requiring a determination of significant contribution and that do not meet any of the other criteria above, a clear and compelling case is required based on available data for the five EPA factors to make a nonattainment recommendation.

The purpose of this technical support document is to describe the analyses performed by the Virginia Department of Environmental Quality (VDEQ) to support the area designations recommendations that are being submitted to the EPA as part of the ozone standard implementation process.

EPA will consider these recommendations and either accept or modify these recommendations. EPA will notify the Commonwealth of any modifications made by letter no later than June 2, 2017 and will then provide a 30-day public comment period. The Commonwealth will then have an opportunity to submit additional information prior to EPA's final issuance of designations by October 1, 2017.

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2015 OZONE AREA DESIGNATIONS

Section 107(d) (1) of the CAA directs the EPA to designate an area "nonattainment" if it is violating the NAAQS or if it is contributing to a violation of the NAAQS in a nearby area. In identifying any air quality monitoring sites with data that show a violation of the 2015 ozone NAAQS, VDEQ considered both the EPA certified 2013-2015 8-hour ozone data (Enclosure I) and preliminary 2014-2016 8-hour ozone data (Appendix A). The certified 2013-2015 8-hour ozone data clearly demonstrate that no monitors in Virginia are in violation of the new ozone standard of 70 ppb. However, preliminary 2014-2016 ozone data indicate that the Aurora Hills monitor in Arlington County, VA is above the new standard (i.e., 72 ppb). The Aurora Hills monitor is the only monitor in the Commonwealth that is out of compliance with the 2015 ozone standard.

2015 OZONE AREA DESIGNATIONS: NONATTAINMENT AREA ANALYSES AND BOUNDARY DETERMINATION

Arlington County, VA is part of the Greater Washington DC/MD/VA Metropolitan Statistical Area (MSA). When determining non-attainment area boundaries, this analysis primarily considers the ozone factors (Appendix B) and hierarchy or ranking of criteria for jurisdictions located in the Greater Washington DC/MD/VA MSA (Appendix C) and previous non-attainment area boundaries. As part of the 1997 ozone standard designation process, the City of Fredericksburg, Stafford County, and Spotsylvania County were designated as a separate nonattainment and air quality planning area for ozone in 2004. Because of the precedent set this separate status under the CAA and because the monitors associated with this area in compliance with the new 2015 ozone standard by a large margin, these jurisdictions were not included this analyses.

As a result of this analysis and other considerations, the Commonwealth of Virginia recommends retaining the boundaries of the Northern Virginia non-attainment area set during the designation process for the 1997 and 2008 ozone standards. The jurisdictions that make up this nonattainment area are shown and listed below:

Northern VA Nonattainment Area

Arlington County
Fairfax County
Loudoun County
Prince William County
City of Alexandria
City of Fairfax
City of Falls Church
City of Manassas
City of Manassas Park

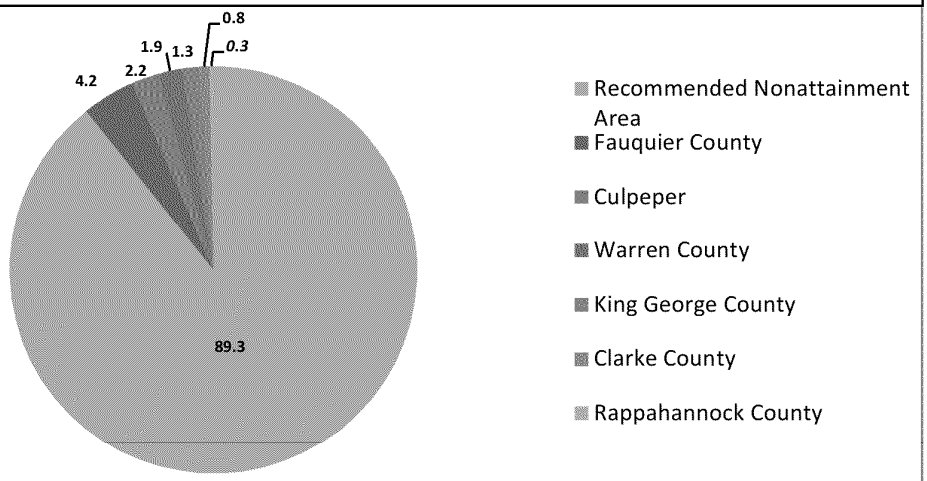
The Northern Virginia Nonattainment area is part of the Metropolitan Washington DC-MD-VA nonattainment area, which also includes the District of Columbia and jurisdictions in southern Maryland.

As shown by the figures below, the Commonwealth believes that these nonattainment recommendations for the Virginia portion of the Metropolitan Washington DC-MD-VA nonattainment area are reasonable and appropriate in that the recommended jurisdictions account for 89.3% of the ozone precursor pollutants, population, expected growth, and vehicle miles of travel for the area.

Ranking of Selected Ozone Criteria for the Virginia Jurisdictions in the Virginia portion of the DC/MD/VA MSA

County/City	Area Emissions[1]	Area Population	Population Growth for Area	Vehicle Miles Traveled	Combined Average	Emission Density ton/sq mile/per day	Population Density Population/ sq mile
			Percent				
Recommended Nonattainment Jurisdictions							
FAIRFAX COUNTY	37.0	44.6	26.6	45.7	38.5	0.242	2,767
PRINCE WILLIAM COUNTY	15.6	16.6	21.9	15.7	17.4	0.118	1,195
LOUDOUN COUNTY	14.3	12.9	27.9	11.5	16.6	0.071	606
ARLINGTON COUNTY	8.0	8.6	9.5	7.7	8.4	0.790	7,994
ALEXANDRIA CITY	4.8	5.8	6.0	3.6	5.0	0.822	9,314
MANASSAS CITY	1.3	1.6	1.7	1.2	1.5	0.349	3827.6
FAIRFAX CITY	1.0	0.9	0.6	0.8	0.9	0.410	3616.8
MANASSAS PARK CITY	0.4	0.6	0.6	0.1	0.4	0.423	5632.6
FALLS CHURCH CITY	0.4	0.5	0.7	0.3	0.5	0.344	6169.1
Recommended Attainment Jurisdictions							
FAUQUIER COUNTY	6.8	2.7	1.6	5.7	4.2	0.027	100.7
CULPEPER COUNTY	3.1	1.9	1.2	2.5	2.2	0.021	123.1
WARREN COUNTY	3.3	1.5	0.7	2.0	1.9	0.039	176.0
KING GEORGE COUNTY	2.0	1.0	0.9	1.4	1.3	0.028	131.3
CLARKE COUNTY	1.4	0.6	0.1	1.3	0.8	0.020	79.7
RAPPAHANNOCK CO.	0.6	0.3	0.0	0.4	0.3	0.005	27.7
	100.0	**100.0**	**100.0**	**100.0**	**100.0**	**0.081**	**766**

Contribution of Nonattainment and Attainment Areas to Selected Ozone Criteria



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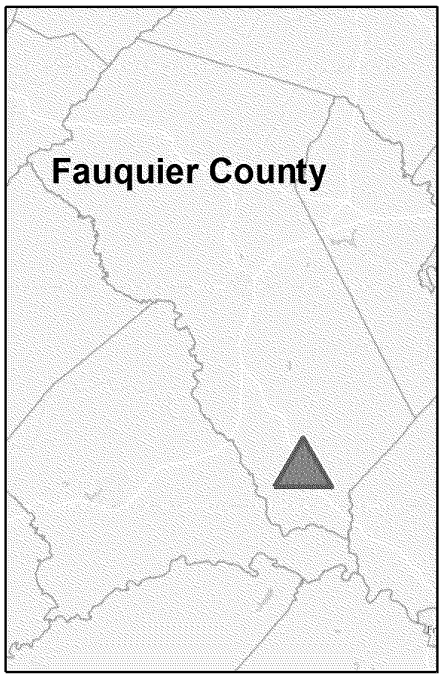
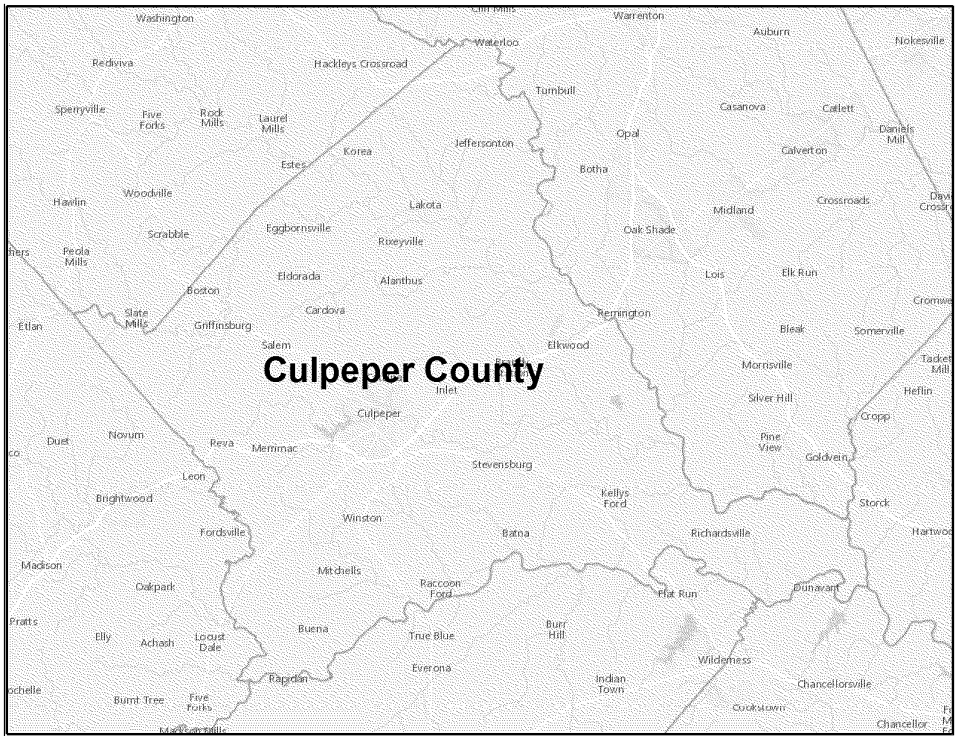
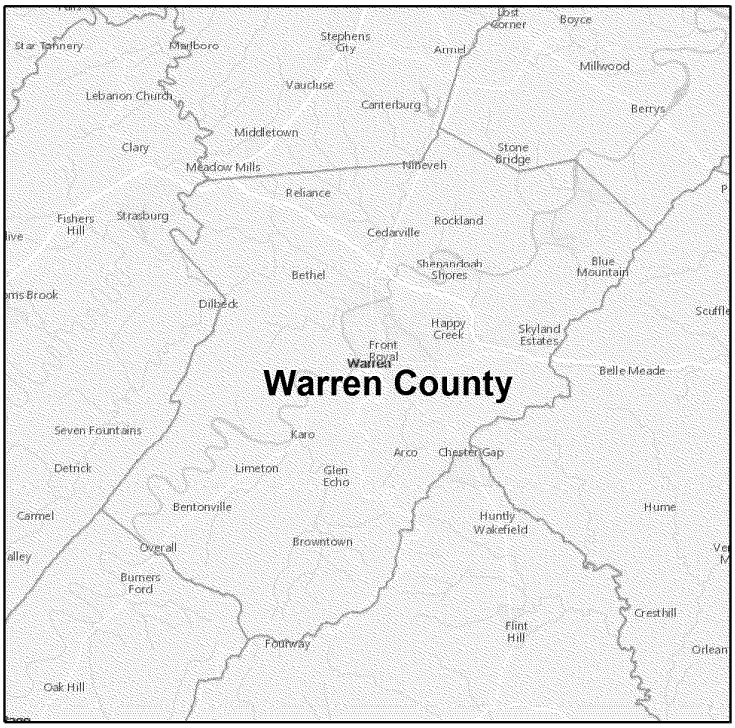
The individual jurisdictions recommended for attainment status do not significantly contribute to the overall levels of the major ozone related criteria of emissions, population, growth, and vehicle traffic. Also in the specific case of Fauquier County, there is an ozone monitor located in this county that has a certified design value of 58 ppb, has a preliminary design value of 59 ppb, and is in compliance with the new standard. Specific factor data is provided below for each recommended attainment jurisdiction.



Analysis of Ozone Related Criteria	
Emissions (2011)	3,003 tons/year VOC and 3,377 tons/year NO_X (6.8% of ozone precursor emissions in the study area).
Emissions Density	0.027 tons/day/ square mile.
Population (2010)	65,203 – 101 per square mile (2.7% of the total population in the study area).
Population Growth	Population has grown to 68,782 in 2015, which represents only 1.6% of the total population growth expected in the study area.
Air Quality	**Compliant Monitor** - Design Value (20013 to 2015): **58 ppb**.
Commuting Patterns	The majority of county workforce trips are internal. Most external commutes are to other jurisdictions in the study area.
Annual VMT (2011)	1.2 billion annual vehicle miles of travel (5.7% of total VMT in the area). Mostly through traffic on Interstate 66 and Route 17.
Major Sources	There are two major sources in the County which is a natural gas fired simple cycle peaking electric generation stations. However, these are new facilities that are controlled and subject to the CSAPR utility control program. Total County point source emission of both VOC and NO_X are less than 100 tons/year.
Geography	County is located to the Southwest of the proposed nonattainment area.
Boundaries	County is part of the Washington, DC-MD-VA MSA.
Level of Controls	Currently subject to attainment permit and control requirements. Emissions should be significantly reduced by regional and national controls.



Analysis of Ozone Related Criteria	
Emissions (2011)	1,597 tons/year VOC and 1,343 tons/year NO_X (3.1% of ozone precursor emissions in the study area).
Emissions Density	0.021 tons per square mile.
Population (2010)	46,689 – 123 per square mile (1.9% of the total population in the study area).
Population Growth	Population has grown to 49,432 in 2015, which represents only 1.2% of the total population growth expected in the study area.
Air Quality	No monitor located in the County but ozone air quality is expected to be attainment based on closest monitored values.
Commuting Patterns	The majority of county workforce trips are internal. Most external commutes are to other jurisdictions in the study area.
Annual VMT (2011)	530 million annual vehicle miles of travel (2.5% of total VMT in the area). Mostly through traffic on Interstate 66 and Route 29.
Major Sources	There is one major source of VOCs in the County which is a cabinet manufacturing facility. However, VOCs do not contribute significantly to ozone formation in the area. Total County point source emission of both VOC and NO_X are less than 260 tons/year.
Geography	County is located to the Southwest of the proposed nonattainment area.
Boundaries	County is part of the Washington, DC-MD-VA MSA.
Level of Controls	Currently subject to attainment permit and control requirements. Emissions should be significantly reduced by regional and national controls.



Analysis of Ozone Related Criteria	
Emissions (2011)	1,644 tons/year VOC and 1,397 tons/year NO_X (3.3% of ozone precursor emissions in the study area).
Emissions Density	0.039 tons/day/ square mile.
Population (2010)	37,575–176 per square mile (1.5% of the total population in the study area).
Population Growth	Population has grown to 39,083 in 2015, which represents only 0.7% of the total population growth expected in the study area.
Air Quality	No monitor located in the County but ozone air quality is expected to be attainment based on closest monitored values.
Commuting Patterns	The majority of county workforce trips are internal. Most external commutes are to other jurisdictions in the study area and the Winchester area.
Annual VMT (2011)	436.5 million annual vehicle miles of travel (2.0% of total VMT in the area). Mostly through traffic on Interstate 66 and Route15.
Major Sources	There is one major source in the County which is a natural gas combined cycle electric generating station. This EGU did not commence commercial operation until 2014. However, this new facility is highly controlled and subject to the CSAPR utility control program. Total County point source emission of both VOC and NO_X are less than 100 tons/year.
Geography	County is located to the Southwest of the proposed nonattainment area.
Boundaries	County is part of the Washington, DC-MD-VA MSA.
Level of Controls	Currently subject to attainment permit and control requirements. Emissions should be significantly reduced by regional and national controls.

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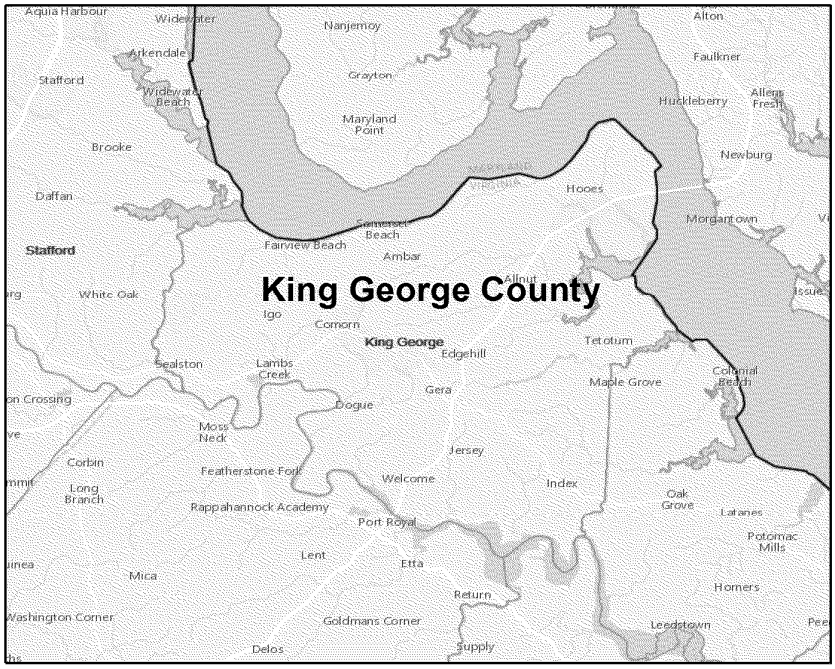

Analysis of Ozone Related Criteria	
Emissions (2011)	900 tons/year VOC and 924 tons/year NO_X (2.0% of ozone precursor emissions in the study area).
Emissions Density	0.028 tons/day/ square mile
Population (2010)	25,584 – 131 per square mile (1.0% of the total population in the study area).
Population Growth	Population has decreased to 25,515 in 2015, which represents only 0.9% of the total population growth expected in the study area.
Air Quality	No monitor located in the County but ozone air quality is expected to be attainment based on closest monitored values.
Commuting Patterns	The majority of county workforce trips are internal. Most external commutes are to the Fredericksburg area and southern Maryland.
Annual VMT (2011)	305.8 million annual vehicle miles of travel (1.4% of total VMT in the area). Mostly from traffic on Route 301.
Major Sources	There is one major source in the County which is a coal-fired electric generating station. However, this facility is highly controlled and subject to MACT and the CSAPR utility control program. Total County point source emission of both VOC and NO_X are less than 500 tons/year.
Geography	County is located to the Southeast of the proposed nonattainment area.
Boundaries	County is part of the Washington, DC-MD-VA MSA.
Level of Controls	Currently subject to attainment permit and control requirements. Emissions should be significantly reduced by regional and national controls.

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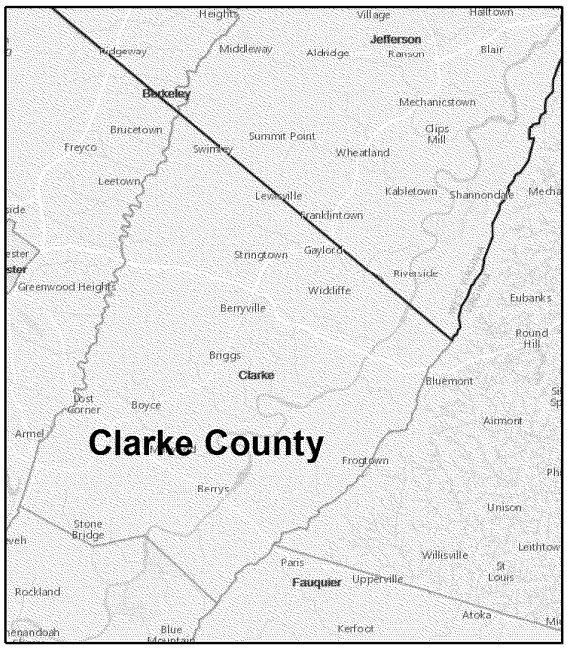

Analysis of Ozone Related Criteria	
Emissions (2011)	666 tons/year VOC and 615 tons/year NO_X (1.4% of ozone precursor emissions in the study area).
Emissions Density	0.020 tons/day/ square mile.
Population (2010)	14,034 – 80 per square mile (0.6% of the total population in the study area)
Population Growth	Population has grown to 14,363 in 2015, which represents only 0.1% of the total population growth expected in the study area.
Air Quality	No monitor located in the County but ozone air quality is expected to be attainment based on closest monitored values.
Commuting Patterns	The majority of county workforce trips are external commutes to other jurisdictions in the study area.
Annual VMT (2011)	275.5 million annual vehicle miles of travel (1.3% of total VMT in the area). Mostly through traffic on Interstate 66 and Route 29 and Route 17.
Major Sources	There are no major point sources in the County. Total County point source emission of both VOC and NO_X are less than 50 tons/year.
Geography	County is located to the Southeast of the proposed nonattainment area
Boundaries	County is part of the Washington, DC-MD-VA MSA.
Level of Controls	Currently subject to attainment permit and control requirements. Emissions should be significantly reduced by regional and national controls.

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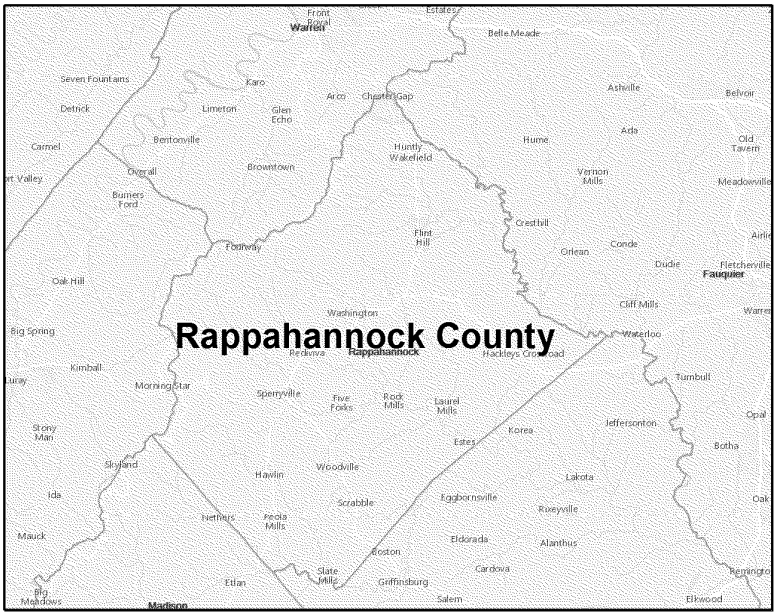

Analysis of Ozone Related Criteria	
Emissions (2011)	307 tons/year VOC and 209 tons/year NO_X (0.6% of ozone precursor emissions in the study area).
Emissions Density	0.005 tons/day/ square mile.
Population (2010)	7,373 – 28 per square mile (0.3% of the total population in the study area).
Population Growth	Population has grown to 7,378 in 2015, which represents only 0.0% of the total population growth expected in the study area.
Air Quality	No monitor located in the County but ozone air quality is expected to be attainment based on closest monitored values.
Commuting Patterns	The majority of county workforce trips are internal. Most external commutes are to other jurisdictions in the study area.
Annual VMT (2011)	94.4 million annual vehicle miles of travel (0.4% of total VMT in the area). Mostly through traffic on Route 522 and 211.
Major Sources	There are no major point sources in the County. Total County point source emission of both VOC and NO_X are less than 10 tons/year.
Geography	County is located to the Southwest of the proposed nonattainment area.
Boundaries	County is part of the Washington, DC-MD-VA MSA.
Level of Controls	Currently subject to attainment permit and control requirements. Emissions should be significantly reduced by regional and national controls.

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Appendix A – Preliminary 2014-2016 Virginia Ozone 8-hour Ozone Data

Virginia Department of Environmental Quality
2014-2016 Fourth Highest Daily Maximum Ozone 8-hour Averages
Units, ppb
Updated 9/26/16

Monitoring Sites	AIRS ID	2014	2015	2016 (through 9/25/16)	3-year average
Wythe Co.	511970002	64	58	62	61
Rockbridge Co.	511630003	58	56	60	58
Page Co.	511390004	58	59	Disc	58
Fauquier Co.	510610002	59	56	63	59
Caroline Co.	510330001	61	62	62	61
Rockingham Co.	511650003	58	60	62	60
Albemarle Co.	510030001	59	59	62	60
Roanoke Area:					
Roanoke Co.	511611004	60	62	64	62
Frederick County Area:					
Frederick Co.	510690010	59	61	65	61
Richmond Area:					
Chesterfield Co.	510410004	61	63	63	62
Henrico Co.	510870014	62	64	66	64
Hanover Co.	510850003	62	61	65	62
Charles City Co.	510360002	66	59	65	63
Hampton Roads Area:					
Hampton	516500008	61	65	68	64
Suffolk - TCC	518000004	58	61	63	60
Suffolk - Holland	518000005	63	60	61	61
Fredericksburg Area:					
Stafford Co.	511790001	62	63	66	63
Northern Virginia Area:					
Loudoun Co.	511071005	63	71	68	67
Prince William Co.	511530009	62	67	67	65
Arlington Co.	510130020	71	73	72	72
Fairfax Co. - Lee Park	510590030	65	72	73	70
Shenandoah National Park - Madison Co. (Site operated by the National Park Service)	511130003	60	63	66	63
Giles Co. CASTNET	510719991	62	63	62	62
Prince Edward Co. CASTNET	511479991	63	57	60	60

Sites in italics exceeded the 8-hour ozone standard for 2014-2016

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Appendix B: Data Table for Virginia Nonattainment Designation Ozone Factors Analysis

County/City[1]	Land Area[2]	Population[3]		Growth Rate	Annual Emissions[4]		Total	Area Emissions	Area Population	Population Growth for Area	Combined Average	Emission Density	Population Density	Vehicle miles Travelled[5]	Vehicle miles Travelled	Certified 2013-2015 Design Values	Preliminary/ Uncertified 2014-2016 Design Values
					NOX	VOC											
	Sq. Miles	2010	2015	Percent	tons/year							ton/perday/sq. mile	No/sq. mile	Annual	Percent	ppb	ppb
ALEXANDRIA CITY	15.03	139,966	153,511	1.86	2,266	2,244	4,510	4.8	5.8	6.0	5.5	0.822	9,314	776,631,863	3.6	N/A	N/A
ARLINGTON COUNTY	25.97	207,627	229,164	1.99	4,061	3,433	7,493	8.0	8.6	9.5	8.7	0.790	7,994	1,668,842,699	7.7	70	72
CLARKE COUNTY	176.18	14,034	14,363	0.46	615	666	1,281	1.4	0.6	0.1	0.7	0.020	80	275,483,696	1.3	N/A	N/A
CULPEPER COUNTY	379.23	46,689	49,432	1.15	1,343	1,597	2,940	3.1	1.9	1.2	2.1	0.021	123	530,145,141	2.5	N/A	N/A
FAIRFAX COUNTY	390.97	1,081,726	1,142,234	1.09	15,199	19,336	34,534	37.0	44.6	26.6	36.1	0.242	2,767	9,884,211,505	45.7	68	70
FAIRFAX CITY	6.24	22,565	24,013	1.25	258	675	933	1.0	0.9	0.6	0.9	0.410	3,617	182,988,258	0.8	N/A	N/A
FALLS CHURCH CITY	2.00	12,332	13,892	2.41	121	288	409	0.4	0.5	0.7	0.5	0.560	6,169	56,374,487	0.3	N/A	N/A
FAUQUIER COUNTY	647.45	65,203	68,782	1.07	3,377	3,003	6,379	6.8	2.7	1.6	3.7	0.027	101	1,236,123,735	5.7	58	59
KING GEORGE COUNTY	179.64	23,584	25,515	1.59	924	900	1,824	2.0	1.0	0.9	1.3	0.028	131	305,783,532	1.4	N/A	N/A
LOUDOUN COUNTY	515.56	312,311	375,629	3.76	6,689	6,648	13,338	14.3	12.9	27.9	18.3	0.071	606	2,489,966,360	11.5	66	67
MANASSAS CITY	9.88	37,821	41,764	2.00	466	791	1,258	1.3	1.6	1.7	1.5	0.349	3,828	257,068,406	1.2	N/A	N/A
MANASSAS PARK CITY	2.53	14,273	15,726	1.96	102	289	391	0.4	0.6	0.6	0.5	0.422	5,633	24,777,086	0.1	N/A	N/A
PRINCE WILLIAM COUNTY	336.40	402,002	451,721	2.36	6,784	7,739	14,523	15.6	16.6	21.9	18.0	0.118	1,195	3,394,199,629	15.7	65	65
RAPPAHANNOCK COUNTY	266.23	7,373	7,378	0.01	209	307	516	0.6	0.3	0.0	0.3	0.005	28	94,398,473	0.4	N/A	N/A
WARREN COUNTY	213.47	37,575	39,083	0.79	1,397	1,644	3,041	3.3	1.5	0.7	1.8	0.039	176	436,554,493	2.0	N/A	N/A
	3,167	**2,425,081**	**2,652,207**	**1.81**	**43,812**	**49,557**	**93,369**	**100.0**	**100.0**	**100.0**		**0.081**	**766**	**21,613,549,363**	**100**		

1) City of Fredericksburg, Stafford County, and Spotsylvania County were not included in the analyses because these jurisdictions are located in a separate regional transportation planning organization and there are no monitors in these jurisdictions in violation of the 2015 ozone NAAQS.

2) Dataset provided by EPA to support the five-factor analysis: County Population (excel spreadsheet) downloaded from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data

3) Dataset provided by EPA to support the five-factor analysis: County Population (excel spreadsheet) downloaded from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data

4) 2011-2011 NEI V2. Estimates of emissions and percentages include only anthropogenic sources.

5) Dataset provided by EPA to support the five-factor analysis: Vehicle Miles Traveled (excel spreadsheet) downloaded from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data

Enclosure III

48. In §81.347, the table entitled "Virginia- 2015 Ozone 8-Hour Ozone NAAQS (Primary and secondary)" is revised to read as follows:

Designated Area	Designation	Classification
	Type	Type
Washington, DC-MD-VA……...	Nonattainment	Marginal
Arlington County		
Fairfax County		
Loudoun County		
Prince William County		
Alexandria City		
Fairfax City		
Falls Church City		
Manassas City		
Manassas Park City		
Eastern Tennessee-SW Virginia Interstate…….....	Unclassifiable/Attainment	
Bland County		
Buchanan County		
Carroll County		
Dickerson County		
Grayson County		
Lee County		
Russell County		
Scott County		
Smyth County		
Tazewell County		
Washington County		
Wise County		
Wythe County		
Bristol City		
Galax City		
Norton City		
Central Virginia Intrastate……..	Unclassifiable/Attainment	
Amelia County		
Amherst County		
Appomattox County		
Bedford County		
Brunswick County		
Buckingham County		
Campbell County		
Charlotte County		
Cumberland County		
Franklin County		

Halifax County Henry County Lunenburg County Mecklenburg County Nottoway County Patrick County Pittsylvania County Prince Edward County Bedford City Danville City Lynchburg City Martinsville City South Boston City		
Hampton Roads Intrastate……..	Unclassifiable/Attainment	
Isle of Wight County James City County Southampton County York County Chesapeake City Franklin City Hampton City Newport News City Norfolk City Poquoson City Portsmouth City Suffolk City Virginia Beach City Williamsburg City		
NE Virginia Intrastate…….	Unclassifiable/Attainment	
Accomack County Albemarle County Caroline County Culpeper County Essex County Fauquier County Fluvanna County Gloucester County Greene County King and Queen County King William County Lancaster County Louisa County Madison County Matthews County Middlesex County Nelson County Northampton County		

Northumberland County Orange County Rappahannock County Richmond County Spotsylvania County Stafford County Westmoreland County Charlottesville City City of Fredericksburg		
State Capitol Intrastate……	Unclassifiable/Attainment	
Charles City County Chesterfield County Dinwiddie County Goochland County Greensville County Hanover County Henrico County New Kent County Powhatan County Prince George County Surry County Sussex County Colonial Heights City Emporia City Hopewell City Petersburg City Richmond City		
Valley of Virginia Intrastate……..	Unclassifiable/Attainment	
Alleghany County Augusta County Bath County Botetourt County Craig County Floyd County Frederick County Giles County Highland County Montgomery County Page County Pulaski County Roanoke County Rockbridge County Rockingham County Shenandoah County Warren County Buena Vista City Clifton Forge City		

Covington City Harrisonburg City Lexington City Radford City Roanoke City Salem City Staunton City Waynesboro City Winchester City		

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

October 3, 2016

Mr. Shawn M. Garvin
Regional Administrator
EPA Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Dear Mr. Garvin:

Pursuant to Section 107 (d) (1) (A) of the Clean Air Act and on behalf of the Governor of the Commonwealth of Virginia, I hereby submit the initial recommendations and comments on the designations of areas in Virginia under the 2015 8-hour Ozone National Ambient Air Quality Standard (NAAQS).

Let me first state that great progress has been made in improving ozone air quality in Virginia and nationwide since the 1997 and 2008 ozone standards were implemented. This progress is due to coordinated efforts at the federal, state, and local levels to reduce ozone precursor pollutants and the transport of ozone from one area to another. This progress is clear in that most of Virginia is already in attainment status for the 2015 ozone standard.

However, the new 2015 ozone standard poses a significant challenge to us all that will require an even higher level of cooperation. We believe that new or revised regional and national control programs must be a key component to the overall attainment strategy for this standard if states and individual nonattainment areas are to achieve timely compliance. Emission inventory analyses and air quality modeling results show that sectors such as non-road and on-road diesel engines as well as on-road gasoline engines are very important sectors to ozone formation. Implementation of control programs for these sectors is problematic for states due to statutory constraints and the ubiquitous nature of these emissions sectors. Therefore, I urge the EPA to move forward quickly to evaluate and implement new or updated strategies that can assist the states in this regard.

Virginia jurisdictions have successfully used both the Early Action Compact program and the Ozone Advance program to implement voluntary measures aimed at reducing ozone precursors. EPA should continue to offer these flexible programs as options for effective

ozone planning. EPA should also offer the option of participating in such a program to marginal ozone nonattainment areas. Such areas have a short timeline for compliance and no formal planning requirements other than inventory development. Allowing marginal areas to participate would encourage local and regional reductions of precursors to further aid in timely compliance so that citizens may breathe healthier air sooner.

The specific area recommendations of the Commonwealth are provided with this letter, and the enclosures to this letter provide more detail and supporting documentation. While the certified 2013 through 2015 ozone air quality data for Virginia presented in Enclosure I demonstrates that all monitors in the Commonwealth complied with the 2015 ozone standard, the most recent preliminary ozone air quality data for Virginia shows one monitor in Northern Virginia (i.e., Aurora monitor, Arlington, VA) is likely to be slightly above the new standard. Therefore, these recommendations are partially based on uncertified air quality data and cover the years 2014 through 2016. A copy of the uncertified 2014-2016 air quality data is included as part of the supporting documentation for these recommendations contained in Enclosure II.

Northern Virginia Nonattainment Area

The Commonwealth's recommendation for this area, which is part of the Greater Washington DC/MD/VA Metropolitan statistical Area (MSA), is that the nonattainment area boundary in Virginia be the same as the previous 2008 8-hour nonattainment area. We believe that this recommendation is supported by the marginal nature and scope of the nonattainment situation in the DC area with only two potentially violating monitors at the current time. As such, Virginia believes that a designation of marginal nonattainment for this area is most appropriate based on preliminary air quality data for years 2014-2016. The Commonwealth further recommends that the greater Washington, DC/MD/VA area remain a separate nonattainment area under the new standard, as this area already has well established and effective air quality and transportation planning processes.

Remaining Areas in Virginia

As I mentioned previously, all other monitors in the Commonwealth are in compliance with the new ozone standard. Therefore, Virginia recommends that all the remaining areas in Virginia be designated unclassified/attainment for this standard. Further specifics on these recommended designations can be found in Enclosure III.

As always, the Commonwealth reserves the right to provided additional and/or updated information to inform the designation process as it proceeds. This information could include, but is not limited to, updated ozone monitoring data as it becomes available.

In summary, the Commonwealth of Virginia requests that the EPA carefully consider and adopt the area recommendations provided by this letter. We believe that the recommendations made are both reasonable and appropriate given the supporting

documentation provided. These area designations, along with timely and effective programs at the national level addressing significant sources of ozone precursor emissions and the continuance of voluntary programs like Ozone Advance, will provide the tools needed to further improve air quality in Virginia.

Thank you again for this opportunity to provide input on this important issue for Virginia. Please contact me if you have any questions concerning these recommendations.

Sincerely,

David K. Paylor

Enclosures

cc: Cristina Fernandez, EPA Region II Air Protection Division Director
Michael G. Dowd, DEQ Air Division Director

west virginia department of environmental protection

Executive Office
601 57th Street SE
Charleston, WV 25304

Earl Ray Tomblin, Governor
Randy C. Huffman, Cabinet Secretary
www.wvdep.gov

September 29, 2016

Mr. Shawn M. Garvin
Regional Administrator
U.S. EPA Region 3 (3RA00)
1650 Arch Street
Philadelphia, PA 19103-2029

RE: West Virginia Initial Designations for the 2015 Ozone National Ambient Air Quality Standards

Dear Administrator Garvin:

On October 1, 2015, the Environmental Protection Agency (EPA) promulgated revised primary and secondary Ozone National Ambient Air Quality Standards (NAAQS) to provide requisite protection of public health and welfare, respectively. The final rule was published in the Federal Register on October 26, 2015 [80 FR 65292], strengthening both standards to a level of 0.070 parts per million (ppm), while retaining their indicators (O_3), averaging times (eight hours), and forms (fourth-highest daily maximum, averaged across three consecutive years).

In accordance with Section 107(d) of the Clean Air Act (CAA), the State of West Virginia is submitting our initial designations for the revised NAAQS by 1 year after October 1, 2015 [80 FR 65438]. Due to the form of the 2015 Ozone NAAQS relying on a 3-year average, the 3 most recent years of quality assured monitoring data available, 2013 to 2015, were used by the state on which to base our recommendations.

Based upon the latest certified data which has been completely uploaded to EPA's Air Quality System (AQS), for the eight hour, fourth-highest daily maximum for Ozone, averaged across the most recent three consecutive years (2013 to 2015), West Virginia has determined the initial area designations based on the 2015 Ozone NAAQS to be unclassifiable/attainment statewide. Please see the enclosed area list and accompanying air quality design value summary.

Our agency calculated design values pursuant to the Code of Federal Regulations Title 40 Part 50, Appendix I.

If you have any questions regarding this submittal or require additional information, please contact Mr. Fred Durham, Director of the Division of Air Quality at (304) 926-0462.

Sincerely,

Randy C. Huffman
Cabinet Secretary

cc: William F. Durham, WV DAQ
Cristina Fernandez, EPA Region 3 (3AP00)

Attachments (2)

State of West Virginia
2015 Ozone National Ambient Air Quality Standards
Initial Area Designations
September 2016

WEST VIRGINIA – OZONE (2015 8-HOUR STANDARD)

Designated Area	Designation Type
Statewide:	Unclassifiable/Attainment
Barbour	
Berkeley	
Boone	
Braxton	
Brooke	
Cabell	
Calhoun	
Clay	
Doddridge	
Fayette	
Gilmer	
Grant	
Greenbrier	
Hampshire	
Hancock	
Hardy	
Harrison	
Jackson	
Jefferson	
Kanawha	
Lewis	
Lincoln	
Logan	
Marion	
Marshall	
Mason	
McDowell	
Mercer	
Mineral	
Mingo	
Monongalia	
Monroe	
Morgan	
Nicholas	
Ohio	
Pendleton	
Pleasants	
Pocahontas	
Preston	
Putnam	
Raleigh	
Randolph	
Ritchie	
Roane	
Summers	
Taylor	
Tucker	
Tyler	
Upshur	
Wayne	
Webster	
Wetzel	
Wirt	
Wood	
Wyoming	

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West Virginia
Primary 8-Hour Ozone Standard Analysis

(standard not attained when the 4th highest daily maximum 8-hour concentration, averaged over three (3) years, exceeds 0.070 ppm)

DATE	8 hr average	08-10 average	DATE	8 hr average	09-11 average	DATE	8 hr average	10-12 average	DATE	8 hr average	11-13 average	DATE	8 hr average	12-14 average	DATE	8 hr average	13-15 average
CHARLESTON																	
7/8/10	.087	.078	7/1/11	.091	.082	6/29/12	.082	.086	4/21/13	.074	.082	8/27/14	.070	.075	5/7/15	.072	.072
9/2/10	.074	.073	9/2/11	.091	.077	7/6/12	.076	.080	4/18/13	.071	.079	7/11/14	.069	.072	5/8/15	.070	.070
7/27/10	.071	.071	9/3/11	.090	.075	8/23/12	.075	.078	4/20/13	.068	.078	4/21/14	.067	.070	5/6/15	.069	.068
6/21/10	.070	.069	7/6/11	.080	.070	5/26/12	.073	.074	5/15/13	.067	.073	8/5/14	.067	.069	9/16/15	.067	.067
4/15/10	.068	.068	6/6/11	.077	.068	8/30/12	.073	.072	6/20/13	.067	.072	8/29/14	.066	.069	8/16/15	.066	.066
GREENBRIER COUNTY																	
4/13/10	.073	.072	8/18/11	.069	.070	6/29/12	.082	.074	5/15/13	.069	.073	5/6/14	.068	.073	5/4/15	.061	.066
4/15/10	.072	.069	4/7/11	.065	.067	6/28/12	.072	.069	4/6/13	.063	.067	4/19/14	.062	.066	4/20/15	.059	.061
4/12/10	.071	.067	6/2/11	.065	.066	8/8/12	.066	.067	4/5/13	.061	.064	4/13/14	.061	.063	5/6/15	.058	.060
4/2/10	.069	.066	7/1/11	.065	.065	7/8/12	.065	.066	4/26/13	.060	.063	4/20/14	.060	.062	4/30/15	.057	.059
5/7/10	.069	.066	8/2/11	.065	.065	5/16/12	.064	.066	5/14/13	.060	.063	4/22/14	.060	.061	5/23/15	.056	.059
HUNTINGTON																	
8/10/10	.076	.073	7/1/11	.080	.074	6/29/12	.089	.081	7/17/13	.063	.077	7/11/14	.071	.074	6/10/15	.071	.068
9/2/10	.071	.068	9/3/11	.080	.071	6/28/12	.078	.076	7/18/13	.062	.073	8/27/14	.064	.068	5/8/15	.069	.065
4/2/10	.068	.067	9/2/11	.077	.069	7/3/12	.075	.073	6/21/13	.061	.071	6/7/14	.063	.066	8/9/15	.067	.064
8/8/10	.068	.066	6/6/11	.074	.067	7/4/12	.075	.072	4/6/13	.059	.069	8/4/14	.063	.065	5/7/15	.066	.062
8/28/10	.067	.065	8/2/11	.071	.066	7/7/12	.075	.071	9/8/13	.058	.068	4/21/14	.062	.065	9/18/15	.066	.062
VIENNA																	
7/6/10	.078	.074	9/3/11	.084	.075	6/28/12	.084	.082	6/12/13	.074	.081	4/21/14	.070	.076	6/10/15	.079	.074
7/7/10	.076	.071	6/4/11	.072	.070	6/29/12	.083	.077	5/15/13	.072	.076	6/7/14	.070	.075	7/28/15	.073	.072
8/29/10	.074	.070	8/18/11	.068	.067	8/2/12	.078	.073	6/20/13	.066	.071	8/5/14	.070	.071	8/16/15	.072	.069
4/15/10	.073	.068	6/6/11	.065	.066	8/8/12	.077	.071	7/18/13	.064	.068	6/27/14	.067	.069	8/22/15	.071	.067
5/30/10	.073	.068	6/8/11	.065	.066	8/1/12	.075	.071	4/5/13	.063	.068	8/4/14	.066	.068	5/8/15	.070	.066
WEIRTON																	
8/30/10	.083	.079	9/2/11	.080	.078	6/28/12	.083	.082	6/21/13	.082	.082	4/21/14	.074	.080	5/8/15	.074	.077
8/20/10	.079	.077	5/11/11	.075	.074	6/10/12	.080	.078	5/15/13	.074	.076	7/11/14	.068	.074	7/28/15	.071	.071
8/10/10	.077	.074	7/1/11	.075	.073	8/3/12	.080	.077	6/25/13	.073	.076	6/15/14	.067	.073	5/9/15	.070	.070
4/15/10	.076	.073	6/4/11	.073	.072	8/24/12	.076	.075	5/18/13	.069	.072	4/18/14	.065	.070	6/10/15	.069	.067
4/2/10	.074	.072	6/6/11	.073	.071	5/20/12	.075	.074	6/20/13	.069	.072	6/7/14	.065	.070	6/11/15	.069	.068
WHEELING																	
8/30/10	.082	.077	9/2/11	.076	.076	6/28/12	.087	.082	6/21/13	.074	.080	6/15/14	.067	.076	6/11/15	.074	.072
4/15/10	.078	.075	8/5/11	.075	.075	6/29/12	.080	.077	5/15/13	.071	.075	4/21/14	.066	.072	6/10/15	.072	.070
7/27/10	.078	.074	6/4/11	.074	.074	5/20/12	.075	.075	6/20/13	.068	.072	7/11/14	.066	.070	7/28/15	.070	.068
7/8/10	.076	.073	9/3/11	.074	.073	6/9/12	.074	.074	4/27/13	.063	.070	7/12/14	.066	.067	5/8/15	.069	.066
7/7/10	.075	.072	6/6/11	.072	.072	8/25/12	.074	.073	9/10/13	.063	.070	8/30/14	.063	.067	7/29/15	.068	.065
MORGANTOWN																	
5/30/10	.083	.073	9/3/11	.076	.076	6/29/12	.085	.081	6/21/13	.075	.079	7/11/14	.067	.076	6/11/15	.080	.074
7/8/10	.083	.071	7/1/11	.070	.072	6/28/12	.075	.076	5/30/13	.066	.070	7/12/14	.067	.069	5/8/15	.071	.068
8/30/10	.078	.069	6/4/11	.069	.070	8/8/12	.073	.073	6/20/13	.066	.069	4/21/14	.065	.068	6/10/15	.070	.067
7/7/10	.077	.068	7/22/11	.069	.069	7/3/12	.072	.072	6/22/13	.064	.068	6/27/14	.064	.066	5/6/15	.069	.065
8/9/10	.077	.068	9/2/11	.069	.069	5/31/12	.071	.072	6/23/13	.062	.067	8/5/14	.063	.065	8/17/15	.068	.064
MARTINSBURG																	
7/8/10	.089	.079	7/2/11	.072	.077	6/29/12	.082	.081	4/27/13	.068	.074	7/11/14	.064	.071	8/17/15	.070	.067
8/17/10	.074	.072	7/20/11	.070	.071	6/9/12	.070	.071	6/21/13	.068	.069	8/5/14	.062	.067	5/8/15	.068	.066
8/30/10	.074	.072	6/8/11	.069	.070	8/31/12	.070	.071	5/15/13	.065	.068	8/27/14	.062	.066	7/28/15	.067	.065
8/10/10	.073	.070	6/9/11	.068	.068	5/19/12	.069	.070	6/5/13	.063	.066	4/13/14	.060	.064	9/1/15	.066	.063
9/2/10	.073	.068	6/4/11	.067	.067	6/10/12	.069	.069	8/17/13	.063	.066	5/20/14	.060	.064	9/4/15	.066	.063

ED_001361_00018594

To: Mirzakhalili, Ali (DNREC)[Ali.Mirzakhalili@state.de.us]
Cc: Gentry, Penny J. (DNREC)[Penny.Gentry@state.de.us]; Amirikian, Ronald A. (DNREC)[Ronald.Amirikian@state.de.us]; Fees, David F. (DNREC)[David.Fees@state.de.us]; Fernandez, Cristina[fernandez.cristina@epa.gov]; Khadr, Asrah[khadr.asrah@epa.gov]; Velez-Rosa, Emlyn[velez-rosa.emlyn@epa.gov]; Schmitt, Ellen[Schmitt.Ellen@epa.gov]
From: Pino, Maria
Sent: Thur 10/13/2016 1:04:24 PM
Subject: RE: DE Designation Recommendation
DE 2015 O3 Designation Recommendation 9-23-16.pdf

Thanks, Ali. We are looking for it.

Maria A. Pino, Acting Associate Director

Office of Air Program Planning

US EPA Region III

1650 Arch St.

Philadelphia, PA 19103

(215) 814-2181

From: Mirzakhalili, Ali (DNREC) [mailto:Ali.Mirzakhalili@state.de.us]
Sent: Wednesday, October 12, 2016 4:34 PM
To: Pino, Maria <Pino.Maria@epa.gov>
Cc: Gentry, Penny J. (DNREC) <Penny.Gentry@state.de.us>; Amirikian, Ronald A. (DNREC) <Ronald.Amirikian@state.de.us>; Fees, David F. (DNREC) <David.Fees@state.de.us>
Subject: DE Designation Recommendation

Hi Maria,

Attached is Delaware's recommendation letter which was sent out a while ago. I noticed that we had not copied you on the transmittal but I hope that you can find it in the office. We will track the submittal from this end as well.

Thanks,

Ali

Ali Mirzakhalili, P.E.

Director

Division of Air Quality

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Dover, DE 19904

(302) 739-9402

STATE OF DELAWARE
OFFICE OF THE GOVERNOR
TATNALL BUILDING, SECOND FLOOR
WILLIAM PENN STREET, DOVER, DE 19901

JACK A. MARKELL
GOVERNOR

PHONE: 302-744-4101
FAX: 302-739-2775

September 23, 2016

Shawn M. Garvin
Regional Administrator
Region III
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Dear Administrator Garvin:

On October 1, 2015, the EPA strengthened the primary and secondary National Ambient Air Quality Standards (NAAQS) for ground-level ozone from the current 0.075 parts per million (ppm) over an 8-hour period to a new 0.070 ppm. Section 107(d) of the Clean Air Act (CAA) requires the Governor of each State to submit to the EPA a list of all areas (or portions thereof) in the State, designating each as nonattainment, attainment, or unclassifiable. This letter fulfills Delaware's obligations under Section 107(d) of the CAA.

Emissions cause ozone nonattainment and Delaware believes it is necessary to establish nonattainment boundaries that encompass enough of these emissions to make attainment a feasible and possible goal for the area. To this end Delaware hereby recommends that the nonattainment area borders associated with New Castle County be the borders of the States of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin, as shown in Figure 1 in the attached Executive Summary, due to EPA's analysis that these states significantly impact Delaware as part of the CSAPR and CSAPR Update. If the EPA again rejects establishing a nonattainment area that is consistent with science to solve the problem, Delaware requests EPA establish New Castle County as a stand-alone nonattainment area under the 2015 8-hour ozone NAAQS. The attached five factor analysis supports this recommendation.

Thank you for your consideration of the above recommendations. If you have any questions concerning this submittal or would like to discuss it further, please contact Mr. Ali Mirzakhalili, the Director of the Division of Air Quality, at (302)739-9402.

Sincerely,

Jack A. Markell
Governor

Attachment
pc: David Small
Ali Mirzakhalili
Cristina Fernandez, EPA Region III

Executive Summary

Area Description and Attainment/Nonattainment Status

Delaware is composed of three counties, namely New Castle, Kent, and Sussex, laying from north to south. The northern portion of New Castle County lies above the Chesapeake and Delaware Canal (C&D Canal), a waterway that connects the Chesapeake Bay with the Delaware Bay. The remainder of Delaware lies south of the Canal and is connected to the north primarily by the Route 1 Bridge. The portion of New Castle County located above the C&D Canal is more metropolitan and industrialized than the remainder of Delaware; however this area has experienced a significant decline in heavy industrial sources over the last two decades. Delaware is geographically situated, along with portions of Maryland and Virginia, on a land mass known as the Delmarva Peninsula. This land mass is separated from the Continental U.S. by the Chesapeake Bay on the west and from the State of New Jersey by the Delaware Bay on the east. These large water bodies surrounding the relatively large, flat Peninsula, plus the Atlantic Ocean, situate Delaware in an area that is geographically unlike any other. Further, these large water bodies create complex meteorological mountains and valleys that at times funnel transported emissions around the Peninsula and up the I-95 corridor, and at other times trap upwind emissions such that those emissions are recirculated by ocean and bay breezes, and impact Delaware multiple times.

Delaware operates a dense ozone monitoring network that includes ambient ozone monitors in each of its counties (four monitors in New Castle, one monitor in Kent, and two monitors in Sussex). Based on certified 2013 through 2015 ozone monitoring data (i.e., the most recent, certified three years), the 8-hour ozone design values for New Castle, Kent, and Sussex counties are 0.069 ppm, 0.065 ppm, and 0.069 ppm, respectively. However, 2016 ozone monitoring data shows that these three counties have 8-hour ozone design values based upon 2014 through 2016 ozone monitoring data of 0.072 ppm, 0.066 ppm, and 0.069 ppm, respectively. Based on 2014 through 2016 data Delaware recommends that Kent and Sussex County be designated as attainment, and that New Castle County be designated as nonattainment for both the primary and secondary 0.070 ppm 8-hour ozone NAAQS.

Nonattainment Area Boundaries associated with New Castle County

Over the past 40+ years, and in particular since 1990, Delaware's local sources of ozone precursor emissions have all been well controlled, yet Delaware's air quality remains nonattainment relative to ozone. Emission controls have been established and implemented in Delaware at a great economic cost to Delaware citizens and industry. Both large and small, new and modified, sources have been subject to costly nonattainment New Source Review control and offset requirements for more than two decades. Power plants, industrial boilers, consumer products, and paints are regulated in Delaware at levels far below national levels – and the list goes on. After many rounds of regulation[1], Delaware's sources that cause and contribute to ozone formation (i.e., volatile organic compound (VOC) and nitrogen oxides (NOx) emitting sources) are well controlled. Delaware's

[1] For example, all Delaware electric generating units (EGUs) have been subject to reasonably available control requirements (RACT) in 1995, the OTC NOx Budget Program in 1998, the EPA NOx SIP Call in 2002, the EPA CAIR in 2006, and 7 DE Admin Code 1146 in 2008. All Delaware EGUs are now subject to unit specific best available control technology (BACT) controls that were installed at a cost of between $1,200 and $11,000 per ton of NOx reduced.

emissions are likely controlled to a greater level than any other state that impacts Delaware's air quality – yet Delaware's air quality remains unhealthy because of high ozone concentrations. Many studies have shown that the health benefits of clean air far outweigh the cost of controls needed to clean the air; typically by more than 10:1. Delaware citizens and industry have endured the cost of controls, and despite this, have not reaped the economic benefit of clean air because of uncontrolled emissions generated outside of Delaware's borders. As such, Delaware suffers from this dual malfeasance.

The establishment of nonattainment boundaries is critical because it is within these boundaries that the nonattainment provisions of the CAA are applied. If the EPA again establishes small, metropolitan based nonattainment areas, Delaware's well controlled sources will undergo another round of costly regulation, and any additional emission reductions will come at a high cost, with control strategies generally being technology forcing. In contrast, very cost effective emissions reduction opportunities outside this small nonattainment area will not be realized, and the uncontrolled sources that are contributing to the problem will remain uncontrolled. This is unfair, and contrary to the CAA.

Emissions cause ozone nonattainment and Delaware believes it is necessary to establish nonattainment boundaries that encompass enough of these emissions to make attainment a feasible and possible goal for the area. To this end Delaware hereby recommends that the nonattainment area borders associated with New Castle County be the borders of the States of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin, as shown in Figure 1, due to EPA's analysis that these states significantly impact Delaware as part of the CSAPR and CSAPR Update. Delaware has made this same recommendation in the past and the EPA has provided the following rationale for rejecting this recommendation in the past. Delaware asks EPA to reconsider its position for the following reasons.

- EPA has indicated that Section 107(d) of the CAA requires EPA to designate as nonattainment all areas violating the ozone NAAQS and any nearby areas that are contributing to a violation in another area. U nder the designation provision, only "nearby" areas that contribute to the violation must be included as part of the nonattainment area. The issue here is that the term nearby must be interpreted consistent with the scale of the problem. The Courts have ruled that EPA has discretion on how it interprets the term nearby, and that interpreting nearby as a large area is a feasible construct of the statutory language.

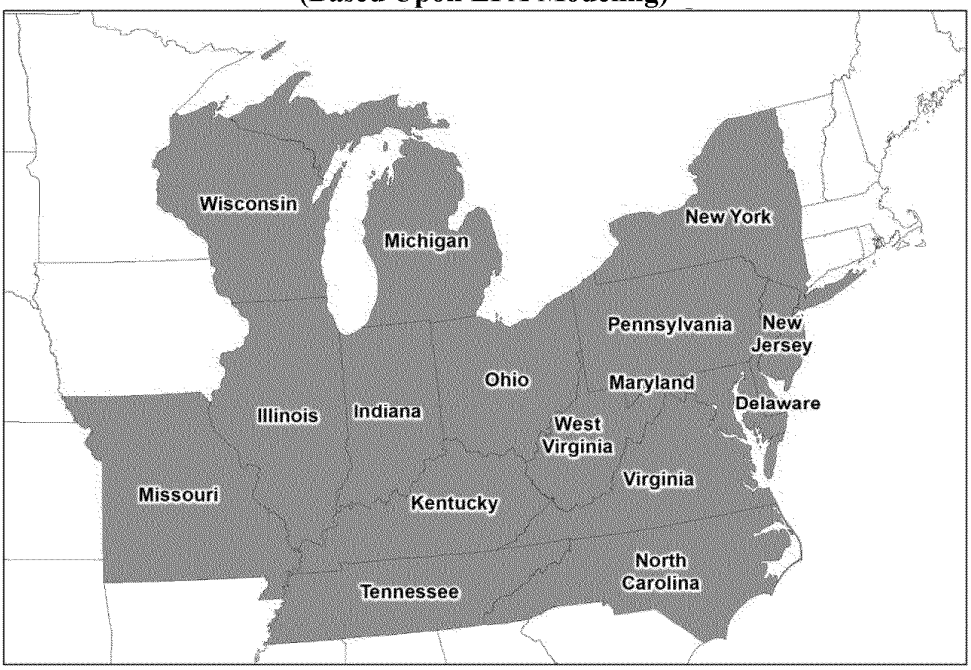
- EPA has indicated that there are other provisions of the CAA that address longer range transport of ozone pollution, such as sections 110(a)(2)(D), 126, and 176A. The phenomenon of ozone transport must be balanced against the need to have smaller areas that can focus on local control measures. Delaware has and continues to take action under these CAA provisions, but notes the dates for EPA to take action come and go and EPA fails to act. EPA has effectively made these provisions of no effect. Further, given that this would be the 4th round of applying the CAA ozone requirements to the Phila delphia area since 1990 there are few local control measures that remain for this area to focus on. It is not reasonable for EPA to knowingly establish nonattainment area boundaries that task the areas within the boundaries to achieve a goal that they can not achieve, that requires these

areas to make demonstrations and implement costly controls that cannot lead to attainment, and point to solutions that lead to other discretionary processes that are also outside the control of these areas. EPA ignoring th e scale of the problem during the designation process does nothing more than penalize these areas with unhealthy air quality.

- EPA in the past has noted that most of the states that Delaware seeks to include as part of this large nonattainment area did not make a similar request. EPA indicated that in the absence of broad agreement among a large group of states to create such a large nonattainment area, demonstrating a commitment to work together to address both long - range and local transport of emissions, they do not intend to designate a large nonattainment area as suggested by Delaware. Seeking broad agreement makes no sense and will not happen. Agreement was sought through the State Collaborative On Ozone Transport (SCOOT) process, but did not occur. Due to the upwind/downwind nature and the false perception that almost all of the potential benefits of reducing emissions lie in the Northeastern states while all costs lie in the Midwestern states. EPA alone has the authority to designate areas and fed eral intervention is necessary to require the area to work together and resolve the problem.

Figure 1 - Delaware Recommended Large Nonattainment Area

(Based Upon EPA Modeling)



Attachment 1

Delaware's Five Factor Analysis
For Establishment of Nonattainment Area Boundaries
For the 0.070 ppm 8-Hour Ozone NAAQS

As a framework for area-specific analyses, the EPA has recommended that states and tribes base their boundary recommendations on an evaluation of the following five factors[1]: Air Quality Data, Emissions and Emissions -Related Data , Meteorology, Geography/Topography, and Jurisdictional Boundaries. This EPA guidance indicates that states and tribes may identify and evaluate other relevant factors or circumstances specific to a particular area.

Delaware's primary boundary recommendation is to include New Castle County as part of a large multi-state nonattainment area. The information and analysis that Delaware submitted to the EPA in its nonattainment boundary recommendations for the 2008 8-hour ozone NAAQS still stand as justification for recommending a large nonattainment area. This recommendation is in line with current science and the Courts have ruled that EPA has sufficient authority under the CAA to adopt it. In the event that EPA does not accept Delaware's recommendation for the establishment of a large nonattainment area, Delaware hereby provides the following detailed discussion and analyses on each of the five factors, which indicate New Castle County should be established as a stand-alone nonattainment area. This alternate recommendation follows EPA guidance but not science.

Delaware considers in this analysis all counties considered by the EPA in their factor assessment associated with the Area Designations for Delaware under the 2008 Ozone National Ambient Air Quality Standards.[2] These counties are identified in Table 1 and are represented in Figure 1.

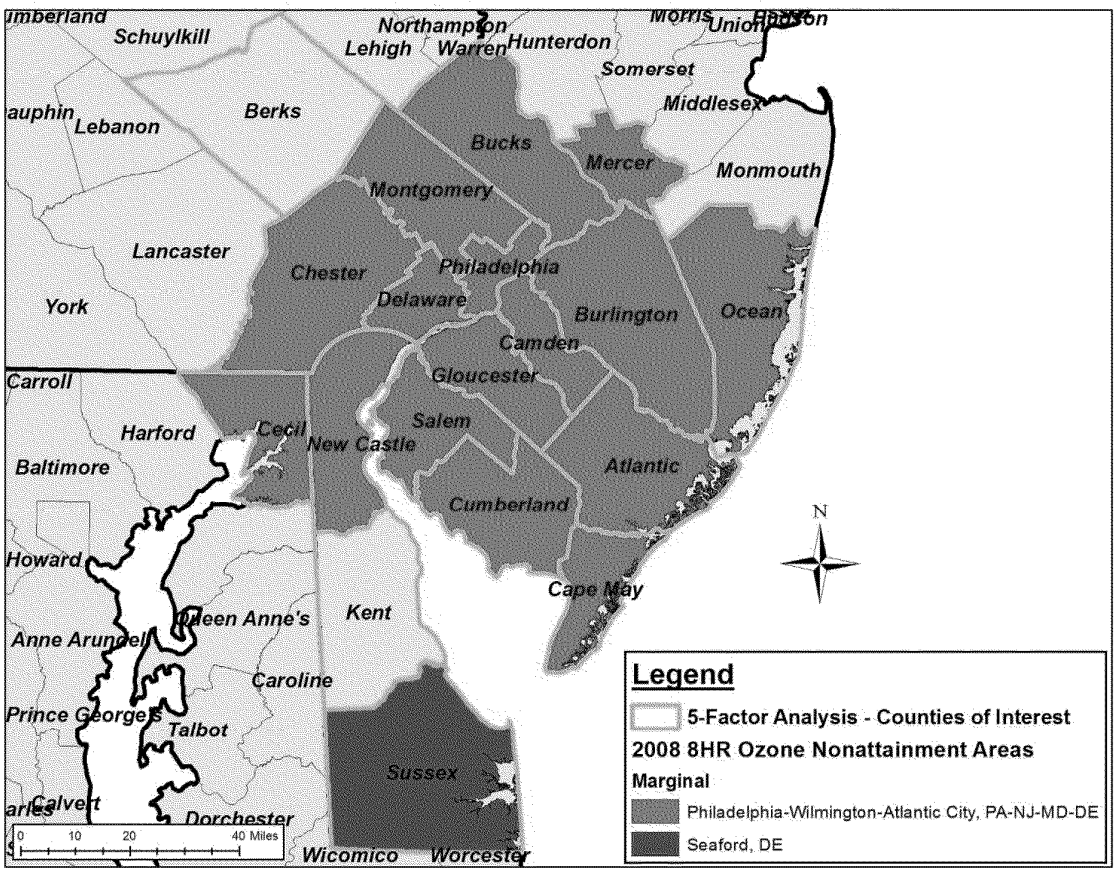
Table 1 - Counties of Interest

FIPS Code	State	County
10001	DE	Kent County, Delaware
10003	DE	New Castle County, Delaware
10005	DE	Sussex County, Delaware
24015	MD	Cecil County, Maryland
34001	NJ	Atlantic County, New Jersey
34005	NJ	Burlington County, New Jersey
34007	NJ	Camden County, New Jersey
34009	NJ	Cape May County, New Jersey
34011	NJ	Cumberland County, New Jersey
34015	NJ	Gloucester County, New Jersey
34021	NJ	Mercer County, New Jersey
34029	NJ	Ocean County, New Jersey

[1] Memorandum: Area Designations for the 2015 Ozone National Ambient Air Quality Standards; Janet G. McCabe, Acting Assistant Administrator, US EPA, February 25, 2016.
[2] https://archive.epa.gov/ozonedesignations/web/html/region3r.html

FIPS Code	State	County
34033	NJ	Salem County, New Jersey
42011	PA	Berks County, Pennsylvania
42017	PA	Bucks County, Pennsylvania
42029	PA	Chester County, Pennsylvania
42045	PA	Delaware County, Pennsylvania
42091	PA	Montgomery County, Pennsylvania
42101	PA	Philadelphia County, Pennsylvania

Figure 1 - Counties of Interest



Factor 1: Air Quality Data

For this factor Delaware evaluated 8-hour ozone design values (DV, in parts per million (ppm)) for air quality monitors in the counties of interest . A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2015 8-hour ozone NAAQS is met when the annual fourth -highest daily maximum 8 -hour average concentration, averaged over 3 years, is 0.070 ppm or less. Where several monitors are located in a county (or a

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designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest value. Delaware considered monitoring data for the 2014-2016. This is the 2 most recent years of certified air quality data, plus uncertified 2016 data through 9/14/16. Delaware believes it is important to consider 2016 data at this time because 1) EPA has indicated they will consider it when they make final designations in 2017, and 2) ozone concentrations were low in 2015 due to abnormal meteorological conditions.

Table 2 and Figure 2 below detail the draft 2016 DVs for the counties of interest, as well as the violating monitors in these counties. While all monitors in Delaware were monitoring attainment with the 2015 8-hour ozone NAAQS based upon 2015 DVs, it is only with the most recent, uncertified 2016 data that New Castle County's northern-most monitor located in the Brandywine Creek State Park (Site ID 10003 1010) exceeds the 2015 8-hour ozone NAAQS. The closest monitor to the Brandywine monitor is Delaware's Bellefonte monitor (Site ID 100031013), which is monitoring attainment just 4.6 miles away to the southeast, while the second closest monitor is the Chester monitor (Site ID 420450002) in Delaware County, Pennsylvania, which is monitoring nonattainment 10.3 miles away to the east.

Table 2 - Counties of Interest – 2016 Design Values

County	2016 8-hour Ozone DV (ppm)
Atlantic, NJ	0.064
Berks, PA	0.071
Bucks, PA	0.077
Burlington, NJ	--
Camden, NJ	0.074
Cape May, NJ	--
Cecil, MD	0.074
Chester, PA	0.070
Cumberland, NJ	0.067
Delaware, PA	0.072
Gloucester, NJ	0.073
Kent, DE	0.066
Mercer, NJ	0.073
Montgomery, PA	0.072
New Castle, DE	0.072
Ocean, NJ	0.072
Philadelphia, PA	0.076
Salem, NJ	--
Sussex, DE	0.069

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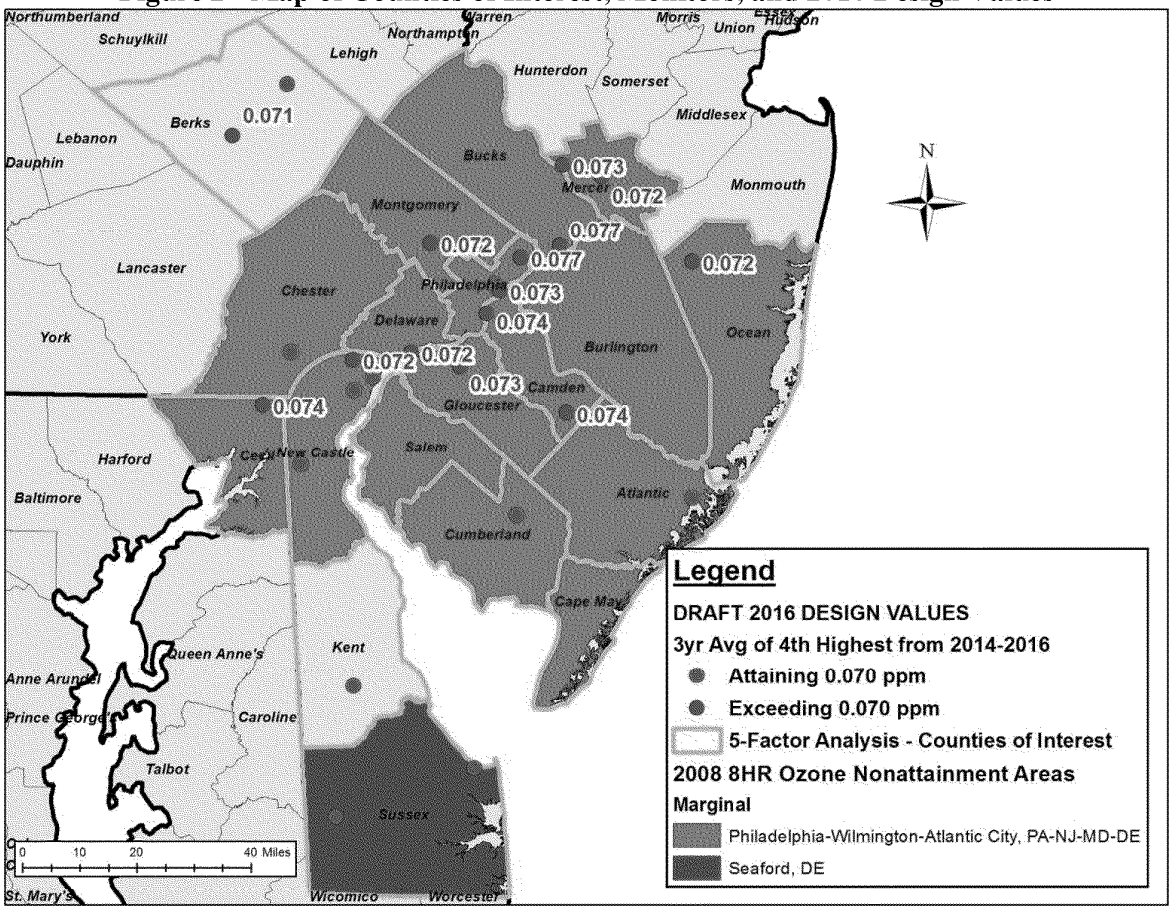
Figure 2 - Map of Counties of Interest, Monitors, and 2016 Design Values



In accordance with section 107(d) of the Clean Air Act, EPA must designate an area nonattainment if it is violating the 2015 8-hour ozone NAAQS. New Castle County in Delaware is violating the 2015 8-hour ozone NAAQS.

Factor 2: Emissions and Emissions-Related Data

Emissions

Table 3 and Table 4 show the emissions of NOx and VOC (in tons per year) for the counties of interest. The emissions were provided by EPA and are from the 2011 NEI V3 dataset.[3]

[3] https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data

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Table 3 - 2011 NEI V3 NOx Emissions

FIPS	State	County	NOX Fires (tpy)	NOX Nonpoint[4] (tpy)	NOX Nonroad (tpy)	NOX Onroad (tpy)	NOX Point (tpy)	NOX Total (tpy)
42101	PA	Philadelphia County	-	5,791	2,480	10,201	2,568	**21,041**
42045	PA	Delaware County	21	2,839	1,124	5,643	7,642	**17,270**
42091	PA	Montgomery County	-	2,369	3,076	9,533	1,456	**16,435**
42011	PA	Berks County	15	1,766	1,529	7,665	3,140	**14,114**
10003	DE	New Castle County	7	2,889	1,748	6,459	2,755	**13,859**
42017	PA	Bucks County	1	1,631	2,196	7,680	1,271	**12,779**
42029	PA	Chester County	1	1,208	2,214	6,841	1,530	**11,794**
10005	DE	Sussex County	11	2,109	1,721	4,399	2,457	**10,697**
34007	NJ	Camden County	9	2,441	1,150	5,353	433	**9,386**
34005	NJ	Burlington County	30	1,365	1,512	5,936	286	**9,128**
34021	NJ	Mercer County	7	1,323	1,433	4,659	639	**8,061**
34015	NJ	Gloucester County	2	1,734	871	3,576	1,758	**7,942**
34029	NJ	Ocean County	30	1,388	2,264	3,969	255	**7,905**
34001	NJ	Atlantic County	7	936	1,161	2,808	202	**5,115**
10001	DE	Kent County	4	1,026	878	2,583	412	**4,902**
34009	NJ	Cape May County	-	1,022	1,227	1,193	602	**4,045**
34011	NJ	Cumberland County	29	1,106	766	1,394	723	**4,017**
24015	MD	Cecil County	0	494	529	2,757	77	**3,858**
34033	NJ	Salem County	1	345	311	1,078	1,540	**3,276**

[4] EPA's 2011 NEI V3 Emissi ons data included biogenic emissions within the nonpoint emissions data. The nonpoint NOx emissions in Table 3 exclude the biogenics emissions which EPA had added for each county.

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Table 4 - 2011 NEI V3 VOC Emissions

FIPS	State	County	VOC Fires (tpy)	VOC Nonpoint[5] (tpy)	VOC Nonroad (tpy)	VOC Onroad (tpy)	VOC Point (tpy)	VOC Total (tpy)
42101	PA	Philadelphia County	-	11,129	2,518	5,641	1,598	**20,886**
42091	PA	Montgomery County	-	8,756	4,211	5,016	729	**18,712**
42017	PA	Bucks County	14	7,382	3,206	4,025	524	**15,150**
34029	NJ	Ocean County	1,002	4,968	4,416	2,636	73	**13,095**
42011	PA	Berks County	168	5,845	1,651	3,831	1,224	**12,719**
42029	PA	Chester County	14	4,766	2,646	3,223	799	**11,448**
42045	PA	Delaware County	491	4,715	1,788	3,000	1,393	**11,387**
10003	DE	New Castle County	15	4,626	1,931	3,051	848	**10,470**
34005	NJ	Burlington County	969	4,424	2,036	2,518	237	**10,183**
34007	NJ	Camden County	259	4,756	1,433	2,450	219	**9,117**
34015	NJ	Gloucester County	25	5,129	1,240	1,499	939	**8,832**
10005	DE	Sussex County	88	2,315	2,589	2,856	817	**8,665**
34021	NJ	Mercer County	75	4,168	1,185	1,964	135	**7,528**
34001	NJ	Atlantic County	204	3,245	2,230	1,261	98	**7,038**
34011	NJ	Cumberland County	889	2,613	780	676	70	**5,028**
34009	NJ	Cape May County	-	1,534	2,943	517	21	**5,014**
10001	DE	Kent County	80	1,578	1,127	1,010	85	**3,878**
24015	MD	Cecil County	4	951	1,055	853	20	**2,883**
34033	NJ	Salem County	13	1,024	525	387	199	**2,148**

[5] EPA's 2011 NEI V3 Emissions data included biogenic emissions within the nonpoint emissions data. The nonpoint VOC emissions in Table 4 exclude the biogenics emissions which EPA had added for each county.

Philadelphia County has the highest individual NOx or VOC emissions of the counties of interest and the highest combined emissions (NOx + VOC emissions). New Castle County's combined emissions are about half of Philadelphia County's combined emissions. New Castle County's emissions beyond 2011 have decreased, and continue to decline, in part due to enforceable coal to gas fuel switching; adoption and implementation of NOx measures which significantly reduce refinery emissions and VOC measures such as the updated AIM and Consumer Products rules; and adoption of CA LEV III.

During the designations proces s for the 2008 8-hour ozone NAAQS , the EPA's factor assessment characterized Berks County emissions as "moderate," and excluded Berks County from the 2008 Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE nonattainment area (2008 Philadelphia NAA). Berks County's total 2008 NOx and VOC emissions were similar to New Castle County's total 2008 NOx and VOC emissions, as well as Chester County 's (which separates Berks County and New Castle County) , both of which were included within the 2008 Philadelphia NAA. Berks County's 2011 NOx and VOC emissions are higher than New Castle County's emissions. For this reason, emissions indicate New Castle County is separate from the other counties of interest.

Population and Degree of Urbanization

Table 5 contains various demographic information for the counties of interest, to include each county's land area (in square miles), 2014 population, population density, and the percent of the population which reside in an urban area. These demographic data were obtained from the U.S. Census Bureau website at www.census.gov.[6]

Table 5 - 2014 Population and Density

FIPS	State	County	Land Area (SQ MI, US 2014 Gazeteer)	2014 Population (5yr ACS)	2014 Population/ Sq. Mile (people/mile^2)	% Urban Population (2010 Census)
42101	PA	Philadelphia County	134.11	**1,546,920**	11,535	100.0%
42091	PA	Montgomery County	483.04	**809,372**	1,676	97.1%
42017	PA	Bucks County	604.32	**626,205**	1,036	91.2%
34029	NJ	Ocean County	628.83	**581,413**	925	97.1%
42045	PA	Delaware County	183.84	**560,775**	3,050	99.5%
10003	DE	New Castle County	426.29	**545,846**	1,280	95.4%
34007	NJ	Camden County	221.27	**512,632**	2,317	98.4%
42029	PA	Chester County	750.51	**506,422**	675	86.7%
34005	NJ	Burlington County	798.58	**450,155**	564	93.3%
42011	PA	Berks County	856.48	**413,016**	482	76.3%

[6] Land Area obtained from US Census Bureau, 2014 U.S. Gazetteer Files, http://www.census.gov/geo/maps-data/data/gazetteer2014.htm. Population estimates are from the U.S. Census Bureau, American Community Survey, 5 year estimates. http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.

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34021	NJ	Mercer County	224.57	**369,526**	1,645	96.5%
34015	NJ	Gloucester County	322.02	**289,705**	900	91.7%
34001	NJ	Atlantic County	555.71	**275,325**	495	87.3%
10005	DE	Sussex County	936.09	**203,737**	218	58.7%
10001	DE	Kent County	586.32	**167,477**	286	73.0%
34011	NJ	Cumberland County	483.76	**157,429**	325	77.0%
24015	MD	Cecil County	346.28	**101,803**	294	57.9%
34009	NJ	Cape May County	251.43	**96,286**	383	82.5%
34033	NJ	Salem County	331.99	**65,501**	197	54.7%

Philadelphia County has the highest population and population density among the counties of interest. Bucks, Chester, Delaware, and Montgomery Counties, in Pennsylvania; Burlington, Camden, and Ocean Counties in New Jersey; and New Castle County in Delaware have somewhat large populations compared to Kent and Sussex Counties in Delaware. Although Cecil County in Maryland and several counties in New Jersey that were included in the 2008 Philadelphia NAA have comparatively small populations and population densities, they have lower populations and population densities than Berks County, which was excluded from the 2008 Philadelphia NAA. Although New Castle County's population and population density are higher than those of Berks County, these values are more alike than the values between New Castle County and Philadelphia County. In the factor assessment for Berks County for the 2008 8-hour ozone NAAQS, EPA states that it considers these demographic factors as indicators of the probable location and magnitude of nonpoint source emissions. For the factor assessment of Berks County EPA stated, "*...non-point source emissions from Lebanon or Schuylkill Counties are not likely to contribute to ozone violations in Berks County*" since Berks County's population was nearly three times higher than the other two counties. By this reasoning, it would suggest that nonpoint source emissions from New Castle County are not likely to contribute to ozone violations in Philadelphia County.

Traffic and Commuting Patterns

Traffic and commuting patterns usually show similarities in cities and counties with similar rural or urban patterns, such as within a CBSA/CSA. Their relations with local onroad mobile emissions seem to be more apparent or more easily identified on a local scale. As shown in Table 6, New Castle County's vehicle miles traveled (VMT) in 2011 are similar to that of the counties in and around Philadelphia County.[7]

Table 6 - 2011 VMT

FIPS	State	County	Vehicle Miles Traveled (VMT)
42091	PA	Montgomery County	**6,505,446,421**
42101	PA	Philadelphia County	**5,344,508,760**

[7] 2011 Vehicle Miles Traveled provided by EPA at https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data

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FIPS	State	County	Vehicle Miles Traveled (VMT)
10003	DE	New Castle County	**5,201,246,605**
42017	PA	Bucks County	**4,727,709,143**
34029	NJ	Ocean County	**4,617,759,793**
34005	NJ	Burlington County	**4,477,567,355**
42029	PA	Chester County	**4,277,236,066**
34007	NJ	Camden County	**3,848,560,437**
42011	PA	Berks County	**3,381,679,887**
42045	PA	Delaware County	**3,336,446,326**
34021	NJ	Mercer County	**3,325,914,191**
34015	NJ	Gloucester County	**2,713,227,986**
34001	NJ	Atlantic County	**2,676,389,714**
10005	DE	Sussex County	**2,224,310,996**
10001	DE	Kent County	**1,601,985,389**
24015	MD	Cecil County	**1,356,020,045**
34011	NJ	Cumberland County	**1,122,284,008**
34009	NJ	Cape May County	**1,043,389,878**
34033	NJ	Salem County	**779,668,486**

National, regional, and local emission inventory data have shown for many years that the onroad mobile source emissions remain a major portion of an area's or county's total emission inventory. The emissions data in Table 3 and Table 4 show that onroad emissions contribute between one third to two thirds of the NOx emissions in the counties of interest, while onroad emissions contribute no more than a third of the VOC emissions. While onroad emissions contribute to less than half of the NOx emissions in New Castle County, onroad emissions contribute to well more than half of the NOx emissions in some counties surrounding Delaware. Not surprisingly, onroad contributions of NOx and VOC emissions from the onroad sector, compared to emissions in total, are more prevalent in counties along the I-95 corridor. However, Berks County is an exception to this statement, which is not near the I-95 corridor, and has relatively fewer VMT in 2011 than New Castle County. Yet, 54% and 30% of Berks County's total 2011 NOx and VOC emissions, respectively, are onroad emissions (both of which are greater percentages than New Castle County's onroad emissions contributions).

Table 7 contains the "Commuting (Journey to Work) Worker Flows" for the counties of interest.[8] From the data it can be seen that most Delaware commuters work within Delaware. This makes sense as most commuters work in the same county in which they live, and is true for most of the counties shown. For New Castle County, over 26,000 commuters travel into Pennsylvania to work in one of the counties of interest, with over 24,000 traveling specifically to either Chester County, Delaware County, or Philadelphia County. Cecil County has many commuters who

[8] Commuting (Journey to Work) Worker Flows are from US, Census Bureau, American Community Survey, 5 year estimates 2009-2013. http://www.census.gov/hhes/commuting/data/commutingflows.html

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work in the same county, but about 10,000 of its commuters travel to Delaware, primarily in New Castle County. In Pennsylvania, only a small percentage of commuters travel into Delaware, but the total commuters to Delaware just from the 5 counties of interest in Pennsylvania are almost the same as all Delaware c ommuters which travel into Pennsylvania. The same can be said about the counties of interest in New Jersey, in that the number of commuters from those counties is nearly the same as all Delaware commuters which travel into New Jersey. In regards to New C astle County specifically, more commuters travel into the county from the counties of interest (about 47,000, excluding Kent and Sussex Counties in Delaware), than commuters from New Castle County travel to counties of interest of the surrounding states (a bout 36 ,000, excluding Kent and Sussex Counties in Delaware). By this metric, more onroad emissions are coming into New Castle County from out of state commuters than from Delaware workers commuting to the surrounding states.

In the factor assessment for Delaware for the 2008 8-hour ozone NAAQS, Berks County is shown to have as many workers commuting into Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania as New Castle County (based upon commuting work flows from the 2000 Census). E PA excluded Berks County from the 2008 Philadelphia NAA despite this data. The latest worker flow data below confirms that both New Castle County and Berks County still have about the same number of workers which commute into one of the four previously named counties in Pennsylvania.

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Table 7 - County to County Commuting Flows- ACS 2009-2013

COMMUTING FROM...

FIPS	County Name	10001 Kent	10003 New Castle	10005 Sussex	24015 Cecil	34001 Atlantic	34005 Burlington	34007 Camden	34009 Cape May	34011 Cumberland	34015 Gloucester	34021 Mercer	34029 Ocean	34033 Salem	42017 Berks	42017 Bucks	42029 Chester	42045 Delaware	42091 Montgomery	42101 Philadelphia
10001	Kent	**52,320**	3,529	**6,208**	345	20	18	25		22	4		28	38			77	48	49	99
10003	New Castle	**9,460**	**211,593**	**1,133**	**10,409**	149	702	1,447	23	298	2,376	87	69	**2,428**	184	492	**14,602**	9,451	1,431	2,712
10005	Sussex	**5,819**	464	**65,614**	12						10		30		13			120	48	
24015	Cecil	553	4,384	28	**21,722**		36			2	4			94		38	1,215	157		43
34001	Atlantic	6	148	12		**102,097**	1,920	4,846	**5,622**	**4,105**	3,041	141	**4,405**	252		111	91	588	151	587
34005	Burlington	64	625	3		2,083	**121,646**	**34,850**	415	574	**9,378**	**4,969**	**4,209**	468	29	5,919	441	1,423	2,128	6,054
34007	Camden	98	777	66	36	**3,492**	**25,242**	**119,946**	471	1,350	**23,078**	985	789	1,266	62	1,989	470	2,322	1,947	8,352
34009	Cape May		48	14		**3,890**	292	343	**32,131**	1,898	404		406	40	23	110	169	326	259	305
34011	Cumberland		211	45	10	**3,769**	441	1,760	**974**	**43,792**	4,209	62	138	**2,909**		87	16	77	65	480
34015	Gloucester	91	1,312	19	40	1,619	3,203	**17,249**	215	**3,120**	**63,519**	234	212	**4,833**		397	376	1,765	407	3,066
34021	Mercer	38	153	3		256	**22,362**	4,210	186	333	1,265	**117,053**	**6,964**	114	26	**19,632**	271	394	1,682	3,075
34029	Ocean		31	8		1,298	2,127	512	137	46	223	899	**141,719**	44		335	6	62	47	150
34033	Salem	159	1,601	23	105	222	264	991	60	**2,214**	2,874	46	45	**13,443**	29	34	201	321	115	185
42011	Berks		13	20	59	59		22	4		7	10			**142,041**	308	2,545	204	4,313	195
42017	Bucks	60	332		54	246	4,328	1,857	159	19	961	**4,753**	340	84	1,090	**175,586**	1,386	1,838	**25,722**	**24,860**
42029	Chester	155	**6,466**	141	**1,168**	202	502	689	113	126	939	134	47	86	**7,499**	2,741	**158,395**	**19,107**	**25,083**	7,479
42045	Delaware	294	**9,318**	120	482	225	1,244	2,642	219	114	3,455	202	112	600	550	2,457	**19,784**	**137,377**	12,435	**17,181**
42091	Montgomery	31	2,036	126	96	236	3,205	3,356	287	185	2,321	896	304	151	**14,822**	**45,800**	**29,813**	**28,263**	**258,752**	**59,146**
42101	Philadelphia	465	**8,290**	**161**	396	1,602	**16,425**	**33,685**	**777**	754	**16,075**	1,776	564	862	1,039	**34,856**	12,577	**51,283**	**59,910**	**460,086**

COMMUTING TO

BOLD YELLOW - Represents destination counties with commuters within the top 25% of commuters to counties of interest from a single county.

Sonoma Technologies Inc. (STi) conducted air quality modeling using the Comprehensive Air Quality Model with extensions (CAMx) Ozone Source Apportionment Technology (OSAT) , and its results indicates that mobile emissions significantly impact monitors in and around Delaware.[9] The maximum impact to any monito r in the area, from onroad emissions in a single state, is shown in Table 8.

Table 8 – Maximum Impacts from State Onroad Emissions, To Monitors In and Around Delaware

State	Maximum Impact from State (ppb)
Pennsylvania	20.76
Maryland	17.65
New Jersey	10.74
Virginia	7.52
Ohio	4.93
Delaware	4.82
Michigan	4.11
New York – Downstate	3.51
New York – Upstate	3.42
Indiana	2.86
Connecticut	1.58
Illinois	1.57
District of Columbia	1.04
West Virginia	0.99

Mobile emissions from Pennsylvania and Maryland impact the area the most, followed by New Jersey, Virginia, Ohio, and then Delaware. The large impacts from Maryland onroad emissions are likely from the Baltimore area and not from Cecil County. The maximum impact of Delaware onroad mobile emissions on the area are about 45% less than the impacts of Virginia onroad mobile emissions, and are on par with the onroad mobile impacts of Ohio, Mi chigan, and throughout New York.

Mobile sources are regulated at the federal level through tailpipe emissions standards, and at the state level through vehicle inspection/maintenance programs, transportation conformity, and adoption of California Low Em ission Vehicles. Each of the counties in the Philadelphia area have these programs in place. Transportation conformity is implemented at the county level – each county in the area has established and demonstrates compliance with its own conformity budget separate from the other parts of the CBSA. This means that mobile emissions and planning do not, and have not , historically tie the area together. The lack of interstate planning, to include transportation conformity coordination, indicates that mobile emissions should not be a significant consideration in establishing small, local scale nonattainment area boundaries

[9]Ozone Impacts from Brunner Island Power Plant in 2011, Sonoma Technology Inc., August 6, 2015, https://content.sierraclub.org/coal/sites/content.sierraclub.org.coal/files/docs/Sonoma_8-6-15_Brunner_Memo_1.pdf.

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around the Philadelphia area. Similarly, while the impact of mobile emissions to the area is significant, modeling shows that most of the mobile source impact is due to emissions outside of the area immediately surrounding Philadelphia; and the impact of Delaware onroad mobile emissions are more like the areas further away from the Philadelphia area.

Evaluation of Factor 2 indicates New Castle County be established as a stand alone nonattainment area, separate from the other counties of interest.

Factor 3: Meteorology

There are many components in meteorology which affect ozone formation and transport, such as precipitation, cloud coverage, solar radiation, temperature gradients, and wind. Extensive studies have been done on effects of meteorological components on ozone formation and transport, and the results consistently support the regional nature of the ozone problem (see "The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description," Final Report by NESCAUM, October 2006; "A conceptual Model for Ozone Transport," by Dr. Robert Hudson, University of Maryland, January, 2006; and "A Guide to Mid-Atlantic Regional Air Quality," by MARAMA, October 2005.).

In brief, a number of meteorological processes affect local ozone levels within the Ozone Transport Region (OTR). Transport within the OTR can be divided into three principle components: ground level transport at the surface, transport by the nocturnal low level jet, and transport aloft. All three modes of transport depend on the location of the high pressure system. Ground level transport is the result of interaction between the synoptic flow and local effects, such as the sea breeze and the Appalachian lee side trough. Transport within the OTR can occur by the nocturnal low level jet that forms late at night or in the very early morning hours. This phenomenon is a result of the differential heating of the air between the Appalachian Mountains and the Atlantic Ocean. It has been observed from Georgia to Maine. The nocturnal low level jet can transport ozone that formed within the OTR or was transported into the OTR from outside the region. Transport aloft is dominated by the anti-cyclonic flow around a high pressure system, which can lead to transport of an ozone reservoir, created by emissions in areas that lie outside the OTR, into the OTR. Local emissions within the OTR add to the polluted air mixing down from above that arrived from more distant locations. A number of modeling studies indicate that pollution sources in the Ohio River Valley and the Southeast significantly contribute to ozone nonattainment problems in various portions of the OTR. In fact, meteorology and its impact on ozone and ozone precursor transport, and its impact on the formation of ozone in the atmosphere, make this a main factor that sets ozone part from other criteria pollutants. Delaware believes that the meteorology factor strongly supports the establishment of large nonattainment boundaries due its wide-range impacts.

Despite the fact that science supports establishment of large nonattainment area boundaries, an evaluation of the local Philadelphia area indicates meteorology in New Castle County is different than other parts of the Philadelphia area. Table 9 below shows the days in 2013 through 2016 which were forecast to be Air Quality Action Days (AQAD) for ozone in Delaware and the

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"Greater Philadelphia Region," as forecast by the Department of Meteorology of The Pennsylvania State University.[10]

Table 9 - Air Quality Action Days Forecast in Delaware and the Greater Philadelphia Region for Ozone for 2013 through 2016

2016		
Date	Greater Philadelphia Region	Delaware
5/25/2016	Code Orange	Code Orange
5/26/2016	Code Red	Code Red
5/27/2016	Code Orange	Code Orange
6/11/2016	Code Yellow	Code Orange
6/18/2016	Code Orange	Code Yellow
6/19/2016	Code Orange	Code Yellow
6/20/2016	Code Orange	Code Orange
6/26/2016	Code Orange	Code Yellow
7/6/2016	Code Orange	Code Orange
7/7/2016	Code Orange	Code Orange
7/17/2016	Code Orange	Code Yellow
7/22/2016	Code Orange	Code Orange
7/28/2016	Code Orange	Code Yellow
# of AQADs	12	8

2015		
Date	Greater Philadelphia Region	Delaware
6/11/2015	Code Orange	Code Orange
6/12/2015	Code Orange	Code Orange
7/12/2015	Code Orange	Code Yellow
7/19/2015	Code Orange	Code Orange
7/29/2015	Code Orange	Code Orange
8/15/2015	Code Orange	Code Yellow
8/16/2015	Code Orange	Code Yellow
8/17/2015	Code Orange	Code Yellow
9/1/2015	Code Orange	Code Yellow
9/3/2015	Code Orange	Code Orange
9/17/2015	Code Orange	Code Orange
9/18/2015	Code Orange	Code Orange
# of AQADs	12	7

2014		
Date	Greater Philadelphia Region	Delaware
6/17/2014	Code Orange	Code Orange
7/12/2014	Code Orange	Code Orange
7/22/2014	Code Orange	Code Yellow
8/5/2014	Code Orange	Code Orange
8/27/2014	Code Orange	Code Orange
# of AQADs	5	4

2013		
Date	Greater Philadelphia Region	Delaware
5/30/2013	Code Orange	Code Orange
5/31/2013	Code Orange	Code Orange
6/22/2013	Code Orange	Code Yellow
6/23/2013	Code Orange	Code Green
6/25/2013	Code Orange	Code Orange
7/17/2013	Code Orange	Code Orange
7/18/2013	Code Orange	Code Orange
7/19/2013	Code Orange	Code Yellow
8/20/2013	Code Orange	Code Yellow
8/21/2013	Code Orange	Code Yellow
# of AQADs	10	5

This data shows that there have been more AQADs forecast in Delaware and the Greater Philadelphia Region in the last two years,[11] but there have been fewer AQADs forecast for Delaware than the Greater Philadelphia Region. Additionally, the daily ozone forecast values for Delaware (of which the Air Quality Index and AQADs are based) were typically lower than the daily forecast values for the Greater Philadelphia Region. During the months of May through

[10] AQAD data is summarized from daily emails received by DAQ staff regarding the ground level ozone forecasts received either directly from Penn State University or from the Enviroflash listserve emails in recent years.
[11] Beginning in 2016, AQADs were based on forecasts which exceeded the new 0.070 ppm standard, whereas AQADs in 2013, 2014, and 2015 were based on forecasts which exceeded the previous 0.075 ppm standard.

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September, from May 2013 until the end of July 2016, the daily ozone forecast for Delaware has been lower than that of the Greater Philadelphia Region 65% of the time.[12] On average, the Delaware daily ozone forecast values have been 1.5 parts per billion (ppb) lower than those of the Greater Philadelphia region (see Table 10). When averaging the values by month, over the same time period, it can be seen from Table 10 that the Delaware forecast values vary between 0.64 ppb to 2.24 ppb lower than Greater Philadelphia region forecast values.

Table 10 -Average Difference in Daily Ozone Forecast Values 5/1/13 – 7/30/16 (Greater Philadelphia Region – Delaware)

	(ppb)
Overall Average Difference	**1.50**
Average Difference in May	0.64
Average Difference in June	1.42
Average Difference in July	1.65
Average Difference in August	2.24
Average Difference in September	1.74

This is in part due to the different weather patterns that Delaware sees versus those of the Philadelphia area. During 2013 to 2015, hot weather was seen to still be necessary for high ozone concentrations, but it is no longer sufficient to solely cause high ozone concentrations. Temperatures during June, July, and August 2015 were about average compared to 1981-2010, which would suggest an average ozone season, which indeed it was. However, 2015, like 2013-2014, was marked by an atypical weather pattern that limited the development of heat waves in June-August and inhibited the frequency of westerly transport aloft. In a study for Delaware that analyzed air mass transport patterns in the Northeast, STi looked at ozone data and back trajectories for 2008 through 2015. In comparing the ozone data from all days in the ozone season to days with high ozone (the top 10% daily 8-hr max), STi found discernable trajectory patterns between high ozone days and all days. As shown in Figure 3 there are differences in transport patterns in 2011 and 2015 compared to all other years. Specifically in 2015, the study confirms a more persistent westerly and northwesterly flow inhibited southerly transport. This shift in weather patterns in 2015 likely contributed to the recent "step-down" in observed ozone levels in Delaware, although the effects are minor compared to ongoing reductions on ozone precursor emissions, of which Delaware has made huge strides.[13]

[12] Daily ozone forecast data obtained from Dr. Amy K. Huff, Department of Meteorology, The Pennsylvania State University, via email on 8/7/16. Analysis performed on days when there were forecasts for both Delaware and the Greater Philadelphia Region – 507 days out of 557 days.

[13] "State of Delaware Final Report: Ozone Observations and Forecasts in 2015," A Report Prepared for the Delaware Department of Natural Resources and Environment, by Dr. Amy K. Huff and William F. Ryan, Department of Meteorology, The Pennsylvania State University, February 29, 2016

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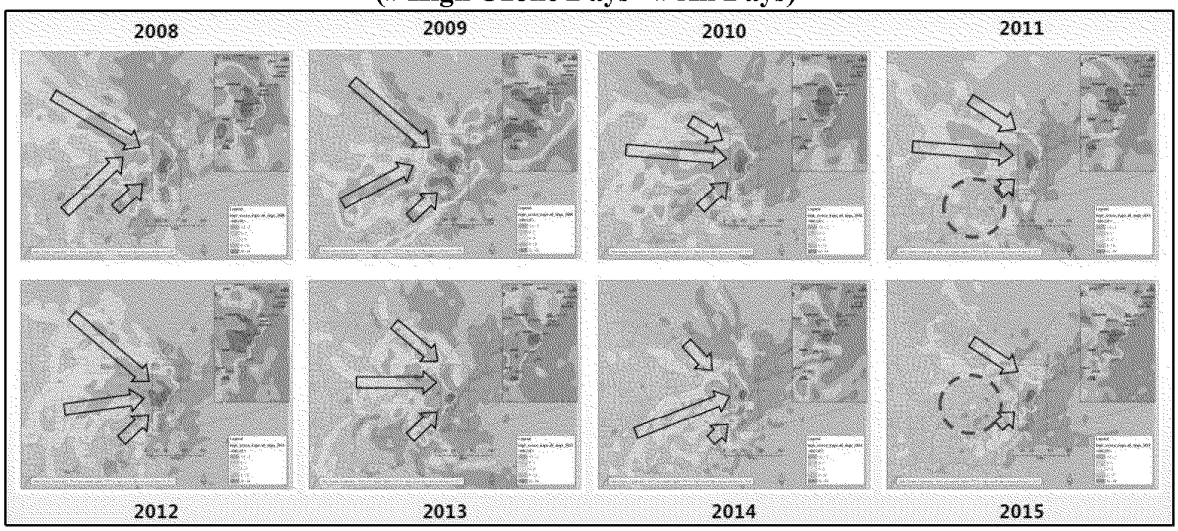
Figure 3 - Difference Comparisons
(# High Ozone Days - # All Days)



Factor 4: Geography/Topography

Delaware is on a level plain, with the lowest mean elevation of any state in the nation. It is bounded to the north by Pennsylvania; to the east by the Delaware River, Delaware Bay, part of New Jersey, and the Atlantic Ocean; and to the west and south by Maryland. Beyond Maryland to the west of Delaware is the Chesapeake Bay. The distance between the Chesapeake Bay and the Delaware River is less than 20 miles across Maryland and Delaware at the narrowest land area around the Chesapeake & Delaware Canal (C&D Canal). New Castle County is separated from New Jersey by about 1 mile of water at its closest and about 5 miles of water at its furthest (at the southern most boundary of New Castle County). Together, Delaware's geography and the land, water, and air interactions discussed below play an important part in Delaware's air quality. The two bays on either side of Delaware potentially segregate local and transported emissions, by both blocking some emissions yet concentrating other emissions. Delaware is unique i n this aspect, in that it is the only state which is almost entirely surrounded by water , thus making it geographically different from the Philadelphia region.

In the OTR, land and sea breezes, and mountain and valley breezes , can have an important influence on local air quality. These local winds are driven by a difference in temperature that produces a difference in pressure. The sea breeze forms in the afternoon when the land is considerably hotter than the ocean or bay. Air then flows from the high pressure over the ocean toward the low pressure over land. At night, the opposite may happen as the land cools to below the ocean's temperature, and a land breeze blows out to sea. Because the nighttime land and water temperature differences are usually much smaller than in the day, the land breeze is weaker

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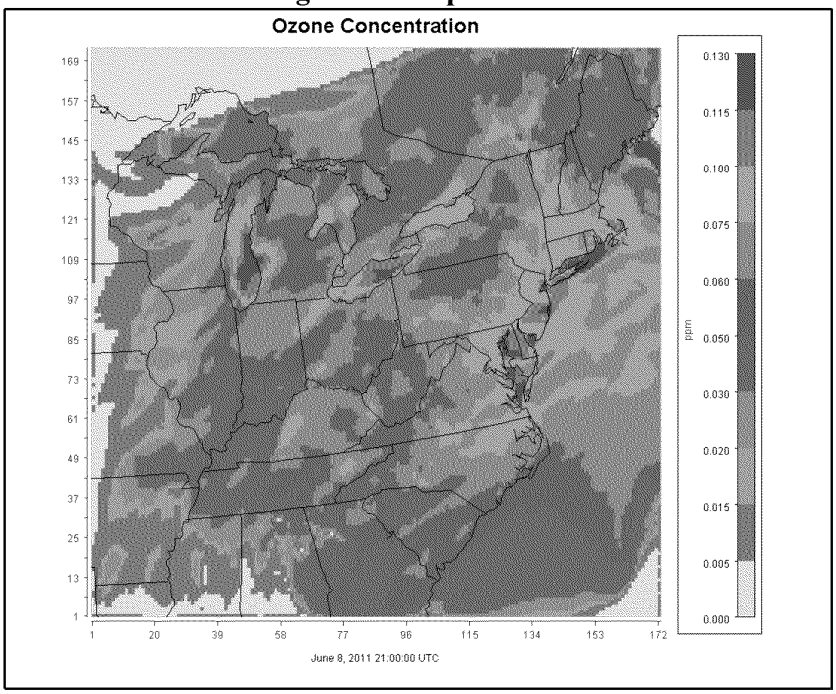
than the sea breeze. Sea breezes typically only penetrate a few kilometers inland because they are driven by temperature contrasts that disappear inland.[14]

Along coastlines, such as coastal Delaware, sea breezes bring in air pollution transported near the surface over water from urban locations located to the southwest. These sites are located many miles away from the coast, and receive ozone transported over water from the sea up through the coastal bays and rivers. In other cases, sea breezes can affect air quality in coastal cities because, under stagnant synoptic-scale winds, a city's emissions may be recirculated or pushed back over land after having drifted out over the sea earlier. Before sea breeze circulation begins, air pollution from a coastal city can move out over the water. In the absence of a shift in winds due to a sea breeze, the city's air pollution will be blown away. When a sea breeze circulation sets up, however, the polluted air is pushed back toward the city. The sea breeze only pushes a few miles inland, which is where the barrier to mixing lies. Later in the day, the air may be quite clean on the ocean side of the city, but the air is usually quite dirty on the inland side. The city suffers from its own recirculated pollution, and also from the sea breeze that does not allow pollution from the city to flow away from it. Depending on the exact conditions (time of day, meteorology, local emissions, etc.), the pollution may even be more concentrated off the coast, as shown in Figure 4, which represents modeled ozone concentrations for the high-ozone episode of 6/8/2011.

Figure 4 – Modeled Ozone Concentrations (ppm)
For the High-Ozone Episode of 6/8/2011



[14] "The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description" Prepared by NESCAUM, October 2006. www.nescaum.org/documents/2006-1013b-o3-conceptual-model-draft-final-all.pdf/

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The bay breeze is a shallow circulation over large inland bays, and may only extend a couple hundred meters above the surface. For example, bay breezes from the Chesapeake Bay often make Baltimore's summertime air quality particularly poor. Air from the city cannot escape directly across the Bay. On the other hand, a few miles closer to the Bay, conditions a re often considerably cleaner, since no fresh emissions have gotten into the air there since earlier that morning. Polluted air from the west side of the Bay can still mix upward, where it meets the stronger winds aloft, pass over the Bay breeze circulation and come back down on the east side of the Bay. In a recent study, results from meteorological and air -quality model simulations, airborne and shipborne in situ air -quality observations, and routine air -quality and meteorological observations from grou nd-based monitoring stations were used to investigate how the Chesapeake Bay breeze affects air quality.[15] The study's results show that a strong and prolonged bay breeze on July 11, 2011 caused locally high surface ozone concentrations near the bay breeze convergence zone, which penetrated into the urban corridor. An extended period of convergence of air pollution at the bay breeze front resulted in a significant amount of air pollution being transported up and into the free troposphere. This elevated layer of air pollution aloft was transported far downwind into New England by early the following morning where it likely mixed down to the surface, affecting air quality in that region.

Factor 5: Jurisdictional Boundaries

Jurisdictional boundaries limits the authority of a nonattainment area (a county or state within a CBSA/CSA) to address upwind impacts on its nonattainment problems. Sections 110 and 126 of the Clean Air Act provide states a mechanism to petition to EPA for controls on upwind emission sources, and although Delaware has petitioned EPA under th ese provisions, EPA has not responded effectively. As part of EPA's reasoning for incorporating New Castle County in a multi-state nonattainment area under the 2008 8-hour ozone NAAQS, EPA states:

> "New Castle County has historically been part of the Philadelphia nonattainment area for ozone (1 -hour and 8 -hour) and fine particulate matter (PM2.5). New Castle County is part of the Wilmington, DE -MD-NJ Metropolitan Division of the Philadelphi a-Camden-Wilmington Metropolitan Statistical Area (MSA) in the Philadelphia -Camden-Vineland CSA. Being part of a statistical area indicates that counties are linked through employment and commuting. According to the Office of Management and Budget's "Standards for Defining Metropolitan and Micropolitan Statistical Areas," published in the Federal Register on December 27, 2000 (65 FR 82228), the "general concept of a Metropolitan Statistical Area or a Micropolitan Statistical Area is that of an area containing a recognized population nucleus and adjacent communities that have a high degree of integration with that nucleus." Delaware, Pennsylvania, Maryland and New Jersey have a long history of working cooperatively through the Ozone Transport Commission (OTC) and the Mid -Atlantic Northeast Visibility Union (MANE -VU) with

[15] Christopher P. Loughner, Maria Tzortziou, Melanie Follette -Cook, Kenneth E. Pickering, Daniel Goldberg, Chinmay Satam, Andrew Weinheimer, James H. Crawford, David J. Knapp, Denise D. Montzka, Glenn S. Diskin, and Russell R. Dickerson. " Impact of Bay -Breeze Circulations on Surface Air Quality and Boundary Layer Export." Journal Of Applied Meteorology And Climatol ogy, vol. 53, July 2014, pp. 1697 -1713. DOI: 10.1175/JAMC-D-13-0323.1

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ozone attainment planning. Furthermore, the two local MPOs, DVRPC and WILMAPCO, have worked together for decades."

While it is true that New Castle County has historically been part of a Philadelphia based nonattainment area and statistical area, it is not logical to keep the county in future Philadelphia based nonattainment areas simply to keep the "status quo." EPA's logic that Delaware's cooperation with its immediately neighboring states as part of the OTC or MANE-VU as a basis for including it in a multi-state nonattainment area does not make sense. The OTR and OTC were created under the Clean Air Act to advise EPA on transport issues and to develop and implement regional solutions to ground-level ozone in the OTR. These entities are established and operate separate from nonattainment designations. Using EPA's logic, each state, in whole, in the OTR should be incorporated into a single multi-state nonattainment area as every state in the OTR works cooperatively at ozone attainment planning. Delaware has petitioned EPA to expand the OTR to include all of the States that science indicates should be included and the EPA has not yet acted on this petition despite the statuary deadline for action having passed more than 15 months ago. Also, EPA was incorrect that local MPOs support including New Castle County, Delaware as part of the Philadelphia area in the 2008 designations, and that rationale remains incorrect now. Transportation conformity is implemented at the county level – each county in the area has established and demonstrates compliance with its own conformity budget separate from the other parts of the CBSA. This means that mobile emissions and planning do not, and have not, historically tie the area together. The lack of interstate planning, to include transportation conformity coordination, indicates that mobile emissions should not be a significant consideration in establishing small, local scale nonattainment area boundaries around the Philadelphia area. Thus, unless Delaware's primary recommendation of a large nonattainment area is accepted by EPA, Delaware believes evaluation of this factor supports establishment of a nonattainment boundary for New Castle County that follows the jurisdictional boundaries of the county.

Summary

The above five factor analysis in determining the nonattainment boundary that would include New Castle County is summarized as follows:

- Delaware air quality, based on 2014-2016 monitoring data, indicates nonattainment of the 2015 8-hour ozone NAAQS in New Castle County.
- In New Castle County, ozone exceedances are generally associated with two general scenarios: long-range transport from the southwest or west, and local circulation along the I-95 corridor which runs from southwest to northeast. Differences in daily ozone forecast values between Delaware and southeastern counties in Pennsylvania suggest that meteorological differences between the areas are an important part of the differences in ozone values in each area.
- New Castle County's emissions of VOC and NOx are similar, yet lower, than many other counties surrounding it. Its 2011 emissions are lower than those of Berks County, which was excluded from the 2008 Philadelphia NAA despite having similar 2008 emissions as New Castle County.

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- The population, population density, and level of urbanization of New Castle County are relatively similar to those of the counties of interest. By EPA's reasoning that such demographic data is an indicator of nonpoint emissions, New Castle County's nonpoint emissions have no greater impact on ground -level ozone than most other counties surrounding it. Philadelphia County's high population, population density, and high 2011 nonpoint emissions reflect EPA's rationale.
- The numbers of vehicle miles traveled in New Castle County is similar to that in other counties surrounding it, though more workers commute into New Castle County than workers which commute out of the cou nty. Its VMT and worker flow data is similar to Berks County, which was excluded from the 2008 Philadelphia NAA , despite Berks County having just as much impact to the Philadelphia "urban core" as New Castle County. In fact, New Castle County's 2011 onroad emissions are less than Berks County's 2011 onroad emissions.
- Delaware is geographically in an area that is unlike any other. The large water bodies which practically surround the state create complex meteorological mountains and valleys that at times funnel transported emissions around the Delmarva Peninsula and up the I-95 corridor, and at other times trap upwind emissions such that those emissions are recirculated by ocean and bay breezes, and impact Delaware multiple times.

Based on the data and analysis presented above , Delaware recommends a standalone nonattainment area be established for New Castle County. Also, Based upon EPA's rationale for segregating Berks County as its own nonattainment area in the previous assessment, New Castle County should be segregated into its own nonattainment area in the current assessment. New Castle County has lower emissions than Berks County, similar demographics to Berks County, and similar commuting patterns to Berks County. Delaware's unique geography and meteorology (due to the land, water, and air interactions) make New Castle County even more unique than Berks County.

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From: Sosnowski, Dave
Sent: Wed 6/28/2017 10:55:09 AM
Subject: Agenda for today's OBD Stakeholder Call
OBD_call_agenda_062817.doc
OBD_call_NOTES_050317.doc

Bi-monthly OBD Stakeholder Call

Wednesday, June 28, 2017, 1-2:00 PM ET

Redacted

Dear OBD Stakeholder:

Please find attached the notes from our last call and the agenda for today's call.

--Dave S.

Bi-monthly OBD Stakeholder Call
Wednesday, May 3, 2017, 1-2:00 PM ET

Redacted

Agenda Items

- Roll call by Region/State
  - Region 1: NH, CT, RI
  - Region 2: Reema Loutan, NY, NJ
  - Region 3: PA
  - Region 4: Dale Aspy, GA, NC
  - Region 5: OH, WI
  - Region 6: TX
  - Region 7: Jed Wolkins, MO
  - Region 8: UT
  - Region 9: N/A
  - Region 10: ID
  - OTAQ: Dave Sosnowski
  - Others: ON, Weber State

- Notes from the January 11, 2017 OBD Stakeholder Call
  - No corrections, additions, or deletions.

- Redacted

- Status of the ozone NAAQS(s)
  - The proposed implementation rule for the 2015 ozone standard was published in the *Federal Register* on November 17, 2016 and the comment period ended on February 13, 2017, after being extended.
  - States have submitted their recommendations for nonattainment areas under the new standard to EPA and the Agency is currently scheduled to make designation sometime in October 2017.
  - The Agency is being sued by numerous parties over the 2015 standard (for being too lenient as well as too strict) but before presenting oral arguments, EPA successfully petitioned the court for a delay while the Agency reviews the standard and decides next steps.

- There have been reports of Congressional interest in delaying implementation of or possibily eliminating the new standard, but nothing definitive has occurred to date.
- 120-day letters should be going out to states in June, so they'll have a good idea of which areas in the state will be nonattainment areas.

- Volkswagen Notice of Violation
  - During a press conference in January, DOJ announced criminal charges against 6 Volkswagen executives connected to the so-called "Dieselgate" scandal, including the manager in charge of U.S. compliance who was arrested in Florida by FBI agents while attempting to board a flight to Germany.
  - VW has plead guilty to conspiracy to commit wire fraud, violations of the Clean Ar Act, customs violations, and obstruction of justice amounting to $4.3 billion in criminal and civil penalties, bringing the total cost of settling the case to $20 billion making it one of the costliest corporate scandals in history.
  - Any questions you may have or get about VW and the VW settlement, please use the following resources:
    - Public inquiries should be directed to: VW_settlement@epa.gov
    - FAQs are available at: https://www.epa.gov/vw/frequent-questions-about-volkswagen-violations

- Miscellaneous Issues?
  - Dave mentioned that he will be at the I/M Solutions Training Forum in Denver to do the Ask EPA segment on May 22, 2017.

- Next OBD Stakeholder Call
  - June 28, 2017, 1:00 PM ET

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Cc: David Grimes[dgrimes@semorpc.org]
From: David Grimes
Sent: Fri 6/23/2017 2:35:17 PM
Subject: June 19 Monitor Report
June 19.pdf

Folks:

Attached are the monitor readings for June 19 (the week of June 12 – 18). As you can see, readings are comfortably back down into the 40s and 50s parts per billion. That was a week that was “warm,” high temperatures in the low to middle 80s, but not “hot.” Remember, we just had the first day of summer though, and the hottest part of the year is still to come.

Keep doing what we've been doing. Stop at the click. Plan your trips. Watch your idling. Be very careful when fueling your vehicle and your outdoor power equipment. Mow in the evening. All of these little things add up.

As always, thank you for your ongoing interest and support.

Dave

David Grimes

Deputy Director

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MISSOURI NATURAL RESOURCES

Air Quality Analysis for Ozone

The following information is for the ambient air monitors operated by the state. This information is reported to the U.S. Environmental Protection Agency's Air Quality System database. The monitoring information provided in the chart below includes the preliminary design values for the ozone National Ambient Air Quality Standard, or NAAQS.

In March 2008, EPA strengthened the ozone NAAQS by setting it at a level of 0.075 parts per million (ppm) measured over 8 hours. Based on 2008-2010 monitoring data, the department recommended the St. Louis area as the only nonattainment area in the state with a boundary encompassing St. Louis City and St. Louis, St. Charles, Jefferson, and Franklin counties. In April 2012, the EPA finalized St. Louis as a nonattainment area for the 2008 ozone standard. In April 2016, EPA determined that the area has until July 20, 2016, to attain the standard. Missouri is following up that action by requesting that EPA review 2013 to 2015 ozone monitoring data to verify the area met the standard, and Missouri is working on plans so that EPA can formally redesignate the area back to attainment.

In October 2015 (effective in December 2015), EPA further strengthened the ozone NAAQS by setting it at a level of 0.070 ppm measured over 8 hours. Based on 2013 to 2015 monitoring data, only the West Alton site in the St. Louis area exceeds the standard. Missouri will submit recommended designations for the entire state by October 2016, and EPA will make final designations, likely based on 2014 to 2016 monitoring data, by October 2017.

More information on ozone health effects, the ozone standard, and the designation process is online at http://dnr.mo.gov/env/apcp/ozone.htm

MISSOURI DEPARTMENT OF NATURAL RESOURCES

8-Hour Ozone Design Values[a]

Weekly Reporting Date 6/19/2017

Site	County	4th High 8-hr Average (ppb) 2013	2014	2015	2016	2017[c] (Year-to-Date)	CV - 70	# of Exceedances > 70 ppb (15 Std) 2017^	Design Value 13-15	14-16	15-17[c] (Year-to-Date)
St. Louis											
Arnold West	Jefferson	69	72	69	70	45	74	0	70	70	61
Blair Street*	St. Louis City	66	66	63	68	67	82	1	65	65	66
Foley West^	Lincoln	72	67	65	65	65	83	1	68	65	65
Maryland Hts	St. Louis	70	72	69	73	64	71	1	70	71	68
Orchard Farm	St. Charles	71	72	66	76	64	71	2	69	71	68
Pacific	St. Louis	67	65	65	67	61	81	0	65	65	64
West Alton	St. Charles	71	72	70	75	67	68	3	71	72	70
Ste. Genevieve											
Bonne Terre	Ste. Genevieve	65	69	63	67	62	83	1	65	66	64
South East											
Farrar	Perry	65	67	67	69	64	77	0	66	67	66
Kansas City											
Liberty	Clay	67	65	62	66	68	85	1	64	64	65
RG South	Cass	64	65	65	61	62	87	2	64	63	62
Rocky Creek	Clay	71	66	68	69	67	76	0	68	67	68
Trimble	Clinton	71	64	68	69	66	76	0	67	67	67
Watkins Mill	Clay	67	67	64	66	67	83	1	66	65	65
Springfield											
Fellows Lake	Greene	64	60	61	59	62	93	0	61	60	60
Hillcrest H.S.	Greene	62	60	61	58	60	94	0	61	59	59
Outstate											
Alba	Jasper	69	65	61	59	57	93	0	65	61	59
Branson	Taney	63	58	59	56	56	98	0	60	57	57
Eldorado Spgs.	Cedar	64	65	60	60	58	93	0	63	61	59
Finger Lakes	Boone	62	64	63	65	60	85	0	63	64	62
Mark Twain*	Monroe	61	60	58	59	60	96	0	59	59	59
New Bloomfield	Callaway	61	64	65	64	58	84	0	63	64	62
Savannah	Andrew	66	64	64	62	60	87	0	64	63	62
								13			

[a]Quality assured data through December 31, 2016.

[c]Year-to-date preliminary data. Do not quote, do not cite.

*Year-round ozone monitoring.

^Monitor relocated less than a mile east of the previous site (within the same neighborhood scale of representativeness) beginning March 1, 2017.

Design values in red are violations of 2015 standard.

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MISSOURI DEPARTMENT OF NATURAL RESOURCES

6/19/2017

2017[c]

Four Highest 8-Hour Ozone Values (ppb) Year-To-Date

ST. LOUIS	1st High	2nd High	3rd High	4th High	CV - 70
Arnold West	47	47	45	45	74
Blair Street*	75	69	68	67	82
Foley West^	72	69	65	65	83
Maryland Hts	83	67	65	64	71
Orchard Farm	89	77	68	64	71
Pacific	64	62	62	61	81
West Alton	78	76	72	67	68
Ste. Genevieve					
Bonne Terre	71	66	64	62	83
South East					
Farrar	70	68	67	64	77
Kansas City					
Liberty	72	69	68	68	85
RG South	75	71	63	62	87
Rocky Creek	70	70	67	67	76
Trimble	68	68	66	66	76
Watkins Mill	72	69	69	67	83
Springfield					
Fellows Lake	64	62	62	62	93
Hillcrest H.S.	64	63	60	60	94
Outstate					
Alba	60	58	58	57	93
Branson	61	58	57	56	98
Eldorado Spgs	60	59	59	58	93
Finger Lakes	63	62	61	60	85
Mark Twain*	66	62	60	60	96
New Bloomfield	60	59	59	58	84
Savannah	68	61	61	60	87

CV - 70: The Critical Value (CV) is the current Year's 4th highest value which, if monitored, could yield a violation of the Ozone NAAQS for the most current three year period. (CV = 213ppb – Last year's 4th highest value – previous year's 4th highest value).

[c]Year-to-date preliminary data. Do not quote, do not cite.

*Year-round ozone monitoring

MISSOURI DEPARTMENT OF NATURAL RESOURCES

6/19/2017

2017 RUNNING LIST OF SITES WITH EXCEEDANCES AND DATES^

13-May		15-May		26-May		2-Jun	
Bonne Terre	0.071	West Alton	0.072	R.G. South	0.075	Blair Street	0.075
						Foley West	0.072
						Maryland Heights	0.083
						Orchard Farm	0.089
						West Alton	0.078
3-Jun		5-Jun		8-Jun			
Orchard Farm	0.077	R.G. South	0.071	Liberty	0.072		
West Alton	0.076			Watkins Mill	0.072		

^All the 2017 data has not been quality assured and is preliminary.

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season)^

	Area's Maxi	Site's Maxi	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar	6-Mar
ST. LOUIS	**0.089**							
Arnold West		0.047	0.033	0.032	0.031	0.043	0.037	0.029
Blair Street		**0.075**	0.038	0.038	0.037	0.052	0.043	0.037
Foley West		**0.072**	0.036	0.039	0.039	0.053	0.045	0.037
Maryland Hts		**0.083**	0.038	0.039	0.037	0.053	0.045	0.037
Orchard Farm		**0.089**	0.037	0.038	0.037	0.050	0.044	0.037
Pacific		0.064	0.040	0.042	0.039	0.057	0.046	0.038
West Alton		**0.078**	0.038	0.038	0.039	0.052	0.044	0.038
Ste. Genevieve	**0.071**							
Bonne Terre		**0.071**	0.043	0.045	0.041	0.056	0.048	0.041
South East	0.70							
Farrar		0.070	0.044	0.044	0.044	0.052	0.049	0.043
Kansas City	**0.075**							
Liberty		0.072	0.040	0.041	0.040	0.057	0.043	0.038
RG South		**0.075**	0.041	0.043	0.050	0.058	0.044	0.040
Rocky Creek		**0.070**	0.041	0.043	0.043	0.059	0.044	0.040
Trimble		0.068	0.040	0.040	0.040	0.058	0.043	0.039
Watkins Mill		0.072	0.042	0.044	0.043	0.061	0.046	0.040
Springfield	0.064							
Fellows Lake		0.064	0.043	0.049	0.047	0.058	0.050	0.037
Hillcrest H.S.		0.064	0.042	0.049	0.043	0.057	0.049	0.036
Outstate	0.068							
Alba		0.060	0.041	0.045	0.058	0.060	0.047	0.038
Branson		0.061	0.040	0.046	0.044	0.054	0.048	0.037
Eldorado Spgs		0.060	0.041	0.045	0.048	0.060	0.047	0.036
Finger Lakes		0.063	0.041	0.040	0.042	0.057	0.047	0.040
Mark Twain		0.066	0.035	0.038	0.040	0.054	0.045	0.037
New Bloomfield		0.060	0.038	0.040	0.039	0.052	0.044	0.037
Savannah		0.068	0.038	0.038	0.040	0.056	0.041	0.040

^All the 2017 data have not been quality assured, and they are preliminary. Do not quote, do not cite. Averages in red or bold exceed the 2015 standard.

Ozone season is from March 1 to October 31.

Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season) ^

	7-Mar	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	16-Mar	17-Mar	18-Mar
Arnold West	0.036	0.042	0.040	0.030	0.028	0.031	0.028	0.030	0.033	0.026	0.026	0.029
Blair Street	0.046	0.047	0.052	0.038	0.034	0.041	0.035	0.038	0.043	0.035	0.035	0.041
Foley West	0.046	0.048	0.048	0.040	0.037	0.040	0.039	0.041	0.045	0.036	0.045	0.041
Maryland Hts	0.046	0.050	0.050	0.040	0.035	0.041	0.037	0.041	0.044	0.037	0.042	0.041
Orchard Farm	0.045	0.045	0.049	0.040	0.038	0.040	0.040	0.043	0.046	0.037	0.043	0.043
Pacific	0.046	0.052	0.050	0.042	0.036	0.040	0.039	0.039	0.044	0.042	0.038	0.042
West Alton	0.046	0.045	0.048	0.040	0.038	0.042	0.038	0.042	0.042	0.038	0.039	0.038
Bonne Terre	0.046	0.054	0.048	m	m	m	m	m	m	m	m	m
Farrar	0.047	0.052	0.051	0.043	0.038	0.046	0.037	0.040	0.044	0.042	0.035	0.045
Liberty	0.043	0.052	0.044	0.041	0.039	0.040	0.040	0.042	0.040	0.049	0.044	0.051
RG South	0.044	0.057	0.041	0.040	0.031	0.039	0.036	0.038	0.040	0.047	0.044	0.049
Rocky Creek	0.044	0.052	0.041	0.041	0.038	0.038	0.040	0.042	0.036	0.049	0.043	0.052
Trimble	0.044	0.049	0.039	0.039	0.039	0.038	0.039	0.041	0.038	0.050	0.043	0.053
Watkins Mill	0.046	0.053	0.046	0.041	0.040	0.042	0.040	0.042	0.042	0.048	0.044	0.050
Fellows Lake	0.047	0.055	0.045	0.043	0.038	0.044	0.036	0.040	0.045	0.041	0.044	0.051
Hillcrest H.S.	0.047	0.052	0.043	0.043	0.038	0.043	0.036	0.040	0.044	0.040	0.041	0.052
Alba	0.015	0.055	0.042	0.041	0.032	0.039	0.031	0.036	0.041	0.043	0.041	0.049
Branson	0.044	0.052	0.040	0.037	0.034	0.040	0.032	0.035	0.040	0.037	0.037	0.048
Eldorado Sp.	0.045	0.057	0.041	0.041	0.038	0.041	0.034	0.040	0.041	0.046	0.045	0.059
Finger Lakes	0.045	0.052	0.045	0.042	0.036	0.041	0.048	0.046	0.047	0.045	0.043	0.047
Mark Twain	0.046	0.043	0.043	0.038	0.036	0.039	0.040	0.042	0.047	0.040	0.044	0.041
New Bloomf.	0.044	0.052	0.042	0.038	0.034	0.038	0.038	0.038	0.043	0.041	0.042	0.047
Savannah	0.044	0.046	0.039	0.039	0.039	0.038	0.038	0.040	0.037	0.048	0.043	0.051

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Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season) ^

	19-Mar	20-Mar	21-Mar	22-Mar	23-Mar	24-Mar	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar	30-Mar
Arnold West	0.022	0.036	0.032	0.033	0.027	0.037	0.032	0.015	0.013	0.023	0.028	0.023
Blair Street	0.036	0.054	0.040	0.039	0.036	0.049	0.048	0.023	0.024	0.030	0.032	0.034
Foley West	0.034	0.052	0.047	0.042	0.042	0.050	0.046	0.029	0.027	0.034	0.035	0.031
Md. Hts.	0.035	0.051	0.047	0.043	0.041	0.050	0.048	0.029	0.023	0.034	0.037	0.034
Orchard Fm.	0.037	0.052	0.048	0.045	0.040	0.052	0.052	0.029	0.031	0.040	0.039	0.037
Pacific	0.034	0.052	0.045	0.044	0.045	0.051	0.047	0.026	0.022	0.030	0.039	0.033
West Alton	0.037	0.052	0.046	0.044	0.039	0.051	0.050	0.027	0.029	0.038	0.035	0.037
Bonne Terre	m	m	m	0.044	0.051	0.052	0.053	0.033	0.043	0.035	0.043	0.038
Farrar	0.034	0.045	0.042	0.047	0.047	0.050	0.053	0.036	0.047	0.034	0.046	0.047
Liberty	0.049	0.053	0.049	0.044	0.053	0.040	0.029	0.021	0.022	0.030	0.030	0.025
RG South	0.049	0.062	0.047	0.044	0.054	0.045	0.028	0.028	0.021	0.031	0.034	0.020
Rocky Creek	0.051	0.055	0.048	0.044	0.055	0.045	0.027	0.021	0.026	0.030	0.030	0.024
Trimble	0.050	0.052	0.046	0.043	0.055	0.043	0.022	0.022	0.025	0.026	0.028	0.025
Watkins Mill	0.050	0.054	0.048	0.043	0.053	0.044	0.026	0.022	0.019	0.028	0.028	0.024
Fellows Lake	0.049	0.053	0.041	0.048	0.058	0.052	0.049	0.041	0.041	0.040	0.043	0.025
Hillcrest H.S	0.048	0.051	0.040	0.045	0.056	0.051	0.048	0.041	0.041	0.040	0.041	0.023
Alba	0.049	0.049	0.042	0.044	0.053	0.047	0.028	0.040	0.032	0.037	0.047	0.023
Branson	0.045	0.056	0.036	0.044	0.054	0.049	0.044	0.040	0.043	0.039	0.042	0.029
Eldorado Sp	0.053	0.057	0.043	0.045	0.053	0.048	0.038	0.037	0.025	0.036	0.042	0.024
Finger Lakes	0.037	0.054	0.057	0.046	0.056	0.047	0.042	0.025	0.030	0.041	0.035	0.024
Mark Twain	0.036	0.049	0.047	0.042	0.042	0.046	0.043	0.024	0.026	0.032	0.030	0.025
New Bloomf	0.035	0.054	0.045	0.042	0.052	0.045	0.040	0.030	0.022	0.033	0.033	0.028
Savannah	0.050	0.051	0.045	0.041	0.052	0.042	0.019	0.022	0.027	0.027	0.028	0.025

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Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season) ^

	31-Mar	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr	7-Apr	8-Apr	9-Apr	10-Apr	11-Apr
Arnold West	0.020	0.035	0.030	0.025	0.024	0.028	0.029	0.034	0.043	0.039	0.037	0.022
Blair Street	0.031	0.046	0.042	0.036	0.033	0.040	0.043	0.048	0.060	0.054	0.047	0.030
Foley West	0.033	0.047	0.047	0.040	0.034	0.039	0.042	0.048	0.060	0.053	0.050	0.036
Md. Hts.	0.032	0.047	0.044	0.033	0.034	0.042	0.041	0.048	0.060	0.054	0.052	0.033
Orchard Fm.	0.035	0.049	0.047	0.041	0.035	0.045	0.045	0.049	0.061	0.054	0.047	0.033
Pacific	0.032	0.050	0.045	0.036	0.035	0.044	0.044	0.048	0.061	0.054	0.051	0.031
West Alton	0.034	0.047	0.044	0.039	0.036	0.044	0.040	0.045	0.061	0.055	0.049	0.032
Bonne Terre	0.029	0.047	0.050	0.046	0.045	0.048	0.044	0.051	0.062	0.059	0.055	0.034
Farrar	0.032	0.048	0.047	0.045	0.045	0.046	0.045	0.050	0.060	0.059	0.049	0.030
Liberty	0.030	0.037	0.035	0.031	0.035	0.044	0.044	0.051	0.056	0.045	0.040	0.054
RG South	0.031	0.031	0.035	0.036	0.033	0.043	0.046	0.049	0.056	0.044	0.046	0.041
Rocky Creek	0.030	0.035	0.036	0.029	0.036	m	m	0.052	0.058	0.047	0.038	0.053
Trimble	0.030	0.036	0.036	0.028	0.037	0.044	0.044	0.051	0.059	0.046	0.037	0.055
Watkins Mill	0.029	0.038	0.035	0.031	0.035	0.043	0.043	0.053	0.057	0.045	0.039	0.049
Fellows Lake	0.031	0.036	0.046	0.043	0.043	0.041	0.046	0.054	0.062	0.054	0.054	0.040
Hillcrest H.S	0.033	0.036	0.044	0.041	0.043	0.042	0.047	0.052	0.060	0.053	0.050	0.037
Alba	0.033	0.033	0.042	0.040	0.035	0.042	0.046	0.053	0.058	0.046	0.055	0.034
Branson	0.037	0.034	0.040	0.045	0.049	0.039	0.042	0.048	0.061	0.051	0.052	0.037
Eldorado Sp	0.031	0.032	0.043	0.042	0.031	0.042	0.045	0.052	0.059	0.047	0.055	0.039
Finger Lakes	0.031	0.045	0.040	0.037	0.030	0.047	0.043	0.053	0.063	0.053	0.050	0.040
Mark Twain	0.034	0.046	0.042	0.029	0.035	0.039	0.043	0.049	0.062	0.051	0.051	0.042
New Bloomf.	0.028	0.043	0.040	0.037	0.029	0.036	0.041	0.050	0.059	0.050	0.050	0.038
Savannah	0.030	0.038	0.033	0.024	0.036	0.043	0.043	0.051	0.057	0.047	0.032	0.043

Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season) ^

	12-Apr	13-Apr	14-Apr	15-Apr	16-Apr	17-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	23-Apr
Arnold West	0.032	0.036	0.033	0.038	0.033	0.026	0.030	0.025	0.027	0.021	0.027	0.041
Blair Street	0.046	0.054	0.046	0.052	0.049	0.039	0.046	0.041	0.043	0.030	0.035	0.054
Foley West	0.050	0.050	0.047	0.051	0.045	0.053	0.048	0.041	0.040	0.036	0.045	0.053
Md. Hts.	0.050	0.053	0.046	0.053	0.046	0.050	0.046	0.039	0.041	0.033	0.040	0.054
Orchard Fm.	0.051	0.056	0.049	0.054	0.048	0.056	0.051	0.043	0.043	0.037	0.042	0.056
Pacific	0.050	0.051	0.046	0.052	0.045	0.043	0.046	0.039	0.041	0.029	0.037	0.054
West Alton	0.049	0.057	0.050	0.053	0.047	0.049	0.051	0.044	0.043	0.035	0.042	0.053
Bonne Terre	0.051	0.054	0.054	0.053	0.043	0.044	0.045	0.041	0.038	0.028	0.029	0.056
Farrar	0.053	0.055	0.053	0.050	0.039	0.047	0.043	0.041	0.035	0.029	0.035	0.055
Liberty	0.049	0.059	0.052	0.047	0.045	0.052	0.044	0.043	0.041	0.040	0.048	0.058
RG South	0.051	0.055	0.053	0.047	0.040	0.049	0.044	0.041	0.038	0.037	0.047	0.060
Rocky Creek	0.050	0.060	0.053	0.048	0.044	0.054	0.045	0.044	0.041	0.039	0.048	0.060
Trimble	0.048	0.058	0.052	0.048	0.043	0.053	0.048	0.045	0.041	0.038	0.047	0.059
Watkins Mill	0.049	0.059	0.051	0.047	0.046	0.053	0.044	0.043	0.040	0.039	0.047	0.057
Fellows Lake	0.052	0.052	0.052	0.051	0.051	0.040	0.044	0.039	0.039	0.033	0.037	0.051
Hillcrest H.S.	0.050	0.050	0.050	0.050	0.051	0.040	0.040	0.037	0.038	0.033	0.038	0.052
Alba	0.055	0.050	0.056	0.046	0.047	0.040	0.047	0.036	0.034	0.037	0.037	0.049
Branson	0.047	0.048	0.052	0.049	0.041	0.032	0.039	0.037	0.029	0.028	0.030	0.047
Eldorado Sp.	0.051	0.051	0.055	0.048	0.046	0.043	0.049	0.040	0.036	0.033	0.038	0.052
Finger Lakes	0.054	0.050	0.048	0.050	0.032	0.054	0.047	0.044	0.035	0.039	0.049	0.056
Mark Twain	0.049	0.049	0.044	0.050	0.044	0.053	0.048	0.042	0.036	0.038	0.049	0.057
New Bloomf.	0.048	0.047	0.045	0.049	0.038	0.049	m	m	0.035	0.034	0.045	0.054
Savannah	0.044	0.052	0.049	0.043	0.044	0.052	0.045	0.043	0.039	0.039	0.047	0.058

Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season) ^

	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	30-Apr	1-May	2-May	3-May	4-May	5-May
Arnold West	0.030	0.039	0.029	0.018	0.010	0.020	0.029	0.024	0.030	0.029	0.034	0.035
Blair Street	0.059	0.061	0.045	0.033	0.014	0.030	0.042	0.038	0.049	0.039	0.047	0.046
Foley West	0.065	0.061	0.044	0.038	0.025	0.028	0.042	0.039	0.046	0.043	0.048	0.049
Md. Hts.	0.064	0.062	0.047	0.035	0.018	0.029	0.044	0.039	0.048	0.040	0.047	0.048
Orchard Fm	0.064	0.064	0.046	0.041	0.023	0.028	0.042	0.039	0.047	0.043	0.048	0.047
Pacific	0.061	0.062	0.042	0.033	0.018	0.031	0.045	0.040	0.048	0.042	0.044	0.049
West Alton	0.063	0.063	0.042	0.039	0.021	m	0.044	0.041	0.048	m	m	m
Bonne Terre	0.059	0.066	0.052	0.033	0.029	0.040	0.045	0.040	0.047	0.038	0.046	0.049
Farrar	0.058	0.063	0.045	0.031	0.030	0.045	0.045	0.041	0.049	0.041	0.049	0.051
Liberty	0.057	0.052	0.022	0.043	0.027	0.035	0.036	0.048	0.046	0.047	0.051	0.058
RG South	0.057	0.052	0.019	0.040	0.038	0.030	0.037	0.046	0.045	0.047	0.048	0.057
Rocky Creek	0.059	0.054	0.023	0.042	0.028	0.036	0.035	0.047	0.045	0.046	0.050	0.059
Trimble	0.059	0.055	0.023	0.041	0.029	0.037	0.035	0.049	0.046	0.047	0.050	0.059
Watkins Mill	0.058	0.053	0.021	0.044	0.026	0.034	0.034	0.046	0.046	0.047	0.051	0.058
Fellows Lake	0.057	0.062	0.043	0.041	0.033	0.043	0.042	0.044	0.047	0.042	0.050	0.051
Hillcrest H.S.	0.057	0.060	0.042	0.040	0.031	0.044	0.041	0.041	0.045	0.042	0.050	0.051
Alba	0.055	0.053	0.024	0.037	0.033	0.031	0.039	0.045	0.044	0.041	0.049	0.048
Branson	0.052	0.056	0.037	0.037	0.021	0.038	0.043	0.046	0.045	0.036	0.045	0.045
Eldorado Sp.	0.055	0.055	0.025	0.036	0.031	0.034	0.039	0.045	0.044	0.041	0.049	0.055
Finger Lakes	0.060	0.059	0.030	0.041	0.027	0.029	0.036	0.036	0.046	0.053	0.051	0.049
Mark Twain	0.060	0.055	0.036	0.038	0.025	0.032	0.034	0.041	0.046	0.043	0.052	0.050
New Bloomf.	0.057	0.056	0.038	0.039	0.022	0.026	0.039	0.036	0.045	0.043	0.051	0.049
Savannah	0.058	0.050	0.019	0.041	0.032	0.038	0.036	0.048	0.048	0.044	0.049	0.059

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Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season) ^

	6-May	7-May	8-May	9-May	10-May	11-May	12-May	13-May	14-May	15-May	16-May	17-May
Arnold West	0.038	0.040	0.034	0.038	0.027	0.030	0.043	0.047	0.039	0.030	0.035	0.031
Blair Street	0.051	0.057	0.056	0.063	0.051	0.040	0.054	0.069	0.059	0.063	0.057	0.047
Foley West	0.051	0.054	0.052	0.062	0.047	0.038	0.056	0.059	0.056	0.053	0.053	0.050
Md. Hts.	0.052	0.056	0.052	0.059	0.047	0.042	0.055	0.064	0.056	0.053	0.056	0.051
Orchard Fm	0.052	0.054	0.057	0.059	0.050	0.046	0.058	0.061	0.057	0.060	0.055	0.048
Pacific	0.053	0.054	0.048	0.060	0.047	0.037	0.057	0.064	0.056	0.047	0.055	0.051
West Alton	m	m	m	m	0.046	0.046	0.056	0.063	0.059	0.072	0.058	0.050
Bonne Terre	0.056	0.055	0.053	0.061	0.049	0.045	0.054	0.071	0.058	0.050	0.060	0.054
Farrar	0.055	0.057	0.050	0.061	0.051	0.050	0.053	0.068	0.063	0.063	0.064	0.050
Liberty	0.056	0.058	0.068	0.061	0.044	0.042	0.058	0.062	0.054	0.061	0.056	0.050
RG South	0.060	0.056	0.063	0.052	0.041	0.035	0.058	0.059	0.054	0.058	0.055	0.052
Rocky Creek	0.056	0.063	0.070	0.059	0.045	0.041	0.057	0.065	0.058	0.064	0.057	0.052
Trimble	0.055	0.062	0.068	0.063	0.045	0.042	0.055	0.066	0.059	0.065	0.059	0.052
Watkins Mill	0.055	0.059	0.069	0.062	0.045	0.039	0.055	0.062	0.054	0.061	0.056	0.049
Fellows Lake	0.057	0.060	0.064	0.062	0.046	0.038	0.054	0.061	0.055	0.055	0.056	0.047
Hillcrest H.S.	0.057	0.059	0.060	0.058	0.042	0.040	0.054	0.063	0.052	0.054	0.054	0.046
Alba	0.052	0.057	0.057	0.056	0.039	0.040	0.049	0.057	0.049	0.052	0.054	0.051
Branson	0.053	0.055	0.058	0.058	0.042	0.038	0.042	0.056	0.056	0.047	0.053	0.046
Eldorado Sp.	0.055	0.058	0.058	0.057	0.042	0.034	0.051	0.055	0.049	0.057	0.056	0.052
Finger Lakes	0.053	0.057	0.058	0.061	0.042	0.038	0.059	0.057	0.053	0.053	0.053	0.052
Mark Twain	0.051	0.055	0.050	0.060	0.045	0.037	0.058	0.057	0.052	0.052	0.051	0.046
New Bloomf.	0.054	0.055	0.059	0.060	0.044	0.034	0.058	0.058	0.054	0.050	0.051	0.048
Savannah	0.054	0.061	0.060	0.055	0.040	0.047	0.051	0.058	0.054	0.058	0.052	0.048

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Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts Per Million

(Since March 1, 2017, beginning of ozone season)

	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May
Arnold West	0.024	0.027	0.021	0.029	0.034	0.025	0.025	0.029	0.030	0.032	0.027	0.032
Blair Street	0.052	0.049	0.039	0.043	0.059	0.042	0.041	0.051	0.051	0.047	0.044	0.052
Foley West	0.047	0.024	0.039	0.043	0.051	0.036	0.040	0.045	0.048	0.045	0.044	0.050
Maryland Hts	0.050	m	m	0.044	0.056	0.037	0.041	0.047	0.048	0.047	0.043	0.049
Orchard Fm.	0.054	0.036	0.042	0.043	0.057	0.041	0.042	0.046	0.051	0.048	0.043	0.049
Pacific	0.047	0.042	0.031	0.044	0.053	0.037	0.038	0.045	0.043	0.047	0.039	0.049
West Alton	0.056	0.040	0.043	0.044	0.063	0.041	0.040	0.050	0.056	0.049	0.045	0.051
Bonne Terre	0.038	0.046	0.040	0.044	0.054	0.043	0.035	0.045	0.044	0.047	0.039	0.048
Farrar	0.037	0.046	0.047	0.041	0.057	0.049	0.040	0.046	0.052	0.049	0.041	0.049
Liberty	0.044	0.032	0.032	0.052	0.040	0.044	0.038	0.047	0.056	0.042	0.045	0.051
RG South	0.047	0.038	0.035	0.053	0.042	0.045	0.039	0.047	0.075	0.047	0.044	0.050
Rocky Creek	0.044	0.034	0.032	0.053	0.039	0.046	0.040	0.052	0.056	0.042	0.044	0.050
Trimble	0.040	0.032	0.031	0.052	0.040	0.045	0.040	0.051	0.055	0.044	0.046	0.051
Watkins Mill	0.042	0.027	0.030	0.050	0.036	0.042	0.036	0.047	0.051	0.037	0.044	0.050
Fellows Lake	0.046	0.041	0.041	0.049	0.048	0.042	0.032	0.048	0.048	0.041	0.045	0.049
Hillcrest H.S.	0.045	0.040	0.039	0.049	0.050	0.043	0.032	0.046	0.045	0.041	0.045	0.048
Alba	0.043	0.040	0.038	0.046	0.049	0.043	0.037	0.049	0.052	0.038	0.045	0.049
Branson	0.040	0.039	0.039	0.045	0.046	0.039	0.032	0.043	0.045	0.044	0.042	0.048
Eldorado Sp.	0.044	0.041	0.039	0.048	0.044	0.044	0.035	0.045	0.051	0.038	0.045	0.050
Finger Lakes	0.044	0.026	0.036	0.045	0.043	0.035	0.036	0.048	0.044	0.045	0.043	0.046
Mark Twain	0.044	0.023	0.037	0.044	0.044	0.036	0.037	0.044	0.044	0.043	0.041	0.046
New Bloomf.	0.046	0.036	0.039	0.048	0.044	0.040	0.037	0.045	0.046	0.043	0.044	0.048
Savannah	0.029	0.020	0.028	0.052	0.037	0.042	0.039	0.052	0.053	0.044	0.047	0.051

Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season)

	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun
Arnold W.	0.032	0.041	0.040	0.047	0.045	0.033	0.038	0.043	0.035	0.045	0.034
Blair Street	0.052	0.059	0.060	**0.075**	0.068	0.055	0.059	0.053	0.046	0.065	0.057
Foley West	0.047	0.049	0.065	**0.072**	0.069	0.042	0.058	0.051	0.046	0.057	0.058
Md. Hts.	0.047	0.056	0.062	**0.083**	0.067	0.046	0.053	0.054	0.047	0.065	0.056
Orchard Fm	0.049	0.052	0.068	**0.089**	**0.077**	0.047	0.056	0.055	0.046	0.060	0.060
Pacific	0.047	0.055	0.056	0.054	0.054	0.043	0.047	0.056	0.050	0.062	0.053
West Alton	0.051	0.052	0.066	**0.078**	**0.076**	0.052	0.051	0.053	0.047	0.060	0.064
Bonne Terre	0.047	0.049	0.058	0.047	0.048	0.034	0.061	0.060	0.054	0.064	0.048
Farrar	0.063	0.049	0.061	0.057	0.056	0.035	0.056	0.058	0.051	0.061	0.048
Liberty	0.056	0.049	0.054	0.052	0.057	0.035	0.068	0.050	0.057	**0.072**	0.069
RG South	0.047	0.048	0.051	0.046	0.052	0.038	**0.071**	0.053	0.057	0.057	0.057
Rocky Cr.	0.054	0.049	0.059	0.061	0.059	0.040	0.067	0.051	0.057	0.070	0.067
Trimble	0.053	0.051	0.059	0.064	0.060	0.038	0.068	0.050	0.055	0.065	0.066
Watkins Mil	0.055	0.048	0.054	0.049	0.054	0.031	0.067	0.050	0.056	**0.072**	0.069
Fellows Lake	0.049	0.050	0.049	0.045	0.037	0.034	0.045	0.049	0.049	0.059	0.057
Hillcrest H.S.	0.045	0.046	0.053	0.046	0.037	0.035	0.046	0.051	0.050	0.064	0.052
Alba	0.049	0.050	0.049	0.044	0.039	0.026	0.042	0.053	0.050	0.055	0.050
Branson	0.042	0.048	0.038	0.037	0.030	0.024	0.033	0.048	0.044	0.050	0.053
Eldorado Sp.	0.049	0.044	0.045	0.047	0.041	0.025	0.041	0.047	0.049	0.053	0.055
Finger Lakes	0.047	0.047	0.054	0.046	0.055	0.032	0.062	0.049	0.047	0.060	0.059
Mark Twain	0.046	0.047	0.058	0.056	0.051	0.033	0.066	0.047	0.046	0.056	0.058
New Bloomf.	0.047	0.051	0.049	0.044	0.048	0.033	0.050	0.049	0.047	0.055	0.057
Savannah	0.049	0.049	0.053	0.055	0.055	0.052	0.068	0.048	0.055	0.061	0.060

Cont.

Daily 2017 Maximum Average Eight-Hour Concentration of Ground-Level Ozone in Parts per Million

(Since March 1, 2017, beginning of ozone season)

	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun	15-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun
Arnold W.	0.042	0.035	0.024	0.022	0.029	0.040	0.034	0.029	0.026			
Blair St.	0.067	0.054	0.048	0.042	0.044	0.057	0.056	0.049	0.043			
Foley W.	0.059	0.050	0.040	0.033	0.050	0.052	0.062	0.038	0.039			
Md. Hts.	0.061	0.049	0.039	0.032	0.040	0.053	0.057	0.043	0.040			
Orchard Fm.	0.062	0.048	0.044	0.035	0.049	0.051	0.062	0.047	0.040			
Pacific	0.058	0.049	0.034	0.031	0.044	0.050	0.055	0.029	0.039			
West Alton	0.067	0.055	0.050	0.046	0.050	0.052	0.060	0.058	0.042			
Bonne Terre	0.060	0.055	0.038	0.036	0.048	0.054	0.050	0.037	0.036			
Farrar	0.070	0.059	0.039	0.045	0.045	0.067	0.051	0.051	0.035			
Liberty	0.059	0.053	0.047	0.040	0.047	0.061	0.061	0.046	0.048			
RG South	0.058	0.051	0.043	0.037	0.037	0.046	0.049	0.038	0.043			
Rocky Cr.	0.062	0.055	0.051	0.043	0.047	0.062	0.062	0.044	0.046			
Trimble	0.062	0.056	0.054	0.044	0.049	0.063	0.062	0.042	0.047			
Watkins Mill	0.058	0.052	0.047	0.040	0.046	0.063	0.062	0.043	0.045			
Fellows Lake	0.052	0.047	0.037	0.025	0.031	0.047	0.058	0.030	0.033			
Hillcrest H.S.	0.053	0.047	0.035	0.024	0.030	0.041	0.051	0.029	0.031			
Alba	0.055	0.047	0.037	0.026	0.032	0.040	0.043	0.036	0.031			
Branson	0.052	0.046	0.031	0.021	0.027	0.042	0.044	0.024	0.034			
Eldorado Sp.	0.054	0.048	0.039	0.029	0.039	0.045	0.047	0.034	0.038			
Finger Lakes	0.053	0.048	0.041	0.031	0.040	0.057	0.053	0.035	0.038			
Mark Twain	0.051	0.047	0.041	0.031	0.046	0.050	0.048	0.033	0.038			
New Bloomf.	0.050	0.046	0.038	0.027	0.045	0.054	0.053	0.031	0.039			
Savannah	0.058	0.050	0.046	0.042	0.044	0.055	0.053	0.036	0.047			

Designations Process

Presented by Joe Schulingkamp, EPA Region III

U.S. Environmental Protection Agency

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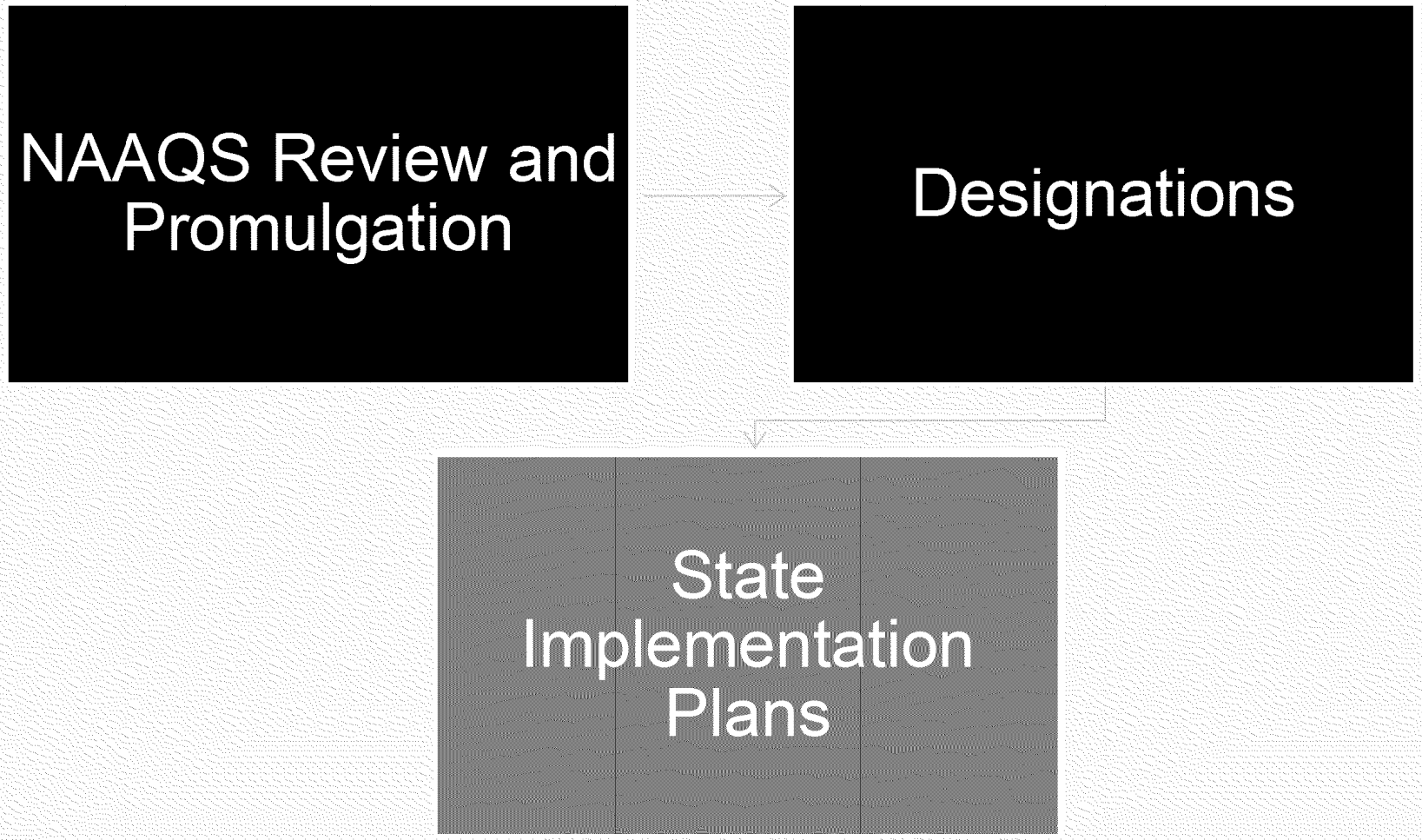
The (simplified) NAAQS process



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CAA Designation-Related Mandates

- Nonattainment (NA) Area Definition: CAA §107(d)(1)(A)(i)
  - "…any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant"
- NA Area Boundaries for ozone & carbon monoxide: CAA §107(d)(4)(A)(iv) & (v)
  - Metro area (MSA/CMSA) boundaries for Serious+ areas already NA before CAAA of 1990. States could request exclusion of portions not contributing to NA.
  - Subsequent EPA guidance extends metro area approach to Moderate/Marginal areas & allows larger/smaller boundaries if justified by multi-factor analysis.
- CAA also sets deadlines for states and EPA…

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Designations – when does it start?

- After EPA promulgates a NAAQS the 2 year clock starts ticking
  - Governors (or their designee) have one year from promulgation to submit recommendations to EPA (CAA §107(d)(1)(A)
- To assist States in their recommendations, EPA issues guidance on what factors should be considered to determine if an area will be designated as nonattainment (sometimes)

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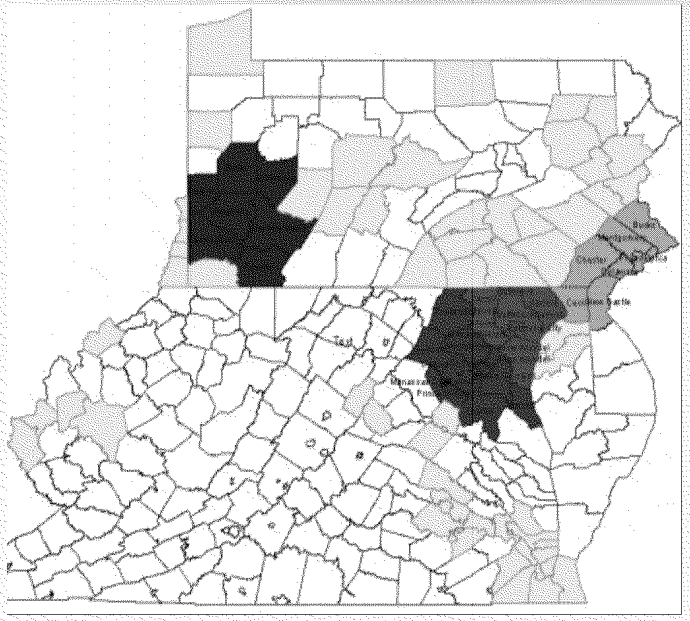
Factors to Consider



- Air quality data
- Emissions data
- Population density and degree of urbanization
- Traffic and commuting patterns
- Growth rates and patterns
- Meteorology
- Geography/topography
- Jurisdictional boundaries
- Level of control of emission sources

- A nonattainment area includes the area where there is a monitor violating the standard and any nearby areas that contribute to the violation.
- The size of area varies by pollutant.

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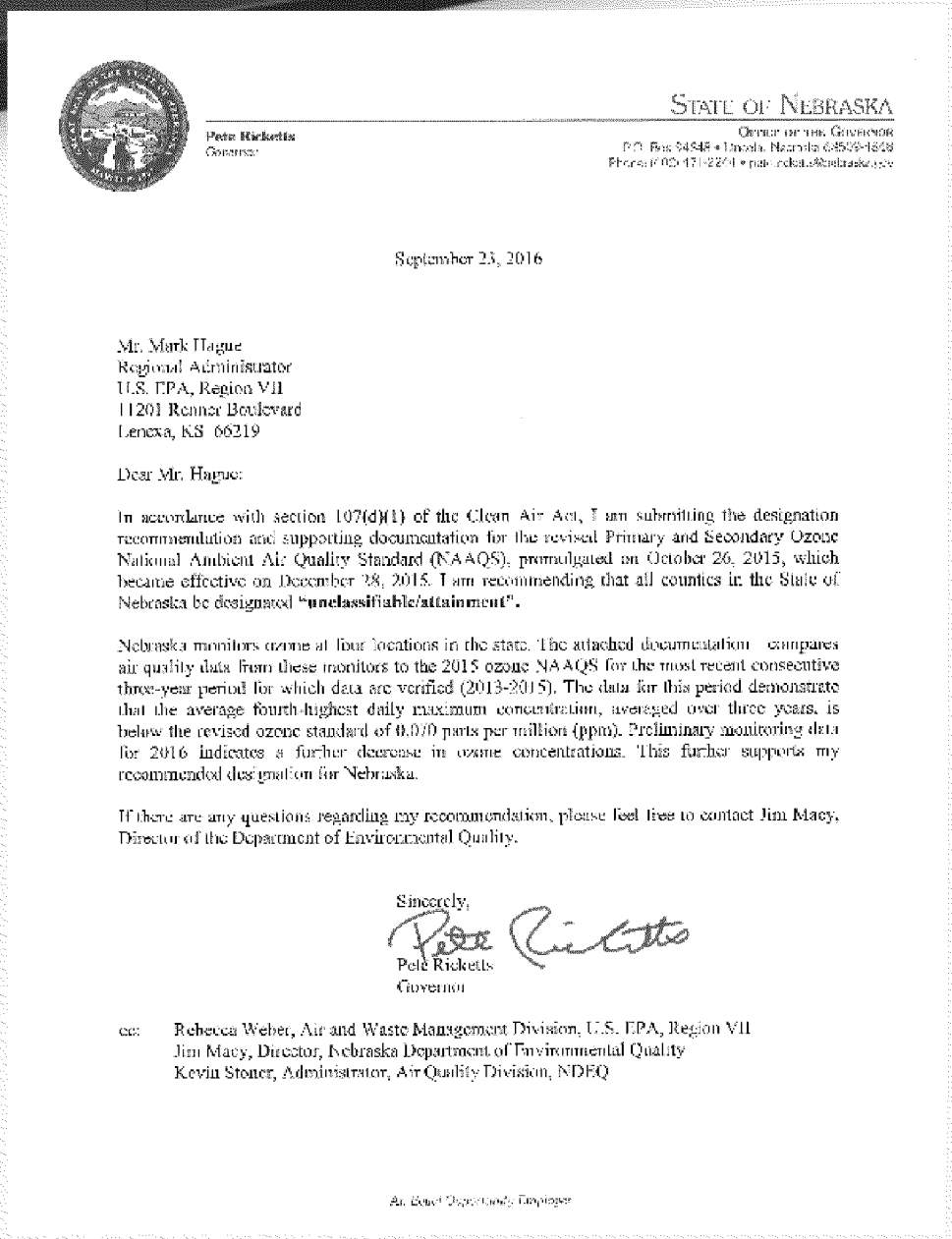
State Recommendations

- Typical recommendation letters can range anywhere from a simple one page letter…
  - See NE 2015 ozone recommendation ->
- . . . to a lengthy recommendation with Technical Support Document and other attachments
- Depends on how complex the state's air quality problems are



STATE OF NEBRASKA

Pete Ricketts
Governor

OFFICE OF THE GOVERNOR
P.O. Box 94848 • Lincoln, Nebraska 68509-4848
Phone: (402) 471-2244 • pete.ricketts@nebraska.gov

September 23, 2016

Mr. Mark Hague
Regional Administrator
U.S. EPA, Region VII
11201 Renner Boulevard
Lenexa, KS 66219

Dear Mr. Hague:

In accordance with section 107(d)(1) of the Clean Air Act, I am submitting the designation recommendation and supporting documentation for the revised Primary and Secondary Ozone National Ambient Air Quality Standard (NAAQS), promulgated on October 26, 2015, which became effective on December 28, 2015. I am recommending that all counties in the State of Nebraska be designated "**unclassifiable/attainment**".

Nebraska monitors ozone at four locations in the state. The attached documentation compares air quality data from these monitors to the 2015 ozone NAAQS for the most recent consecutive three-year period for which data are verified (2013-2015). The data for this period demonstrate that the average fourth-highest daily maximum concentration, averaged over three years, is below the revised ozone standard of 0.070 parts per million (ppm). Preliminary monitoring data for 2016 indicates a further decrease in ozone concentrations. This further supports my recommended designation for Nebraska.

If there are any questions regarding my recommendation, please feel free to contact Jim Macy, Director of the Department of Environmental Quality.

Sincerely,

Pete Ricketts
Governor

cc: Rebecca Weber, Air and Waste Management Division, U.S. EPA, Region VII
Jim Macy, Director, Nebraska Department of Environmental Quality
Kevin Stoner, Administrator, Air Quality Division, NDEQ

An Equal Opportunity Employer

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EPA Review

- EPA reviews state recommendations and, based on the factors, determines whether it agrees, or whether an area should be designated differently, or whether an area should include more/less of the recommended areas
  - EPA either accepts or changes recommendations
- EPA then issues "120 day letters," which communicate initial thoughts on the recommendations and provide states an opportunity to discuss before proposed rulemaking (CAA §107(d)(1)(A)&(B)
- States then respond

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What Does EPA Designate?

- Three main designation options:
  - Nonattainment = does not meet the NAAQS
  - Attainment = does meet the NAAQS
  - Unclassifiable = not enough data to determine
- Also "unclassifiable/attainment"
  - Not enough data to make a determination, but generally the area is not thought to have a NAAQS problem
  - Typically done for "rest of the state" areas

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Final Steps

- Within 2 years of issuance of the new NAAQS, EPA must designate areas (CAA §107(d)(1)(B)) (typically, we're late)
  - When ready, EPA publishes a notice of proposed rulemaking in the Federal Register with a 60 day public comment period (sometimes extended)
  - Once the comment period closes, EPA reviews the comments and issues a final rulemaking notice with the final designations

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Any questions?

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Pete Ricketts
Governor

STATE OF NEBRASKA
OFFICE OF THE GOVERNOR
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Sincerely,

Pete Ricketts
Governor

cc: Rebecca Weber, Air and Waste Management Division, U.S. EPA, Region VII
Jim Macy, Director, Nebraska Department of Environmental Quality
Kevin Stoner, Administrator, Air Quality Division, NDEQ

Ozone Data - Comparison of 8-Hour Ozone levels to the NAAQS[1]					
Site	**2013**	**2014**	**2015**	**3-Year Design Value**	**% of NAAQS**
NCore Omaha 311-055-0019	**0.066**	**0.063**	**0.062**	**0.063**	**90%**
2411 O Street, Omaha 311-055-0028	**0.058**	**0.059**	**0.055**	**0.057**	**81%**
30th & Fort, Omaha[2] 31-055-0035	**0.061**	**0.060**	**ND**	**NA**	**NA**
1616 Whitmore, Omaha[2] 311-055-0053	**ND**	**ND**	**0.064**	**NA**	**NA**
First & Maple, Davey 31-109-0016	**0.055**	**0.061**	**0.061**	**0.059**	**84%**
The sites below are not operated by Nebraska state or local agencies, but the attainment status of these sites could impact portions of Nebraska.					
Pisgah, IA #2[3] 19-085-0007	**0.065**	**0.063**	**0.061**	**0.063**	**90%**
Harrison County, IA [3] 19-085-1101	**0.065**	**0.062**	**0.061**	**0.062**	**89%**
31102 471st Ave, Union, SD[4] 46-127-0001	**0.063**	**0.062**	**0.061**	**0.062**	**89%**
Santee Indian Reservation[5] 31-107-9991	**0.067**	**0.063**	**0.063**	**0.064**	**91%**

Footnotes:

[1] Ozone levels and design values are shown in parts per million (ppm) units. Attainment is indicated if the 3-year design value does not exceed the 8-hour ozone NAAQS of 0.070 ppm.

[2] The 30th & Fort Site was shut down due to construction after 2013 and the monitor was moved to the Whitmore site for the 2014 and 2015 monitoring years.

[3] The Pisgah, IA and Harrison County, IA sites are operated by the Iowa Department of Natural Resources and are within the Omaha-Council Bluffs metropolitan statistical area.

[4] The Union County, SD site is operated by the South Dakota Department of Environment and Natural Resources and is located in the Sioux City metropolitan statistical area, which includes Dixon and Dakota Counties in NE

[5] The Santee Indian Reservation site in Knox County, NE is an EPA CASTNET site.

Abbreviations:

ND – No data collected as site was not operated in those years.

NA – Not available; i.e., there is not 3 years of data for the site to calculate the 2013-15 DV.

To: Alston, Lala[alston.lala@epa.gov]
From: South, Peter
Sent: Thur 3/23/2017 12:31:20 PM
Subject: FW: Ozone Designations briefing for Page
O3D S Page Overview 2017Mar22_6pm.pptx

Hi Lala,

See attached for Steve's binder today (in prep for O3 designations meeting).

Thanks.

From: Mathias, Scott
Sent: Wednesday, March 22, 2017 6:22 PM
To: Koerber, Mike <Koerber.Mike@epa.gov>; South, Peter <South.Peter@epa.gov>
Cc: Johnson, Yvonne W <Johnson.Yvonnew@epa.gov>; Long, Pam <Long.Pam@epa.gov>; Scott, Denise <Scott.Denise@epa.gov>; Jones, Rhea <Jones.Rhea@epa.gov>; Oldham, Carla <Oldham.Carla@epa.gov>; Wood, Anna <Wood.Anna@epa.gov>
Subject: Ozone Designations briefing for Page

See attached. It is still a work in progress and we look forward to guidance on how to trim this down as we go up the decision chain.

Scott Mathias | Associate Director, Air Quality Policy Division | U.S. EPA, RTP, NC 27711 | 919.541.5310

Area Designations for 2015 Ozone NAAQS

draft MARCH 28, 2017

SUMMARY

By **October 1, 2017**, the Administrator is required by Clean Air Act (CAA) section 107(d) to establish, and publish a notice in the Federal Register promulgating air quality designations for all areas of the United States under the 2015 ozone NAAQS. The designations of "attainment", "nonattainment", or "unclassifiable" are based upon air quality monitoring data and other relevant information pertaining to the air quality in the affected area, including whether an area contains emissions sources that contribute to a violation of the standard in a nearby area. This deadline may be extended for up to one year in the event the Administrator has insufficient information to promulgate the designations. If the Administrator intends to modify any of the designation recommendations previously provided by States or Tribes, he must notify those States or Tribes no less than 120 days prior to promulgating final designations and provide them an opportunity to demonstrate why a proposed modification is inappropriate. These "120-day letters" must be issued no later than **June 2, 2017** to meet the October 1, 2017 deadline for final designations.

CURRENT STATUS AND ISSUES

- **Recommendations Provided by States and Tribes:** States (except Maryland), U.S. territories, and 6 Tribes submitted to the EPA their designation recommendations for the areas within their jurisdiction in October 2016. Most state and tribal submissions adhered to the directives of CAA section 107(d) and followed EPA's February 2016 guidance on developing designation recommendations. Several states failed to apply the CAA designation categories according to their statutory definitions, and/or failed to provide any relevant information to support their recommendations. ***See Table 1 - Areas with Incomplete or Unsupported State Recommendations***.
- **EPA Staff Recommendations to Modify State's Recommended Nonattainment Areas:** After reviewing and analyzing all state and tribal nonattainment area recommendations and any supporting documentation, EPA staff are recommending that Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

- **Area Classifications:** The CAA requires for the ozone NAAQS that each area designated nonattainment also be assigned a classification based on the severity of the ozone levels in the area. The classifications, from lowest to highest are Marginal, Moderate, Serious, Severe, and Extreme. The air quality thresholds for the classifications in CAA section 181(a)(1) are based on values that range from 15% (for Marginal) to 133% (for Extreme) above the 0.120 ppm 1-hour ozone standard that existed in 1990. The 1-hour average ozone standard was replaced with an 0.08 ppm 8-hour average standard in 1997, which was again revised to 0.075 ppm in 2008 and to 0.070 ppm in 2015. For each

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new 8-hour standard, the EPA established new air quality thresholds for each classification through rulemaking conducted in parallel with the designations process. For the 2015 ozone NAAQS, the EPA proposed for comment a set of classification thresholds in November 2016 (82 FR 81276). ***This rulemaking would need to be finalized no later than the promulgation of final designations***.

- **Exceptional Events:** Several air agencies have submitted requests to exclude from designations decisions certain ozone monitoring data that have been influenced by exceptional events. Under the authority of CAA section 319 and the procedures in EPA's implementing regulations (40 CFR 501., 50.14, and 51.930), EPA staff are currently reviewing demonstrations submitted by the air agencies in Wyoming and Nevada, and Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process Texas has indicated their intent to submit additional information to support the "clear causal relationship" criterion.

- **Ozone Data Quality and Completeness Issues:** The state and tribal networks of EPA-approved ozone monitors totals more than 1300 monitors. However, for a variety reasons the EPA is not able to calculate a valid ozone design value for comparison to the level of the NAAQS at all monitoring sites. These reasons include incomplete data capture across the three-year design value period, and data being invalidated for failing to meet minimum quality standards. Approximately 14% of the monitors in the national network do not have valid design values (DV) for the period 2013-2015 (i.e., 2015 DV).

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process Historically, for areas required to monitor that have incomplete monitoring data to characterize the area, the EPA has designated the area "unclassifiable".

- **Rural Transport Areas:** The state of California has requested that the Administrator treat Tuscan Buttes, CA ozone nonattainment area as a Rural Transport Area (RTA) under the authority in CAA section 182(h). EPA staff have evaluated this request and Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process EPA staff anticipate that following the 120-day letters, the state of Wisconsin will submit a nonattainment recommendation for a portion of Door County and request that it be treated as an RTA.

- **Designation Categories**
  - ***nonattainment*** = areas that do not meet the NAAQS and areas that contribute to a nearby violation of the NAAQS
  - ***attainment*** = areas that meet the NAAQS and do not contribute to a nearby violation of the NAAQS
  - ***unclassifiable*** = areas that based on available information cannot be classified as meeting or not meeting the NAAQS
  - ***unclassifiable/attainment*** = combination of above definitions, which relieves states and EPA of the burden of rationalizing boundaries between attainment and unclassifiable areas. While not strictly listed in the CAA, the category has been used in all recent designations efforts involving the NAAQS for ozone, PM, Lead, and NO2. Most states have historically supported this approach because they prefer that the word "attainment" (rather than unclassifiable alone) appear in the designations tables found the CFR. But in the recent SO2 NAAQS designations efforts, some states have recommended and advocated in court filings that "unclassifiable" is the appropriate designation for areas where air quality is not fully

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characterized. If that approach was adopted for ozone designations, EPA staff recommend

Ex. 5 - Deliberative Process

TABLE 1 - EPA Staff Recommendations

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

TABLE 2 - EPA Staff Recommended Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

TABLE 3 - EPA Staff Recommended Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

BACKGROUND

- **4-Step Designations Process in CAA Section 107(d)**
  - **Step 1 – State Recommendations:** After a national ambient air quality standard (NAAQS) is revised, state governors and tribal leaders send designation recommendations to the EPA for all of the areas in their jurisdiction.
  - **Step 2 – EPA Notifies States of Preliminary Decisions:** The Administrator reviews and makes reasoned decisions regarding the suitability of state recommendations. The Administrator must notify states of any intended modifications to state recommendations no less than 120-days prior to finalizing designations. We refer to these communications to the states as "120-day letters."
  - **Step 3 – Optional State Responses:** States may provide additional information to EPA to explain why an intended EPA modification is not appropriate. Though not mandated by the CAA, the EPA has also historically sponsored a public comment period during the 120-day period.
  - **Step 4 – EPA Final Decisions:** EPA reviews any new information provided by states and public commenters and announces final designation decisions in a Federal Register notice.
- **Ozone Formation:** Ozone forms from emissions of nitrogen oxides (NOx) and volatile organic compounds (VOC), and carbon monoxide (CO) in the presence of sunlight and elevated temperatures. Typical sources of NOx include burning of fossil fuels in vehicles, power plants, and industrial boilers. Typical sources of VOC include vehicles, oil and gas development and transmission, solvent use, paints and other coatings.
- **Ozone is an Urban-scale Pollutant:** Ozone is referred to as an urban-scale or regional-scale pollutant because elevated levels are experienced over the scale of 10s of miles. The sources of NOx and VOC emissions that contribute to ozone formation are ubiquitous and are spread throughout wide areas of land.
- **Factors Used in Determining Appropriate Nonattainment Area Boundaries:** Section 107(d)(4) of the 1990 CAA amendments prescribed the entire consolidated metropolitan statistical area as the boundary for any ozone nonattainment area classified Serious, Severe, or Extreme, and indicates that factors such as population density, traffic congestion, commercial and industrial development, meteorological conditions and pollution transport may be considered in determining appropriate nonattainment boundaries. Today, the EPA's analysis of nearby contribution uses this directive as a touchstone for examining appropriate nonattainment area boundaries. EPA's ozone designations guidance recommends using a weight-of-evidence approach to developing boundaries, considering factors such as the location of emissions sources and emissions-generating activities, meteorology, topography, air quality data, and existing jurisdictional boundaries.
- **Background Ozone:** Background ozone refers to ozone formed from natural sources of NOx and VOC emission, and ozone formed from non-U.S. sources of NOx and VOC emissions (e.g., emissions from Mexico and Canada). Also, in some high elevation locations, short-duration springtime meteorological events result in stratospheric ozone being mixed down into the troposphere. Some sources of background ozone may be considered Exceptional Events and the monitoring data associated with the event may be eligible for exclusion in designations decisions.

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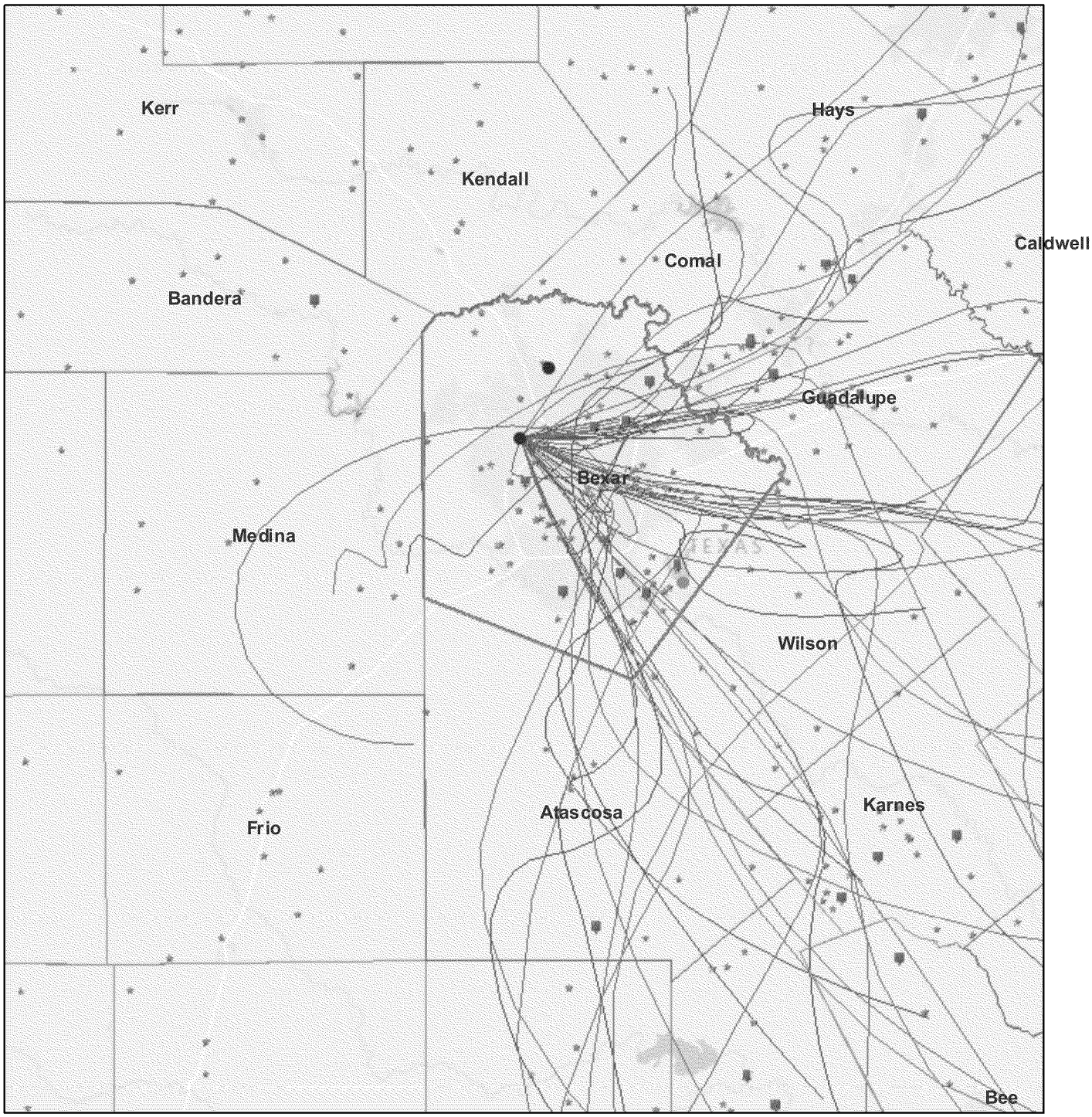
San Antonio - Northwest Monitoring Site



March 7, 2017

1:1,155,581

0 10 20 40 mi

0 15 30 60 km

CBSAs - Metropolitan Statistical Areas

USA_Counties

San Antonio

Ozone 2016 Site Level DVs (preliminary)

Violating

Attaining

Incomplete

OAR/OAQPS/AQAD/AQAG
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Web AppBuilder for ArcGIS

nning and Standards (OAQPS) | OAR/OAQPS/AQAD/AQAG | U.S. EPA Office of Air and Radiation (OAR) - Office of Air Quality Planning and Standards (OAQPS), U.S. Census Bureau | Source: U.S. Census Bureau |

To: Benjamin, Lynorae[benjamin.lynorae@epa.gov]
Cc: Munsey, Elisabeth[Elisabeth.Munsey@dnr.ga.gov]; Grodzinsky, Gil[Gil.Grodzinsky@dnr.ga.gov]; Davis, Scott[Davis.ScottR@epa.gov]; Wong, Richard[Wong.Richard@epa.gov]; Spann, Jane[Spann.Jane@epa.gov]
From: Boylan, James
Sent: Tue 10/4/2016 7:21:32 PM
Subject: RE: Removing Low RVP Gasoline in Atlanta

Lynorae,

Thanks for the information. Are you saying that if the Atlanta area is redesignated to attainment for the 2008 ozone NAAQS that we still would not be able to move forward with removing the low RVP requirements if we have any monitors in Atlanta above the 2015 ozone NAAQS (even though designations will not be done until October 1, 2017)? Please confirm.

Thanks!!

Jim

From: Benjamin, Lynorae [mailto:benjamin.lynorae@epa.gov]
Sent: Tuesday, October 04, 2016 3:09 PM
To: Boylan, James
Cc: Munsey, Elisabeth; Grodzinsky, Gil; Davis, Scott; Wong, Richard; Spann, Jane
Subject: RE: Removing Low RVP Gasoline in Atlanta

Hi Jim,

Thanks for your email. In order for the Administrator to use her (his) discretion to remove requirements, we have to consider the current standard (in this case the 2015 NAAQS) and whether there are violating monitors. I do not know of any case where this discretion has been used when there is a violating monitor. With regard to the hypothetical that you present on what a possible boundary is for the 2015 standard would be and what counties might be covered, we cannot speculate until the designations are done. As you know for designations, we have to consider counties with violating monitors AND those that CONTRIBUTE to the counties with the violating monitor. Please give me a call if you would like to discuss further but this is all we can tell you for now.

I hope your day is going well.

Lynorae

From: Boylan, James [mailto:James.Boylan@dnr.ga.gov]
Sent: Monday, October 03, 2016 7:26 PM
To: Benjamin, Lynorae <benjamin.lynorae@epa.gov>
Cc: Munsey, Elisabeth <Elisabeth.Munsey@dnr.ga.gov>; Grodzinsky, Gil <Gil.Grodzinsky@dnr.ga.gov>; Davis, Scott <Davis.ScottR@epa.gov>; Wong, Richard <Wong.Richard@epa.gov>; Spann, Jane <Spann.Jane@epa.gov>
Subject: RE: Removing Low RVP Gasoline in Atlanta

Yes, there will be five monitors above the 2015 standard based on preliminary 2016 data. Does that mean we can't relax the RVP requirement in Atlanta? What if our new nonattainment area for the 2015 standard is smaller than the counties currently covered by the RVP requirement? In that case, can we relax the RVP requirements in the counties that are outside the new nonattainment area?

Jim

From: Benjamin, Lynorae [mailto:benjamin.lynorae@epa.gov]
Sent: Monday, October 03, 2016 6:03 PM
To: Boylan, James
Cc: Munsey, Elisabeth; Grodzinsky, Gil; Davis, Scott; Wong, Richard; Spann, Jane
Subject: Re: Removing Low RVP Gasoline in Atlanta

Hi Jim,

The question hinges on whether there is a violating monitor in the Atlanta area for the 2015 standard.

I hope your day is going well.

Sent from my iPhone

On Oct 3, 2016, at 5:28 PM, Boylan, James <James.Boylan@dnr.ga.gov> wrote:

Lynorae,

We would like to find out what is required to relax the lower RVP requirements in Atlanta from June 1 to September 15. Since EPA is moving forward with our ozone redesignation, we thought this would be a good time to remove this SIP requirement. Do you think a conference call would be useful to help get us started?

Jim

James W. Boylan, Ph.D.

Manager, Planning & Support Program

Georgia Department of Natural Resources

Environmental Protection Division - Air Protection Branch

4244 International Parkway, Suite 120

Atlanta, GA 30354

Office: 404-363-7014 Fax: 404-363-7100

E-mail: James.Boylan@dnr.ga.gov

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Cc: Munsey, Elisabeth[Elisabeth.Munsey@dnr.ga.gov]; Grodzinsky, Gil[Gil.Grodzinsky@dnr.ga.gov]; Davis, Scott[Davis.ScottR@epa.gov]; Wong, Richard[Wong.Richard@epa.gov]; Spann, Jane[Spann.Jane@epa.gov]
From: Boylan, James
Sent: Tue 10/4/2016 8:21:38 PM
Subject: RE: Removing Low RVP Gasoline in Atlanta

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From: Benjamin, Lynorae [mailto:benjamin.lynorae@epa.gov]
Sent: Tuesday, October 04, 2016 4:17 PM
To: Boylan, James
Cc: Munsey, Elisabeth; Grodzinsky, Gil; Davis, Scott; Wong, Richard; Spann, Jane
Subject: RE: Removing Low RVP Gasoline in Atlanta

Yes… if we go with precedent. The 2015 standard is in effect as of October 1, 2015.

From: Boylan, James [mailto:James.Boylan@dnr.ga.gov]
Sent: Tuesday, October 04, 2016 3:22 PM
To: Benjamin, Lynorae <benjamin.lynorae@epa.gov>
Cc: Munsey, Elisabeth <Elisabeth.Munsey@dnr.ga.gov>; Grodzinsky, Gil <Gil.Grodzinsky@dnr.ga.gov>; Davis, Scott <Davis.ScottR@epa.gov>; Wong, Richard <Wong.Richard@epa.gov>; Spann, Jane <Spann.Jane@epa.gov>
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Manager, Planning & Support Program

Georgia Department of Natural Resources

Environmental Protection Division - Air Protection Branch

4244 International Parkway, Suite 120

Atlanta, GA 30354

Office: 404-363-7014 Fax: 404-363-7100

E-mail: James.Boylan@dnr.ga.gov

To: AIR_DIST[air_dist@dhec.sc.gov]; AIR_ASSESS_INOV_REG[air_assess_inov_reg@dhec.sc.gov]; AIR_Update[baqupdate@dhec.sc.gov]; EQC_BEHS_AREADIR[eqc_behs_areadir@dhec.sc.gov]
From: Baecker, Renee
Sent: Fri 4/14/2017 1:53:32 PM
Subject: BAQ Update - April 14, 2017
BAQ Update attachment April 12_rjb_updated.docx

In this installment of the BAQ Update, you will find information on the following:

1. The EPA Advance Program has shared the attached document containing funding, training and other opportunities. The Bureau of Air Quality is a participant in the EPA's "Advance Program" which is a collaborative effort between DHEC, EPA, and local governments. The attached opportunities may be of interest to you as you work to improve the air quality in your area. To find out more about our participation in EPA's Advance Program and learn how you can help to improve air quality in South Carolina, visit www.scdhec.gov/Advance and EPA's website at www.epa.gov/advance.

2.

Help SC DHEC win the 2017 Air Quality Flag Program Spring Challenge!

Did you know?

- Air pollution can make asthma symptoms worse and trigger attacks.
- You can take steps to help protect your health from air pollution.
- In 2016, SC DHEC came in second in the Air Quality Flag Program Spring Challenge!

How can you help/participate?

1. **It's very easy**: Sign up to SPREAD the word and FLY the Air Quality Flags.

2. Purchase the flags. Many suppliers are available on the internet. EPA uses this one.

3. Educate your organization and the community.

4. Fly the day's flag. Learn which flag to fly here.

5. Take actions when the air quality is unhealthy.

Who can participate? Pretty much anyone! Schools, Businesses, Hospitals, Non-profits, etc. For more information visit the AirNow Flag Program website

3. Earth Day events:

1. April 15 -- Party for the Planet, Greenville Zoo, 9 am – 1 pm

2. April 15 -- Charleston County's Annual Earth Day, Riverfront Park, North Charleston, 11 am - 4 pm

3. April 22 – Earth Day Aiken, Newberry Street, Aiken, 8:30 am – 2 pm

4. April 22 – Earth Day at Columbia Soda City Market, Main Street, Columbia, 9 am – 1 pm

5. April 22 – Spartanburg, 210 Henry Place, 10 am - 4 pm

6. April 22 – Earth Day at the Bay, Ocean Bay Middle School, Myrtle Beach, 11 am – 2 pm

7. April 22 – Kalmia Gardens, Coker College, Hartsville,9:30 am – 1:30 pm

8. April 29 – York County Earthday Birthday, Museum of York County, Rock Hill, 10 am – 3 pm

Renee Baecker
Administrative Coordinator
S.C. Dept. of Health & Environmental Control

Office of Environmental Affairs
Office: (803) 898-4132

Mobile: (803) 917-4960
Fax: (803) 898-1246
Connect: www.scdhec.gov Facebook Twitter

To: AIR_DIST[air_dist@dhec.sc.gov]; AIR_ASSESS_INOV_REG[air_assess_inov_reg@dhec.sc.gov]; AIR_Update[baqupdate@dhec.sc.gov]; EQC_BEHS_AREADIR[eqc_behs_areadir@dhec.sc.gov]
From: Baecker, Renee
Sent: Thur 10/27/2016 2:23:24 PM
Subject: BAQ Update - October 27, 2016
Federal Funds and Training OCTOBER BAQ Update.docx

;;;;;;
In this installment of the BAQ Update, you will find information on the following:

1. Notice of Final Regulation: 2015 End of Year Revisions - On September 23, 2016, the Department of Health and Environmental Control's (Department) Bureau of Air Quality published a Notice of Final Regulation in the *State Register,* amending Regulation 61-62 and the South Carolina State Implementation Plan (SIP).

The Department amended Regulation 61-62.1, *Section III, Emissions Inventory and Emissions Statements*; Regulation 61-62.60, *South Carolina Designated Facility Plan and New Source Performance Standards*; Regulation 61-62.63, *National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories*; Regulation 61-62.5, *Standard No. 2, Ambient Air Quality Standards*; and the SIP, adopting the federal amendments to these standards put forth from January 1, 2015, through December 31, 2015.

The Department also amended Regulation 61-62.1, *Section II, Permit Requirements*; Regulation 61-62.5, *Standard No.1, Emissions from Fuel Burning Operations*; and Regulation 61-62.5, *Standard 4, Emissions from Process Industries*, to address periods of excess emissions during startup, shutdown, or malfunction (SSM) events as required by the EPA in response to a national petition for rulemaking and to address a finding of substantial inadequacy (referred to as a 'SIP call') (80 FR 33840, June 12, 2015).

The Department made other changes to Regulation 61-62 to improve the overall text of the regulation as necessary. Legislative review was not required because the Department was promulgating the amendments to maintain compliance with federal law.

Please contact Caitlan Bell at bellcl@dhec.sc.gov if you have any questions. This notice can be found at: http://www.scstatehouse.gov/state_register.php.

2. 2015 Ozone NAAQS Attainment Recommendations – On September 30, 2016, as required by the Clean Air Act, South Carolina submitted a recommendation of "attainment" for every area in the state, including Rock Hill and the eastern, urbanized part of York County. This recommendation was based on 2013-2015 ozone monitoring

results in accordance with the Clean Air Act. DHEC is now awaiting EPA's response to this recommendation. For more information, please see DHEC's 2015 ozone NAAQS page. The North Carolina Department of Environmental Resources is also recommending to the EPA that all of NC be designated "attainment."

3. Funding, Training, and Other Opportunities -The EPA Advance Program has shared the attached document containing funding, training and other opportunities. The Bureau of Air Quality is a participant in the EPA's "Advance Program" which is a collaborative effort between DHEC, EPA, local governments and other stakeholders. These opportunities may be of interest to you as you work to improve the air quality in your area.

To find out more about our participation in EPA's Advance Program and learn how you can help to improve air quality in South Carolina, visit www.scdhec.gov/Advance.

4. Energy Action Month - Governor Nikki Haley has proclaimed October as Energy Action Month. Smart energy choices encourage clean energy investments and job creation, help to protect valuable natural resources and improve air quality. South Carolina is leading by example by encouraging public agencies, school districts and colleges and universities to reduce their energy consumption by 20 percent by 2020. All South Carolinians are encouraged to look for ways to take action today and every day to conserve and use energy more efficiently. Read the Governor's proclamation at http://www.energy.sc.gov/files/view/Energy%20Action%20Month%202016.pdf.

Renee Baecker
Administrative Coordinator
S.C. Dept. of Health & Environmental Control

Office of Environmental Affairs
Office: (803) 898-4132

Mobile: (803) 917-4960
Fax: (803) 898-1246
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Diesel Emissions Reduction Act (DERA) National and State Grants
The 2017 Clean Diesel National Grants RFP is expected to open in **April**. Prospective area projects could be developed now so that they are available for submission when the RFP opens. More information: https://www.epa.gov/cleandiesel/clean-diesel-national-grants

Dept. of Transportation
Fixing America's Surface Transportation Act (FAST)
Assuming funding is made available to DOT under FAST in 2017, this funding opportunity would continue to support state, tribal, and local governments (including MPOs) with transportation projects that focus on safety, freight, transit, and/or transit-oriented development, among other things. A variety of funding opportunities were made available via FAST in 2016 (see https://www.transportation.gov/administrations/office-policy/fast-act-implementation-highlights). If the program follows the same pattern in 2017, then funding announcements might begin to appear in **spring 2017**. Notably, the FAST Act continued the Congestion Mitigation and Air Quality Improvement Program (CMAQ) to support transportation projects to help meet the requirements of the Clean Air Act in states and local governments with nonattainment or maintenance areas. An estimated $2.309 billion was made available in 2016, and an estimated $2.360 billion is expected to be available in 2017.
http://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm

Dept. of Agriculture
South Carolina Conservation Innovation Grants
The purpose of Conservation Innovation Grants (CIG) is to stimulate the development and adoption of innovative conservation approaches and technologies, while leveraging the Federal investment in environmental enhancement and protection in conjunction with agricultural production. CIG funds projects targeting innovative on the ground conservation, including pilot projects and field demonstrations. Projects benefiting air quality may be included. Total program funding for eligible entities from South Carolina is $300,000, and individual awards will not exceed $75,000.
Deadline for applications is **April 28, 2017**.
More information: https://www.grants.gov/web/grants/view-opportunity.html?oppId=292453

Dept. of Agriculture, Forest Service
Urban and Community Forestry Challenge Cost Share Grant Program
Grants will be made for program development, study, and collaboration to address strategies in the National Ten Year Urban Forestry Action Plan (2016-2026). The 2018 RFP specifically addresses planting, inventory, and analysis for forest and environmental health. Projects should increase knowledge about, or understanding of, how urban planting, inventory, and, analysis of our urban forest natural resources contributes to the health, energy, ecological, economic, and other critical benefits our urban forests provide communities and in improving human well-

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being. Organizations, local governments, tribal agencies, and partnerships are encouraged to submit proposals. Estimated total program funding is approximately $500,000-$900,000, with awards ranging from $50,000-$200,000.
Deadline for applications is **May 24, 2017**.
https://www.grants.gov/web/grants/view-opportunity.html?oppId=291515
https://www.fs.fed.us/managing-land/urban-forests/ucf/nucfac
https://www.fs.fed.us/ucf/supporting_docs/fy2018/2018NationalUrbanCommForestryRFPs.pdf

National Forest Foundation
Matching Awards Program
The focus of this grant opportunity (with 1:1 matching) is on on-the-ground conservation and restoration projects that improve forest health and outdoor experiences on or benefiting National Forests and Grasslands. Nonprofits, universities, and tribes are eligible to apply.
Deadline for proposals is **June 26, 2017**.
More information: https://www.nationalforests.org/grant-programs/map

Dept. of Transportation, Federal Highway Administration (FHWA)
Accelerated Innovation Deployment (AID) Demonstration
The FHWA AID Demonstration provides incentive funding for any project activities eligible for assistance under title 23, U.S.C. in any phase of a highway transportation project between project planning and project delivery including planning, financing, operation, structures, materials, pavements, environment, and construction that address the program goals. The notice of funding opportunity requests grant applications and provides selection criteria, application requirements, and technical assistance with Grants.gov during the grant solicitation period. Applications are accepted on a rolling basis. Estimated total funding is $50 million, with individual awards ranging from $50,000 to $1 million.
Deadline for applications is **Sept. 30, 2020**.
More information: http://www.grants.gov/web/grants/view-opportunity.html?oppId=288651 and https://www.fhwa.dot.gov/innovation/grants/. Examples of past projects across the country: https://www.fhwa.dot.gov/innovation/grants/projects/ (includes dynamic signage for safety and congestion mitigation, geospatial data projects, energy efficient lighting, recycled road materials, etc.)

Dept. of Energy
Property Assessed Clean Energy (PACE) Program
PACE is an innovative mechanism for financing energy efficiency, solar, and related improvements on private property. PACE programs allow local and state governments and other inter-jurisdictional authorities, when authorized by state law, to fund the up-front cost of energy improvements on commercial and residential properties, which are paid back over time by the property owners. PACE financing for clean energy projects is generally based on an existing "land-secured financing district," or assessment district, where the local government

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issues bonds to fund projects with a public purpose such as street lights, sewer systems, or underground utility lines. PACE was recently extended to energy efficiency and renewable energy, which allows property owners to implement improvements without a large up-front cash payment. Property owners who opt to participate in a PACE program can repay their improvement costs over a set time period (typically 10-20 years) through property assessments which are secured by the property itself and paid as an addition to the owners' property tax bills. The repayment obligation may transfer with property ownership depending on state legislation.
More information: http://energy.gov/eere/slsc/property-assessed-clean-energy-programs
List of current PACE programs: http://www.pacenation.us/resources/all-programs/

Dept. of Energy
Low Income Housing Energy Assistance Program (LIHEAP)
This funding opportunity may be of particular interest to Advance areas that are interested in energy efficiency programs and/or that have concerns about wood smoke. LIHEAP assists families with energy costs associated with home energy bills, energy crises, and weatherization and energy-related minor home repairs. LIHEAP provides, on average, more than $3 billion a year to communities and includes a provision that allows grantees to access 15-25% of their annual funding for low cost weatherization and energy efficiency improvements. HHS and DOE are offering technical assistance to LIHEAP grantees to increase their ability to use their funding to support the deployment of renewable energy.
Ongoing funding opportunity.
http://www.acf.hhs.gov/ocs/programs/liheap/about

Dept. of Energy
SolSmart Technical Assistance – Nationally Distinguished, Locally Powered
SolSmart is a national recognition and a no-cost technical assistance program for local governments. The program is designed to drive greater solar deployment and help make it possible for more homes and businesses to access affordable and renewable solar energy to meet their electricity needs. SolSmart experts will design personalized action plans for communities that outline a path to designation as a SolSmart community, along with a rough timeline. SolSmart is federally funded for a three-year period, but is expected to persist beyond this timeframe. Stakeholder and community benefits are described on the program website.
Ongoing technical assistance opportunity.
http://www.gosparc.org/

The Fruit Tree Planting Foundation (FTPF)
Orchard Donation Program
FTPF is a nonprofit charity dedicated to planting fruit trees and plants to alleviate world hunger, combat global warming, strengthen communities, and improve the surrounding air, soil, and water. FTPF programs strategically donate orchards where the harvest will best serve

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communities for generations, at places such as community gardens, public schools, city/state parks, low income neighborhoods, and Native American reservations.
Ongoing opportunity; applications accepted on a rolling basis.
http://www.ftpf.org/apply.htm

Training and Resources

Environmental Protection Agency
Bringing People Together: 20 Years Investing in Communities Conference – August 2017, Kansas City, MO
This conference will bring together EPA staff, partners, and the communities they serve to provide training on tools and techniques to address all aspects of public outreach and engagement. The training is designed for those who plan and implement environmental community involvement activities, engagement, partnership, stewardship, outreach, and education programs.

Environmental Protection Agency Webinar Recordings
Advance Program
https://www.epa.gov/advance/webinars-and-training

Environmental Protection Agency
Ozone and PM Designations Mapping Tools
EPA designed mapping tools to assist air quality planners with designations for the 2015 ozone and 2012 PM NAAQS, however the tools provide features that may be of interest to Advance areas as well. These include air quality data and trends, emissions data, source and monitor locations, population by county and Census tract, etc.
Ozone Designations Mapping Tool and explanatory webinar: https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data (bottom of page)
PM Designations Mapping Tool and explanatory materials:
https://www3.epa.gov/pmdesignations/2012standards/techinfo.htm#C (bottom of page)

Environmental Protection Agency
Office of Research and Development
The Health Impact Assessment Resource and Tool Compilation
The HIA is a comprehensive list of resources and tools that can be used as a guide through the health impact assessment process.
https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=334197&simpleSearch=0&showCriteria=2&searchAll=health+impact+assessment&TIMSType=&dateBeginPublishedPresented=02%2F14%2F2015

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Sustainable City Network
Live and Online Training Opportunities
Courses on a variety of sustainability topics are available, along with a library of on-demand videos, many of which can be accessed free of charge.
http://www.sustainablecitynetwork.com/topic_channels/policy/article_e7d69ebe-cab9-11e5-b943-3b976faba2e1.html?utm_source=SCN+InBox+e-Newsletter&utm_campaign=400488c333-Newsletter_2-3-2016_Muni&utm_medium=email&utm_term=0_11e7ac761c-400488c333-188859017&mc_cid=400488c333&mc_eid=76907d0b36

Free downloadable webinars include topics such as measuring sustainability, green infrastructure (cutting energy costs in wastewater treatment), energy efficient lighting retrofits, design guidelines for transit supportive communities, and sustainability efforts in a number of cities:
http://www.sustainablecitynetwork.com/webinars/?utm_source=SCN+InBox+e-Newsletter&utm_campaign=821ce3e4f3-SCN_Newsletter&utm_medium=email&utm_term=0_11e7ac761c-821ce3e4f3-188859017&mc_cid=821ce3e4f3&mc_eid=76907d0b36

(1) MOBILE SOURCES

LOCUS (a program of Smart Growth America)
2017 LOCUS Leadership Summit: P3 is for Partnerships, Placemaking, and Policy, April 24-25, 2017, Washington DC
What impact could a potential $1 trillion infrastructure package have on transit-oriented development? How can TOD staff, real estate developers, and local elected leaders work together to improve infrastructure, create jobs, and rebuild neighborhood for the future? This conference is an opportunity to learn, meet, and connect with others building walkable places served by transit across the country. The Summit this year will explore themes around community engagement, creating a robust sense of place, and the way public policy fits in.
https://nvite.com/LOCUSsummit/e939#program

Federal Transit Administration
Funding Options for Bicycle-Related Programs
https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/livable-sustainable-communities/fta-program-bicycle

Federal Highway Administration
Bicycle and Pedestrian Program - Guidance for State and Local Governments
https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/index.cfm
Environmental Protection Agency

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Recommendations for Constructing Roadside Vegetation Barriers to Improve Near-Road Air Quality
This report summarizes research on the best practices for building roadside vegetative barriers to improve air quality. These recommendations can be used by states, communities and individuals interested in reducing roadside pollution. https://www.epa.gov/air-research/recommendations-constructing-roadside-vegetation-barriers-improve-near-road-air-quality

Environmental Protection Agency, Smart Growth Program
Infrastructure Financing Options for Transit-Oriented Development
https://www.epa.gov/sites/production/files/2014-02/documents/infrastructure_financing_options_for_transit-oriented_development.pdf

Environmental Protection Agency, Office of Transportation and Air Quality
Ports Primer for Communities – New Website
This new web area provides guidance to near-port communities interested in becoming more involved in decisions that may impact local land use, the environment and quality of life. The Ports Primer pages are intended to help community members participate effectively in decision-making processes.
https://www.epa.gov/ports-initiative/draft-ports-primer-communities-2?utm_source=Ports+Initiative+Newsletter+February+2017+Final&utm_campaign=Ports+Initiative+Newsletter+February+2017&utm_medium=email

Environmental Protection Agency, Office of Transportation and Air Quality
Travel Efficiency Assessment Method (TEAM) Information
Travel efficiency strategies are emission reduction strategies that affect travel activity, such as travel demand management (e.g., telecommuting, transit subsidies), public transit fare changes and service improvements, road and parking pricing, and land use/smart growth.
https://www.epa.gov/state-and-local-transportation/estimating-road-greenhouse-gas-emissions

American Trucking Research Institute (ATRI), National Assn. of Truck Stop Operators (NATSO), American Trucking Assns.
"Park My Truck" Mobile App
A new, free mobile app is available to help commercial truck drivers, fleets, and others identify available parking. Truck parking providers can establish an account to share parking availability information by contacting the NATSO Foundation at (703) 549-2100 or hello@parkmytruck.com.

Dept. of Transportation and Smart Growth America
Transit-Oriented Development (TOD) Technical Assistance

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This website provides information about TOD projects, including a data base of research, information about funding/financing options for projects, and opportunities for professionals to connect. https://TODresources.org

Environmental Protection Agency
SmartWay Program
More than 500 companies joined SmartWay in 2016. This included nearly 350 carriers, more than 150 logistics and shipper companies, and several affiliate organizations that share a goal for cleaner, more efficient freight. The program is a public-private partnership that provides tools to assess freight activity and incentives to improve the efficiency and environmental performance of how your goods move. More information: https://www.epa.gov/smartway
Upcoming and recorded webinars: https://www.epa.gov/smartway/smartway-webinars-events

Dept. of Energy
Vehicle Technologies Office
Idle reduction resources, including a savings calculator, locations of electrified parking spaces, status of the weight exemption for idling reduction devices, back issues of the National Idling Reduction Network News, IdleBox (an electronic, modular toolkit to facilitate idling reduction outreach and implementation), IdleBase (a database of idling regulations for all classes of on-road vehicles), and the Alternative Fuels Data Center idle reduction page.
https://energy.gov/eere/vehicles/vehicle-technologies-office-idle-reduction

Transportation for America Reports, Mapping Tools, Books, Other Resources
Information about innovative transportation policies states can consider, funding and policy resources, case studies and lessons learned, etc.
http://transportationforamerica.org/maps-tools/
Guidebook for innovative Metropolitan Planning Organizations: http://t4america.org/maps-tools/the-innovative-mpo/
Support for bus rapid transit projects: http://transportationforamerica.org/2016/01/12/new-study-finds-positive-economic-development-benefits-associated-with-bus-rapid-transit-projects/ The report includes a review of several existing BRT systems, including those in Advance areas **Las Vegas, NV** and **Kansas City, MO**.
Case studies on prioritizing public health to build prosperous regions:
http://t4america.org/maps-tools/mpo-case-studies/

(2) ENERGY

ENERGY STAR Webinars
Portfolio Manager 101, 201, and 301, March 28-30, April 18-20, May 23-25 **at 1pm EST each day**

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Learn about EPA's ENERGY STAR Portfolio Manager tool. On February 21 and March 28, the 101 level presentation will teach attendees how to navigate Portfolio Manager, add a property and enter details about it, enter energy and water consumption data, and generate template performance reports to assess progress. On February 22 and March 29, the 201 level presentation will be a deeper dive into more advanced functionalities such as editing property data, correcting/updating property use details, using the data quality checker, and sharing property data. On February 23 and March 30, the 301 level presentation will discuss advanced features such as using spreadsheet upload templates to update property data, setting goals and targets to plan energy improvements for properties, creating custom reports, and using the Sustainable Buildings Checklist.
To register for any/all of the three sessions:
https://esbuildings.webex.com/mw3100/mywebex/default.do?siteurl=esbuildings

Dept. of Energy
Better Buildings Summit – May 15-17, 2017, Washington, DC
This national meeting is a forum for leading organizations across key sectors to showcase solutions to cut energy intensity in their buildings portfolio-wide by 20% over the next ten years. At the 2017 Summit, more than 900 participants will focus on sharing proven approaches. Speakers from the commercial, industrial, public, multifamily, residential and data center sectors will share how they draw on energy efficiency technologies, business practices, and partnerships to save money on utility bills, create new jobs, and improve their organization's competitiveness.
More information and to register: https://betterbuildingssolutioncenter.energy.gov/summit

Clean Energy States Alliance Workshop
Bringing the Benefits of Solar to Low- and Moderate-Income Residents, June 14, 2017 9-5pm EST, Metropolitan Washington DC Council of Governments Training Center
This workshop for state officials will examine the challenges states face in promoting low and moderate income solar and ideas for overcoming those challenges. Participants will discuss financing, using community solar, reducing lifecycle costs, and harnessing existing poverty and housing programs for solar. The workshop will help state officials identify and plan strategies for low and moderate income solar for their particular state. Workshop attendees who request travel support will receive reimbursement covering most or all of their travel and hotel costs. Applications will be reviewed on a rolling basis until the workshop has been filled.
Agenda: http://www.cesa.org/assets/2017-Files/LMI-Solar-Workshop-Agenda.pdf
More information and to register:
https://docs.google.com/forms/d/e/1FAIpQLSevD8cmSu6W2cU97yINlhBQhzid4kKQMdhy5dkt3ZigxilytQ/viewform?c=0&w=1

Dept. of Energy
2017 National Energy Codes Conference – July 18-20, 2017, Pittsburgh, PA

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The conference will focus on achieving compliance, and sessions will also cover development, adoption, policy, tools and research. This is the only national conference dedicated solely to energy codes.
More information: https://www.energycodes.gov/events/2017-doe-national-energy-codes-conference

Dept. of Energy
Better Buildings Financing Navigator
Use this website to explore energy efficiency financing options and see how they compare to each other, and connect with financial allies who can finance your projects.
Website: https://betterbuildingssolutioncenter.energy.gov/financing-navigator/

Dept. of Energy
State and Local Energy Data (SLED) Website
This new website provides planning tools for cities. Provides city-specific data for 23,400 cities across the U.S., including estimates of electricity and natural gas use and costs by sector, energy market profiles that provide data on fuel types, and the fuel economy of vehicles registered in each city. The profiles also provide an estimate of vehicle fuel consumption, vehicle miles traveled, rooftop solar energy potential for small buildings, a building stock characterizations, and a snapshot of the top energy consuming industries in each city.
The website also includes a local energy toolbox, where communities can access a customizable list of actions to help make strategic energy decisions. The more than 500 searchable resources in the toolbox are technology-neutral, actionable energy strategies based on the energy activities cities are currently pursuing.
http://apps1.eere.energy.gov/sled/#/

Dept. of Energy Webinars
Low Income Home Energy Assistance Program (LIHEAP)
http://www.acf.hhs.gov/ocs/resource/liheap-trainings

Dept. of Energy
Building Energy Software
The Building Energy Asset Scoring Tool (the Asset Score) generates a simple energy efficiency rating that enables comparison among commercial and multifamily residential buildings, helps identify building energy improvement opportunities and can reduce utility expenses.
More information: http://energy.gov/eere/buildings/building-energy-asset-score and http://www.energymanagertoday.com/does-building-energy-asset-score-platform-a-useful-first-step-to-efficiency-0122941/

Dept. of Energy
Better Buildings Energy Data Accelerator Resources Toolkit

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A compilation of case studies, guidance and real-world best practices adopted by cities and utilities to help building owners measure and track energy use, and benchmark the energy performance of their buildings.
http://betterbuildingssolutioncenter.energy.gov/toolkits/energy-data-access-blueprint-action and http://energy.gov/eere/articles/energy-department-announces-publication-better-buildings-energy-data-accelerator

Dept. of Energy Tool for Locating State Tax Credits, Rebates, Savings
http://www.energy.gov/

Fannie Mae HomeStyle Energy Program
This program enables more Americans to invest in energy efficiency, including solar. The HomeStyle Energy Program is a mortgage option that gives borrowers the ability to complete clean energy upgrades up to 15 percent of the as-completed appraised property value of the home. Borrowers are able to finance energy efficient upgrades when purchasing or refinancing a home, eliminating the need for a subordinate lien, home equity line of credit, Property Assessed Clean Energy loan or unsecured loan.
More information:
http://www.sustainablecitynetwork.com/topic_channels/energy/article_136827e8-0050-11e6-9c74-3354d46d47b2.html?utm_source=SCN+InBox+e-Newsletter&utm_campaign=3baff22ef5-SCNNewsletter_Municipal&utm_medium=email&utm_term=0_11e7ac761c-3baff22ef5-188859017&mc_cid=3baff22ef5&mc_eid=76907d0b36

(3) GREEN INFRASTRUCTURE

Some green infrastructure programs (tree planting, green roofs, etc.) can result in air quality benefits, and would be worth noting in Advance plans.

Environmental Protection Agency
Green Infrastructure Program
Green Infrastructure Wizard (GIWiz):
This interactive web application connects communities to a wealth of tools and resources to help manage stormwater runoff. https://cfpub.epa.gov/giwiz/
Webinar Recordings:
https://www.epa.gov/green-infrastructure/green-infrastructure-webcast-series
Soak Up the Rain Outreach Tools: https://www.epa.gov/soakuptherain/soak-rain-ready-use-outreach-tools
Watershed Management Optimization Support Tool (WMOST): This tool can be used to screen a wide range of potential water resources management options for cost effectiveness as well as environmental and economic sustainability. https://www.epa.gov/exposure-assessment-models/wmost

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Environmental Protection Agency
Office of Research and Development
EPA's EnviroAtlas provides users with interactive tools, geospatial data, and resources for exploring the benefits people receive from nature, also known as ecosystem goods and services. Such benefits are critically important to health and well-being, but are easy to overlook due to a lack of information. The EnviroAtlas resources help fill this information gap.
https://www.epa.gov/enviroatlas

Dept. of Agriculture Webinar Recordings
Urban Forest Connections
This webinar series brings experts together to discuss the latest science, practice, and policy on urban forestry and the environment.
https://www.fs.fed.us/research/urban-webinars/

U.S. Forest Service Resources
Urban Watershed Forestry Manual
Part 1: Methods for Increasing Forest Cover in a Watershed -
https://www.treesearch.fs.fed.us/pubs/19916?utm_source=Copy+of+January+Urban+Forest+Connections+Webinar+Follow+Up&utm_campaign=Urban+Forest+Connections+Webinar&utm_medium=email
Part 2: Conserving and Planting Trees at Development Sites -
https://www.treesearch.fs.fed.us/pubs/19936?utm_source=Copy+of+January+Urban+Forest+Connections+Webinar+Follow+Up&utm_campaign=Urban+Forest+Connections+Webinar&utm_medium=email
Part 3: Urban Tree Planting Guide -
https://www.treesearch.fs.fed.us/pubs/10500?utm_source=Copy+of+January+Urban+Forest+Connections+Webinar+Follow+Up&utm_campaign=Urban+Forest+Connections+Webinar&utm_medium=email
i-Tree Hydro
Simulates the effects of changes in urban tree cover and impervious surfaces on the hydrological cycle.
http://www.itreetools.org/hydro/index.php?utm_source=Copy+of+January+Urban+Forest+Connections+Webinar+Follow+Up&utm_campaign=Urban+Forest+Connections+Webinar&utm_medium=email

Georgetown Climate Center
Green Infrastructure Toolkit

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Designed to help local governments find the resources and examples that are most helpful to them. The toolkit analyzes common trends in the approaches cities are taking to planning, implementing, and funding green infrastructure to manage stormwater. The kit contains a variety of resources including best practices information, financing strategies and sources of funding, communication strategies, etc.
http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/introduction.html

Environmental Protection Agency
Smart Growth Program – "City Green: Innovative Green Infrastructure Solutions for Downtowns and Infill Locations"
This report is a collection of 12 case studies of projects in cities overcoming challenges to implementing green infrastructure. Potential benefits of green infrastructure include reduced municipal water use, reduced ozone and PM, reduced air temperatures in developed areas, and reduced energy use.
https://www.epa.gov/sites/production/files/2016-06/documents/city_green_0.pdf

(4) URBAN HEAT ISLAND

Environmental Protection Agency Webinar Recordings
Urban Heat Island Program
https://www.epa.gov/heat-islands/heat-island-webcasts

(5) WOOD SMOKE

Environmental Protection Agency
BurnWise Program
https://www.epa.gov/burnwise
A BurnWise Health and Safety Awareness Kit is available to state, local, and tribal air agencies interested in reducing residential wood smoke pollution. It includes best burn tips, infographics, social media messages, a fast facts one pager and an article template. These materials will make it easier for you/your agency to add facts to your website, post information on social media, or conduct a health and safety awareness campaign.
https://www.epa.gov/burnwise/burn-wise-awareness-kit

(6) EDUCATION/AWARENESS

Environmental Protection Agency
Air Quality Awareness Week
Air Quality Awareness Week will take place from **May 1-5, 2017**. The daily themes this year will

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include Wildfires (Monday), Asthma and Air Quality/World Asthma Day (Tuesday), Air Quality Trends (Wednesday), Air Quality Around the World (Thursday), and Citizen Science (Friday). If your area is planning any activities or events, we can help you spread the word by noting them on the AirNow Air Quality Awareness Week website ("Events" page), which will be created this spring. Send your submissions to advance@epa.gov.

Environmental Protection Agency
Air Quality Workshop for Teachers – July 11-12, 2017 9am-4pm EDT, Durham, NC
This FREE annual workshop for teachers covers a variety of air quality information and resources.
To register: https://www3.epa.gov/airnow/teachers/aqw-recruit-2017.pdf
For information about the topics covered at the 2016 workshop:
https://www3.epa.gov/airnow/teachers/aqw-recruit-2017.pdf

Air Quality Resources for Teachers
Includes curriculum resources, information about past and upcoming teacher workshops, links to web sites for teachers and students, and activities and materials for students.
https://www.airnow.gov/index.cfm?action=learning.forteachers

APTI-Learn Portal
APTI-Learn is the EPA's technical training portal for federal, state, tribal, and local air pollution professionals. Supported by the Air Pollution Training Institute (APTI) – a partnership of EPA, instructors, and regional multi-jurisdictional organizations – APTI-Learn is where these professionals can find the knowledge they need to implement environmental programs and policies. Courses include topics such as: introduction to air pollution, permitting, enforcement, monitoring and data analysis. Courses are available in several formats: classroom, videos, webinars, and self-instructional. To see course offerings and classroom course schedules and to register, go to: http://www.apti-learn.net

Free Environmental Education Materials
EPA's National Service Center for Environmental Publications offers materials grouped by grade range.

- Teachers can order environmental education materials for students: http://www.epa.gov/nscep/teacher-order-forms-epa-environmental-materials
- Explore lesson plans, activity books, posters, videos, project ideas, student awards, and more: http://www.epa.gov/students
- Learn more about how Environmental Education increases public awareness and knowledge about environmental issues or problems: http://www.epa.gov/education

The National Environmental Education Foundation also provides free materials and educator toolkits through its Learning Center: https://www.neefusa.org/greening-stem-learning-center

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EPA Advance Program - Funding Opportunities, Training, and Resources
August 2016

Environmental Protection Agency, Office of Transportation and Air Quality (OTAQ) - Applying TEAM in Regional Sketch Planning
EPA recently released a new report that serves as a resource for areas interested in travel efficiency strategies. The report provides three case studies from areas that have used the Travel Efficiency Assessment Method (TEAM) to forecast potential regional travel activity and emission reductions from travel efficiency strategies. Over the past several years, OTAQ has been providing technical assistance to Metropolitan Planning Organizations in applying TEAM to evaluate the emission reduction potential of a wide range of travel efficiency strategies. EPA plans to solicit applications for another round of technical assistance in FY17; the solicitation is expected to be available by **early fall 2016**.
https://www3.epa.gov/otaq/stateresources/ghgtravel.htm

Environmental Protection Agency
Environmental Justice Small Grants Program
EPA anticipates issuing a new RFP to support collaborative partnerships that address local environmental and public health issues in **September 2016**.
http://www3.epa.gov/environmentaljustice/grants/ej-smgrants.html

Environmental Protection Agency
Diesel Emissions Reduction Act School Bus Rebate Program
EPA anticipates soliciting applications for another school bus rebate program in **October 2016**. Eighteen projects in ten Advance areas received funding via this program in 2015. http://www.epa.gov/cleandiesel/clean-diesel-rebates
https://www.epa.gov/cleandiesel/clean-school-bus

EPA Offers up to $80,000 to Communities to Develop Air Sensor Data Best Practices
The EPA recently announced a grant opportunity to assist communities in developing best practices for air sensor data. The EPA plans to award up to $40,000 to two communities to develop a community based air sensor network. The purpose of these funds would be to act as seed money. The EPA expects that the community awarded the grant to deploy between 250 and 500 sensors and to develop methods of evaluating, operating the sensors in addition to developing methods to share the data with the public. Applications are due by 4:00 pm on October 28, 2016. Awards will be announced in December. Detailed information on this grant opportunity including instructions on how to apply, and performance criteria for judging the quality of each application can be found at: https://www.challenge.gov/challenge/smart-city-air-challenge/.

Dept. of Energy - SunShot Initiative

The Dept. of Energy is developing a Community Solar Challenge that will award funds (up to $100,000) and/or technical assistance to teams in dozens of communities to develop innovative models to increase solar deployment and cut communities' energy bills, in particular in low-income communities. The competition may occur in **fall 2016**. Shared solar systems of 2 megawatts or less with 40% low- and moderate-income subscribers, solar systems that benefit low-income families, and solar for community assets (hospitals, schools, etc.) will be eligible. Total funding for the program is expected to be $5 million. Up to $1.5 million in prizes may be awarded at the conclusion of the competition in early 2018.
More information: http://www.energy.gov/eere/sunshot/request-information-community-solar-challenge

Dept. of Energy, Office of Energy Efficiency and Renewable Energy
Scaling up the Next Generation of Building Efficiency Packages
The Dept. of Energy intends to issue a funding opportunity in **October 2016** to seek innovative partnerships to promote emerging and underutilized energy efficient and cost-effective building technology packages. Applicants will propose high impact real building demonstrations led by strategically structured teams who will identify and verify the cost and energy performance of multi-system energy efficiency packages (groups of technologies that improve efficiency across two or more systems, such as envelope, lighting/electrical, plug, process, heating, ventilation, cooling, refrigeration, energy management and information, sensors and controls.
https://eere-exchange.energy.gov/#Foald7f6d3759-ce4c-4099-9989-60fee9282b4c

Environmental Protection Agency, Office of Environmental Education
Environmental Education Grants Program
The EPA intends to offer another funding opportunity at the **end of 2016** for environmental education projects. The program supports environmental education projects that increase public awareness about environmental issues and provide participants with the skills to take responsible actions to protect the environment. Financial support is provided for projects that design, demonstrate and/or disseminate environmental education practices, methods or techniques. Since 1992, EPA has distributed between $2 million and $3.5 million in grant funding per year, supporting more than 3,600 grant projects. To learn about past projects and to sign up for updates, go to this website:
https://www.epa.gov/education/environmental-education-ee-grants

Dept. of Energy, Office of Energy Efficiency and Renewable Energy
Building Energy Codes Program
The Dept. of Energy intends to issue another funding opportunity at the **end of 2016** focused on identifying the energy code requirements for commercial buildings that can provide the maximum cost-effective energy and cost savings through increased compliance. DOE has done pilot work, but there has been little research on commercial

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energy codes. The funding opportunity will support DOE's continued interest in providing tools and data to help local governments, utilities, industry, design and construction professionals and other entities better understand the impact of energy codes and how to most effectively increase energy and cost savings.
http://www.grants.gov/web/grants/view-opportunity.html?oppId=281515

Dept. of Transportation
Transportation Investment Generating Economic Recovery (TIGER) 2017 Discretionary Grants
Assuming funding is made available to DOT for another round of TIGER grants in 2017, notice of the funding opportunity would potentially be provided in **winter/spring 2017**. See, for example, the Feb. 2016 funding opportunity announcement for the 2016 competition:
https://www.transportation.gov/sites/dot.gov/files/docs/2016%20TIGER%20NOFO%20FR.pdf

Dept. of Transportation
Fixing America's Surface Transportation Act (FAST)
Assuming funding is made available to DOT under FAST in 2017, this funding opportunity would continue to support state, tribal, and local governments (including MPOs) with transportation projects that focus on safety, freight, transit, and/or transit-oriented development, among other things. A variety of funding opportunities were made available via FAST in 2016 (see https://www.transportation.gov/administrations/office-policy/fast-act-implementation-highlights). If the program follows the same pattern in 2017, then funding announcements might begin to appear in **spring 2017**. Notably, the FAST Act continued the Congestion Mitigation and Air Quality Improvement Program (CMAQ) to support transportation projects to help meet the requirements of the Clean Air Act in states and local governments with nonattainment or maintenance areas. An estimated $2.309 billion was made available in 2016, and an estimated $2.360 billion is expected to be available in 2017.
http://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm

Dept. of Transportation, Maritime Administration
Vessel Emission Reduction Pilot/Demonstration Project
Funding for projects that demonstrate criteria air pollutant (such as NOx or PM) or greenhouse gas emission reductions and/or energy savings from marine vessels through either vessel repowering or the use of energy conservation technologies or measures. Eligible applicants include vessel owners, operators, or sponsors of U.S. flagged vessels operating on inland or coastal waterways, the Great Lakes, and in international trade. Estimated total program funding is up to $650,000 in cost sharing (50%) funding for up to two projects.
Deadline for applications is **Sept. 23, 2016**.

http://www.grants.gov/web/grants/view-opportunity.html?oppId=286922

Dept. of Energy, Office of Indian Energy Policy and Programs
First Steps Toward Developing Renewable Energy and Energy Efficiency on Tribal Lands
The Dept. of Energy has issued a request for proposals from Indian tribes and tribal energy resource development organizations for renewable energy and energy efficiency projects. The topic areas may include: (1) conducting energy options analyses, (2) establishing baseline energy use, (3) developing energy organizations, (4) conducting climate resiliency planning, (5) establishing policy, regulations and codes to reduce energy use or promote energy development, (6) obtaining skills and training related to energy use and development. Cost share must be at least 10% of the total allowable costs of the project, must come from non-Federal sources unless otherwise allowed by law, and may include cash or in-kind contributions. Estimated total program funding is $2-3 million, with individual awards ranging from $50,000-$250,000. Deadline for applications is **Oct. 20, 2016**.
http://www.grants.gov/web/grants/view-opportunity.html?oppId=287557

Transportation for America
Formation of National Collaborative
Transportation for America is soliciting applications for a new national, multi-city collaborative with Sidewalk Labs. The partnership will help cities use technology to meet their pressing transportation challenges. Cities will become part of working groups, each focusing on one aspect of a smart city, and they will develop pilot projects, share successes and failures, and engage with one another to come up with new, creative solutions. Applications accepted in **summer/fall 2016**.
http://t4america.org/2016/08/10/applications-are-open-for-t4americas-smart-city-collaborative/

Dept. of Energy
Property Assessed Clean Energy (PACE) Program
PACE is an innovative mechanism for financing energy efficiency, solar, and related improvements on private property. PACE programs allow local and state governments and other inter-jurisdictional authorities, when authorized by state law, to fund the up-front cost of energy improvements on commercial and residential properties, which are paid back over time by the property owners. PACE financing for clean energy projects is generally based on an existing “land-secured financing district,” or assessment district, where the local government issues bonds to fund projects with a public purpose such as street lights, sewer systems, or underground utility lines. PACE was recently extended to energy efficiency and renewable energy, which allows property owners to implement improvements without a large up-front cash payment. Property owners who opt to participate in a PACE program can repay their improvement costs over a set time period (typically 10-20 years) through property assessments which are secured by the property

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itself and paid as an addition to the owners' property tax bills. The repayment obligation may transfer with property ownership depending on state legislation.
More information: http://energy.gov/eere/slsc/property-assessed-clean-energy-programs
List of current PACE programs: http://www.pacenation.us/resources/all-programs/

Dept. of Energy
Low Income Housing Energy Assistance Program (LIHEAP)
This funding opportunity may be of particular interest to Advance areas that are interested in energy efficiency programs and/or that have concerns about wood smoke. LIHEAP assists families with energy costs associated with home energy bills, energy crises, and weatherization and energy-related minor home repairs. LIHEAP provides, on average, more than $3 billion a year to communities and includes a provision that allows grantees to access 15-25% of their annual funding for low cost weatherization and energy efficiency improvements. HHS and DOE are offering technical assistance to LIHEAP grantees to increase their ability to use their funding to support the deployment of renewable energy.
http://www.acf.hhs.gov/ocs/programs/liheap/about

National Park Service and Clean Cities
National Parks Initiative
Supports transportation projects that educate park visitors on the benefits of cutting petroleum use and vehicle emissions. Since 2010, 32 projects have deployed alternative fuel and fuel-efficient vehicles to the road, reduced vehicle idling, and improved vehicle efficiency. Four of these projects were located in Advance areas, i.e. **Minnesota** (installing 12 electric vehicle charging stations at 11 sites)**, Springfield, MO** (will add a propane truck, four propane lawnmowers, and propane refueling infrastructure to park fleet)**, San Antonio, TX** (replacing two gas-powered trucks with propane-fueled trucks, installing two electric vehicle charging stations and a propane vehicle refueling site), and **Kansas City** (replacing a gas-powered truck and mower with propane-fueled truck and mower, launching an idle-reduction education and outreach initiative). To learn more and to propose new projects for funding, go to:
https://cleancities.energy.gov/national-parks/

Training and Resources

Environmental Protection Agency Webinar – **September 7, 2016 2-3pm EDT**
Strut Your SmartWay Stuff!
Join SmartWay staff to learn about the suite of SmartWay marketing resources, from data to the array of publicity and advertising resources, appropriate uses of the logo for partners, affiliates, trucks and trailers, as well as the logo request process. This webinar will equip SmartWay partners to highlight their companies as freight industry leaders.
To register: https://attendee.gotowebinar.com/register/1972530833949961731

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Environmental Protection Agency Webinar – September 14, 2016 2-3pm EDT
SmartWay Program, "Global Green Freight Action"
Business leaders, policy makers, and civil society are expanding global cooperation and collaboration on Green Freight programs, strategies, and technologies, with a common goal of reducing freight transport fuel use, emissions and costs. EPA SmartWay worked with the United National Environment Programme and the Climate and Clean Air Coalition to develop the Global Green Freight Action Plan to serve as a roadmap to advance these efforts. Join the webinar to learn about the action plan and key action areas, hear the call to action from an industry peer, and understand roles your firm can play and opportunities of engaging in Global Green Freight efforts.
To register: https://attendee.gotowebinar.com/register/7521860574414320132

Environmental Protection Agency Advance Program Webinar – September 15, 2016 2-3pm - Heat Island Effect and Air Quality
Join us to hear about the urban heat island effect and how it relates to air quality and energy and what communities can do to mitigate its negative impacts. "Heat island" describes built up areas that are hotter than surrounding areas. Heat islands can affect communities by increasing summertime energy demand, air pollution, greenhouse gas emissions, and heat-related illnesses. The elevated temperatures of a heat island can directly increase the rate of ground-level ozone formation. This webinar will provide Advance Program participants with an overview of the causes and impacts of heat islands and describe strategies that states, tribes, and local governments can implement to help reduce both the heat island effect and ozone levels (e.g. green roofs, trees, cool pavements).
Registration information will be distributed on August 29, 2016.
More information about the heat island effect: www.epa.gov/heat-islands

Environmental Protection Agency Webinar – November 2016
Building the Case for Green Infrastructure: Outreach and Education
http://www.epa.gov/green-infrastructure/green-infrastructure-webcast-series

Environmental Protection Agency Webinar – November 16, 2016 2-3pm EST
SmartWay: Efficiency Begins At Home, But Then There's The Neighbors: Getting to Know Your Carriers
A panel will discuss building your company's supply chain efficiency by acquiring information regarding potential supply chain partners. Three SmartWay shippers will each bring one of their SmartWay carriers/logistics companies to explain how they use data on environmental performance when making decisions on who moves freight and how, and how they meet efficiency objectives across their supply chain. Register at https://attendee.gotowebinar.com/register/512439862482263297

APTI-Learn Portal

APTI-Learn is the EPA's technical training portal for federal, state, tribal, and local air pollution professionals. Supported by the Air Pollution Training Institute (APTI) – a partnership of EPA, instructors, and regional multi-jurisdictional organizations – APTI-Learn is where these professionals can find the knowledge they need to implement environmental programs and policies. Courses include topics such as: introduction to air pollution, permitting, enforcement, monitoring and data analysis. Courses are available in several formats: classroom, web-based videos, webinars, online self-instructional courses.
To see course offerings and classroom course schedules and to register, go to: http://www.apti-learn.net

Free Environmental Education Materials
EPA's National Service Center for Environmental Publications offers materials grouped by grade range.

- Teachers can order environmental education materials for students: http://www.epa.gov/nscep/teacher-order-forms-epa-environmental-materials
- Explore lesson plans, activity books, posters, videos, project ideas, student awards, and more: http://www.epa.gov/students
- Learn more about how Environmental Education increases public awareness and knowledge about environmental issues or problems: http://www.epa.gov/education

The National Environmental Education Foundation also provides free materials and educator toolkits through its Learning Center: https://www.neefusa.org/greening-stem-learning-center

Environmental Protection Agency
Air Quality Awareness Materials

- Visit the AirNow Facebook page to see what state and local air programs are doing and to share how you are doing your part (https://www.facebook.com/airnow).
- Check the website and Twitter feed to learn about cool citizen science projects, links between asthma and air quality, information about air quality around the world, and trends in air quality (https://www3.epa.gov/airnow/airaware/ and https://twitter.com/search?q=airnow&src=typd). Primary Twitter hashtag is #careforyourair.
- Download AIRNow to a smartphone for air quality information on the go (https://developer.epa.gov/airnow/).

Environmental Protection Agency
Ozone and PM Designations Mapping Tools
EPA designed mapping tools to assist air quality planners with designations for the 2015 ozone and 2012 PM NAAQS, however the tools provide features that may be of interest

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to Advance areas as well. These include air quality data and trends, emissions data, source and monitor locations, population by county and Census tract, etc.
Ozone Designations Mapping Tool and explanatory webinar:
https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data (bottom of page)
PM Designations Mapping Tool and explanatory materials:
https://www3.epa.gov/pmdesignations/2012standards/techinfo.htm#C (bottom of page)

Dept. of Transportation and Smart Growth America
Transit-Oriented Development (TOD) Technical Assistance
A new website is now available to provide information and ideas about TOD projects. The site includes a data base of research, information about popular funding and financing options for projects, and opportunities for professionals to connect with one another.
www.TODresources.org

Alternative Fuel Station Locator (CNG, LNG, Multi)
Maintained by Penske, an EPA SmartWay program partner.
http://www.altfuelstations.com/

Webinar Recordings

EPA Webinars
Advance Program: https://www.epa.gov/advance/webinars-and-training
SmartWay Program: https://www.epa.gov/smartway/smartway-webinars-events
Green Infrastructure Program: https://www.epa.gov/green-infrastructure/green-infrastructure-webcast-series
Urban Heat Island Program: https://www.epa.gov/heat-islands/heat-island-webcasts

Dept. of Energy Webinars
Low Income Home Energy Assistance Program (LIHEAP):
http://www.acf.hhs.gov/ocs/resource/liheap-trainings

Environmental Protection Agency
Valley Identification and Valley Profile Tools
Valleys in New England are especially vulnerable to higher levels of PM2.5 from wood smoke during winter air inversions. These tools identify populated valleys throughout New England that are at risk for wood smoke pollution. They can be used to better plan air quality monitoring, outreach, and mitigation. The Valley Identification Tool and Valley Profile Tool can be found on the following page under the “Websites” heading:
https://www.epa.gov/advance/advance-resources

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Other Opportunities

Dept. of Energy
NEW! State and Local Energy Data (SLED) Website
This new website provides planning tools for cities. Provides city-specific data for 23,400 cities across the U.S., including estimates of electricity and natural gas use and costs by sector, energy market profiles that provide data on fuel types, and the fuel economy of vehicles registered in each city. The profiles also provide an estimate of vehicle fuel consumption, vehicle miles traveled, rooftop solar energy potential for small buildings, a building stock characterizations, and a snapshot of the top energy consuming industries in each city.
The website also includes a local energy toolbox, where communities can access a customizable list of actions to help make strategic energy decisions. The more than 500 searchable resources in the toolbox are technology-neutral, actionable energy strategies based on the energy activities cities are currently pursuing.
Website: http://apps1.eere.energy.gov/sled/#/

Free Dept. of Energy Building Energy Software
Office of Energy Efficiency and Renewable Energy
DOE is encouraging the use of its Building Energy Asset Scoring Tool (the Asset Score). The software tool was first released in 2014 and has since been used on 825 commercial and multifamily residential buildings nationwide. The tool generates a simple energy efficiency rating that enables comparison among buildings, helps identify building energy improvement opportunities and can reduce utility expenses. It is available for voluntary use and is free!
More information: http://energy.gov/eere/buildings/building-energy-asset-score and http://www.energymanagertoday.com/does-building-energy-asset-score-platform-a-useful-first-step-to-efficiency-0122941/

Dept. of Energy
Better Buildings Energy Data Accelerator Resources Toolkit
A compilation of case studies, guidance and real-world best practices adopted by cities and utilities to help building owners measure and track energy use, and benchmark the energy performance of their buildings.
http://betterbuildingssolutioncenter.energy.gov/toolkits/energy-data-access-blueprint-action and http://energy.gov/eere/articles/energy-department-announces-publication-better-buildings-energy-data-accelerator

Sustainable City Network
Live and Online Training Opportunities
Courses on a variety of sustainability topics are available, along with a library of on-demand videos, many of which can be accessed free of charge.
http://www.sustainablecitynetwork.com/topic_channels/policy/article_e7d69ebe-cab9-

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11e5-b943-3b976faba2e1.html?utm_source=SCN+InBox+e-Newsletter&utm_campaign=400488c333-Newsletter_2-3-2016_Muni&utm_medium=email&utm_term=0_11e7ac761c-400488c333-188859017&mc_cid=400488c333&mc_eid=76907d0b36
Free downloadable webinars include topics such as measuring sustainability, green infrastructure (cutting energy costs in wastewater treatment), energy efficient lighting retrofits, design guidelines for transit supportive communities, and sustainability efforts in a number of cities (including several Advance areas – Dubuque, IA, Austin, TX, Las Vegas, NV):
http://www.sustainablecitynetwork.com/webinars/?utm_source=SCN+InBox+e-Newsletter&utm_campaign=821ce3e4f3-SCN_Newsletter&utm_medium=email&utm_term=0_11e7ac761c-821ce3e4f3-188859017&mc_cid=821ce3e4f3&mc_eid=76907d0b36

EPA Grants 101 Tutorial
Information on applying for an EPA grant, accepting the award, carrying out activities, and closing out the grant.
http://www.epa.gov/grants/epa-grants-101-tutorial

Dept. of Energy Tool for Locating State Tax Credits, Rebates, Savings
http://www.energy.gov/

Fannie Mae HomeStyle Energy Program
This new program will enable more Americans to invest in energy efficiency, which includes solar. The HomeStyle Energy Program is a new mortgage option that gives borrowers the ability to complete clean energy upgrades up to 15 percent of the as-completed appraised property value of the home. Borrowers are able to finance energy efficient upgrades when purchasing or refinancing a home, eliminating the need for a subordinate lien, home equity line of credit, Property Assessed Clean Energy loan or unsecured loan.
More information:
http://www.sustainablecitynetwork.com/topic_channels/energy/article_136827e8-0050-11e6-9c74-3354d46d47b2.html?utm_source=SCN+InBox+e-Newsletter&utm_campaign=3baff22ef5-SCNNewsletter_Municipal&utm_medium=email&utm_term=0_11e7ac761c-3baff22ef5-188859017&mc_cid=3baff22ef5&mc_eid=76907d0b36

Safer, More Efficient Wood Stove Heating and the Low Income Home Energy Assistance Program (LIHEAP)
A recording of this November 2015 EPA/Health and Human Services webinar has been posted here: http://www.acf.hhs.gov/programs/ocs/resource/liheap-trainings

Smart Growth America "The Best Complete Streets Policies of 2015"

Released in April 2016, this free report ranks the Complete Streets policies that have been adopted by communities across the nation. In 2015, 82 new Complete Streets policies were passed by communities. Nationwide, a total of 899 policies are now in place and are located in every state. The policies create safer multimodal transportation networks.
The report is available here: http://www.smartgrowthamerica.org/best-complete-streets-policies-of-2015
A recorded webinar about the report, including representatives from top-scoring communities is also available:
http://www.smartgrowthamerica.org/2016/04/14/recorded-webinar-the-best-complete-streets-of-2015/

Transportation for America Reports, Mapping Tools, Books, Other Resources
Information about innovative transportation policies states can consider, funding and policy resources, case studies and lessons learned, etc.
http://transportationforamerica.org/maps-tools/
Guidebook for innovative Metropolitan Planning Organizations:
http://t4america.org/maps-tools/the-innovative-mpo/
Support for bus rapid transit projects:
http://transportationforamerica.org/2016/01/12/new-study-finds-positive-economic-development-benefits-associated-with-bus-rapid-transit-projects/ The report includes a review of several existing BRT systems, including those in Advance areas Las Vegas, NV and Kansas City, MO.

Environmental Protection Agency
Smart Growth Program – "City Green: Innovative Green Infrastructure Solutions for Downtowns and Infill Locations"
This report is a collection of 12 case studies of projects in cities overcoming challenges to implementing green infrastructure. Potential benefits of green infrastructure include reduced municipal water use, reduced ozone and PM, reduced air temperatures in developed areas, and reduced energy use.
https://www.epa.gov/sites/production/files/2016-06/documents/city_green_0.pdf

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Funding Opportunities, Training, and Resources

Environmental Protection Agency, Office of Transportation and Air Quality (OTAQ)
Applying TEAM in Regional Sketch Planning
EPA recently released a new report that serves as a resource for areas interested in travel efficiency strategies. The report provides three case studies from areas that have used the Travel Efficiency Assessment Method (TEAM) to forecast potential regional travel activity and emission reductions from travel efficiency strategies. Travel efficiency strategies affect travel activity, such as travel demand management (e.g., telecommuting, transit subsidies), public transit fare changes and service improvements, road and parking pricing, and land use/smart growth. Over the past several years, OTAQ has been providing technical assistance to Metropolitan Planning Organizations in applying TEAM to evaluate the emission reduction potential of a wide range of travel efficiency strategies. EPA plans to solicit applications for another round of technical assistance in FY17; the solicitation is expected to be available by **fall 2016**.
https://www3.epa.gov/otaq/stateresources/ghgtravel.htm
https://www.epa.gov/state-and-local-transportation/estimating-road-greenhouse-gas-emissions

Environmental Protection Agency
Environmental Justice Small Grants Program
EPA anticipates issuing a new RFP to support collaborative partnerships that address local environmental and public health issues in **fall 2016**.
http://www3.epa.gov/environmentaljustice/grants/ej-smgrants.html

Environmental Protection Agency
Diesel Emissions Reduction Act School Bus Rebate Program
EPA anticipates soliciting applications for another school bus rebate program from **September 29 – November 1, 2016**. If any school districts in your area are operating older (pre-2006) buses, then this program may be especially useful. Applications are funded via a lottery system. Eighteen projects in ten Advance areas received funding via this program in 2015.
http://www.epa.gov/cleandiesel/clean-diesel-rebates
https://www.epa.gov/cleandiesel/clean-school-bus

Dept. of Energy
SunShot Initiative – Community Solar Challenge
The Dept. of Energy is developing a Community Solar Challenge that will award funds (up to $100,000) and/or technical assistance to teams in dozens of communities to develop innovative models to increase solar deployment and cut communities' energy bills, in particular in low-income communities. The competition may occur in **fall 2016**. Shared solar systems of 2

megawatts or less with 40% low- and moderate-income subscribers, solar systems that benefit low-income families, and solar for community assets (hospitals, schools, etc.) will be eligible. Total funding for the program is expected to be $5 million. Up to $1.5 million in prizes may be awarded at the conclusion of the competition in early 2018.
More information: http://www.energy.gov/eere/sunshot/request-information-community-solar-challenge
DOE Community and Shared Solar website: http://energy.gov/eere/sunshot/community-and-shared-solar

Dept. of Energy, Office of Energy Efficiency and Renewable Energy
Scaling up the Next Generation of Building Efficiency Packages
The Dept. of Energy intends to issue a funding opportunity in **October 2016** to seek innovative partnerships to promote emerging and underutilized energy efficient and cost-effective building technology packages. Applicants will propose high impact real building demonstrations led by strategically structured teams who will identify and verify the cost and energy performance of multi-system energy efficiency packages (groups of technologies that improve efficiency across two or more systems, such as envelope, lighting/electrical, plug, process, heating, ventilation, cooling, refrigeration, energy management and information, sensors and controls.
https://eere-exchange.energy.gov/#Foaid7f6d3759-ce4c-4099-9989-60fee9282b4c

Dept. of Energy, Office of Indian Energy Policy and Programs
Deployment of Clean Energy and Energy Efficiency Projects on Indian Lands
The Dept. of Energy intends to issue a funding opportunity in **November 2016** for Indian Tribes (including Alaska Native Regional Corporations and Village Corporations) and tribal energy resource development organizations to (1) install clean energy and energy efficiency retrofit projects for tribal buildings, and (2) deploy clean energy systems on a community scale. There will be multiple assistance awards, with awards for projects in category (1) ranging from $50,000-$500,000 and awards for projects in category (2) ranging from $250,000-$1,000,000.
http://www.grants.gov/web/grants/view-opportunity.html?oppId=289134

Environmental Protection Agency, Office of Environmental Education
Environmental Education Grants Program
The EPA intends to offer another funding opportunity at the **end of 2016** for environmental education projects. The program supports environmental education projects that increase public awareness about environmental issues and provide participants with the skills to take responsible actions to protect the environment. Financial support is provided for projects that design, demonstrate and/or disseminate environmental education practices, methods or techniques. Since 1992, EPA has distributed between $2 million and $3.5 million in grant funding per year, supporting more than 3,600 grant projects. To learn about past projects and to sign up for updates, go to this website:

https://www.epa.gov/education/environmental-education-ee-grants

Dept. of Energy, Office of Energy Efficiency and Renewable Energy
Building Energy Codes Program
The Dept. of Energy intends to issue another funding opportunity at the **end of 2016** focused on identifying the energy code requirements for commercial buildings that can provide the maximum cost-effective energy and cost savings through increased compliance. DOE has done pilot work, but there has been little research on commercial energy codes. The funding opportunity will support DOE's continued interest in providing tools and data to help local governments, utilities, industry, design and construction professionals and other entities better understand the impact of energy codes and how to most effectively increase energy and cost savings.
http://www.grants.gov/web/grants/view-opportunity.html?oppId=281515

Environmental Protection Agency
FAQs for Beneficiaries to the Volkswagen Mitigation Trust Agreement
The June 2016 partial Volkswagen settlement request Volkswagen to establish and fund a $2.7 billion environmental mitigation trust. The trust will be administered by an independent trustee. Eligible mitigation actions are focused on large mobile sources of NOx pollution across the country, and involved reducing NOx from older, dirtier diesel engines, vehicles, equipment, and vessels. Appendix D-2 to the Consent Decree details the 10 eligible mitigation actions and eligible expenditures. Actions eligible under the Diesel Emission Reduction act (DERA) operation include truck stop electrification, fuel efficiency and idle reduction equipment, and other types of cleaner cargo handling equipment, construction equipment, smaller marine vessels, and diesel generators. Frequently asked questions about the settlement are answered in this July 2016 document: https://www.epa.gov/sites/production/files/2016-07/documents/faqvwmitigationtrusdtbeneficariesfirstedition0716.pdf

Dept. of Transportation
Transportation Investment Generating Economic Recovery (TIGER) 2017 Discretionary Grants
Assuming funding is made available to DOT for another round of TIGER grants in 2017, notice of the funding opportunity would potentially be provided in **winter/spring 2017**. See, for example, the Feb. 2016 funding opportunity announcement for the 2016 competition:
https://www.transportation.gov/sites/dot.gov/files/docs/2016%20TIGER%20NOFO%20FR.pdf

Dept. of Transportation
Fixing America's Surface Transportation Act (FAST)
Assuming funding is made available to DOT under FAST in 2017, this funding opportunity would

continue to support state, tribal, and local governments (including MPOs) with transportation projects that focus on safety, freight, transit, and/or transit-oriented development, among other things. A variety of funding opportunities were made available via FAST in 2016 (see https://www.transportation.gov/administrations/office-policy/fast-act-implementation-highlights). If the program follows the same pattern in 2017, then funding announcements might begin to appear in **spring 2017**. Notably, the FAST Act continued the Congestion Mitigation and Air Quality Improvement Program (CMAQ) to support transportation projects to help meet the requirements of the Clean Air Act in states and local governments with nonattainment or maintenance areas. An estimated $2.309 billion was made available in 2016, and an estimated $2.360 billion is expected to be available in 2017.
http://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm

Dept. of Energy, Office of Indian Energy Policy and Programs
First Steps Toward Developing Renewable Energy and Energy Efficiency on Tribal Lands
The Dept. of Energy has issued a request for proposals from Indian tribes and tribal energy resource development organizations for renewable energy and energy efficiency projects. The topic areas may include: (1) conducting energy options analyses, (2) establishing baseline energy use, (3) developing energy organizations, (4) conducting climate resiliency planning, (5) establishing policy, regulations and codes to reduce energy use or promote energy development, (6) obtaining skills and training related to energy use and development. Cost share must be at least 10% of the total allowable costs of the project, must come from non-Federal sources unless otherwise allowed by law, and may include cash or in-kind contributions. Estimated total program funding is $2-3 million, with individual awards ranging from $50,000-$250,000.
Deadline for applications is **Oct. 20, 2016**.
http://www.grants.gov/web/grants/view-opportunity.html?oppId=287557

Environmental Protection Agency
Smart City Air Challenge
EPA is offering up to $80,000 to communities to develop air sensor data best practices. Communities will work with their residents to crowdsource air quality data and share it with the public online. The projects will give individuals a role in collecting the data and understanding how environmental conditions affect their health and community. Prize funds will serve as seed money, so communities will need to partner with others, such as sensor manufacturers, data management companies, and universities. Initial awards of $40,000 each will be made to two communities to deploy air sensors, share data with the public, and develop data management best practices from sensors. Up to $10,000 each will be awarded to each of the winning

communities based on their accomplishments and collaboration.
Deadline for applications is **Oct. 28, 2016**.
https://www.challenge.gov/challenge/smart-city-air-challenge/

Transportation for America
Formation of National Collaborative
Transportation for America is soliciting applications for a new national, multi-city collaborative with Sidewalk Labs. The partnership will help cities use technology to meet their pressing transportation challenges. Cities will become part of working groups, each focusing on one aspect of a smart city, and they will develop pilot projects, share successes and failures, and engage with one another to come up with new, creative solutions.
Applications accepted in **summer/fall 2016**.
http://t4america.org/2016/08/10/applications-are-open-for-t4americas-smart-city-collaborative/

The Nature Conservancy
Grants for K-12 Schools
Grants will be awarded to support projects related to access to healthy food, air quality, heat island effect, climate change, or storm water collection. Young people will work as social innovators to help their communities through project design and implementation. A $2,000 grant will be awarded to 55 schools.
Deadline for applications is **October 31, 2016**.
More information: https://www.natureworkseverywhere.org/grants/

Robert Wood Johnson Foundation (RWJF)
Culture of Health Prize
The RWJF Culture of Health Prize recognizes communities that have placed a priority on health and are creating powerful partnerships and deep commitments that will enable everyone, especially those facing the greatest challenges, with the opportunity to live well. A Culture of Health recognizes that health and well being are greatly influenced by where we live, work, the safety of our surroundings, and the relationships we have. The Prize elevates the stories of local leaders and community members who are coming together to create conditions for health and prosperity by transforming neighborhoods, schools, and businesses that that good health flourishes everywhere. Prize amount is $25,000. Consider whether the air quality and other efforts in your Advance area might warrant recognition in this way!
Deadline for applications is **November 3, 2016**.
More information: http://www.rwjf.org/en/library/funding-opportunities/2016/2017-rwjf-culture-of-health-prize.html

Dept. of Agriculture

Farm to School Grant for FY2017

USDA anticipates awarding approximately $5 million in grant funding to support efforts that improve access to local foods in schools. Reduced transportation of foods can benefit local air quality, and some Advance areas have mentioned local foods programs in their paths forward. Applicants may apply for a planning grant ($20,000-$45,000), implementation grant ($65,000-$100,000), support service grant ($65,000-$100,000), or training grant ($15,000-$50,000). Applicants must provide at least 25 percent of the costs of the total project.

USDA will host an informational webinar on **September 29, 2016** at 1pm EDT. To register: https://cc.readytalk.com/registration/#/?meeting=d789foa16vmz&campaign=kwnoxjv0elb7

Deadline for applications is **December 8, 2016**.

More information: http://www.fns.usda.gov/fy17-farm-school-grant

Dept. of Transportation, Federal Highway Administration (FHWA)

Accelerated Innovation Deployment (AID) Demonstration

The FHWA AID Demonstration provides incentive funding for any project activities eligible for assistance under title 23, U.S.C. in any phase of a highway transportation project between project planning and project delivery including planning, financing, operation, structures, materials, pavements, environment, and construction that address the program goals. The notice of funding opportunity requests grant applications and provides selection criteria, application requirements, and technical assistance with Grants.gov during the grant solicitation period. Applications are accepted on a rolling basis. Estimated total funding is $50 million, with individual awards ranging from $50,000 to $1 million.

Deadline for applications is **Sept. 30, 2020**.

More information: http://www.grants.gov/web/grants/view-opportunity.html?oppId=288651 and https://www.fhwa.dot.gov/innovation/grants/. Examples of past projects across the country: https://www.fhwa.dot.gov/innovation/grants/projects/ (includes dynamic signage for safety and congestion mitigation, geospatial data projects, energy efficient lighting, recycled road materials, etc.)

Dept. of Energy

Property Assessed Clean Energy (PACE) Program

PACE is an innovative mechanism for financing energy efficiency, solar, and related improvements on private property. PACE programs allow local and state governments and other inter-jurisdictional authorities, when authorized by state law, to fund the up-front cost of energy improvements on commercial and residential properties, which are paid back over time by the property owners. PACE financing for clean energy projects is generally based on an existing "land-secured financing district," or assessment district, where the local government issues bonds to fund projects with a public purpose such as street lights, sewer systems, or underground utility lines. PACE was recently extended to energy efficiency and renewable energy, which allows property owners to implement improvements without a large up-front

cash payment. Property owners who opt to participate in a PACE program can repay their improvement costs over a set time period (typically 10-20 years) through property assessments which are secured by the property itself and paid as an addition to the owners' property tax bills. The repayment obligation may transfer with property ownership depending on state legislation.
More information: http://energy.gov/eere/slsc/property-assessed-clean-energy-programs
List of current PACE programs: http://www.pacenation.us/resources/all-programs/

Dept. of Energy
Low Income Housing Energy Assistance Program (LIHEAP)
This funding opportunity may be of particular interest to Advance areas that are interested in energy efficiency programs and/or that have concerns about wood smoke. LIHEAP assists families with energy costs associated with home energy bills, energy crises, and weatherization and energy-related minor home repairs. LIHEAP provides, on average, more than $3 billion a year to communities and includes a provision that allows grantees to access 15-25% of their annual funding for low cost weatherization and energy efficiency improvements. HHS and DOE are offering technical assistance to LIHEAP grantees to increase their ability to use their funding to support the deployment of renewable energy.
http://www.acf.hhs.gov/ocs/programs/liheap/about

Dept. of Energy
SolSmart Technical Assistance – Nationally Distinguished, Locally Powered
SolSmart is a national recognition and a no-cost technical assistance program for local governments. The program is designed to drive greater solar deployment and help make it possible for more homes and businesses to access affordable and renewable solar energy to meet their electricity needs. SolSmart experts will design personalized action plans for communities that outline a path to designation as a SolSmart community, along with a rough timeline. SolSmart is federally funded for a three-year period, but is expected to persist beyond this timeframe. Stakeholder and community benefits are described on the program website.
Ongoing technical assistance opportunity.
http://www.gosparc.org/

National Park Service and Clean Cities
National Parks Initiative
Supports transportation projects that educate park visitors on the benefits of cutting petroleum use and vehicle emissions. Since 2010, 32 projects have deployed alternative fuel and fuel-efficient vehicles to the road, reduced vehicle idling, and improved vehicle efficiency. Four of these projects were located in Advance areas, i.e. **Minnesota** (installing 12 electric vehicle charging stations at 11 sites)**, Springfield, MO** (will add a propane truck, four propane lawnmowers, and propane refueling infrastructure to park fleet)**, San Antonio, TX** (replacing

two gas-powered trucks with propane-fueled trucks, installing two electric vehicle charging stations and a propane vehicle refueling site), and **Kansas City** (replacing a gas-powered truck and mower with propane-fueled truck and mower, launching an idle-reduction education and outreach initiative). To learn more and to propose new projects for funding, go to: https://cleancities.energy.gov/national-parks/

The Fruit Tree Planting Foundation (FTPF)
Orchard Donation Program
FTPF is a nonprofit charity dedicated to planting fruit trees and plants to alleviate world hunger, combat global warming, strengthen communities, and improve the surrounding air, soil, and water. FTPF programs strategically donate orchards where the harvest will best serve communities for generations, at places such as community gardens, public schools, city/state parks, low income neighborhoods, and Native American reservations.
Ongoing opportunity; applications accepted on a rolling basis.
http://www.ftpf.org/apply.htm

Training and Resources

(1) MISCELLANEOUS/MULTI-TOPIC

Environmental Protection Agency Webinar Recordings
Advance Program
https://www.epa.gov/advance/webinars-and-training

Environmental Protection Agency Video Training Series
2015 Ozone National Ambient Air Quality Standards
This new video training series cover the key changes to the standards in the 2015 update. To access the videos on the Air Pollution Training Institute APTI-Learn website, choose "Learn" then "Planning/Regulation Development" and then "Launch Course" beside each of the modules. The modules include APTI V-237-1 through V-237-6, and cover these topics: introduction, primary standards, secondary standards, air quality index, implementation, and monitoring.
APTI-Learn site: https://www.apti-learn.net/LMS/EPAHomePage.aspx
Ozone NAAQS site: https://www3.epa.gov/ttn/naaqs/standards/ozone/s_o3_index.html

Environmental Protection Agency
Ozone and PM Designations Mapping Tools
EPA designed mapping tools to assist air quality planners with designations for the 2015 ozone

and 2012 PM NAAQS, however the tools provide features that may be of interest to Advance areas as well. These include air quality data and trends, emissions data, source and monitor locations, population by county and Census tract, etc.
Ozone Designations Mapping Tool and explanatory webinar: https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data (bottom of page)
PM Designations Mapping Tool and explanatory materials:
https://www3.epa.gov/pmdesignations/2012standards/techinfo.htm#C (bottom of page)

Sustainable City Network
Live and Online Training Opportunities
Courses on a variety of sustainability topics are available, along with a library of on-demand videos, many of which can be accessed free of charge.
http://www.sustainablecitynetwork.com/topic_channels/policy/article_e7d69ebe-cab9-11e5-b943-3b976faba2e1.html?utm_source=SCN+InBox+e-Newsletter&utm_campaign=400488c333-Newsletter_2-3-2016_Muni&utm_medium=email&utm_term=0_11e7ac761c-400488c333-188859017&mc_cid=400488c333&mc_eid=76907d0b36
Free downloadable webinars include topics such as measuring sustainability, green infrastructure (cutting energy costs in wastewater treatment), energy efficient lighting retrofits, design guidelines for transit supportive communities, and sustainability efforts in a number of cities (including several Advance areas – Dubuque, IA, Austin, TX, Las Vegas, NV):
http://www.sustainablecitynetwork.com/webinars/?utm_source=SCN+InBox+e-Newsletter&utm_campaign=821ce3e4f3-SCN_Newsletter&utm_medium=email&utm_term=0_11e7ac761c-821ce3e4f3-188859017&mc_cid=821ce3e4f3&mc_eid=76907d0b36

EPA Grants 101 Tutorial
Information on applying for an EPA grant, accepting the award, carrying out activities, and closing out the grant.
http://www.epa.gov/grants/epa-grants-101-tutorial

(2) MOBILE SOURCES

Environmental Protection Agency Webinar – November 16, 2016 2-3pm EST
SmartWay: Efficiency Begins At Home, But Then There's The Neighbors: Getting to Know Your Carriers
A panel will discuss building your company's supply chain efficiency by acquiring information regarding potential supply chain partners. Three SmartWay shippers will each bring one of their SmartWay carriers/logistics companies to explain how they use data on environmental

performance when making decisions on who moves freight and how, and how they meet efficiency objectives across their supply chain.
To register: https://attendee.gotowebinar.com/register/512439862482263297

Environmental Protection Agency, Office of Transportation and Air Quality
National Assessment of Strategies to Reduce Air Pollution at Ports
This report finds that air pollution at the nation's ports can be reduced significantly at all port types and sizes through a variety of strategies and cleaner technologies. The assessment examines current and future emission trends from diesel engines in port areas, and explores the emission reduction potential of strategies like replacing and repowering older, dirtier vehicles and engines and deploying zero emissions technologies.
To view the report: https://www.epa.gov/ports-initiative/national-port-strategy-assessment
More information on EPA's Ports Initiative: https://www.epa.gov/ports-initiative

Dept. of Transportation and Smart Growth America
Transit-Oriented Development (TOD) Technical Assistance
A new website is now available to provide information and ideas about TOD projects. The site includes a data base of research, information about popular funding and financing options for projects, and opportunities for professionals to connect with one another.
www.TODresources.org

Alternative Fuel Station Locator (CNG, LNG, Multi)
Maintained by Penske, an EPA SmartWay program partner.
http://www.altfuelstations.com/

Environmental Protection Agency Webinar Recordings
SmartWay Program
https://www.epa.gov/smartway/smartway-webinars-events

Smart Growth America "The Best Complete Streets Policies of 2015"
Released in April 2016, this free report ranks the Complete Streets policies that have been adopted by communities across the nation. In 2015, 82 new Complete Streets policies were passed by communities. Nationwide, a total of 899 policies are now in place and are located in every state. The policies create safer multimodal transportation networks. The policy established in **Omaha, NE** (an Advance area) was recognized as one of the top 10 policies in the nation. The 39 Advance areas that currently have Complete Streets policies of various kinds include:

Delaware – State Executive Order, State internal policy, regional policy (Wilmington area)
Middle Georgia – City resolution (Macon)
Dubuque, IA – City resolution (Dubuque)

Alexandria, LA – State internal policy
Baton Rouge, LA – State internal policy, city policy (Baton Rouge)
Houma-Thibodaux, LA – State internal policy
Lafayette, LA – State internal policy
Lake Charles, LA – State internal policy
New Orleans, LA – State internal policy, city legislation (New Orleans)
Shreveport, LA – State internal policy
Minnesota – State legislation, State internal policy, regional resolution (St. Cloud area), regional policy (Rochester area), county resolutions (Wilkin, Clay, Hennepin Counties), county policy (Hennepin County), city resolutions (Northfield, Battle Lake, Pipestone, St. Cloud, Breckenridge, Red Wing, Byron, Otterfail, Parkers Prairie, Stewartville, Worthington, Fergus Falls, Frazee, Dilworth, New Hope, Independence, St. Paul, Duluth, Golden Valley), city policies (New Hope, Brooklyn Center, Hopkins, Big Lake, Falcon Heights, Independence, Maple Plain, Austin, Maplewood)
DeSoto County, MS – State internal policy
Gulf Coast, MS – State internal policy, regional policy, city resolution (Pascagoula)
Joplin, MO – State resolution
Kansas City, MO – State resolution, regional policy, county resolution (Johnson County), city resolutions (Kansas City, Overland Park)
Southeastern MO – State resolution
Springfield, MO – State resolution, city policy (Springfield)
Helena, MT – City resolution (Helena)
Cumberland County, NC – State internal policy
Clark County, NV – Regional policy
Dayton-Springfield, OH – Regional policy, city policy (Dayton)
Oklahoma City, OK – City resolution (Edmond)
Tulsa, OK – City resolutions (Tulsa, Owasso)
Lakeview, OR – State legislation
Prineville, OR – State legislation
Omaha, NE – City policy (Omaha)
South Carolina - State resolution, county resolutions (Richland, Spartanburg Counties), county policy (Richland County), city legislation (North Myrtle Beach, Conway), city resolutions (Anderson, Camden, Myrtle Beach, Columbia, Greenville, Greenwood, Ninety-Six, Spartanburg)
Austin, TX – State internal policy, city legislation (Austin, San Marcos), city resolution (Austin)
Corpus Christi, TX – State internal policy
Hood County, TX – State internal policy
Houston, TX – State internal policy, city executive order (Houston)
San Antonio, TX – State internal policy, regional resolution, city policy (San Antonio)
Tyler-Longview, TX – State internal policy

Waco, TX – State internal policy
Rutland, VT – State legislation
Caroline County, VA – State internal policy
Fredericksburg, VA – State internal policy
Richmond-Petersburg, VA – State internal policy, city policy (Richmond)
Yakima, WA – State legislation

The report is available here: http://www.smartgrowthamerica.org/best-complete-streets-policies-of-2015
A recorded webinar about the report, including representatives from top-scoring communities is also available: http://www.smartgrowthamerica.org/2016/04/14/recorded-webinar-the-best-complete-streets-of-2015/

Transportation for America Reports, Mapping Tools, Books, Other Resources
Information about innovative transportation policies states can consider, funding and policy resources, case studies and lessons learned, etc.
http://transportationforamerica.org/maps-tools/
Guidebook for innovative Metropolitan Planning Organizations: http://t4america.org/maps-tools/the-innovative-mpo/
Support for bus rapid transit projects: http://transportationforamerica.org/2016/01/12/new-study-finds-positive-economic-development-benefits-associated-with-bus-rapid-transit-projects/ The report includes a review of several existing BRT systems, including those in Advance areas Las Vegas, NV and Kansas City, MO.

(3) ENERGY

Dept. of Energy Webinars
Low Income Home Energy Assistance Program (LIHEAP)
http://www.acf.hhs.gov/ocs/resource/liheap-trainings

Dept. of Energy
2017 National Energy Codes Conference – July 17-20, 2017, Pittsburgh, PA
The conference will focus on achieving compliance, and sessions will also cover development, adoption, policy, tools and research. This is the only national conference dedicated solely to energy codes.
More information: https://www.energycodes.gov/events/2017-doe-national-energy-codes-conference

Dept. of Energy
State and Local Energy Data (SLED) Website
This new website provides planning tools for cities. Provides city-specific data for 23,400 cities

across the U.S., including estimates of electricity and natural gas use and costs by sector, energy market profiles that provide data on fuel types, and the fuel economy of vehicles registered in each city. The profiles also provide an estimate of vehicle fuel consumption, vehicle miles traveled, rooftop solar energy potential for small buildings, a building stock characterizations, and a snapshot of the top energy consuming industries in each city.
The website also includes a local energy toolbox, where communities can access a customizable list of actions to help make strategic energy decisions. The more than 500 searchable resources in the toolbox are technology-neutral, actionable energy strategies based on the energy activities cities are currently pursuing.
Website: http://apps1.eere.energy.gov/sled/#/

Free Dept. of Energy Building Energy Software
Office of Energy Efficiency and Renewable Energy
DOE is encouraging the use of its Building Energy Asset Scoring Tool (the Asset Score). The software tool was first released in 2014 and has since been used on 825 commercial and multifamily residential buildings nationwide. The tool generates a simple energy efficiency rating that enables comparison among buildings, helps identify building energy improvement opportunities and can reduce utility expenses. It is available for voluntary use and is free!
More information: http://energy.gov/eere/buildings/building-energy-asset-score and http://www.energymanagertoday.com/does-building-energy-asset-score-platform-a-useful-first-step-to-efficiency-0122941/

Dept. of Energy
Better Buildings Energy Data Accelerator Resources Toolkit
A compilation of case studies, guidance and real-world best practices adopted by cities and utilities to help building owners measure and track energy use, and benchmark the energy performance of their buildings.
http://betterbuildingssolutioncenter.energy.gov/toolkits/energy-data-access-blueprint-action and http://energy.gov/eere/articles/energy-department-announces-publication-better-buildings-energy-data-accelerator

Dept. of Energy Tool for Locating State Tax Credits, Rebates, Savings
http://www.energy.gov/

Arlington County, VA Initiative to Rethink Energy (AIRE)
Energy Podcast – Local Sustainability Stories
This podcast series explores the concept of sustainability and interviews industry leaders to highlight their diversity of energy challenges, strategies, and success stories. Topics include (or will include): air sealing and ventilating homes for health and energy benefits, net zero schools, passive home construction, and more. The podcast is available both as an application and online at Soundcloud: https://soundcloud.com/rethinkenergy

Fannie Mae HomeStyle Energy Program
This new program will enable more Americans to invest in energy efficiency, which includes solar. The HomeStyle Energy Program is a new mortgage option that gives borrowers the ability to complete clean energy upgrades up to 15 percent of the as-completed appraised property value of the home. Borrowers are able to finance energy efficient upgrades when purchasing or refinancing a home, eliminating the need for a subordinate lien, home equity line of credit, Property Assessed Clean Energy loan or unsecured loan.

More information:
http://www.sustainablecitynetwork.com/topic_channels/energy/article_136827e8-0050-11e6-9c74-3354d46d47b2.html?utm_source=SCN+InBox+e-Newsletter&utm_campaign=3baff22ef5-SCNNewsletter_Municipal&utm_medium=email&utm_term=0_11e7ac761c-3baff22ef5-188859017&mc_cid=3baff22ef5&mc_eid=76907d0b36

(4) GREEN INFRASTRUCTURE

Environmental Protection Agency/Advance Program Webinar – Oct/Nov 2016 Green Infrastructure: Ideas for Advance Areas More information soon!

Environmental Protection Agency Webinar – November 2016
Building the Case for Green Infrastructure: Outreach and Education
http://www.epa.gov/green-infrastructure/green-infrastructure-webcast-series

Environmental Protection Agency Webinar Recordings
Green Infrastructure Program
Note that some green infrastructure programs (tree planting, green roofs, etc.) can result in air quality benefits, and would be worth noting in Advance plans!
https://www.epa.gov/green-infrastructure/green-infrastructure-webcast-series

Georgetown Climate Center
Green Infrastructure Toolkit
Designed to help local governments find the resources and examples that are most helpful to them. The toolkit analyzes common trends in the approaches cities are taking to planning, implementing, and funding green infrastructure to manage stormwater. The kit contains a variety of resources including best practices information, financing strategies and sources of funding, communication strategies, etc.

http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/introduction.html

Environmental Protection Agency
Smart Growth Program – "City Green: Innovative Green Infrastructure Solutions for Downtowns and Infill Locations"
This report is a collection of 12 case studies of projects in cities overcoming challenges to implementing green infrastructure. Potential benefits of green infrastructure include reduced municipal water use, reduced ozone and PM, reduced air temperatures in developed areas, and reduced energy use.
https://www.epa.gov/sites/production/files/2016-06/documents/city_green_0.pdf

(5) URBAN HEAT ISLAND

Environmental Protection Agency Webinar Recordings
Urban Heat Island Program
https://www.epa.gov/heat-islands/heat-island-webcasts

(6) WOOD SMOKE

Environmental Protection Agency
BurnWise Program
https://www.epa.gov/burnwise

Safer, More Efficient Wood Stove Heating and the Low Income Home Energy Assistance Program (LIHEAP)
A recording of this November 2015 EPA/Health and Human Services webinar has been posted here: http://www.acf.hhs.gov/programs/ocs/resource/liheap-trainings

Environmental Protection Agency
Valley Identification and Valley Profile Tools
Valleys in New England are especially vulnerable to higher levels of PM2.5 from wood smoke during winter air inversions. These tools identify populated valleys throughout New England that are at risk for wood smoke pollution. They can be used to better plan air quality monitoring, outreach, and mitigation. The Valley Identification Tool and Valley Profile Tool can be found on the following page under the "Websites" heading:
https://www.epa.gov/advance/advance-resources

(7) EDUCATION/AWARENESS

APTI-Learn Portal

APTI-Learn is the EPA's technical training portal for federal, state, tribal, and local air pollution professionals. Supported by the Air Pollution Training Institute (APTI) – a partnership of EPA, instructors, and regional multi-jurisdictional organizations – APTI-Learn is where these professionals can find the knowledge they need to implement environmental programs and policies. Courses include topics such as: introduction to air pollution, permitting, enforcement, monitoring and data analysis. Courses are available in several formats: classroom, web-based videos, webinars, and online self-instructional courses. To see course offerings and classroom course schedules and to register, go to: http://www.apti-learn.net

Free Environmental Education Materials

EPA's National Service Center for Environmental Publications offers materials grouped by grade range.

- Teachers can order environmental education materials for students: http://www.epa.gov/nscep/teacher-order-forms-epa-environmental-materials
- Explore lesson plans, activity books, posters, videos, project ideas, student awards, and more: http://www.epa.gov/students
- Learn more about how Environmental Education increases public awareness and knowledge about environmental issues or problems: http://www.epa.gov/education

The National Environmental Education Foundation also provides free materials and educator toolkits through its Learning Center: https://www.neefusa.org/greening-stem-learning-center

Environmental Protection Agency
Air Quality Awareness Materials

- Visit the AirNow Facebook page to see what state and local air programs are doing and to share how you are doing your part (https://www.facebook.com/airnow).
- Check the website and Twitter feed to learn about citizen science projects, links between asthma and air quality, information about air quality around the world, and trends in air quality (https://www3.epa.gov/airnow/airaware/ and https://twitter.com/search?q=airnow&src=typd). Primary Twitter hashtag is #careforyourair.
- Download AIRNow to a smartphone for air quality information on the go (https://developer.epa.gov/airnow/).

To: Spann, Jane[Spann.Jane@epa.gov]; Wong, Richard[Wong.Richard@epa.gov]
Cc: Benjamin, Lynorae[benjamin.lynorae@epa.gov]
From: Davis, Scott
Sent: Fri 9/23/2016 2:55:16 PM
Subject: Fwd: Georgia's Designation Recommendations for the 2015 Ozone NAAQS
GAEPD_2015_Ozone_Recommendation_Cover_Letter_Signed.pdf
ATT00001.htm

FYI from Georgia

Sent from my iPhone

Begin forwarded message:

From: "Boylan, James" <James.Boylan@dnr.ga.gov>
To: "Davis, Scott" <Davis.ScottR@epa.gov>, "Benjamin, Lynorae" <benjamin.lynorae@epa.gov>
Cc: "Hays, Karen" <Karen.Hays@dnr.ga.gov>, "Kuoh, Dika" <Dika.Kuoh@dnr.ga.gov>, "Tian, Di" <Di.Tian@dnr.ga.gov>, "Munsey, Elisabeth" <Elisabeth.Munsey@dnr.ga.gov>
Subject: Georgia's Designation Recommendations for the 2015 Ozone NAAQS

Dear Mr. Davis,

Please find attached Georgia's designation recommendations for the 2015 ozone NAAQS. EPD performed a detailed five factor analysis in accordance with U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards". In addition, EPD performed source contribution modeling with CAMx-APCA. Based on this analysis, EPD recommends that the following eight (8) counties be designated as nonattainment for the 2015 ozone NAAQS: Fulton, Gwinnett, DeKalb, Cobb, Bartow, Clayton, Henry, and Rockdale. The remaining 151 counties in Georgia are recommended as unclassifiable/attainment.

The attachments include:

- EPD Transmittal Letter,
- Attachments to EPD Transmittal Letter,
- EPD Ozone Designation Technical Analysis Document (TAD), and

•□□□□□□□ EPD Ozone Designation Modeling Technical Support Document (TSD).

A hard copy, DVD version (with all Appendices), and an external hard drive with all the photochemical modeling files (inputs, outputs, scripts) will be placed in the mail today. We look forward to your review and concurrence with our recommendations. Should you or your staff have any questions, please feel free to contact me at (404) 363-7014.

Sincerely,

Jim Boylan

James W. Boylan, Ph.D.

Manager, Planning & Support Program

Georgia Department of Natural Resources

Environmental Protection Division - Air Protection Branch

4244 International Parkway, Suite 120

Atlanta, GA 30354

Office: 404-363-7014 Fax: 404-363-7100

E-mail: James.Boylan@dnr.ga.gov

From: "Boylan, James" <James.Boylan@dnr.ga.gov>
To: "Davis, Scott" <Davis.ScottR@epa.gov>, "benjamin.lynorae@epa.gov"<benjamin.lynorae@epa.gov>
Cc: "Hays, Karen" <Karen.Hays@dnr.ga.gov>, "Kuoh, Dika"<Dika.Kuoh@dnr.ga.gov>, "Tian, Di" <Di.Tian@dnr.ga.gov>, "Munsey, Elisabeth"<Elisabeth.Munsey@dnr.ga.gov>
Subject: Georgia's Designation Recommendations for the 2015 Ozone NAAQS
GAEPD_2015_Ozone_Recommendation_Cover_Letter_Signed.pdf
GAEPD_2015_Ozone_Recommendation_Attachments.pdf
GAEPD_2015_Ozone_Recommendation_TAD.pdf
GA_EPD_Ozone_Designation_Modeling_TSD.pdf

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- EPD Ozone Designation Modeling Technical Support Document (TSD).

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Sincerely,

Jim Boylan

James W. Boylan, Ph.D.

Manager, Planning & Support Program

Georgia Department of Natural Resources

Environmental Protection Division - Air Protection Branch

4244 International Parkw ay, Suite 120

Atlanta, GA 30354

Office: 404-363-7014 Fax: 404-363-7100

E-mail: James.Boylan@dnr.ga.gov

Georgia's Nonattainment Area Designation Recommendations for the 2015 Ozone NAAQS – Modeling Technical Support Document –

EPA's designation guidance memo[1] states that source apportionment modeling can be used as part of the initial area designation process. The Georgia Environmental Protection Division (EPD) applied the Comprehensive Air Quality Model with eXtensions (CAMx)[2] with its Anthropogenic Precursor Culpability Assessment (APCA) tool to determine the contribution of each of the 39 counties in the Atlanta combined statistical area (CSA)[3] to the five violating ozone monitors in the Atlanta CSA. The five violating monitors were identified based on 2014-2016 preliminary ozone data and include: Confederate Avenue (Fulton county), McDonough (Henry county), Conyers (Rockdale county), South DeKalb (DeKalb county), and Gwinnett Tech (Gwinnett county). EPD used a similar approach with CAMx-APCA as EPA used for the proposed and final Cross-State Air Pollution Rule modeling[4] (hereafter, Transport Rule Modeling). The following sections describe how EPD conducted its 2011 base year modeling, 2017 future year modeling, and 2017 contribution modeling.

1. 2011 Base Year Modeling

Modeling Approach

EPD conducted 2011 CAMx modeling for the ozone season (April 1 to October 31) using 2011 meteorology and 2011 emissions. The EPD model set-up and inputs were similar to EPA's Transport Rule modeling. Also, EPD's model set-up and inputs were nearly identical to modeling performed by Georgia Tech for SESARM's Southeastern Modeling, Analysis, and Planning (SEMAP) project. A summary of configuration differences between the EPA, SESARM, and EPD modeling platforms is contained in Table 1.

Table 1. Configuration differences between the EPA, SESARM, and EPD modeling platforms.

	EPA	SESARM	EPD
WRFCAMx	WRFCAMx 4.0 beta	WRFCAMx 4.3	WRFCAMx 4.3
TUV	TUV4.8 (May 6, 2013 version)*	TUV4.8 (February 25, 2015 version)	TUV4.8 (February 25, 2015 version)
CAMx	CAMx v6.11 with modification for super-stepping routine for HMAX.	CAMx 6.11	CAMx 6.2

*Ramboll-Environ confirmed that there was an error in NO3_NO2.PHF file in the May 6, 2013 version.

[1] EPA, Guidance on the Area Designations for the 2015 Ozone National Ambient Air Quality Standards, https://www.epa.gov/ozone-designations/epa-guidance-area-designations-2015-ozone-naaqs

[2] Ramboll-Environ, CAMx Overview, http://www.camx.com/about/default.aspx

[3] EPD used the Atlanta CSA definition published by the Office of Budget and Management in February, 2013 that is available on the U.S. Census website (http://www.census.gov/population/metro/files/lists/2013/List1.xls).

[4] EPA, Proposed and Final Cross-State Air Pollution Rule, https://www.epa.gov/airmarkets/proposed-cross-state-air-pollution-update-rule and https://www.epa.gov/airmarkets/final-cross-state-air-pollution-rule-update.

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All CAMx versions were modified to read point-source formatted APCA emissions and override biogenic emissions as the region "1" to be consistent across platforms. The modeling inputs for the Transport Rule Modeling covered the continental U.S. (CONUS). These inputs were extracted for the SESARM and EPD modeling domains (Figures 1 and 2). The 2011 meteorological inputs were prepared using the official WRFCAMx utility (version 4.3) with Weather Research and Forecasting (WRF) model outputs developed for the Transport Rule Modeling. Ten days (March 22 – 31) were used as ramp-up days for 2011 modeling. Ozone column files and photolysis rates were prepared prior to the CAMx run with Ramboll-Environ's O3MAP utility released on May 6, 2013 and TUV utility (version 4.8). O3MAP requires ozone column data in text format and EPD used the Level 3 Ozone Monitoring Instrument (OMI) product. There was no missing data for the 2011 OMI dataset. 2011 initial and boundary conditions (IC/BCs) were developed using the SESARM modeling results. The SESARM modeling results were compared to EPA's Transport Rule modeling results and all differences were explained by the configuration differences shown in Table 1[5]. The EPD modeling results were compared with the SESARM modeling results (Figure 3) to evaluate impacts of the smaller EPD modeling domain and newer version of CAMx. The slope and r^2 values were 1.00 indicating insignificant differences between the two modeling platforms.

Figure 1. Domains for the Transport Rule Modeling (brown box), SESARM Modeling (orange box), and EPD Modeling (red box).

[5] Talat, O. and Hu, Y., Georgia Tech, SEMAP 2017 Ozone Projections and Sensitivity to NOx Emissions, Presented to SEMAP Air Quality Modeling Workgroup, August 15, 2016.

ED_001361_00020213

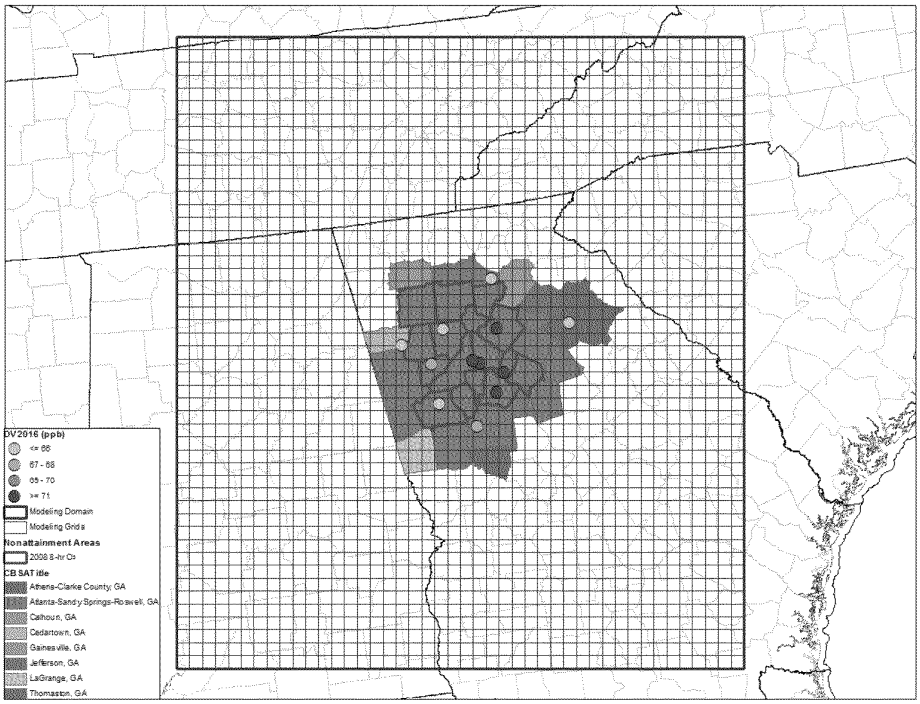

Figure 2. EPD's modeling domain and grids (red squares), preliminary 2014-2016 design values (colored circles), nonattainment areas for the 2008 ozone NAAQS (thick red outlines), and the Atlanta CSA broken down by CBSAs. All shaded counties were evaluated as part of the source contribution assessment.

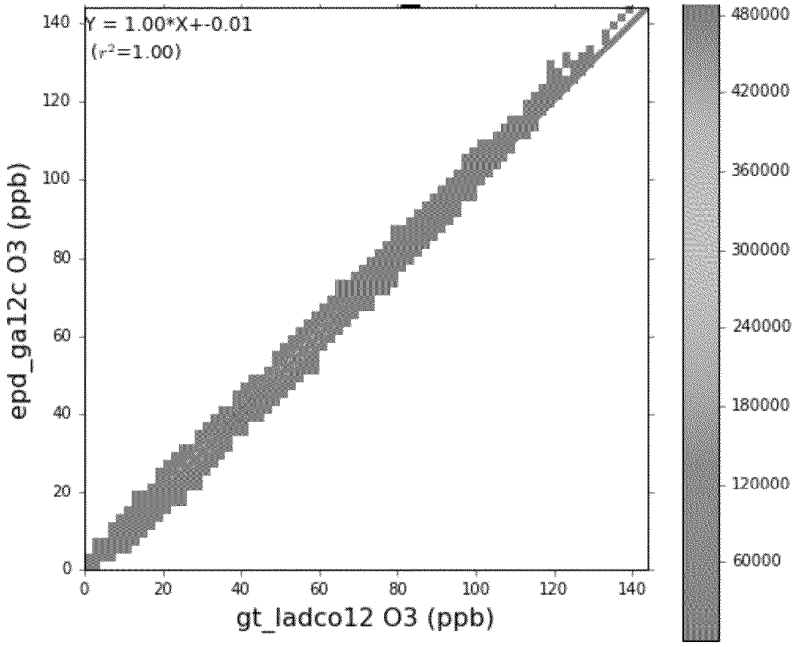

Figure 3. Comparison of 2011 CAMx modeling results between the SESARM and EPD modeling platforms. The color scale indicates the number of data points.

Model Performance Evaluation

Detailed model performance statistics listed below were calculated for the EPD CAMx modeling.

$$\text{Mean Observation} = \frac{\sum \square \square}{\square \square}$$

$$\text{Mean Prediction} = \frac{\sum \square \square}{\square \square}$$

$$\text{Mean Bias} = \frac{\sum(\square - \square \square)\square}{\square \square}$$

$$\text{Mean Gross Error} = \frac{\sum|\square - \square \square|\square}{\square \square}$$

$$\text{Normalized Mean Bias (NMB)} = 100\,\% \times \frac{\sum(\square - \square \square)\square}{\sum \square \square}$$

$$\text{Normalized Mean Error (NME)} = 100\,\% \times \frac{\sum|\square - \square \square|\square}{\sum \square \square}$$

N is the number of days when observed ozone concentrations are above the threshold, 60 ppb. *P* and *O* represent predicted ozone values and observed ozone values at each monitor for days above the performance statistics threshold.

At every monitor in the EPD modeling domain, NMB and NME were calculated for modeled daily maximum 8-hour ozone concentrations (MDA8O3, Figure 4) and daily maximum 1-hour ozone concentrations (MDA1O3, Figure 5). The EPD modeling with CAMx slightly over-predicted ozone concentrations at monitors in the Atlanta CSA. Detailed model performance statistics of MDA8O3 for Georgia monitors in the Atlanta CSA and outside Atlanta CSA are summarized in Table 2. NMB is less than ±15% for most monitors, except +15.6% for monitor 13-077-0002 in Coweta County and +15.2% for monitor 13-135-0002 in Gwinnett County. NME is less than 20% for all monitors in Georgia.

EPD also developed time series plots for MDA8O3 for the five ozone monitors violating the 2015 ozone NAAQS based on preliminary 2014-2016 design values (Figures 6 - 10). The ozone design value at the Confederate Avenue monitor is the highest in the Atlanta CSA. In general, EPD CAMx modeling over-predicted MDA8O3. EPD believes that the over-prediction on high ozone days will lead to higher modeled contributions compared to each county's actual contributions. Hence, the modeling results will be conservative (upper-bound) estimates of the contributions.

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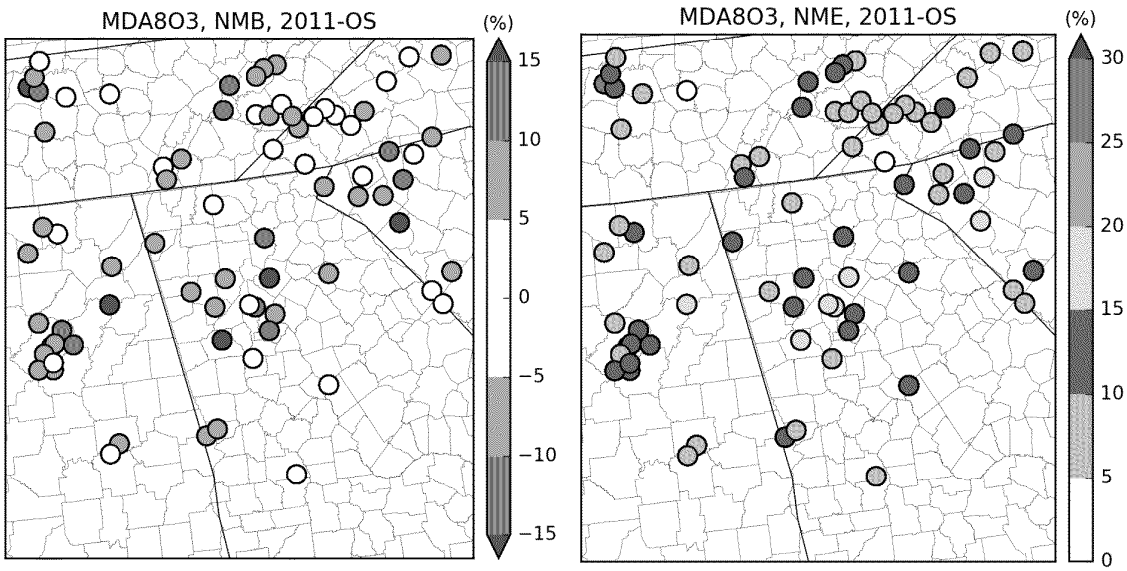

Figure 4. Normalized mean bias (left) and normalized mean error (right) of modeled daily maximum 8-hour ozone concentrations for the 2011 ozone season (April 1 to October 31). Cutoff = 60 ppb.

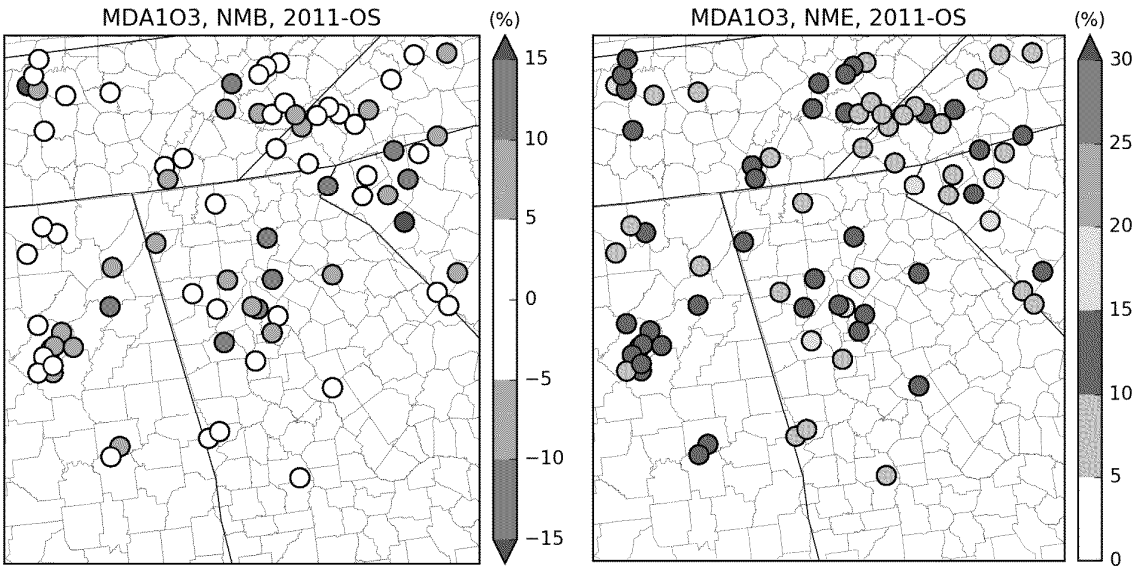

Figure 5. Normalized mean bias (left) and normalized mean error (right) of modeled daily maximum 1-hour ozone concentrations for the 2011 ozone season (April 1 to October 31). Cutoff = 60 ppb.

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Table 2. Model performance statistics of daily maximum 8-hour ozone for monitors in the Atlanta CSA and outside the Atlanta CSA in GA for the 2011 ozone season (April 1 - October 31). Cutoff = 60 ppb.

Area	AIRS _ID	N (#)	Mean Observation (ppb)	Mean Prediction (ppb)	Mean Bias (ppb)	Mean Gross Error (ppb)	Normalized Mean Bias (%)	Normalized Mean Error (%)
Atlanta CSA	13-059-0002	62	65.6	71.5	5.9	8.1	8.9	12.4
	13-067-0003	50	68.5	74.8	6.3	8.1	9.2	11.8
	13-077-0002	27	65.6	75.8	10.2	12.1	15.6	18.5
	13-085-0001	16	63.8	71.2	7.4	7.4	11.5	11.6
	13-089-0002	55	68.5	76.9	8.4	13.6	12.3	19.8
	13-097-0004	46	67.3	71.8	4.5	7.7	6.6	11.4
	13-121-0055	73	69.3	72.7	3.3	10.6	4.8	15.3
	13-135-0002	52	68.1	78.4	10.3	11.7	15.2	17.2
	13-151-0002	60	68.5	76.1	7.6	9.0	11.2	13.1
	13-223-0003	42	67.1	70.5	3.4	6.6	5.1	9.9
	13-231-9991	48	66.0	68.5	2.6	5.1	3.9	7.8
	13-247-0001	76	69.6	74.8	5.2	7.9	7.4	11.3
Outside Atlanta CSA in GA	13-021-0012	59	67.3	70.0	2.7	6.8	4.1	10.1
	13-055-0001	18	64.6	70.2	5.6	6.7	8.7	10.3
	13-073-0001	45	65.8	67.5	1.7	4.7	2.7	7.1
	13-213-0003	51	64.8	67.5	2.7	4.9	4.2	7.5
	13-215-0008	33	63.5	69.0	5.5	6.3	8.6	9.9
	13-245-0091	56	65.4	67.2	1.8	5.5	2.8	8.4
	13-261-1001	29	63.3	62.9	-0.4	4.3	-0.6	6.8

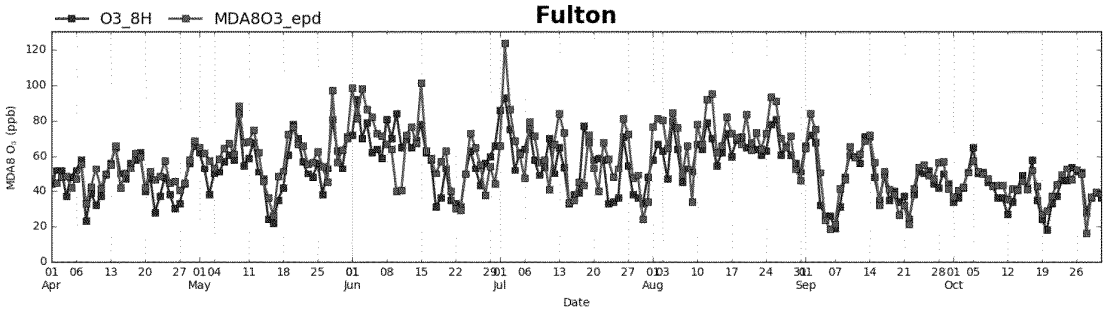

Figure 6. Time series of daily maximum 8-hour ozone concentrations at the Confederate Avenue monitor (13-121-0055) in Fulton County, GA.

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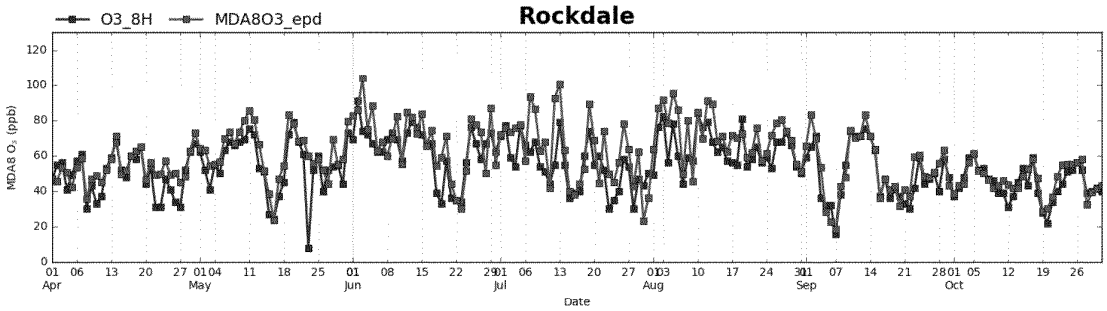

Figure 7. Time series of daily maximum 8-hour ozone concentrations at the Conyers monitor (13-247-0001) in Rockdale County, GA.

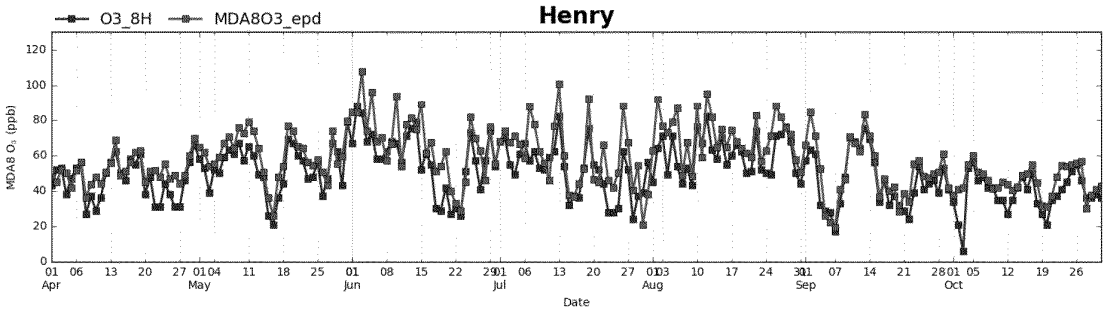

Figure 8. Time series of daily maximum 8-hour ozone concentrations at the McDonough monitor (13-151-0002) in Henry County, GA.

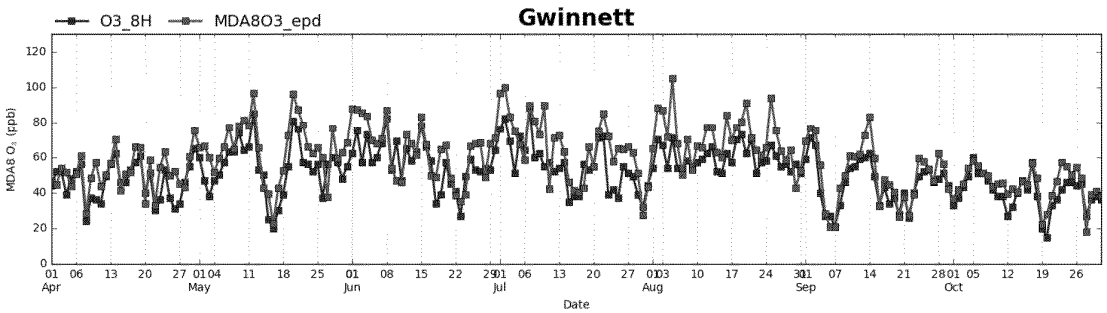

Figure 9. Time series of daily maximum 8-hour ozone concentrations at the Gwinnett Tech monitor (13-135-0002) in Gwinnett County, GA.

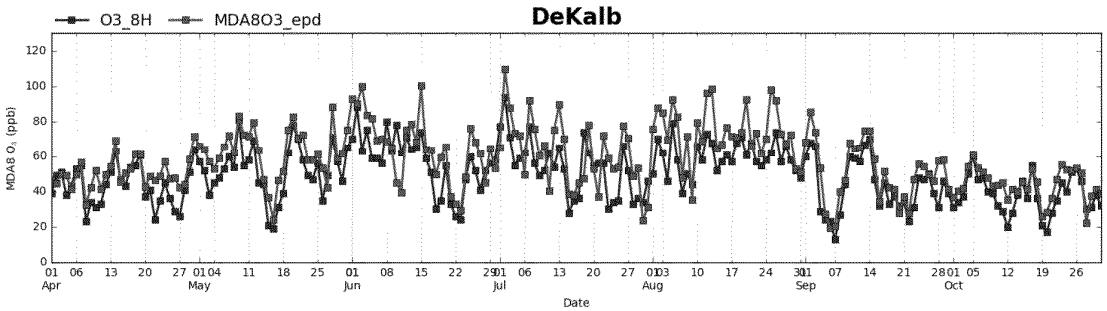

Figure 10. Time series of daily maximum 8-hour ozone concentrations at the South DeKalb monitor (13-089-0002) in DeKalb County, GA.

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2. 2017 Future Year Modeling

EPD conducted the 2017 future year modeling with CAMx-APCA for the ozone season using 2017 SESARM emissions and EPA 2011 meteorology. 2017 SESARM emissions were developed using the same emissions that were used for the Transport Rule modeling except that the 2017 Electrical Generating Units (EGU) emissions were updated for the SESARM states based on feedback from those states. SESARM applied scaling factors to emission records in EPA's 2017 or 2011 hourly point source emission input files to adjust EGU emissions to reflect SESARM states emission estimates for 2017.

EPD updated the 2017 emissions from seven EGU facilities in Georgia in the EPA "2017eh" inventory. The 2014 emissions which were reported by each facility and collected by Georgia EPD were used to represent 2017 emissions for most facilities, except SO_2, PM_{10}, and $PM_{2.5}$ emissions from Plant Scherer (Unit 1) and all emissions from Plant Yates (Units Y6BR and Y7BR).

- <u>SO_2, PM_{10}, and $PM_{2.5}$ emissions from Plant Scherer (Unit 1):</u>
  SO_2, PM_{10}, and $PM_{2.5}$ emissions from Plant Scherer (Unit 1) during 2014 were adjusted to reflect the impacts of flue gas desulfurization (FGD) controls which came online in May 2014 for Unit 1. The SO_2 emissions for Unit 1 were estimated by multiplying the 2014 NOx emission from Unit 1 by the ratio of total SO_2 emissions to total NOx emissions from Units 2-4. The PM_{10} and $PM_{2.5}$ emissions for Unit 1 were reduced by 50% according to the SESARM report[6].
- <u>All Emissions from Plant Yates (Units Y6BR and Y7BR):</u>
  These two units were converted from coal to natural gas boilers in 2015. According to Georgia Power, this facility will be run as a peaking unit with a 25% capacity factor (maximum). Therefore, EPD calculated its potential NOx emissions in 2017 using its potential usage, the nominal heat rate of 12 mmBtu/MWh, and the measured NOx emission rates after the conversion to natural gas (0.116 lbs/mmBtu for Unit Y6BR and 0.141 lbs/mmBtu for Unit Y7BR). For CO and VOC emissions, the maximum measured emission rates during May and June of 2015 were used. For SO_2, PM_{10} and $PM_{2.5}$, the AP-42 emission factors were used.

Next, a scaling ratio was calculated for each unit based on annual emissions. In most cases, the scaling ratio was calculated by dividing the EPD 2017 emissions by the EPA 2017 emissions. Then, the scaling ratio was applied to the EPA hourly 2017 EGU emissions to generate EPD hourly 2017 EGU emissions. For Plant Yates and Plant McIntosh, EPA 2017 emissions were zero. Therefore, the scaling ratio was calculated by dividing the EPD 2017 emissions by the EPA 2011 emissions. Then, the scaling ratio was applied to the EPA's hourly 2011 EGU emissions to generate EPD hourly 2017 EGU emissions. Table 3 shows Georgia's EGUs that were adjusted for SESARM and EPD modeling, adjustment approach, and scaling ratios used to adjust emissions. Table 4 shows the final adjusted emissions used for the 2017 SESARM and EPD modeling. The detailed calculations are contained in Appendix B (GA_EPD_Adjusted_EGU_Emissions.xlsx). The same 2017 modeling platform was also used for the APCA modeling described in the next chapter.

[6] AMEC, Development of the 2018 Projection Point Source Emission Inventory in the SESARM Region (Version 1.0).

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Table 3. Approach and scaling ratios used to adjust EPA 2017 EGU emissions for SESARM and EPD modeling.

Plant	ORIS ID	BOILER ID	Approach	CO Ratio	NH3 Ratio	NOx Ratio	PM10 Ratio	PM2.5 Ratio	SO2 Ratio	VOC Ratio
Plant Bowen	703	1BLR	Scale 2017 emissions	1.98	1.01	2.27	2.69	2.06	3.81	2.55
Plant Bowen	703	2BLR	Scale 2017 emissions	1.90	1.00	1.93	0.79	0.70	4.37	2.44
Plant Bowen	703	3BLR	Scale 2017 emissions	1.95	0.93	3.09	1.47	1.17	5.20	2.51
Plant Bowen	703	4BLR	Scale 2017 emissions	2.53	1.27	3.55	2.00	1.60	5.30	3.25
Plant Hammond	708	1	Scale 2017 emissions	0.08	0.00	0.26	0.16	0.18	0.03	0.15
Plant Hammond	708	2	Scale 2017 emissions	0.10	0.00	0.41	0.25	0.27	0.30	0.19
Plant Hammond	708	3	Scale 2017 emissions	0.11	0.00	0.36	0.22	0.24	0.07	0.20
Plant Hammond	708	4	Scale 2017 emissions	0.08	0.00	0.27	0.15	0.17	0.03	0.15
Plant Wansley	6052	1	Scale 2017 emissions	0.25	0.41	0.59	0.22	0.18	0.41	0.38
Plant Wansley	6052	2	Scale 2017 emissions	0.19	0.32	0.44	0.26	0.21	0.29	0.28
Plant Scherer	6257	1	Scale 2017 emissions	1.05	0.05	1.29	0.13	0.11	0.11	1.35
Plant Scherer	6257	2	Scale 2017 emissions	0.91	0.05	0.93	0.13	0.10	0.08	1.17
Plant Scherer	6257	3	Scale 2017 emissions	1.63	0.05	1.44	0.14	0.09	0.10	1.16
Plant Scherer	6257	4	Scale 2017 emissions	1.24	0.05	1.06	0.11	0.07	0.10	1.08
Plant Yates	728	Y6BR	Scale 2011 emissions	0.45	0.00	0.23	0.11	0.16	0.00	0.13
Plant Yates	728	Y7BR	Scale 2011 emissions	0.63	0.00	0.42	0.20	0.26	0.00	0.18
Plant McIntosh	6124	1	Scale 2011 emissions	4.43	0.00	4.06	4.97	4.52	3.28	4.44
Mid-Georgia Co-gen	55040	1	Scale 2017 emissions	0.04	0.02	0.10	6.72	10.97	0.00	0.41
Mid-Georgia Co-gen	55040	2	Scale 2017 emissions	0.05	0.02	0.11	7.54	12.31	0.00	0.46
Mid-Georgia Co-gen	55040	ST1	Scale 2017 emissions	0.03	0.00	0.02	0.68	1.10	0.00	0.10

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Table 4. Emission adjustment approach and emissions used for SESARM and EPD modeling.

Plant	ORIS ID	BOILER ID	Approach	CO Emissions	NH3 Emissions	NOx Emissions	PM10 Emissions	PM2.5 Emissions	SO2 Emissions	VOC Emissions
Plant Bowen	703	1BLR	Scale 2017 emissions	345.9	8.2	1643.0	307.6	235.6	1313.0	41.5
Plant Bowen	703	2BLR	Scale 2017 emissions	334.2	8.2	1477.0	90.9	80.1	1518.0	40.0
Plant Bowen	703	3BLR	Scale 2017 emissions	419.7	9.2	1666.0	207.1	165.2	2207.0	50.3
Plant Bowen	703	4BLR	Scale 2017 emissions	523.4	12.2	2273.0	272.5	216.7	2166.0	62.8
Plant Hammond	708	1	Scale 2017 emissions	17.0	0.0	181.0	25.2	20.4	32.0	2.0
Plant Hammond	708	2	Scale 2017 emissions	21.6	0.0	282.0	37.5	29.5	290.0	2.6
Plant Hammond	708	3	Scale 2017 emissions	22.1	0.0	238.0	32.9	26.5	59.0	2.6
Plant Hammond	708	4	Scale 2017 emissions	72.7	0.1	773.0	107.4	87.0	145.0	8.6
Plant Wansley	6052	1	Scale 2017 emissions	293.8	19.0	1200.0	135.1	111.6	1426.0	35.2
Plant Wansley	6052	2	Scale 2017 emissions	214.2	14.5	820.0	159.4	125.5	1017.0	25.6
Plant Scherer	6257	1	Scale 2017 emissions	829.2	1.9	3733.0	142.0	85.1	269.0	99.5
Plant Scherer	6257	2	Scale 2017 emissions	725.6	1.7	2872.0	142.5	82.8	198.0	87.0
Plant Scherer	6257	3	Scale 2017 emissions	1325.2	1.7	3584.0	140.8	81.9	253.0	88.7
Plant Scherer	6257	4	Scale 2017 emissions	986.5	1.7	3161.0	110.8	64.6	241.0	80.1
Plant Yates	728	Y6BR	Scale 2011 emissions	79.1	0.0	533.5	34.3	34.3	2.7	3.0
Plant Yates	728	Y7BR	Scale 2011 emissions	79.1	0.0	648.5	34.3	34.3	2.7	3.0
Plant McIntosh	6124	1	Scale 2011 emissions	36.4	0.0	1046.0	39.5	21.2	2267.0	4.3
Mid-Georgia Co-gen	55040	1	Scale 2017 emissions	9.6	0.4	18.0	5.7	5.7	0.0	2.3
Mid-Georgia Co-gen	55040	2	Scale 2017 emissions	10.7	0.4	19.0	6.4	6.4	0.0	2.6
Mid-Georgia Co-gen	55040	ST1	Scale 2017 emissions	5.6	0.0	4.0	0.6	0.6	0.0	0.6

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A comparison of total anthropogenic NOx emissions (2011 NEI, 2011 modeled, 2011 NEI with 2014 EGUs, and 2017 modeled) by county are included in Table 5. The 2011 NEI and 2011 modeled NOx emissions are nearly identical. However, there are some significant differences between the 2011 NEI with 2014 EGUs vs. the 2017 modeled emissions.

Table 5. Total anthropogenic NOx emissions by county in the Atlanta CSA.

County	2011 NEI_v2	2011 model	2011 w/ 2014 point	EPA 2017 model	EPD 2017 model
Fulton	23,881	23,497	23,110	14,932	14,932
Gwinnett	16,464	16,205	16,460	9,585	9,585
Cobb	16,259	16,045	13,622	8,493	8,493
DeKalb	14,648	14,433	14,546	8,307	8,307
Bartow	14,309	14,242	12,923	6,373	10,762
Clayton	10,536	10,454	10,622	8,067	8,067
Coweta	10,384	10,336	4,861	2,282	3,464
Henry	7,327	7,263	6,681	4,182	4,182
Hall	5,172	5,101	5,217	2,916	2,916
Carroll	4,300	4,249	4,302	2,551	2,551
Cherokee	4,207	4,147	4,275	2,519	2,519
Madison	3,992	3,981	2,411	2,080	2,080
Troup	3,732	3,695	3,748	2,215	2,215
Jackson	3,705	3,664	3,876	2,212	2,212
Forsyth	3,590	3,535	3,608	2,208	2,208
Heard	3,437	3,443	2,930	4,671	2,783
Gordon	3,336	3,305	3,344	2,086	2,086
Clarke	2,985	2,939	2,964	1,699	1,699
Douglas	2,976	2,935	2,976	1,694	1,694
Newton	2,913	2,874	2,904	1,628	1,628
Paulding	2,600	2,568	2,600	1,601	1,601
Walton	2,520	2,325	2,286	1,266	1,266
Morgan	2,313	2,296	2,218	1,590	1,590
Fayette	2,165	2,132	2,163	1,274	1,274
Barrow	2,118	2,088	2,130	1,172	1,172
Rockdale	2,045	2,020	2,050	1,188	1,188
Butts	1,817	1,805	1,817	1,246	1,246
Meriwether	1,671	1,660	1,729	1,188	1,188
Haralson	1,649	1,636	1,649	1,096	1,096
Spalding	1,633	1,611	1,632	877	877
Polk	1,529	1,505	1,455	858	858
Oconee	1,287	1,262	1,287	675	675
Upson	1,161	1,147	1,301	659	659
Pickens	1,029	1,014	1,030	564	564
Lamar	810	800	1,056	491	491
Dawson	712	702	712	396	396
Jasper	599	593	614	398	398
Pike	583	576	583	341	341
Oglethorpe	508	503	508	304	304
Total	186,905	184,588	174,202	107,883	111,566

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Table 6 shows that the majority of the differences are coming for on-road mobile emissions which show significant emission reductions between 2011 and 2017. Since the 2017 emissions are the closest emissions to the current emissions in 2016 and the EPA designations will be finalized in 2017, EPD feels it is most appropriate to use 2017 emission in the contribution modeling. The detailed calculations for Tables 5 and 6 are contained in Appendix C (2011_2017_Modeled_Emissions.xlsx).

Table 6. Total anthropogenic NOx emissions by source sector in the Atlanta CSA.

Sector	2011 NEI_v2	2011 model	2011 w/ 2014 point	EPA 2017 model	EPD 2017 model
Fires	785	785	785	785	785
Point	30,614	30,527	17,911	13,635	17,318
Area	14,891	14,886	14,886	13,776	13,776
On-road	111,803	109,876	109,876	59,280	59,280
Non-road	28,811	28,515	28,515	20,408	20,408

2017 initial and boundary conditions were developed using the SESARM modeling results. EPD's 2017 CAMx modeling results were compared with SESARM 2017 modeling results (Figure 11) to evaluate the impacts of using the smaller EPD modeling domain. Small differences between the SESARM and EPD modeling results (r^2=1.00, slope =1.00, intercept=0.01) indicates that the impacts of using a smaller modeling domain is insignificant.

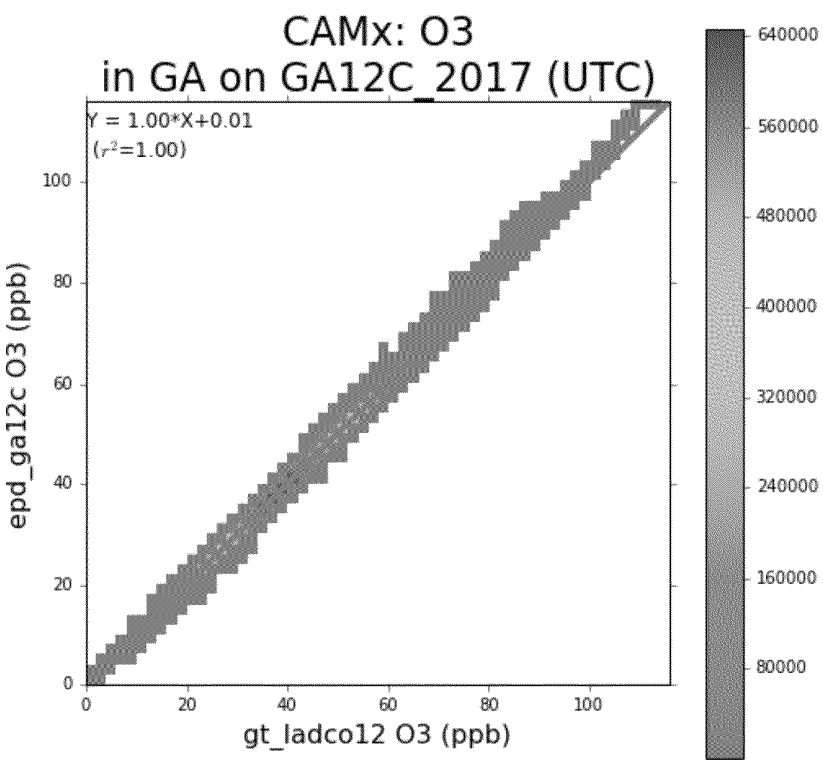

Figure 11. Comparison of 2017 CAMx modeling results between the SESARM and EPD modeling. The color scale indicates the number of data points.

2017 Future Design Values

EPD calculated the 2017 future design values by running the U.S. EPA's Modeled Attainment Test Software (MATS) version 2.6.1 following EPA's draft modeling guidance[7], except that EPD used the grid cell containing the monitor rather than the maximum in the 3x3 array. The 2017 ozone design values (DVF) were calculated by multiplying the 2011 5-year weighted ozone design value (DVC) by the relative response factor (RRF), where the RRF is the ratio of modeled 2011 MDA8O3 concentrations to modeled 2017 MDA8O3 concentrations at each modeling grid cell.

$$\mathrm{DVF} = \left(\frac{2017\ \mathrm{MDA8O3}}{2011\ \mathrm{MDA8O3}}\right) \square\ \mathrm{DVC}$$

Appendix A contains the detailed MATS run configuration. Table 7 summarizes the projected 2017 ozone design values estimated with the EPD modeling platform.

Table 7. Projected 2017 ozone design values.

Area	AIRS_ID	DVF2017	COUNTY
Atlanta CSA	13-059-0002	58.3	Clarke
	13-067-0003	64.6	Cobb
	13-077-0002	52.9	Coweta
	13-085-0001	56.5	Dawson
	13-089-0002	65.4	DeKalb
	13-097-0004	61.9	Douglas
	13121-0055	69.9	Fulton
	13-135-0002	64.8	Gwinnett
	13-151-0002	67.0	Henry
	13-223-0003	60.8	Paulding
	13-231-9991	60.5	Pike
	13-247-0001	64.8	Rockdale
Outside Atlanta CSA	13-021-0012	59.8	Bibb
	13-055-0001	57.0	Chattooga
	13-073-0001	59.1	Columbia
	13-213-0003	60.2	Murray
	13-215-0008	56.4	Muscogee
	13-245-0091	60.6	Richmond
	13-261-1001	57.6	Sumter

[7] EPA, 2014. Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze.

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3. Source Apportionment Modeling

Preparation of "Tagged" APCA Emissions Inputs

For 2017 APCA emission inputs, EPD conducted Sparse Matrix Object Kernel Emission (SMOKE, version 3.6.5) modeling to spatially and temporally allocate emissions into the EPD modeling grids, as well as speciate inventory pollutants to modeling species using the CB6r2 chemical mechanism (Figure 12). SMOKE was also run in source apportionment mode to tag anthropogenic emissions from each of the 39 counties in the Atlanta CSA as an individual source region; anthropogenic emissions from all other counties in the modeling domain were tagged as the "other" region, and emissions from biogenic sources, wildfires, and prescribed burning were tagged as the "biogenic" source group (Table 8). Biogenic and dust emissions were tagged as "1" and fire emissions were tagged as "42".

Low level emissions (e.g. onroad, nonroad, area etc.) were processed in SMOKE from county level data and spatially allocated to grid cells that overlap the county using spatial surrogates from the NEI 2011eh v2 platform. The resulting emissions received a source apportionment tag that corresponds to the source county. In the case where one grid cell overlaps multiple counties, that particular grid cell would contain separately tagged emissions from each of the overlapped counties according to the amounts of the total county emissions allocated by the spatial surrogates. This step takes place during emissions processing and thus eliminates the need to separate each county's emissions in a particular grid cell using area fractions within the air quality model which is less accurate.

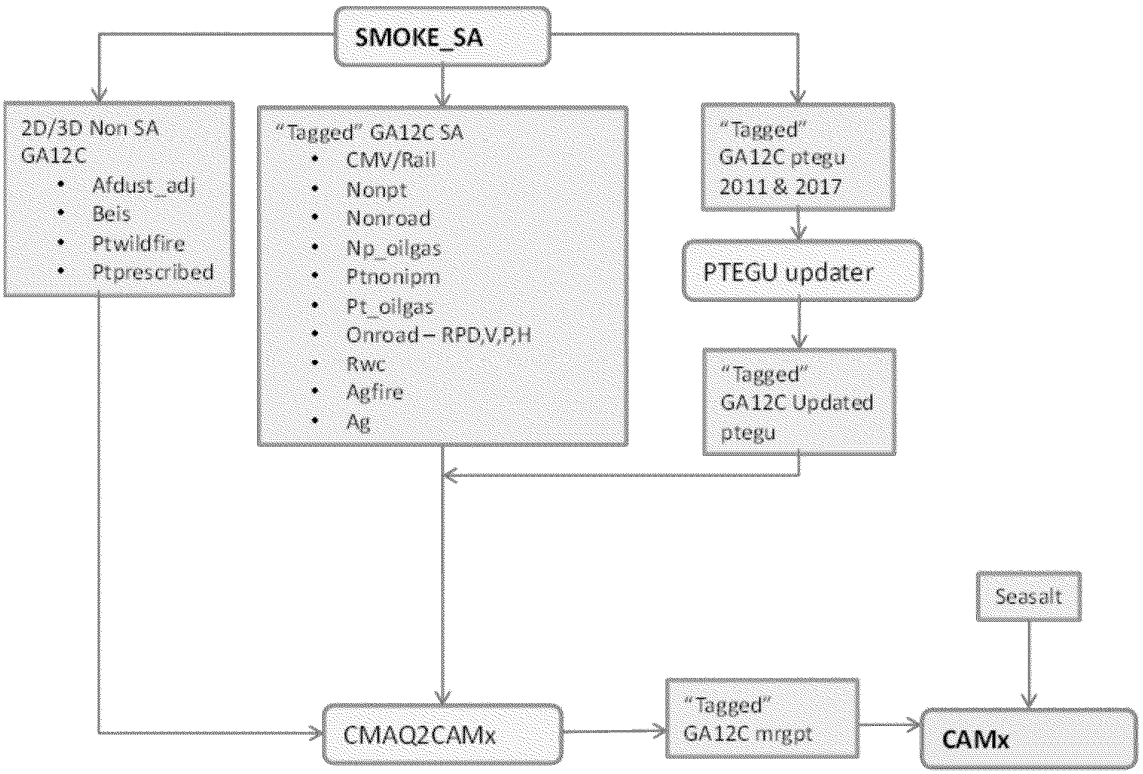

Figure 12. SMOKE processing procedures for CAMx-APCA modeling.

Table 8. County tag list for the CAMx-APCA modeling

Tag	County FIPS	County Name
2	"13059"	Clarke
3	"13195"	Madison
4	"13219"	Oconee
5	"13221"	Oglethorpe
6	"13013"	Barrow
7	"13015"	Bartow
8	"13035"	Butts
9	"13045"	Carroll
10	"13057"	Cherokee
11	"13063"	Clayton
12	"13067"	Cobb
13	"13077"	Coweta
14	"13085"	Dawson
15	"13089"	DeKalb
16	"13097"	Douglas
17	"13113"	Fayette
18	"13117"	Forsyth
19	"13121"	Fulton
20	"13135"	Gwinnett
21	"13143"	Haralson
22	"13149"	Heard
23	"13151"	Henry
24	"13159"	Jasper
25	"13171"	Lamar
26	"13199"	Meriwether
27	"13211"	Morgan
28	"13217"	Newton
29	"13223"	Paulding
30	"13227"	Pickens
31	"13231"	Pike
32	"13247"	Rockdale
33	"13255"	Spalding
34	"13297"	Walton
35	"13129"	Gordon
36	"13233"	Polk
37	"13139"	Hall
38	"13157"	Jackson
39	"13285"	Troup
40	"13293"	Upson
41	"0"	All Other Counties

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Source Contribution Calculation

Source contributions of each county in the Atlanta CSA were calculated following similar procedures used in the Transport Rule Modeling.

1) Calculate the average "high" 2017 MDA8 value by averaging 2017 MDA8 ozone concentrations (MDA8H) for days showing 2017 MDA8 ozone concentrations greater or equal to 71 ppb[8] at each monitor. If the number of days with 2017 MDA8 ozone concentrations over 71 ppb is less than five at any monitor, the top five 2017 MDA8 ozone concentrations are selected by lowering the threshold to 60 ppb. If a monitor does not have five days above or equal 60 ppb, contributions were not calculated at the monitor;
2) Calculate the 2017 8-hour ozone source contribution of each county for the grid cells containing ozone monitors using CAMx-APCA outputs. Daily 2017 8-hour ozone source contribution of each county for the days and hours were extracted corresponding to the days and hours used to compute the average "high" 2017 MDA8 value;
3) Calculate the average 2017 8-hour ozone source contribution (AOC) of each county at a monitor;
4) Calculate final source contribution of a county at a monitor by multiplying its AOC and the ratio of the 2017 future design value at the monitor and MDA8H at the monitor: County Contribution = AOC x (2017 DVF/MDA8H).

4. Results and Conclusions

Contributions of 39 counties in the Atlanta CSA to the five violating ozone monitors are summarized in Table 9. A contribution threshold of 1.0 ppb (after rounding at the second decimal place) was used to determine which counties significantly contribute to the violating monitors. The 1.0 ppb threshold was chosen because it is EPA's recently proposed significant impact level for single source PSD modeling[9]. The following counties had more than a 1.0 ppb impact on at least one violating ozone monitor: Fulton, Gwinnett, DeKalb, Cobb, Bartow, Clayton, and Henry.

[8] GA EPD used 71 ppb as the threshold compared with 76 ppb for the EPA's Transport Rule Modeling because GA EPD's goal is to estimate contributions for the 2015 Ozone NAAQS, 70 ppb, while the EPA's modeling was for the 2008 Ozone NAAQS, 75 ppb.

[9] EPA, 2016. Draft Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program.

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Table 9. Contributions of 39 counties in the Atlanta CSA to violating ozone monitors. Red values indicate more than 1.0 ppb contribution to a violating ozone monitor.

Monitor	Confederate Ave. (13-121-0055)	Conyers (13-247-0001)	McDonough (13-151-0002)	Gwinnett Tech (13-135-0002)	South DeKalb (13-089-0002)
Barrow	0.12	0.06	0.10	0.23	0.10
Bartow	**1.17**	0.77	0.97	**1.45**	0.96
Butts	0.04	0.07	0.14	0.02	0.04
Carroll	0.24	0.33	0.15	0.09	0.26
Cherokee	0.40	0.30	0.36	0.64	0.33
Clarke	0.08	0.03	0.10	0.09	0.08
Clayton	**3.54**	**4.22**	**3.85**	0.68	**3.26**
Cobb	**2.69**	**1.50**	**1.72**	**2.49**	**2.05**
Coweta	0.24	0.38	0.29	0.14	0.23
Dawson	0.03	0.03	0.03	0.04	0.03
DeKalb	**3.04**	**3.07**	**3.17**	**2.33**	**5.56**
Douglas	0.68	0.41	0.33	0.16	0.55
Fayette	0.21	0.31	0.40	0.07	0.18
Forsyth	0.29	0.26	0.24	0.78	0.24
Fulton	**8.74**	**4.12**	**4.07**	**3.92**	**5.98**
Gordon	0.15	0.11	0.14	0.07	0.13
Gwinnett	**1.71**	**1.93**	**1.60**	**8.25**	**1.58**
Hall	0.26	0.18	0.16	0.61	0.19
Haralson	0.07	0.10	0.03	0.04	0.09
Heard	0.14	0.26	0.16	0.09	0.15
Henry	0.55	**2.65**	**4.08**	0.26	0.88
Jackson	0.16	0.07	0.12	0.29	0.13
Jasper	0.01	0.01	0.03	0.01	0.01
Lamar	0.01	0.02	0.03	0.01	0.01
Madison	0.07	0.03	0.07	0.11	0.07
Meriwether	0.02	0.03	0.03	0.02	0.03
Morgan	0.06	0.02	0.08	0.03	0.06
Newton	0.17	0.29	0.34	0.06	0.21
Oconee	0.04	0.01	0.05	0.04	0.04
Oglethorpe	0.01	0.00	0.01	0.01	0.01
Paulding	0.35	0.20	0.22	0.20	0.29
Pickens	0.05	0.05	0.05	0.03	0.05
Pike	0.01	0.01	0.02	0.01	0.01
Polk	0.09	0.06	0.05	0.07	0.08
Rockdale	0.23	0.95	0.41	0.09	0.31
Spalding	0.04	0.10	0.15	0.03	0.05
Troup	0.03	0.04	0.04	0.03	0.04
Upson	0.01	0.01	0.01	0.01	0.01
Walton	0.16	0.09	0.20	0.14	0.17

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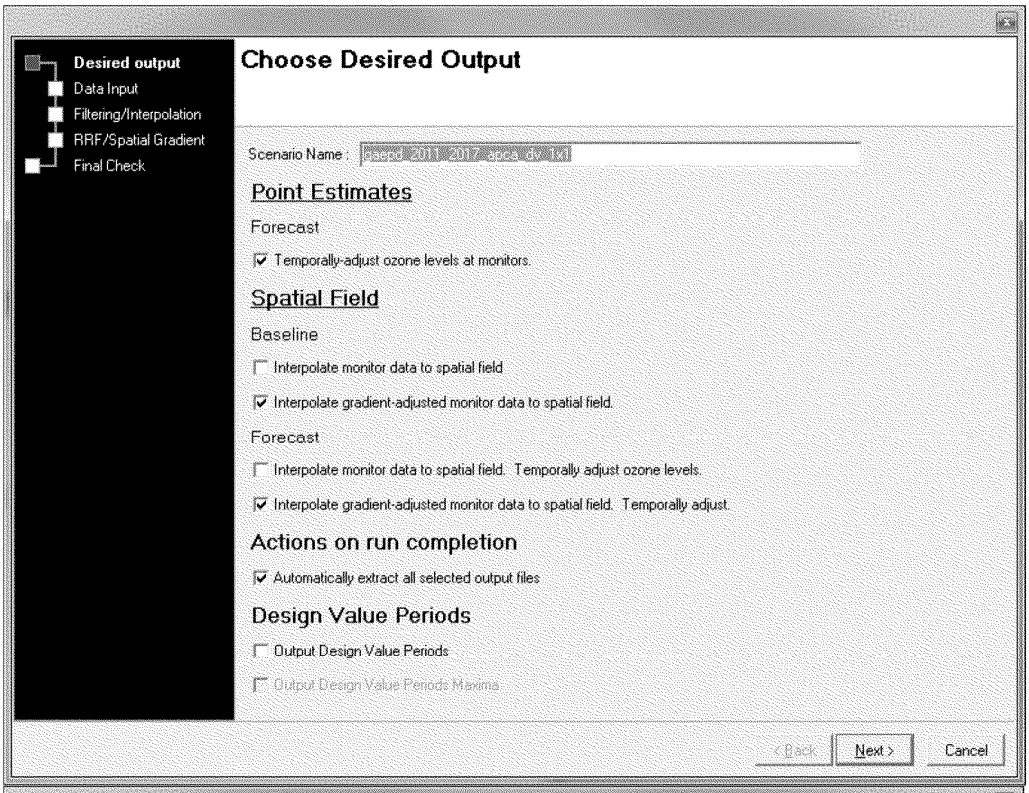
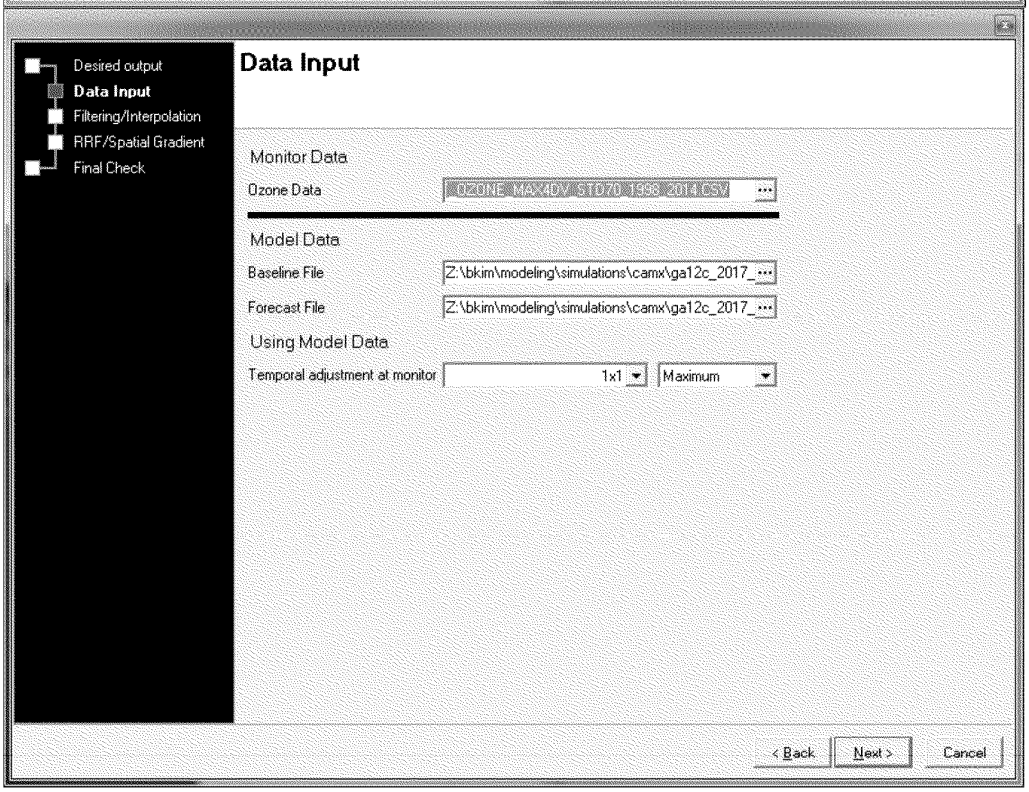
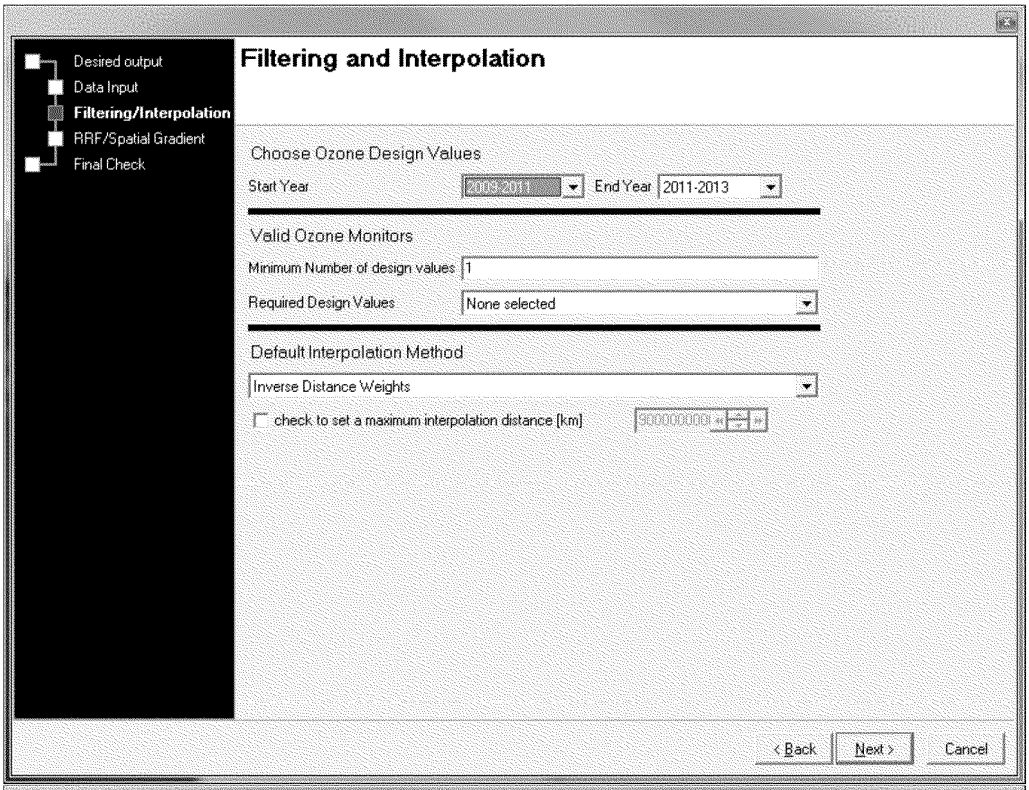
Appendix A. MATS Configuration for the 2017 design value projections.



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Data Input
Filtering/Interpolation
RRF/Spatial Gradient
Final Check
Filtering and Interpolation
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Start Year
2009-2011
End Year
2011-2013
Valid Ozone Monitors
Minimum Number of design values
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Required Design Values
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Default Interpolation Method
Inverse Distance Weights
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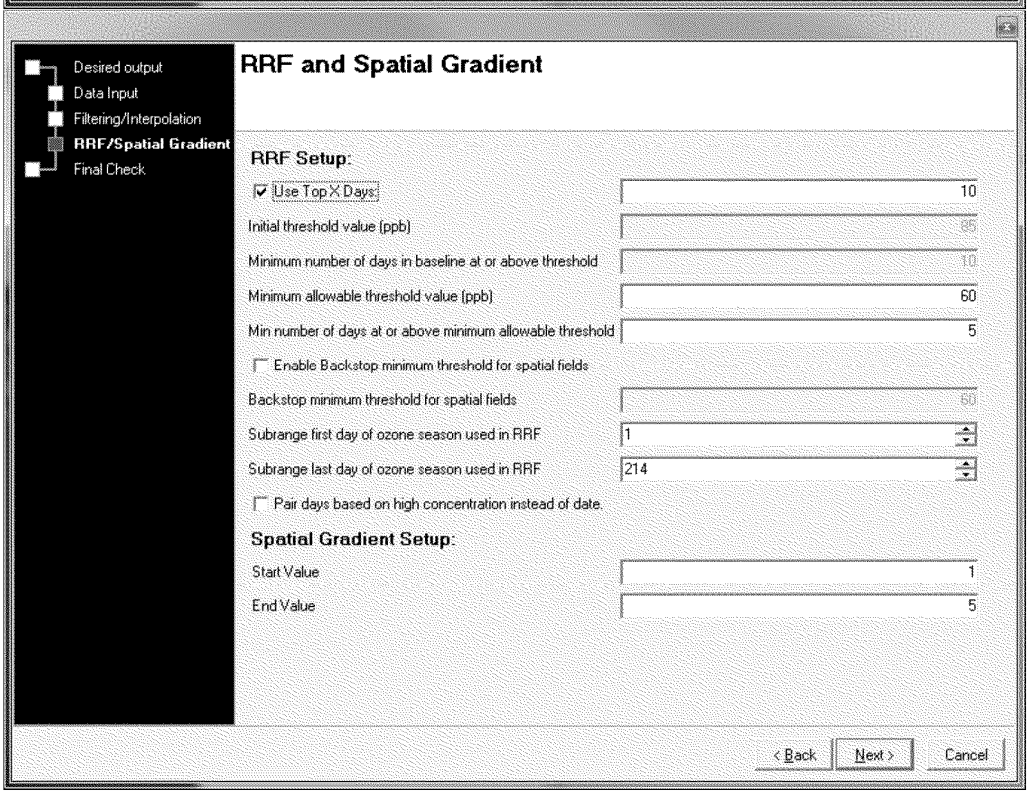
Next >
Cancel


Desired output
Data Input
Filtering/Interpolation
RRF/Spatial Gradient
Final Check
RRF and Spatial Gradient
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Use Top X Days:
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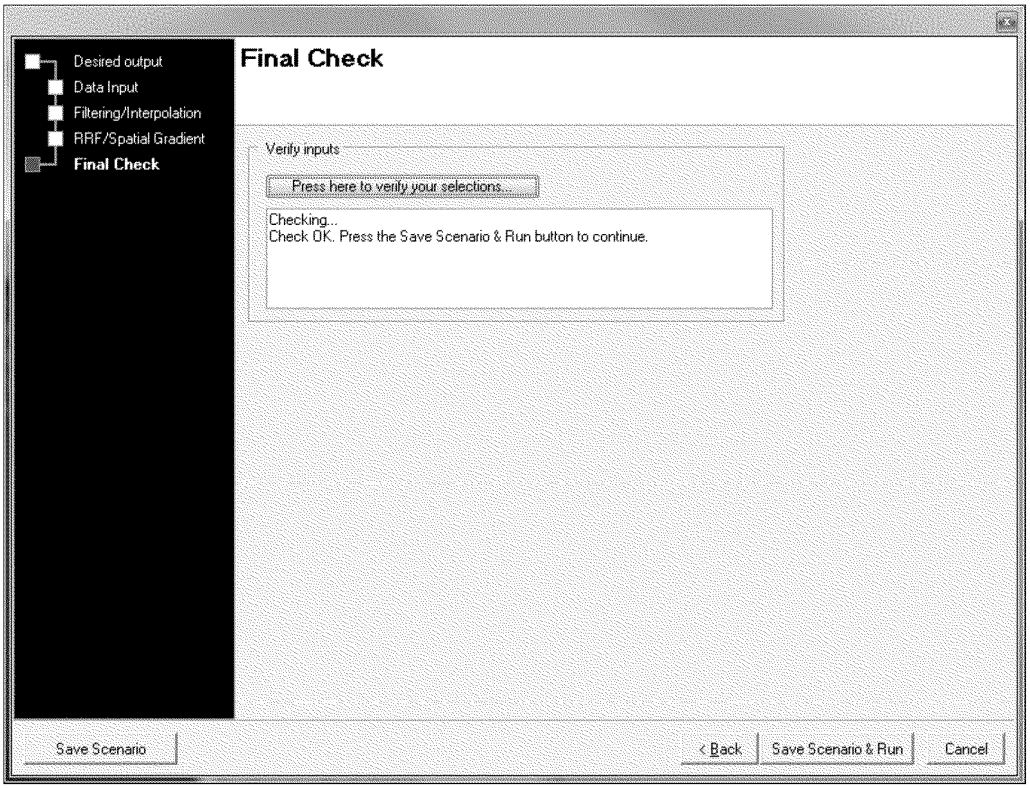
Initial threshold value (ppb)
85
Minimum number of days in baseline at or above threshold
10
Minimum allowable threshold value (ppb)
60
Min number of days at or above minimum allowable threshold
5
Enable Backstop minimum threshold for spatial fields
Backstop minimum threshold for spatial fields
60
Subrange first day of ozone season used in RRF
1
Subrange last day of ozone season used in RRF
214
Pair days based on high concentration instead of date.
Spatial Gradient Setup:
Start Value
1
End Value
5
< Back
Next >
Cancel



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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

Table 1. EPD's designation recommendations for counties in Georgia.

County Name	Designation Recommendation
Appling	Unclassifiable/Attainment
Atkinson	Unclassifiable/Attainment
Bacon	Unclassifiable/Attainment
Baker	Unclassifiable/Attainment
Baldwin	Unclassifiable/Attainment
Banks	Unclassifiable/Attainment
Barrow	Unclassifiable/Attainment
Bartow	**Nonattainment**
Ben Hill	Unclassifiable/Attainment
Berrien	Unclassifiable/Attainment
Bibb	Unclassifiable/Attainment
Bleckley	Unclassifiable/Attainment
Brantley	Unclassifiable/Attainment
Brooks	Unclassifiable/Attainment
Bryan	Unclassifiable/Attainment
Bulloch	Unclassifiable/Attainment
Burke	Unclassifiable/Attainment
Butts	Unclassifiable/Attainment
Calhoun	Unclassifiable/Attainment
Camden	Unclassifiable/Attainment
Candler	Unclassifiable/Attainment
Carroll	Unclassifiable/Attainment
Catoosa	Unclassifiable/Attainment
Charlton	Unclassifiable/Attainment
Chatham	Unclassifiable/Attainment
Chattahoochee	Unclassifiable/Attainment
Chattooga	Unclassifiable/Attainment
Cherokee	Unclassifiable/Attainment
Clarke	Unclassifiable/Attainment
Clay	Unclassifiable/Attainment
Clayton	**Nonattainment**
Clinch	Unclassifiable/Attainment
Cobb	**Nonattainment**
Coffee	Unclassifiable/Attainment
Colquitt	Unclassifiable/Attainment
Columbia	Unclassifiable/Attainment
Cook	Unclassifiable/Attainment
Coweta	Unclassifiable/Attainment
Crawford	Unclassifiable/Attainment
Crisp	Unclassifiable/Attainment
Dade	Unclassifiable/Attainment
Dawson	Unclassifiable/Attainment

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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

County Name	Designation Recommendation
Decatur	Unclassifiable/Attainment
DeKalb	**Nonattainment**
Dodge	Unclassifiable/Attainment
Dooly	Unclassifiable/Attainment
Doughtery	Unclassifiable/Attainment
Douglas	Unclassifiable/Attainment
Early	Unclassifiable/Attainment
Echols	Unclassifiable/Attainment
Effingham	Unclassifiable/Attainment
Elbert	Unclassifiable/Attainment
Emanuel	Unclassifiable/Attainment
Evans	Unclassifiable/Attainment
Fannin	Unclassifiable/Attainment
Fayette	Unclassifiable/Attainment
Floyd	Unclassifiable/Attainment
Forsyth	Unclassifiable/Attainment
Franklin	Unclassifiable/Attainment
Fulton	**Nonattainment**
Gilmer	Unclassifiable/Attainment
Glascock	Unclassifiable/Attainment
Glynn	Unclassifiable/Attainment
Gordon	Unclassifiable/Attainment
Grady	Unclassifiable/Attainment
Greene	Unclassifiable/Attainment
Gwinnett	**Nonattainment**
Habersham	Unclassifiable/Attainment
Hall	Unclassifiable/Attainment
Hancock	Unclassifiable/Attainment
Haralson	Unclassifiable/Attainment
Harris	Unclassifiable/Attainment
Hart	Unclassifiable/Attainment
Heard	Unclassifiable/Attainment
Henry	**Nonattainment**
Houston	Unclassifiable/Attainment
Irwin	Unclassifiable/Attainment
Jackson	Unclassifiable/Attainment
Jasper	Unclassifiable/Attainment
Jeff Davis	Unclassifiable/Attainment
Jefferson	Unclassifiable/Attainment
Jenkins	Unclassifiable/Attainment
Johnson	Unclassifiable/Attainment
Jones	Unclassifiable/Attainment
Lamar	Unclassifiable/Attainment

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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

County Name	Designation Recommendation
Lanier	Unclassifiable/Attainment
Laurens	Unclassifiable/Attainment
Lee	Unclassifiable/Attainment
Liberty	Unclassifiable/Attainment
Lincoln	Unclassifiable/Attainment
Long	Unclassifiable/Attainment
Lowndes	Unclassifiable/Attainment
Lumpkin	Unclassifiable/Attainment
McDuffie	Unclassifiable/Attainment
McIntosh	Unclassifiable/Attainment
Macon	Unclassifiable/Attainment
Madison	Unclassifiable/Attainment
Marion	Unclassifiable/Attainment
Meriwether	Unclassifiable/Attainment
Miller	Unclassifiable/Attainment
Mitchell	Unclassifiable/Attainment
Monroe	Unclassifiable/Attainment
Montgomery	Unclassifiable/Attainment
Morgan	Unclassifiable/Attainment
Murray	Unclassifiable/Attainment
Muscogee	Unclassifiable/Attainment
Newton	Unclassifiable/Attainment
Oconee	Unclassifiable/Attainment
Oglethorpe	Unclassifiable/Attainment
Paulding	Unclassifiable/Attainment
Peach	Unclassifiable/Attainment
Pickens	Unclassifiable/Attainment
Pierce	Unclassifiable/Attainment
Pike	Unclassifiable/Attainment
Polk	Unclassifiable/Attainment
Pulaski	Unclassifiable/Attainment
Putnam	Unclassifiable/Attainment
Quitman	Unclassifiable/Attainment
Rabun	Unclassifiable/Attainment
Randolph	Unclassifiable/Attainment
Richmond	Unclassifiable/Attainment
Rockdale	**Nonattainment**
Schley	Unclassifiable/Attainment
Screven	Unclassifiable/Attainment
Seminole	Unclassifiable/Attainment
Spalding	Unclassifiable/Attainment
Stephens	Unclassifiable/Attainment
Stewart	Unclassifiable/Attainment

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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

County Name	Designation Recommendation
Sumter	Unclassifiable/Attainment
Talbot	Unclassifiable/Attainment
Taliaferro	Unclassifiable/Attainment
Tattnall	Unclassifiable/Attainment
Taylor	Unclassifiable/Attainment
Telfair	Unclassifiable/Attainment
Terrell	Unclassifiable/Attainment
Thomas	Unclassifiable/Attainment
Tift	Unclassifiable/Attainment
Toombs	Unclassifiable/Attainment
Towns	Unclassifiable/Attainment
Treutlen	Unclassifiable/Attainment
Troup	Unclassifiable/Attainment
Turner	Unclassifiable/Attainment
Twiggs	Unclassifiable/Attainment
Union	Unclassifiable/Attainment
Upson	Unclassifiable/Attainment
Walker	Unclassifiable/Attainment
Walton	Unclassifiable/Attainment
Ware	Unclassifiable/Attainment
Warren	Unclassifiable/Attainment
Washington	Unclassifiable/Attainment
Wayne	Unclassifiable/Attainment
Webster	Unclassifiable/Attainment
Wheeler	Unclassifiable/Attainment
White	Unclassifiable/Attainment
Whitfield	Unclassifiable/Attainment
Wilcox	Unclassifiable/Attainment
Wilkes	Unclassifiable/Attainment
Wilkinson	Unclassifiable/Attainment
Worth	Unclassifiable/Attainment

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Table 2. 2013-2015 and preliminary 2014-2016 ozone design values in Georgia by Core Based Statistical Area (CBSA).

CBSA Name	County	AQS Site ID	Local Site Name	DV 2013-2015	DV 2014-2016*
Americas, GA	Sumter	13-261-1001	Leslie-Union High School	0.058	0.059
Athens-Clarke County, GA	Clarke	13-059-0002	Fire Station # 7	0.061	0.064
Atlanta-Sandy Springs-Marietta, GA	**Fulton**	13-121-0055	Confederate Avenue	**0.073**	**0.075**
	Rockdale	13-247-0001	Conyers	**0.072**	**0.074**
	Henry	13-151-0002	McDonough-County Extension Office	**0.071**	**0.074**
	Gwinnett	13-135-0002	Gwinnett Tech	0.069	**0.072**
	DeKalb	13-089-0002	South DeKalb	0.067	**0.071**
	Douglas	13-097-0004	W. Strickland Street	0.066	0.068
	Pike	13-231-9991	Georgia Station	0.066	0.068
	Cobb	13-067-0003	Kennesaw-National Guard	0.065	0.066
	Dawson	13-085-0001	Dawsonville, Georgia Forestry Commission	0.064	0.065
	Coweta	13-077-0002	Newnan	0.062	0.066
	Paulding	13-223-0003	Yorkville, King Farm	0.062	0.062
Augusta-Richmond County, GA-SC	Richmond	13-245-0091	Bungalow Road	0.061	0.062
	Columbia	13-073-0001	Evans-Riverside Park	0.060	0.060
Brunswick, GA	Glynn	13-127-0006	Risley Middle School	0.056	0.056
Columbus, GA-AL	Muscogee	13-215-0008	Columbus- Airport	0.061	0.062
Dalton, GA	Murray	13-213-0003	Fort Mountain	0.064	0.065
Macon, GA	Bibb	13-021-0012	Macon SE	0.063	0.065
Savannah, GA	Chatham	13-051-0021	Savannah-E. President Street	0.058	0.058
Summerville, GA	Chattooga	13-055-0001	Summerville-DNR Fish Hatchery	0.060	0.061

*The 2014-2016 preliminary design values are based on uncertified ozone data through August 21, 2016.

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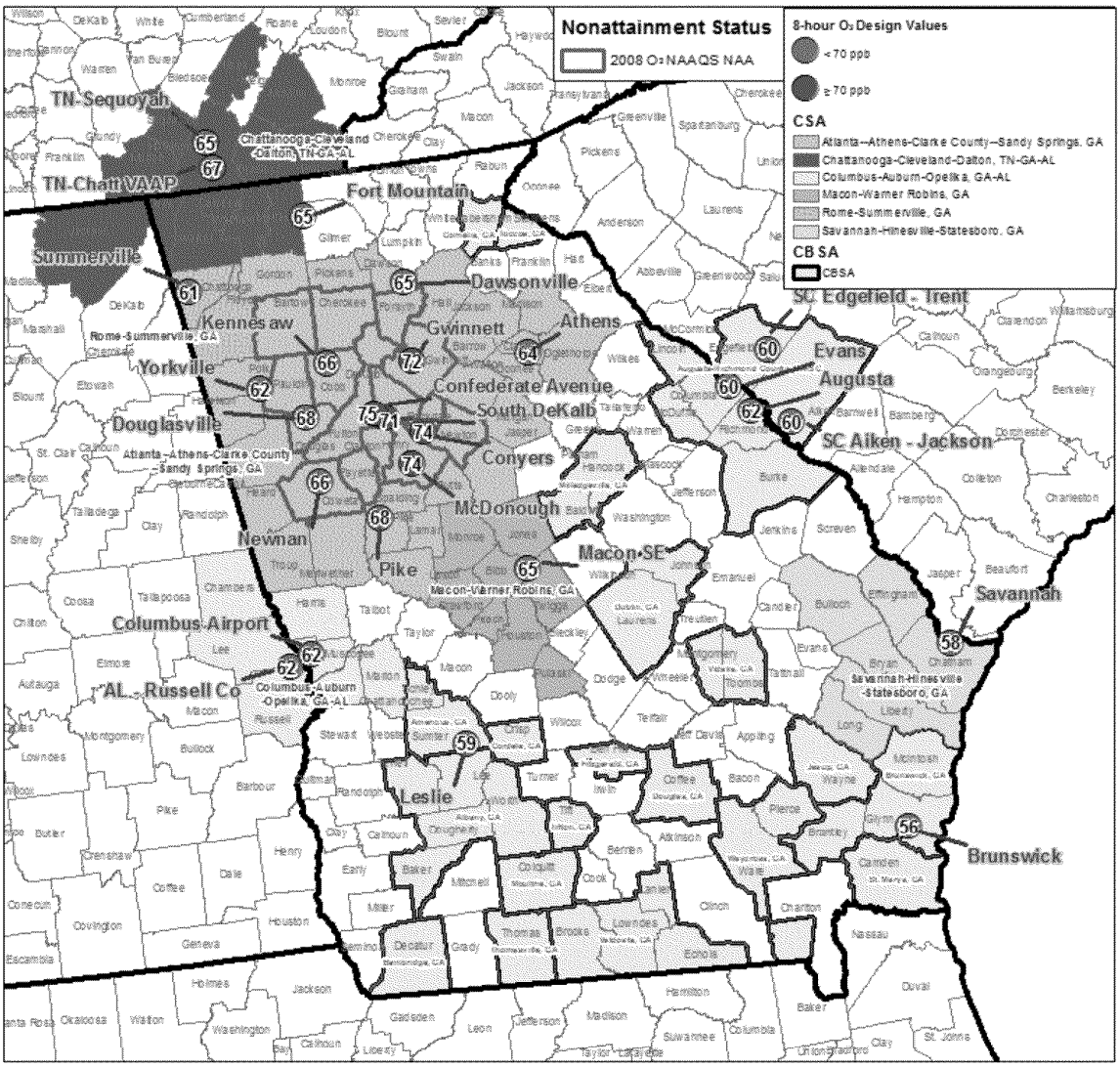

Figure 1. CSA and CBSA boundaries (CBSAs in CSAs are not shown) and preliminary 2014-2016 design values at ozone monitors in and around Georgia. Nonattainment area boundaries for the 2008 ozone NAAQS are outlined in purple.

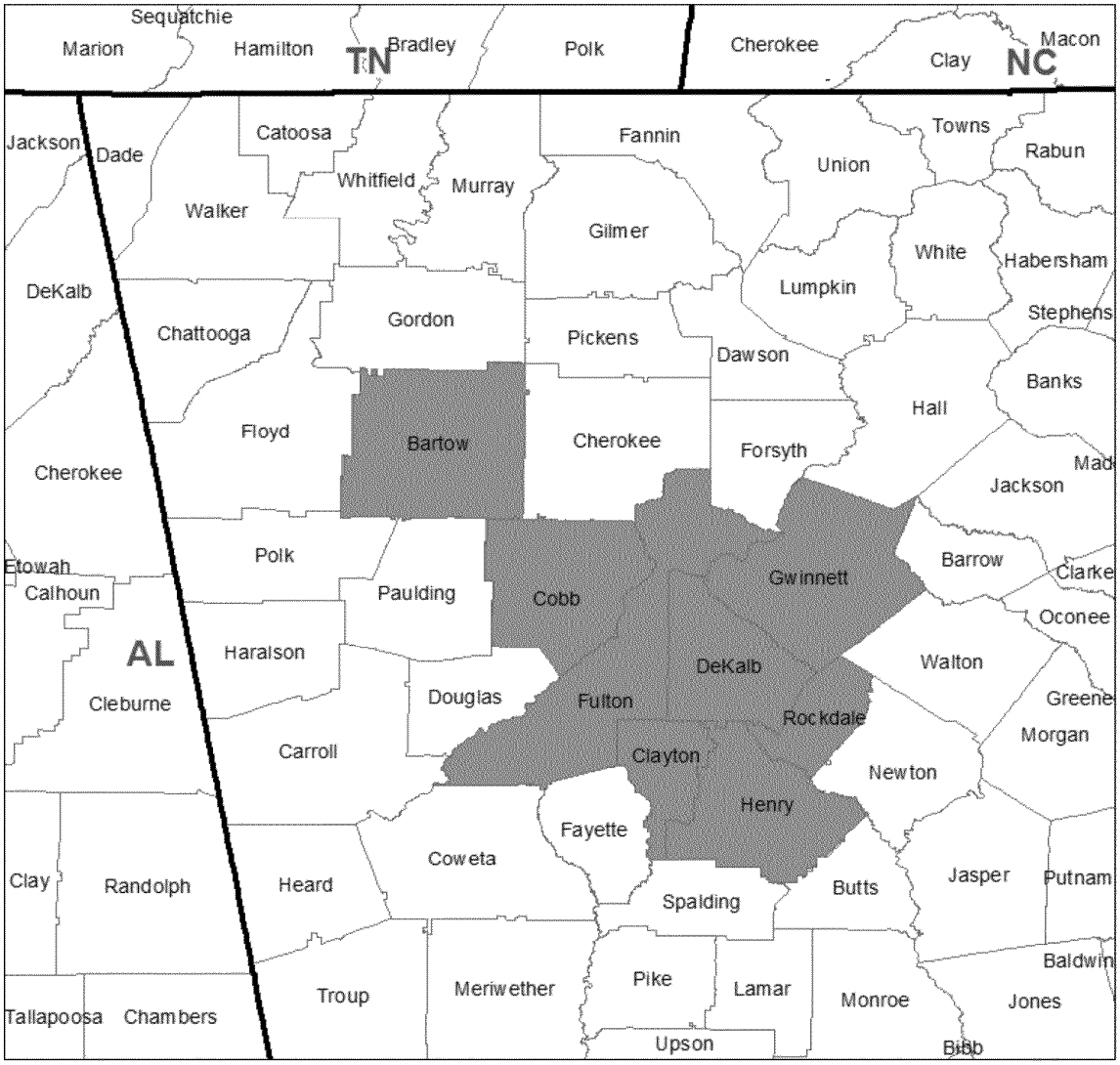

Figure 2: Map of eight counties (orange shading) in the Atlanta CSA recommended by EPD as nonattainment for the 2015 ozone NAAQS.

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Richard E. Dunn, Director

EPD Director's Office
2 Martin Luther King, Jr. Drive
Suite 1456, East Tower
Atlanta, Georgia 30334
404-656-4713

SEP 23 2016

Heather McTeer Toney
Regional Administrator
U.S. EPA, Region 4
61 Forsyth Street, S.W.
Atlanta, Georgia 30303-3104

Re: Georgia's Designation Recommendations for the 2015 Ozone NAAQS

Dear Ms. Toney:

On October 1, 2015, the United States Environmental Protection Agency (EPA) promulgated a revised National Ambient Air Quality Standard (NAAQS) for ozone. Section 107(d)(1) of the Clean Air Act requires each state to submit to EPA no later than one year following promulgation of a new or revised NAAQS, its designation recommendations for each area of the state as attainment, nonattainment, or unclassifiable under the standard. The Georgia Environmental Protection Division (EPD) developed designation recommendations in accordance with U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards".

The attached table (Table 1) provides EPD's recommendations for the designation status of each county in Georgia. Georgia's recommendations are based on 2013-2015 design values calculated using certified monitoring data and 2014-2016 design values calculated using preliminary 2016 ozone data. A list of 2013-2015 and preliminary 2014-2016 ozone design values for all monitors in Georgia is attached in Table 2. A spatial plot of the preliminary 2014-2016 ozone design values is attached in Figure 1. It can be seen from Figure 1 that the five Georgia monitors violating the 70 ppb NAAQS are all located in the Atlanta--Athens-Clarke County--Sandy Springs, GA Combined Statistical Area (CSA).

Based on a rigorous 5-factor analysis and source contribution photochemical grid modeling, EPD recommends that the following eight (8) counties be designated **nonattainment** for the 2015 ozone NAAQS (Figure 2):

- Bartow,
- Clayton,
- Cobb,
- DeKalb,
- Fulton,
- Gwinnett,
- Henry, and
- Rockdale.

In addition, EPD recommends that all other counties in Georgia be designated as **unclassifiable/attainment** for the 2008 ozone NAAQS. A detailed technical analysis to support our recommendations is attached.

If you have any questions or need more information, please contact James Boylan at James.Boylan@dnr.ga.gov or (404) 363-7014.

Sincerely,

Richard E. Dunn
Director

Attachments

c: Scott Davis, U.S. EPA Region 4
Lynorae Benjamin, U.S. EPA Region 4
Karen Hays, Branch Chief, Air Protection Branch

Georgia's Nonattainment Area Designation Recommendations for the 2015 Ozone NAAQS - Technical Analysis Document -

This document contains Georgia Environmental Protection Division's (EPD) technical analysis for designation recommendations for areas in Georgia for the 2015 ozone National Ambient Air Quality Standards (NAAQS). This analysis was conducted in accordance with U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards". This memo recommends evaluating five factors:

1. Air quality data
2. Emissions and emissions-related data
3. Meteorological data
4. Geography/topography
5. Jurisdictional boundaries

Each of the 159 counties in Georgia has been evaluated and recommended as unclassifiable/attainment or nonattainment based on the available information and data.

Air Quality Data and Potential Nonattainment Areas in Georgia

Federal Reference Method (FRM) measurements of ozone concentrations in Georgia, during the most recent three consecutive years (2013-2015), were analyzed and used to identify sites currently violating the 2015 ozone NAAQS of 0.070 ppm. These ozone measurements have been quality-assured and certified and are stored in EPA's Air Quality System (AQS) database. Design values (DV) were calculated for each monitor by averaging the fourth-highest daily maximum 8-hour average ozone concentrations for three consecutive years. If the 2013-2015 DV for a monitor is greater than 0.070 ppm, the monitor is violating the NAAQS.

According to the U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards":

> *"..Section I07(d) explicitly requires that the EPA designate as nonattainment not only the area that is violating the pertinent standard, but also those nearby areas that contribute to the violation in the violating area. After identifying each monitor that indicates a violation of the 2015 ozone NAAQS in an area, the EPA will determine which nearby areas contribute to the violation(s)."*

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"..for analyzing whether nearby areas contribute to a violating area. The EPA intends to consider information relevant to designations associated with the counties in the Combined Statistical Area (CSA) or, where appropriate, the Core Based Statistical Area (CBSA) in which the violating monitor(s) are located. The CSAs and CBSAs are delineated by the Office of Management and Budget (OMB) as part of their Metropolitan and Micropolitan Statistical Area program."

Of the 21 ozone monitors in Georgia, there are currently three (3) monitors in the Atlanta-Sandy Springs-Marietta, GA CBSA that are violating the 2015 ozone NAAQS (Table 1). Also, the 2013-2015 DVs in neighboring states were checked and no violating monitors were identified (Figure 1).

Table 1. 2013-2015 design values (DVs) at each ozone monitor in Georgia by CBSA. Counties in red are violating the 2015 ozone NAAQS based on 2013-2015 DVs.

CBSA Name	County	AQS Site ID	Local Site Name	2013-2015 DVs (ppm)
Americas, GA	Sumter	132611001	Leslie-Union High School	0.058
Athens-Clarke County, GA	Clarke	130590002	Fire Station # 7	0.061
Atlanta-Sandy Springs-Marietta, GA	**Fulton**	131210055	Confederate Avenue	**0.073**
	Rockdale	132470001	Monastery	**0.072**
	Henry	131510002	McDonough-County Extension Office	**0.071**
	Gwinnett	131350002	Gwinnett Tech	0.069
	DeKalb	130890002	South DeKalb	0.067
	Douglas	130970004	W. Strickland Street	0.066
	Pike	132319991	Georgia Station	0.066
	Cobb	130670003	Kennesaw-National Guard	0.065
	Dawson	130850001	Dawsonville, Georgia Forestry Commission	0.064
	Paulding	132230003	Yorkville, King Farm	0.062
	Coweta	130770002	Newnan	0.062
Augusta-Richmond County, GA-SC	Richmond	132450091	Bungalow Road	0.061
	Columbia	130730001	Evans-Riverside Park	0.060
Brunswick, GA	Glynn	131270006	Risley Middle School	0.056
Columbus, GA-AL	Muscogee	132150008	Columbus- Airport	0.061
Dalton, GA	Murray	132130003	Fort Mountain	0.064
Macon, GA	Bibb	130210012	Macon SE	0.063
Savannah, GA	Chatham	130510021	Savannah-E. President Street	0.058
Summerville, GA	Chattooga	130550001	Summerville-DNR Fish Hatchery	0.060

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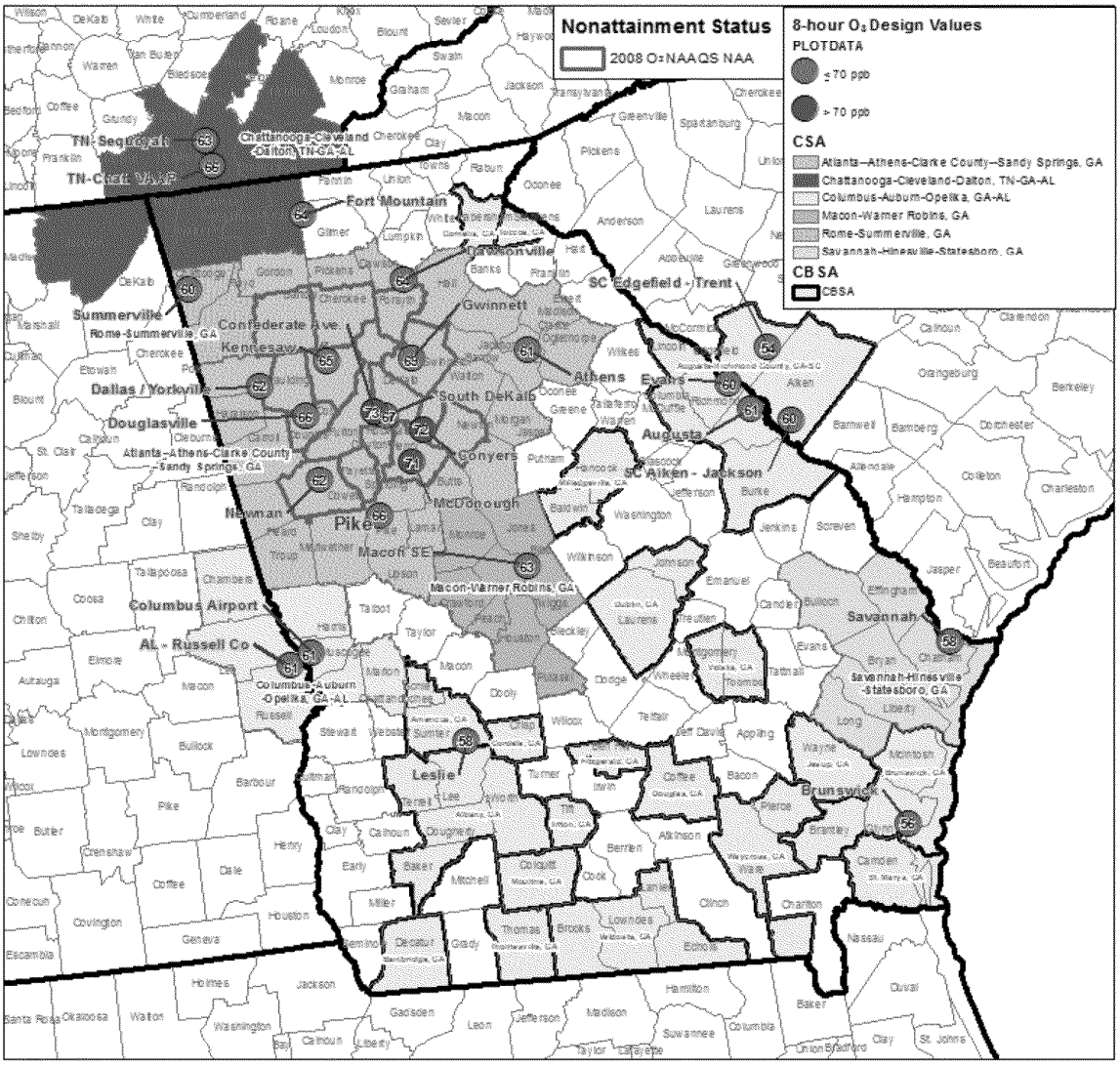

Figure 1. CSA and CBSA boundaries (CBSAs in CSAs are not shown) and 2013-2015 DVs at ozone monitors in and around Georgia. Nonattainment area boundaries for the 2008 ozone NAAQS are outlined in purple.

There are 39 counties (Table 2) in the Atlanta--Athens-Clarke County--Sandy Springs, GA CSA (Atlanta CSA). The Atlanta CSA includes the following CBSAs: Athens-Clarke County, Atlanta-Sandy Springs-Marietta, Calhoun, Cedartown, Gainesville, Jefferson, LaGrange, and Thomaston. All 39 counties in the Atlanta CSA were evaluated as potential nonattainment areas. The remaining 120 counties in Georgia have no violating monitors in their CBSAs. Therefore, no additional analysis will be performed for these counties and they will be recommended as unclassifiable/attainment.

Table 2. List of CBSAs and counties in the Atlanta CSA. Counties with violating monitors based on 2013-2015 DVs are marked in red.

CBSA Name	County Name and Federal Information Processing Standard (FIPS) code
Athens-Clarke County, GA	Clarke (13059), Madison (13195), Oconee (13219), Oglethorpe (13221)
Atlanta-Sandy Springs-Roswell, GA	Barrow (13013), Bartow (13015), Butts (13035), Carroll (13045), Cherokee (13057), Clayton (13063), Cobb (13067), Coweta (13077), Dawson (13085), DeKalb (13089), Douglas (13097), Fayette (13113), Forsyth (13117), **Fulton (13121)**, Gwinnett (13135), Haralson (13143), Heard (13149), **Henry (13151)**, Jasper (13159), Lamar (13171), Meriwether (13199), Morgan (13211), Newton (13217), Paulding (13223), Pickens (13227), Pike (13231), **Rockdale (13247)**, Spalding (13255), Walton (13297)
Calhoun, GA	Gordon (13129)
Cedartown, GA	Polk (13233)
Gainesville, GA	Hall (13139)
Jefferson, GA	Jackson (13157)
LaGrange, GA	Troup (13285)
Thomaston, GA	Upson (13293)

Five-Factor Analysis in the Atlanta CSA

The nonattainment area boundaries were evaluated using five factors as described in the U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards":

1. Air quality data
2. Emissions and emissions-related data
3. Meteorological data
4. Geography/topography
5. Jurisdictional boundaries

Factor 1: Air Quality Data

The 2013-2015 DVs at ozone monitors in Fulton, Henry, and Rockdale counties violate the 2015 ozone NAAQS. The preliminary 2016 ozone data indicate that monitors in Gwinnett and DeKalb will also violate the 2015 ozone NAAQS (Table 3). Therefore, these 5 counties with violating monitors will be recommended as nonattainment. The other 34 counties in the Atlanta CSA do not have a violating monitor. These counties were evaluated to determine whether or not they contribute to violations at the ozone monitors in Fulton, Henry, Rockdale, Gwinnett, and DeKalb.

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Table 3. 2013-2015 and preliminary 2014-2016 ozone design values in the Atlanta CSA.

County	AQS Site ID	Local Site Name	DV 2013-2015	DV 2014-2016*
Fulton	131210055	Confederate Avenue	0.073	0.075
Rockdale	132470001	Monastery	0.072	0.074
Henry	131510002	McDonough-County Extension Office	0.071	0.074
Gwinnett	131350002	Gwinnett Tech	0.069	0.072
DeKalb	130890002	South DeKalb	0.067	0.071
Douglas	130970004	W. Strickland Street	0.066	0.068
Pike	132319991	Georgia Station	0.066	0.068
Cobb	130670003	Kennesaw-National Guard	0.065	0.066
Dawson	130850001	Dawsonville, Georgia Forestry Commission	0.064	0.065
Coweta	130770002	Newnan	0.062	0.066
Paulding	132230003	Yorkville, King Farm	0.062	0.062
Clarke	130590002	Fire Station # 7	0.061	0.064

*The 2014-2016 preliminary design values are based on uncertified ozone data through August 21, 2016.

Factor 2: Emissions and Emissions-Related Data

EPD evaluated emissions of ozone precursors and other emissions-related data that provide information on areas contributing to the violating monitors.

NOx and VOC Emissions Data

EPD analyzed county-level emissions data for nitrogen oxides (NOx) and volatile organic compounds (VOCs) from the 2011 National Emissions Inventory (NEI)[1]. Most of the 2014 NEI data is still draft, but the 2014 point source emissions are very reliable since they matched the emissions that EPD submitted to EPA's Emissions Inventory System (EIS) for the 2014 NEI. Therefore, EPD replaced 2011 point source emissions data with 2014 point source emissions data. This is the best available data to represent recent NOx (Table 4) and VOC (Table 6) emission levels in the Atlanta CSA. In addition to the county-level emissions (tons per year, tpy), emission densities (tons per year per square mile, tpy/mile^2) were also calculated since all counties are not the same size geographically. Significant emissions levels in a nearby county may indicate the potential for that area to contribute to observed ozone violations. Percent of NOx (Table 5) and VOC (Table 7) emissions by source categories (including fire, nonpoint, nonroad, onroad, and point) are summarized by each county in the Atlanta CSA. Fire emissions include prescribed fires and wildfires. Nonpoint (area source) emissions include small-scale industrial, commercial, and residential sources that generate emissions. Nonroad vehicles do not typically operate on roads or highways and include agricultural equipment; construction and mining equipment; lawn and garden equipment; aircraft and airport equipment; locomotives; and commercial marine vessels. Onroad mobile emission sources consist of automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways. Point sources include Electric Generating Units (EGUs) and non-EGUs.

[1] Obtained from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.

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NOx emissions from 6 counties (Fulton, Gwinnett, DeKalb, Cobb, Bartow, and Clayton) are each higher than 10,000 tpy. Also, each of these counties has more than double (>100%) the CSA average NOx emissions, has a NOx emission density of more than 26 tpy/mi^2, and are more than 75% higher than the Atlanta CSA average NOx emission density. None of the other 33 counties in the Atlanta CSA meet any of these criteria. In total, NOx emissions from Fulton, Gwinnett, DeKalb, Cobb, Bartow, and Clayton account for 51.5% of all NOx emissions in the Atlanta CSA. The majority of the NOx emissions in Fulton (70.6%), Gwinnett (68.3%), DeKalb (76.8%), and Cobb (61.6%) come from on-road mobile sources. The NOx emissions in Bartow mostly come from on-road mobile (33.9%) and point (55.6%), some of which is attributed to Georgia Power's Plant Bowen. The NOx emissions in Clayton mostly come from on-road mobile (45.0%) and non-road mobile (55.6%), some of which is attributed to airport emissions from the Hartsfield-Jackson Atlanta International Airport.

Modeling studies have demonstrated that emission reductions of anthropogenic VOCs have a much smaller impact on daily 8-hour ozone concentrations in the Southeastern U.S. compared to NOx emissions[2]. In addition, GA EPD has demonstrated that the Atlanta area is strongly NOx limited as presented in the Atlanta 8-hour Ozone Attainment Demonstration submitted to EPA on October 21, 2009. For this reason, the VOC emission factor will account for a lower total percent of emissions than in our NOx analysis. VOC emissions from 4 counties (Fulton, Gwinnett, Cobb, and DeKalb) are each higher than 20,000 tpy. Also, each of these counties is more than 75% higher than the CSA average VOC emissions. Cobb, DeKalb, and Clayton have a VOC emission density of more than 65 tpy/mi^2, and are more than 65% higher than the Atlanta CSA average VOC emission density. None of the other 34 counties in the Atlanta CSA meet any of these criteria. In total, VOC emissions from Fulton, Gwinnett, DeKalb, Cobb, and Clayton account for 23.4% of all VOC emissions in the Atlanta CSA. The majority of the VOC emissions in Fulton (65.4%), Gwinnett (60.9%), Cobb (64.0%), DeKalb (62.2%), and Clayton (61.6%) come from nonpoint (area) sources.

[2] Odman M.T., Hu Y., Russell A.G., Hanedar A., Boylan J.W., and Brewer P.F., 2009, Quantifying the sources of ozone, fine particulate matter, and regional haze in the Southeastern United States,*Journal of Environmental Management*, 90, 3155–3168.

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Table 4. NO_X Emissions by county in the Atlanta CSA. Red values meet EPD thresholds.

County	NOx (tpy)	NOx % CSA Total	NOx % CSA Average	NOx Density (tpy/sq mi)	NOx Density % of CSA Average
Fulton	23,218	13.0%	408.1%	43.48	194.9%
Gwinnett	16,576	9.3%	262.8%	37.93	157.2%
DeKalb	14,617	8.2%	219.9%	53.94	265.8%
Cobb	13,716	7.7%	200.2%	39.76	169.6%
Bartow	13,059	7.3%	185.8%	27.79	88.4%
Clayton	10,675	6.0%	133.6%	74.13	402.7%
Henry	6,786	3.8%	48.5%	20.75	40.7%
Hall	5,347	3.0%	17.0%	12.46	-15.5%
Coweta	4,998	2.8%	9.4%	11.21	-24.0%
Carroll	4,464	2.5%	-2.3%	8.86	-39.9%
Cherokee	4,375	2.5%	-4.3%	10.08	-31.6%
Jackson	4,012	2.3%	-12.2%	11.70	-20.7%
Troup	3,884	2.2%	-15.0%	8.71	-40.9%
Forsyth	3,690	2.1%	-19.3%	14.94	1.3%
Gordon	3,469	1.9%	-24.1%	9.69	-34.3%
Douglas	3,046	1.7%	-33.3%	15.15	2.8%
Heard	3,031	1.7%	-33.7%	10.07	-31.7%
Clarke	3,027	1.7%	-33.8%	25.02	69.7%
Newton	3,017	1.7%	-34.0%	10.81	-26.7%
Paulding	2,688	1.5%	-41.2%	8.56	-42.0%
Madison	2,540	1.4%	-44.4%	8.88	-39.8%
Walton	2,424	1.4%	-47.0%	7.35	-50.2%
Morgan	2,364	1.3%	-48.3%	6.66	-54.8%
Fayette	2,240	1.3%	-51.0%	11.26	-23.7%
Barrow	2,229	1.3%	-51.2%	13.68	-7.2%
Rockdale	2,117	1.2%	-53.7%	16.04	8.8%
Butts	1,900	1.1%	-58.4%	10.10	-31.5%
Meriwethe	1,869	1.0%	-59.1%	3.70	-74.9%
Haralson	1,743	1.0%	-61.9%	6.16	-58.2%
Spalding	1,714	1.0%	-62.5%	8.57	-41.9%
Polk	1,562	0.9%	-65.8%	5.01	-66.1%
Upson	1,399	0.8%	-69.4%	4.27	-71.1%
Oconee	1,370	0.8%	-70.0%	7.37	-50.0%
Lamar	1,141	0.6%	-75.0%	6.13	-58.4%
Pickens	1,089	0.6%	-76.2%	4.67	-68.3%
Dawson	760	0.4%	-83.4%	3.55	-75.9%
Jasper	730	0.4%	-84.0%	1.96	-86.7%
Pike	674	0.4%	-85.2%	3.08	-79.1%
Oglethorpe	644	0.4%	-85.9%	1.46	-90.1%
Average	**4,569**			**14.75**	
Total	**178,201**	**100.0%**			

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Table 5. Percent of NO_X emissions by county and source categories in the Atlanta CSA.

County	Fires	Nonpoint	Nonroad	Onroad	Point
Fulton	0.0%	10.5%	17.0%	70.6%	1.9%
Gwinnett	0.0%	8.0%	23.7%	68.3%	0.0%
DeKalb	0.0%	8.9%	13.4%	76.8%	0.9%
Cobb	0.0%	13.8%	18.9%	61.6%	5.7%
Bartow	0.1%	6.5%	3.9%	33.9%	55.6%
Clayton	0.0%	4.1%	49.8%	45.0%	1.0%
Henry	0.1%	9.2%	13.1%	53.6%	24.0%
Hall	0.0%	9.7%	16.6%	70.5%	3.2%
Coweta	1.2%	11.3%	9.8%	52.3%	25.5%
Carroll	0.4%	9.8%	11.1%	77.9%	0.8%
Cherokee	0.1%	7.4%	23.0%	67.2%	2.3%
Jackson	0.1%	6.2%	9.6%	77.0%	7.2%
Troup	1.3%	16.1%	8.2%	73.0%	1.4%
Forsyth	0.0%	6.1%	27.0%	65.4%	1.4%
Gordon	0.1%	23.1%	7.7%	68.8%	0.2%
Douglas	0.1%	10.0%	12.4%	77.5%	0.0%
Heard	0.9%	4.2%	2.1%	10.1%	82.6%
Clarke	0.0%	9.8%	16.6%	66.1%	7.5%
Newton	0.6%	8.5%	15.0%	74.9%	1.0%
Paulding	0.2%	18.3%	15.3%	66.2%	0.0%
Madison	0.5%	11.7%	2.1%	28.1%	57.5%
Walton	0.5%	10.3%	16.6%	67.7%	4.8%
Morgan	1.9%	11.7%	6.6%	75.1%	4.8%
Fayette	0.0%	14.5%	21.6%	63.5%	0.3%
Barrow	0.1%	12.9%	10.4%	74.9%	1.8%
Rockdale	0.1%	9.5%	15.6%	72.2%	2.6%
Butts	0.8%	20.6%	4.9%	73.7%	0.0%
Meriwether	6.3%	33.4%	4.4%	44.4%	11.4%
Haralson	0.8%	18.9%	3.6%	76.7%	0.0%
Spalding	0.9%	12.0%	10.4%	76.7%	0.0%
Polk	1.0%	28.7%	7.6%	58.2%	4.5%
Upson	5.4%	13.6%	4.9%	42.4%	33.6%
Oconee	0.5%	11.3%	15.1%	73.1%	0.0%
Lamar	1.1%	12.5%	5.4%	59.3%	21.7%
Pickens	1.0%	10.4%	13.9%	74.3%	0.4%
Dawson	1.3%	10.1%	16.8%	71.8%	0.0%
Jasper	13.6%	25.8%	8.9%	47.7%	4.0%
Pike	5.9%	20.7%	9.4%	64.0%	0.0%
Oglethorpe	9.0%	26.1%	10.8%	54.2%	0.0%
All counties in CSA	**0.4%**	**10.6%**	**16.2%**	**62.7%**	**10.1%**

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Table 6. Anthropogenic VOC emissions by county in the Atlanta CSA. Red values meet EPD thresholds.

County	VOC (tpy)	VOC % CSA Total	VOC % CSA Average	VOC Density (tpy/sq mi)	VOC Density % CSA Average
Fulton	**30,934**	**6.3%**	**147.3%**	57.93	43.5%
Gwinnett	**26,794**	**5.5%**	**114.2%**	61.31	51.9%
Cobb	**23,603**	**4.8%**	**88.7%**	**68.41**	**69.5%**
DeKalb	**21,988**	**4.5%**	**75.8%**	**81.14**	**101.0%**
Hall	16,310	3.3%	30.4%	38.02	-5.8%
Meriwether	16,142	3.3%	29.0%	31.97	-20.8%
Troup	16,013	3.3%	28.0%	35.9	-11.1%
Bartow	15,601	3.2%	24.7%	33.19	-17.8%
Cherokee	15,509	3.2%	24.0%	35.73	-11.5%
Carroll	15,403	3.2%	23.1%	30.56	-24.3%
Coweta	14,826	3.0%	18.5%	33.24	-17.7%
Oglethorpe	13,694	2.8%	9.5%	30.98	-23.3%
Jasper	13,128	2.7%	4.9%	35.2	-12.8%
Upson	12,712	2.6%	1.6%	38.76	-4.0%
Paulding	11,592	2.4%	-7.3%	36.92	-8.6%
Morgan	11,579	2.4%	-7.4%	32.62	-19.2%
Henry	11,494	2.4%	-8.1%	35.15	-12.9%
Gordon	11,265	2.3%	-10.0%	31.47	-22.1%
Newton	11,071	2.3%	-11.5%	39.68	-1.7%
Polk	11,022	2.3%	-11.9%	35.33	-12.5%
Clayton	10,996	2.3%	-12.1%	**76.36**	**89.1%**
Heard	10,796	2.2%	-13.7%	35.87	-11.2%
Walton	10,651	2.2%	-14.9%	32.27	-20.1%
Forsyth	10,553	2.2%	-15.6%	42.72	5.8%
Haralson	10,351	2.1%	-17.3%	36.58	-9.4%
Jackson	10,230	2.1%	-18.2%	29.82	-26.1%
Douglas	9,660	2.0%	-22.8%	48.06	19.0%
Madison	8,938	1.8%	-28.5%	31.25	-22.6%
Pickens	8,649	1.8%	-30.9%	37.12	-8.1%
Fayette	8,554	1.8%	-31.6%	42.99	6.5%
Butts	8,162	1.7%	-34.8%	43.41	7.5%
Pike	8,059	1.7%	-35.6%	36.8	-8.9%
Clarke	7,829	1.6%	-37.4%	64.7	60.3%
Spalding	7,728	1.6%	-38.2%	38.64	-4.3%
Lamar	7,588	1.6%	-39.3%	40.8	1.0%
Dawson	7,555	1.5%	-39.6%	35.31	-12.6%
Barrow	7,132	1.5%	-43.0%	43.75	8.4%
Rockdale	7,010	1.4%	-44.0%	53.1	31.5%
Oconee	6,774	1.4%	-45.9%	36.42	-9.8%
Average	**12,510**			**40.37**	
Total	**487,894**	**100.0%**			

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Table 7. Percent of anthropogenic VOC emissions by county and source categories in the Atlanta CSA.

County	Fires	Nonpoint	Nonroad	Onroad	Point
Fulton	0.0%	65.4%	9.6%	24.2%	0.8%
Gwinnett	0.0%	60.9%	14.3%	24.6%	0.3%
Cobb	0.0%	64.0%	12.6%	21.4%	2.1%
DeKalb	0.0%	62.2%	6.2%	25.8%	5.8%
Hall	0.0%	73.7%	9.9%	13.8%	2.6%
Meriwether	1.5%	94.6%	1.3%	2.2%	0.4%
Troup	0.7%	84.6%	4.7%	6.6%	3.5%
Bartow	0.1%	81.3%	4.7%	11.6%	2.2%
Cherokee	0.1%	84.0%	5.4%	10.3%	0.2%
Carroll	0.2%	84.1%	2.8%	11.1%	1.8%
Coweta	0.8%	88.5%	2.4%	7.6%	0.6%
Oglethorpe	0.9%	97.0%	0.6%	1.5%	0.0%
Jasper	1.5%	95.3%	0.7%	1.6%	0.9%
Upson	1.2%	92.8%	0.6%	3.0%	2.4%
Paulding	0.1%	88.8%	2.4%	8.7%	0.0%
Morgan	0.8%	90.5%	2.2%	4.2%	2.3%
Henry	0.1%	75.9%	5.0%	15.2%	3.8%
Gordon	0.1%	86.4%	4.1%	8.9%	0.5%
Newton	0.3%	80.4%	3.5%	12.1%	3.6%
Polk	0.3%	91.6%	0.9%	5.1%	2.1%
Clayton	0.1%	61.6%	14.4%	22.0%	1.9%
Heard	0.5%	94.2%	0.9%	1.6%	2.9%
Walton	0.2%	85.3%	2.7%	10.8%	0.9%
Forsyth	0.0%	73.8%	12.4%	11.9%	1.9%
Haralson	0.3%	90.5%	0.6%	5.0%	3.7%
Jackson	0.1%	85.4%	1.8%	10.7%	2.0%
Douglas	0.1%	85.5%	2.5%	11.9%	0.0%
Madison	0.3%	91.3%	2.3%	4.7%	1.5%
Pickens	0.2%	91.7%	2.7%	5.3%	0.0%
Fayette	0.0%	82.0%	6.0%	11.1%	0.8%
Butts	0.4%	92.6%	1.2%	5.8%	0.0%
Pike	0.9%	93.2%	2.6%	3.3%	0.0%
Clarke	0.0%	80.0%	3.4%	16.3%	0.3%
Spalding	0.4%	86.3%	1.7%	10.8%	0.8%
Lamar	0.3%	92.0%	0.7%	4.0%	3.1%
Dawson	0.3%	94.0%	1.5%	4.2%	0.0%
Barrow	0.1%	82.9%	2.4%	13.8%	0.8%
Rockdale	0.1%	83.1%	3.7%	10.6%	2.5%
Oconee	0.2%	89.5%	2.0%	8.3%	0.0%
All counties in CSA	**0.3%**	**81.3%**	**5.0%**	**11.7%**	**1.6%**

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Population Density and VMT Data

EPD evaluated the population and vehicle use characteristics and trends in the Atlanta CSA. This information is a good indicator for nonpoint, on-road mobile, and non-road mobile source emissions. Areas of dense population and traffic usually are associated with higher nonpoint and mobile emissions, and may contribute to counties with violating ozone monitors. Rapid growth of population and VMT in a county indicates increasing integration with the core urban area.

2010 population data was obtained from the designation data provided by EPA[3]. 2013 population data was obtained from the Georgia statistics center[4]. Table 8 summarizes 2010 and 2013 population data, as well as population density and population trends. 2010 and 2013 population in five counties (Fulton, Gwinnett, Cobb, DeKalb, and Clayton) are each higher than 250,000 people. Fulton, Gwinnett, Cobb, DeKalb, and Clayton have a population density of more than 1,500 person/mi^2, and are more than triple (>200%) the CSA average population. The 2013-2010 increase in population is over 20,000 people in Fulton, Gwinnett, Cobb, and DeKalb which is more than 225% higher compared to the Atlanta CSA average. None of the other 34 counties in the Atlanta CSA meet any of these criteria. In total, population from Fulton, Gwinnett, DeKalb, Cobb, and Clayton account for 57.4% of all people in the Atlanta CSA.

2011 vehicle miles traveled (VMT) data was obtained from the designation data provided by EPA[2]. 2014 VMT data was developed by EPD as part of the 2014 NEI. Table 9 summarizes 2011 and 2014 VMT data. VMT from 6 counties (Fulton, Gwinnett, Cobb, DeKalb, Clayton, and Henry) are each higher than 2.2×10^9 miles for 2011 and higher than 2.4×10^9 miles for 2014. VMT from Fulton, Gwinnett, Cobb, DeKalb, Clayton, and Henry are each 30% higher compared to the Atlanta CSA average. None of the other 33 counties in the Atlanta CSA meet any of these criteria. In total, VMT from Fulton, Gwinnett, DeKalb, Cobb, Clayton, and Henry account for 60.8% of all VMT in the Atlanta CSA.

[3] Download from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data#F2.
[4] http://georgiastats.uga.edu

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Table 8. Population and growth in the Atlanta CSA. Red values meet EPD thresholds.

County	2010 Population	2013 Population	% CSA Total	2013 Density (pop/sq mi)	% CSA Average	2013-2010 Change	% CSA Change Average
Fulton	920,581	984,293	15.97%	1,843	261.5%	63,712	886.4%
Gwinnett	805,321	859,304	13.94%	1,966	285.6%	53,983	735.8%
Cobb	688,078	717,190	11.64%	2,079	307.7%	29,112	350.7%
DeKalb	691,893	713,340	11.58%	2,632	416.2%	21,447	232.1%
Clayton	259,424	264,220	4.29%	1,835	259.8%	4,796	-25.7%
Cherokee	214,346	225,106	3.65%	519	1.7%	10,760	66.6%
Henry	203,922	211,128	3.43%	646	26.6%	7,206	11.6%
Forsyth	175,511	195,405	3.17%	791	55.1%	19,894	208.0%
Hall	179,684	187,745	3.05%	438	-14.2%	8,061	24.8%
Paulding	142,324	146,950	2.38%	468	-8.2%	4,626	-28.4%
Douglas	132,403	136,379	2.21%	679	33.1%	3,976	-38.4%
Coweta	127,317	133,180	2.16%	299	-41.4%	5,863	-9.2%
Clarke	116,714	121,265	1.97%	1,002	96.5%	4,551	-29.5%
Carroll	110,527	112,355	1.82%	223	-56.3%	1,828	-71.7%
Fayette	106,567	108,365	1.76%	545	6.8%	1,798	-72.2%
Newton	99,958	102,446	1.66%	367	-28.0%	2,488	-61.5%
Bartow	100,157	101,273	1.64%	215	-57.7%	1,116	-82.7%
Rockdale	85,215	86,919	1.41%	658	29.1%	1,704	-73.6%
Walton	83,768	85,754	1.39%	260	-49.0%	1,986	-69.3%
Barrow	69,367	71,453	1.16%	438	-14.0%	2,086	-67.7%
Troup	67,044	69,053	1.12%	155	-69.6%	2,009	-68.9%
Spalding	64,073	63,829	1.04%	319	-37.4%	-244	-103.8%
Jackson	60,485	61,044	0.99%	178	-65.1%	559	-91.3%
Gordon	55,186	55,757	0.90%	156	-69.5%	571	-91.2%
Polk	41,475	41,183	0.67%	132	-74.1%	-292	-104.5%
Oconee	32,808	34,035	0.55%	183	-64.1%	1,227	-81.0%
Pickens	29,431	29,584	0.48%	127	-75.1%	153	-97.6%
Haralson	28,780	28,495	0.46%	101	-80.3%	-285	-104.4%
Madison	28,120	28,057	0.46%	98	-80.8%	-63	-101.0%
Upson	27,153	26,566	0.43%	81	-84.1%	-587	-109.1%
Butts	23,655	23,361	0.38%	124	-75.6%	-294	-104.6%
Dawson	22,330	22,686	0.37%	106	-79.2%	356	-94.5%
Meriwet	21,992	21,232	0.34%	42	-91.8%	-760	-111.8%
Lamar	18,317	17,959	0.29%	97	-81.1%	-358	-105.5%
Pike	17,869	17,796	0.29%	81	-84.1%	-73	-101.1%
Morgan	17,868	17,781	0.29%	50	-90.2%	-87	-101.3%
Oglethor	14,899	14,548	0.24%	33	-93.5%	-351	-105.4%
Jasper	13,900	13,601	0.22%	36	-92.8%	-299	-104.6%
Heard	11,834	11,558	0.19%	38	-92.5%	-276	-104.3%
Average	**151,546**	**158,005**		**509**		**6,459**	
Total	**5,910,296**	**6,162,195**	**100%**				

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Table 9. VMT data in the Atlanta CSA. Red values meet EPD thresholds.

County	2011 VMT (10^6)	2014 VMT (10^6)	% Total CSA	% CSA Average
Fulton	**12,222**	**13,389**	**18.79%**	**632.67%**
Gwinnett	**7,422**	**8,655**	**12.14%**	**373.61%**
Cobb	**6,617**	**8,029**	**11.27%**	**339.35%**
DeKalb	**7,644**	**7,956**	**11.16%**	**335.37%**
Clayton	**2,881**	**2,834**	**3.98%**	**55.06%**
Henry	**2,215**	**2,441**	**3.42%**	**33.56%**
Forsyth	1,690	2,124	2.98%	16.23%
Cherokee	1,872	2,119	2.97%	15.96%
Hall	1,762	2,067	2.90%	13.14%
Bartow	1,651	1,908	2.68%	4.42%
Douglas	1,588	1,758	2.47%	-3.82%
Coweta	1,460	1,699	2.38%	-7.02%
Carroll	1,249	1,602	2.25%	-12.31%
Paulding	940	1,179	1.65%	-35.48%
Newton	870	1,108	1.56%	-39.35%
Rockdale	985	1,089	1.53%	-40.40%
Fayette	888	1,040	1.46%	-43.09%
Clarke	952	1,038	1.46%	-43.22%
Jackson	930	1,026	1.44%	-43.87%
Troup	969	976	1.37%	-46.59%
Walton	698	906	1.27%	-50.42%
Barrow	704	858	1.20%	-53.04%
Gordon	798	773	1.08%	-57.69%
Spalding	550	677	0.95%	-62.93%
Oconee	478	477	0.67%	-73.90%
Morgan	465	457	0.64%	-75.01%
Polk	377	366	0.51%	-80.00%
Haralson	343	338	0.47%	-81.50%
Butts	333	334	0.47%	-81.70%
Pickens	315	315	0.44%	-82.79%
Meriwether	297	278	0.39%	-84.76%
Madison	287	265	0.37%	-85.48%
Dawson	220	232	0.32%	-87.33%
Lamar	248	226	0.32%	-87.65%
Upson	249	219	0.31%	-88.02%
Pike	168	158	0.22%	-91.33%
Oglethorpe	140	125	0.18%	-93.16%
Jasper	136	121	0.17%	-93.38%
Heard	124	107	0.15%	-94.13%
Average	1,634	1,827		
Total	63,736	71,268	100.00%	

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Factor 3: Meteorological Data

Meteorological impacts on violating monitors were evaluated using the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) modeling results provided by EPA[5].

24-hour back-trajectories were created for all exceedance days (> 70 ppb) at each violating ozone monitor from 2013-2014 (Figures 2 - 6). Back-trajectories were developed for three different heights: 1000 meters (green), 500 meters (blue), and 100-meters (red). For the South DeKalb monitor (13-089-0002), the majority of the back-trajectories pass over DeKalb, Fulton, and Cobb counties. For the Confederate Avenue monitor (13-121-0055), the majority of the back-trajectories pass over DeKalb, Fulton, Cobb, and Bartow counties. For the Gwinnett Tech monitor (13-135-0002), the majority of the back-trajectories pass over Gwinnett, DeKalb, and Fulton counties. For the McDonough monitor (13-151-0002), the majority of the back-trajectories pass over Henry, DeKalb, Fulton, Cobb, Clayton, and Bartow counties. For the Conyers monitor (13-247-0001), the majority of the back-trajectories pass over Rockdale, DeKalb, Fulton, and Cobb counties.

Factor 4: Geography/Topography

This factor did not play a significant role in this evaluation of the Atlanta CSA since it does not have any geographical or topographical barriers significantly limiting air pollution transport within its air shed.

Factor 5: Jurisdictional Boundaries

All counties discussed in this technical analysis are within Georgia and fall within the jurisdiction of GA EPD. The Atlanta-Sandy Springs-Gainesville CBSA has previously established nonattainment boundaries associated with both the 1-hour and the 8-hour ozone NAAQS (Table 10).

Table 10. Nonattainment counties associated with the 1-hour, 1997 8-hour, and the 2008 8-hour ozone standards.

Atlanta nonattainment boundary for the 1-hour ozone standard	Atlanta nonattainment boundary for the 1997 8-hour ozone standard	Atlanta nonattainment boundary for the 2008 8-hour ozone standard
Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale.	Barrow, Bartow, Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Newton, Paulding, Rockdale, Spalding, and Walton.	Bartow, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Newton, Paulding, and Rockdale.

[5] Download from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data#F2.

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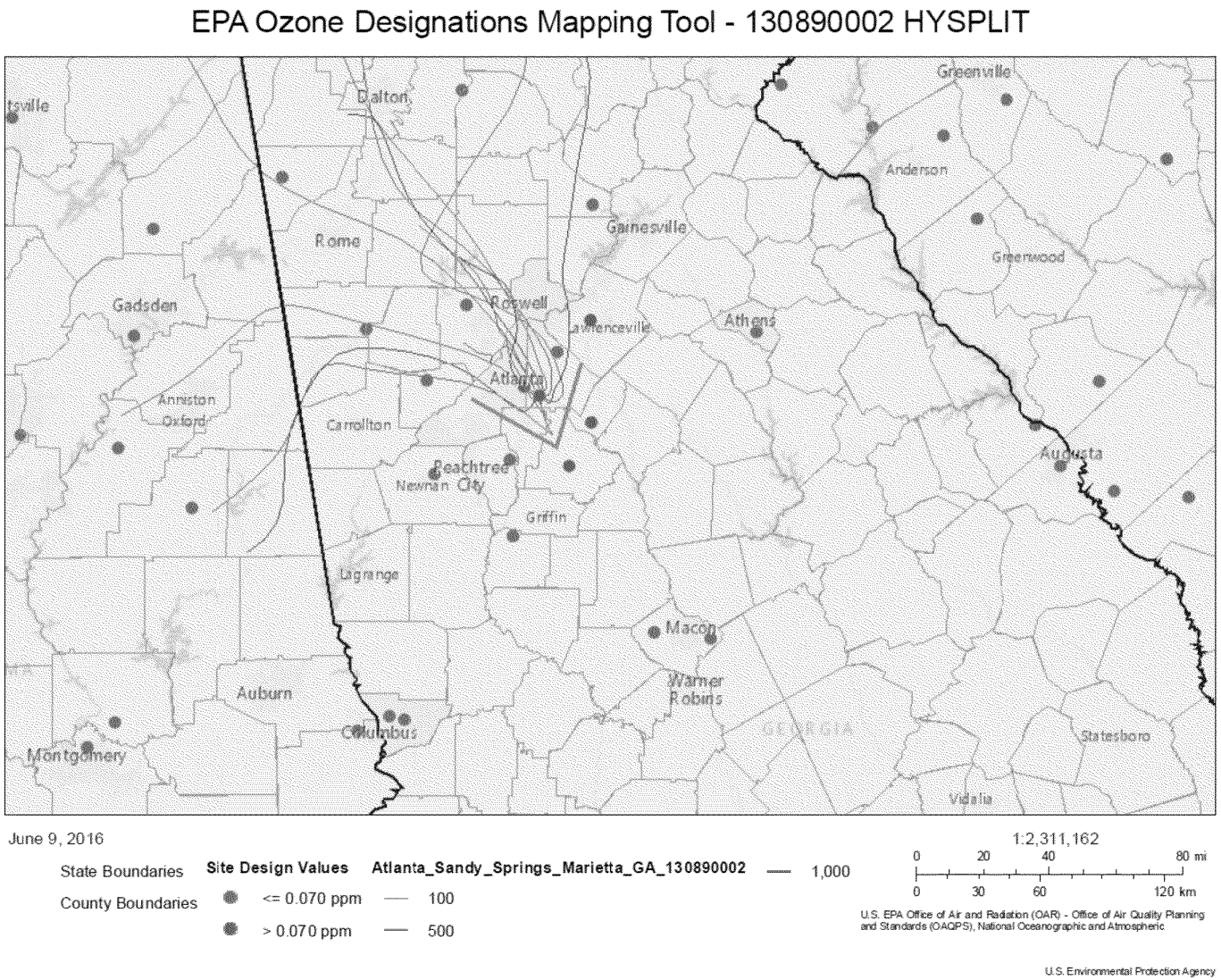

Figure 2. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the South DeKalb monitor (13-089-0002) in DeKalb County.

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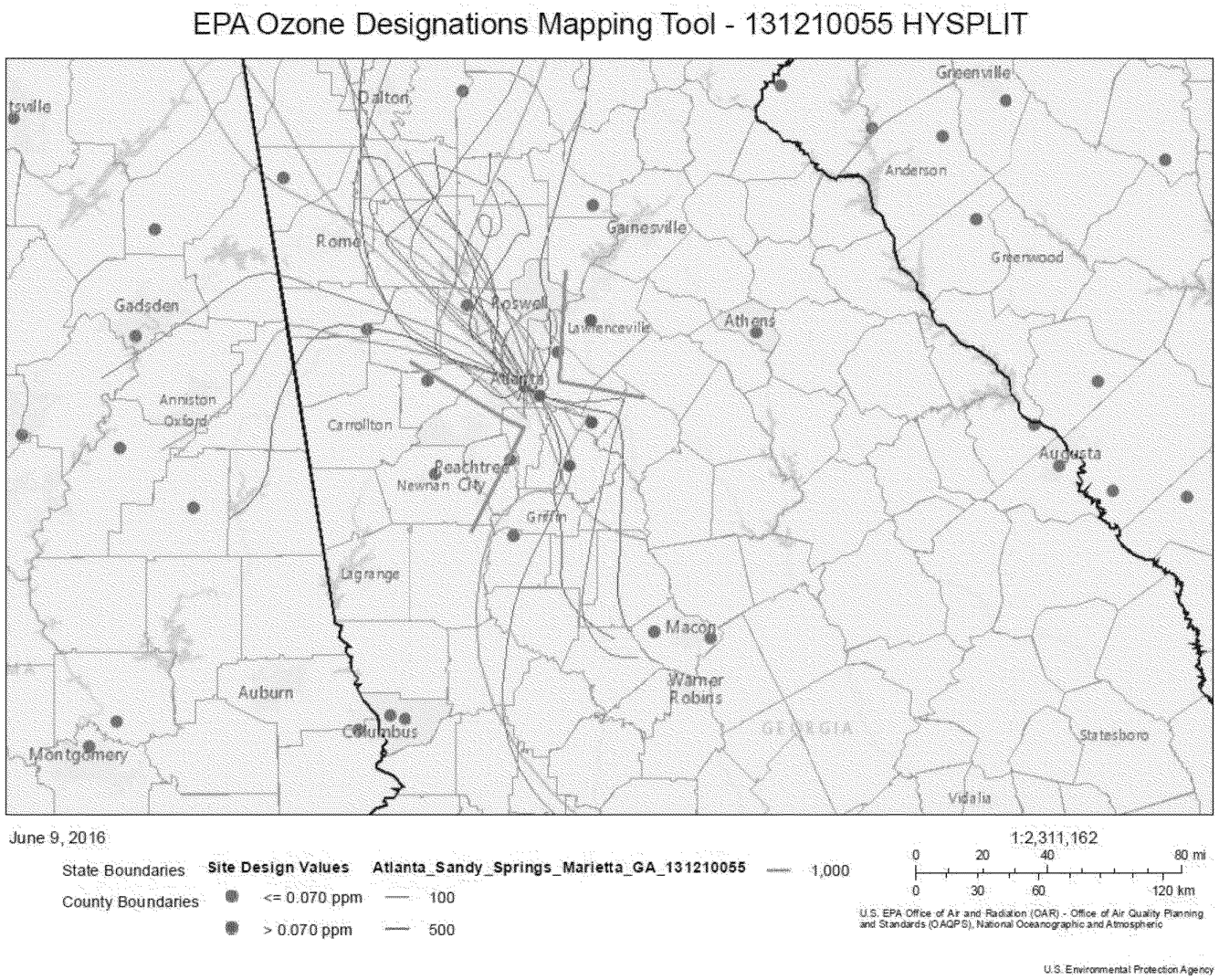

Figure 3. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the Confederate Avenue monitor (13-121-0055) in Fulton County.

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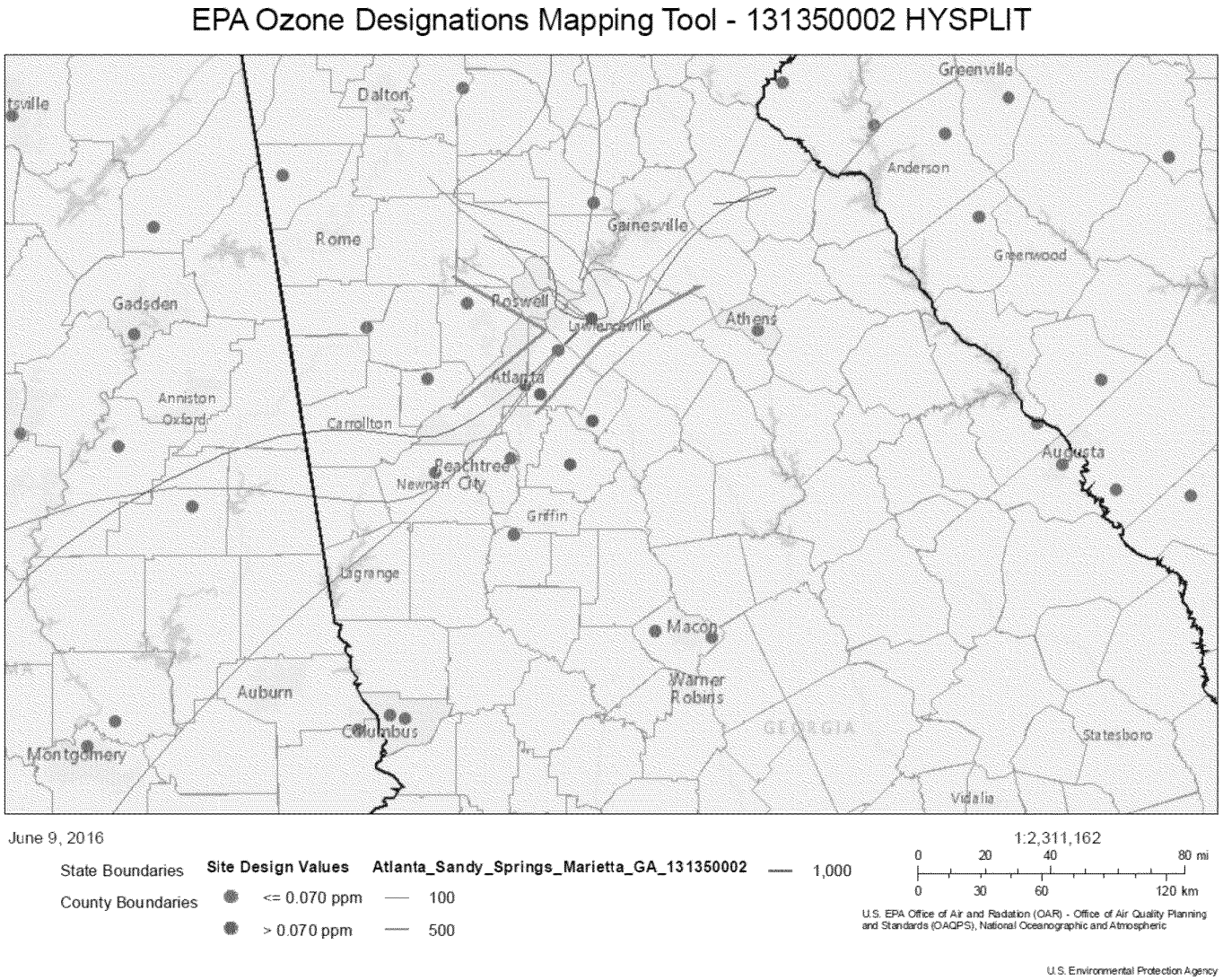

Figure 4. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the Gwinnett Tech monitor (13-135-0002) in Gwinnett County.

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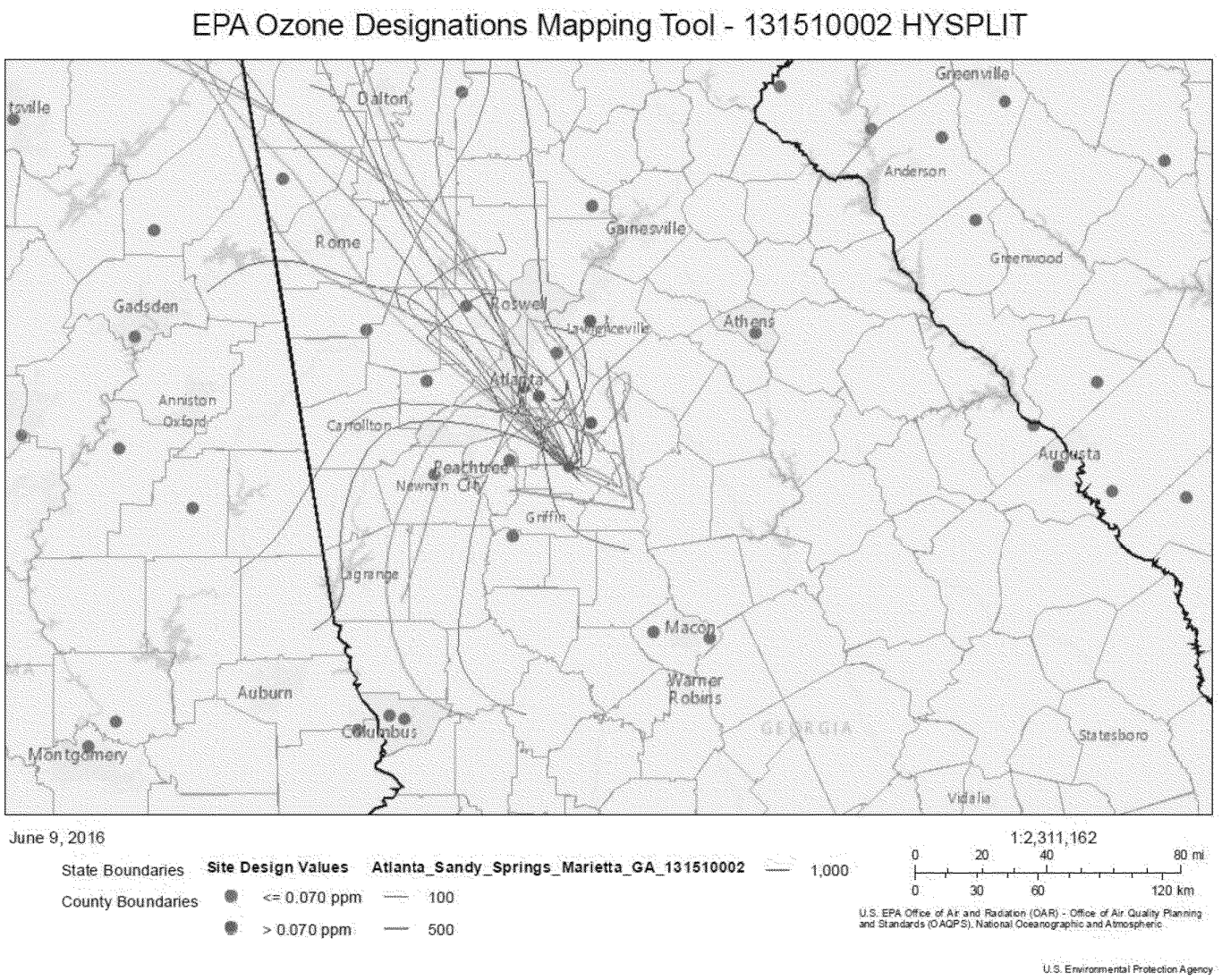

Figure 5. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the McDonough monitor (13-151-0002) in Henry County.

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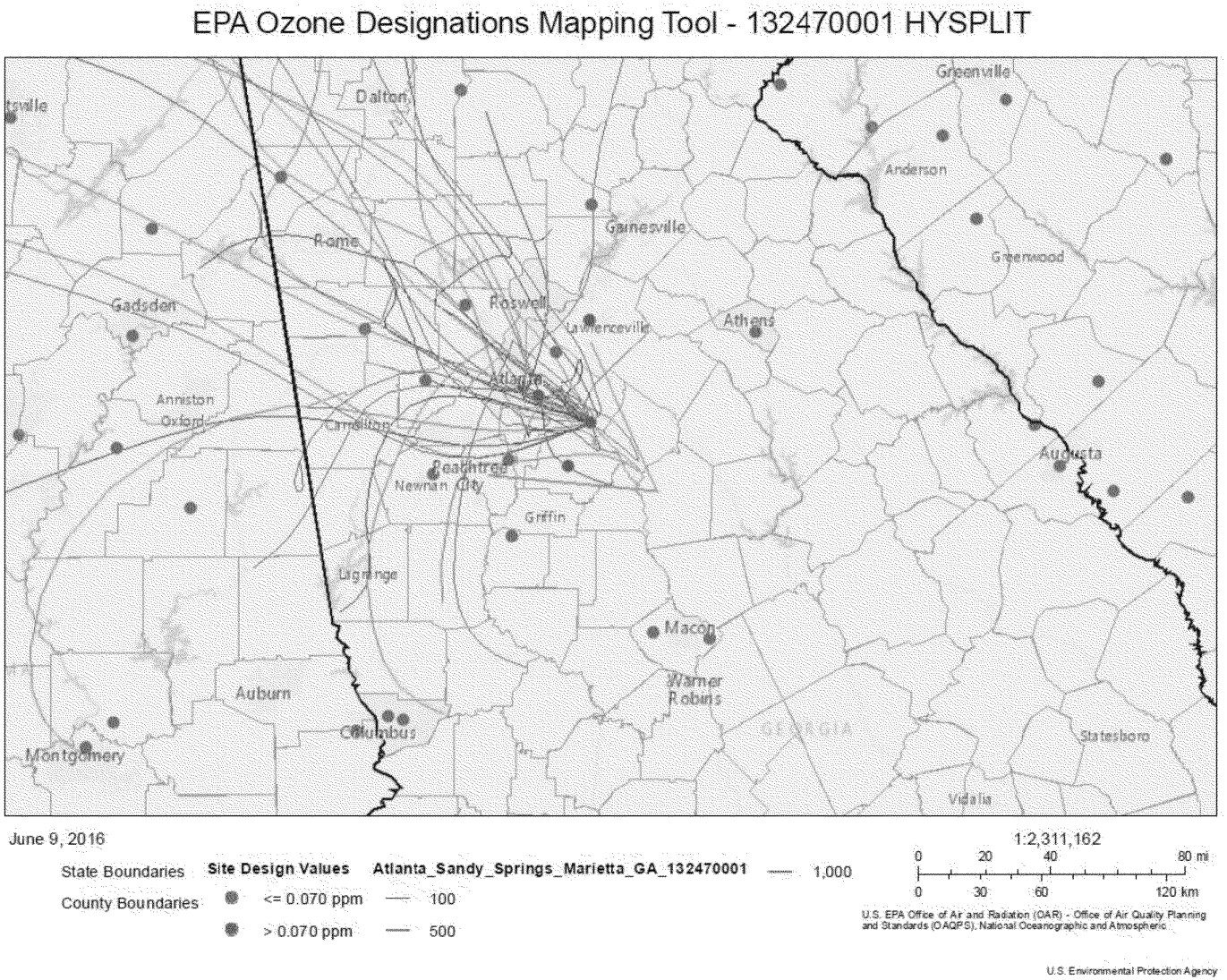

Figure 6. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the Conyers monitor (13-247-0001) in Rockdale County

Source Apportionment with CAMx-APCA

EPA's designation guidance memo states that source apportionment modeling can be used as part of the initial area designation process. EPD applied the Comprehensive Air Quality Model with eXtensions (CAMx) model[6] (version 6.2) with its Anthropogenic Precursor Culpability Assessment (APCA) tool to determine the contribution of each of the 39 counties in the Atlanta CSA to the five violating ozone monitors. EPD used a similar approach with CAMx-APCA as EPA used for the proposed Cross-State Air Pollution Rule modeling[7] (hereafter, Transport Rule Modeling).

EPD conducted the CAMx-APCA run for the ozone season from April 1 to October 31 using 2017 projected emissions and 2011 meteorology on a 12-km grid centered on the Atlanta CSA and covering most of Georgia and parts of neighboring states (Figure 7). The year 2017 was chosen since EPA's designations will be finalized by October 1, 2017 and high-quality modeling data used for EPA's Transport Rule Modeling was readily available. EPD also conducted 2011 modeling to evaluate model performance. EPD conducted Sparse Matrix Object Kernel Emission (SMOKE) modeling for 2017 emissions to tag anthropogenic emissions from each of the 39 counties in the Atlanta CSA as an individual source region; anthropogenic emissions from all other counties in the modeling domain were tagged as the "other" region, and emissions from biogenic sources, wildfires, and prescribed burning were tagged as the "biogenic" source group. The 2017 emissions used for the Transport Rule Modeling were updated to include more accurate 2017 EGU emission projections based on information that EPD sent to EPA as part of Georgia's comments on the Transport Rule NODA. Additional details on the SMOKE, CAMx, and CAMx-APCA modeling can be found in the attached modeling technical support document.

This modeling combines the first four factors discussed of the five-factor analysis into a single contribution value for each county (Table 11). A contribution threshold of 1.0 ppb was used to determine which counties significantly contribute to the violating monitors. The 1.0 ppb threshold was chosen because it is EPA's recently proposed significant impact level for single source PSD modeling[8]. The following counties had more than a 1.0 ppb impact on a violating ozone monitor: Fulton, Gwinnett, DeKalb, Cobb, Bartow, Clayton, and Henry.

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[6] Environ, CAMx Overview, http://www.camx.com/about/default.aspx

[7] EPA, Proposed Cross-State Air Pollution Update Rule, https://www.epa.gov/airmarkets/proposed-cross-state-air-pollution-update-rule

[8] EPA, 2016. Draft Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program.

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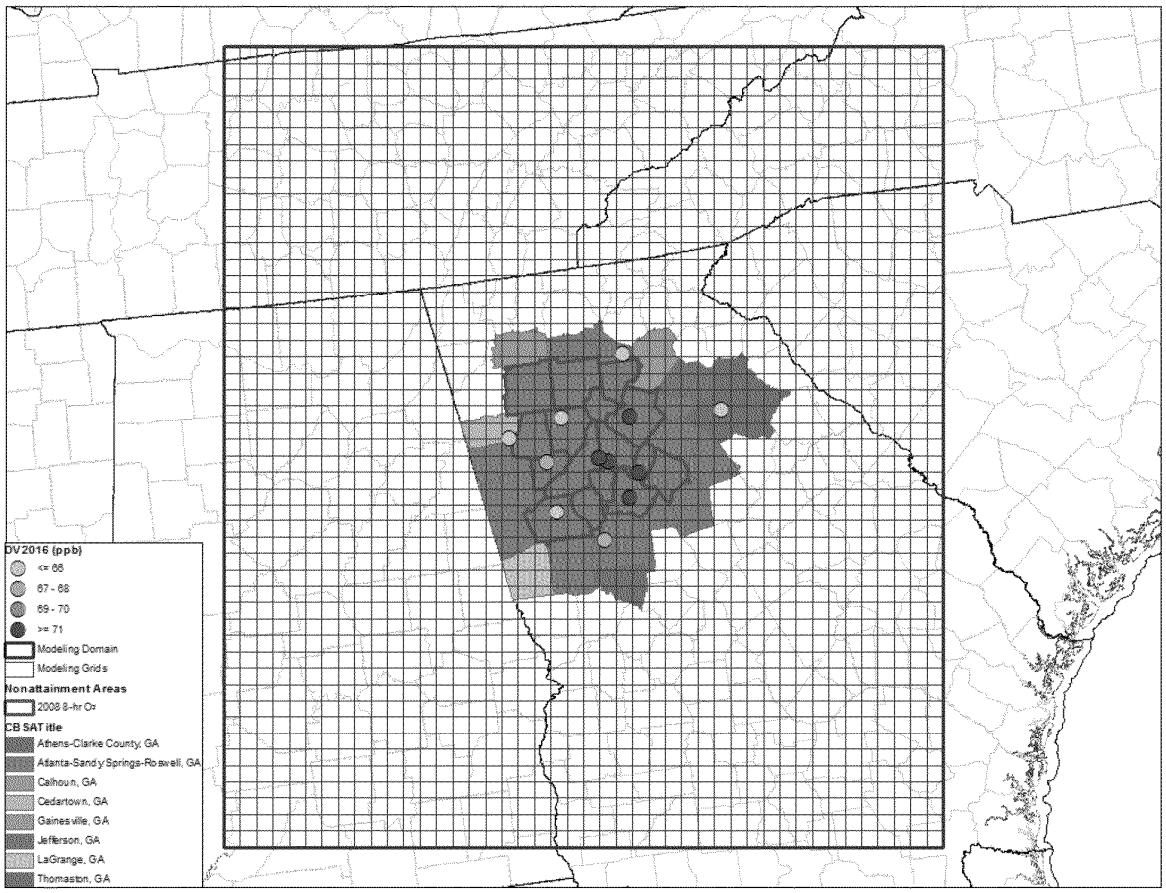

Figure 7. GA EPD's modeling domain for the source contribution assessment. Also shown are the preliminary 2014-2016 design values, nonattainment counties for the 2008 ozone NAAQS, and the Atlanta CSA broken down by CBSAs.

Table 11. Contributions of 39 counties in the Atlanta CSA to violating ozone monitors. Red values indicate more than 1.0 ppb contribution to a violating ozone monitor.

Monitor	Confederate Ave. (13-121-0055)	Conyers (13-247-0001)	McDonough (13-151-0002)	Gwinnett Tech (13-135-0002)	South DeKalb (13-089-0002)
Barrow	0.12	0.06	0.10	0.23	0.10
Bartow	**1.17**	0.77	0.97	**1.45**	0.96
Butts	0.04	0.07	0.14	0.02	0.04
Carroll	0.24	0.33	0.15	0.09	0.26
Cherokee	0.40	0.30	0.36	0.64	0.33
Clarke	0.08	0.03	0.10	0.09	0.08
Clayton	**3.54**	**4.22**	**3.85**	0.68	**3.26**
Cobb	**2.69**	**1.50**	**1.72**	**2.49**	**2.05**
Coweta	0.24	0.38	0.29	0.14	0.23
Dawson	0.03	0.03	0.03	0.04	0.03
DeKalb	**3.04**	**3.07**	**3.17**	**2.33**	**5.56**
Douglas	0.68	0.41	0.33	0.16	0.55
Fayette	0.21	0.31	0.40	0.07	0.18
Forsyth	0.29	0.26	0.24	0.78	0.24
Fulton	**8.74**	**4.12**	**4.07**	**3.92**	**5.98**
Gordon	0.15	0.11	0.14	0.07	0.13
Gwinnett	**1.71**	**1.93**	**1.60**	**8.25**	**1.58**
Hall	0.26	0.18	0.16	0.61	0.19
Haralson	0.07	0.10	0.03	0.04	0.09
Heard	0.14	0.26	0.16	0.09	0.15
Henry	0.55	**2.65**	**4.08**	0.26	0.88
Jackson	0.16	0.07	0.12	0.29	0.13
Jasper	0.01	0.01	0.03	0.01	0.01
Lamar	0.01	0.02	0.03	0.01	0.01
Madison	0.07	0.03	0.07	0.11	0.07
Meriwether	0.02	0.03	0.03	0.02	0.03
Morgan	0.06	0.02	0.08	0.03	0.06
Newton	0.17	0.29	0.34	0.06	0.21
Oconee	0.04	0.01	0.05	0.04	0.04
Oglethorpe	0.01	0.00	0.01	0.01	0.01
Paulding	0.35	0.20	0.22	0.20	0.29
Pickens	0.05	0.05	0.05	0.03	0.05
Pike	0.01	0.01	0.02	0.01	0.01
Polk	0.09	0.06	0.05	0.07	0.08
Rockdale	0.23	0.95	0.41	0.09	0.31
Spalding	0.04	0.10	0.15	0.03	0.05
Troup	0.03	0.04	0.04	0.03	0.04
Upson	0.01	0.01	0.01	0.01	0.01
Walton	0.16	0.09	0.20	0.14	0.17

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Summary and Recommendations

EPD performed a detailed analysis that considered EPA's five factors. In addition, EPD performed source contribution modeling with CAMx-APCA. A summary of the factors that were evaluated for the Atlanta CSA are contained in Table 12. Based on this analysis, EPD recommends that the following eight (8) counties be designated as **nonattainment** for the 2015 ozone NAAQS (Figure 8):

- **Fulton** (based on Factors 1, 2, 3, 5, and CAMx-APCA);
- **Gwinnett** (based on Factors 1, 2, 3, 5, and CAMx-APCA);
- **DeKalb** (based on Factors 1, 2, 3, 5, and CAMx-APCA);
- **Cobb** (based on Factors 2, 3, 5, and CAMx-APCA);
- **Bartow** (based on Factors 2, 3, 5, and CAMx-APCA);
- **Clayton** (based on Factors 2, 3, 5, and CAMx-APCA);
- **Henry** (based on Factors 1, 2, 3, 5, and CAMx-APCA); and
- **Rockdale** (based on Factors 1, 3, and 5).

The remaining 151 counties in Georgia are recommended as **unclassifiable/attainment**.

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Table 12. Summary of the Atlanta CSA counties exceeding EPD thresholds for various factors.

County	Air Quality Data (Factor 1)	NOx Emissions (Factor 2)	VOCs Emissions (Factor 2)	Population (Factor 2)	VMT (Factor 2)	HYSPLIT (Factor 3)	CAMx-APCA Source Contribution
Barrow							
Bartow		X				X	X
Butts							
Carroll							
Cherokee							
Clarke							
Clayton		X	X	X	X	X	X
Cobb		X	X	X	X	X	X
Coweta							
Dawson							
DeKalb	X	X	X	X	X	X	X
Douglas							
Fayette							
Forsyth							
Fulton	X	X	X	X	X	X	X
Gordon							
Gwinnett	X	X	X	X	X	X	X
Hall							
Haralson							
Heard							
Henry	X				X	X	X
Jackson							
Jasper							
Lamar							
Madison							
Meriweth							
Morgan							
Newton							
Oconee							
Oglethorp							
Paulding							
Pickens							
Pike							
Polk							
Rockdale	X					X	
Spalding							
Troup							
Upson							
Walton							

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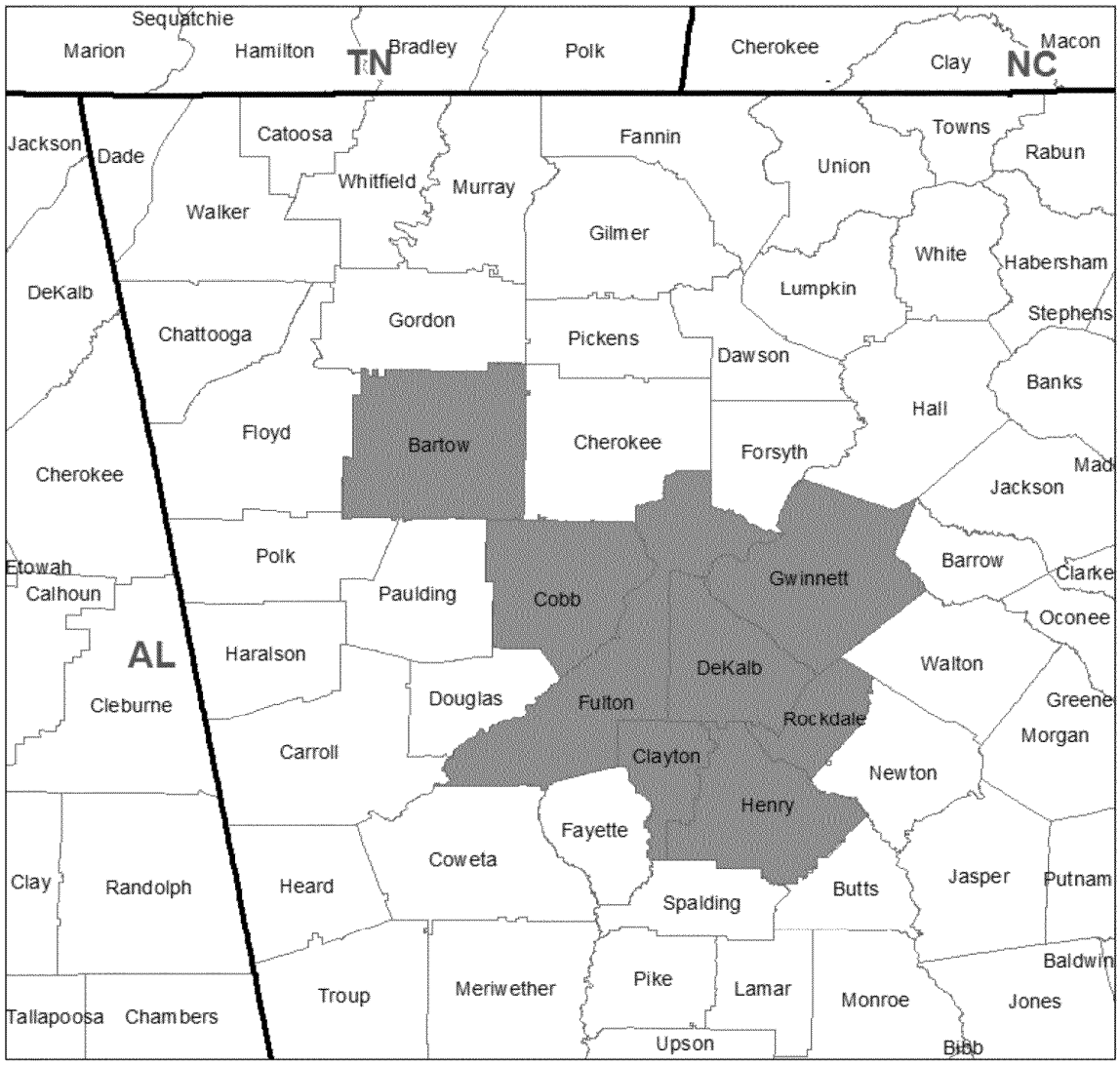

Figure 8. Map of eight counties (orange shading) in the Atlanta CSA recommended by EPD as nonattainment for the 2015 ozone NAAQS.

To: COLLIER David[david.collier@state.or.us]
Cc: Suzuki, Debra[Suzuki.Debra@epa.gov]; Koprowski, Paul[Koprowski.Paul@epa.gov]; DOWNING Kevin[kevin.downing@state.or.us]; jaclyn.palermo@state.or.us[jaclyn.palermo@state.or.us]
From: Pepple, Karl
Sent: Mon 10/3/2016 3:52:47 PM
Subject: RE: Follow-up RE: Oregon ozone designation letter

Good morning Mr. Collier,

Thank you for submitting the OR recommendation letter.

Here are the anticipated dates for the next steps of the process:

1) No later than June 2, 2017

"120-day letters": EPA notifies states and tribes concerning any intended modifications to their recommendations.

2) Around June 9, 2017

EPA publishes public notice of state and tribal recommendations and the EPA's intended modifications, it any, and initiates a 30-day public comment period.

3) Around July 10, 2017

End of 30-day public comment period

4) By August 7, 2017

States and tribes submit additional information, if any, to respond to the EPA's modification of a recommended designation.

5) No later than October 1, 2017

EPA promulgates final ozone designations.

This is the schedule we anticipate trying to meet. We will see how it all plays out. Note that the designations will contain an effective date for the action. That might be 30 days or so after publication in the FR.

Please contact me with any other questions. Have a great day!

KP

From: Suzuki, Debra
Sent: Monday, October 03, 2016 8:34 AM
To: Pepple, Karl <Pepple.Karl@epa.gov>
Subject: FW: Follow-up RE: Oregon ozone designation letter

From: COLLIER David [mailto:david.collier@state.or.us]
Sent: Friday, September 30, 2016 4:35 PM
To: COLLIER David <david.collier@state.or.us>; PALERMO Jaclyn <jaclyn.palermo@state.or.us>; Koprowski, Paul <Koprowski.Paul@epa.gov>; Suzuki, Debra <Suzuki.Debra@epa.gov>
Cc: DOWNING Kevin <kevin.downing@state.or.us>
Subject: Follow-up RE: Oregon ozone designation letter

Hey Deb, can you please remind me what happens next. When does EPA get back to us and accept or not our recommendations?

Thanks

D

From: COLLIER David
Sent: Friday, September 30, 2016 3:55 PM

To: 'Suzuki, Debra'; KOPROWSKI Paul
Cc: HNIDEY Emil; WILES Wendy; FELDON Leah
Subject: Oregon ozone designation letter

Hi Deb. Please accept Oregon's recommendations for area designations under the 2015 ozone NAAQS. Please let me know if you have any questions.

D

To: Pepple, Karl[Pepple.Karl@epa.gov]; Suzuki, Debra[Suzuki.Debra@epa.gov]; COLLIER David[david.collier@state.or.us]
Cc: STOCUM Jeffrey[jeffrey.g.stocum@state.or.us]; Koprowski, Paul[Koprowski.Paul@epa.gov]; BARNACK Anthony[anthony.barnack@state.or.us]; DOWNING Kevin[kevin.downing@state.or.us]
From: STOCUM Jeffrey
Sent: Thur 9/8/2016 5:16:22 PM
Subject: RE: Assistance Requested- Oregon ozone designation letter
dv.pdf

Hi Karl,

Thank you for the link to the previous letter and the possible recommendation language. Those are a great help.

So, I'm shepherding this while David is out and got a little confused by your reference to Hermiston where we do have plenty of data for a 3 year calculation. Please see the attached report and let me know if that changes your expectations and thus more aligns with David's draft letter of the whole state designation as "attainment/unclassifiable". Does that clear it up? I'm available to chat most of today as I try to this forward for David.

Jeffrey

Jeffrey Stocum / Air Quality Technical Services Manager / Environmental Solutions Division

Phone: 503-229-5506 / email: stocum.jeffrey@deq.state.or.us

From: Pepple, Karl [mailto:Pepple.Karl@epa.gov]
Sent: Friday, September 02, 2016 1:09 PM
To: Suzuki, Debra; COLLIER David
Cc: STOCUM Jeffrey; KOPROWSKI Paul; BARNACK Anthony; DOWNING Kevin; OLIPHANT Margaret
Subject: RE: Assistance Requested- Oregon ozone designation letter

In response to the questions below:

1) EPA requested the letter by October 1, 2016. Letters should be sent to the Regional

Administrator. If you would, please copy folks like Tim Hamlin (OAW Director) and Debra Suzuki (Manager, Air Planning Unit). You can also copy Paul Koprowski and me, but Tim and Debra are the critical folks. In case it helps, I found the previous letter that OR submitted for the 2008 ozone NAAQS (link).

2) As to the content: we basically want to know how you want the boundaries to appear in the Part 81 tables. A recommendation along the lines of "Statewide and Any Areas of Indian Country" would work. Again, it all depends on how you want this to appear in Part 81.

I see in the letter that ODEQ is recommending the entire state be designated as "Unclassifiable/Attainment." I was expecting the Hermiston area to be recommended as "Unclassifiable" due to the lack of 3-years of data. However, I have not seen the latest data from the area. Did you decide against that?

Please let me know if there is anything else I can do to assist.

Have a great day

KP

From: Suzuki, Debra
Sent: Friday, September 02, 2016 7:54 AM
To: COLLIER David <david.collier@state.or.us>; Pepple, Karl <Pepple.Karl@epa.gov>
Cc: STOCUM Jeffrey <jeffrey.g.stocum@state.or.us>; Koprowski, Paul <Koprowski.Paul@epa.gov>; BARNACK Anthony <anthony.barnack@state.or.us>; DOWNING Kevin <kevin.downing@state.or.us>; OLIPHANT Margaret <margaret.oliphant@state.or.us>
Subject: Re: Assistance Requested- Oregon ozone designation letter

Sent from my iPhone

On Sep 1, 2016, at 3:46 PM, COLLIER David <david.collier@state.or.us> wrote:

Hi Jeffery, Paul and Deb. I'm leaving on vacation until Sept 16th and could use your help moving something forward. I have a flag in my calendar that Oregon owns our 2015 ozone NAAQS designation letter to EPA by October 1st. Deb, is that still correct?

For the last PM2.5 NAAQS designation we prepared a letter from our governor to EPA, and with memo from our director to the governor explaining. I've drafted the new letter and memo attached re the 2015 ozone NAAQS designations. We need to :

- Confirm when this letter needs to be delivered to EPA and to whom we need to sent it.
- Agree on content (if there's any question)
- Shepherd the letter and memo through Wendy, to Pete, to Gov Brown.

Is this something you three could word on together? I don't want to wait for this to progress until I'm back on the 16th.

Thanks

D

<Director memo to Gov - Ozone Desg 9-1-2016.docx>

<Oregon Ozone NAAQS designation Letter (1).docx>

To: Suzuki, Debra[Suzuki.Debra@epa.gov]; COLLIER David[david.collier@state.or.us]
Cc: STOCUM Jeffrey[jeffrey.g.stocum@state.or.us]; Koprowski, Paul[Koprowski.Paul@epa.gov]; BARNACK Anthony[anthony.barnack@state.or.us]; DOWNING Kevin[kevin.downing@state.or.us]; OLIPHANT Margaret[margaret.oliphant@state.or.us]
From: Pepple, Karl
Sent: Fri 9/2/2016 8:09:15 PM
Subject: RE: Assistance Requested- Oregon ozone designation letter

In response to the questions below:

1) EPA requested the letter by October 1, 2016. Letters should be sent to the Regional Administrator. If you would, please copy folks like Tim Hamlin (OAW Director) and Debra Suzuki (Manager, Air Planning Unit). You can also copy Paul Koprowski and me, but Tim and Debra are the critical folks. In case it helps, I found the previous letter that OR submitted for the 2008 ozone NAAQS (link).

2) As to the content: we basically want to know how you want the boundaries to appear in the Part 81 tables. A recommendation along the lines of "Statewide and Any Areas of Indian Country" would work. Again, it all depends on how you want this to appear in Part 81.

I see in the letter that ODEQ is recommending the entire state be designated as "Unclassifiable/Attainment." I was expecting the Hermiston area to be recommended as "Unclassifiable" due to the lack of 3-years of data. However, I have not seen the latest data from the area. Did you decide against that?

Please let me know if there is anything else I can do to assist.

Have a great day

KP

From: Suzuki, Debra
Sent: Friday, September 02, 2016 7:54 AM
To: COLLIER David <david.collier@state.or.us>; Pepple, Karl <Pepple.Karl@epa.gov>

Cc: STOCUM Jeffrey <jeffrey.g.stocum@state.or.us>; Koprowski, Paul <Koprowski.Paul@epa.gov>; BARNACK Anthony <anthony.barnack@state.or.us>; DOWNING Kevin <kevin.downing@state.or.us>; OLIPHANT Margaret <margaret.oliphant@state.or.us>
Subject: Re: Assistance Requested- Oregon ozone designation letter

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<Director memo to Gov - Ozone Desg 9-1-2016.docx>

<Oregon Ozone NAAQS designation Letter (1).docx>

To: STOCUM Jeffrey[jeffrey.g.stocum@state.or.us]; Koprowski, Paul[Koprowski.Paul@epa.gov]; Suzuki, Debra[Suzuki.Debra@epa.gov]
Cc: BARNACK Anthony[anthony.barnack@state.or.us]; DOWNING Kevin[kevin.downing@state.or.us]; OLIPHANT Margaret[margaret.oliphant@state.or.us]
From: COLLIER David
Sent: Thur 9/1/2016 10:46:07 PM
Subject: Assistance Requested- Oregon ozone designation letter
Director memo to Gov - Ozone Desg 9-1-2016.docx
Oregon Ozone NAAQS designation Letter (1).docx

Hi Jeffery, Paul and Deb. I'm leaving on vacation until Sept 16th and could use your help moving something forward. I have a flag in my calendar that Oregon owns our 2015 ozone NAAQS designation letter to EPA by October 1st. Deb, is that still correct?

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Thanks

D

To: craigk@pscleanair.org[craigk@pscleanair.org]; fran.mcnair@orcaa.org[fran.mcnair@orcaa.org]; gary@yrcaa.org[gary@yrcaa.org]; Julie Oliver[joliver@spokanecleanair.org]; masmundson@nwcleanair.org[masmundson@nwcleanair.org]; robin.priddy@bentoncleanair.org[robin.priddy@bentoncleanair.org]; Uri Papish (uri@swcleanair.org)[uri@swcleanair.org]; Pepple, Karl[Pepple.Karl@epa.gov]; Suzuki, Debra[Suzuki.Debra@epa.gov]
Cc: Altose, Larry (ECY)[LALT461@ECY.WA.GOV]; scla461@ecy.wa.gov[scla461@ecy.wa.gov]; St. Onge, Camille (ECY)[cast461@ECY.WA.GOV]; Pritchett, Nancy (ECY)[npri461@ECY.WA.GOV]; Alberich, Jason (ECY)[jalb461@ECY.WA.GOV]
From: Ekrem, Joanna (ECY)
Sent: Wed 8/17/2016 4:43:46 PM
Subject: Ozone designation comment period
03 Designation NR 7.docx

Good morning,

Ecology opened a public comment period yesterday on air quality designations for ozone. We'd like to give you a preview of the news release that is going out today. Please feel free to contact us if you have any questions.

Best regards, Joanna

Joanna Ekrem
Planner

Air Quality Program

WA Dept. of Ecology

tele 360-407-6826

joanna.ekrem@ecy.wa.gov

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

User ID: YAD

DESIGN VALUE REPORT

Report Request ID: 1477466 Report Code: AMP480 Sep. 6, 2016

GEOGRAPHIC SELECTIONS

Tribal Code	State	County	Site	Parameter	POC	City	AQCR	UAR	CBSA	CSA	EPA Region
	41	059	1003								

PROTOCOL SELECTIONS

Parameter Classification	Parameter	Method	Duration
DESIGN VALUE	44201		

SELECTED OPTIONS

Option Type	Option Value
SINGLE EVENT PROCESSING	EXCLUDE REGIONALLY CONCURRED EVENTS
WORKFILE DELIMITER	,
USER SITE METADATA	STREET ADDRESS
MERGE PDF FILES	YES
QUARTERLY DATA IN WORKFILE	NO
AGENCY ROLE	PQAO

DATE CRITERIA

Start Date	End Date
2008	2015

APPLICABLE STANDARDS

Standard Description
Ozone 8-hour 2015

ED_001361_00020313

ED_001361_00020313

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

Pollutant: Ozone(44201)
Standard Units: Parts per million(007)
NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2008
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State: Oregon

Site ID	Poc	STREET ADDRESS	2008 Valid Days	2008 Percent Complete	2008 4th Max	2008 Cert& Eval	2007 Valid Days	2007 Percent Complete	2007 4th Max	2007 Cert& Eval	2006 Valid Days	2006 Percent Complete	2006 4th Max	2006 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
41-059-1003		HERMISTON MUNICIPAL AIRPORT, 1600 AIRPORT WAY, HERMISTON	150	98	.064		150	98	.066						65	.065	N

Notes: 1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

ED_001361_00020313

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

Pollutant: Ozone(44201)
Standard Units: Parts per million(007)
NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2009

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

State: Oregon

Site ID	Poc	STREET ADDRESS	2009 Valid Days	2009 Percent Complete	2009 4th Max	2009 Cert& Eval	2008 Valid Days	2008 Percent Complete	2008 4th Max	2008 Cert& Eval	2007 Valid Days	2007 Percent Complete	2007 4th Max	2007 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
41-059-1003		HERMISTON MUNICIPAL AIRPORT, 1600 AIRPORT WAY, HERMISTON	142	93	.061		150	98	.064		150	98	.066		96	.063	Y

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ED_001361_00020313

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

Pollutant: Ozone(44201)
Standard Units: Parts per million(007)
NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2010
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State: Oregon

Site ID	Poc	STREET ADDRESS	2010 Valid Days	2010 Percent Complete	2010 4th Max	2010 Cert& Eval	2009 Valid Days	2009 Percent Complete	2009 4th Max	2009 Cert& Eval	2008 Valid Days	2008 Percent Complete	2008 4th Max	2008 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
41-059-1003		HERMISTON MUNICIPAL AIRPORT, 1600 AIRPORT WAY, HERMISTON	150	98	.063		142	93	.061		150	98	.064		96	.062	Y

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

Pollutant: Ozone(44201)
Standard Units: Parts per million(007)
NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2011
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State: Oregon

Site ID	Poc	STREET ADDRESS	2011 Valid Days	2011 Percent Complete	2011 4th Max	2011 Cert& Eval	2010 Valid Days	2010 Percent Complete	2010 4th Max	2010 Cert& Eval	2009 Valid Days	2009 Percent Complete	2009 4th Max	2009 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
41-059-1003		HERMISTON MUNICIPAL AIRPORT, 1600 AIRPORT WAY, HERMISTON	150	98	.058		150	98	.063		142	93	.061		96	.060	Y

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

Pollutant: Ozone(44201)
Standard Units: Parts per million(007)
NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2012
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State: Oregon

Site ID	Poc	STREET ADDRESS	2012 Valid Days	2012 Percent Complete	2012 4th Max	2012 Cert& Eval	2011 Valid Days	2011 Percent Complete	2011 4th Max	2011 Cert& Eval	2010 Valid Days	2010 Percent Complete	2010 4th Max	2010 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
41-059-1003		HERMISTON MUNICIPAL AIRPORT, 1600 AIRPORT WAY, HERMISTON	149	97	.067	Y	150	98	.058		150	98	.063		98	.062	Y

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NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2013
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State: Oregon

Site ID	Poc	STREET ADDRESS	2013 Valid Days	2013 Percent Complete	2013 4th Max	2013 Cert& Eval	2012 Valid Days	2012 Percent Complete	2012 4th Max	2012 Cert& Eval	2011 Valid Days	2011 Percent Complete	2011 4th Max	2011 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

Pollutant: Ozone(44201)
Standard Units: Parts per million(007)
NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2014
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State: Oregon

Site ID	Poc	STREET ADDRESS	2014 Valid Days	2014 Percent Complete	2014 4th Max	2014 Cert& Eval	2013 Valid Days	2013 Percent Complete	2013 4th Max	2013 Cert& Eval	2012 Valid Days	2012 Percent Complete	2012 4th Max	2012 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
41-059-1003		HERMISTON MUNICIPAL AIRPORT, 1600 AIRPORT WAY, HERMISTON	145	95	.064	Y	150	98	.062	Y	149	97	.067	Y	97	.064	Y

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

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NAAQS Standard: Ozone 8-hour 2015
Statistic: Annual 4th Maximum **Level:** .07

Design Value Year: 2015
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State: Oregon

Site ID	Poc	STREET ADDRESS	2015 Valid Days	2015 Percent Complete	2015 4th Max	2015 Cert& Eval	2014 Valid Days	2014 Percent Complete	2014 4th Max	2014 Cert& Eval	2013 Valid Days	2013 Percent Complete	2013 4th Max	2013 Cert& Eval	3 - Year Percent Complete	3 - Year Design Value	D. V. Validity
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 6, 2016

CERTIFICATION EVALUATION AND CONCURRENCE FLAG MEANINGS

FLAG	MEANING
M	The monitoring organization has revised data from this monitor since the most recent certification letter received from the state.
N	The certifying agency has submitted the certification letter and required summary reports, but the certifying agency and/or EPA has determined that issues regarding the quality of the ambient concentration data cannot be resolved due to data completeness, the lack of performed quality assurance checks or the results of uncertainty statistics shown in the AMP255 report or the certification and quality assurance report.
S	The certifying agency has submitted the certification letter and required summary reports. A value of "S" conveys no Regional assessment regarding data quality per se. This flag will remain until the Region provides an "N" or "Y" concurrence flag.
U	Uncertified. The certifying agency did not submit a required certification letter and summary reports for this monitor even though the due date has passed, or the state's certification letter specifically did not apply the certification to this monitor.
X	Certification is not required by 40 CFR 58.15 and no conditions apply to be the basis for assigning another flag value
Y	The certifying agency has submitted a certification letter, and EPA has no unresolved reservations about data quality (after reviewing the letter, the attached summary reports, the amount of quality assurance data submitted to AQS, the quality statistics, and the highest reported concentrations).

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Memo

To: **Richard Whitman**
Natural Resources Policy Director

From: **Pete Shepherd**
Interim Director

Date: **September 9, 2016**

Subject: **Area designations for the National Ambient Air Quality Standard for ozone**

State of Oregon
Department of Environmental Quality

Headquarters
811 SW Sixth Ave
Portland, OR 97204
Phone: 503-229-5659

Fax: 503-229-5675
Email:
www.oregon.gov/DEQ

In October 2015, the U.S. Environmental Protection Agency (EPA) revised the national ambient air quality standard (NAAQS) for ground level ozone to provide increased protection of public health and welfare. Under the Clean Air Act, EPA must designate all areas of the country as "nonattainment" or "attainment" under the revised standard. The term "attainment" means an area has had no ozone violations over a three-year period. In order for EPA to make these designations, the Clean Air Act requires that state governors submit initial designation recommendations to EPA. Oregon must submit its recommended designations by October 1, 2016.

Based on monitoring data collected during 2013, 2014, and 2015, there are no areas in violation of the ozone NAAQS in Oregon. A draft letter is attached for the Governor's signature, recommending that EPA designate these areas as "attainment".

If you have any questions, please contact David Collier, Air Quality Planning Manager, at (503) 229-5177 or Jeffrey Stocum, Air Quality Technical Services Manager, at (503) 229-5506.

September XX, 2016

Dennis McLerran
Regional Administrator
U.S. EPA, Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

Re: Recommendations for Ozone Area Designations

Dear Mr. McLerran:

I am presenting to you my recommendations for attainment and nonattainment air quality designations in the State of Oregon for the revised ozone National Ambient Air Quality Standard (NAAQS), as required in the Final Rule published on October 26, 2015 in the Federal Register.

Based on the most recent three years of quality-assured, federal reference monitoring data collected in 2013, 2014, and 2015, all areas in Oregon are in compliance with the revised ozone public health standard. I recommend all these monitored areas of the state be designated "attainment/unclassifiable".

I would like to acknowledge that all of our former ozone nonattainment areas continue working to maintain clean air. In particularly, the efforts and strategies implemented in the Portland Metro area have been critical in ensuring they would meet the revised and more protective ozone standard.

If you have any questions, please contact David Collier, Manager, Air Quality Planning, Department of Environmental Quality, at (503) 229-5177.

Sincerely,

Kate Brown
Governor

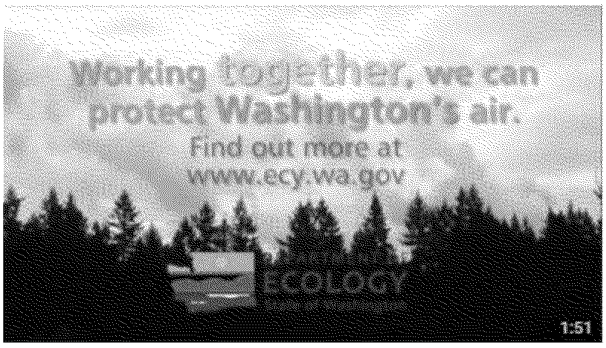
cc: Oregon Department of Environmental Quality
Lane Regional Air Protection Authority

Washington Department of Ecology – *NEWS*
Aug. 17, 2016

Contacts:
Larry Altose, Ecology communications, 425-649-7009, @EcySeattle
Joanna Ekrem, air quality program, 360-407-6826

Draft recommendation would list state as meeting new U.S. ozone standard

Ecology seeks comment on proposed request to EPA



OLYMPIA – The Washington Department of Ecology plans to submit a draft recommendation to the U.S. Environmental Protection Agency stating that Washington meets the new, tougher federal air quality standards for ozone. Ecology now wants the public to weigh in on the proposal.

The EPA adopted a tighter ozone standard last year, based on current health studies. States face an Oct. 1 deadline to recommend whether EPA should designate any counties or regions as not meeting the new standard.

Although Ecology plans to tell federal authorities the state overall meets the new tougher standards, there isn't enough data collected on Benton, Franklin and Walla Walla counties and they will be earmarked as "unclassified" as a result.

"Being marked as unclassified means that we haven't collected enough data to make a recommendation," said Ecology Atmospheric Scientist Ranil Dhammapala. "We've monitored ozone in the Tri-Cities for only one year and the EPA standard requires three years of monitoring data."

Dhammapala and other Ecology scientists have discovered that ozone can reach high levels in the southern Columbia Basin. The agency is conducting a special study in the area to help pinpoint the origin of high Tri-Cities ozone levels.

Ground-level ozone can harm delicate tissues in peoples' respiratory systems. The elderly, very young children and people with existing respiratory or heart conditions are particularly at risk. Ozone also can weaken plants, affecting both natural areas and commercial forest and crop yields.

In the upper atmosphere, ozone is a beneficial gas. There, it filters harmful radiation in sunlight.

Ecology's proposed status for Washington under EPA's new ozone standard is available for

review on the department's website. The public can comment on the draft filing through Sept. 16, 2016.

To submit public comments, please email Ecology at AQComments@ecy.wa.gov, or write to:

Joanna Ekrem
Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

###

TO UNSUBSCRIBE: Please reply and ask to be removed from this list.

To: 'Heil, Cynthia L (DEC)'[cindy.heil@alaska.gov]; mary anderson[Mary.Anderson@deq.idaho.gov]; COLLIER David[david.collier@state.or.us]; Pritchett, Nancy (ECY)[npri461@ECY.WA.GOV]; Alberich, Jason (ECY) (jalb461@ECY.WA.GOV)[jalb461@ECY.WA.GOV]
Cc: Pepple, Karl[Pepple.Karl@epa.gov]
From: Suzuki, Debra
Sent: Wed 6/7/2017 3:38:27 PM
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations
AZ Ducey 6-6-17.pdf

Fyi. I just learned that these letters were sent out to Governors yesterday.

Thanks,

Debra

From: U.S. EPA Media Relations [mailto:no-replysubscriptions@epa.gov]
Sent: Tuesday, June 06, 2017 3:33 PM
To: Holsman, Marianne <Holsman.Marianne@epa.gov>
Subject: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

CONTACT:
press@epa.gov

FOR IMMEDIATE RELEASE
June 6, 2017

EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

WASHINGTON – U.S. Environmental Protection Agency (EPA) Administrator Scott Pruitt sent a letter to governors today to inform them of EPA's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. EPA is extending the deadline for promulgating initial area designations, by one year, for the 2015 ozone NAAQS.

"States have made tremendous progress and significant investment cleaning up the air. We will continue to work with states to ensure they are on a path to compliance," **said Administrator Scott Pruitt.**

The National Ambient Air Quality Standard (NAAQS) for ground-level ozone is an outdoor air regulation under the Clean Air Act. As part of the process to determine what areas of the

country are able to meet the current air quality standards, states are currently submitting their proposals for area designations under the 70 parts per billion (ppb) standard, which was lowed from 75 ppb in 2015. Areas designated as being in "nonattainment" of the standard face consequences, including: increased regulatory burdens, restrictions on infrastructure investment, and increased costs to businesses.

EPA is giving states more time to develop air quality plans and EPA is looking at providing greater flexibility to states as they develop their plans. And, pursuant to the language in the recently-enacted FY2017 Omnibus funding bill, Administrator Pruitt is establishing an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

Additionally, the Agency is taking time to better understand some lingering, complicated issues so that air attainment decisions can be based on the latest and greatest information. This additional time will also provide the agency time to review the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states and localities. The Agency is evaluating these issues, primarily focused on:

- Fully understanding the role of background ozone levels;
- Appropriately accounting for international transport,
- And, timely consideration of exceptional events demonstrations.

"We share the goal of clean air, a robust economy and stronger, healthier communities. We are committed to working with states and local officials to effectively implement the ozone standard in a manner that is supportive of air quality improvement efforts without interfering with local decisions or impeding economic growth," **said Administrator Pruitt.**

Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased.

R107

If you would rather not receive future communications from Environmental Protection Agency, let us know by clicking here.
Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington, DC 20460 United States

To: denise.koch@alaska.gov[denise.koch@alaska.gov]; 'Tiffany.Floyd@deq.idaho.gov'[Tiffany.Floyd@deq.idaho.gov]; COLLIER David[david.collier@state.or.us]; 'scla461@ecy.wa.gov'[scla461@ecy.wa.gov]; 'Heil, Cynthia L (DEC)'[cindy.heil@alaska.gov]; Mary Anderson (mary.anderson@deq.idaho.gov)[mary.anderson@deq.idaho.gov]; Pritchett, Nancy (ECY)[npri461@ECY.WA.GOV]; Alberich, Jason (ECY) (jalb461@ECY.WA.GOV)[jalb461@ECY.WA.GOV]
Cc: Hamlin, Tim[Hamlin.Tim@epa.gov]; Dave Bray[Bray.Dave@epa.gov]; Pepple, Karl[Pepple.Karl@epa.gov]
From: Suzuki, Debra
Sent: Wed 11/2/2016 11:06:57 PM
Subject: Ozone SIP Requirements Rule Proposal Signed
FACT SHEET 2015 ozone Implementation proposal.pdf

Hi. While this rule may not have much impact in Region 10 since we don't expect to have nonattainment areas for the 2015 ozone NAAQS, we wanted to let you know that EPA Administrator Gina McCarthy signed the proposed Classifications & SIP Requirements Rule for the 2015 ozone NAAQS on Wednesday, November 2, 2016. The rule is posted on the EPA web site at https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state. We anticipate publication of this rule in the *Federal Register* in approximately two weeks.

A webinar covering the contents of the proposed SIP Requirements Rule will be scheduled for early December 2016, with details forthcoming. Materials will not be distributed prior to the webinar. Participants will have the opportunity to ask questions during the webinar.

If you have any questions, please contact:

Karl Pepple at (206) 553-1778 or at email pepple.karl@epa.gov; or

Bob Lingard at (919) 541-5272 or at lingard.robert@epa.gov.

Thanks,

Debra Suzuki

EPA Region 10

Air Planning Unit Manager

FACT SHEET

PROPOSED RULE: IMPLEMENTATION OF THE 2015 NATIONAL AMBIENT AIR QUALITY STANDARDS FOR OZONE: NONATTAINMENT AREA CLASSIFICATIONS AND STATE IMPLEMENTATION PLAN REQUIREMENTS

ACTION

- On November 2, 2016, the U.S. Environmental Protection Agency proposed requirements that would apply to state, local, and tribal air agencies for implementing the 2015 National Ambient Air Quality Standards (NAAQS) for ground-level ozone. The EPA revised both the health-based and welfare-based standards for ozone on October 1, 2015.

- Implementation of the NAAQS is a shared responsibility of the EPA, states and tribes. This proposed rule interprets the requirements of the Clean Air Act (CAA) and seeks public comment on proposed requirements that ensure public health protection is achieved by meeting the 2015 ozone standards, while giving the EPA's partners flexibility to reduce administrative burdens, where possible.
    - These requirements would apply to states with nonattainment areas, and states in an ozone transport region (OTR).
    - The EPA will work closely with states, tribes and communities to provide assistance in achieving the 2015 ozone standards.

- This proposed action largely retains and updates the implementing regulations that apply for the 2008 ozone NAAQS, for purposes of the 2015 ozone standards, which creates stability in the planning process. This action is seeking public comment on a number of issues, including:
    - nonattainment area classification thresholds and deadlines for areas to attain the 2015 ozone standards;
    - milestone compliance demonstrations to address reasonable further progress requirements;
    - planning and implementation deadlines for reasonably available control technology;
    - consideration of pollution sources within a state but outside of a nonattainment area for purposes of attainment planning;
    - reconsideration of the optional ozone NAAQS trading provisions for pollutants that react to form ozone, which would allow either volatile organic compounds (VOC) or oxides of nitrogen (NOx) emissions reductions to satisfy nonattainment New Source Review permitting emissions offset requirements for VOC or NO_x emissions increases; and
    - requirements for emissions inventories and emissions statements.

- This action also proposes two options for revoking the 2008 ozone NAAQS.
    - Consistent with the EPA's approach for revoking the 1997 ozone standards, Option 1 would revoke the 2008 NAAQS in all areas effective 1 year after the effective date of designations for the 2015 ozone NAAQS. This option would establish a set of protective anti-backsliding requirements for all nonattainment areas that have not yet attained the 2008 NAAQS at the time of its revocation.
    - Option 2 proposes to revoke the 2008 ozone NAAQS in areas designated attainment for that NAAQS 1 year after the effective date of the designations for each area for the 2015 ozone NAAQS. Under Option 2, the 2008 ozone NAAQS would continue to apply in any

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area designated nonattainment for the 2008 standards until that area is redesignated to attainment. Option 2 would follow the approach established most recently for the $PM_{2.5}$ NAAQS.

- The EPA is also seeking comment on a number of additional topics, including: (1) managing emissions from wildfires and wildland prescribed fires; (2) transportation conformity and general conformity; (3) contingency measures; (4) international transport and background ozone; and (5) additional policies for achieving emissions reductions.

BACKGROUND

- Ozone is formed from NO_X and VOC in the presence of sunlight. Cars, trucks, buses, engines, industries, power plants and products, such as solvents and paints are among the major manmade sources of ozone-forming emissions. Exposure to ground-level ozone pollution is linked to a variety of significant health problems.

- Ozone levels are most commonly elevated in the warm summer months, when hot sunny days make it more likely that ozone will form. But this isn't always the case. In parts of the western United States with high levels of local VOC and NO_X emissions and unique meteorological conditions, ozone levels have been high when snow is on the ground.

- The CAA directs the EPA to set and review air quality standards for common pollutants known as "criteria pollutants," which the agency has identified based on their likelihood of harming public health and welfare. The EPA established air quality standards for ozone in 1979. The EPA subsequently revised the ozone standards in 1997, 2008 and 2015 based on the most recently available scientific studies at the time.
    - In October 2015, the EPA strengthened the ozone NAAQS from 75 parts per billion (ppb) to 70 ppb to ensure the protection of public health and welfare

- After the EPA establishes or revises an air quality standard, the agency follows a process by which states recommend area designations (*i.e.*, as nonattainment, attainment, or unclassifiable) to the EPA. The EPA then evaluates their recommendations and air quality data and other factors prior to making its proposed and final determinations regarding area designations. Ozone nonattainment areas are classified by the severity of their air quality problem based on air quality monitoring data, with classifications ranging from "Marginal" to "Extreme." The EPA anticipates finalizing area designations and classifications for the 2015 ozone NAAQS in late 2017.

- States, and in some cases local agencies or tribes, are the primary implementers of the NAAQS. They are responsible for developing and submitting to the EPA, implementation plans that meet the nonattainment planning requirements of the CAA. The EPA promulgates implementation rules to clarify its interpretation of applicable statutory provisions.

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HOW TO COMMENT

- The EPA will accept comments for 60 days beginning when this proposal is published in the *Federal Register*. All comments should be identified by Docket ID No. EPA-HQ-OAR-2016-0202 and submitted to the Federal e-rulemaking portal (www.regulations.gov). Follow the online instructions for submitting comments. If anyone requests a public hearing within 15 days of the proposal publication date, we will publish a subsequent *Federal Register* document announcing details of the hearing.

- For additional information about other ways to submit comments, please visit https://www.epa.gov/dockets/commenting-epa-dockets.

FOR MORE INFORMATION

- To download a copy of the proposed rule from the EPA website, go to "Regulatory Actions" at the following address: https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state

- This proposed rule and other background information are also available either electronically at http://www.regulations.gov, the EPA's electronic public docket and comment system, or in hardcopy at the EPA Docket Center's Public Reading Room.
    - The Public Reading Room is located in the EPA Headquarters, Room Number 3334 in the EPA William Jefferson Clinton West Building, located at 1301 Constitution Ave., NW, Washington, D.C. Hours of operation are 8:30 a.m. to 4:30 p.m. eastern standard time, Monday through Friday, excluding federal holidays.
    - Visitors are required to show photographic identification, pass through a metal detector and sign the EPA visitor log. All visitor materials will be processed through an X-ray machine as well. Visitors will be provided a badge that must be visible at all times.
    - Materials for this action can be accessed using Docket ID EPA-HQ-OAR-2016-0202.

- Additional information on the ozone nonattainment areas is available on the EPA Green Book at https://www.epa.gov/green-book/green-book-8-hour-ozone-2008-area-information.

- For more information on the proposed rule, contact Robert Lingard at (919) 541-5272 or *lingard.robert@epa.gov*.

ED_001361_00020381

To: Wells, Benjamin[Wells.Benjamin@epa.gov]
From: Jennifer Hains -MDE-
Sent: Thur 9/15/2016 12:21:46 PM
Subject: Fwd: Fw: Ozone Watch Update: September 13, 2016
Ozone_Watch_20160913.xls

Hi Ben,
Can I be added to the ozone watch update email list?
Thanks,
Jennifer Hains
---------- Forwarded message ----------
From: **Michael Woodman -MDE-** <michael.woodman@maryland.gov>
Date: Wed, Sep 14, 2016 at 9:20 PM
Subject: Fwd: Fw: Ozone Watch Update: September 13, 2016
To: Joel Dreessen -MDE- <joel.dreessen@maryland.gov>, James Boyle -MDE- <james.boyle@maryland.gov>, Jennifer Hains -MDE- <jennifer.hains@maryland.gov>
Cc: David Krask -MDE- <david.krask@maryland.gov>

Wanted to pass this along.
Mike
---------- Forwarded message ----------
From: **ellsworth, todd** <ellsworth.todd@epa.gov>
Date: Wed, Sep 14, 2016 at 1:30 PM
Subject: Fw: Ozone Watch Update: September 13, 2016
To: Michael Woodman -MDE- <michael.woodman@maryland.gov>

FYI.

Todd

From: Wells, Benjamin
Sent: Tuesday, September 13, 2016 8:53 AM
To: Aburano, Douglas; Algoe-Eakin, Amy; Arnold, Anne; Arnold, David; Ashley, Jackie; Bailey, Ashten; Banister, Beverly; Beeler, Cindy; Belk, Ellen; Bhesania, Amy; Boyce, Kenneth; Brachtl, Megan; Bredehoft, Deborah; Brown, Ethan; Bunte, Laura; Burkhart, Richard; Cakir, Halil; Casburn, Tracey; CHANG, RANDALL; Chu, Shao-Hang; Clover, Fletcher; Coats, Robert; Coda, Tom; Compher, Michael; Conroy, David; Cortelyou-Lee, Jan; cripps, christopher; D'Agostino, Kathleen; Dail, Lynn; Damberg, Rich; Davis, Alison; Delisio, Edward; devose, pauline; Dickerson, Phil; Dolwick, Pat; Donaldson, Guy; Doty, Edward; Duhadway, Karen; Eder, Brian; Edlund, Carl; Eisele, Adam; ellsworth, todd; Feingersh, Henry; Feldman, Michael; Fernandez, Cristina; Flagg, MichaelA; Foley, Kristen; Fuoco, Marta; Gantt, Brett; Gardella, Anthony; Garver, Daniel; Gilliam, Robert; Hall, Chris; Harnett, Bill; Hass, Andrew; Hemby, James; Hogan,

Sean; Hogrefe, Christian; Husk, Martin; Jackson, Scott; Jay, Michael; Jones, Rhea; Jordan, Deborah; Judge, Robert; Kapichak, Rudolph; Kelly, Bob; Kelly, Johnj; Kelly, ThomasP; Kemp, Lachala; Koerber, Mike; Kurpius, Meredith; LAWRENCE, LAURA; Leon-Guerrero, Tim; LEVIN, NANCY; Liljegren, Jennifer; Lingard, Robert; Lorang, Phil; Mangus, Nick; Mannshardt, Elizabeth; Martinez, Maria; Mathias, Scott; McKinley, Gobeail; McWilliams, Anne K.; Mebust, Anna; Mintz, David; Moraff, Kenneth; Mugdan, Walter; Naess, Liz; Newton, Cheryl; Noel, Jan; Noonan, Jenny; OConnor, Karina; Oldham, Carla; Ostendorf, Jody; Page, Steve; Paige, Carrie; Palmer, Darren; Payne, Melissa; Payton, Richard; Pepple, Karl; Pino, Maria; Possiel, Norm; Rhea, William; Rice, Joann; Rimer, Kelly; Rinck, Todd; Robinson, Randall; Rosenthal, Steven; Ruvo, Richard; Sather, Mark; Scavo, Kimber; Schmitt, Ellen; Schultz, Laurel; Scott, Denise; Senter, Stephen; Sharac, Timothy; Shatas, Angie; Snyder, Erik; Simon, Heather; Solomon, Douglas; South, Mia; South, Peter; Spann, Jane; Stackhouse, Butch; Summerhays, John; Sutton, Lisa; Tapp, Joshua; Tax, Wienke; Timin, Brian; Thompson, Alysha; Ungvarsky, John; Vagenas, Ginger; Vallano, Dena; Vaupel, Claudia; Viswanathan, Krishna; Walther, Katherine; Waterson, Sara; Wayland, Richard; Weber, Rebecca; Whitlow, Jeff; Wieber, Kirk; Weinstock, Lewis; Wilkie, walter; Williams, Jennifer; Wood, Anna; YOSHIMURA, GWEN; Zuco, Arthur
Subject: Ozone Watch Update: September 13, 2016

OZONE WATCH UPDATE:

Ozone Watch can help you keep track of concentrations reported during the 2016 ozone season and understand the possible implications for attainment during the 2014-2016 design value period.

In the attached Excel file, there are four tables with preliminary 2014-2016 design value information in parts per billion (ppb).

* The '2015_County' table shows preliminary design values by county for the 2015 8-hour ozone NAAQS of 70 ppb.

* The '2008_NAA' table shows preliminary design values in areas currently designated Nonattainment for the 2008 8-hour ozone NAAQS of 75 ppb.

* The '1997_NAA' table shows preliminary design values in areas formerly designated Nonattainment for the 1997 8-hour ozone NAAQS of 84 ppb.

* The '1HR_NAA' table shows preliminary design values in areas formerly designated Nonattainment with Severe or Extreme classification for the 1-hour ozone NAAQS of 124 ppb.

For more detailed information, site-level preliminary 2014-2016 design values can be obtained by clicking on the following link:

http://oaqpsapps.epa.gov/MadeInAQAG/index.php?title=Ozone Watch

These preliminary design values are based on 2014-2016 concentration data stored in AQS as of yesterday, combined with 2016 concentration data reported to AirNow on days where data do not yet exist in AQS.

Exceedance days for the 8-hour NAAQS are calculated as the number of days where the daily maximum 8-hour ozone concentration at ANY monitor in a given area is greater than the NAAQS. If these values were reported by different monitors, then there may be four or more exceedance days with a 4th highest daily maximum 8-hour value at or below the NAAQS.

The 2016(2017) critical value is the minimum 4th highest daily maximum 8-hour value that would cause a 2014-2016(2015-2017) design value above the NAAQS, given the data currently available.

This preliminary information is not for official use.

Ozone Watch updates are distributed via email each Tuesday morning, beginning in May and ending in October.

If you have any questions or comments, please contact Ben Wells by phone at 919-541-7507 or by email at Wells.Benjamin@epa.gov.

To: Wieber, Kirk[Wieber.Kirk@epa.gov]
From: Wong, Danny
Sent: Tue 1/3/2017 6:07:54 PM
Subject: RE: Quarterly Meeting
1-31-17 EPA DEP Draft Agenda.docx

Sorry, here's the latest version of the draft agenda.

From: Wong, Danny
Sent: Tuesday, January 03, 2017 1:06 PM
To: 'Wieber, Kirk' <Wieber.Kirk@epa.gov>
Subject: Quarterly Meeting

Kirk,

Who does Annamaria Colecchia report to? We wanted to include MERPs Guidance as an agenda item for the meeting and wanted to make sure put it in the right place in the agenda. Right now, I have it as a Permitting item.

Also, prior to the meeting, I (and Sharon Davis) would like to have a call with you (and your staff) on the agenda items so we can flush out some of them before the meeting itself, such as the NOx Budget Program demonstration. I've attached a rough draft of what I have so far for Planning. And please let me know if there are additional items you would like to talk about.

Danny Wong

Bureau Chief

NJDEP Division of Air Quality – Bureau of Evaluation and Planning
401 East State Street, 2nd Floor
Mail Code 401-02
P.O. Box 420
Trenton, NJ 08625-0420

Telephone (609) 984-2608
Fax (609) 633-1112

http://www.nj.gov/dep/aqes/index.html

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To: Wieber, Kirk[Wieber.Kirk@epa.gov]
From: Wong, Danny
Sent: Tue 1/3/2017 6:06:25 PM
Subject: Quarterly Meeting
1-31-17 EPA DEP Draft Agenda.docx

Kirk,

Who does Annamaria Colecchia report to? We wanted to include MERPs Guidance as an agenda item for the meeting and wanted to make sure put it in the right place in the agenda. Right now, I have it as a Permitting item.

Also, prior to the meeting, I (and Sharon Davis) would like to have a call with you (and your staff) on the agenda items so we can flush out some of them before the meeting itself, such as the NOx Budget Program demonstration. I've attached a rough draft of what I have so far for Planning. And please let me know if there are additional items you would like to talk about.

Danny Wong

Bureau Chief

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To: Fradkin, Kenneth[Fradkin.Kenneth@epa.gov]; Wieber, Kirk[Wieber.Kirk@epa.gov]; Forde, Raymond[Forde.Raymond@epa.gov]; Davis, Sharon[Sharon.Davis@dep.nj.gov]
Cc: Mercado, Edgar[Mercado.Edgar@epa.gov]; Murray, Beth[Murray.Beth@epa.gov]; Lifland, David[Lifland.David@epa.gov]
From: Wong, Danny
Sent: Tue 1/17/2017 4:43:43 PM
Subject: RE: Agenda for the Quarterly Meeting, including NOx Budget Demonstration
CAMD NBP and CAIR.pdf
1-31-17 EPA DEP Draft Agenda v3.docx

All,

Attached is a draft of the demonstration I have put together (of course will need to provide documentation).

- Took all of the NOx Budget Program (NBP) sources at the end of 2008
- Subtract them from the CAIR 2009 OS list
- Removed those that have shut down since
- Left with 8 units at 4 facilities

o Adding up total OS PTE vs 2008 NBP budget (for these 8 units) vs actual emissions since

Also, attached is the latest version of the agenda I have (you may have a later version).

We can discuss further on Thursday's call.

From: Fradkin, Kenneth [mailto:Fradkin.Kenneth@epa.gov]
Sent: Friday, January 13, 2017 9:27 AM
To: Wong, Danny <Danny.Wong@dep.nj.gov>; Wieber, Kirk <Wieber.Kirk@epa.gov>; Forde, Raymond <Forde.Raymond@epa.gov>; Davis, Sharon <Sharon.Davis@dep.nj.gov>
Cc: Mercado, Edgar <Mercado.Edgar@epa.gov>; Murray, Beth <Murray.Beth@epa.gov>; Lifland, David <Lifland.David@epa.gov>
Subject: RE: Agenda for the Quarterly Meeting, including NOx Budget Demonstration

Great. Thanks

We will use the same conference line

1. Dial the toll-free Conference Number - 1-844-637-3111
2. 5-digit Conference Extension - 83702
3. 6-digit Access Code – 123456

Ken

From: Wong, Danny [mailto:Danny.Wong@dep.nj.gov]
Sent: Friday, January 13, 2017 8:26 AM
To: Fradkin, Kenneth <Fradkin.Kenneth@epa.gov>; Wieber, Kirk <Wieber.Kirk@epa.gov>; Forde, Raymond <Forde.Raymond@epa.gov>; Davis, Sharon <Sharon.Davis@dep.nj.gov>
Cc: Mercado, Edgar <Mercado.Edgar@epa.gov>
Subject: RE: Agenda for the Quarterly Meeting, including NOx Budget Demonstration

1-2 on 19th ok with NJDEP.

To: Wortman, Eric[Wortman.Eric@epa.gov]
From: Austin, Darren (DEM)
Sent: Mon 1/30/2017 2:30:17 PM
Subject: RE: Exceptional Event Discussion

Eric,

Doug didn't think he and Laurie's attendance was necessary. I did pass the meeting time along to Gina, so she may be on the call.

Thanks

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

RIDEM - Office of Air Resources

235 Promenade Street, Room 230

Providence, RI 02908

(401) 222-2808 x7430

FAX: 222-2017

darren.austin@dem.ri.gov

From: Wortman, Eric [mailto:Wortman.Eric@epa.gov]
Sent: Friday, January 27, 2017 4:56 PM
To: Austin, Darren (DEM) <darren.austin@dem.ri.gov>
Subject: RE: Exceptional Event Discussion

Hey Darren,

Would you like me to extend the invite to Doug McVay, Laurie Grandchamp, Gina Friedman, and Melinda Viera? I wasn't sure if they were available and planning on joining you.

Eric

From: Wortman, Eric
Sent: Friday, January 27, 2017 2:34 PM
To: 'Austin, Darren (DEM)' <darren.austin@dem.ri.gov>
Subject: RE: Exceptional Event Discussion

Great, here's the conference line information. I'll have a few other EPA folks on the line here, please extend the invite to any others at DEM you wish to attend.

Eric

Conf. Line: 866-299-9141 / Passcode: 8874-7222

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Friday, January 27, 2017 2:21 PM
To: Wortman, Eric <Wortman.Eric@epa.gov>
Subject: RE: Exceptional Event Discussion

Eric,

Thanks for reaching out.

I'm available on 2/1 from 1-2pm.

Just confirm back and I'll mark my calendar.

Thanks

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

RIDEM - Office of Air Resources

235 Promenade Street, Room 230

Providence, RI 02908

(401) 222-2808 x7430

FAX: 222-2017

darren.austin@dem.ri.gov

From: Wortman, Eric [mailto:Wortman.Eric@epa.gov]
Sent: Friday, January 27, 2017 10:59 AM
To: Austin, Darren (DEM) <darren.austin@dem.ri.gov>
Subject: Exceptional Event Discussion

Hello Darren,

My name is Eric Wortman and I'm assisting with the exceptional events demonstrations from the

2016 Ft. McMurray wildfire. I'd like to set up a call between EPA and RI DEM to discuss next steps on your potential demonstration in more detail. Are you guys available next week for a quick call? Here are some available times, let me know what works for you and I'll send out a call-in number.

Wednesday, 2/1 from 1:00 – 2:00

Thursday, 2/2 from 12:00 – 1:00

Friday, 2/3 anytime midmorning or early afternoon.

Thanks,

Eric

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Monday, January 09, 2017 2:37 PM
To: Conroy, David <Conroy.Dave@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>
Cc: McVay, Doug (DEM) <doug.mcvay@dem.ri.gov>; Grandchamp, Laurie (DEM) <laurie.grandchamp@dem.ri.gov>
Subject: Exceptional Event Letter

All

See attached letter.

The hard copy of this letter was mailed today, 1/9/17 addressed

to David Conroy.

Regards

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

RIDEM - Office of Air Resources

235 Promenade Street, Room 230

Providence, RI 02908

(401) 222-2808 x7430

FAX: 222-2017

darren.austin@dem.ri.gov

To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
From: Wortman, Eric
Sent: Tue 5/30/2017 6:42:38 PM
Subject: FW: Connecticut 2016 Exceptional Event Demonstration for May 25-26, 2016
CT_2016_Exceptional_Event_Cover_Letter_signed.pdf
May 2016 Ozone Exceptional Event Analysis_FINAL.pdf

Example cover letter and email from CT. Feel free to send to Art directly and copy me, Dave Conroy, Anne Arnold, and Bob Judge.

Thanks!

Eric

Eric Wortman | Environmental Scientist

U.S. Environmental Protection Agency

Telephone: (617) 918-1624 | Email: wortman.eric@epa.gov

From: Geigert, Michael [mailto:Michael.Geigert@ct.gov]
Sent: Tuesday, May 23, 2017 3:29 PM
To: Johnson, Arthur <Johnson.Arthur@epa.gov>
Cc: Conroy, David <Conroy.Dave@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>
Subject: Connecticut 2016 Exceptional Event Demonstration for May 25-26, 2016

Dear Arthur,

Attached is the final technical support document for the Connecticut Exceptional Event Demonstration for May 2016. Also attached is the signed cover letter from our Air Director, Anne Gobin. We look forward to your approval of our Demonstration and if you need any additional materials, please contact me personally. A paper copy is also being mailed to your attention.

Regards,

Michael

Michael Geigert

Planning and Standards

Bureau of Air Management

Connecticut Department of Energy and Environmental Protection
79 Elm Street, Hartford, CT 06106-5127

P: 860.424.3509 | F: 860.706.5339 | E: Michael.Geigert@ct.gov

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

www.ct.gov/deep

Conserving, improving and protecting our natural resources and environment;

Ensuring a clean, affordable, reliable, and sustainable energy supply.

To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
Cc: gina.friedman@dem.ri.gov[gina.friedman@dem.ri.gov]; doug.mcvay@dem.ri.gov[doug.mcvay@dem.ri.gov]; melinda.viera@health.ri.gov[melinda.viera@health.ri.gov]; Arnold, Anne[Arnold.Anne@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Robert Judge[Judge.Robert@epa.gov]; Taylor, Catherine[taylor.catherine@epa.gov]; Van Arsdale, Alan[vanarsdale.alan@epa.gov]
From: Wortman, Eric
Sent: Thur 2/2/2017 3:18:32 PM
Subject: Draft Q/D for CT Exceptional Event Demo
Q over D.DOCX

Hi Darren,

Attached is the draft Q/D analysis provided by Connecticut, and our initial feedback is also included below. Although this is not the final version and is only a small piece of the demonstration, we wanted to share it with you early to assist with the preparation of Rhode Island's EE demonstration. We'll continue to share information as it becomes available and look forward to discussing things in more detail with you tomorrow.

Please let me know if you have any questions.

Eric

Eric Wortman | Environmental Scientist

U.S. Environmental Protection Agency

Telephone: (617) 918-1624 Email: wortman.eric@epa.gov

From: Wholean, Kiernan [mailto:Kiernan.Wholean@ct.gov]
Sent: Thursday, February 02, 2017 9:15 AM
To: Judge, Robert <Judge.Robert@epa.gov>; Taylor, Catherine <taylor.catherine@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Mackintosh, David <Mackintosh.David@epa.gov>
Cc: Geigert, Michael <Michael.Geigert@ct.gov>; Pirolli, Ric <Ric.Pirolli@ct.gov>; Arnold, Anne <Arnold.Anne@epa.gov>
Subject: RE: Q over D for CT

Thanks for the comments.

Please do share with the other states anything that you think might help them.

From: Judge, Robert [mailto:Judge.Robert@epa.gov]
Sent: Thursday, February 02, 2017 8:45 AM
To: Wholean, Kiernan <Kiernan.Wholean@ct.gov>; Taylor, Catherine <taylor.catherine@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Mackintosh, David <Mackintosh.David@epa.gov>
Cc: Geigert, Michael <Michael.Geigert@ct.gov>; Pirolli, Ric <Ric.Pirolli@ct.gov>; Arnold, Anne <Arnold.Anne@epa.gov>
Subject: RE: Q over D for CT

Kiernan- thanks for this. A few of us looked at this here. In general, this looks fine.

There's a minor math error, probably a transcription error, in the THC calculations. On page 2 it states "17,791 tons of HC emitted during the period from May 19 to May 24" but then on page 3 the number used is not 17,791 but "17,991." And then the numbers from that point forward are also off, but not by much since we still end up with the same 0.69 tpd/km result.

Also, the document states:

The fuel loading is given in AP-42 for different regions of the United States and ranges from 9 to 60 tons per acre. Conservatively, we will estimate a low end emission rate using ***10 tons per acre which is associated with North Central US conifer forests. Note that our results could increase by a factor of 6 were we to expect the high end of emissions.***

The forest fire was in a Boreal Conifer forest in Canada, so the most similar AP-42 classification would be "Region 9: Conifers" at 10 tons per acre. You could probably use 11 tons per acre based on the values for R10 interior, Eastern, or North Central, however stating that the it could

be 6 times would be extremely conservative- as you point out. The factors at 60 tons per acre tend to be coastal areas (wet, grassy) and Fort McMurray is definitely not near the coast—it's the central part of Canada. There might be more research to support a more accurate value, which EPA Canada might even have a more accurate factor for boreal areas, but we don't see it changing the numbers that much. Map identifying the different forest areas: http://www.cec.org/tools-and-resources/map-files/north-american-forests-2011

So bottom line is, as expected, the Q/D is very low, and even multiplying by 6 would still be very small. That said, we've also heard discussion of other fires in the area (ie, NY, midwest) in this timeframe that might be/ should be considered. That said, the conclusion likely remains that even with this Q/D analyses, more detailed analyses are appropriate, and that is exactly what CT is doing…

As a final general point, please let us know if you are comfortable with us sharing these drafts broadly with MA and RI as they are being developed. As you know, both MA and RI are intending to submit EE requests for this fire event. We feel this broad sharing, even in draft form, would be of benefit to all of us, but only want to share what you feel comfortable with.

Thanks! Feel free to give me a call if you have more questions, and we look forward to reviewing your full demo including the narrative description/ conceptual model, soon.

,Bob

From: Wholean, Kiernan [mailto:Kiernan.Wholean@ct.gov]
Sent: Friday, January 27, 2017 12:01 PM
To: Judge, Robert <Judge.Robert@epa.gov>; Taylor, Catherine <taylor.catherine@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>
Cc: Geigert, Michael <Michael.Geigert@ct.gov>; Pirolli, Ric <Ric.Pirolli@ct.gov>
Subject: Q over D for CT

Bob, Catie and Anne:

Attached is a draft of the Q/d analysis for Connecticut's Fort McMurray Exceptional Event Analysis.

I could not find any information on actual or modeled VOC or NOx emissions from the Fort McMurray fire, so I used AP-42 with varying levels of conservatism. I also attempted to estimate emissions based on reported emissions from one of the wildfires used to develop the Q/d guidance. Based on the results of these estimates, it does not seem worth the effort to run some of the emissions models such as SMARTFIRE or CONSUME, especially as I do not know that we have the expertise or data to obtain more meaningful results. Therefore, we will rely, as we expected, on the analyses that Michael is conducting related to ozone concentrations observed on similar days with respect to meteorology and emissions.

Please let us know your thoughts on the draft and procedures in this portion of the draft.

Thank you,

Kiernan Wholean

860-424-3425

To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
From: Wortman, Eric
Sent: Tue 1/31/2017 2:29:18 PM
Subject: RE: Exceptional Event Discussion

Great, thanks. Just sent a reschedule notice for Friday at 1:00.

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Tuesday, January 31, 2017 8:55 AM
To: Wortman, Eric <Wortman.Eric@epa.gov>
Subject: RE: Exceptional Event Discussion

Eric,

Received your voicemail too. Friday is best. I'm flexible but early afternoon is optimal.

Regards

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

RIDEM - Office of Air Resources

235 Promenade Street, Room 230

Providence, RI 02908

(401) 222-2808 x7430

FAX: 222-2017

darren.austin@dem.ri.gov

From: Wortman, Eric [mailto:Wortman.Eric@epa.gov]
Sent: Tuesday, January 31, 2017 8:39 AM
To: Austin, Darren (DEM) <darren.austin@dem.ri.gov>
Subject: RE: Exceptional Event Discussion

Hi Darren,

Can we reschedule this call for 9:00 or 12:00 on Thursday due to a conflict that came up? Friday is good for us too.

Thanks,

Eric

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Monday, January 30, 2017 9:30 AM
To: Wortman, Eric <Wortman.Eric@epa.gov>
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the meeting time along to Gina, so she may be on the call.

Thanks

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Subject: RE: Exceptional Event Discussion

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Eric

From: Wortman, Eric
Sent: Friday, January 27, 2017 2:34 PM
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Great, here's the conference line information. I'll have a few other EPA folks on the line here, please extend the invite to any others at DEM you wish to attend.

Eric

Conf. Line: 866-299-9141 / Passcode: 8874-7222

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Friday, January 27, 2017 2:21 PM
To: Wortman, Eric <Wortman.Eric@epa.gov>
Subject: RE: Exceptional Event Discussion

Eric,

Thanks for reaching out.

I'm available on 2/1 from 1-2pm.

Just confirm back and I'll mark my calendar.

Thanks

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darren.austin@dem.ri.gov

From: Wortman, Eric [mailto:Wortman.Eric@epa.gov]
Sent: Friday, January 27, 2017 10:59 AM
To: Austin, Darren (DEM) <darren.austin@dem.ri.gov>
Subject: Exceptional Event Discussion

Hello Darren,

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Sent: Monday, January 09, 2017 2:37 PM
To: Conroy, David <Conroy.Dave@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>
Cc: McVay, Doug (DEM) <doug.mcvay@dem.ri.gov>; Grandchamp, Laurie (DEM) <laurie.grandchamp@dem.ri.gov>
Subject: Exceptional Event Letter

All

See attached letter.

The hard copy of this letter was mailed today, 1/9/17 addressed

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To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
Cc: doug.mcvay@dem.ri.gov[doug.mcvay@dem.ri.gov]; laurie.grandchamp@dem.ri.gov[laurie.grandchamp@dem.ri.gov]; gina.friedman@dem.ri.gov[gina.friedman@dem.ri.gov]; Robert Judge[Judge.Robert@epa.gov]; Taylor, Catherine[taylor.catherine@epa.gov]; Kahn, Peter R.[kahn.peter@epa.gov]; McWilliams, Anne K.[mcwilliams.anne@epa.gov]; Arnold, Anne[Arnold.Anne@epa.gov]; Conroy, David[Conroy.Dave@epa.gov]
From: Wortman, Eric
Sent: Tue 5/9/2017 2:50:56 PM
Subject: Exceptional Event Demonstration Submittal Process - RI DEM

Darren,

Thank you for notifying us of the public comment period for your proposed exceptional events demonstration for the 2016 Ft. McMurray wildfire. The public comment period for the demonstration ends on May 26, 2017. Given this timeframe, we understand that it may be challenging to provide your final submittal to the EPA by the May 31, 2017 deadline. The exceptional events rule provides flexibility for the EPA to begin its review concurrent with the public comment period, provided that any received public comments and your response to those comments are sent to the EPA by a specified date (see 81 FR 68266/68267). Please note that if RI DEM receives public comments disputing the technical elements of a demonstration during a comment period that runs concurrent with the EPA's review and these comments result in the need to reanalyze or reassess the validity of a claimed event, a second public comment period may be necessary.

In accordance with §50.14(c)(3), RI DEM should submit a copy of the proposed demonstration and documentation of the public comment process to the EPA by May 31, 2017. RI DEM should provide the EPA with a final submittal, including any public comments received and your response to those comments, no later than June 30, 2017. Your submittals may be sent to the following address:

Art Johnson, Acting Director
Office of Ecosystem Protection
U.S. EPA Region 1
5 Post Office Square (Mail Code: OEP-06-5)

Boston, MA 02109-3912

Please let me know if you have any questions,

Eric

Eric Wortman | Environmental Scientist

U.S. Environmental Protection Agency

Telephone: (617) 918-1624 | Email: wortman.eric@epa.gov

To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
From: Wortman, Eric
Sent: Tue 1/31/2017 1:39:12 PM
Subject: RE: Exceptional Event Discussion

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To: Wortman, Eric <Wortman.Eric@epa.gov>
Subject: RE: Exceptional Event Discussion

Eric,

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darren.austin@dem.ri.gov

From: Wortman, Eric [mailto:Wortman.Eric@epa.gov]
Sent: Friday, January 27, 2017 10:59 AM
To: Austin, Darren (DEM) <darren.austin@dem.ri.gov>
Subject: Exceptional Event Discussion

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Thanks,

Eric

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Monday, January 09, 2017 2:37 PM
To: Conroy, David <Conroy.Dave@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>
Cc: McVay, Doug (DEM) <doug.mcvay@dem.ri.gov>; Grandchamp, Laurie (DEM) <laurie.grandchamp@dem.ri.gov>
Subject: Exceptional Event Letter

All

See attached letter.

The hard copy of this letter was mailed today, 1/9/17 addressed

to David Conroy.

Regards

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darren.austin@dem.ri.gov

To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]; Coughlin, Steven (DEP)[steven.coughlin@state.ma.us]; mark.wert@state.ma.us[mark.wert@state.ma.us]; laurie.grandchamp@dem.ri.gov[laurie.grandchamp@dem.ri.gov]
From: Wortman, Eric
Sent: Tue 4/18/2017 5:32:56 PM
Subject: FYI: Public Notice of Connecticut's Exceptional Event Request

Passing this notice along in case you're interested.

Eric

Eric Wortman | Environmental Scientist

U.S. Environmental Protection Agency

Telephone: (617) 918-1624 Email: wortman.eric@epa.gov

From: Wholean, Kiernan [mailto:Kiernan.Wholean@ct.gov]
Sent: Tuesday, April 18, 2017 11:40 AM
To: Conroy, David <Conroy.Dave@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; Taylor, Catherine <taylor.catherine@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>; Arnold, Anne <Arnold.Anne@epa.gov>; Wortman, Eric <Wortman.Eric@epa.gov>
Cc: Farrell, Paul <Paul.Farrell@ct.gov>; Pirolli, Ric <Ric.Pirolli@ct.gov>; Gobin, Anne <Anne.Gobin@ct.gov>
Subject: Public Notice of Connecticut's Exceptional Event Request

Connecticut has issued public notice of its exceptional event demonstration for the May 2016 Fort McMurray fire. The notice, with links to the demonstration and supporting material, is available at the following link:

http://www.ct.gov/deep/cwp/view.asp?A=2586&Q=592114

Thanks for all your help,

Kiernan Wholean.

CTDEEP

860-424-3425

To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
Cc: Robert Judge[Judge.Robert@epa.gov]
From: Wortman, Eric
Sent: Mon 1/30/2017 2:46:27 PM
Subject: RE: Exceptional Event Discussion

Okay thanks. Talk to you then.

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Monday, January 30, 2017 9:30 AM
To: Wortman, Eric <Wortman.Eric@epa.gov>
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Subject: RE: Exceptional Event Discussion

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To: Wortman, Eric <Wortman.Eric@epa.gov>
Subject: RE: Exceptional Event Discussion

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To: Austin, Darren (DEM)[darren.austin@dem.ri.gov]
From: Wortman, Eric
Sent: Fri 1/27/2017 9:56:06 PM
Subject: RE: Exceptional Event Discussion

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Subject: Exceptional Event Discussion

Hello Darren,

My name is Eric Wortman and I'm assisting with the exceptional events demonstrations from the 2016 Ft. McMurray wildfire. I'd like to set up a call between EPA and RI DEM to discuss next steps on your potential demonstration in more detail. Are you guys available next week for a quick call? Here are some available times, let me know what works for you and I'll send out a call-in number.

Wednesday, 2/1 from 1:00 – 2:00

Thursday, 2/2 from 12:00 – 1:00

Friday, 2/3 anytime midmorning or early afternoon.

Thanks,

Eric

From: Austin, Darren (DEM) [mailto:darren.austin@dem.ri.gov]
Sent: Monday, January 09, 2017 2:37 PM
To: Conroy, David <Conroy.Dave@epa.gov>; Judge, Robert <Judge.Robert@epa.gov>; McWilliams, Anne K. <mcwilliams.anne@epa.gov>
Cc: McVay, Doug (DEM) <doug.mcvay@dem.ri.gov>; Grandchamp, Laurie (DEM) <laurie.grandchamp@dem.ri.gov>
Subject: Exceptional Event Letter

All

See attached letter.

The hard copy of this letter was mailed today, 1/9/17 addressed

to David Conroy.

Regards

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Darren Austin – Meteorologist - Senior Air Quality Specialist

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Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep Affirmative Action/Equal Opportunity Emplc

VIA ELECTRONIC MAIL May 23, 2017

Arthur Johnson, Acting Director
Office of Ecosystem Protection
5 Post Office Square - Suite 100
Boston, MA 02109-3912
johnson.arthur@epa.gov

RE: Connecticut Exceptional Event Demonstration for May 25-26, 2016

Dear Mr. Johnson:

Attached, please find for your approval, the Connecticut Exceptional Event Demonstration for May 25-26, 2016 (Demonstration). The Connecticut Department of Energy and Environmental Protection (Department) drafted the Demonstration in fulfillment of the requirements set forth in the Exceptional Events Rule at 40 CFR 50.14.

The Department worked closely with your staff in developing the draft Demonstration and also sought out public comment. The Department posted the draft Demonstration on its website for a 30-day public comment period from April 18 to May 19, 2017. The Department also reached out to its key stakeholders by directly soliciting comments from Connecticut's State Implementation Plan Revision Advisory Committee (SIPRAC). SIPRAC is comprised of approximately 400 members representing business and industry, the environmental community, the public, and academia - all of whom have interest in Connecticut's air quality issues.

The Department received no public comments except for a letter dated May 19, 2017 from David Conroy, Chief, Air Programs Branch of EPA Region 1, stating that EPA had reviewed the draft Demonstration and had no comments. Therefore, according to the provisions in 40 CFR 50.14, the Department has fulfilled the public comment requirement for this Demonstration.

The draft Demonstration has been updated to reflect that ozone data from the Greenwich monitor for the period of April 1- June 14, 2016 is officially invalid. As such, the map in figure 93 of the Demonstration is revised to reflect that the Greenwich monitor has a design value of 80 ppb rather than 82 ppb as indicated in the draft Demonstration. There are no other changes to the draft Demonstration.

I look forward to receiving your approval on this Demonstration for Connecticut. If you have any questions concerning this Demonstration, please contact Michael Geigert of my staff at 860-424-3509.

Sincerely,

Anne Gobin

Anne Gobin, Chief
Bureau of Air Management

CC: Robert Judge, EPA R1
David Conroy, EPA R1

Enc: Connecticut Exceptional Event Demonstration for May 25-26, 2016

Connecticut Department of
ENERGY &
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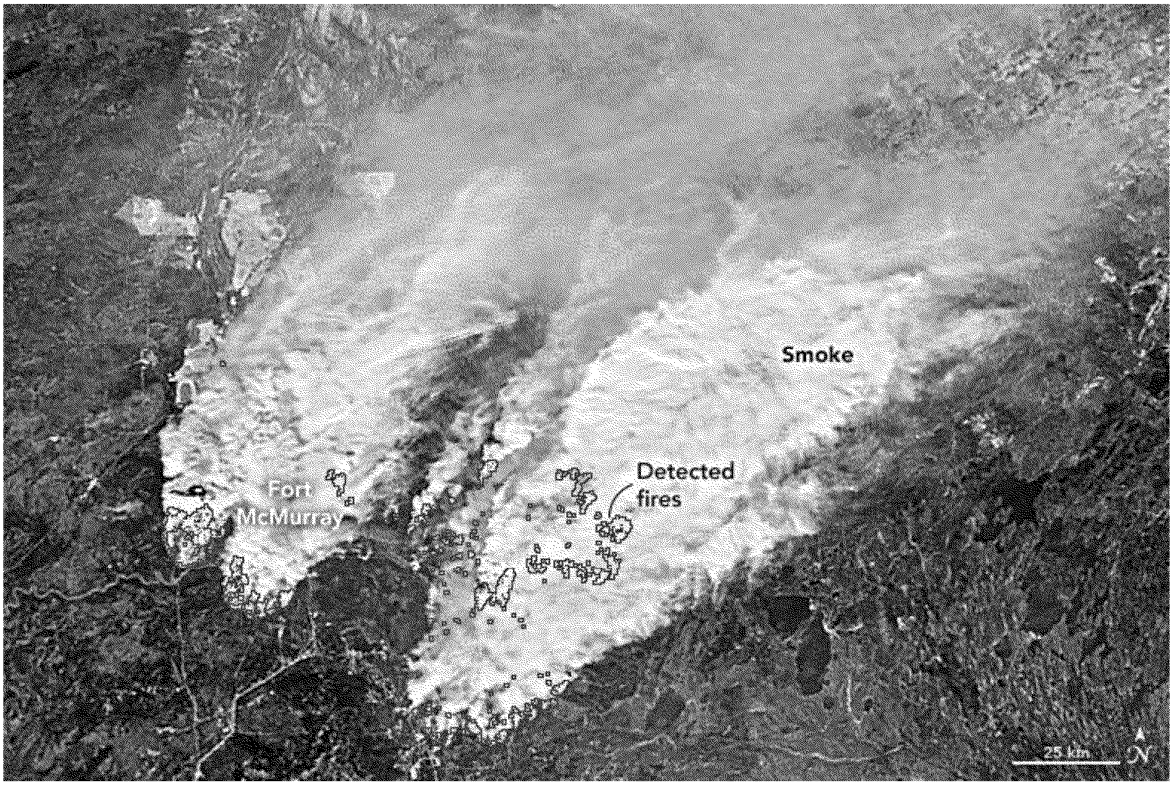
PROTECTION

May 2016 Ozone Exceptional Event Analysis
Technical Support Document



Connecticut Department of Energy and Environmental Protection

May 2017

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1. OVERVIEW

1.1 Introduction

Early in the day on May 25th, 2016, an unusual area of elevated ozone concentrations over the upper Midwest and New York State moved into New England. Widespread, highly elevated ozone levels early in the season occur infrequently. Rarely do ozone events occur under the meteorological conditions observed.

It became quickly evident, initially through discrepancies with the forecast model results, and later through analyses of satellite and other data, that the elevated ozone was likely due to the Fort McMurray wildfire smoke plume that had been moving toward New England for several days. The National Oceanic and Atmospheric Administration (NOAA) operational ozone model, which was not configured to include effects from wildfires, had been predicting good to moderate ozone concentrations throughout the area; nevertheless, air quality reached unhealthy levels in many areas of the State by noon on May 25th.

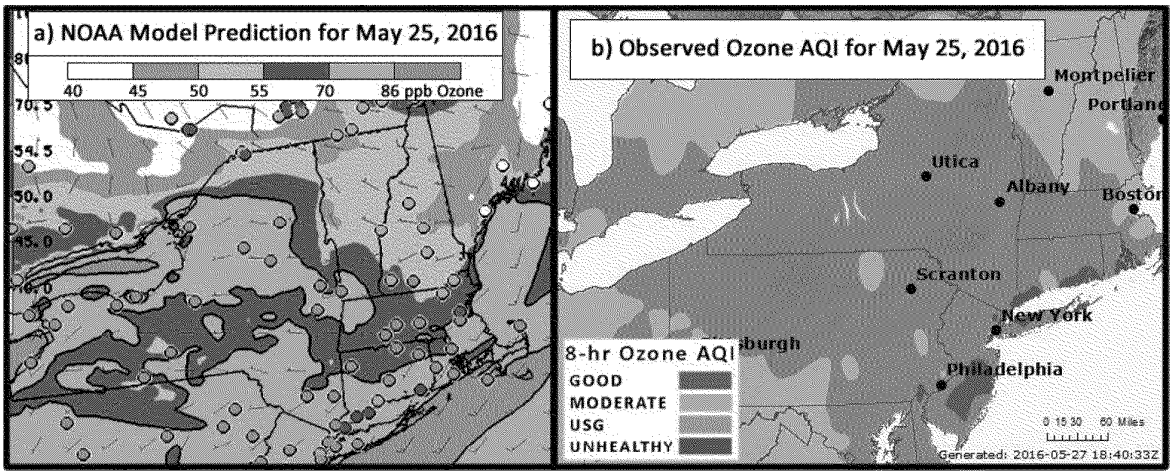

Figure 1. Model Forecasted Air Quality versus Observed. NOAA model forecasted AQI values for May 25th, 2016 (a) and the observed ozone AQI values (b). Figure 1a shows the early morning forecast (isopleths) for the day of May 25th including wind fields and actual observed ozone AQI levels at monitoring sites (circles) in the northeast. Figure 1b shows the extent of the observed ozone levels. Note that Figure 1a color scheme for monitors match the color scheme in figure 1b.

The unusual air quality continued as Connecticut air quality monitors and those in nearby states reported daily maximum 8-hour average ozone levels over the 70 ppb National Ambient Air Quality Standard (NAAQS) from May 25th through the 28th.

In August of 2016, having conducted a preliminary review of the event, the Connecticut Department of Energy and Environmental Protection (DEEP) placed an informational flag on all

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the monitored ozone data for that entire four-day event indicating that the data had been influenced by the Canadian wildfire. As required by the Exceptional Events Rule (Title 40 of the Code of Federal Regulations Part 50.14) DEEP notified the Environmental Protection Agency (EPA) by letter dated September 28th, 2016, that we intended to submit an exceptional events' data exclusion demonstration for the event.

The letter cited the factors indicating that the Fort McMurray wildfire influenced the flagged data as follows:

- Weather patterns were initially not favorable for ozone formation over Connecticut. High pressure trapped pollutants from the wildfire over the upper Great Lakes for several days before normally clean northwest winds transported 'unhealthy' levels of ozone to the east and southeast across New York State and then to Connecticut;
- Visible satellite plumes and back trajectory analyses for the time period before the event showed wildfire smoke transported southeast into the Midwestern States before arriving over Connecticut on May 25th, 2016; and
- The NOAA operational ozone forecast model under-predicted ozone by more than 20 ppb during the period. The under prediction is likely due to the inability of the model to account for the effect of real-time gas-phase smoke emissions from the fire.

Although all four days of the regional ozone event were likely influenced by the smoke plume chemistry, Connecticut believes that the days of May 25-26, 2016 unequivocally qualify for an exceptional event data exclusion and request this exclusion for the four monitors that would have the most regulatory impact. This document, in accordance with the exceptional events rule, provides the evidence for the exclusion of ozone data for the entire 48 hour period of May 25-26, 2016 for the following four monitors: Cornwall, East Hartford, Westport, and Abington.

1.2 EPA Exceptional Event Guidance

The Exceptional Events Rule, contained in Title 40 of the Code of Federal Regulations Part 50.14 (40CFR50.14), was revised by EPA in October of 2016[1]. The revised rule describes the procedures for treating data which has been influenced by an exceptional event. Accordingly, an exceptional events demonstration must include the following elements:

1) A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);

2) A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;

[1] Federal Register / Vol. 81, No. 191 / Monday, October 3, 2016: Treatment of Data Influenced by Exceptional Events

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3) Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times. The Administrator shall not require a State to prove a specific percentile point in the distribution of data;

4) A demonstration that the event was both not reasonably controllable and not reasonably preventable;

5) A demonstration that the event was caused by human activity that is unlikely to recur at a particular location or was a natural event; and

6) Documentation that the submitting air agency followed the public comment process.

Wildfires are defined at 40 CFR 50.1(n) as "…any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." EPA has prepared guidance specific to analyzing the influence of wildfires on ozone events[2].

Furthermore, 40CFR50.14(b)(4) states that the EPA " … Administrator shall exclude data from use in determinations of exceedances and violations where a State demonstrates to the Administrator's satisfaction that emissions from wildfires caused a specific air pollution concentration in excess of one or more national ambient air quality standard at a particular air quality monitoring location and otherwise satisfies the requirements of this section. Provided the Administrator determines that there is no compelling evidence to the contrary in the record, the Administrator will determine every wildfire occurring predominantly on wildland to have met the requirements identified in paragraph (c)(3)(iv)(D) [item (4) above] of this section regarding the not reasonably controllable or preventable criterion."

We address each of the necessary elements above in the subsequent sections of this document, generally relying on the EPA guidance for wildfires. EPA guidance offers suggestions for appropriate analyses to demonstrate the clear causal relationship between the wildfire and excessive ozone levels and recognizes that appropriate levels of analysis will vary for particular locations and conditions. EPA does not intend for the guidance to constrain the analysis and we include some of the suggested analytics, and variations on those methods to support our conclusion that the ozone exceedances throughout the State were caused or worsened by the wildfire plume from the Fort McMurray in May of 2016.

1.3 Regulatory Significance

The exceptional events rule applies to data showing an exceedance of a standard which may affect regulatory determinations regarding attainment designation status or other action by the Administrator. While the wildfire plume was regional in nature and was observable over the State during the four day event, it did not cause all monitors to exceed the standard throughout

[2] Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, US EPA OAQPS, Research Triangle Park, North Carolina, September 2016.

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the event. Nor were all the exceedances such that they would likely affect attainment designation status or other EPA actions.

Attainment designation status is determined by design values derived from monitored values. For ozone the design value is determined by taking the three-year average of the fourth highest 8-hour maximum daily average monitored ozone level.

Table 1 shows the maximum 8-hour ozone averages observed at the Connecticut ozone monitors during the event from May 25th through May 28th. There were monitored exceedances of the 70 ppb ozone NAAQS on all 4 days. However, the more severe exceedances occurred on the first two days of the event and those values are most significant with respect to computation of design values.

Table 1. Event Maximum 8-hour Ozone Concentrations. The maximum 8-hour average ozone concentration in parts per billion (ppb) for each ozone monitoring site in Connecticut during the four day May 2016 ozone event. Data for Connecticut's Greenwich monitor has been invalidated.

Site Name	5/25/2016	5/26/2016	5/27/2016	5/28/2016
Abington	76	83	68	67
Cornwall	81	91	78	65
Danbury	82	99	81	81
East Hartford	75	93	70	81
Groton	87	80	54	60
Madison	89	86	56	63
Middletown	80	91	67	79
New Haven	63	84	65	73
Stafford	74	82	70	73
Stratford	89	76	59	70
Westport	87	90	61	81

The levels which occurred on May 27-28 are consistent with values which occur later in the ozone season and are less likely to affect current or future design values.

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Table 2 compares current 2016 design values (based on 2014-2016 data), calculated with and without the inclusion of all data from the first two days of the event. The table also shows the 2017 critical 4th-high value, which is the fourth highest annual 8-hour average value that would produce a 2017 design value that violates the NAAQS indicated beside it in parenthesis. The difference in critical values is shown in the final column. Where there is no difference in critical value, there can be no regulatory significance to excluding data from the event. Based on the severity of the difference in critical value, and the expectation that those sites with the largest differences will be controlling in any assessment of attainment status, DEEP has decided to focus this demonstration on the four sites with the greatest difference in critical value. If future assessments of attainment status based on inclusion of sites with lower critical differences prove to be controlling, then DEEP will revisit this analysis.

Table 2. Comparison of 2016 Design Values with and without May 25 and May 26, 2016 Data, and Corresponding 2017 Critical 4th High Values.

Current Values						Excluding May 25-26, 2016			Difference in Critical Value
Site Name	4th high 2014	4th high 2015	4th high 2016	2014-2016 DV	2017 Critical 4th High Value (NAAQS Standard)	4th high 2016	2014-2016 DV	2017 Critical 4th High Value (NAAQS Standard)	
Abington	67	70	**74**	70	69 (70)	67	68	76 (70)	7
Westport	**81**	**87**	**87**	**85**	81 (84)	**81**	**83**	87 (84)	6
Cornwall	68	**76**	**78**	**74**	74 (75)	**74**	**72**	78 (75)	4
East Hartford	**77**	**75**	**75**	**75**	78 (75)	**72**	**74**	81 (75)	3
Madison	69	**81**	**80**	**76**	94 (84)	**78**	**76**	96 (84)	2
Stafford	**77**	**72**	**72**	**73**	84 (75)	70	**73**	86 (75)	2
Danbury	**74**	**79**	**81**	**78**	95 (84)	**80**	**77**	96 (84)	1
Middletown	**80**	**78**	**80**	**79**	97 (84)	**79**	**79**	98 (84)	1
Stratford	**74**	**86**	**83**	**81**	86 (84)	**82**	**80**	87 (84)	1
New Haven	**72**	**81**	**75**	**76**	99 (84)	**75**	**76**	99 (84)	0
Groton	65	**77**	**75**	**72**	76 (75)	**75**	**72**	76 (75)	0

Table 3 shows the four sites that DEEP has concluded are affected by the event in a significant regulatory way and to which this data exclusion request is limited. Excluding the two days

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significantly lowers the fourth highest value for 2016 at each of these sites, which then results in a lower design value.

Table 3.Comparison of 2016 Design Values with and without May 25 and 26, 2016 Data, and Corresponding 2017 Critical 4th High Values at the Four Sites Proposed for Exclusion.

Current Values						Revised Values Excluding May 25-26, 2016		
Site Name	4th high 2014	4th high 2015	4th high 2016	2014-2016 DV	2017 Critical 4th High Value (NAAQS Standard)	4th high 2016	2014-2016 DV	2017Critical 4th High Value (NAAQS Standard)
Abington	67	70	**74**	70	69 (70)	67	68	76 (70)
Westport	**81**	**87**	**87**	**85**	81 (84)	**81**	**83**	87 (84)
Cornwall	68	**76**	**78**	**74**	74 (75)	**74**	**72**	78 (75)
East Hartford	**77**	**75**	**75**	**75**	78 (75)	**72**	**74**	81 (75)

The Abington site, which currently measures attainment for all the ozone NAAQS, could easily measure non-compliance in future years if this data is not excluded. Table 3 shows that (including the May 25th and 26th data) a 4th-high value in 2017 of 69 ppb or higher could push Abington into measured nonattainment for the 2015 NAAQS of 70 ppb. Also, the 4th high value in 2016 for Abington is clearly aberrant when the event data is included. This site is a Clean Air Status and Trends Network (CASTNET) site run by EPA. Therefore, on March 23, 2017, in cooperation with EPA, DEEP requested the CASTNET administrator to apply data flags for May 25-26, 2016 to Abington.

The Westport monitor's 2016 design value decreases by 2 ppb if the event is excluded. This decrease is sufficient to bring the site, and the Southwest Connecticut portion of the NY-NJ-CT nonattainment area, back into attainment with the 1997 ozone NAAQS of 84 ppb.

Both the Cornwall and East Hartford monitors currently measure nonattainment for the 2015 NAAQS of 70 ppb. While there is concern that the event data could impede attainment of the 2015 NAAQS, the more immediate concern for these two sites is that the wildfire influenced data could produce 2017 (or 2018) design values that violate the 2008 NAAQS of 75 ppb. This would jeopardize the determination of timely attainment for the Greater Connecticut nonattainment area.

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2. CONCEPTUAL MODEL

2.1 Typical Exceedance Day Meteorological Scenarios

Although Connecticut experiences frequent ozone exceedance days during the summer, these vary from year to year, due to the prevailing meteorology. While ongoing reductions in emissions of ozone forming pollutants have lowered the absolute number of exceedance days, meteorological variation is still an important factor. Figure 2 shows the historical trends for Connecticut's ozone exceedance days with separate lines for each of the 8-hour ozone NAAQS established since 1997. Vertical lines indicate the year the standard was established.

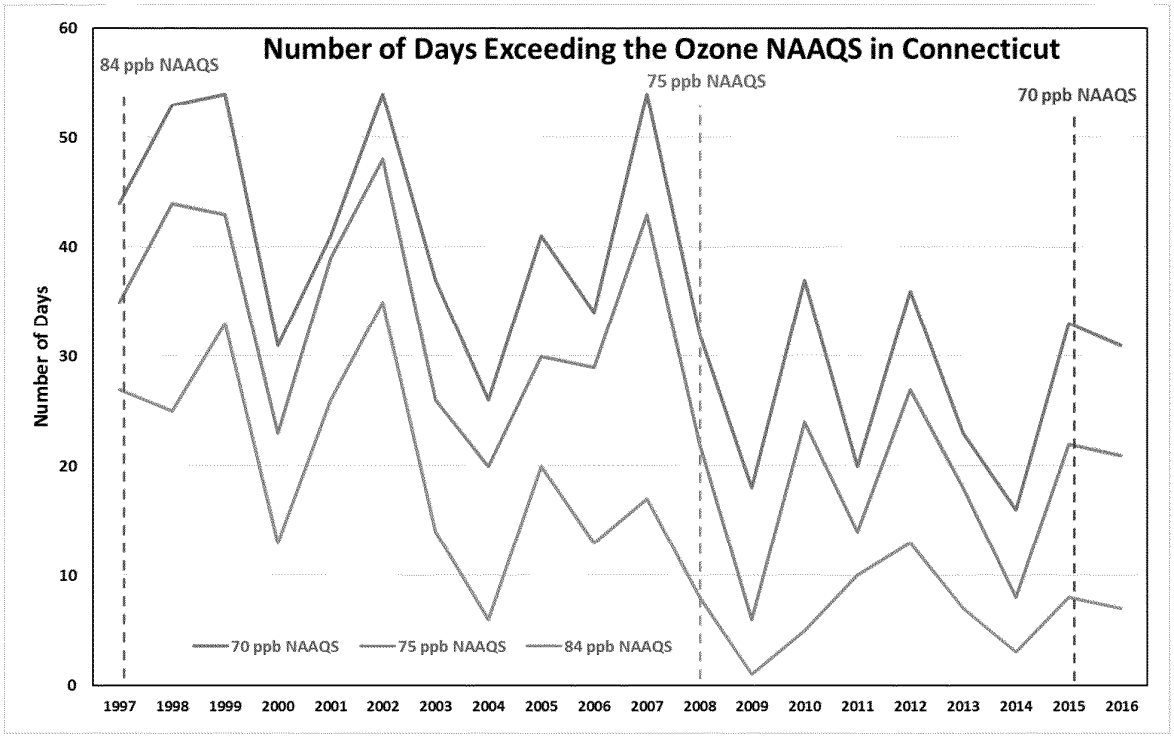

Figure 2. Number of Ozone Exceedance Days. The number of days exceeding the respective ozone standards in Connecticut since 1997. Dashed vertical lines indicate the respective dates the standards were established.

Typically, the bulk of the ozone exceedance days occur during the June-August timeframe, with fewer exceedances during May and September. Exceedances have occurred during April, but only rarely.

Ozone exceedances in Connecticut can be classified into four categories based on spatial patterns of measured ozone and the contributing meteorological conditions. Typically, most exceedances occur on sunny summer days with inland maximum surface temperatures approaching or above 90°F, surface winds from the south and southwest (favorable for transport of pollutants from the I-95 corridor) and aloft winds from the west to southwest (favorable for transport of pollutants from Midwest power plants).

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Inland-only Exceedances: Ozone is transported aloft from the west and mixed down to the surface as daytime heating occurs. At times, transport from the southwest can also occur overnight at lower levels aloft due to the formation of a nocturnal jet. Strong southerly surface winds during the day bring in clean maritime air from the Atlantic Ocean, resulting in relatively low ozone levels along the coast. The maritime front may not penetrate very far inland, and therefore does not mitigate transported and local pollutants' contribution to inland exceedances.

Coastal-only Exceedances: Strong westerly surface winds transport dirty air across Long Island Sound from source regions to the west (e.g., New York and New Jersey). The relatively cool waters of Long Island Sound confine the pollutants in the shallow marine boundary layer. Afternoon heating over coastal land creates a localized sea breeze with a southerly component, resulting in ozone exceedances along the coast. Inland winds from the west carry cleaner air to inland areas and also prevent sea breeze penetration, sometimes contributing to the formation of a convergence zone that can further concentrate ozone along the coast.

Western Boundary-only Exceedances: Southerly maritime surface flow invades the eastern two-thirds of Connecticut, keeping ozone levels in that portion of the state low. The south-southwest urban winds out of New York City result in exceedances along Connecticut's western boundary. Winds aloft are often weak for this scenario.

State-wide Exceedances: This is the classical worst-case pattern, with flow at the surface in the Northeast up the Interstate-95 corridor, transport at mid-levels also from the southwest via

Figure 3. State-wide Ozone Exceedance Scenario

the low level jet and flow at upper levels from the west. All of these flows are from emission-rich upwind areas, serving to transport ozone precursors and previously formed ozone into Connecticut. A weak sea breeze may also develop, which would transport ozone pooling over Long Island Sound into the State.

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The magnitude of the May 25-26, 2016 ozone event over Connecticut would typically be caused by the State-wide Exceedances scenario (Figure 3); however, the necessary meteorological conditions were not present. In fact, the event started with winds originating from the northwest, which would typically result in low ozone levels in Connecticut. Therefore, the event did not fit any of the scenarios which cause widespread multiday ozone exceedance events in Connecticut.

2.2 Regional Emissions

The scenarios described above occur because winds transport ozone precursors, nitrogen oxides (NOx) and volatile organic compounds (VOC), from regional emission sources into Connecticut on sunny days which are conducive to ozone formation. When there is insufficient sunlight or insufficient emissions, ozone episodes do not occur.

The maps below show the location of regional NOx and VOC emissions. Note that winds from the northwest, as occurred as the event initiated, would travel over the cleanest areas of the region and could not typically have transported sufficient precursors from regional sources to instigate such a widespread multiday ozone event of the magnitude that occurred.

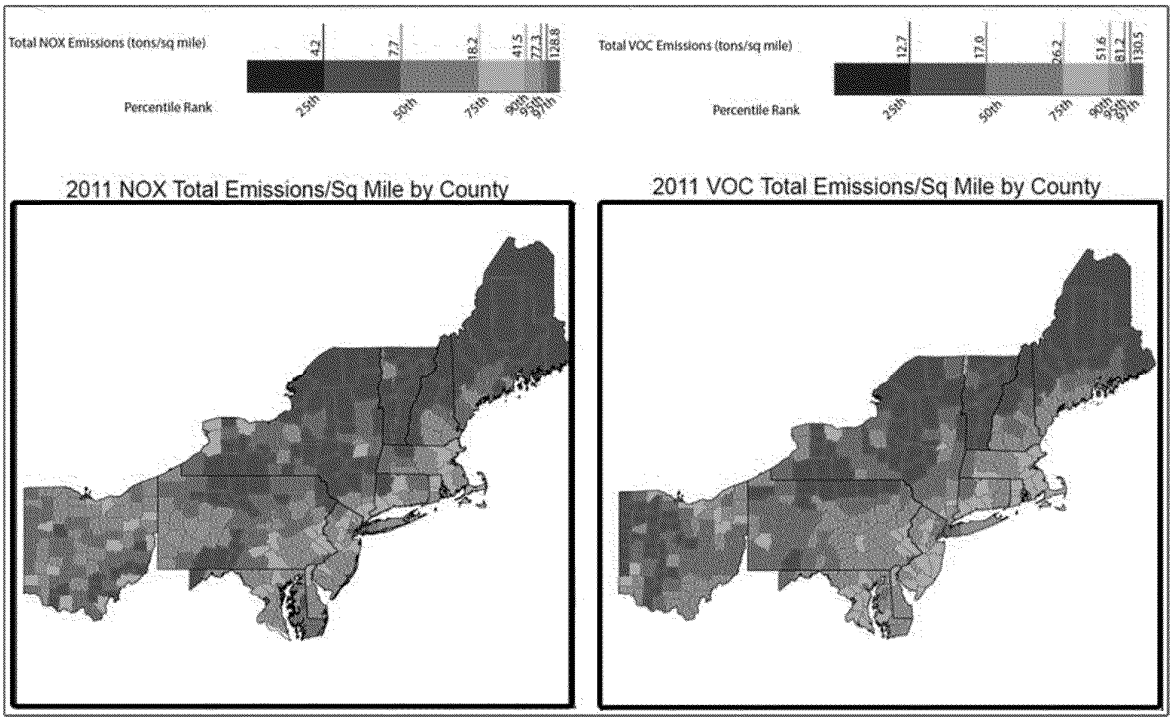

Figure 4. 2011 NEI County Percentile Map of (a) Total NOx Emissions per square mile and (b) Total VOC Emissions per square Mile

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2.3 CSAPR NOx Source Emissions

Power facilities, or electric generating units (EGUs), have traditionally played a major role during ozone events on the East Coast. EGUs are capable of producing a large amount of emissions over a short duration and generally emit at elevations conducive to transport. Therefore, during hot days many of the less frequently used high emitting EGUs come online to supply the high electric demand of air conditioning and refrigeration along with base load units operating at full capacity.

Recognizing the ability of these sources to affect cross state air pollution, EPA monitors the real-time emissions from these facilities and regulates them as under the Cross-State Air Pollution Rule (CSAPR). The following figures show the actual total daily NOx emissions from these CSAPR sources for our closest upwind States -- New York, New Jersey and Pennsylvania – for the 2016 ozone season. Plotted on the right hand axis, as yellow bars, are the number of Connecticut monitors that exceeded the 70 ppb NAAQS each day. Clearly, the May 25-26th ozone event had the most monitored daily exceedances of the summer, while peak NOx emissions from these facilities did not occur until later in the season.

Therefore, the exceedances of May 25 -26th cannot be attributed to EGUs operating on high electric demand days as is more typically the case later in the ozone season.

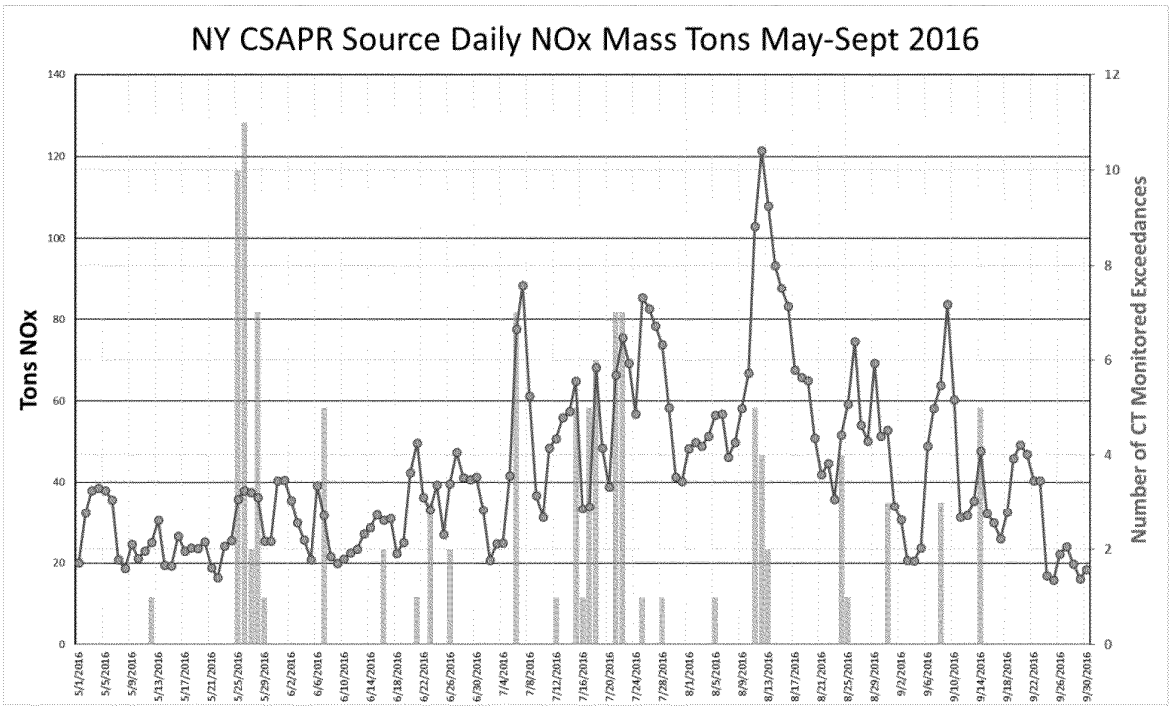

Figure 5. New York CSAPR Source 2016 Daily NOx Emissions

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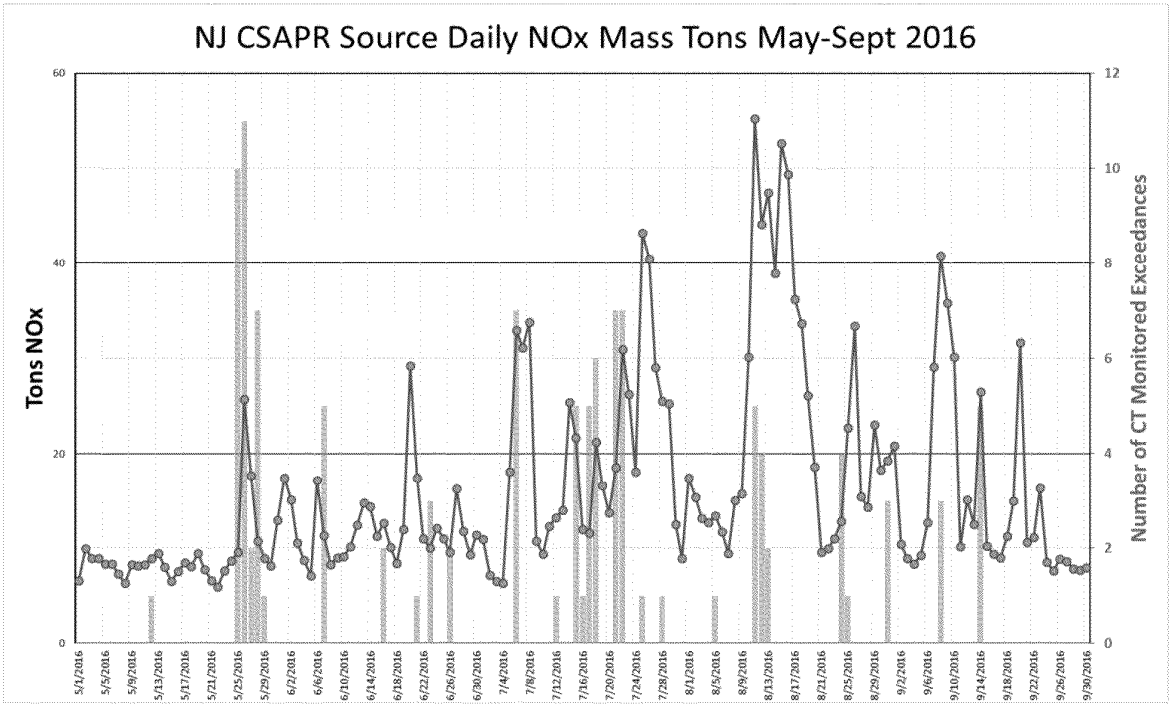

Figure 6. New Jersey CSAPR Source 2016 Daily NOx Emissions

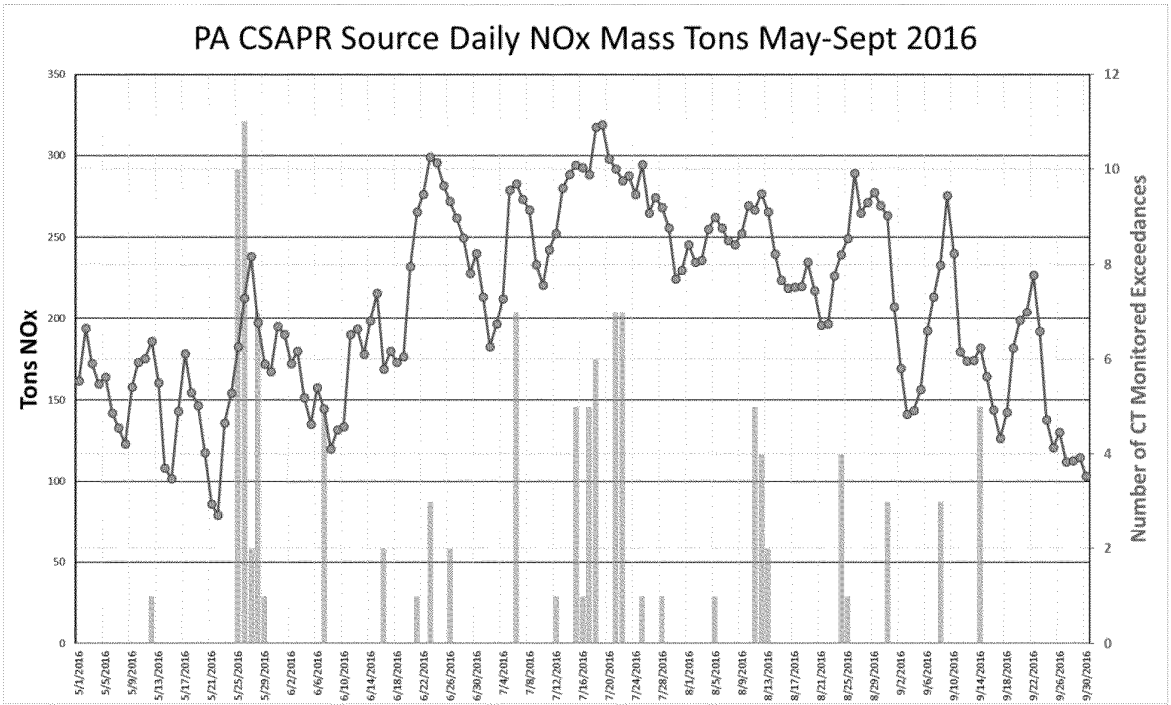

Figure 7. Pensylvania CSAPR Source 2016 Daily NOx Emissions

2.4 The Fort McMurray Fire

On May 1, 2016, a wildfire began southwest of Fort McMurray, Alberta, Canada. Within days, it swept through the community, destroying approximately 2,400 homes and buildings and forcing the largest wildfire evacuation in Albertan history. By May 11, The Guardian Newspaper was reporting on the wildfire that was now nicknamed "the beast" and stated that it was "… an extremely intense fire…so intense the soil is likely scorched, tree roots burned… [and] will likely smoulder and have hotspots for months mainly because of thick peat." [3]

Figure 8. Wildfire as it approaches Fort McMurray. This photo taken, Wednesday, May 4, 2016 shows the plume rising into the atmosphere forming pyro-cumulus clouds. (photo by Jeff McIntosh/CP).

Similarly, the Edmonton Journal was reporting that "firefighters started to realize the uniquely destructive nature of the Fort McMurray wildfire when they saw aspen poplar trees instantaneously and loudly explode into fire." The article continued the fire was so intense it was generating its own weather producing pyro cumulonimbus clouds and thunder and lightning storms.[4]

[3] Leahy, Stephen, *Canada Wildfire – what are the environmental impacts,* The Guardian, May 11, 2016.
[4] Staples, David, *Alberta battles The Beast, a fire that creates its own weather and causes green trees to explode*, Edmonton Journal, May 7, 2016.

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Additional news articles describe a massive plume of global proportions resulting from the Fort McMurray fire:

Wildfires in western Canada send haze to New England

PORTLAND, Maine (May 12, 2016)—

"If you thought the sky didn't seem quite as brilliantly blue on Thursday, you were right, and you can blame wildfires in western Canada.

Smoke continues to billow from fires in western Canada, fanned eastward by winds in the middle and upper atmosphere.

The smoke is just potent enough to cause the sky over much of New England to appear a bit hazy or "milky" in appearance.

Fort McMurray wildfire ash reaches all the way to Spain

By Wallis Snowdon, CBC News Posted: May 25, 2016 2:02 PM MT|

"*The massive plume of particulates from the fire would have travelled more than 12,000 metres into the atmosphere, before the haze was carried east along the jet stream.*

When that column started to build over a couple of those really key days, it got the smoke way, way up into the atmosphere and it basically gets stuck in the jet stream, Gray said.

The jet stream will grab it, and like a river it will carry it down and take it as far as the volume goes. It could circumnavigate the globe if there's enough of it.

...Before the plume travelled east across the Atlantic Ocean, Gray said, it also travelled south, hitting large swaths of the southern United States."

The fire, most likely the result of human activity[5], spread across approximately 590,000 hectares (1,500,000 acres) and became the costliest natural disaster in Canadian history[6] before it was declared to be under control on July 5, 2016.

[5] Canadian Broadcasting Corporation, *Someone likely sparked the Fort McMurray wildfire, but was it a crime? RCMP ask*. June 14, 2016

[6] Insurance Bureau of Canada, *Northern Alberta Wildfire Costliest Insured Natural Disaster in Canadian History – Estimate of insured losses:$3.58 billion*. July 7, 2016.

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2.5 Long Range Transport of Ozone and Precursors from Biomass Burning

Winds during the ozone event of May 2016 originated from the direction of the Fort McMurray fire. Wildfire smoke plumes contain gases including non-methane hydrocarbons (NMHCs), carbon monoxide (CO), nitrogen oxides (NOx), and aerosols, which are all important precursors to photochemical production of tropospheric ozone (O_3), and can travel thousands of kilometers. This may cause urban areas where forest fires seldom occur to see greater enrichment of ozone, as much as 25 ppb in the northeastern United States, than areas where wildfires more frequently occur.[7]

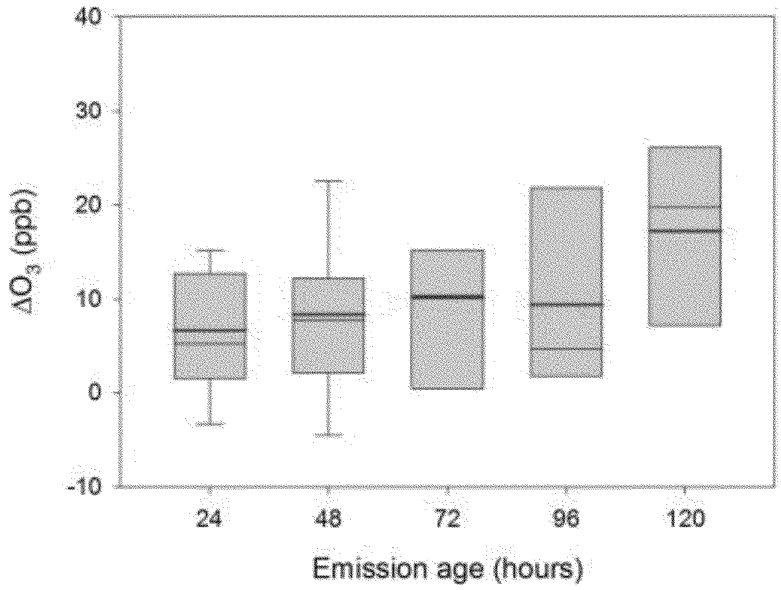

Figure 9. Ozone Enrichment by Age of Plume. This figure, taken from Putero et al[8] shows the results of their study on the influence of biomass burning on ozone concentrations. Ozone enhancement increases as the plume ages. Here we see increases on the order of 20 ppb from a five day old plume.

Many variables, such as type of fuel or forest burned, plume path and distance burned, affect the intensity of the fire and ability of a plume to enhance downwind ozone production. Emissions from boreal forests such as in the area of the Fort McMurray fire can be much higher than from typical forests in the U.S. due to the high available biomass (on the order of 100 tons per acre) that may be stored in the forest floor as lichens, moss, peat and duff.[9] The Fort McMurray fire occurred following an unusually hot dry spring season. Under these conditions the fire can burn and smolder deeper into the forest floor to add considerable emissions to the plume.

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[7] Brey, Steven J. and Emily V. Fischer, Smoke in the City: How Often and Where Does Smoke Impact Summertime Ozone in the United States?, Environmental Science and Technology, vol. 50, pp1288-1294, 2016.
[8] Putero, D. et. al., Influence of open vegetation fires on black carbon and ozone variability in the southern Himilayas, Environmental Pollution, vol 184, pp 597-604, 2014.
[9] Ottmar, Roger D. and Stephen P. Baker, Forest Floor Consumption and Smoke Characterization in Boreal Forested Fuelbed Types of Alaska, Final Report JFSP Project #03-1-3-08, May 25, 2007.

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Typically, NOx emissions react within a few days and are no longer available to participate in ozone reactions. However, at high latitudes cooler ambient temperatures are conducive to the sequestering of NOx emissions as peroxyacetyl nitrates (PAN), aerosols which can decompose back to NOx far downwind. Study of boreal wildfires indicate that as much as 40% of the NOx emitted from the fire can be converted to PAN and transported downwind for six to fifteen days before returning to NOx.[10]

Jaffe and Wigder[11] and others have confirmed that the maximum ozone production is often observed substantially downwind of the fire, after the smoke plumes have aged for several days. Dreesen et al (2016) have noted in their analysis of a June 2015 wildfire that at peak smoke concentrations in Maryland, wildfire-attributable Volatile Organic Compounds (VOCs) more than doubled, while non-NOx oxides of nitrogen (NOz) tripled, suggesting long range transport of NOx within the smoke plume. They also noted that ozone peaks a few days after the maximum smoke plume due to ultra violet (UV) light attenuation, lower temperatures, and non-optimal surface layer composition.

2.6 Fort McMurray Wildfire Emissions Impact on Connecticut using a Q/d Analysis

EPA guidance[12] recommends conducting a fire emissions – transport distance ration (Q/d) analysis as a rough assessment of the ability of a wildfire to cause increased ozone concentrations. The Q/d analysis is simply a comparison of the ratio of Q, the daily tons of VOC and NOx emitted from the fire, to d, the distance in kilometers from the fire to the point of concern. If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern.

EPA guidance indicates that a fire should have a Q/d in excess of 100 tons per day per kilometer (tpd/km) in order to be considered to have a clear causal impact on ozone. This method is intended to be a simple and conservative approach to establishing clear causality. Failure to meet the 100 ton per day per kilometer threshold does not preclude a finding clear causality. EPA developed this value based on limited analyses of four fires which occurred in 2011.

Estimate of Q

The emissions from the fire can be estimated using information from EPA's AP-42 Compilation of Air Emission Factors Section 13.1 Wildfires and Prescribed Burning. The equations given are as follows:

[10] Jaffe, Daniel A. and Nicole L. Wigder, Ozone production from wildfires: A critical review, Atmospheric Environment, 2012, vol 51, pp1-10.
[11] Jaffe, D.; Wigder, N. Ozone production from wildfires: A critical review. Atmos. Environ. 2012, 51, 1−10
[12] Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016

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$F_i = P_i * L$ (Equation 1)
$E_i = F_i * A$ (Equation 2)

F_i = emission factor (mass of pollutant/unit area of forest consumed)
P_i = yield for pollutant "i" (mass of pollutant/unit mass of forest fuel consumed)
= 12 kg/Mg (24 lb/ton) for total hydrocarbon (as CH_4)
= 2 kg/Mg (4 lb/ton) for nitrogen oxides (NO_x)
L = fuel loading consumed (mass of forest fuel/unit land area burned)
A = land area burned
E_i = total emissions of pollutant "i" (mass pollutant)

Combining equations 1 and 2, we have:

$E_i = P_i * L * A$

Pi is given above for total hydrocarbons and for nitrogen oxides. The fuel loading is given in AP-42 for different regions of the United States and ranges from 9 to 60 tons per acre. Conservatively, we will estimate a low end emission rate using 10 tons per acre which is associated with North Central US conifer forests. Note that our results could increase by a factor of 6 were we to expect the high end of emissions.

The Alberta government reported that by June 10, 2016 the fire ultimately covered 589,995 hectares (1,457,909 acres) with a perimeter of 996 kilometers (618 miles). For reference, the total land area of Rhode Island is approximately 270,000 hectares.[13] The chart below (Figure 10) indicates the total area covered by the fire as reported by the Alberta government[14]. During the week prior to the exceptional event in Connecticut the fire grew by approximately 60,000 hectares (148,263 acres).

Therefore, ignoring the smoldering of approximately 500,000 hectares we estimate the total hydrocarbon emissions from the week to be:

Ehc = 24 lbs of HC / ton of forest fuel consumed * 10 tons fuel / acre * 148,263 acres

Ehc = 35,583,120 pounds of HC

Ehc = 17,791 tons of HC emitted during the period from May 19 to May 24

Similarly for NOx:

Enox = 4 lbs of NOx / ton of forest fuel consumed * 10 tons fuel / acre * 148,263 acres

Enox = 5,930,520 pounds of NOx

[13] Any large area estimate can only be considered comprehensible if compared to the State of Rhode Island.
[14] https://www.alberta.ca/release.cfm?xID=41701E7ECBE35-AD48-5793-1642C499FF0DE4CF [Final Update 39: 2016 Wildfires (June 10 at 4:30 p.m.), Alberta Government]

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Enox = 2,965 tons of NOx emitted during the period from May 19 to May 24

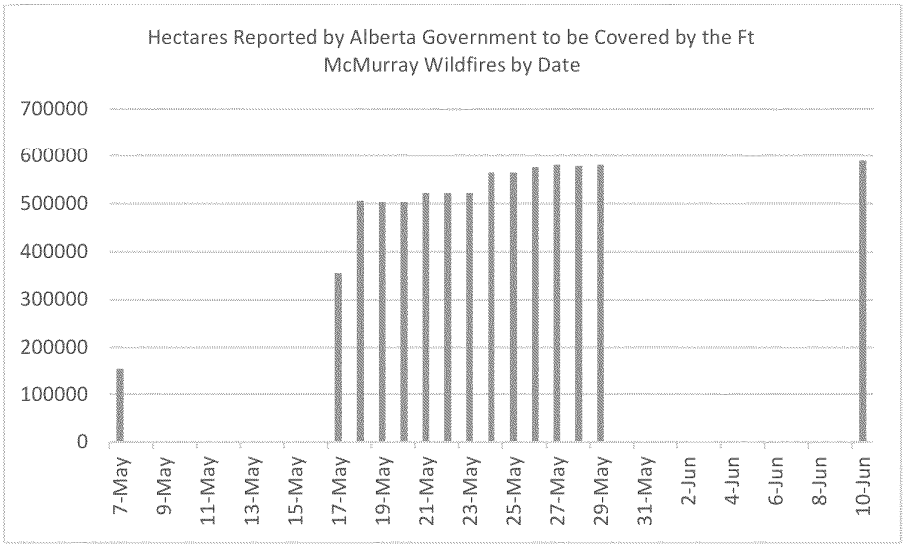

Figure 10. Chart of Hectares Burned. Reported by the Alberta Goverment from May 7-June 10, 2016.

Q is the total daily emission rate in tons per day of reactive hydrocarbons and nitrogen oxides. EPA recommends, in the exceptional events guidance, that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions become rHC = 0.6 * Ehc or 0.6 * 17,991 = 10,794 tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NOx emissions. Therefore the total rHC and NOx emissions over the period are 10794 + 2965, or 13,759 tons over the six days. On average this results in a daily emission rate, or Q, of 2293 tons per day.

Estimate of d

Based on the large distance, we will not present individual analyses for each monitor in Connecticut but estimate the distance from the Fort McMurray fire to the most distant point in Connecticut. We will therefore use a value of d of 3286 kilometers, the flight distance from Fort McMurray to Stonington, CT.

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Q/d Estimate

Using the values determined above, Q/d then becomes 2293 tpd divided by 3286 km or 0.69 tpd/km. This value is well below the EPA recommended level of 100 tpd/km indicating clear causality.

Taking a less conservative approach and using the maximum extent of the burn area over the life of the fire, the result would be a Q/d of 40.8 tpd/km. This is still sufficiently below the EPA recommended threshold for establishing clear causality. Recalling that a worst case fuel loading would increase our results by a factor of six, Q/d would in this case result in 240 tpd/km and would indicate clear causality. While this approach might be justified by the ongoing smoldering of the peat, the intensity of the Fort McMurray fire, variability in the burn rate and other factors, it is difficult to justify without further details that may only be obtained through estimates which introduce their own error.

Taking a slightly different approach we consider the basis for the EPA guidance and look at emissions from one of the four fires EPA relied on in developing their guidance. Appendix A2 of the EPA guidance indicates that EPA based their conclusions on 12 km grid CMAQ modeling of four 2011 multiday fires: Wallow, Waterhole, Big Hill and Flint Hills. Emissions from the fires were based on a program called SMARTFIRE. Using information available on the Wallow Fire, we can approximate the emissions that might be calculated for the Fort McMurray fire.

The Wallow Fire burned in eastern Arizona and western New Mexico from May 29, 2011 through July 8, 2011 and burned 841 square miles (538,240 acres) by June 26th. The maximum daily emissions from that fire were reported as approximately 15,000 tons of rVOC and 1,000 tons of NOx.[15] If we scale this fire up by a factor of three to approximate the acreage burned in the Fort McMurray fire, then we have daily emissions as high as 45,000 tons for rVOC and 3,000 tons for NOx. These emissions produce a Q of 48,000 tpd and Q/d becomes 14.6 – still well below EPA expectation for causality.

Noting the wide variability in emissions estimates from different approaches, and as the Q/d method does not generally satisfy the expectation of a clear causal impact, we present other evidence demonstrating that the plume from the Fort McMurray fire caused elevated ozone levels in Connecticut.

[15] Simulating Fire Event Impacts on Regional O3 and PM2.5 and Looking Forward Toward Evaluation, Kirk Baker, EPA October 5, 2015 and Using SOAS and related field study data for scientific and regulatory modeling, Kirk Baker, EPA, undated; both are slide presentations.

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3. SATELLITE PHOTOS, PLUME ANALYSIS AND W EBCAMS

3.1 Satellite Images

During the month of May, a large smoke plume, fed by the Fort McMurray wildfire, meandered through southern Canada and the Upper Great Lakes to New England. From about May 18- May 24th, surface high pressure settles over the upper Mid-Western United States, trapping residual pollutants from the wildfire in the lower boundary layer of the atmosphere. Coincident with this, wildfire plumes from extensive agricultural fires in the Yucatan Peninsula in Mexico were also observed on the satellite images, but we do not believe that these had a major influence on the ozone observed by the Connecticut monitors.

Figure 11 shows the presence of the smoke plume over the Upper Midwest states on May 18th and May 19th. A satellite animation of this plume that shows the movement of the plume across the upper Midwest into upstate New York and then southeast into New England can be viewed on our web site[16]. The presence of a surface high pressure center allowed pollutants to become trapped near the surface while conditions became conducive for ozone formation on May 23-24th. Figure 12 shows the 3km aerosol optical depth (AOD) image overlaid with the Visible Infrared Imaging Radiometer Suite (VIIRS) satellite image on May 24-25th, 2016. The AOD is indicative of particulate matter transported with the smoke plume over the Northeast States.

Figure 13 shows the progression of the smoke plumes over North America, as analyzed by the Hazard Mapping System (HMS) staff at NOAA, using the satellite images. This series of maps shows the movement of the Fort McMurray smoke plume as it tracks over the Connecticut region on May 25-26, 2016. Figure 13d shows the plume over Michigan, where every monitor in Lower Michigan exceeded the 8-hour ozone NAAQS of 70 ppb.

[16] http://www.ct.gov/deep/lib/deep/air/ozone/2016_exceptional_event_request/fort_mcmurray_2016.wmv

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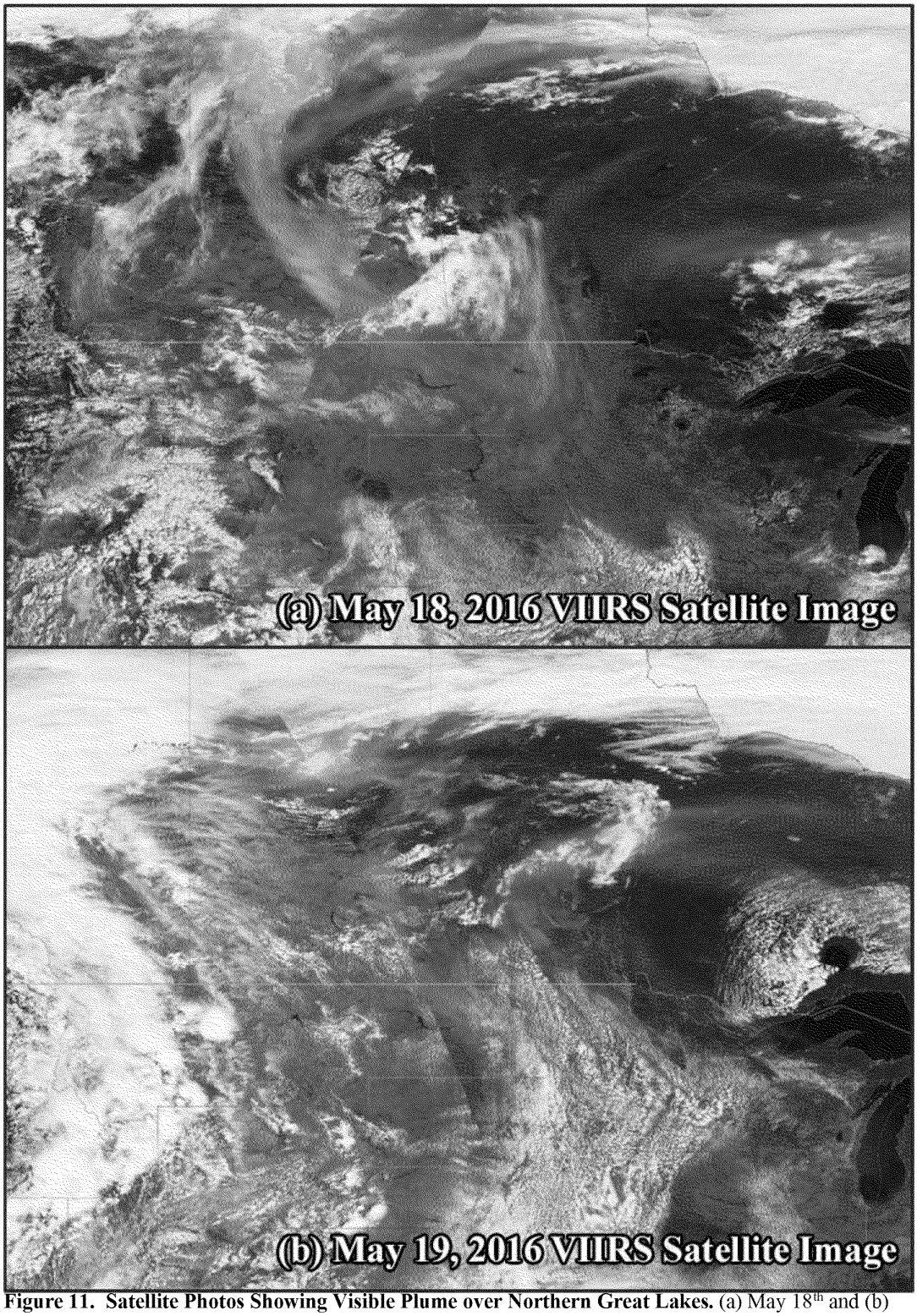

Figure 11. Satellite Photos Showing Visible Plume over Northern Great Lakes. (a) May 18th and (b) May 19th, 2016

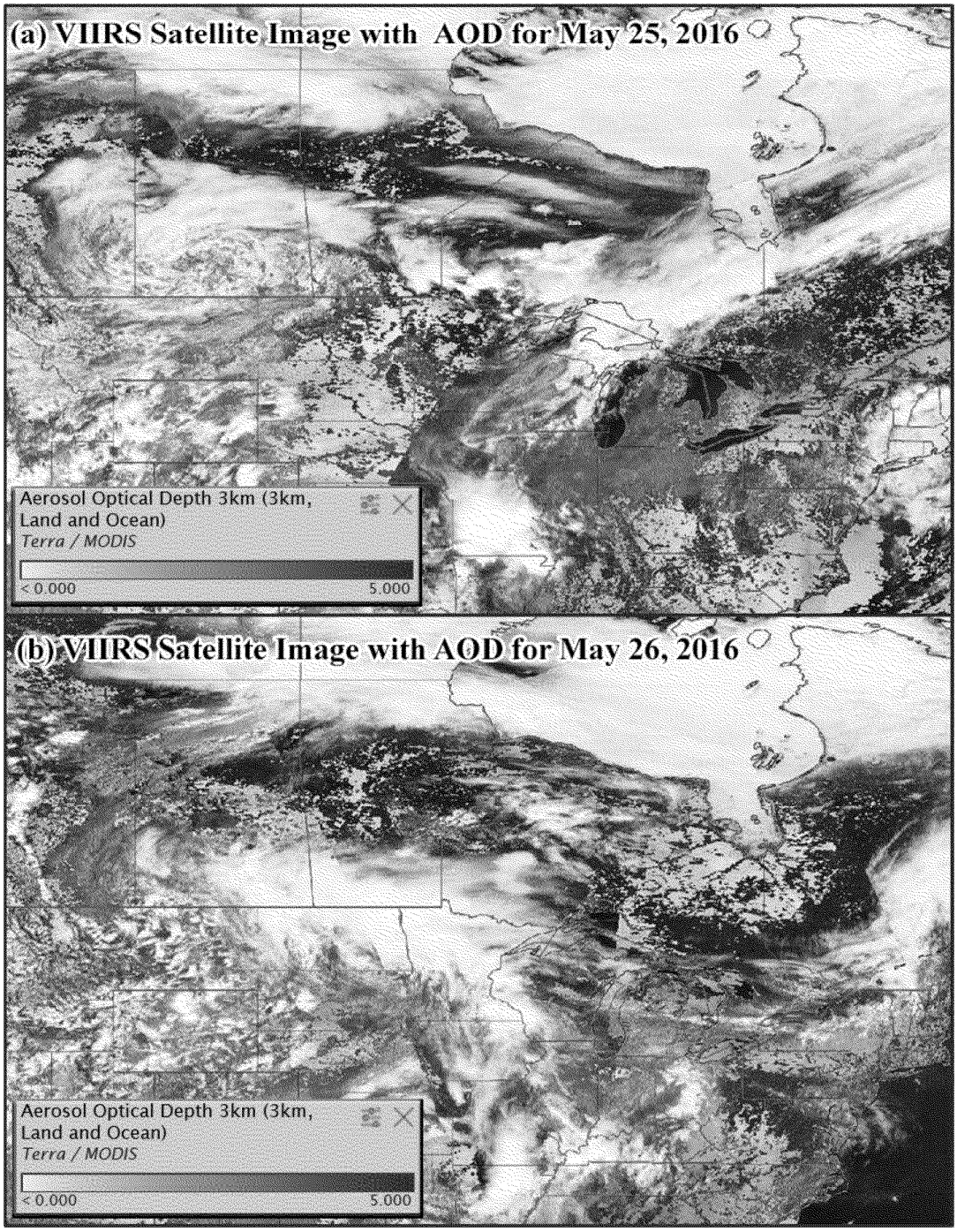

Figure 12. VIIRS Satellite Images. (a)May 25th and (b) May 26th, 2016 showing the Analyzed Aerosol Optical Depth (AOD) Associated with the Smoke Plume.

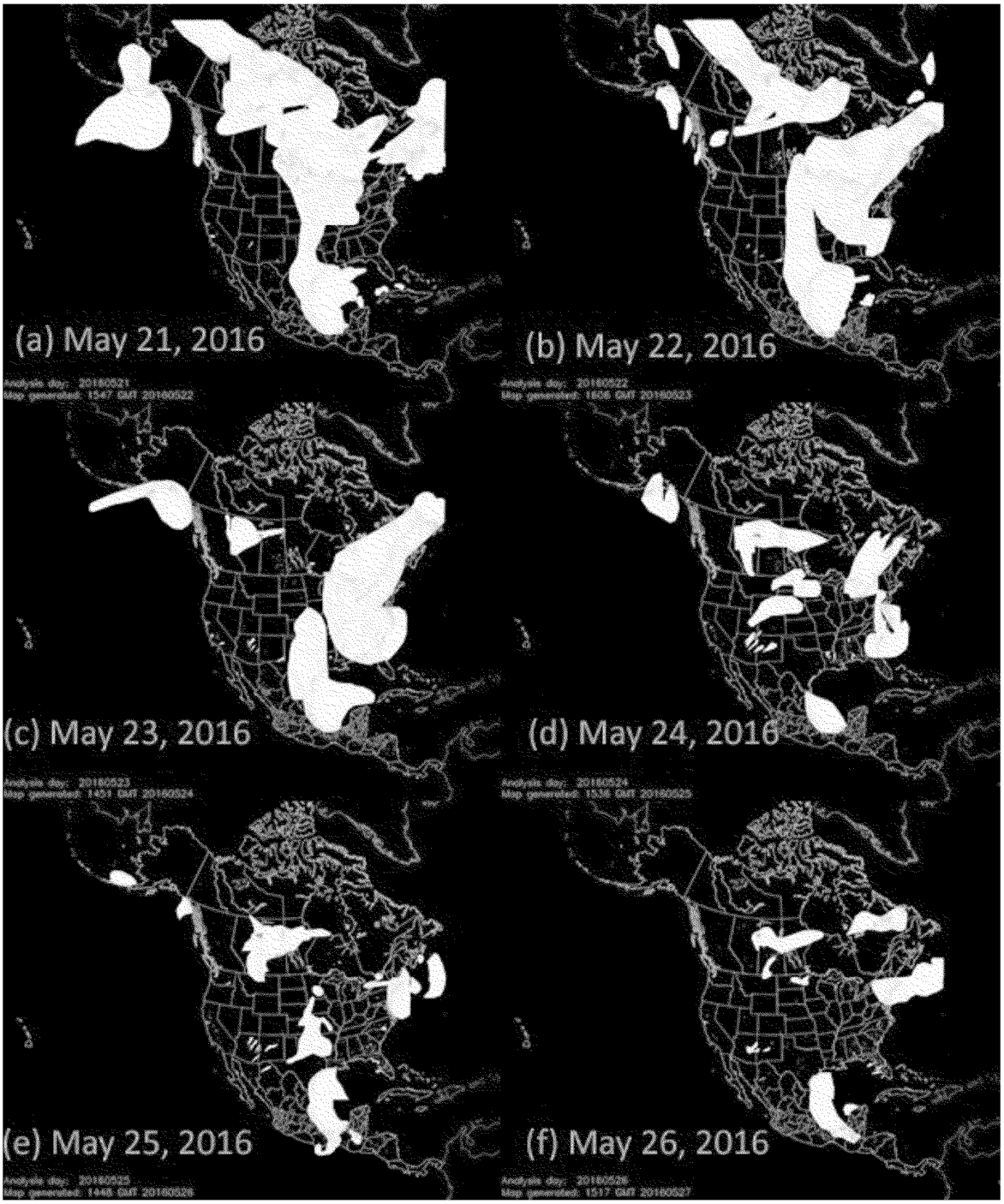

Figure 13. HMS Smoke Analysis from May 21-26(a-f), 2016.

3.2 Satellite Observed Carbon Monoxide Plumes

Further evidence of smoke plumes travelling in to Connecticut can be found in the satellite detection of carbon monoxide (CO), which is a by-product of combustion. The Fort McMurray plume can be seen very distinctly in Figure 14, as darker red pixels, as it meanders across eastern North America. The plume disperses over the Great Lakes by May 19-20 and a visible smoke plume was seen over Connecticut on May 20th, but did not reach the ground.

Figure 15 shows the CO plume dispersing over the Midwestern States and then moving east into Connecticut. The May 20th satellite image in Figure 16 is consistent with the CO plume location over Connecticut. Figure 17 shows a plot of ozone at Westport vs. PM2.5 from our Bridgeport monitor. These sites are about 14 kilometers from each other and one can distinctly observe when the PM2.5 levels rose dramatically on May 25th, with the onset of the ozone episode. Prior to this on May 20th, both PM2.5 and ozone levels remained relatively low, despite the presence of the smoke plume aloft. Click link to view an animation[17] of the mapped twice/day CO concentrations for May 2016 that shows the Fort McMurray fire erupting on May 4th and a dense plume crossing Connecticut on May 20th and the plume settling over the Great Lakes On May 23-24th.

[17] http://www.ct.gov/deep/lib/deep/air/ozone/2016_exceptional_event_request/may_co_animation.gif

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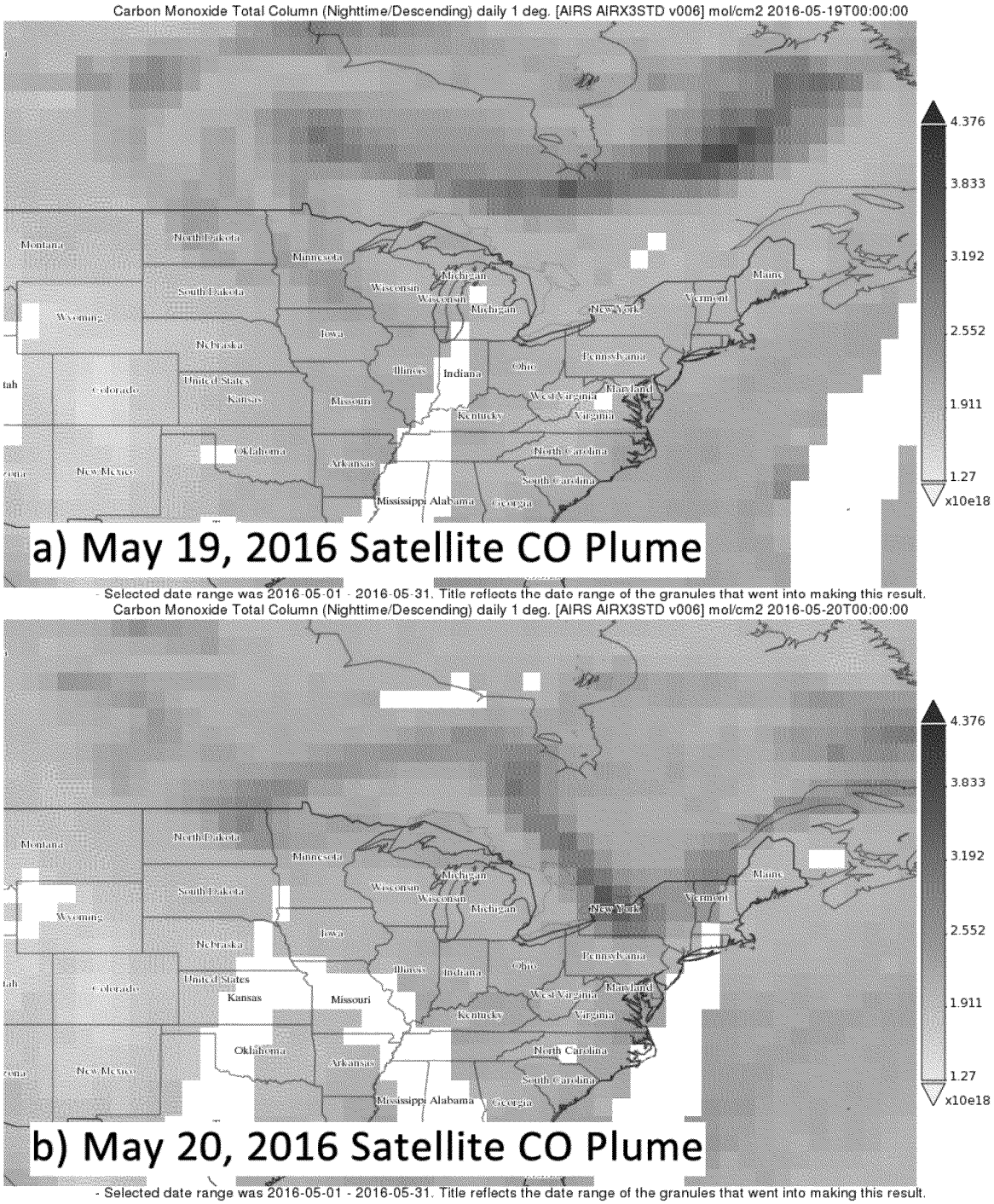

Figure 14. Satellite CO Plume from May 19 (a) and May 20 (b) , 2016. The plume meanders across southern Canada into the U.S. Midwest and across Connecticut.

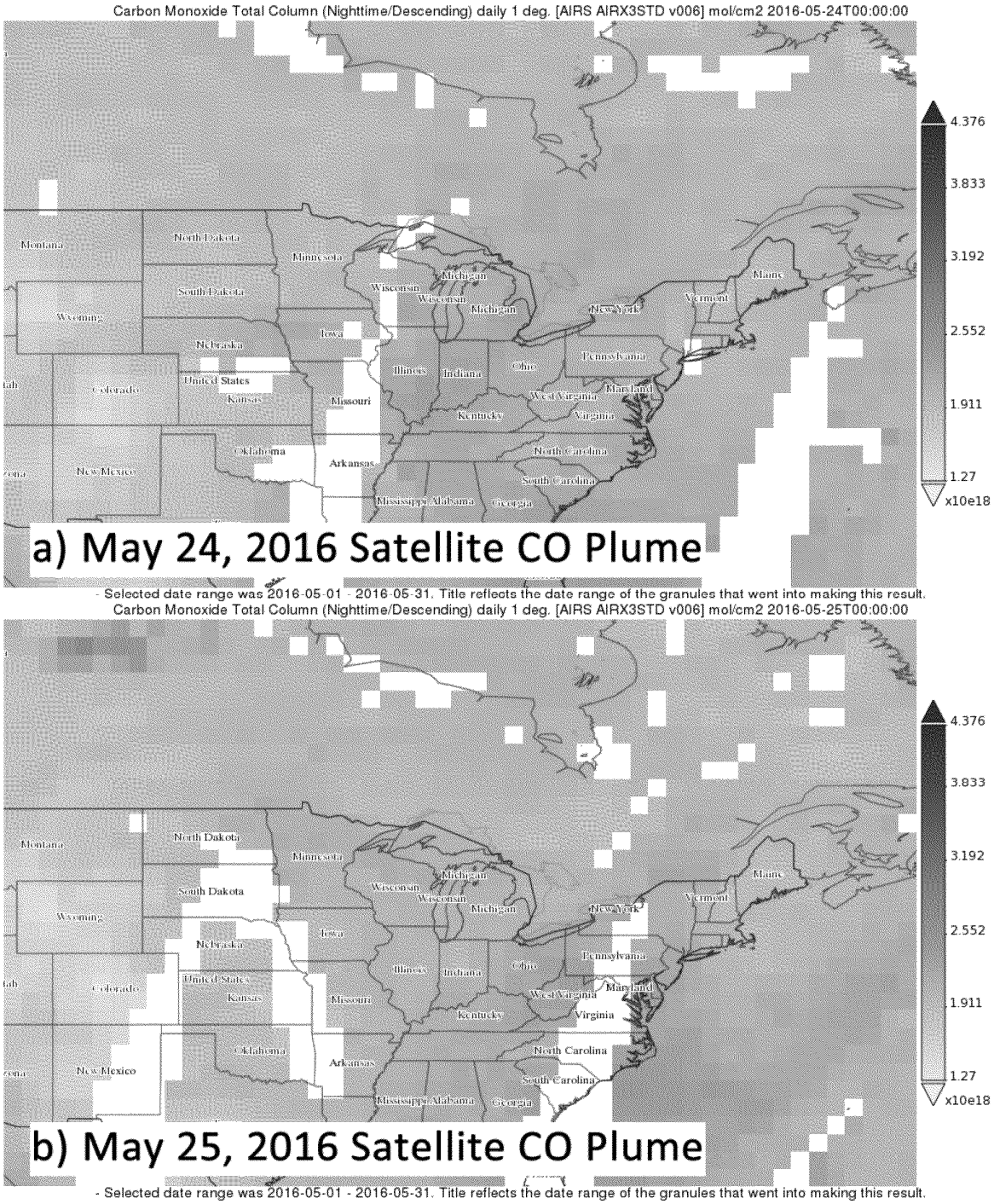

Figure 15. Satellite CO Plume from May 24 (a) and May 25 (b) , 2016. The elevated CO plume settles over the Midwest States and moves east into Connecticut.

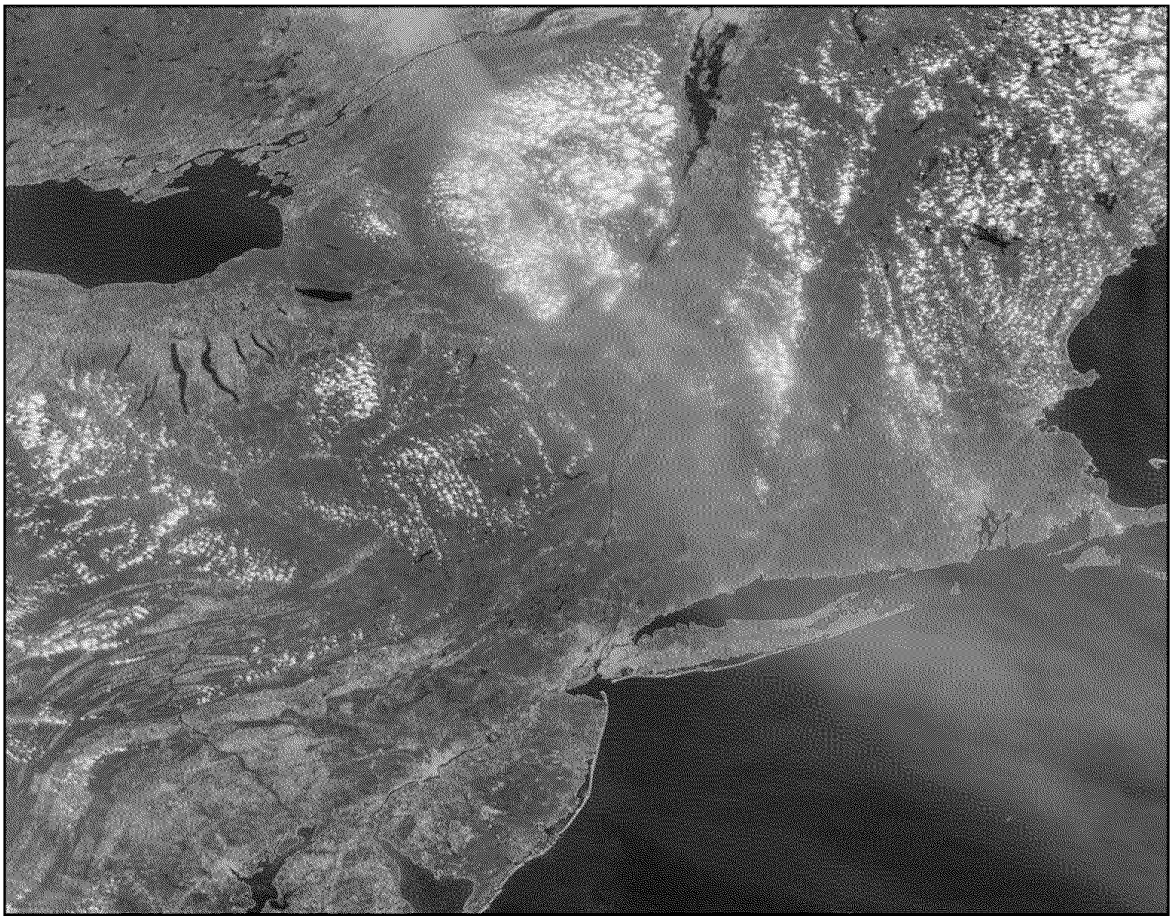

Figure 16. May 20, 2016 VIIRS Satellite Images: Visible on left; AOD on right

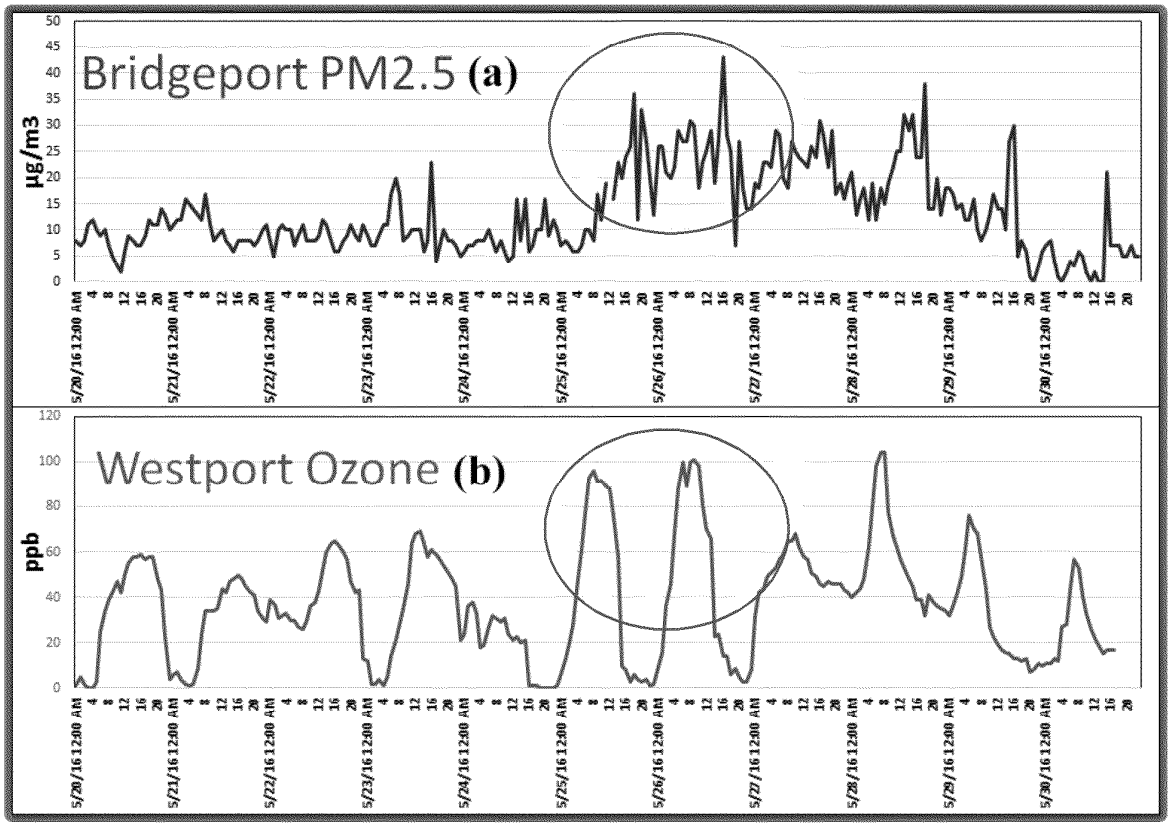

Figure 17. May 20-30, 2016 plots of (a) Bridgeport CT PM2.5 and (b) Westport Ozone Hourly Concentrations. The ozone peaks at Westport on May 25-26 coincide with the PM2.5 peaks at the Bridgeport monitor.

3.3 Webcams

Figure 18(a-d) shows webcam images from our Cornwall CT monitoring site. These show that haze from the smoke is not visible on May 24th (figure 18a) but can be seen increasing on May 25th (18b,c) and continues on May 26th (18d).

Figure 19(a-d) shows images from our Talcott Mountain webcam pointing east toward Hartford. Showing a similar sequence of smoke progression as Cornwall, May 24th (Figure 19a) shows a clean air mass with good visibility while the smoke obscures the sky on May 25-26th (Figure 19b,c,d).

Figure 20 shows images from the Newark New Jersey HazeCam[18] showing the progression of smoke over the May 24-27 period. An animation of these images is available from our web site[19].

The visible satellite photographs over Connecticut on May 25th (Figure 21a) and May 26th (Figure 21b) confirm evidence of a smoke plume.

[18] http://www.hazecam.net/camsite.aspx?site=newark
[19] http://www.ct.gov/deep/lib/deep/air/ozone/2016_exceptional_event_request/newark_hazecam_animation.gif

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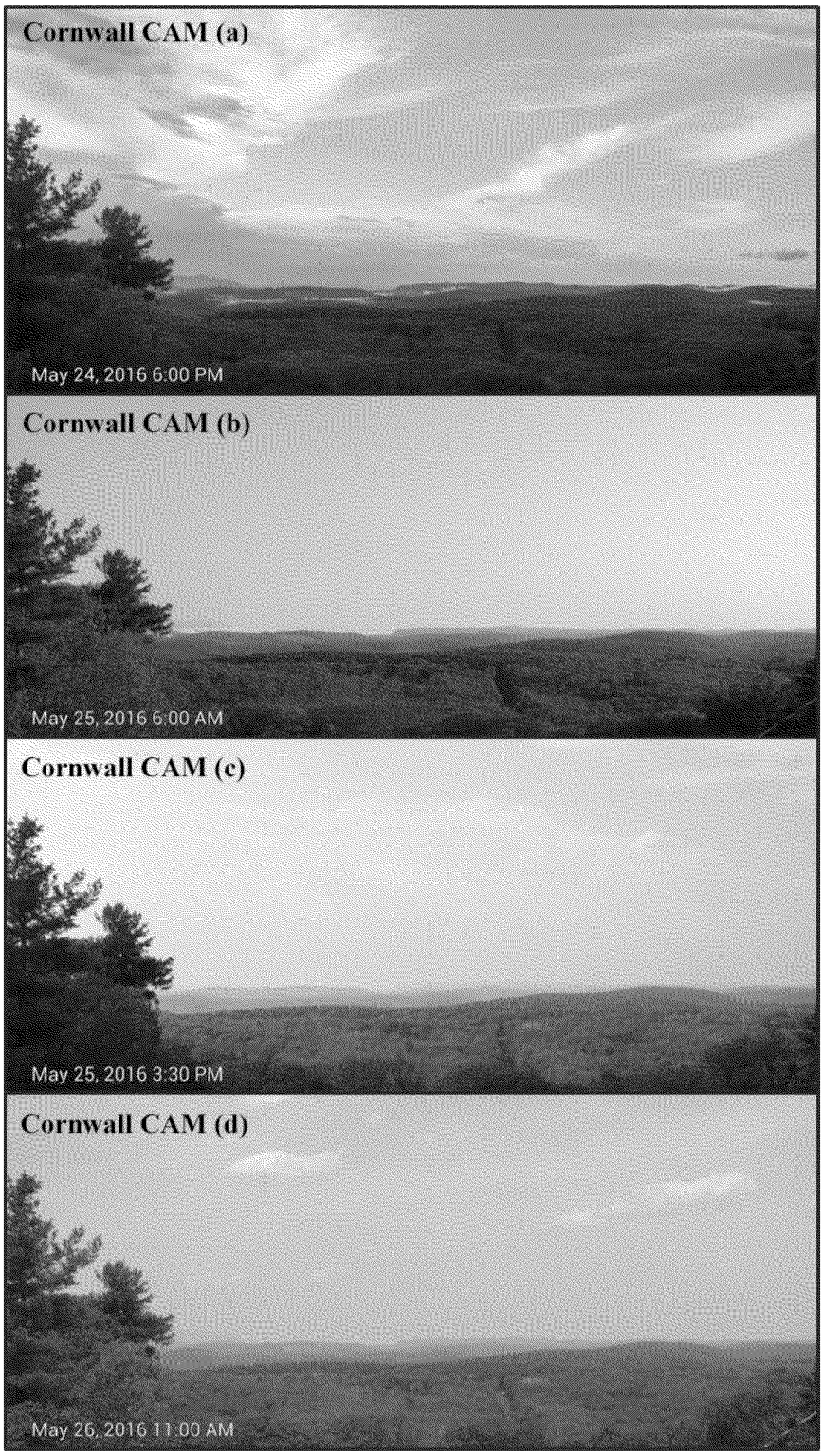

Figure 18. Cornwall Connecticut Webcam. (a)May 24-6:00pm, (b)May 25-6:00am), (c)May 25- 3:30pm and (d)May 26-11:00am, 2016.

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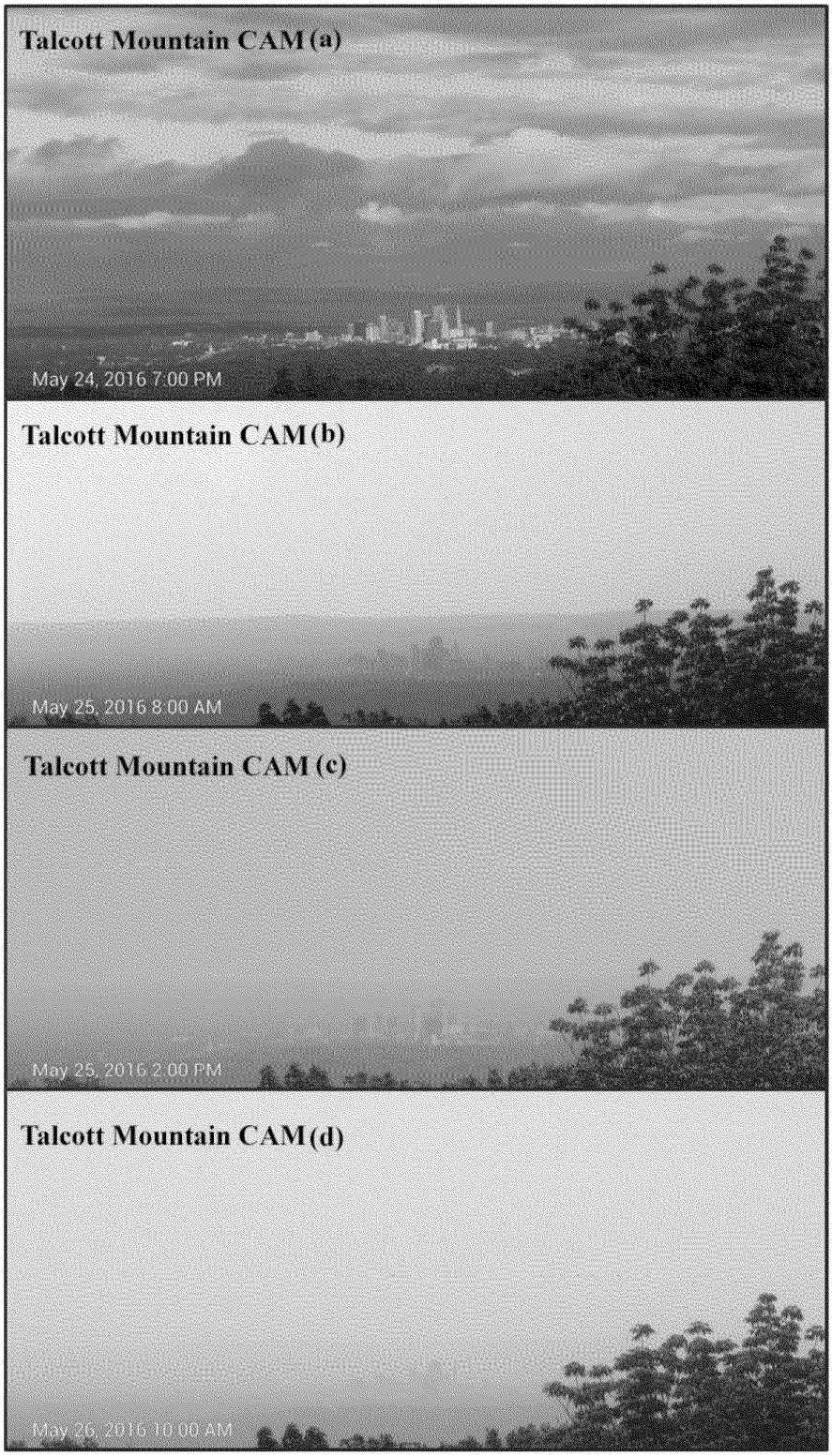

Figure 19. Talcott Mountain Connecticut Webcam. (a)May 24-7:00pm, (b)May 25-8:00am), (c)May 25- 2:00pm and (d)May 26-10:00am, 2016.

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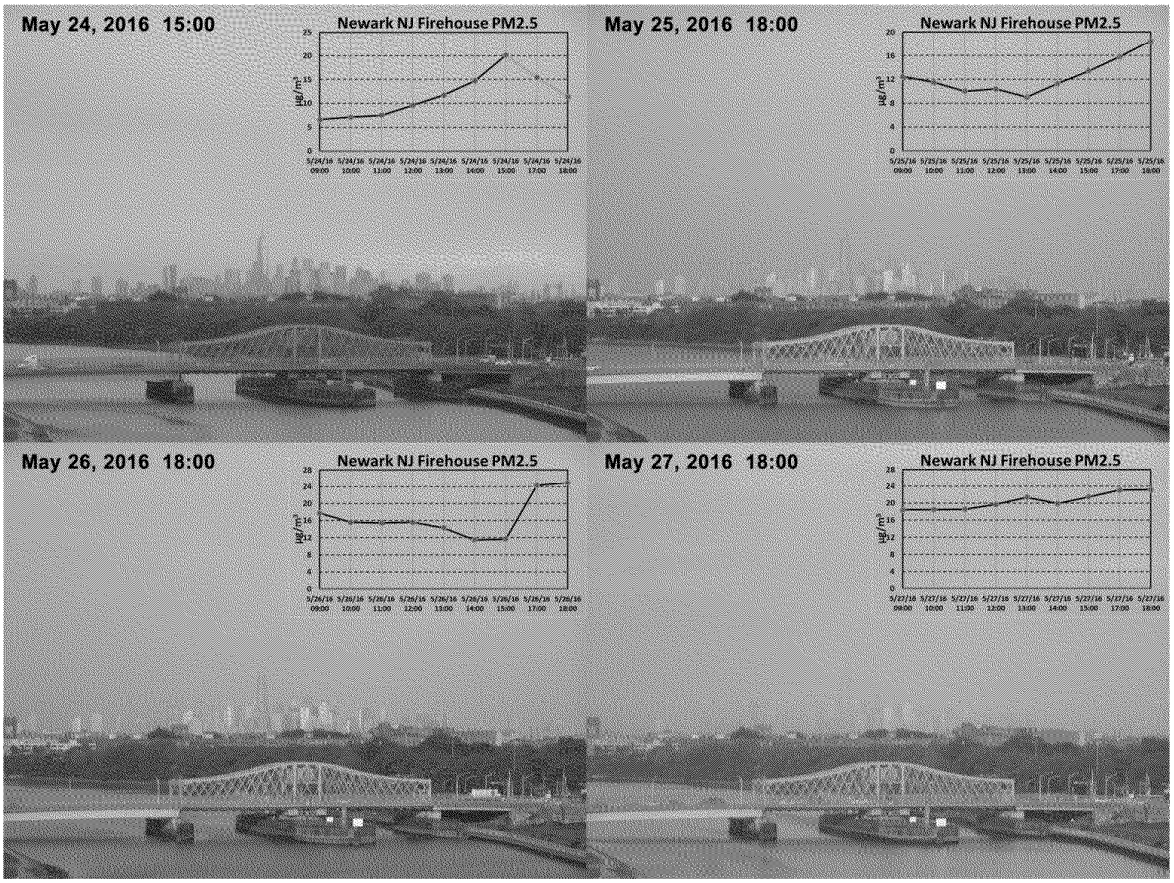

Figure 20. Haze Cam image looking from Newark, NJ to New York City. Images from May 24-27, 2016 with inset of hourly PM2.5 concentration plots of each day from the Newark Firehouse monitor.

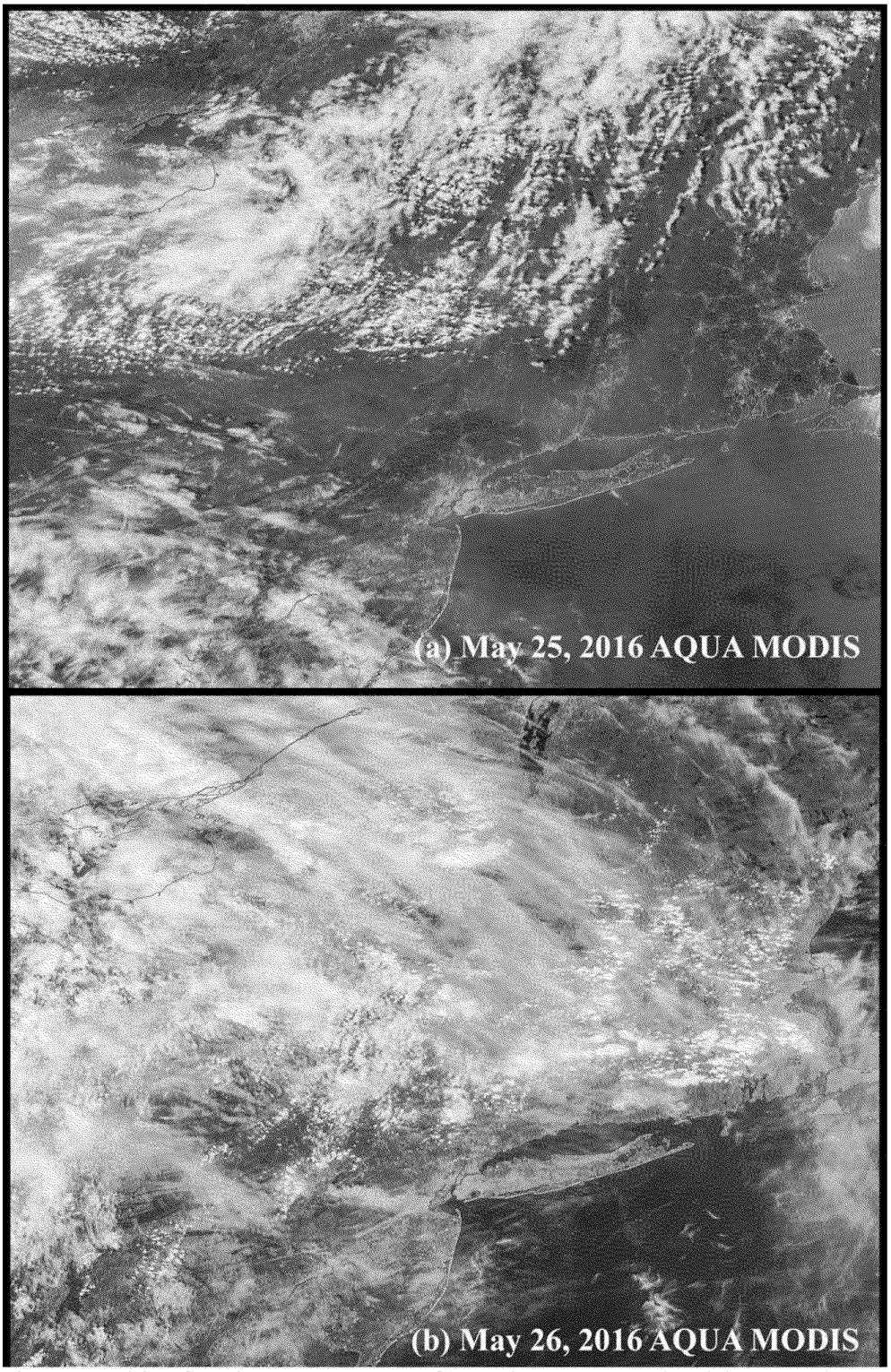

Figure 21. Visible Satellite Photograph over Connecticut. (a) May 25th and (b) May 26th, 2016, showing visible smoke plume.

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4. MONITORING DATA

4.1 Monitoring Network

There are currently fourteen air monitoring stations operating in Connecticut's state-wide network, including two National Core (NCore) multi-pollutant sites: Criscuolo Park in New Haven, and Mohawk Mountain in Cornwall. In addition, EPA operates an ozone site in Abington, in the town of Pomfret, as part of the Clean Air Status and Trends Network (CASTNET). Table 4 provides a summary of pollutant and meteorological parameters currently monitored in the network.

The DEEP air monitoring network meets the minimum monitoring requirements for criteria pollutants as put forth in Title 40 Part 58 of the Code of Federal Regulations (CFR), Appendix D. More detailed descriptions of the monitoring network are provided in the Connecticut 2016 Annual Air Monitoring Network Plan and the Connecticut 2015 Air Monitoring Network Assessment.

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Table 4. List of Connecticut Ambient Air Monitoring Sites and Parameters. Shaded rows indicate the monitors being requested for exclusion as a result of the Fort McMurray wildfire.

Town	Site	PM2.5 (FRM)	PM2.5 (FRM, Collocated)	PM2.5 (Continuous - FEM)	PM10/PM-Coarse (FRM)	PM10/PM-Coarse (FRM, Collocated)	PM10/PM-Coarse (Continuous)	PM Speciation (CSN)	PM Speciation (IMPROVE)	PM2.5 Carbon (BC/UVC, Continuous)	Ozone	SO2	CO	Direct NO_2	NO/NOy	Traffic Count	Wind Speed	Wind Direction	Temperature	Dew Point / Rel. Humidity	Barometric Pressure	Solar Radiation	Mixing Height
Bridgeport	Roosevelt School		1/6†	X	1/6							X	X						X				
Cornwall	**Mohawk Mountain**	**1/3***		**X**			**X**		**1/3**	**X**	**X**	**X**	**X**		**X**		**X**	**X**	**X**	**X**	**X**		
Danbury	Western Connecticut State University	1/6		X						X	X						X	X	X		X		
East Hartford	**McAuliffe Park**	**1/6**		**X**	**1/6**					**X**	**X**	**X**	**X**	**X**			**X**	**X**	**X**	**X**	**X**	**X**	
Greenwich	Point Park										X						X	X	X				
Groton	Fort Griswold	1/6		X							X								X				
Hartford	Huntley Place	1/3		X			X			X			X	X		X	X	X	X		X		
Madison	Hammonasset State Park										X						X	X	X				
Middletown	Connecticut Valley Hospital										X						X	X	X				
New Haven	Criscuolo Park	1/3	1/6	X	1/3	1/6	X	1/3		X	X	X	X	X	X		X	X	X	X	X	X	X
Pomfret	**Abington (EPA)**										**X**												
Stafford	Shenipsit State Forest										X						X	X	X				
Stratford	Stratford Lighthouse										X								X				
Waterbury	Meadow & Bank Street	1/6		X													X	X	X				
Westport	**Sherwood Island State Park**										**X**						**X**	**X**	**X**				

*1 in 3 day sampling schedule †1 in 6 day sampling schedule

Ozone is monitored throughout the ozone season in Connecticut at the twelve sites shown in Figure 22. As of 2017, the ozone monitoring season is March 1 through September 30; previously it was April 1 through September 30. Cornwall has historically measured ozone throughout the year, and as of late 2016 two more sites, East Hartford and New Haven, also began monitoring throughout the year.

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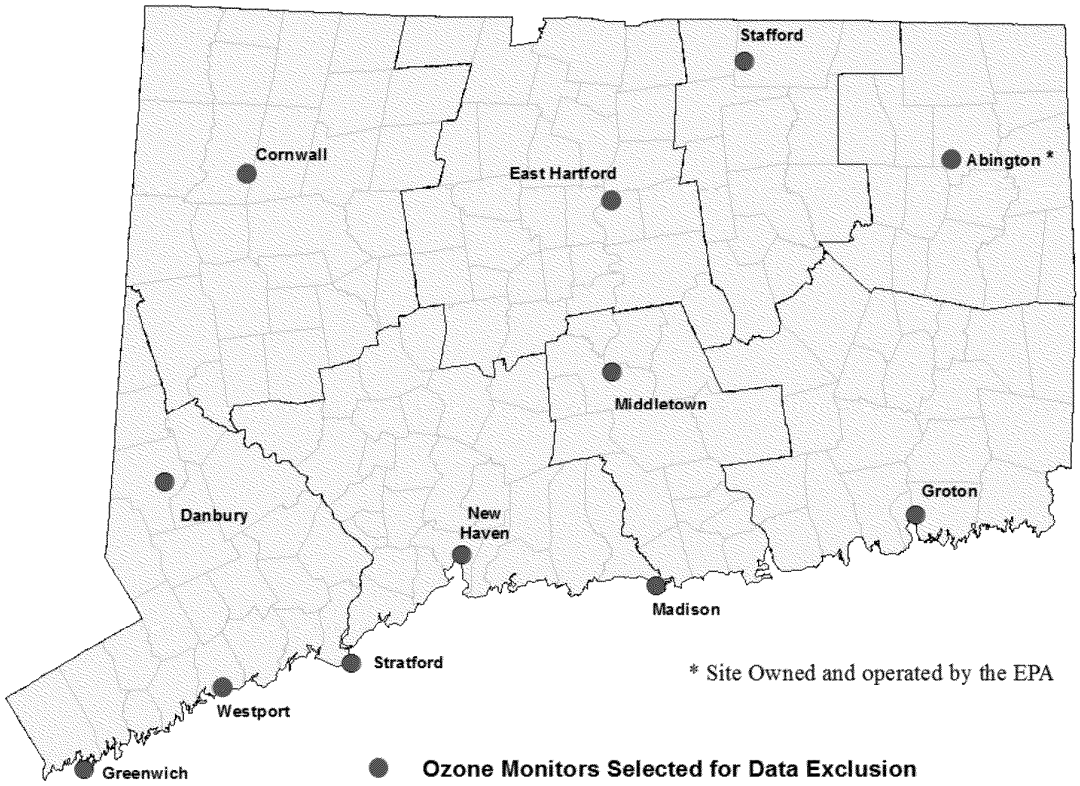

Figure 22. Connecticut Ozone Monitors. Ozone Monitors Selected for Data Exclusion are Highlighted in Red.

Site Descriptions

This exceptional event demonstration is focused on the four monitoring sites described below that were selected for data exclusion. These are: Westport (Sherwood Island State Park), Cornwall (Mohawk Mountain), East Hartford (McAuliffe Park) and Pomfret (Abington).

To help characterize the sites, ozone wind roses were constructed for the period of April 1, 2012 through September 30, 2016. The Cornwall measured ozone year-round, while the other three sites were operating from April 1- September 30th consistently during the five year period. These ozone wind roses are constructed from matching hourly averaged wind vector direction vectors and the hourly monitored ozone concentrations (ppb). Hours with average winds speeds less than 0.25 m/s or with missing ozone data were not plotted. Since the Abington monitoring site is not operated by CT DEEP and does not have wind data, we used wind data from our Mansfield site, which is located about 14 miles to the southwest of Abington. These ozone wind roses show the prevailing wind directions divided into 16 sectors around the compass with due

north at the top. The longer 'petals' of the rose represent sectors where the wind direction is more prominent. Overlaid on these petals are color bars representing specific ranges of ozone concentrations for each wind direction sector. The unique surrounding geography of each site will be reflected in the surface wind patterns. Therefore, the five year wind roses will appear much different for each site and only limited conclusions can be obtained in relation to ozone concentrations.

Pomfret (Abington): AQS ID 09-015-9991; Lat: 41.84046°, Lon: -72.010368°.
The Abington site is a regional-scale site located in a rural/agricultural area in northeast Connecticut in the town of Pomfret. This site is operated by the National Park Service under the direction of EPA as part of their Clean Air Status and Trends Network (CASTNET). It is located on a hilltop approximately 2.3 km south of State Route (SR) 44 and 0.6 km east of SR 97. The site includes a portable shed located in the center of an agricultural field that is surrounded by forest and sits at an elevation of 683 feet and generally has the lowest monitored ozone of all the sites. The wind data was obtained from our nearby Mansfield site (250 feet elevation), which is situated in a shallow valley that is oriented west to east. Because of this, the dominant wind direction is from the west-northwest to northwest (Figure 23). The highest ozone concentrations originate from the south-southwest wind direction.

Cornwall (Mohawk Mountain): AQS ID: 09-005-0005; Lat: 41.82140°, Lon: -73.29733°.
The Mohawk Mountain site is a regional-scale site located in northwestern Connecticut in the town of Cornwall. The site is located at the summit of Mohawk Mountain with an elevation of 505 m (1656 ft), and is approximately 17 km to the east of the New York border and 25 km to the south of the Massachusetts border. Figure 24 shows the dominant wind direction from the north-northwest, which includes the winter months. The highest ozone concentrations of 70-85 ppb (magenta color bar) are shown to occur when the wind is blowing from the south and south-southwest, which is to be expected when there is transport from the I-95 corridor and New York City area. Moderate levels of ozone (55-70 ppb) are also shown to occur in the northwest quadrant, but are most prevalent from the southwest quadrant. The dominant direction for good air quality (<55 ppb) occurs when the wind blows from the north-northwest.

East Hartford (McAuliffe Park): AQS ID: 09-003-1003; Lat: 42.78471°; Lon: -72.63158°.
The McAuliffe Park site is neighborhood-scale site located in central Connecticut in the town of East Hartford. The site is located approximately 120 m to the east of Rte 5, 2.0 km to the east of I-91 and 2.5 km to the south of I-291. This site is located 3.7 km to the northeast of the city of Hartford. Residential neighborhoods are located in all directions from this site. Since the East Hartford site is located in the Connecticut River Valley and the valley is oriented north-south, the dominant wind direction reflects this in Figure 25. Since this ozone wind rose does not cover the winter months, winds from the south become more dominant. The highest ozone concentrations represented in the magenta and brown color bars are plainly visible in the south and south-southwest wind directions. The lowest ozone concentrations occur when the wind blows from the north.

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Westport (Sherwood Island State Park). AQS ID: 09-001-9003; Lat: 41.11822°; Lon: -73.33681°.

The Westport Sherwood Island State Park site is a regional-scale site located in southwestern Connecticut. This is a coastal site that is approximately 0.5 km to the south of I-95 on the Long Island Sound. This site is ideally situated to measure impacts from transported pollution from New York City and the I-95 corridor. Because Westport is coastal site, its winds are often subject to a daily sea breeze that develops during the summer. A prominent spike of high ozone can be seen from the south-southwest wind direction (Figure 26), which is indicative of transport from the I-95 corridor and New York City. Even when the dominant wind is from the northwest over inland areas of the State, the surface wind will turn southwest along the coast. This fact makes it more difficult to correlate surface winds with ozone transport as it is also observed that the highest proportion of good air quality winds (<55 ppb) also come when surface winds originate from the southwest for this site.

Generally, the worst ozone at each site is monitored when the surface winds are from the south-southwest while the winds from the northwest, the dominant wind direction during the May 2016 Fort McMurray wildfire event, are cleaner.

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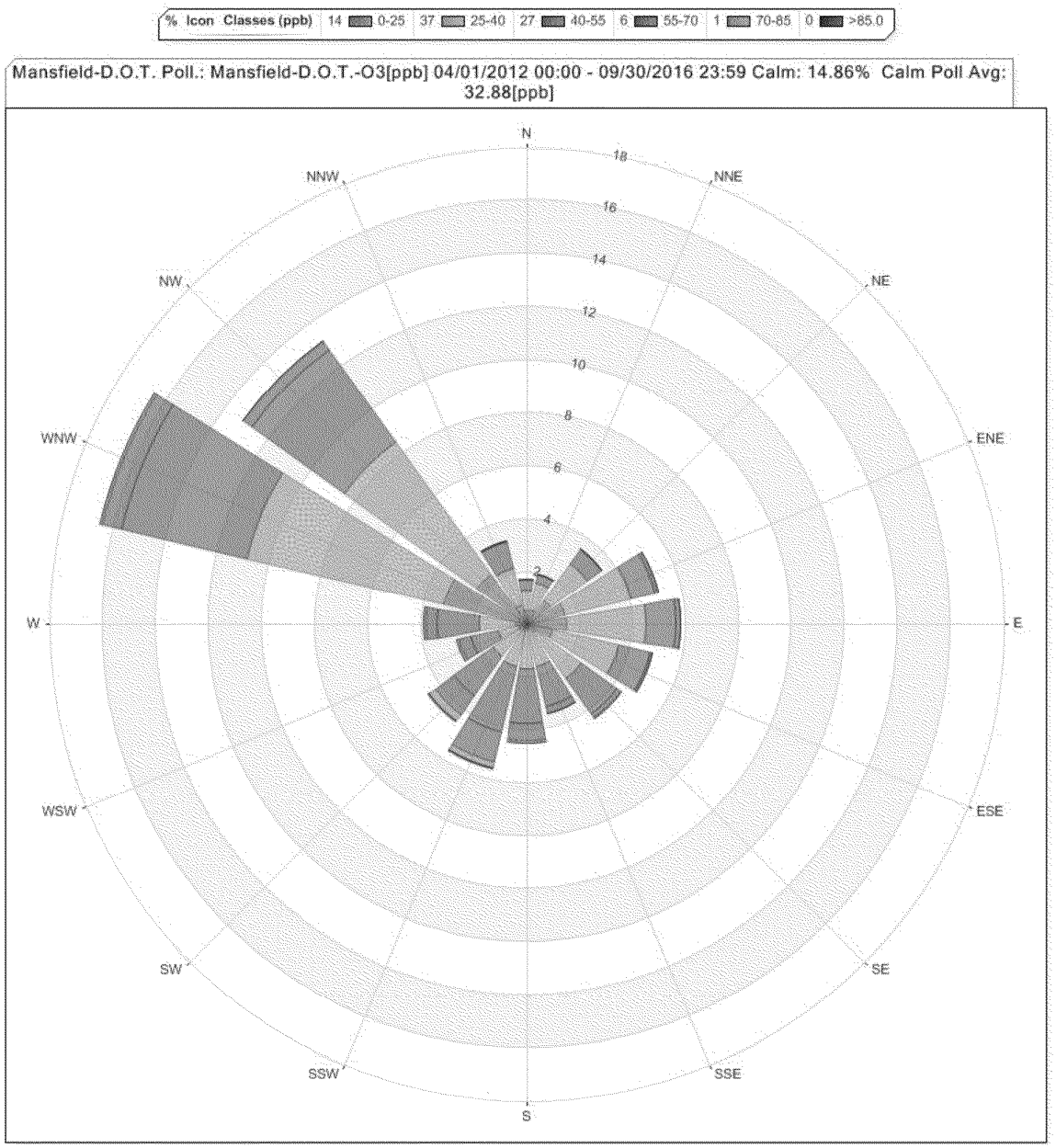

Figure 23. Ozone Wind Rose from Abington Connecticut.

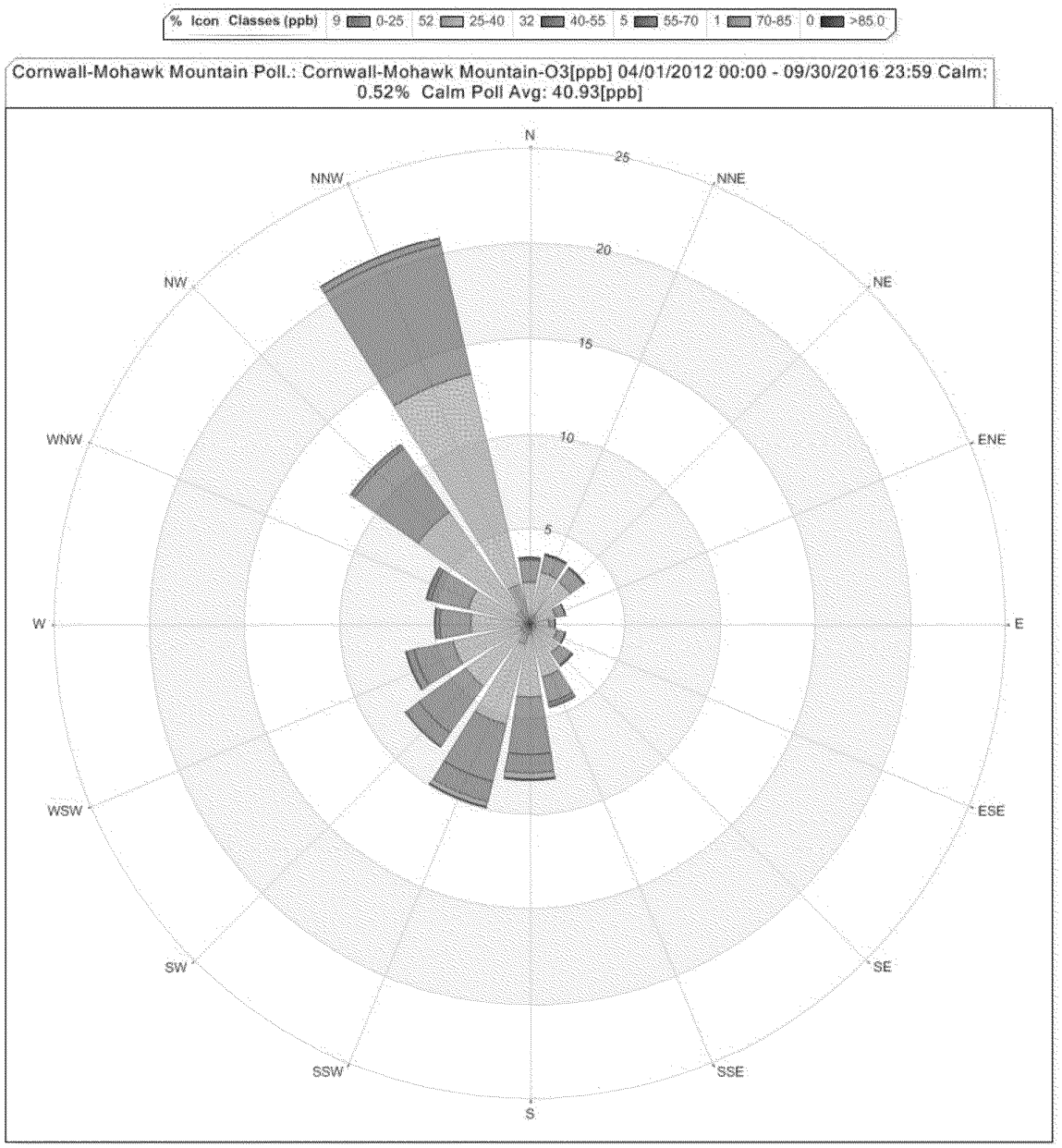

Figure 24. Ozone Wind Rose from Cornwall Connecticut.

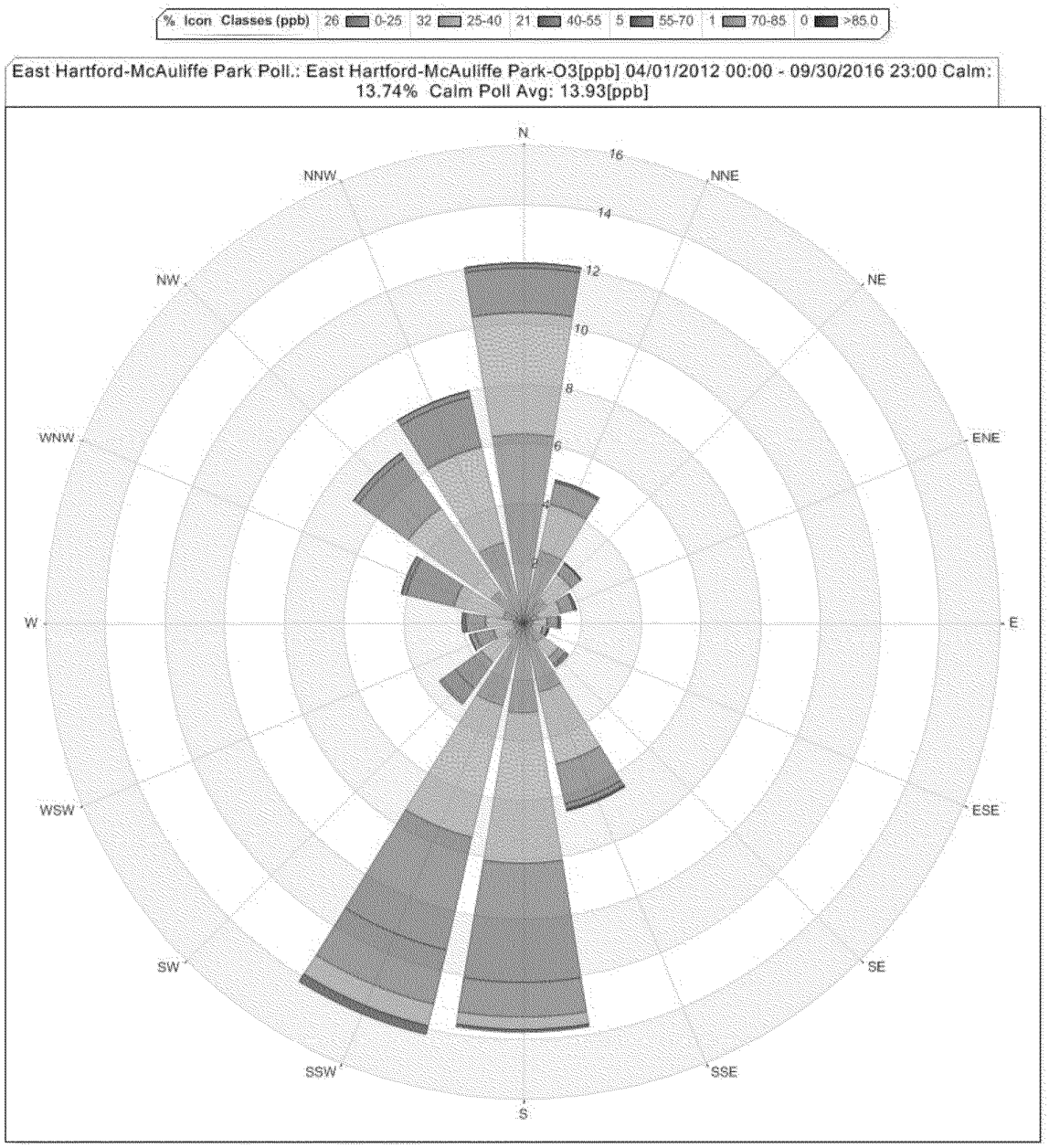

Figure 25. Ozone Wind Rose from East Hartford Connecticut.

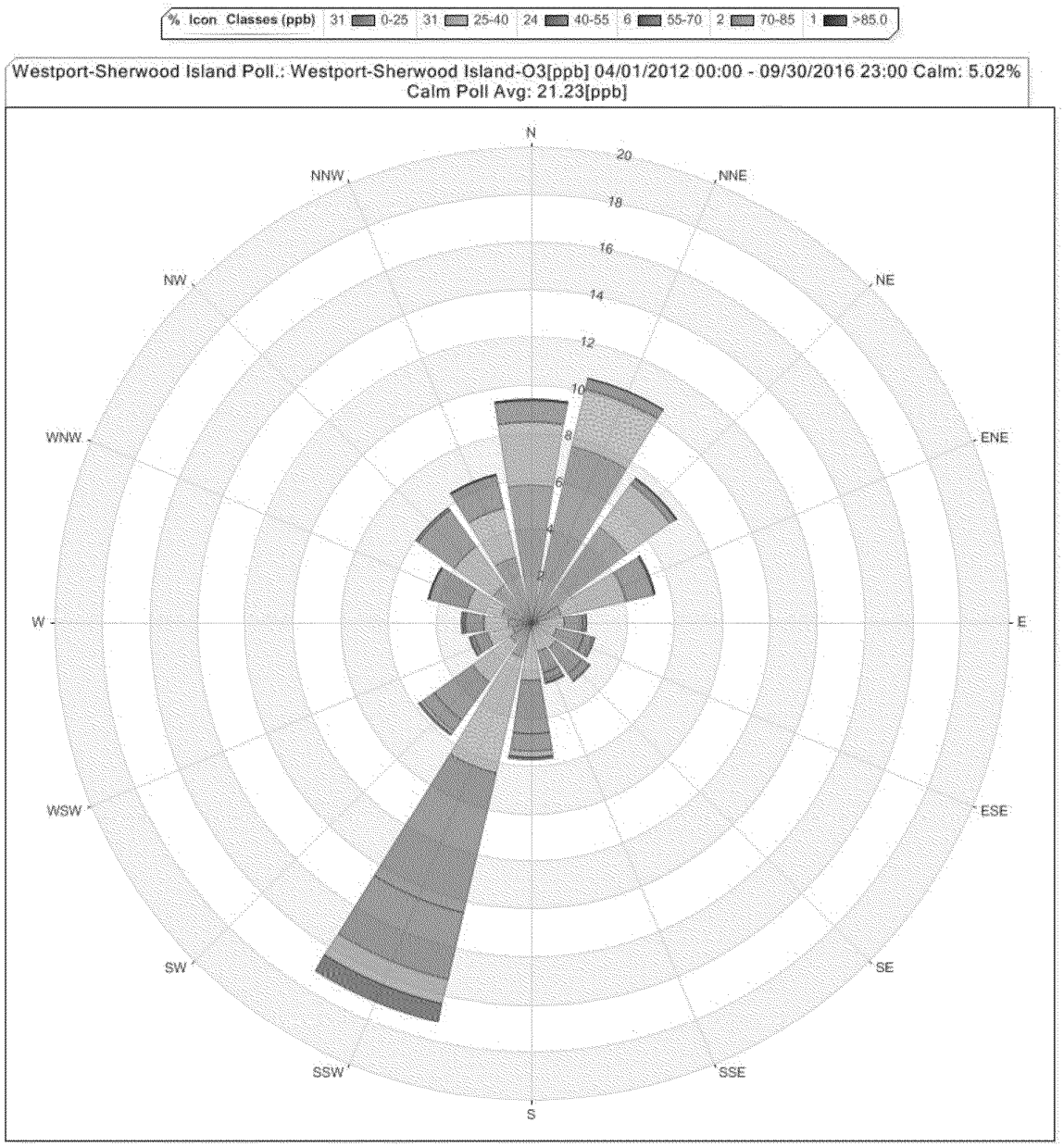

Figure 26. Ozone Wind Rose from Westport Connecticut.

4.2 Ozone Monitored Data

Figure 27 shows the hourly ozone concentrations for the four monitors from May 24-30, 2016. Ozone levels on the 24th are typical of May with a northerly wind direction. Levels spike on the

25th and remain high with a slight decrease on the 27th as cleaner maritime air pushes the ozone northward to Cornwall. Ozone levels increase again on the 28th at Westport and East Hartford before decreasing again by the 30th with a brisk influx of clean maritime air. The decrease at Abington, from the 27th through the 28th was likely due to the persistent mixing with the cleaner maritime air. The increases at the East Hartford and Westport sites on May 28th were likely due to the maritime having less impact on western Connecticut. Transport from the I-95 corridor was occurring during May 27-28th, however it was not a typical setup for a major ozone event.

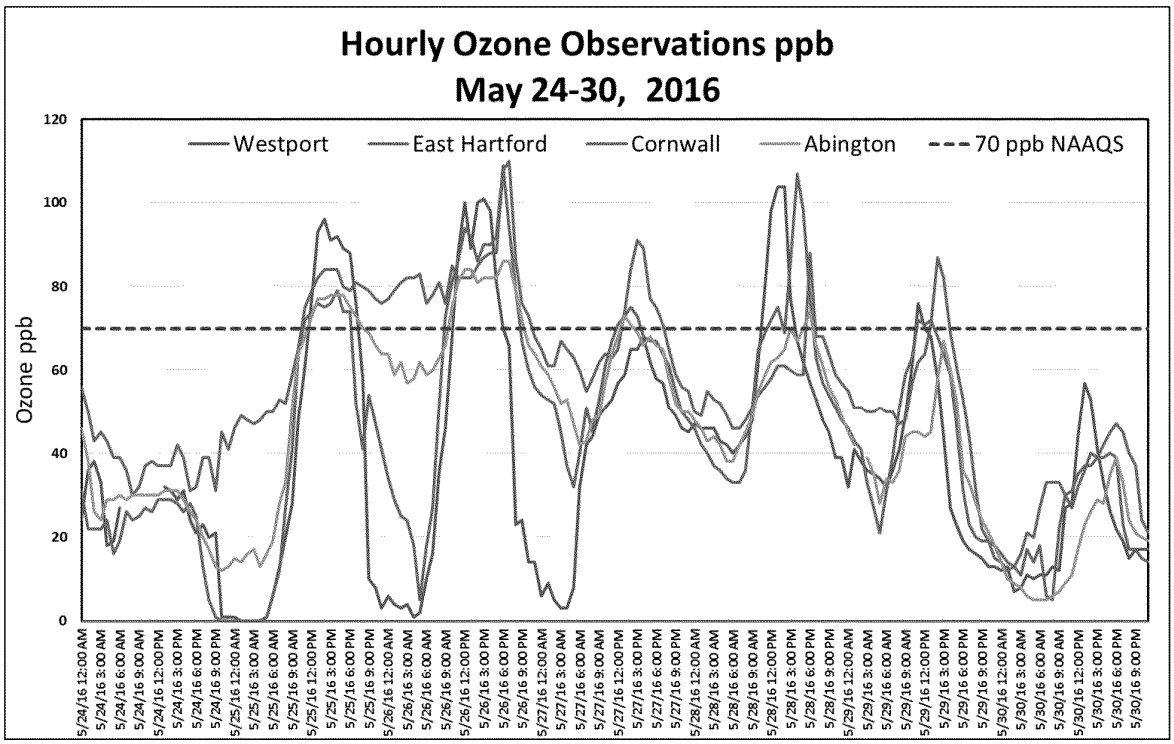

Figure 27. Hourly Ozone Concentrations for May 24-30, 2016 for Data Exclusion Sites.

Figure 28 shows the hourly ozone plots for the remaining seven monitors in Connecticut (Greenwich ozone data was invalidated). These sites show similar hourly ozone trends which may warrant data exclusions request in the future. Danbury showed the highest ozone values overall, likely experiencing the highest impact from the plume (see Figure 42), while Madison and Groton were similar to Abington, which would have had more mixing with maritime air.

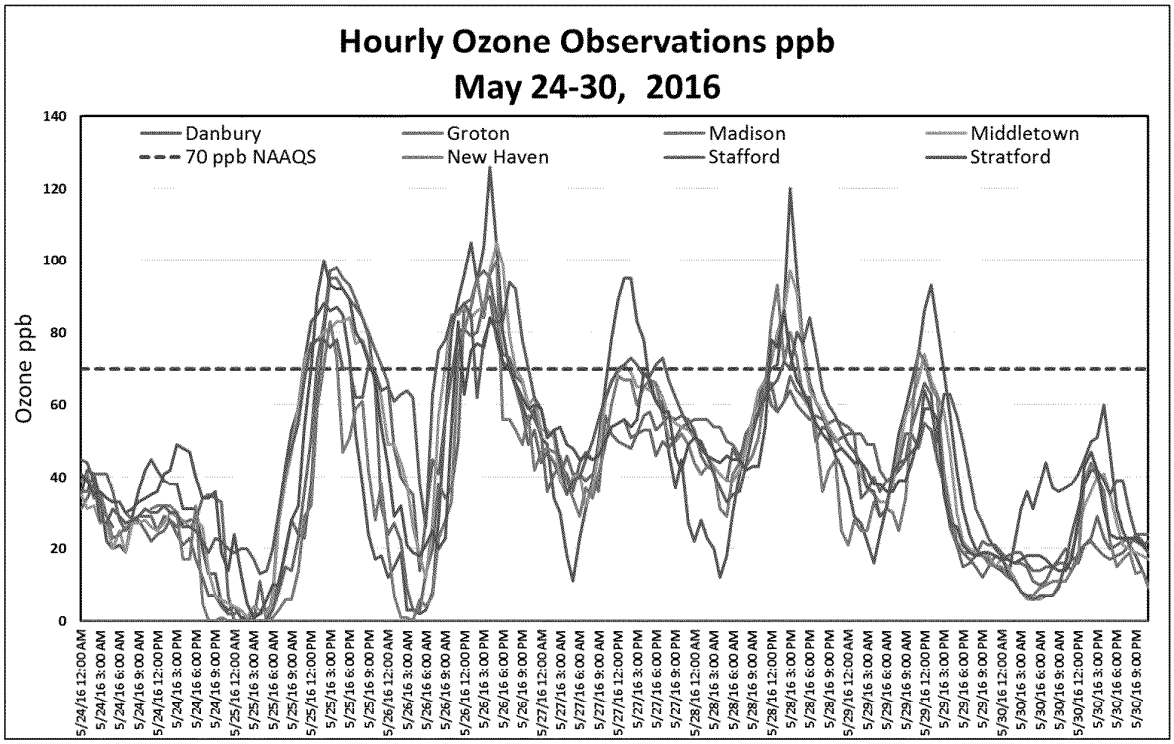

Figure 28. Hourly Ozone Concentrations for May 24-30, 2016 for remaining seven Connecticut Ozone Monitors.

4.3 Site Specific Outlier Analyses

EPA guidance suggests that for each monitor requested for data exclusion, a 5-year percentile of the data on a per monitor basis be determined. If the flagged data is above the 99th or higher percentile of the 5-year distribution of ozone monitoring data, or is one of the four highest ozone concentrations within 1 year, these data can be considered outliers and provide strong evidence for the event.

The following table shows the maximum 8-hour daily ozone levels observed at the four sites on May 25th and 26th compared with the 99th percentile ranked 8-hour ozone levels observed during the last five years. The ozone levels at Abington and Cornwall exceeded the 99th percentile on both days and East Hartford and Westport approached the 99th percentile on the 25th and met or exceeded it on 26th.

Table 5. Five Year 99th Percentile Rankings for May 25th and 26th, 2016

Maximum Daily 8-hour Ozone (ppb) as measured by the monitors on the two days of interest and compared to the 99th percentile daily ozone value from the most recent five years of data.			
Site	May 25, 2016	May 26, 2016	99th Percentile of data from 2012 through 2016
Abington CT	76	83	74
Cornwall CT	81	91	79
East Hartford CT	75	93	78
Westport CT	87	90	90

To further illustrate the outlier status of the event, Figures 29 through 32 plot the ranked percentile 8-hour ozone observations at each site.

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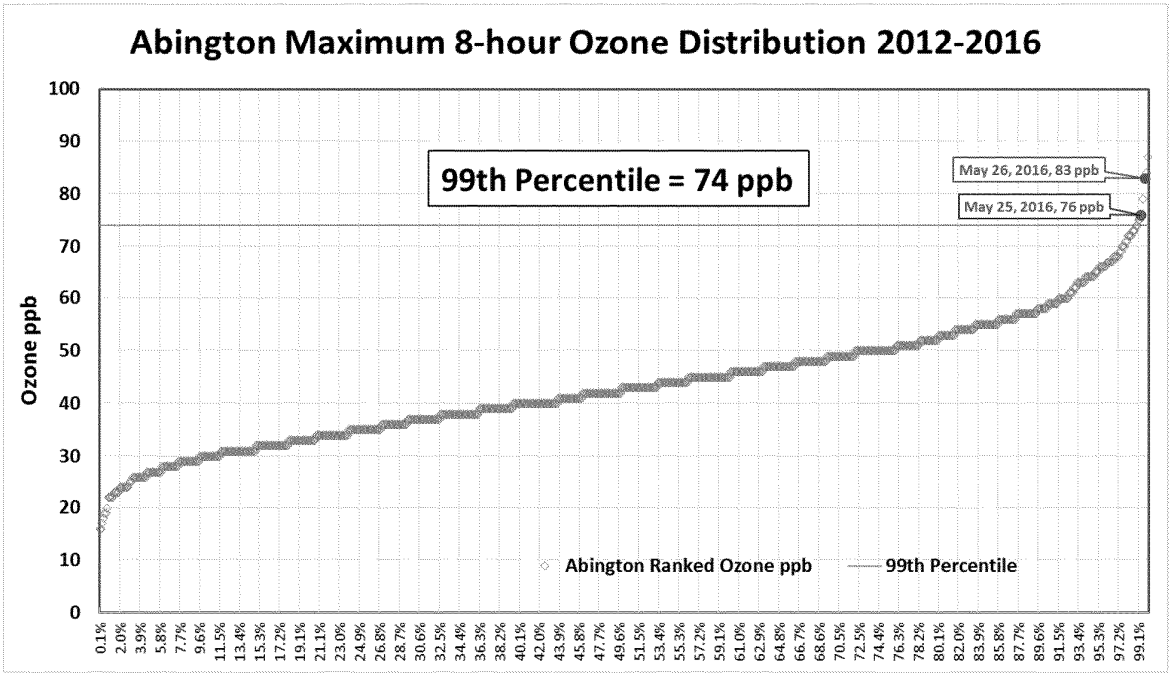

Figure 29. Ranked 8-hour Ozone Distribution for Abington CT 2012-2016

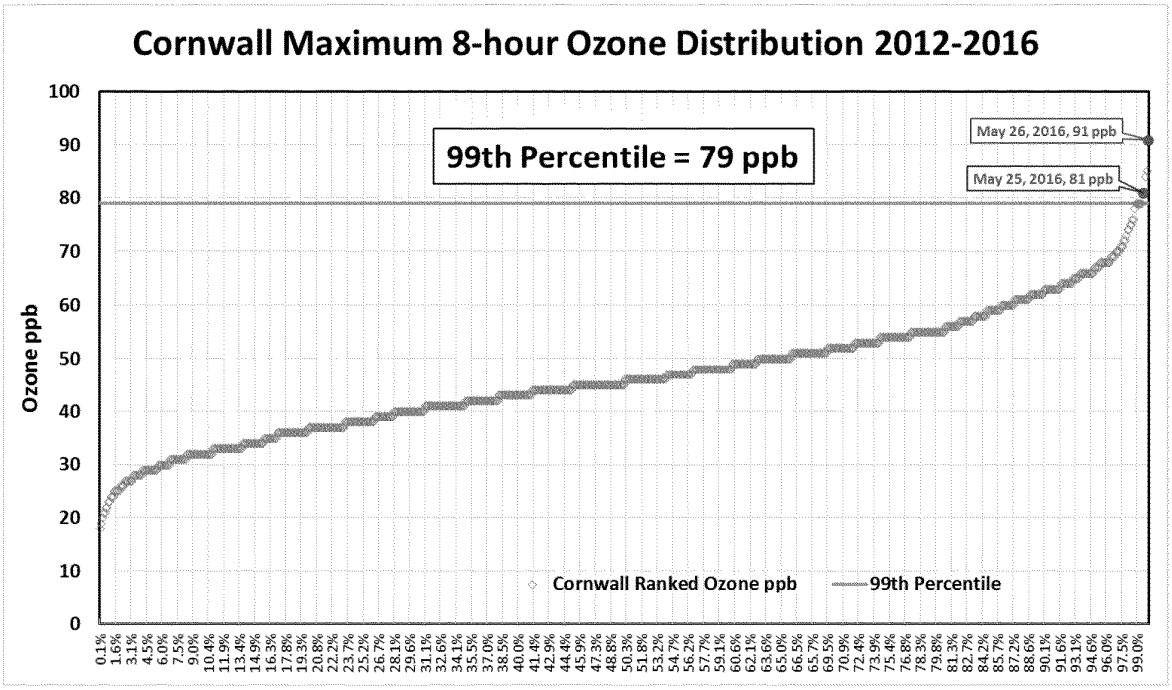

Figure 30. Ranked 8-hour Ozone Distribution for Cornwall CT 2012-2016

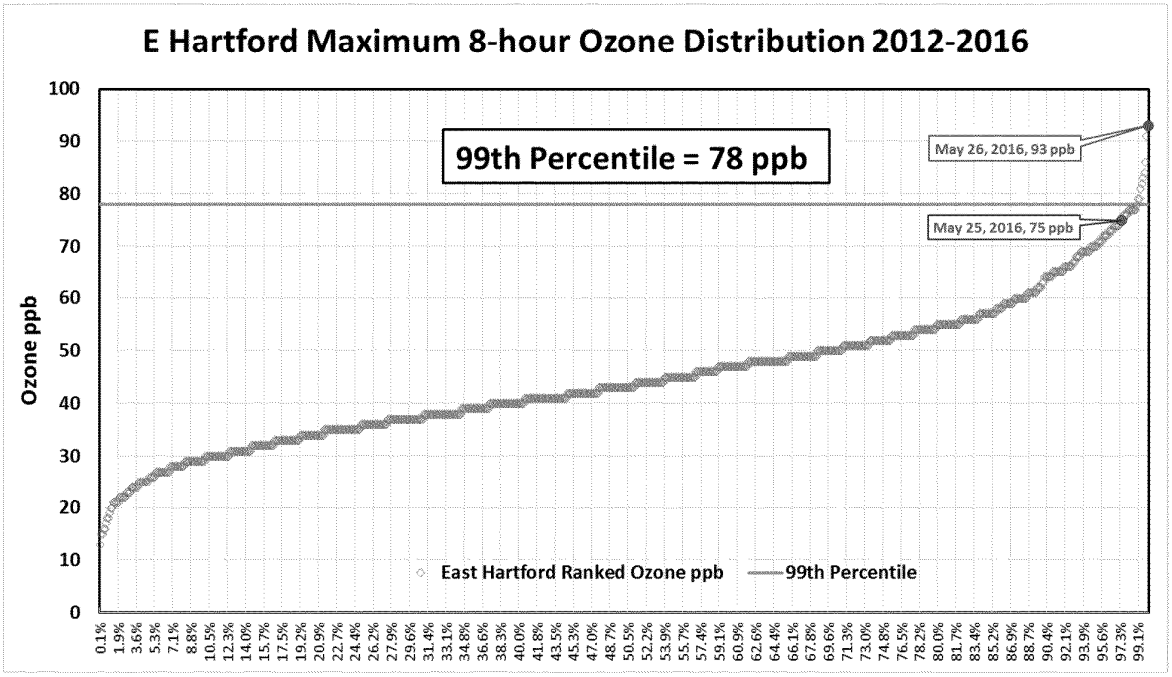

Figure 32. Ranked 8-hour Ozone Distribution for E Hartford CT 2012-2016

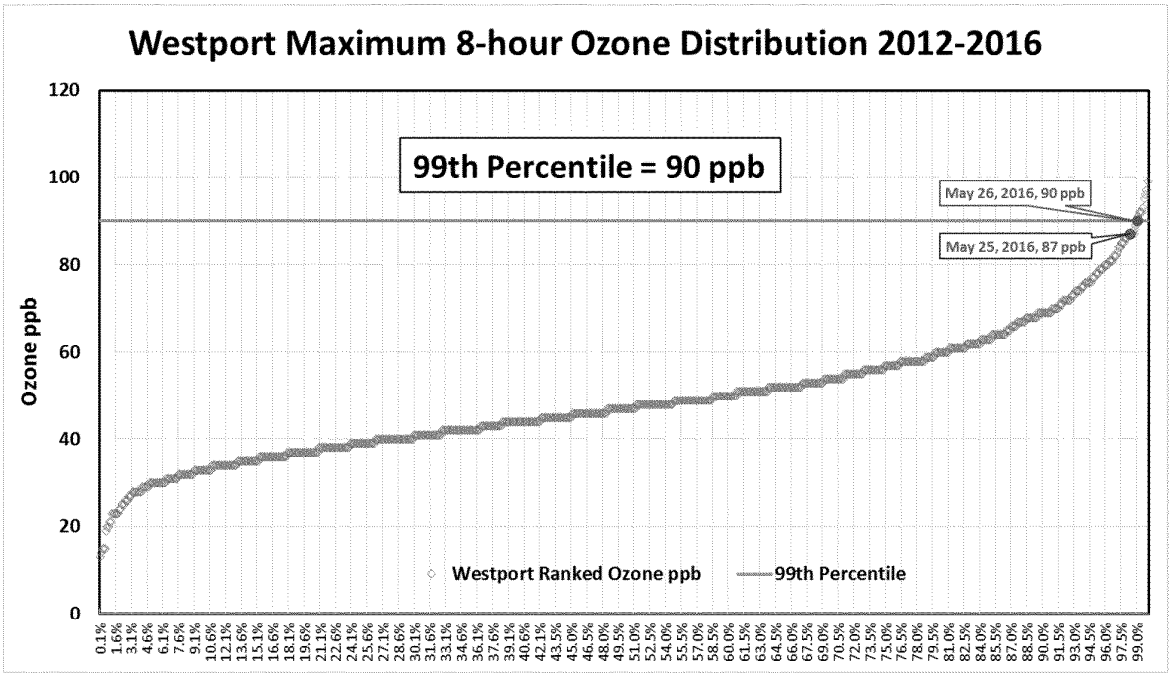

Figure 31. Ranked 8-hour Ozone Distribution for Westport CT 2012-2016

Figures 33 through 36 are plots of daily maximum ozone values for each of the four monitors of interest in Connecticut using five years of data. The 8-hour ozone concentrations for the May

25-26, 2016 event have been circled and the percentile rankings have been labeled next to those data points. To illustrate the frequency of high ozone days (i.e. > 70 ppb) with a northwest wind flow, we obtained sounding wind data from the nearest upwind site, Albany NY (ALY), for the 2010-2016 May-September time period. The National Weather Service (NWS) dispatches weather balloons with sounding instrumentation twice a day from numerous sites across the United States. There are specific 'mandatory' pressure levels that are reported for input into weather models as well as for plotting the pressure height maps. The mandatory sounding height of 925mb (~800m) was chosen, because it represents winds in the middle of the boundary layer and should be relatively free of surface drag effects. On May 25th, 2016, the 925 mb wind direction at ALY was from 305° at 32 knots. We selected a wind direction (WD) compass range between 295°-335° to filter the days with similar wind patterns, which also included May 26th. This range was broad enough to ensure that an ample number of days would be selected.

It is observed that most of the over 70 ppb days disappear over our Greater Connecticut monitors (figures 33-36) when the filter is applied, but the percentile rankings do not always increase since there are generally 75% fewer data points. At our Cornwall monitor, nearly all of the high ozone days are eliminated on days when the 925 mb wind is from this northwest direction. Not surprisingly, our coastal Westport monitor still displays numerous days above 70 ppb when applying this filter because ozone was likely transported from Long Island sound by the surface sea breeze. The sea breeze effect plays an important role in ozone transport to our coastal monitors, and this effect is frequently observed when the ozone levels are far below 70 ppb at our inland monitors. These charts also show an abundance of high ozone days during 2012. This is not sufficiently explained by the emission reductions that may have occurred since then, but it is more likely due to multiple smoke events for that summer that likely had an influence on ozone concentrations in Connecticut. Transport from the northwest generally travels over a region with reduced NOx sources, as already presented in figure 4. Back trajectories over New York State would pass over a region with NOx emissions generally below the 50th percentile of the total.

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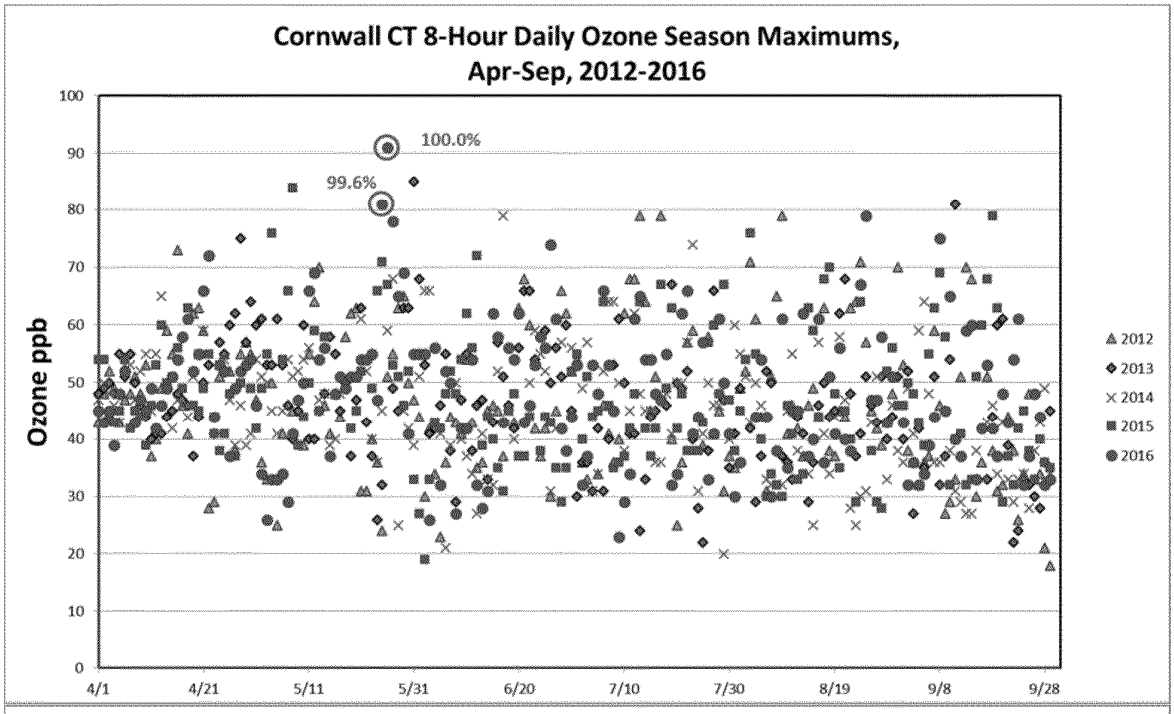
Cornwall Connecticut



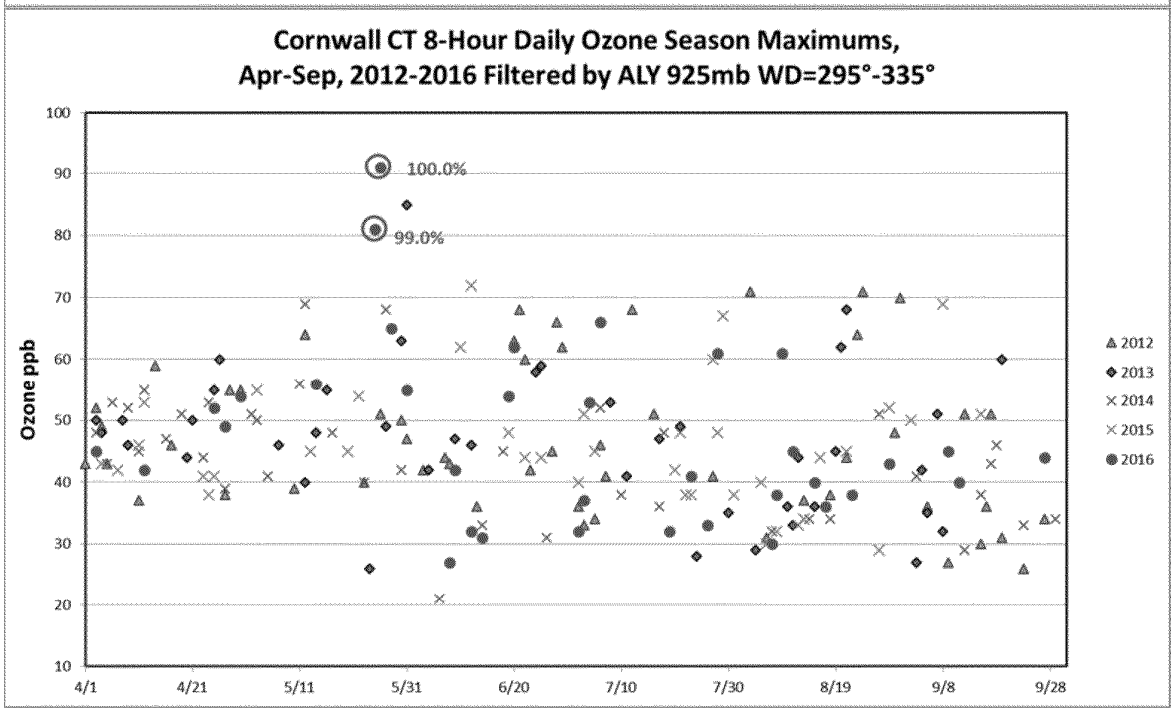
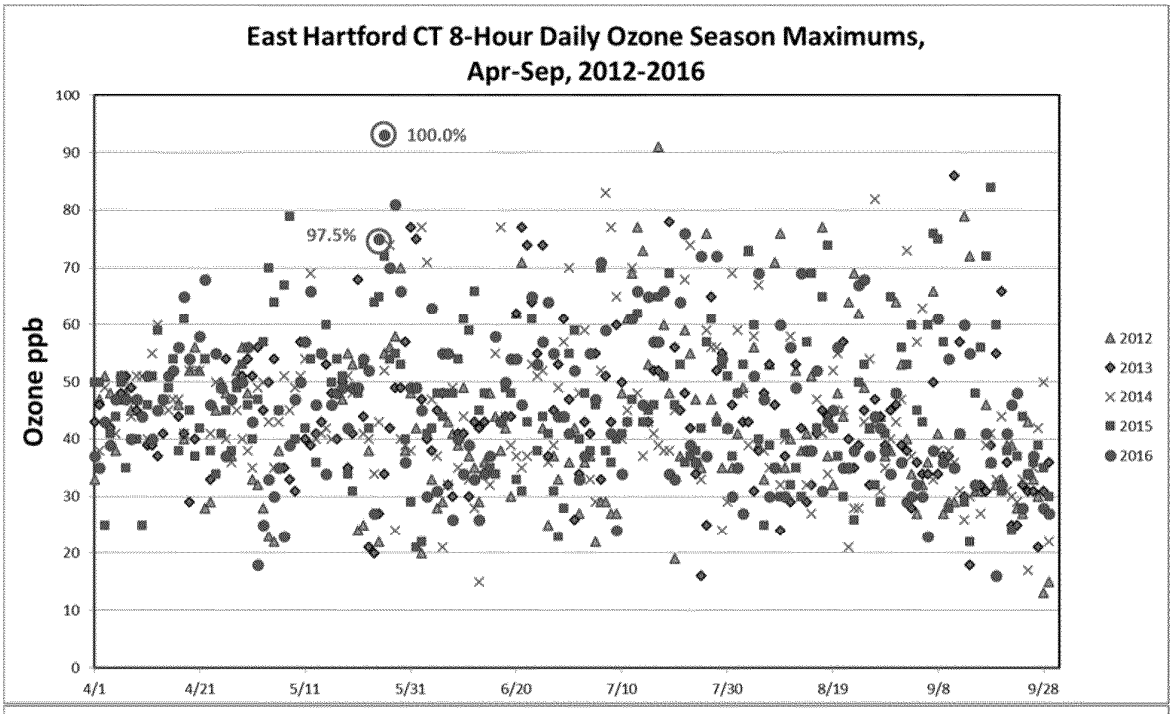


Figure 33. Cornwall CT Daily Ozone Season Maximums 2012-2016

East Hartford Connecticut



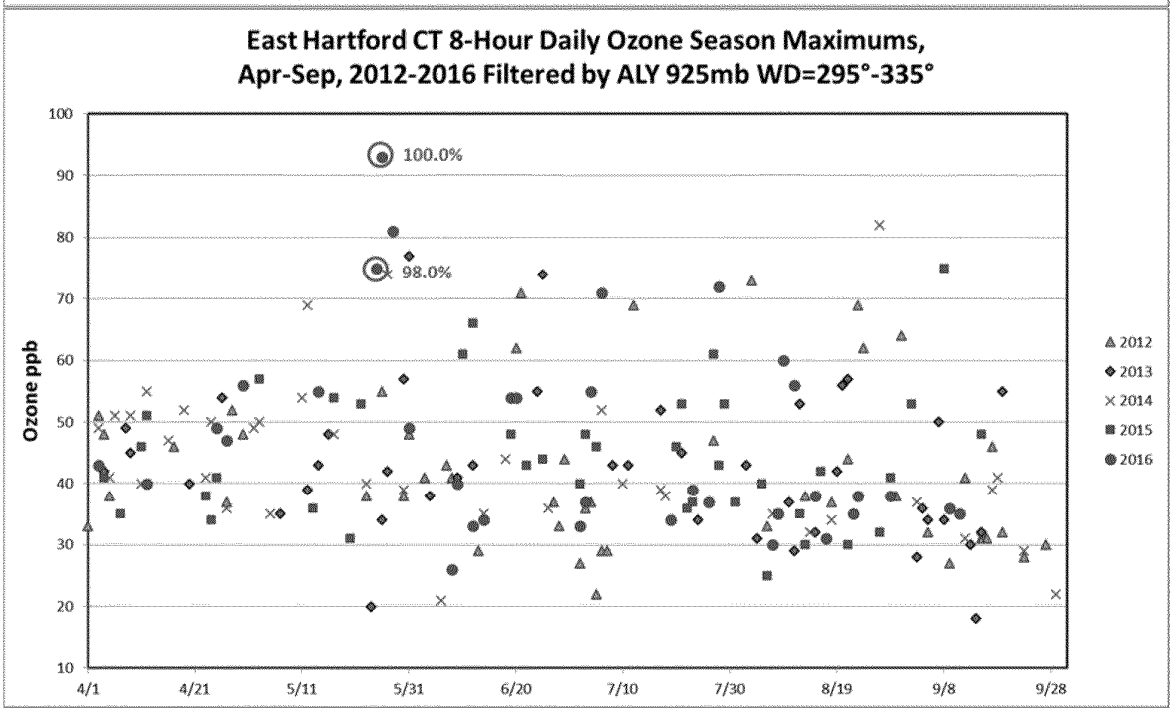


Figure 34. East Hartford CT Daily Ozone Season Maximums 2012-2016

Abington Connecticut

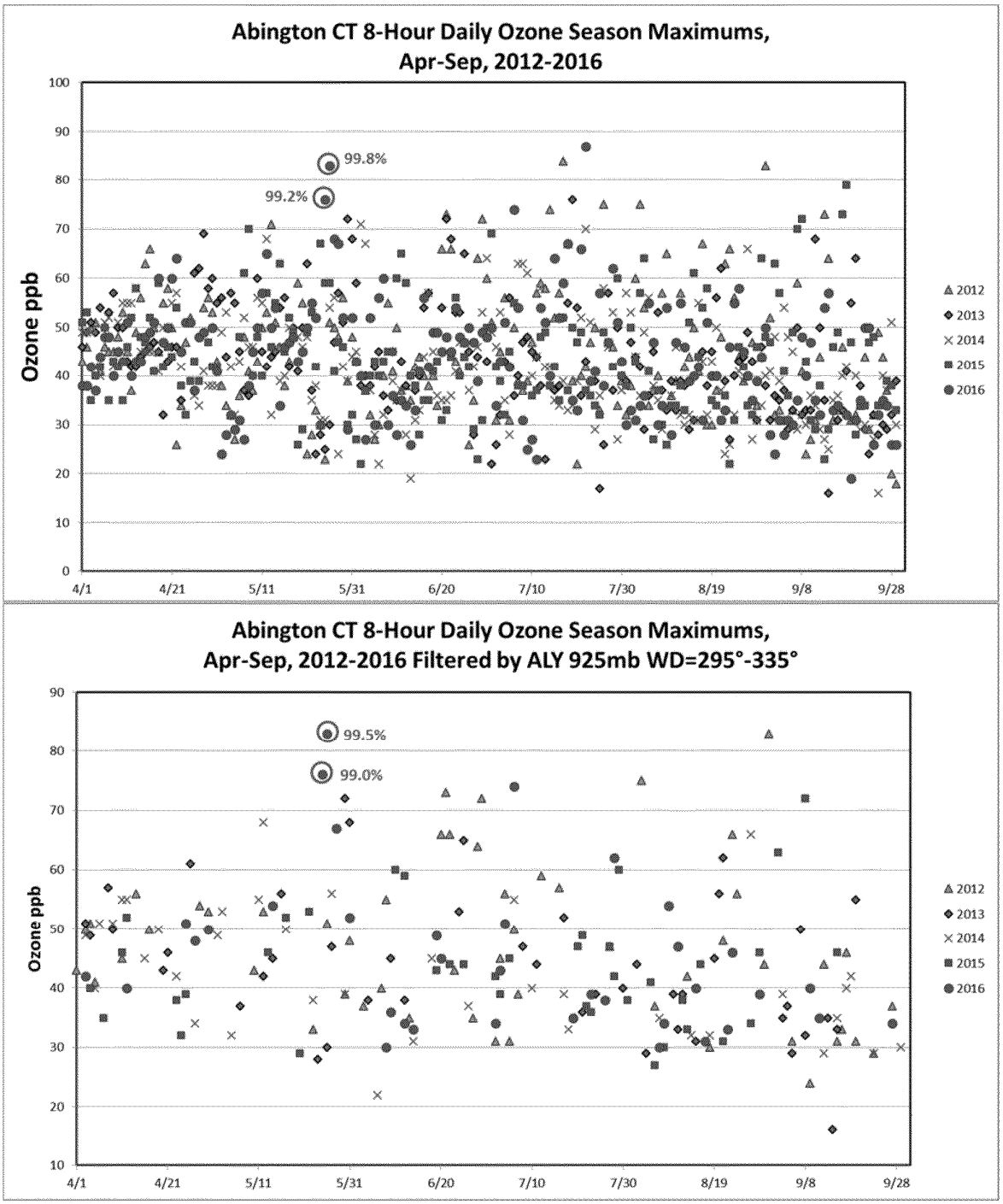
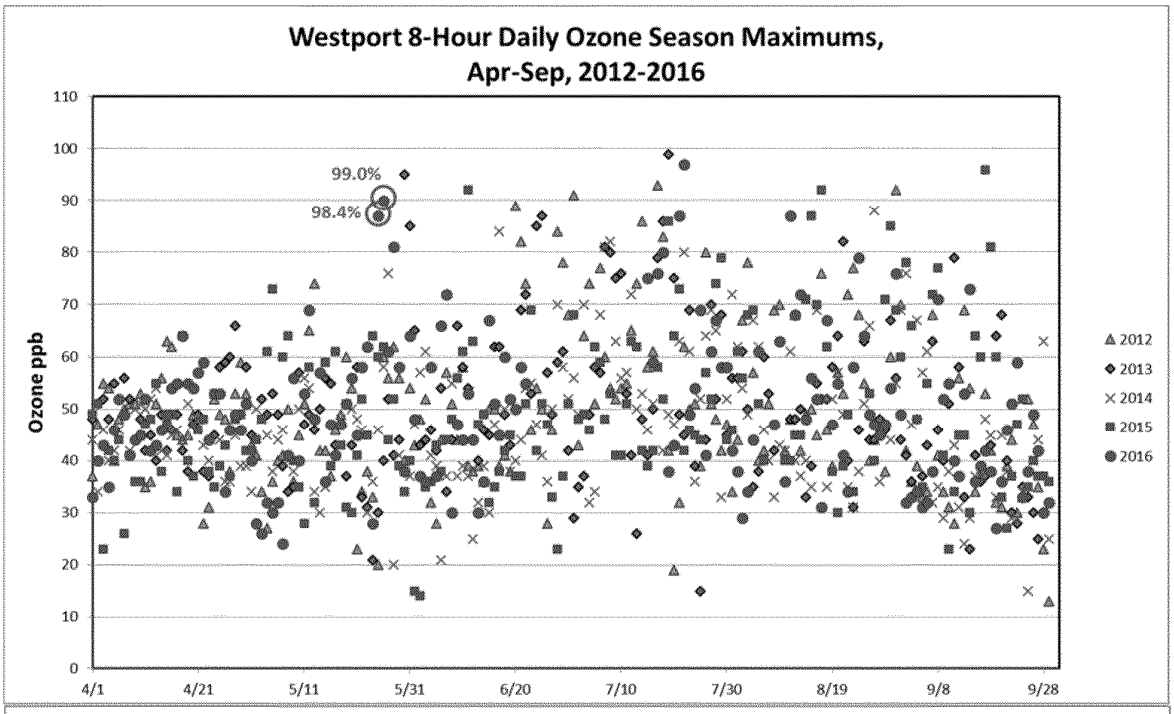


Figure 35. Abington CT Daily Ozone Season Maximums 2012-2016

Westport Connecticut



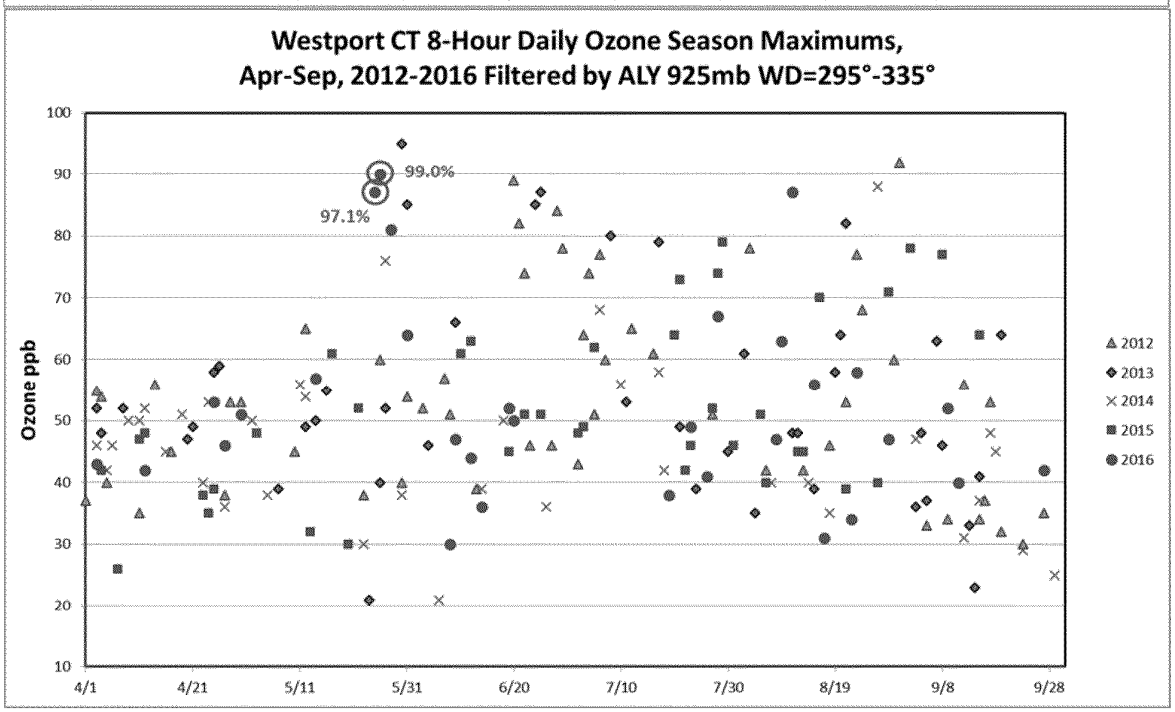


Figure 36. Westport CT Daily Ozone Season Maximums 2012-2016

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4.4 Particulate and Smoke Related Monitored Data

Fine Particulate Matter (PM2.5) likewise showed an upward trend during the May 25-28, 2016 time period. This trend would be expected when a smoke plume interacts with the surface, although concentrations are generally much higher when a wildfire plume is nearby. Figure 37 shows the hourly PM2.5 concentrations for Connecticut monitors during this period. Higher order polynomial trend lines were inserted for the New Haven and Bridgeport monitors to show the upward shift from the pre-event baseline.

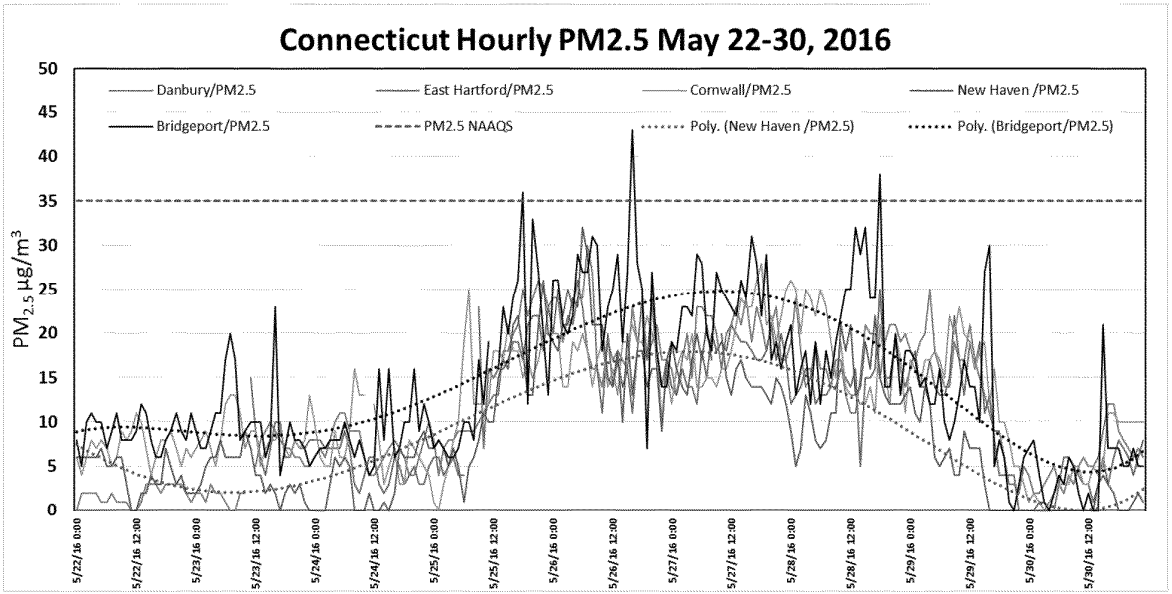

Figure 37. Hourly PM2.5 Concentrations Recorded at Connecticut Monitors from May 22-30, 2016

Connecticut has an aerosol backscatter ceilometer operating at our New Haven monitoring site, from which can be produced, a graphical aerosol backscatter image over the New Haven monitoring site. The CL-51 ceilometer is manufactured by Vaisala and provides LIDAR backscatter plots up to a height of 4000 meters. This instruments runs continuously and the BLVIEW software calculates the height of the maximum aerosol gradients, which are typically the height of the boundary layer(s). The time series of the aerosol backscatter is presented in Figure 38, along with the hourly monitored surface PM2.5 concentrations from the nearby New Haven monitor. The time series shows an unusually dense region of aerosols reaching a height of 3 kilometers. This coincides exactly with the increase in monitored surface PM2.5 and the arrival of the smoke plume over Connecticut on May 25th.

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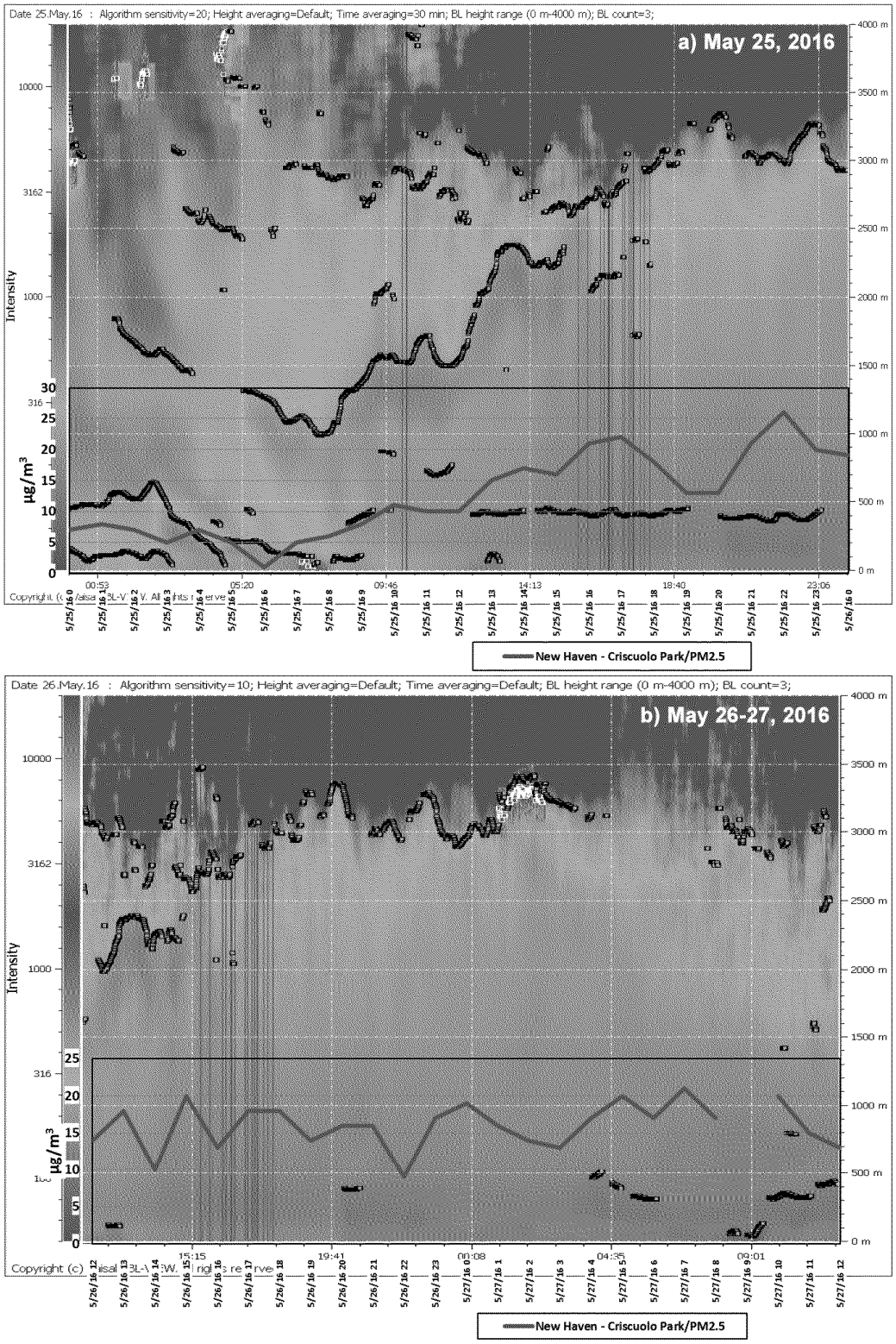

Figure 38. Aerosol Backscatter Intensity over New Haven with PM2.5 Levels

Other monitored parameters that show the likely presence of a smoke plume include black carbon (BC), DeltaC, and carbon monoxide (CO). The Aethalometer measures the attenuation of light thru a filter spot at multiple wavelengths, usually at least at near-IR (880 nm, or BC) and near-UV (370 nm, "UVC"). DeltaC is the difference between the 370 and 880 Aethalometer measurements, in $\mu g/m^3$. It is a semi-quantitative indicator of biomass combustion. At rural summertime sites, DeltaC is very specific to wood smoke. Wood smoke has a BC component to it, ~ 10% of wood smoke PM2.5 is BC. We have plotted the DeltaC PM2.5 parameter which is calculated by multiplying the DeltaC by 10, although multipliers up to 15 have been used.[20]

Our Cornwall monitor, in the northwest corner of the State, was one of the first sites to encounter evidence of smoke related pollutants during this event. The trends are consistent with what would be expected from a distant smoke plume. Figure 39 plots these pollutant trend with the hourly ozone concentrations. DeltaC (Figure 39c), indicative of wood smoke, shows large upward spikes starting on May 25th and BC (figure 39d) shows an increase in base levels together with increased hourly deviations. CO base levels (Figure 39b) also trend upward and increases on the order of 50% from the previous four days. Figure 39(e) shows that the PM2.5 levels suddenly spike on the morning of May 25th and soon after, the other parameters begin to rise. Figures 40 and 41, East Hartford and New Haven respectively, show similar trends as the Cornwall monitor and Figure 42 shows the Danbury monitor without the CO parameter. Additional monitoring data from upwind sites will be presented later that will further confirm these pollutant trends.

[20] Allen GA, Babich P, Poirot RL (2004) Evaluation of a new approach for real time assessment of woodsmoke PM. In "Proceedings of the Regional and Global Perspectives on Haze: Causes, Consequences and Controversies", Paper #16, Air and Waste Management Association Visibility Specialty Conference, Asheville, NC

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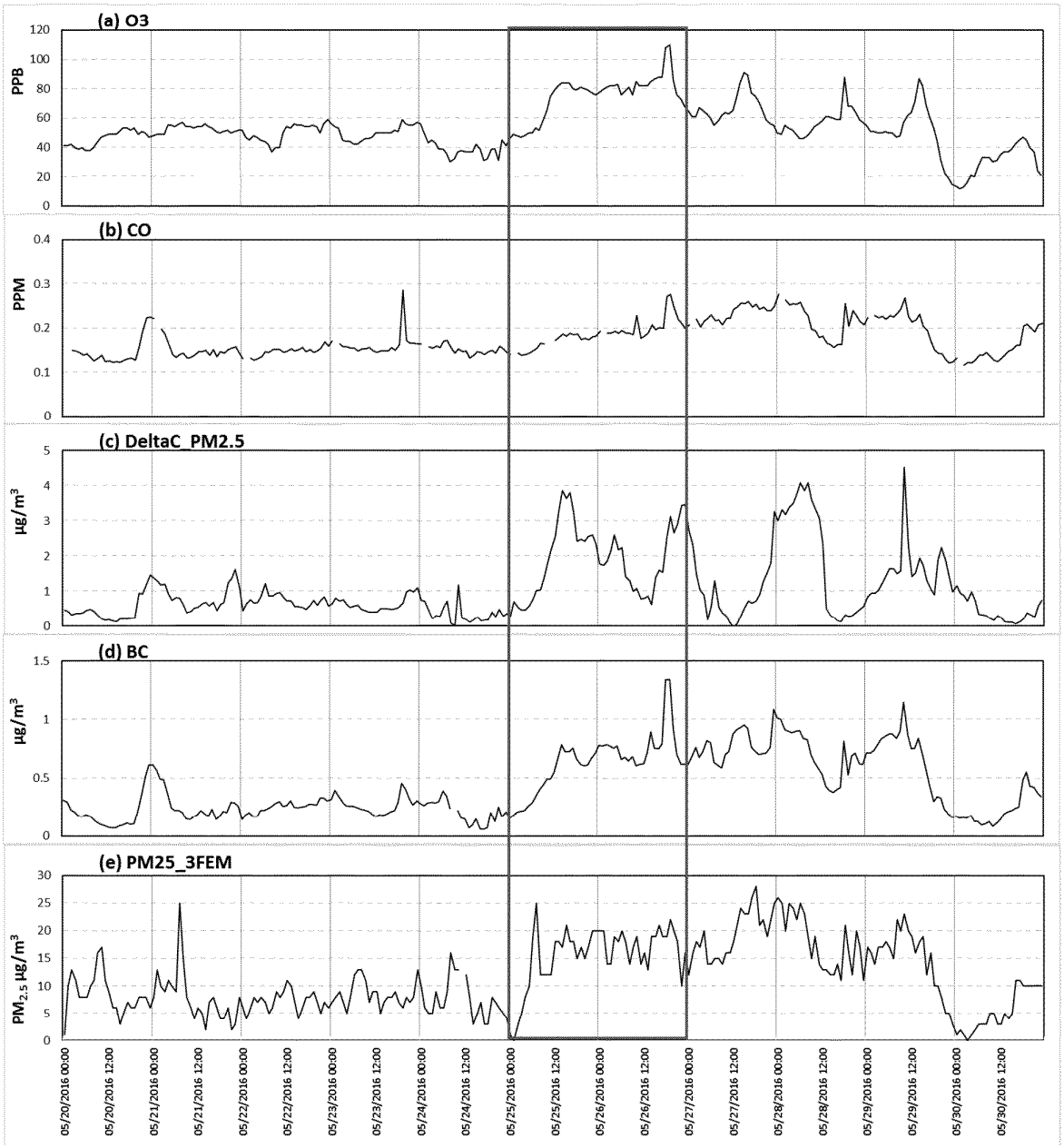

Figure 39. Monitored (a) Ozone, (b) Carbon Monoxide (CO) (c) DeltaC PM2.5 (d) Black Carbon (BC), and (e) PM2.5 at the Cornwall CT Monitor

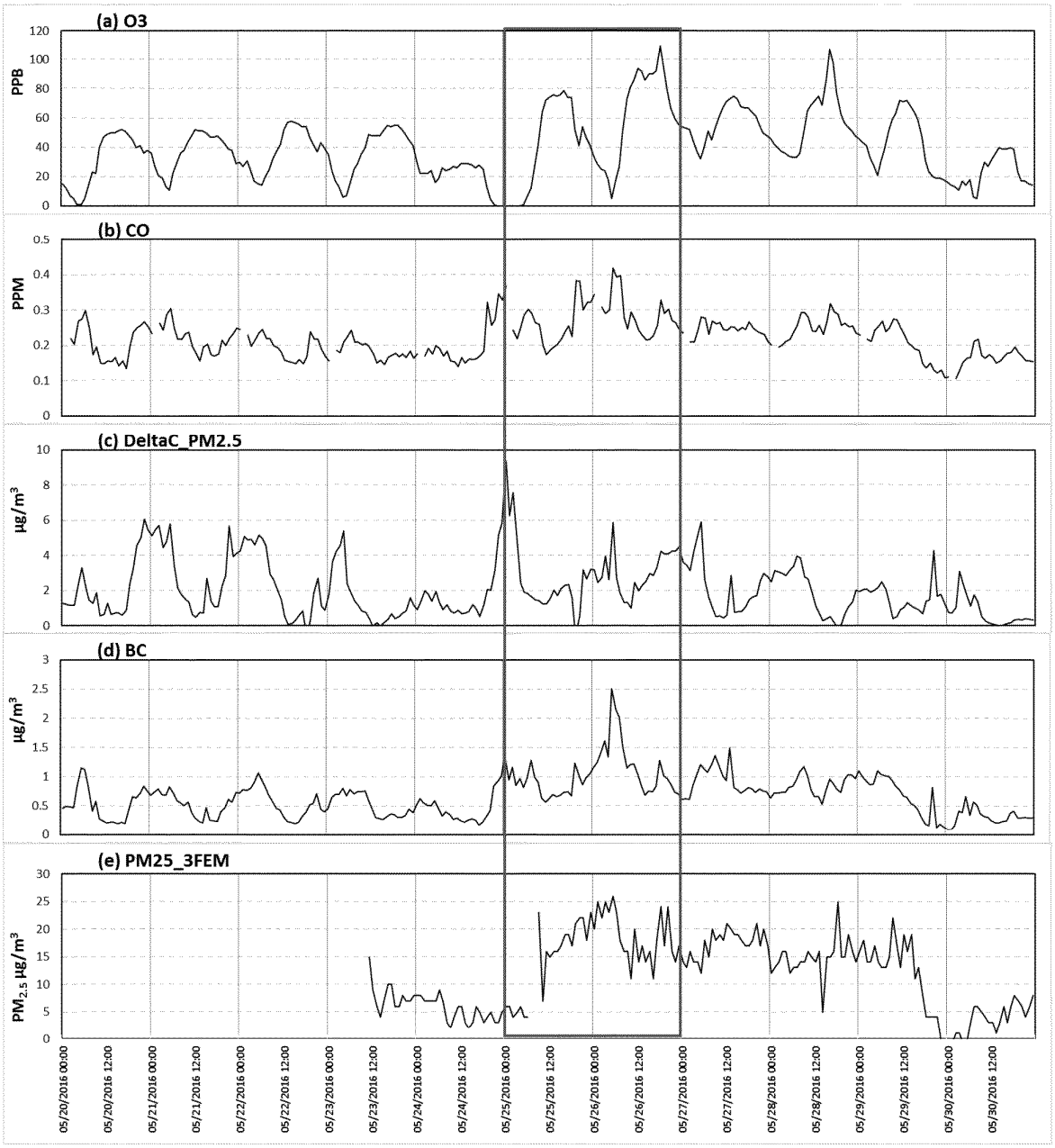

Figure 40. Monitored (a) Ozone, (b) Carbon Monoxide (CO) (c) DeltaC PM2.5 (d) Black Carbon (BC), and (e) PM2.5 at the East Hartford CT Monitor

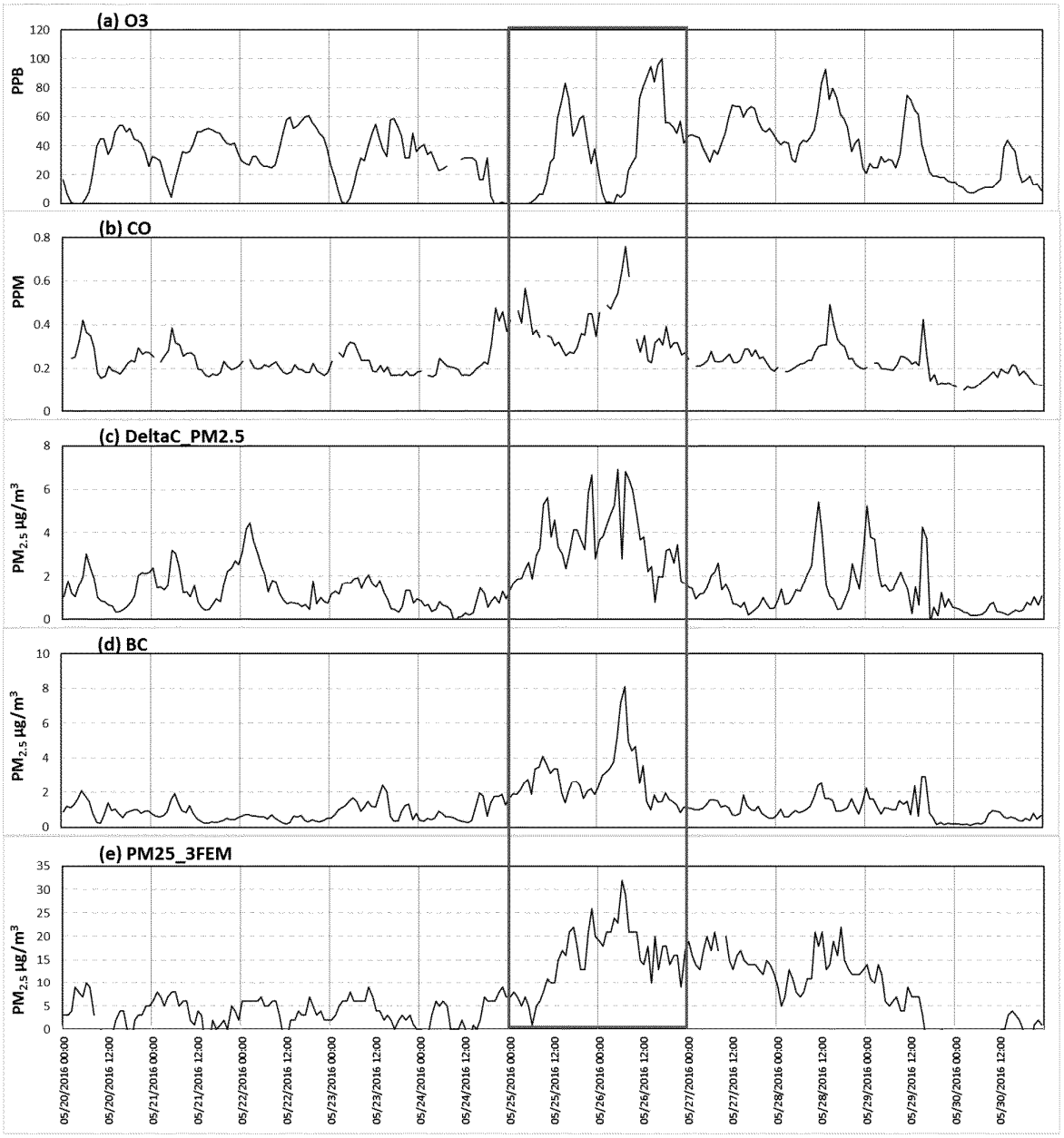

Figure 41. Monitored (a) Ozone, (b) Carbon Monoxide (CO) (c) DeltaC PM2.5 (d) Black Carbon (BC), and (e) PM2.5 at the New Haven CT Monitor

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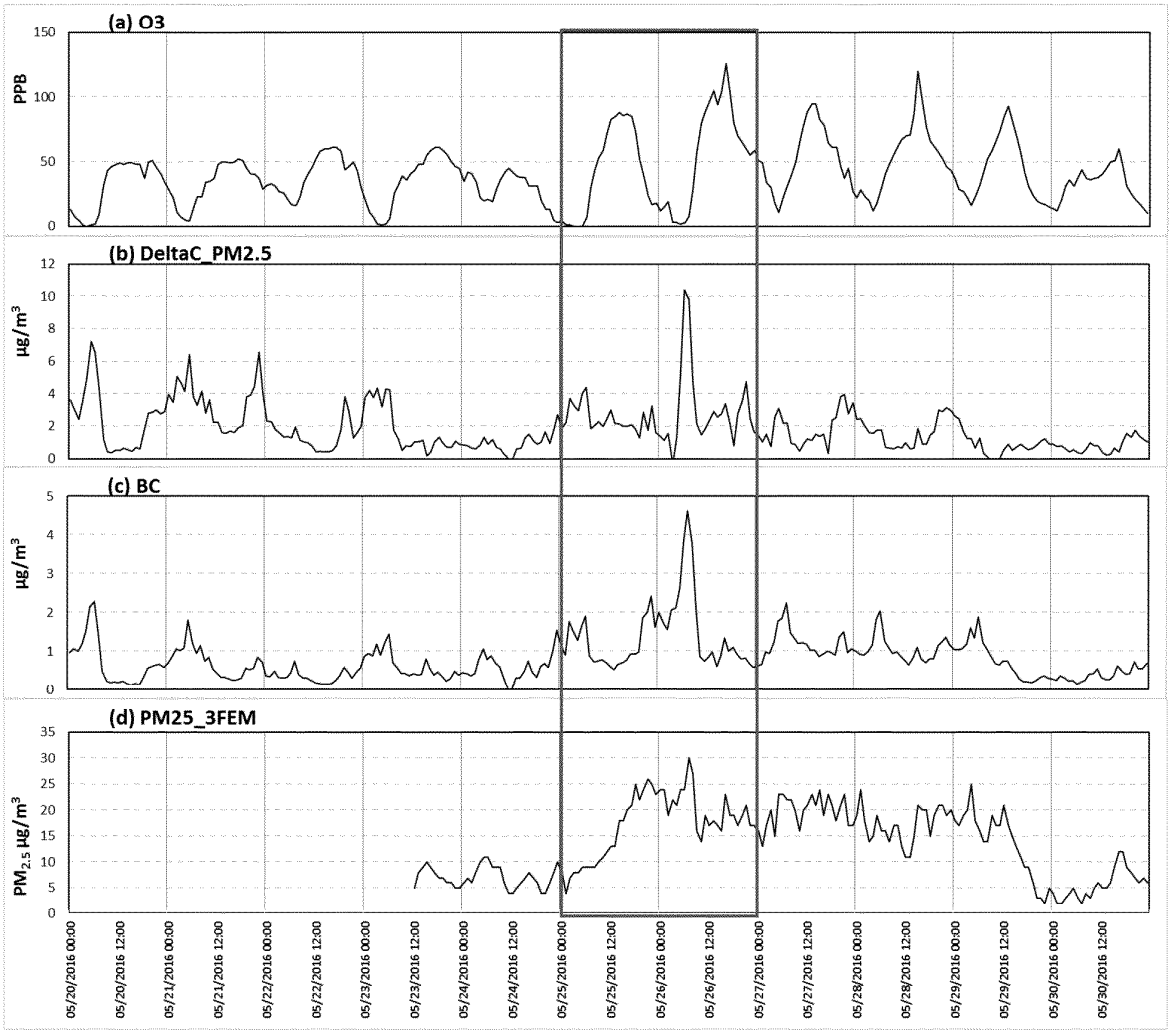

Figure 42. Monitored (a) Ozone, (b) DeltaC PM2.5, (c) Black Carbon (BC), and (d) PM2.5 at the Danbury CT Monitor

4.5 Regional Monitored Data

Fort Lee/ Leonia New Jersey

To observe similar monitored parameters as those in Connecticut, Fort Lee New Jersey was chosen for PM2.5, CO and the aethalometer carbon species. The nearby Leonia NJ monitor was selected for hourly ozone. These sites are approximately 40 miles to the southwest of our Westport monitor and serve as a good comparison for the May 25-26, 2016 period. Figure 43 is a map showing the locations of those monitors and Figure 44 are charts of the monitored

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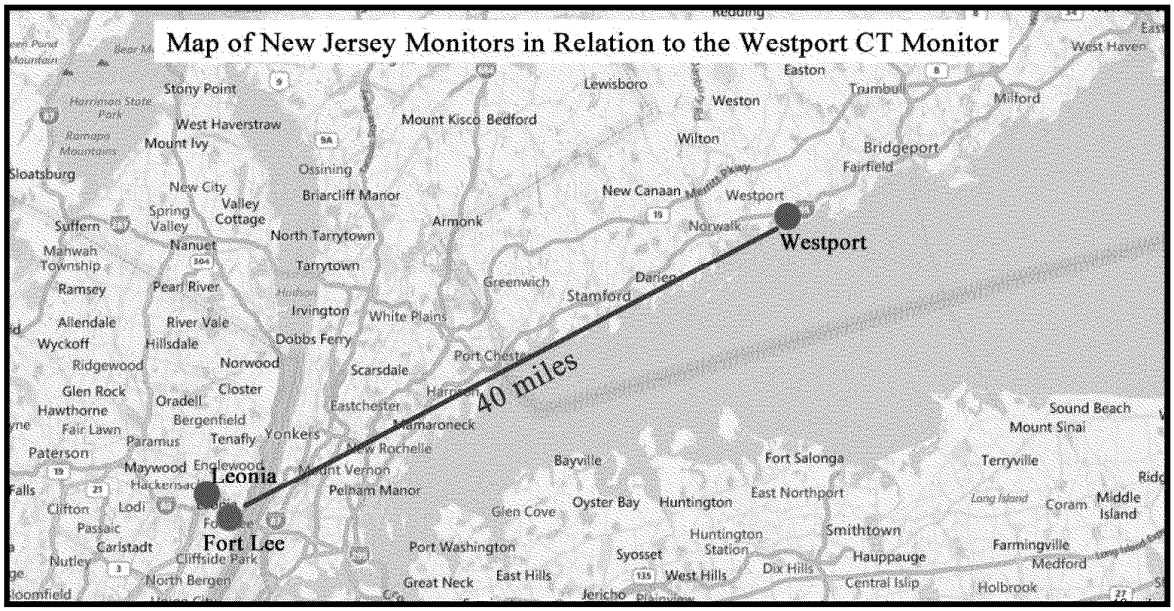

Figure 43. Map of Nearby New Jersey Monitors.

pollutants that shows similar trends as those observed at the New Haven CT monitor with peaks in BC, DeltaC and PM2.5. The Fort Lee NJ monitor stopped reporting during May 27th, just as the PM2.5 parameters appeared to be peaking. These monitors are 12 miles from the Haze Cam location, from which images were presented earlier and show the presence of smoke over New York City.

Connecticut Hill New York

Since ozone exceedances are common in Connecticut due to transport from the southwest, we considered out-of-state monitors that are less influenced by southwest transport to demonstrate the unique influence of the wildfire on ozone levels during the event. The Connecticut Hill monitor in upstate New York, which is north and west of Connecticut, is an example that clearly shows this event was an outlier. Figure 45 shows daily 8-hour maximum monitored ozone for the years of 2011-2016 at the Connecticut Hill monitor and its location in New York. The 77 ppb 8-hour maximum ozone noted for May 25th, 2016, was the highest ozone value reported during those 6 years. The 2012 data stands out as having consistently higher monitored ozone data over this period.

Upwind Chemical Speciation Network (CSN) Sites

The U.S. EPA initiated the national PM2.5 Chemical Speciation Monitoring Network (CSN) in 2000 to support evaluation of long-term trends and to better quantify source impacts of particulate matter (PM) in the size range below 2.5 µm aerodynamic diameter (PM2.5; fine particles). EPA also administers the long standing Interagency Monitoring of Protected Visual Environments (IMPROVE) visibility monitoring network in rural Class 1 Areas across the country. Both networks measure the major chemical components of PM2.5 using historically accepted filter-based methods.

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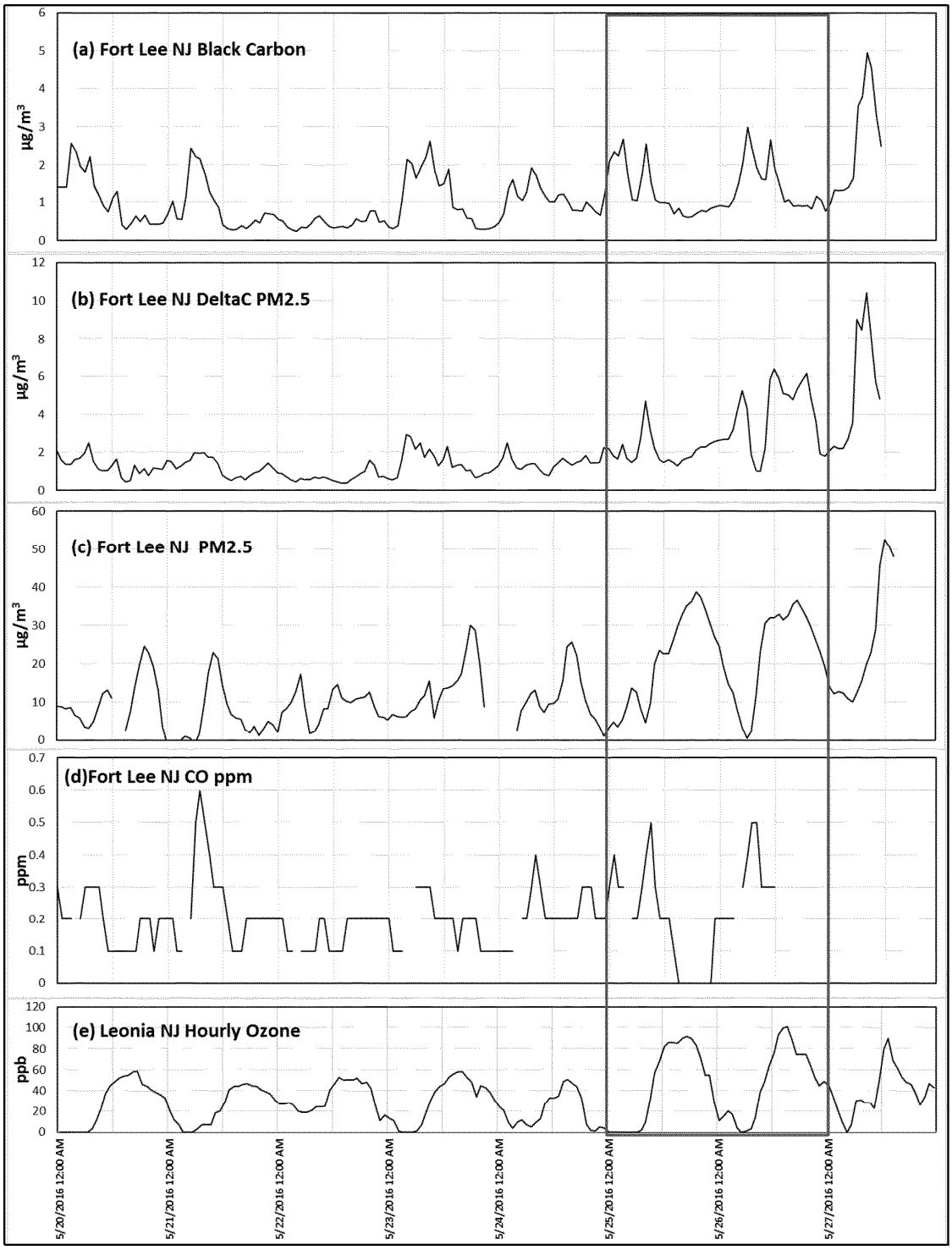

Figure 44. Monitored (a) Black Carbon, (b) DeltaC PM2.5, (c) PM2.5 (d) CO at the Fort Lee NJ monitor and (e) Ozone at the Leonia NJ Monitor.

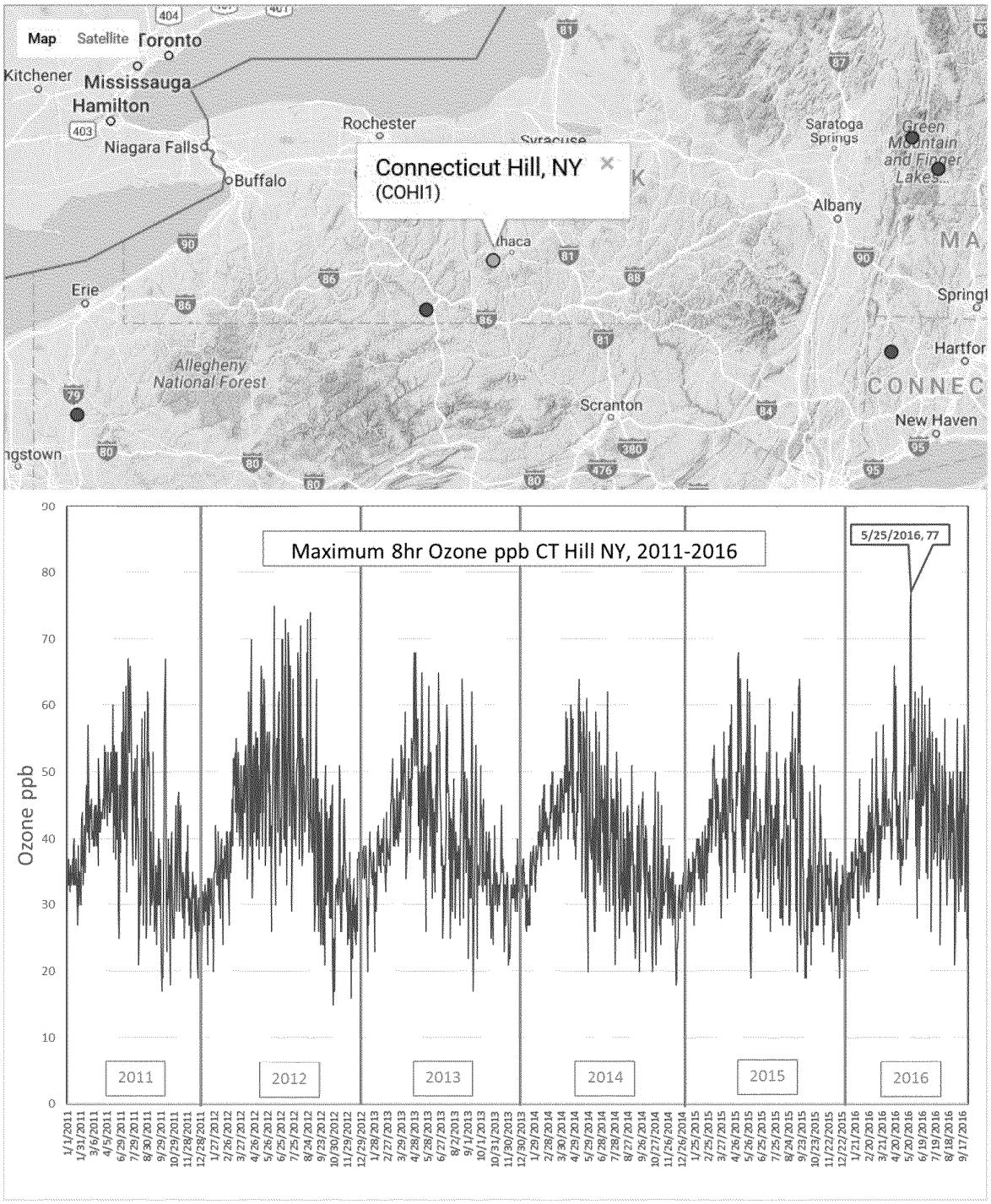

Figure 45. Monitored Daily Maximum 8-hour Ozone for 2011-2016 at Connecticut Hill, NY

Target Species:

- PM2.5 Mass by gravimetry,
- 33 trace elements (such as Al and Pb by X-ray fluorescence),
- Anions (nitrate and sulfate by ion chromatography),
- Cations (ammonium, sodium, and potassium by ion chromatography), and
- Organic Carbon (OC) and Elemental Carbon (EC) by thermal optical methods.

Organic Carbon (OC) and Potassium (K) species are most closely associated with wildfire emissions, so we have selected the sites in Figure 46 to plot these chemical compounds against the monitored 8-hour ozone maximums for these days. Samples are only available at three or six day intervals at these sites. Figures 47-53 generally show that K and/or K+ and OC exhibited upward trends, coinciding with elevated ozone levels. This is particularly evident on May 24th, 2016. This concurs with the presence of a wildfire smoke plume over the area on that day. Seney, Michigan, an IMPROVE wilderness background site, and Grand Rapids show distinct double peaks, which is no doubt due to the meandering nature of the smoke plume over several weeks .

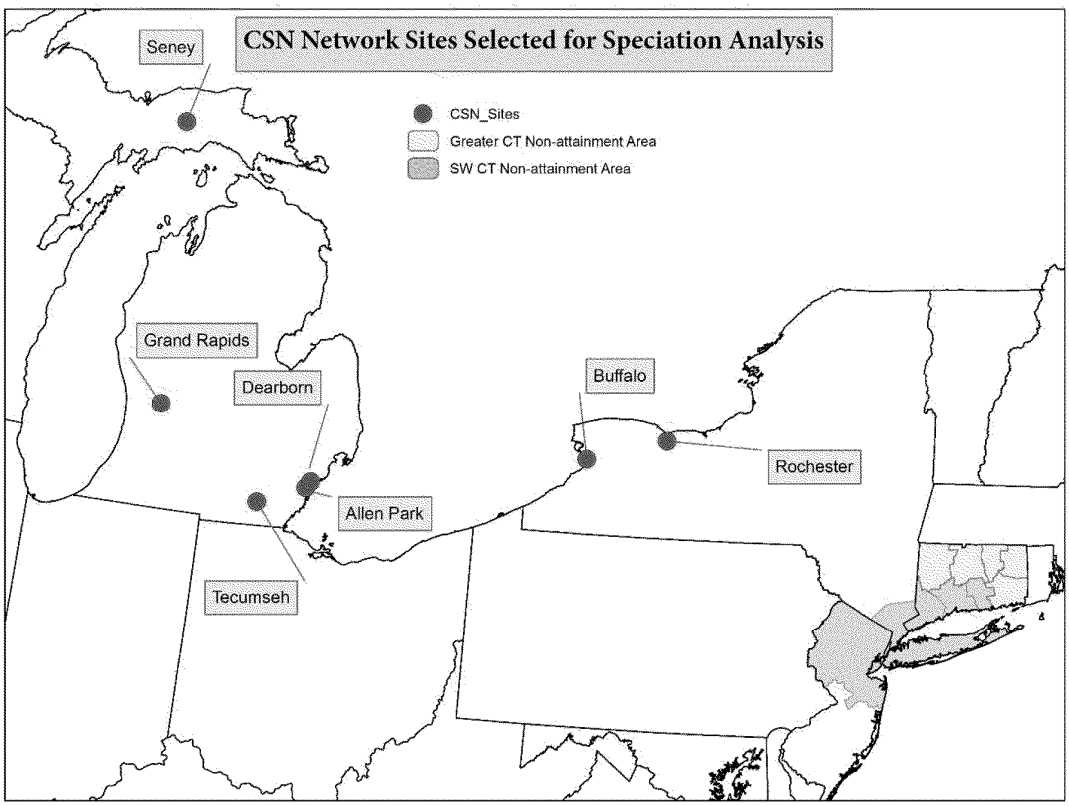

Figure 46. CSN Sites Selected for Speciation Analysis

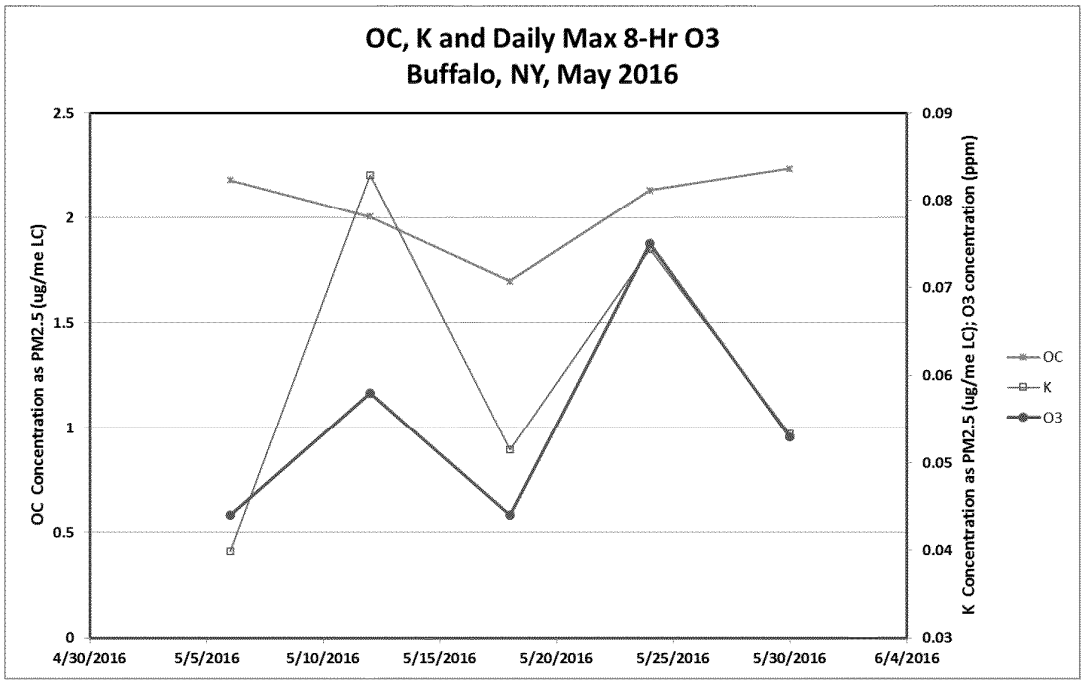

Figure 47. Buffalo New York CSN Data

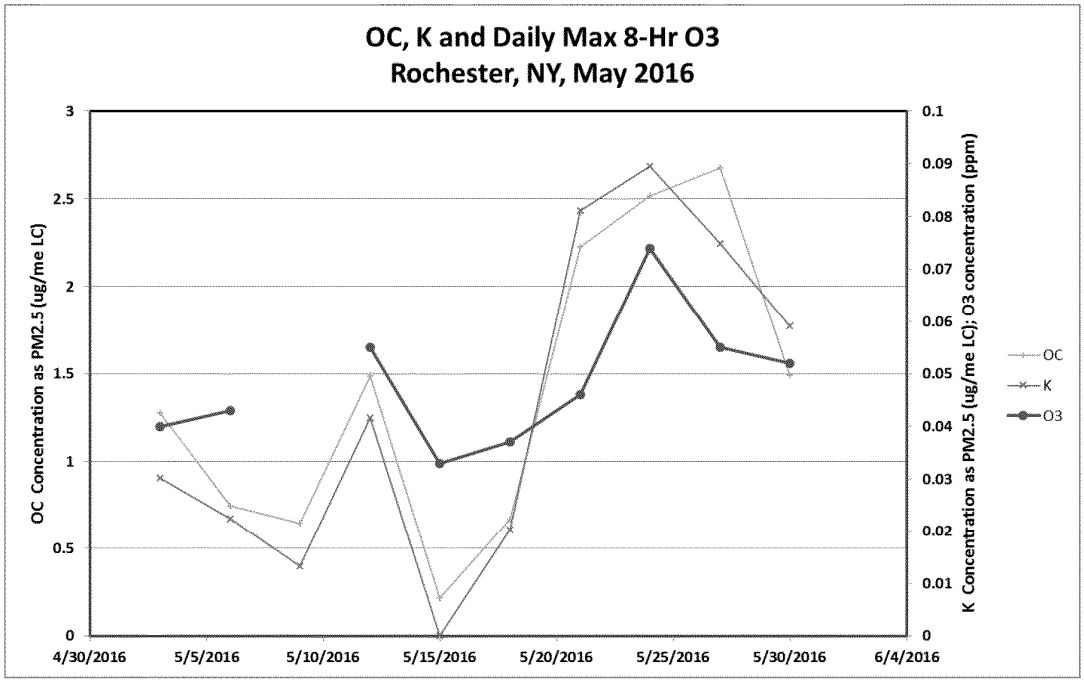

Figure 48. Rochester New York CSN Data

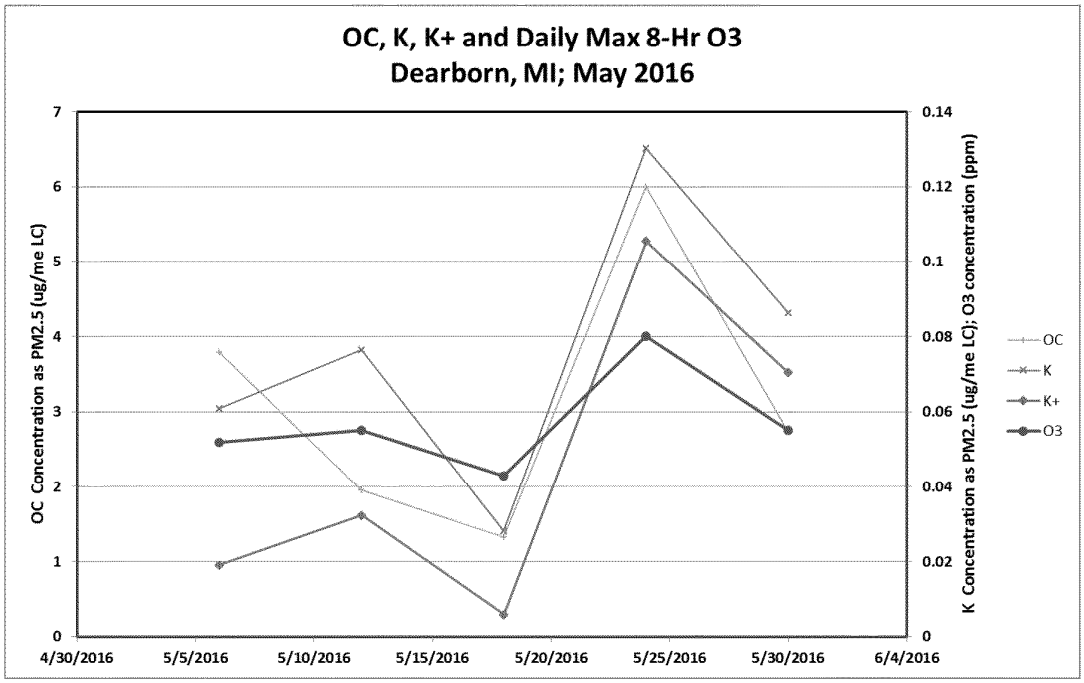

Figure 49. Dearborn Michigan CSN Data

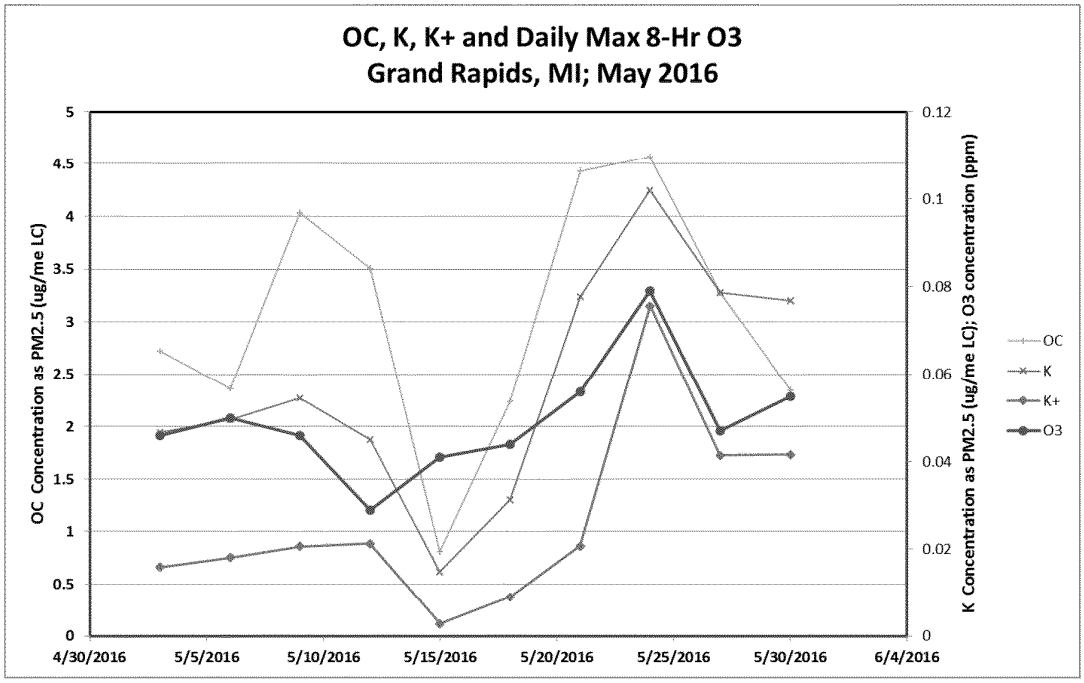

Figure 50. Grand Rapids Michigan CSN Data

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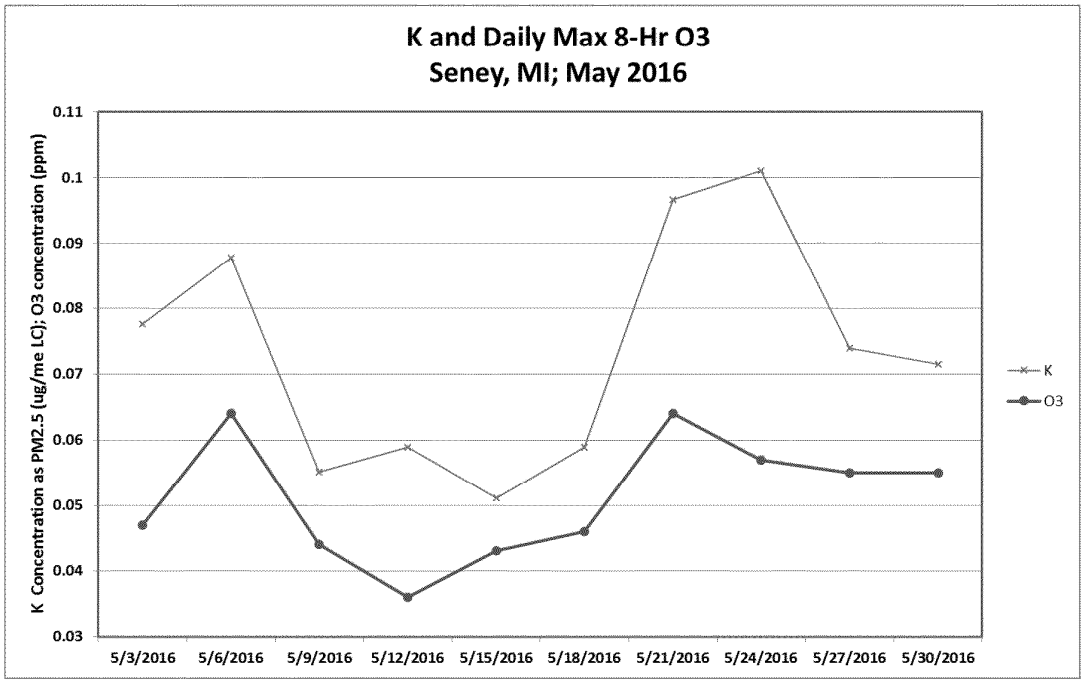

Figure 51. Seney Michigan IMPROVE Data

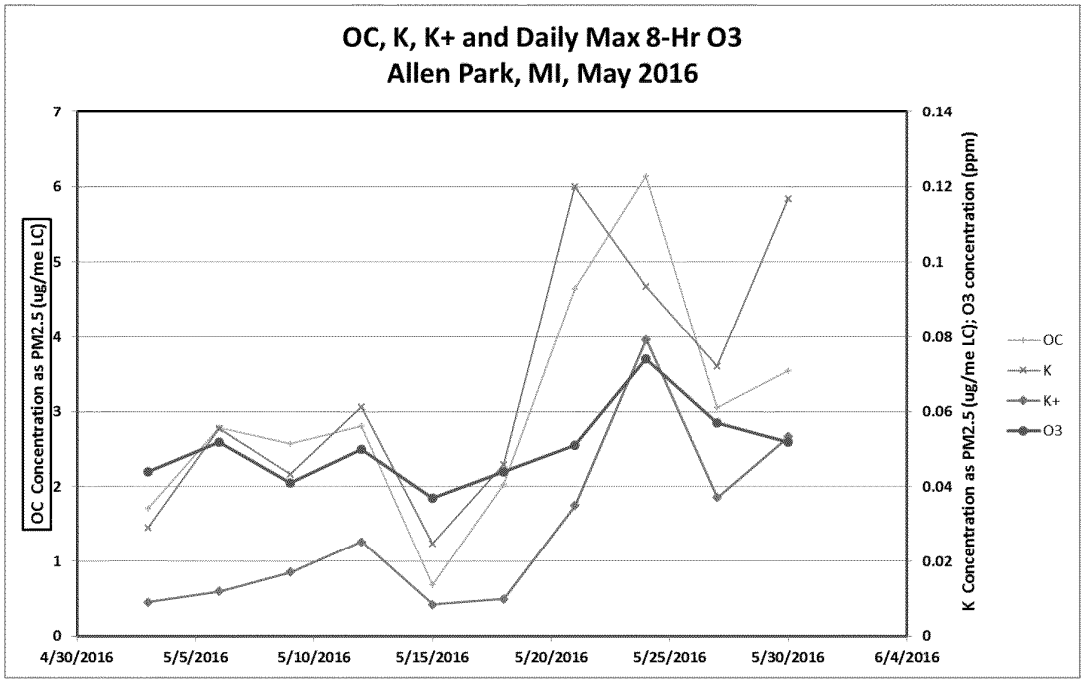

Figure 52. Allen Park Michigan CSN Data

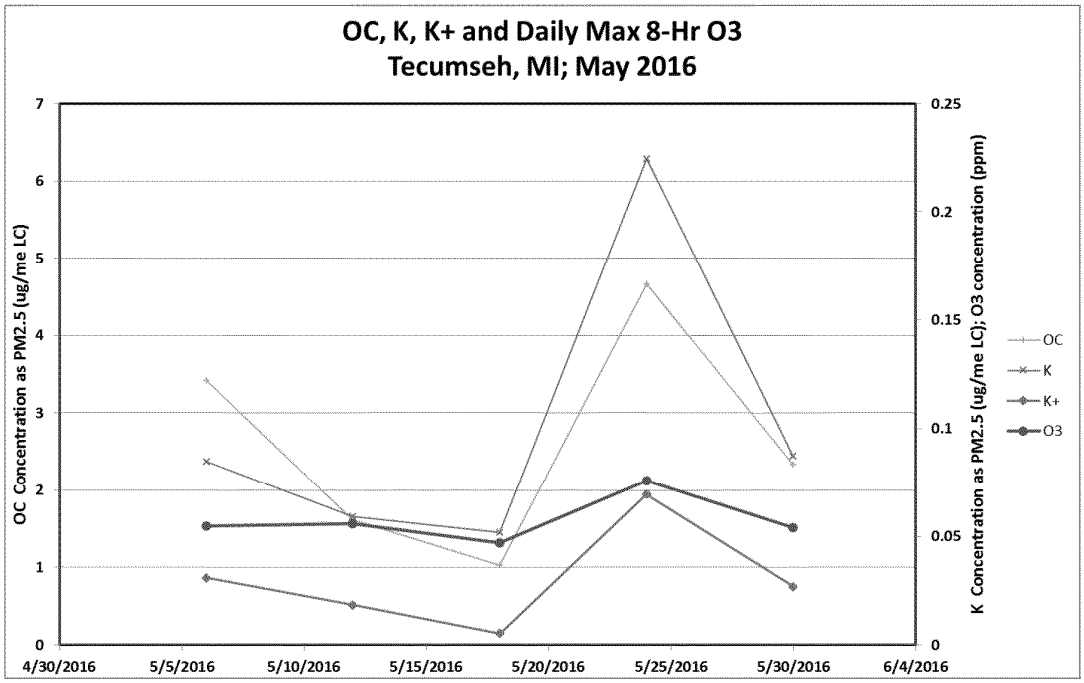

Figure 53. Tecumseh Michigan CSN Data

5. METEOROLOGICAL CONDI TIONS DURING THE EVENT

Weather conditions were dominated by strong high pressure over the Great Lakes early in the period, with weak low pressure passing off the New England coast (Figure 54). The high pressure center over the Great Lakes was responsible for trapping pollutants from the wildfire plumes in the boundary layer while surface temperature began to heat up. Low pressure off the New England coast produced numerous showers over southern New England on May 24th with northeast winds and mild temperatures. By May 25th (Figure 55), the skies cleared over New England and winds were mostly from the northwest throughout the boundary layer.

Of special interest are the 850 millibar (mb) height maps, since this is high enough in the boundary layer (~1500m) that long range transport can occur. In Figure 38, we observed that the aerosol plume extended up to 3000 meters, so the 850mb winds would be a good indicator for long range transport. In Figure 56 we see that there is an 850mb low pressure trough off the U.S. east coast. The airshed for western New York and western New England originates in Quebec and Ontario on May 23- 24th, which is typically a clean air mass, when absent of wildfires.

By May 25th (Figure 57a) the air flow loops around from Michigan, before turning southeast into New York and Connecticut. On May 26th (Figure 57b), the transported boundary layer air flows from the Ohio River Valley before turning east-southeast into Connecticut. After this, the upper level flow becomes more southwest, which could have caused some transport of pollutants from the I-95 corridor. Therefore, May 25-26th, 2016, did not fit any previous typical ozone scenario, and absent the wildfire plume, one would expect cleaner air coming into the region. By May 27th, high pressure moves off the coast, which brings cleaner maritime air into the State, lessening the effect of the plume on many of the monitors.

Figures 58-61 show site specific meteorological data graphed from May 24-28, 2016. The top graph for each site shows the hourly site temperatures plotted with the hourly ozone and the bottom graph plots the wind direction degrees plotted with the hourly ozone. The northerly wind direction is represented at both 0 and 360 degrees, so the wind graph will frequently switch between the two ranges when the wind is from the north. Beginning on May 25th, high temperatures at all the sites were well into the 80's (°F) and approached 90 °F at the East Hartford site. Generally sunny skies during May 25-28th provided sufficient conditions for ozone formation. It can be observed that the wind direction began from the west/northwest at the inland sites on May 25th, but quickly changed to the south at our Westport site because of the sea breeze. All sites showed the wind direction changing to the south and southeast as the synoptic weather pattern changed with the cold front approaching from the north. During May 27-28th, the wind were generally from the south pushing the plume inland and leading to the higher ozone in Cornwall on the 27th. Typically, southerly winds off the ocean tend to transport clean maritime air into the State, pushing an ozone plume north while lowering concentrations.

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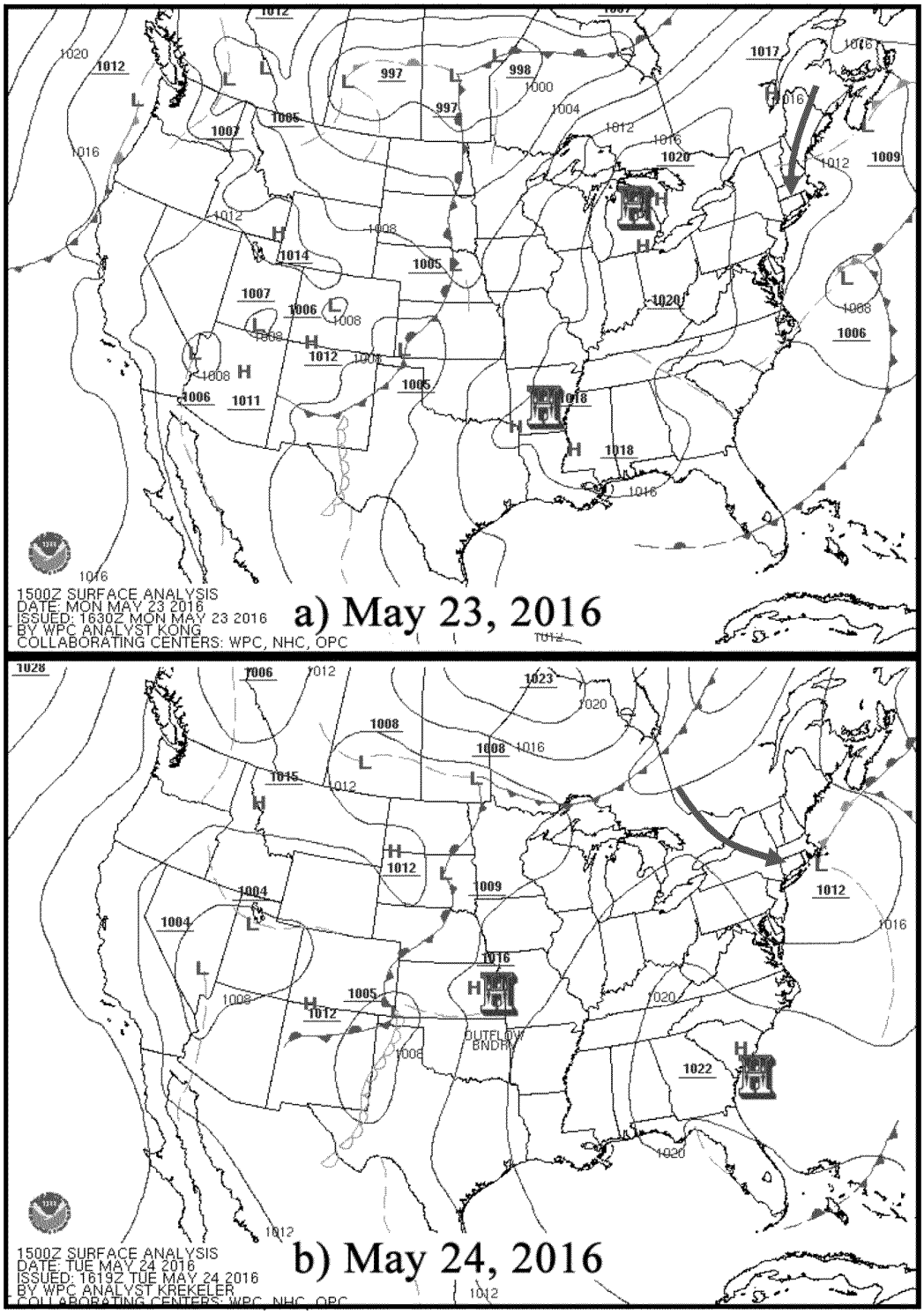

Figure 54. Surface Fronts for May 23-24 (a,b), 2016. Note the high pressure area over the Midwest on May 23-24th, creating subsidence and trapping the smoke plume pollutants over the Midwest.

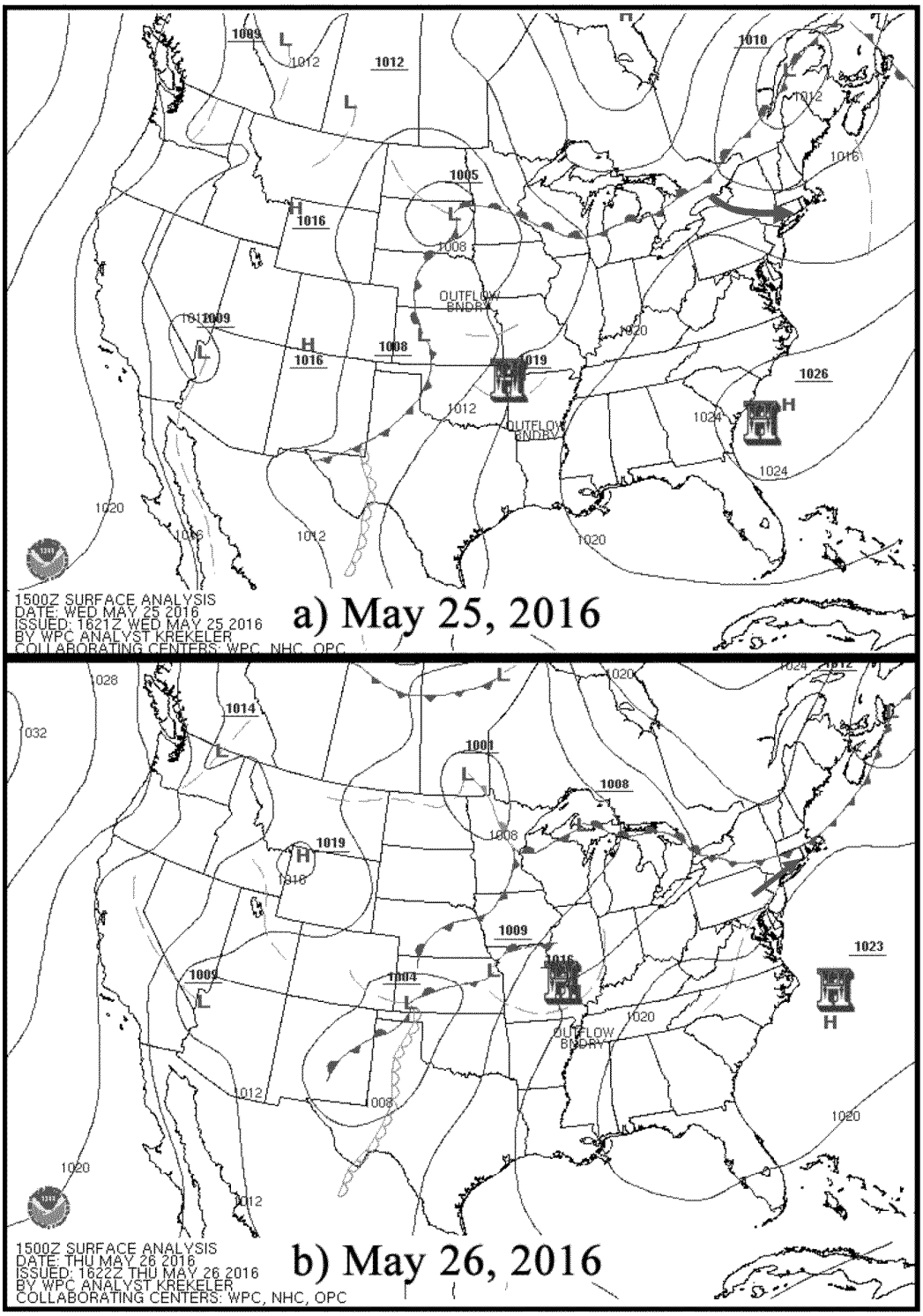

Figure 55. Surface Maps for May 25-26 (a,b), 2016. This shows northwest winds at the surface with approaching coldfront (a) turning the winds to the southwest(b) on May 26th.

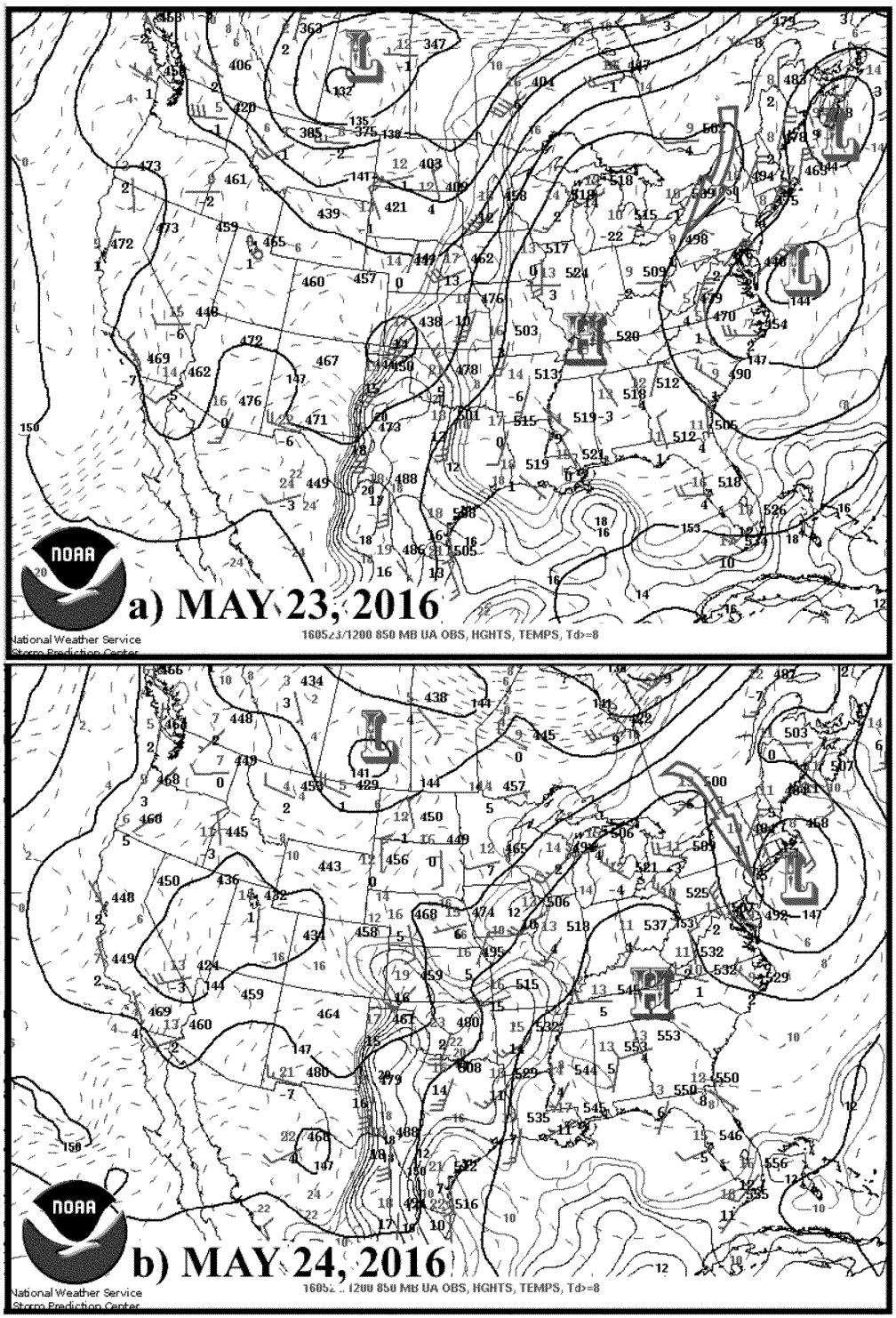

Figure 56. 850 mb Pressure Pattern with Winds for May 23-24 (a,b), 2016. Low pressure center off the New England coast creates a northerly wind at 850 mb.

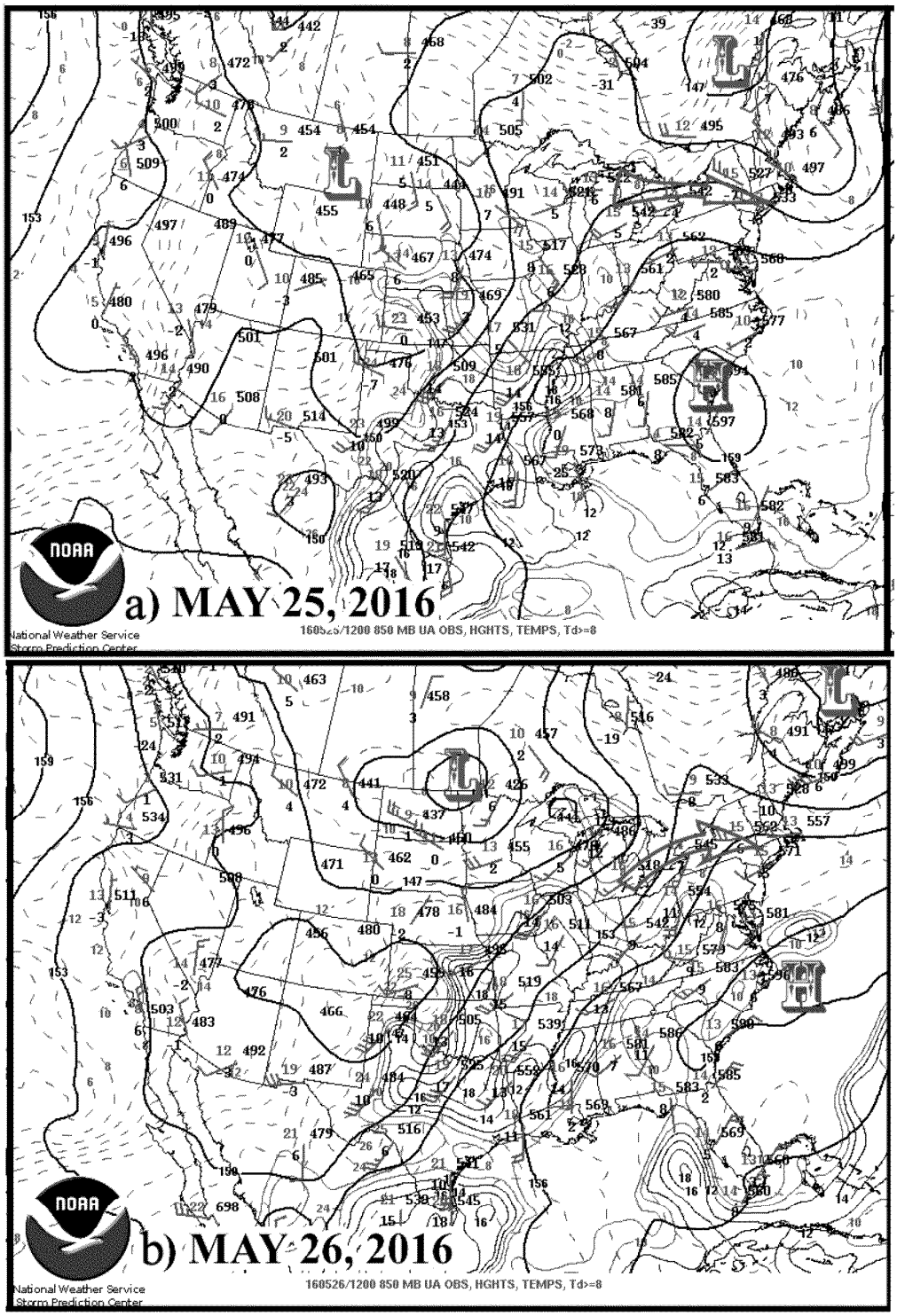

Figure 57. 850 mb Pressure Pattern with Winds for May 25-26 (a,b), 2016. High pressure center moves off the east coast causing the 850 mb transport winds to turn more westerly from Michigan.

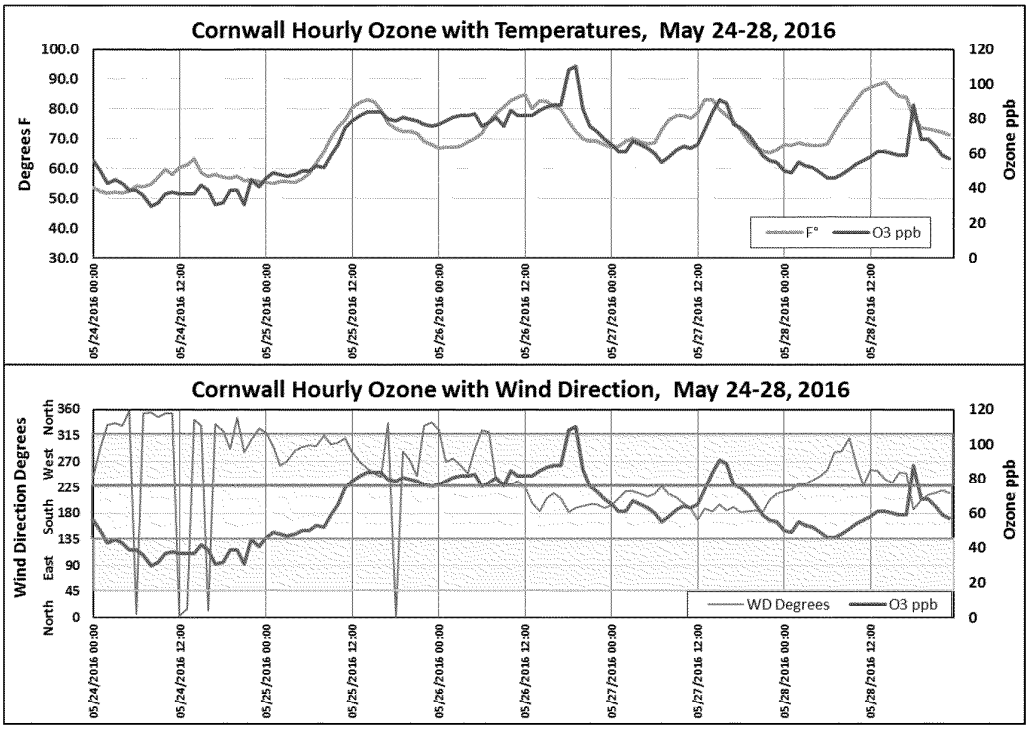

Figure 58. Cornwall Hourly Ozone vs. Temperatures (top); Hourly Ozone with Wind Direction (bottom).

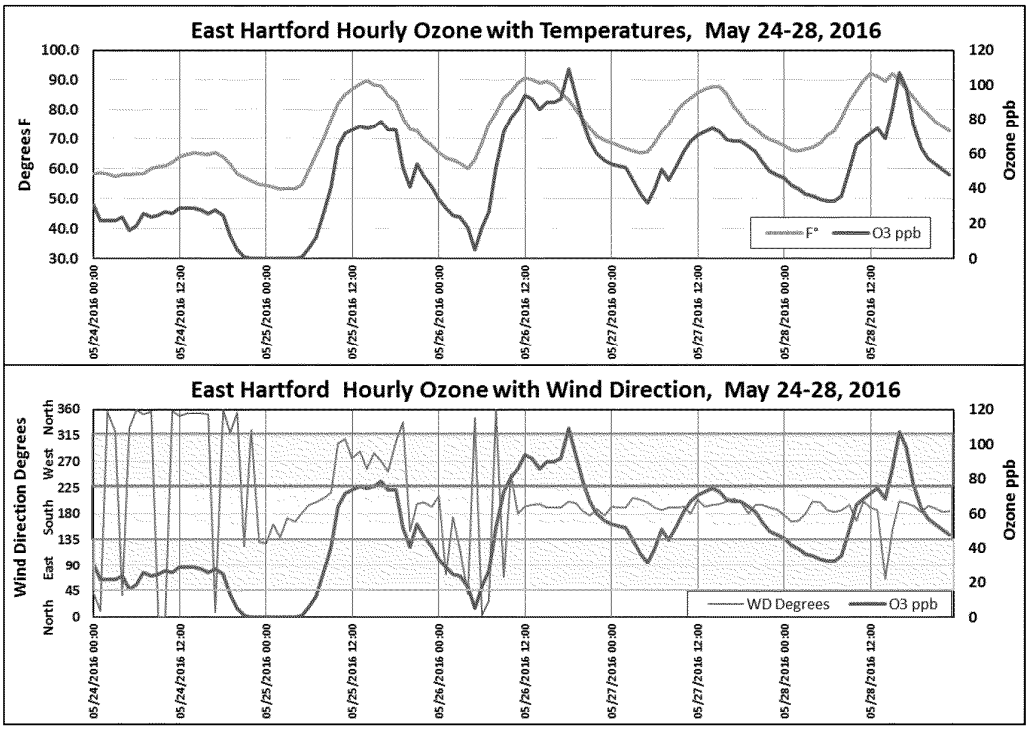

Figure 59. East Hartford Hourly Ozone vs. Temperatures (top); Hourly Ozone with Wind Direction (bottom).

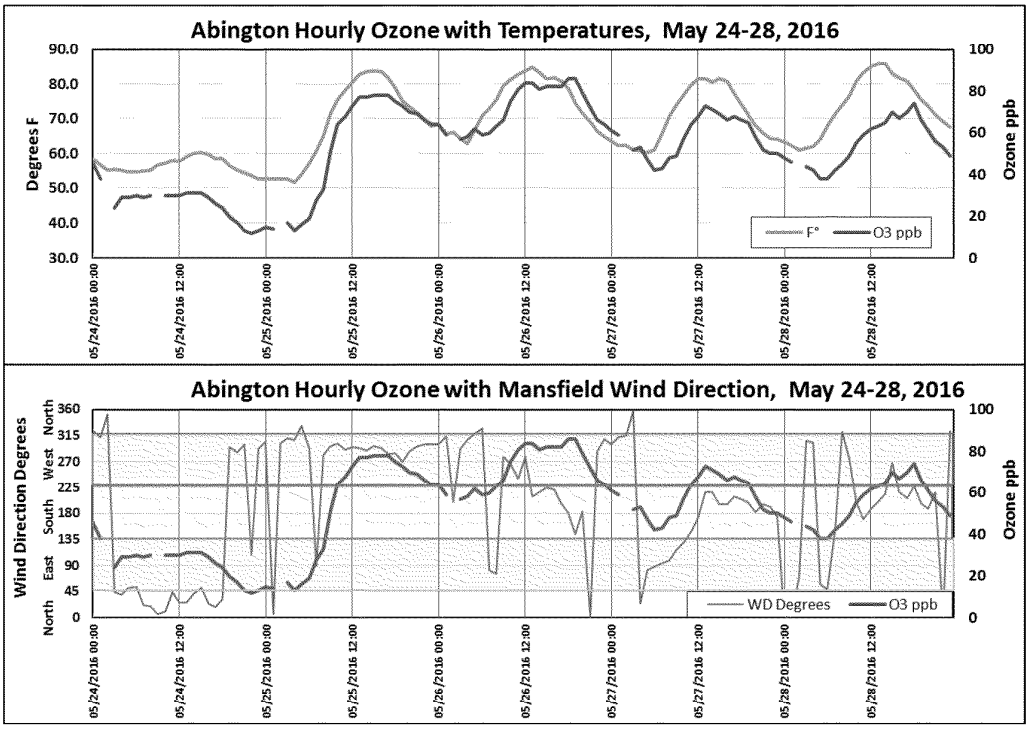

Figure 60. Abington Hourly Ozone vs. Temperatures (top); Hourly Ozone with Wind Direction (bottom).

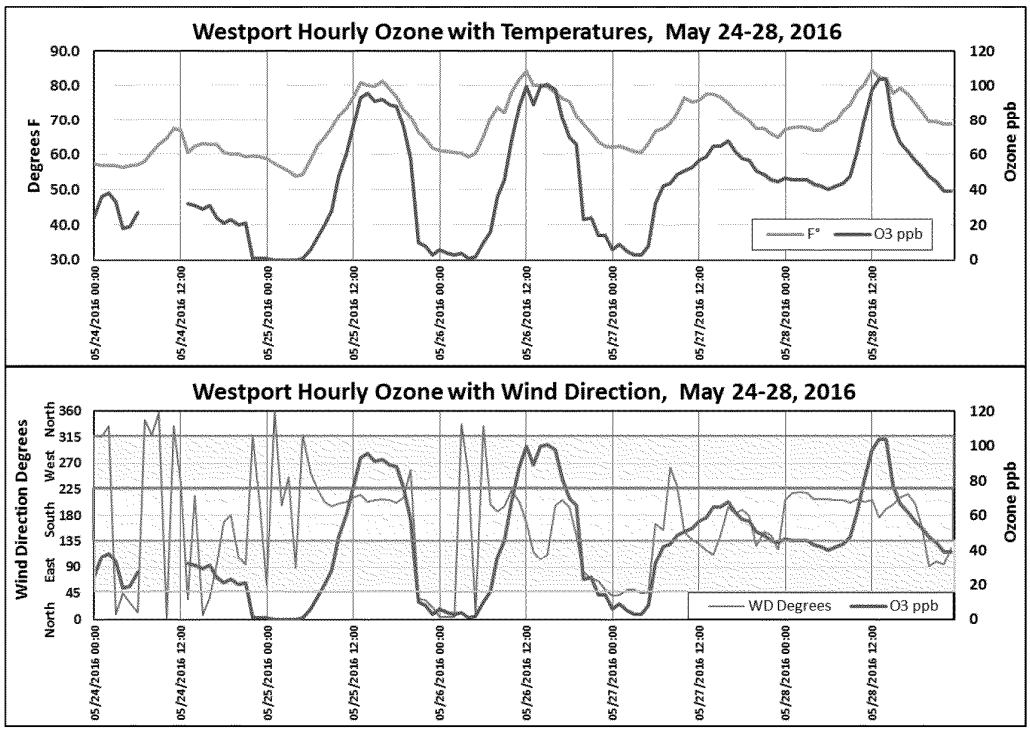

Figure 61. Westport Hourly Ozone vs. Temperatures (top); Hourly Ozone with Wind Direction (bottom).

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6. HYSPLIT TRAJECTORY ANALYSIS

"Air agencies can produce HYSPLIT trajectories for various combinations of time, locations and plume rise. HYSPLIT back-trajectories generated for specific monitor locations for days of high O_3 concentrations illustrate the potential source region for the air parcel that affected the monitor on the day of the high concentration and provide a useful tool for identifying meteorological patterns associated with monitored exceedances. Forward-trajectories from specific wildfire events to specific monitors can also be used to indicate potential receptors."

-EPA guidance: Treatment of Data Influenced by Exceptional Events

6.1 Forward Trajectory Example

Although the actual ozone event over Connecticut occurred after May 24th, 2016, the conditions producing the ozone were taking place several days before over the Mid-western States. Satellite images showed that the wildfire plume had been traversing Great Lakes' States several days after the fire had started. It wasn't until after May 20th that the weather conditions began trapping the plume in the boundary layer over that region. Because of this, it is most useful to begin a forward trajectory analysis from Fort McMurray beginning on May 18th, 2016.

The model of choice for long range transport is the North American Regional Reanalysis (NARR) model, which uses the high resolution NCEP Eta Model (32km/45 layers), together with the Regional Data Assimilation System (RDAS) which, significantly, assimilates precipitation along with other variables. The 120-hour May 18th forward trajectory was chosen as a scenario where particles and VOCs released at 1000-2000 meters above ground level could theoretically travel from the Fort McMurray, Alberta wildfire plume and pass over Michigan after May 21st (Figure 62). The VIIRS satellite image on May 18th (see Figure 11) shows parts of the plume heading east over Hudson Bay on its way to Michigan a few days later. This is significant, since on May 21st, a high pressure system was camped over the mid-western states (Figure 63), which would trap the pollutants and later lead to the production of ozone over the Great Lakes' States.

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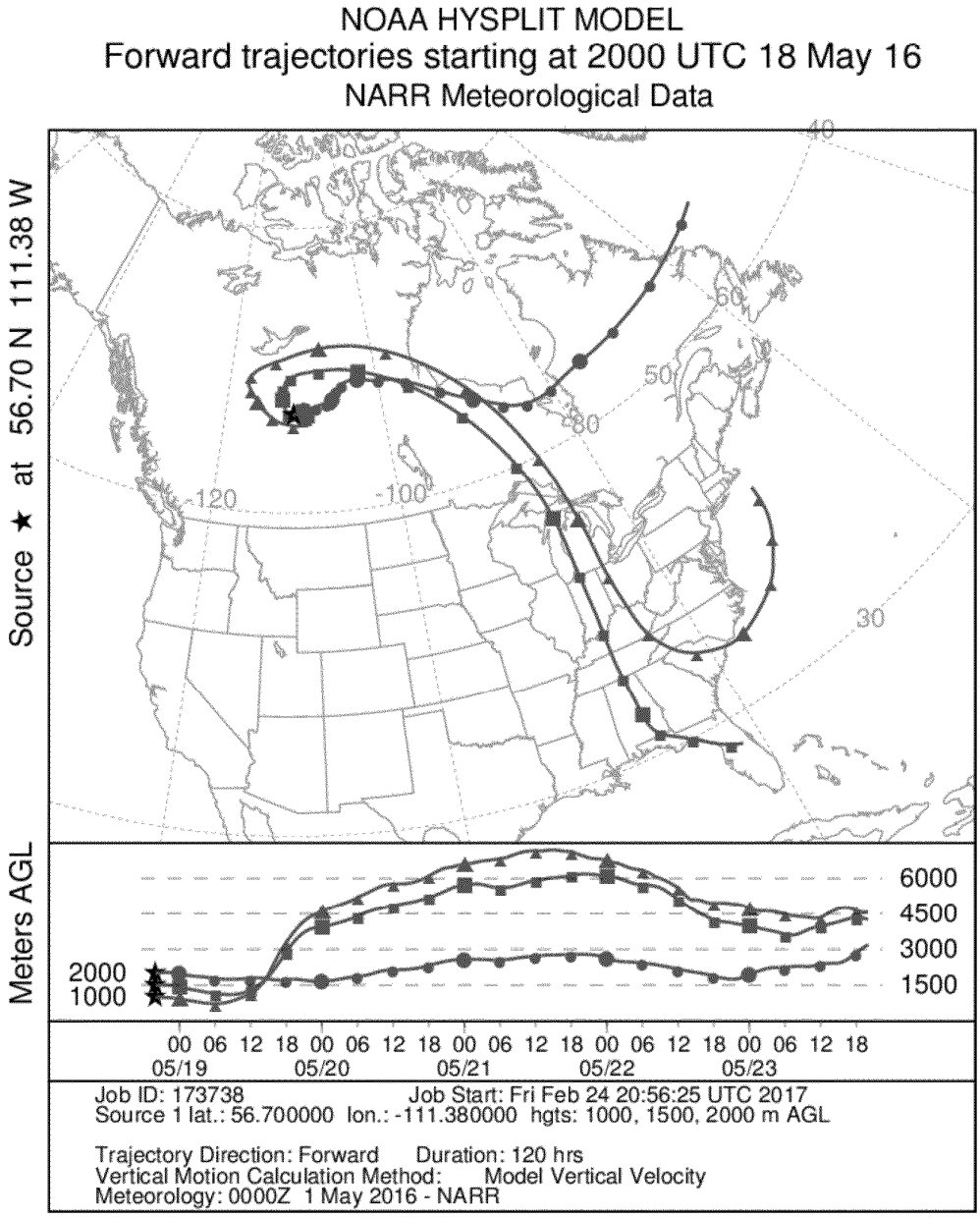

Figure 62. 120-hour HYSPLIT Forward Trajectories from Fort McMurray May 18-23, 2016

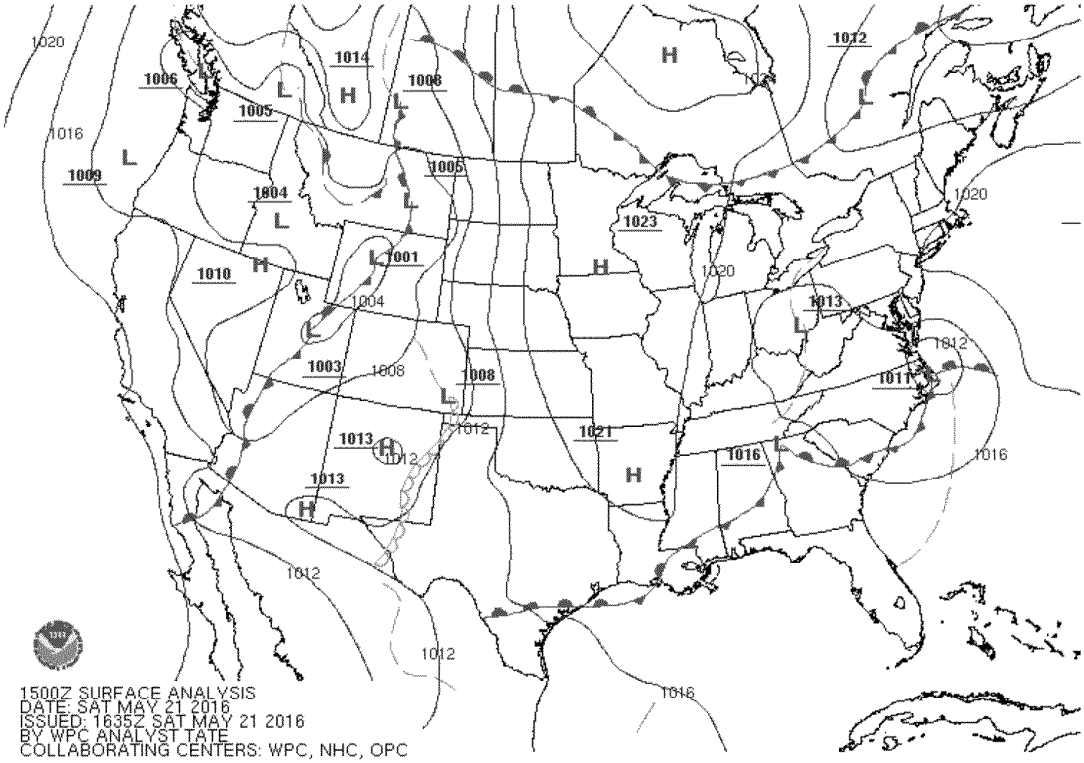

Figure 63. Surface Weather Analysis from May 21, 2016

6.2 Back Trajectory Analysis

Ozone began building up around the Great Lakes' on May 23rd and peaked on May 24th (Figure 64) before moving east to Connecticut. The forward trajectories and plume analysis clearly showed that the smoke plume settled over this area for several days. Back trajectory analysis for this area confirms the source of the ozone precursors (Figure 65). By May 24th, the wind had turned to the southwest, which allowed VOC's from the smoke to mix with emission sources to the south and rapidly produce ozone. Figure 66 shows a matrix of back trajectories ending at 1000m over western New England for both May 25th and May 26th. The source region, 48 hours before, is clearly the Michigan area on both days, but the trajectories shift southward on May 26th. The winds also turned southwestward over Long Island Sound (LIS) on May 26th, which may have provided some ozone enhancement from the New York City area.

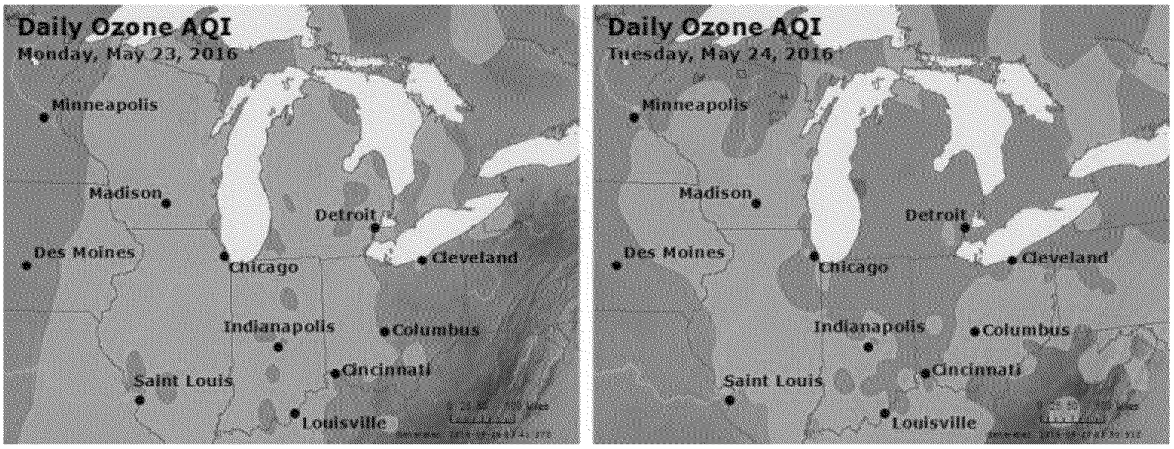

Figure 64. Ozone AQI Maps for May 23-24, 2016.

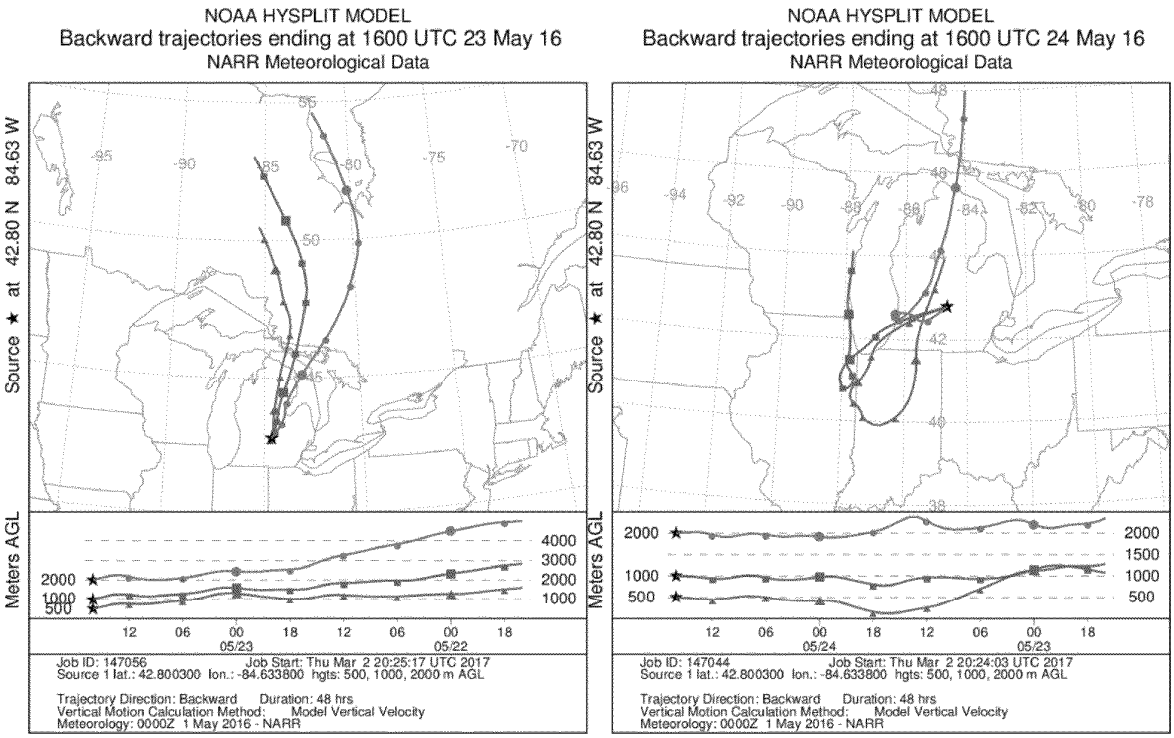

Figure 65. HYSPLIT Back Trajectories from Michigan, May 23- 24, 2016

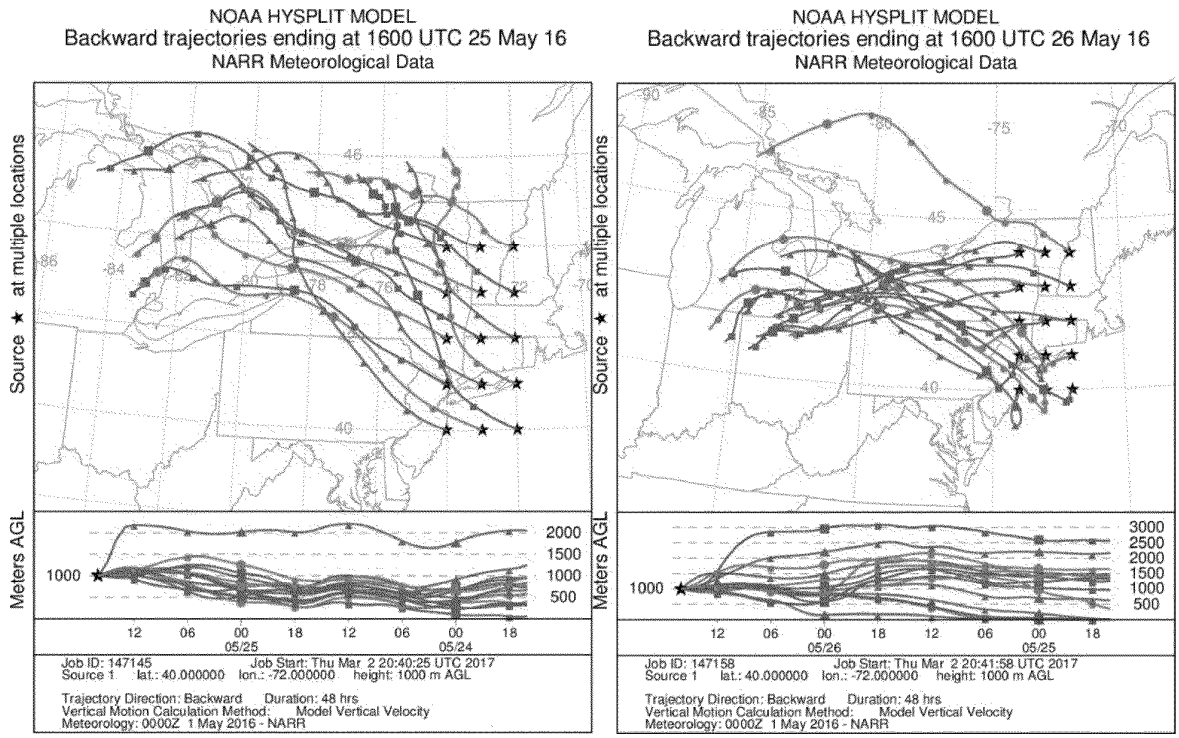

Figure 66. HYSPLIT 48-hour Back Trajectories from New England (left) May 25, 12:00EDT, (right)May 26, 12:00EDT.

Westport Connecticut surface winds often blow from the southwest during the summer due to the sea breeze that develops during the late morning and afternoon. Because of this, it is important to point out that even with clean air being transported aloft from the northwest, the surface winds can turn southwest during the afternoon. Southwest winds are often associated with polluted air being transported northeastward from the I-95 corridor into Connecticut. The previous figure of the New Haven Ceilometer backscatter aerosol levels showed the smoke plume arriving during the early morning on May 25, 2016. The aerosol level reached a height of 3000 meters and a layer of high concentrations was evident at about 500 meters. Accordingly, the ending elevations for the Westport back trajectories were set at 500 and 3000 meters to determine if the paths crossed the Fort McMurray wildfire plume during its journey.

Figure 67 shows the 168-hour back trajectories ending at 8:00 am EDT on May 25, 2016. The 3000 meter trajectory has its start in far northern Canada, and the 500 meter level begins over Hudson Bay. These trajectories would likely pass through a very clean air mass, in the absence of wildfires. Two hours later (10:00am EDT), these back trajectories had already shifted westward (Figure 68). It is observed that both trajectories are approaching the Fort McMurray wildfire area (yellow star) and could have easily traveled through the plume on these paths.

Figure 69 shows the noon EDT 3000 meter back trajectory passing directly over the wildfire area. This path would bring the pollutants from the wildfire to Westport Connecticut over the course of six days. Finally, Figure 70 shows the fire locations with the aerosol plumes on May 20th with the HYSPLIT trajectory paths from May 19-25th. This clearly shows that the plume was present near the wildfire location and that the 3000 meter back-trajectory would have brought the plume to Westport.

It is also important to look at the low level trajectory, ending at 100 meters above Westport, to determine whether local sources would have had much effect on the air quality that day. Initially, the low level winds started out from the northwest, but as the day progressed, the winds turned southwest, likely due to the sea breeze. At 6:00 am LDT on May 25th, Figure 71 shows the winds coming from the northeast, which is normally a source of clean air at the surface. Figure 72 shows the winds coming from a more northerly direction ending at 10:00 am LDT and by 4:00 pm LDT (Figure 73), the ending trajectory does shows the wind traveling along the coast, however by this time, there would have been little time for the I-95 corridor to provide significant ozone enhancement.

On May 26th, the synoptic weather pattern was changing, as a cold front was moving south over New England, turning the surface winds to the southwest and then to the south. Figure 74 reflects this in the low level trajectory turning to the southwest, however it is still not a classic I-95 corridor set up providing a long fetch of pollutants along the corridor into Connecticut. This patterns appears short-lived as the 4:00 pm LDT ending trajectory (Figure 75) already has the wind turning southerly and mixing with maritime air.

Westport monitored its highest ozone concentration of the event on May 26th, but the weather pattern and limited transport over the I-95 corridor does not explain the high concentrations monitored there or at the other monitors in Connecticut. Back trajectory analysis strongly suggests that the Fort McMurray wildfire was the main cause behind these ozone exceedances.

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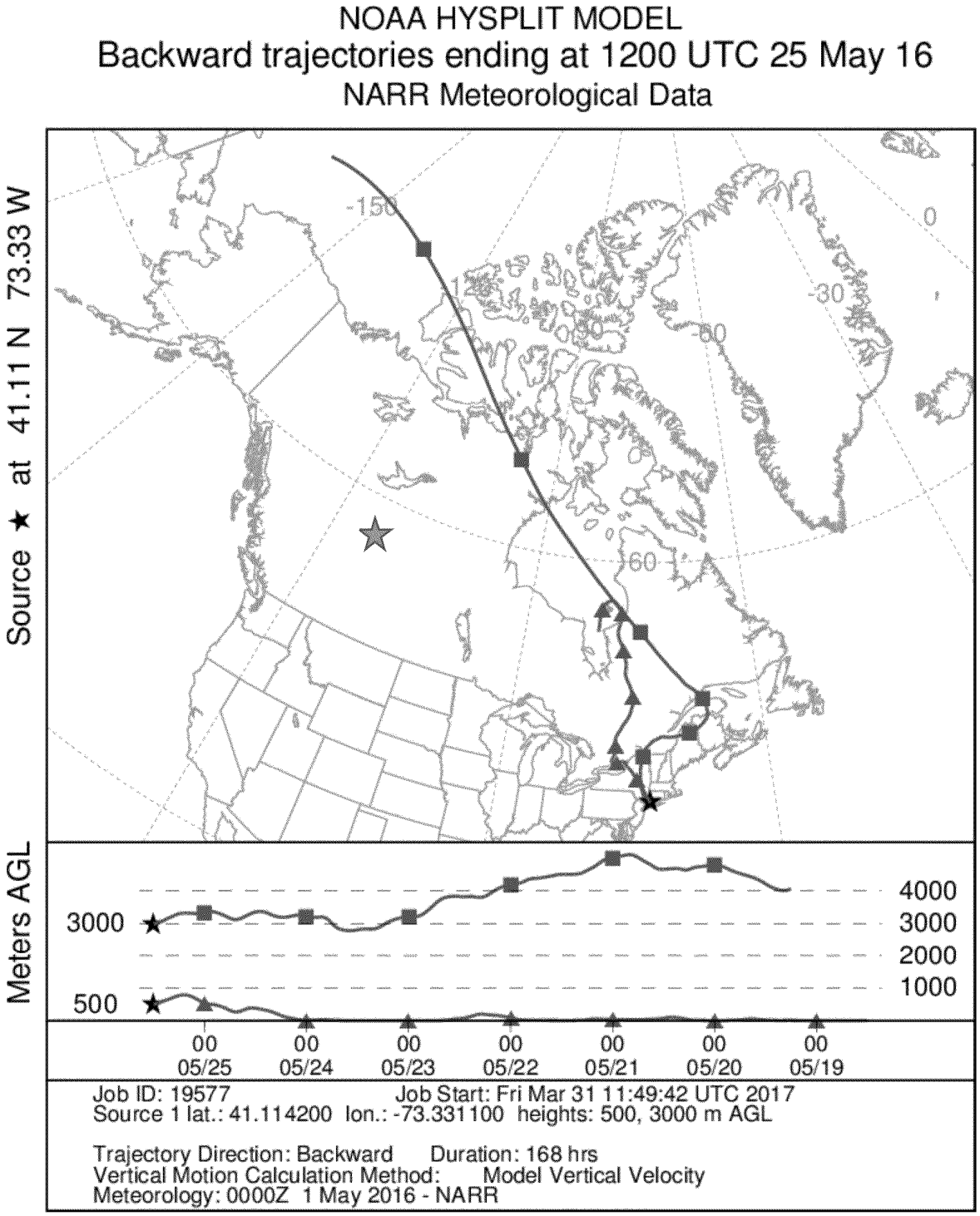

Figure 67. May 25, 2016 12 UTC Back Trajectories from Westport CT.

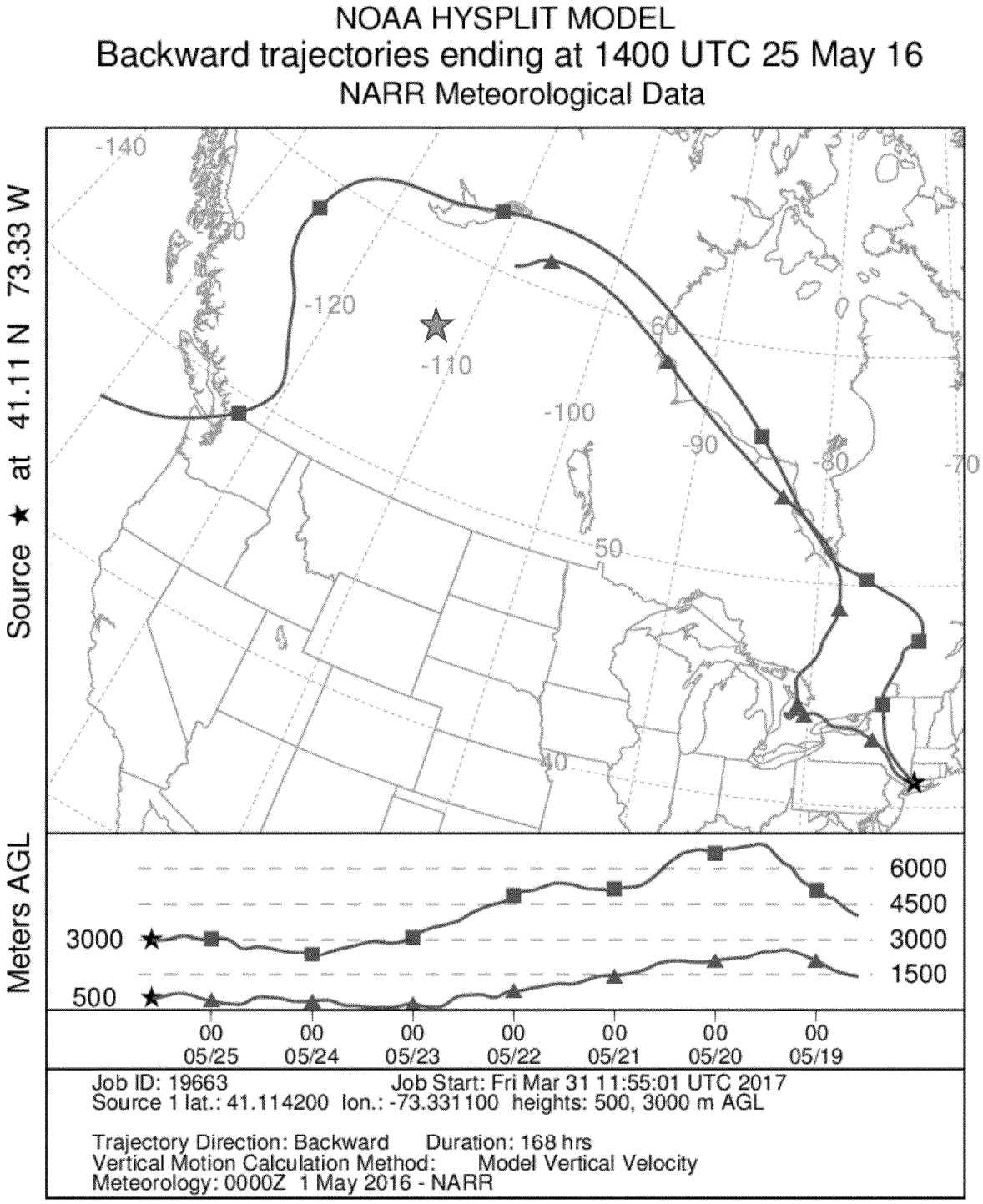

Figure 68. May 25, 2016 14UTC Back Trajectories from Westport CT.

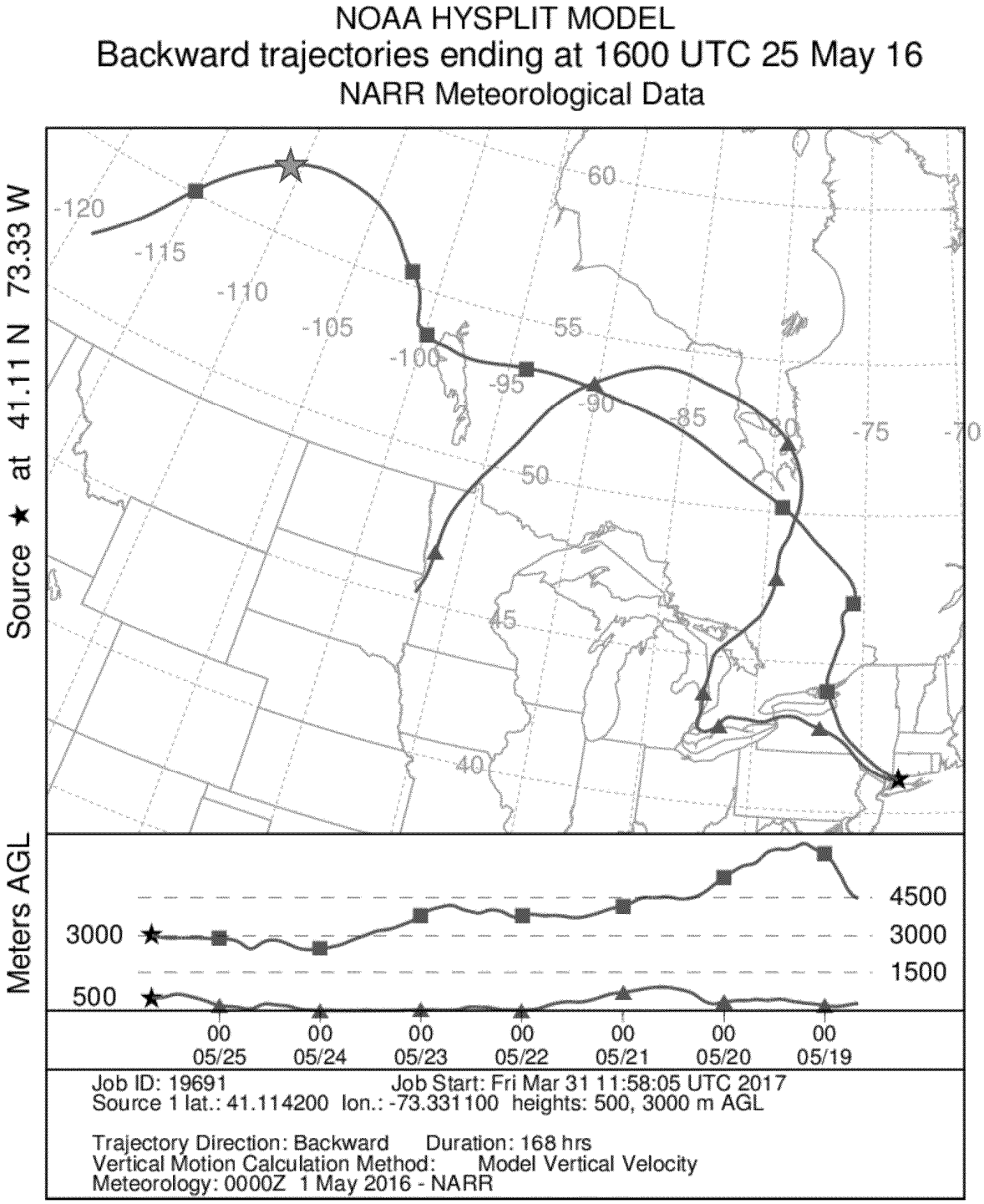

Figure 69. May 25, 2016 16UTC Back Trajectories from Westport CT.

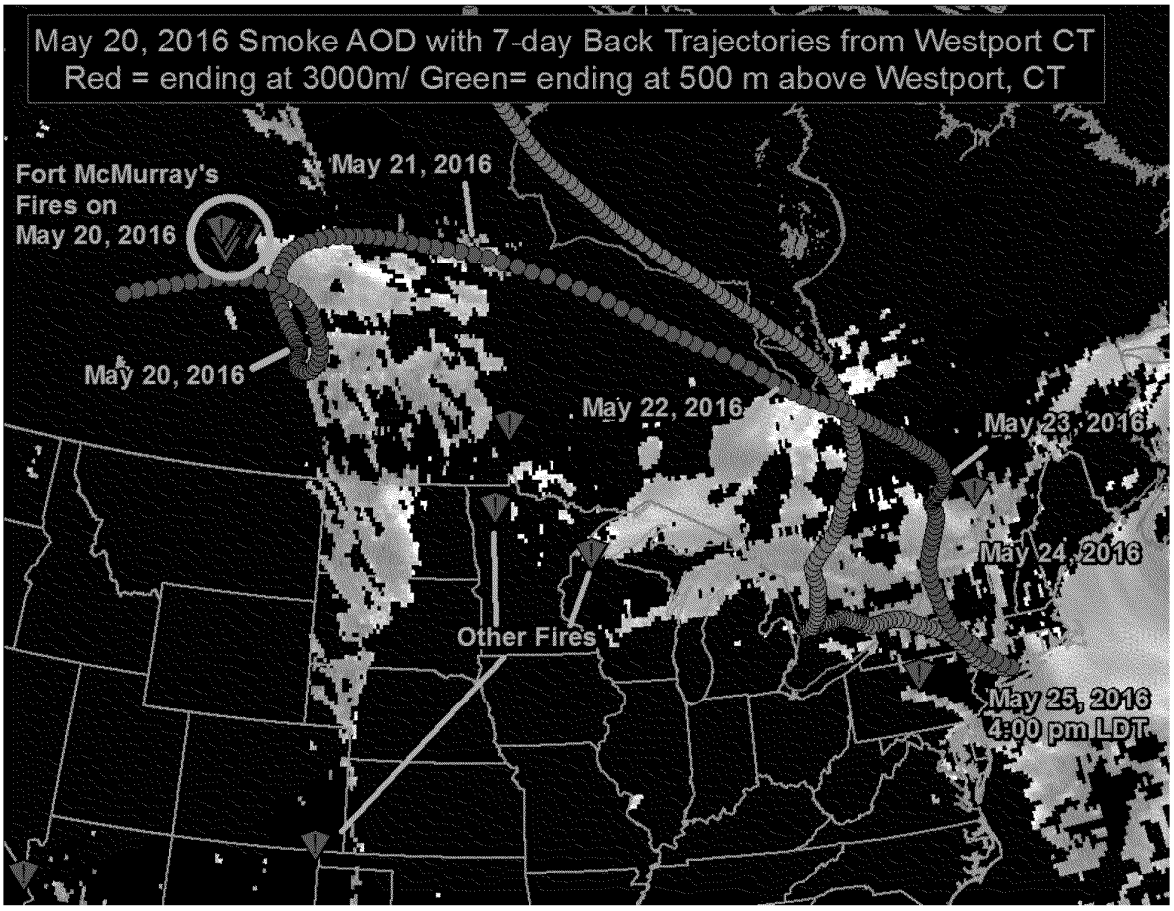

Figure 70. Hourly Back Trajectories ending at 4:00 pm LDT on May 25th with Fire Locations and Satellite AOD from May 20th, showing Path of Transport of Smoke Plume Pollutanst to Westport CT.

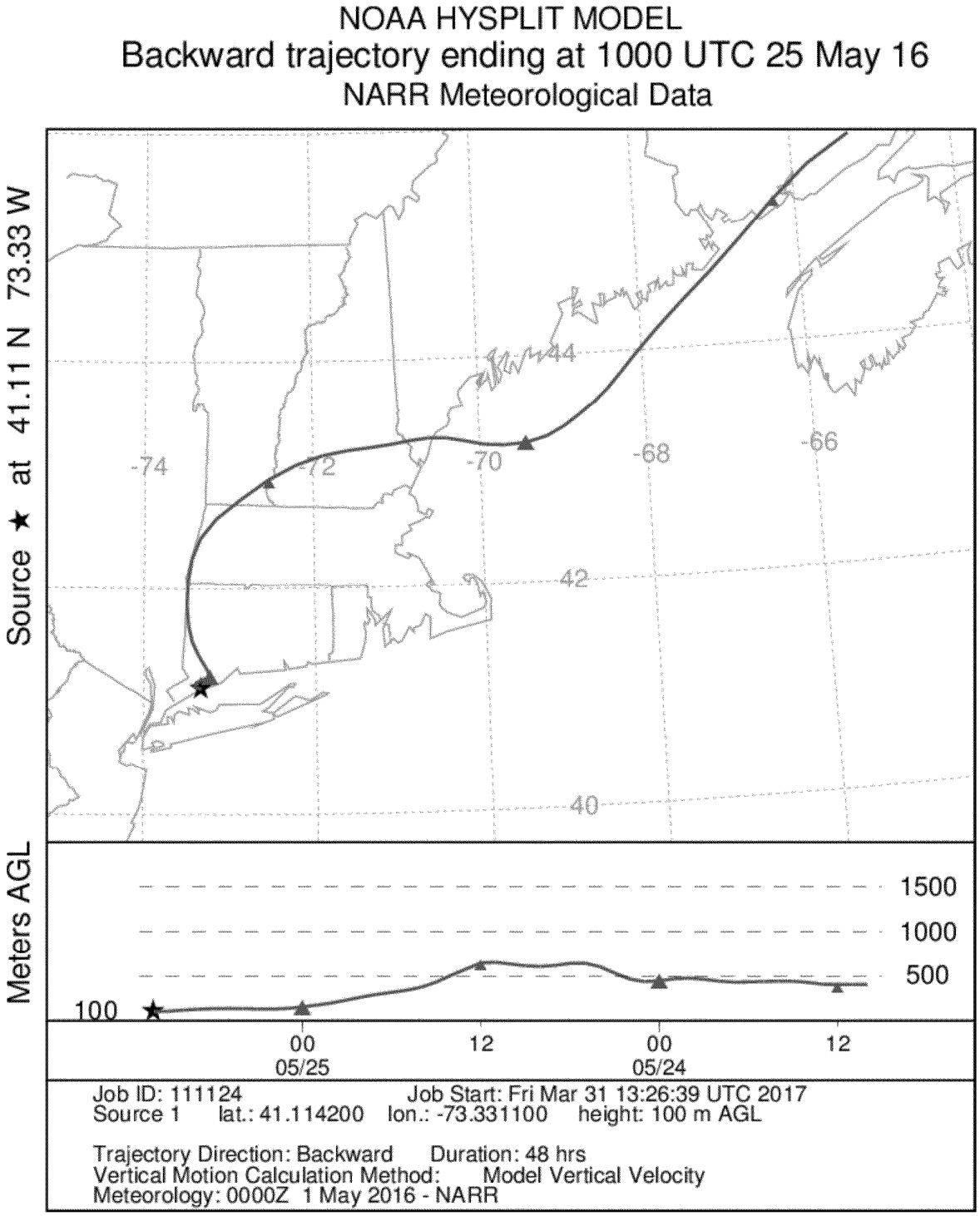

Figure 71. 100 meter Back Trajectory from Westport Connecticut ending at 6:00 am LDT May 25, 2016.

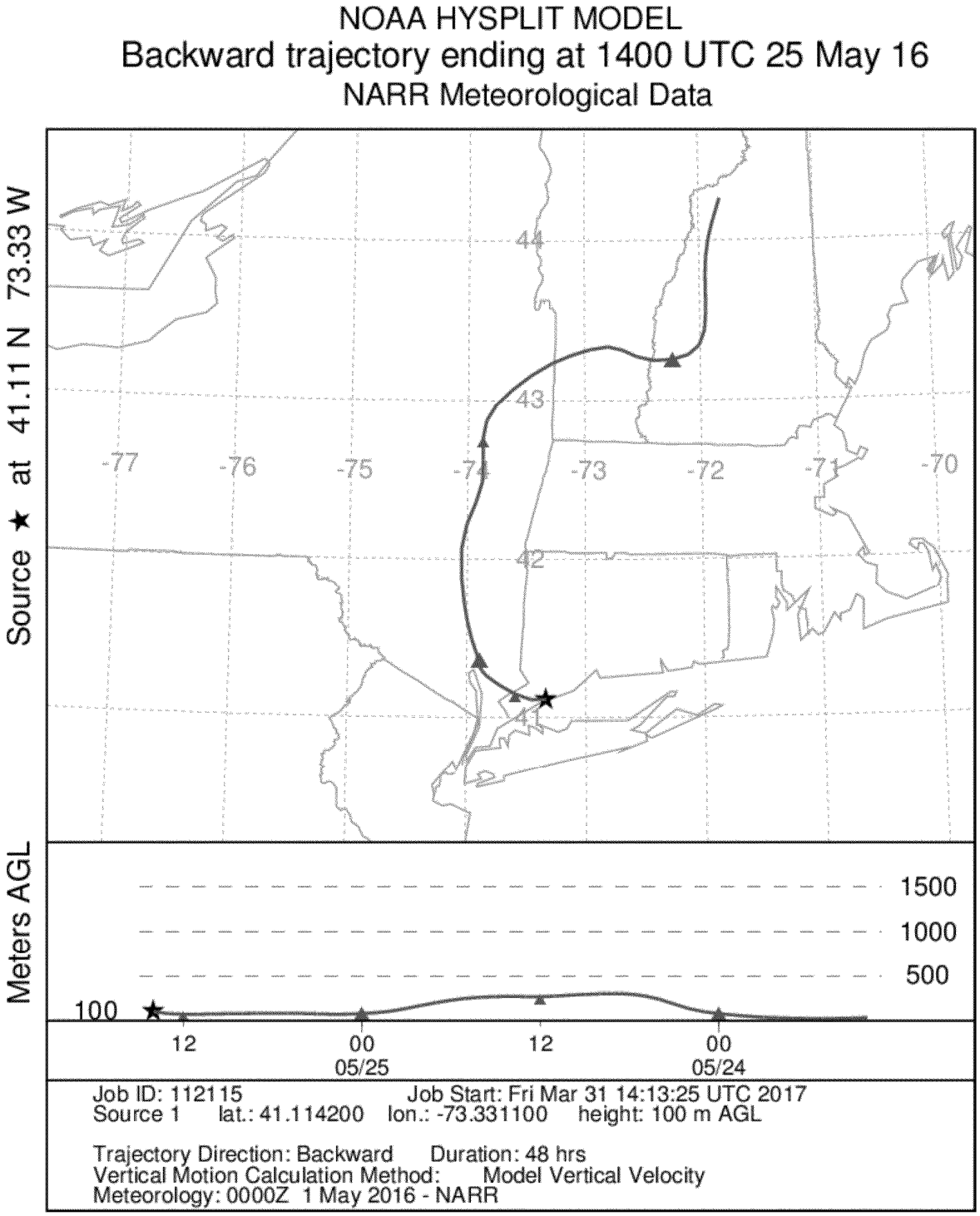

Figure 72. 100 meter Back Trajectory from Westport Connecticut ending at 10:00 am LDT May 25, 2016.

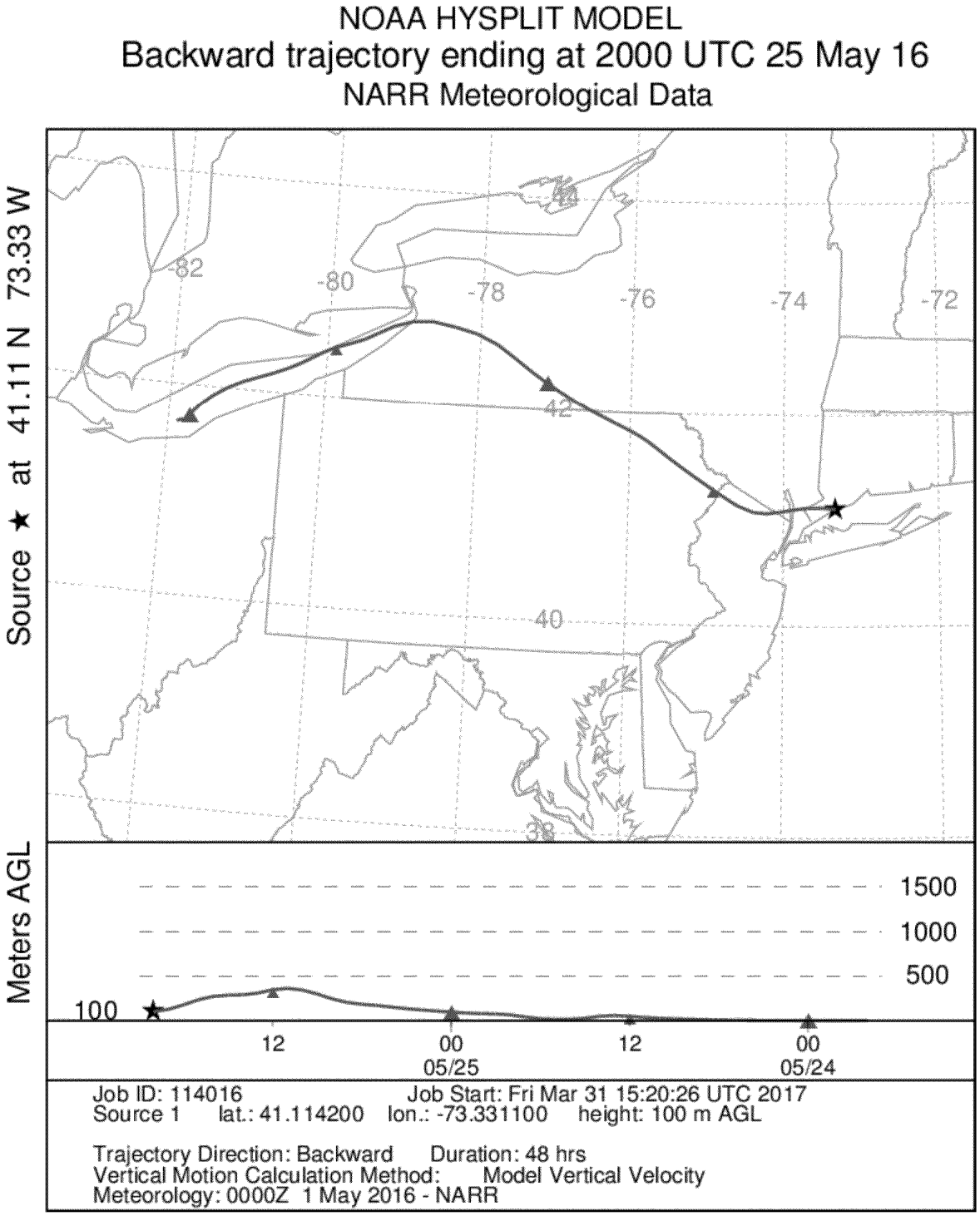

Figure 73. 100 meter Back Trajectory from Westport Connecticut ending at 4:00pm LDT, May 25, 2016.

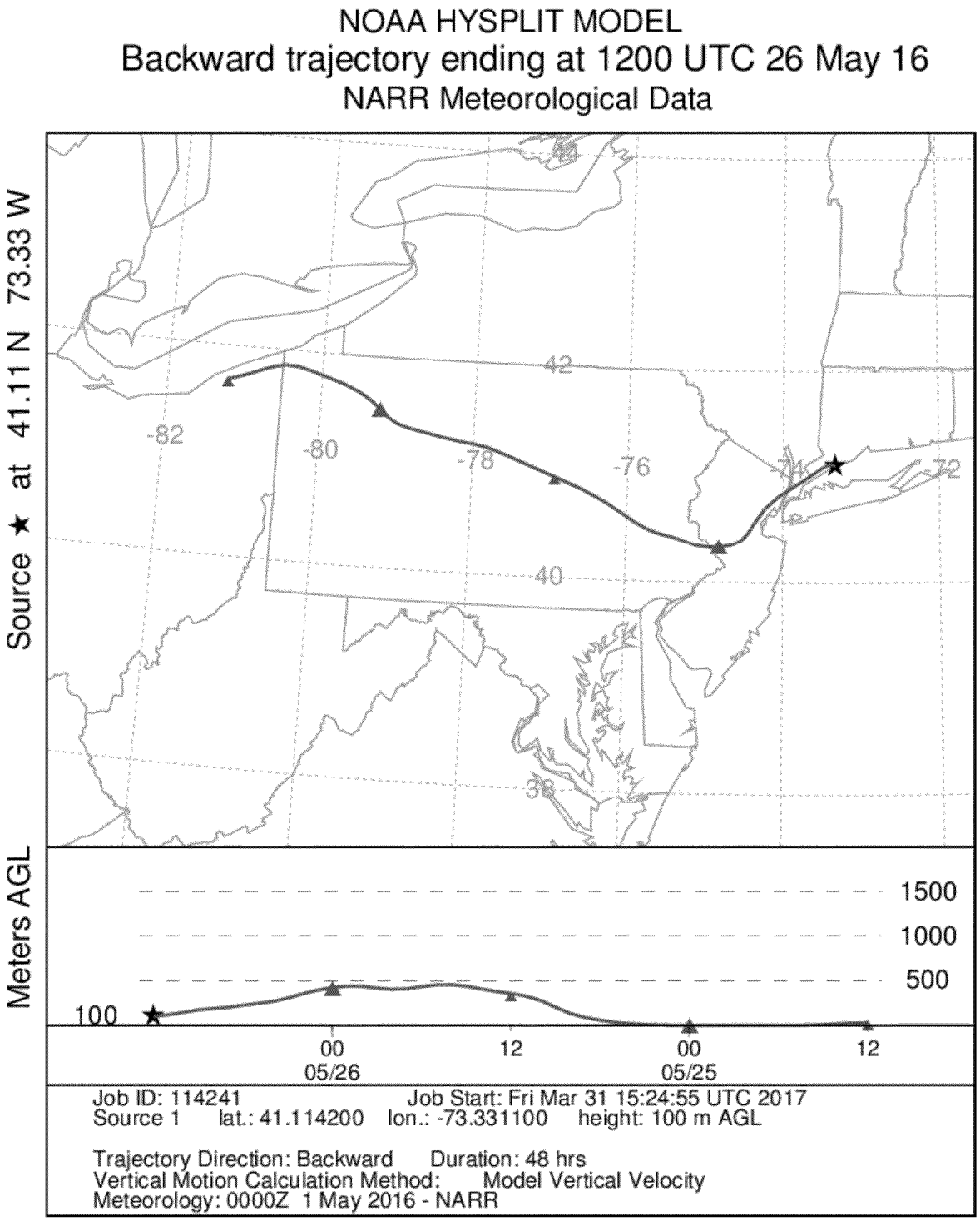

Figure 74. 100 meter Back Trajectory from Westport Connecticut ending at 8:00 am LDT, May 26, 2016.

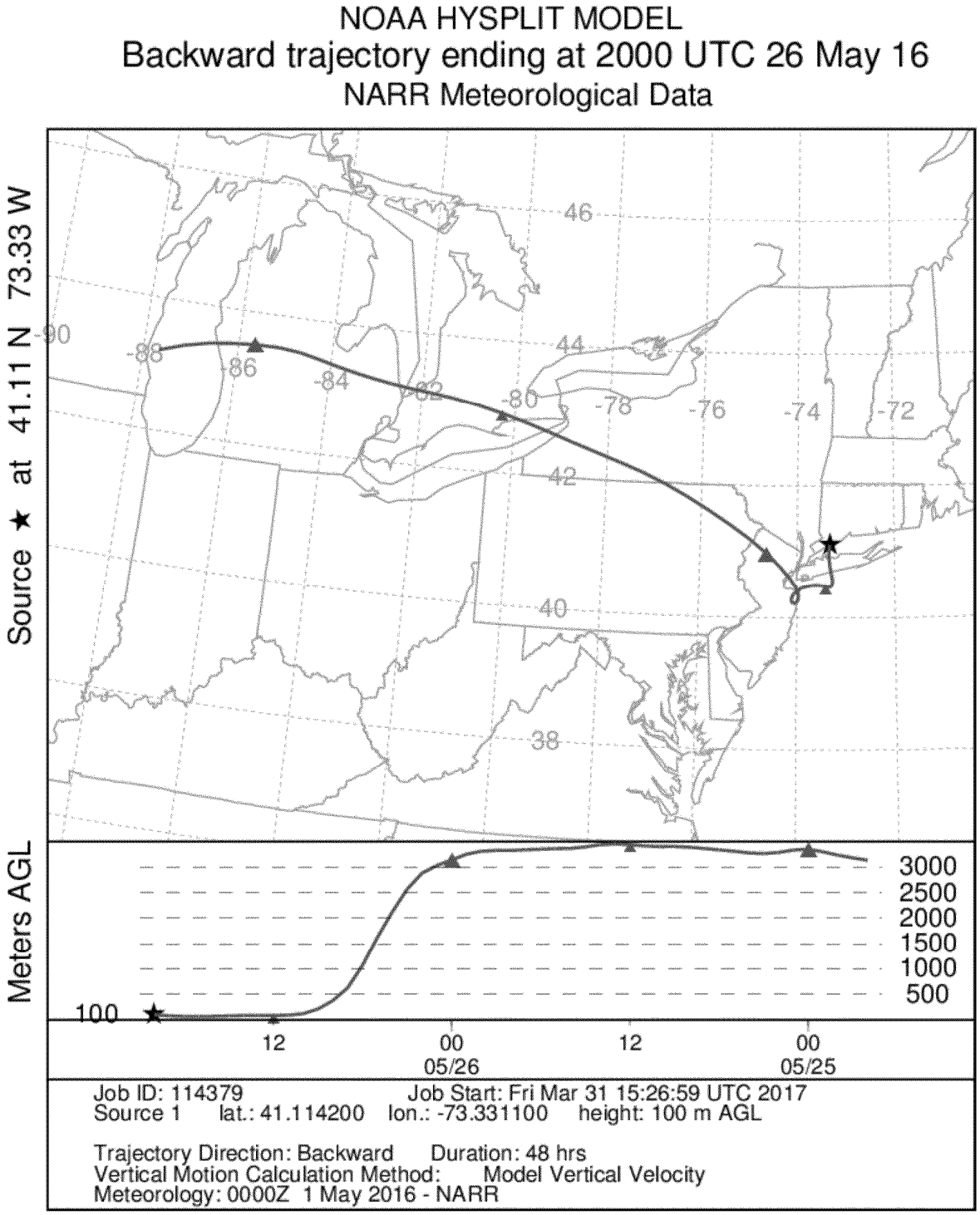

Figure 75. 100 meter Back Trajectory from Westport Connecticut ending at 4:00 pm LDT, May 26, 2016.

To further illustrate the unusually high ozone concentrations observed with the near surface wind flow, it is useful to plot 24-hour back trajectories using a higher resolution model, such as the North American Mesoscale Forecast System (NAM), which has a grid resolution of 12 km. The following figures for May 25th and May 26th start the back trajectories at 12:00 EST and 2:00 EST, respectively. For this, all four monitors in question were selected as end points. Using the Navigator Tool available on Airnowtech[21], it is straightforward to plot HYSPLIT back-trajectories and a map of ozone monitors with their hourly concentrations. Endpoint heights of 100 meters were chosen and 6-hour past intervals are labeled on the trajectories.

On May 25th at 12:00 EST (Figure 76), ozone levels were already above 80 ppb in Connecticut, but the back trajectories originate from the north and northwest, which is normally a source of low ozone and its precursors. On May 26th, at 16:00 EST (Figure 77), ozone levels are very high at all monitors in Connecticut. Except for Cornwall, the 24-hour back trajectories show southwest winds originating over the ocean and becoming southerly 6 hours earlier. The directional wind barbs line up well with these trajectories, adding more proof that surface winds along the I-95 corridor had little influence on these ozone levels.

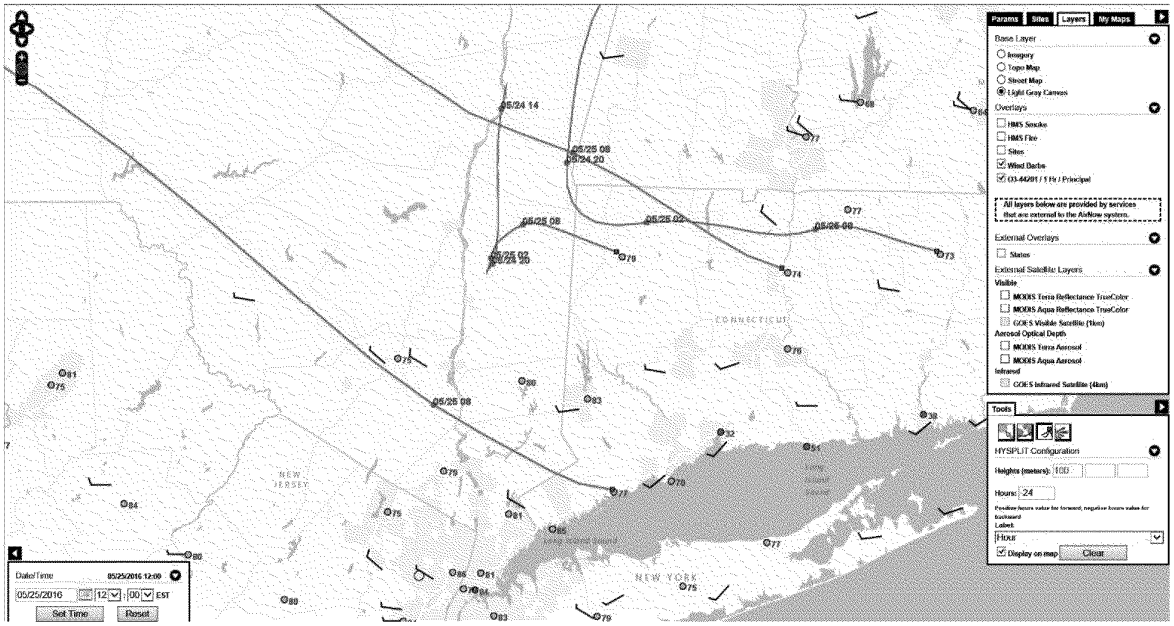

Figure 76. May 25th 24-hour Back Trajectories ending at 12:00 EST.

[21] http://www.airnowtech.org/

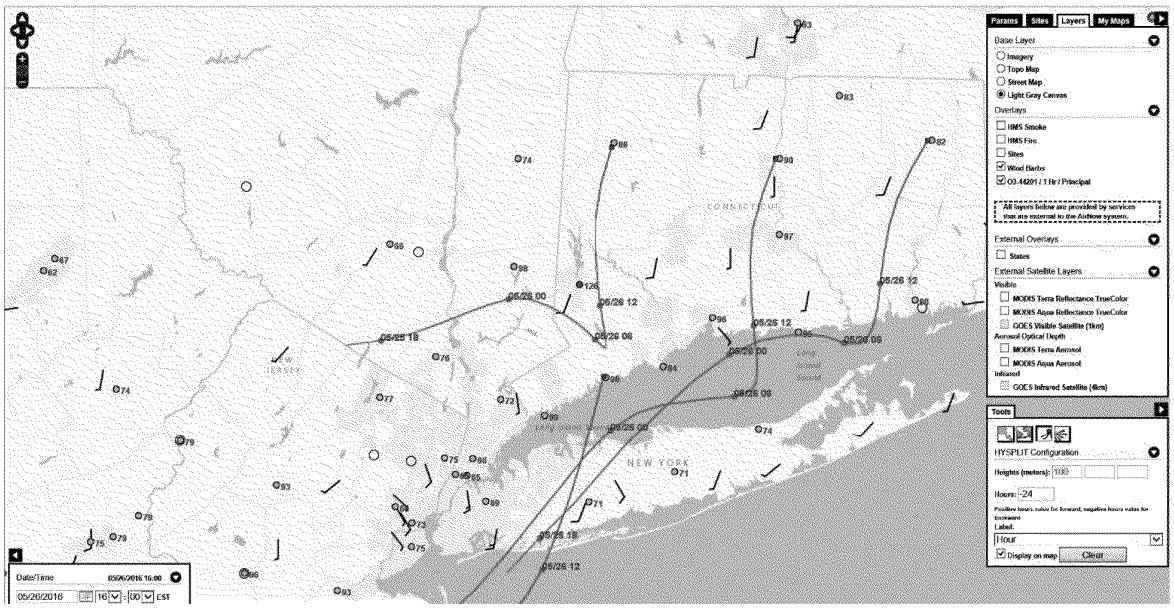

Figure 77. May 26th 24-hour Back Trajectories ending at 16:00 EST.

7 SIMILAR DAY ANALYSIS

"Comparison of O_3 Concentrations on Meteorologically Similar Days (Matching Day Analysis). O_3 formation and transport are highly dependent upon meteorology. Therefore, a comparison between O_3 on meteorologically similar days with and without fire impacts could support a clear causal relationship between the fire and the monitored concentration. Both O_3 concentrations and diurnal behaviors on days with similar meteorological conditions can be useful to compare with days believed to have been influenced by fire. Since similar meteorological days are likely to have similar O_3 concentrations, significant differences in O_3 concentrations among days with similar meteorology may indicate influences from non-typical sources."

-EPA guidance: Treatment of Data Influenced by Exceptional Events

7.1 Methodology

Simply using surface winds and/or temperatures at our Connecticut monitors as a predictor for ozone can be problematic because of the land/sea interface. Inland ozone monitoring sites can observe northwest winds and very warm temperatures while the coastal sites will experience a southwest sea breeze and much cooler temperatures. Historically, temperatures over 90 ° F have been a good indicator for ozone production, but with NOx emissions on the decline, one must look at other factors.

For example, the highest temperature recorded at Bradley Airport, 102° F, occurred on July 6, 2010. Investigating this date further, Figure 78 shows that there was a northwest wind flow for most of the State, except for the immediate coast. Back trajectory analysis generally does not have sufficient spatial resolution to show that there was southwest surface wind transport from the New York City area to the Connecticut coast, aided by the sea-breeze, where an ozone exceedance occurred. While July 6, 2010 was not a similar day to the event in question, it illustrates how extreme heat is no longer the main factor for an ozone exceedance in Connecticut.

July 6, 2010 is a good example to show that high surface temperatures are not always correlated with high ozone concentrations. The path of the wind and the pollutants that are carried to the monitor is often the better indicator for whether there will be elevated ozone a particular day. Surface wind trajectories often will not coincide with those trajectories from higher in the atmosphere. The upper level winds have the ability to transport pollutants from great distances, even across oceans and continents, while the surface winds are more indicative of more localized transport.

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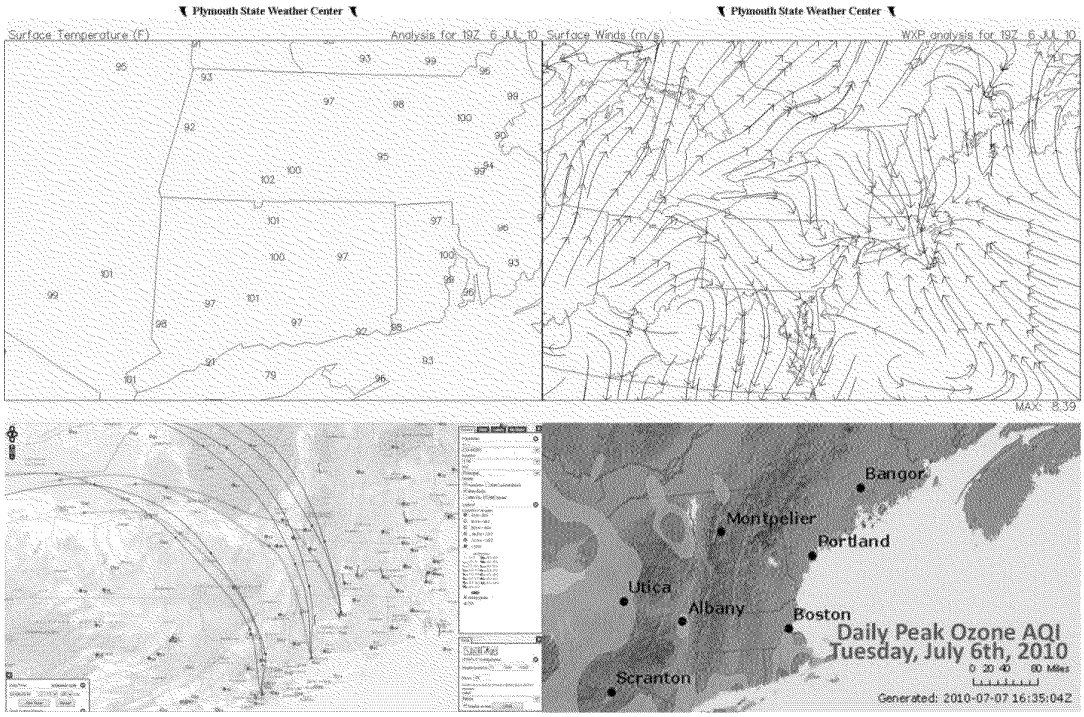

Figure 78. Temperatures and Winds around Connecticut on July 6, 2010

A more reliable variable for identifying similar days from past years is to look for similar 850mb pressure and wind patterns. The following method was used for this analysis to identify days with meteorology similar to the event:

- 12z (12:00 UTC= 8:00 EDT)sounding data from Albany (ALY) was analyzed from May 25th, 2016 to determine 850 mb winds;
- Obtained all ALY sounding data from April- September 2012-2016;
- Filtered wind direction for 310-330 degrees and wind speed greater than or equal to 20 knots;
- Ran 24 hour HYSPLIT back trajectories from 16z (noon) for those days that fit this criteria;
- Chose several days from each year that most closely matched 500m/1500m back-trajectories to Lake Huron region.
- Plotted 850 mb North American Regional Reanalysis (NARR) maps (if available) for those dates, to examine similarity of pressure height patterns.

We used May 25th 12z sounding data from ALY because it was the beginning of the event at our Cornwall monitor and was the closest location for sounding data. It was determined from the 12z sounding that the 850mb wind from ALY was from 320 degrees at 23 knots. Figure 79 is a

graphic of the 12z sounding on May 25th. The wind speed/ wind direction flags on the right vertical bar shows northwest wind flow from all levels above the surface.

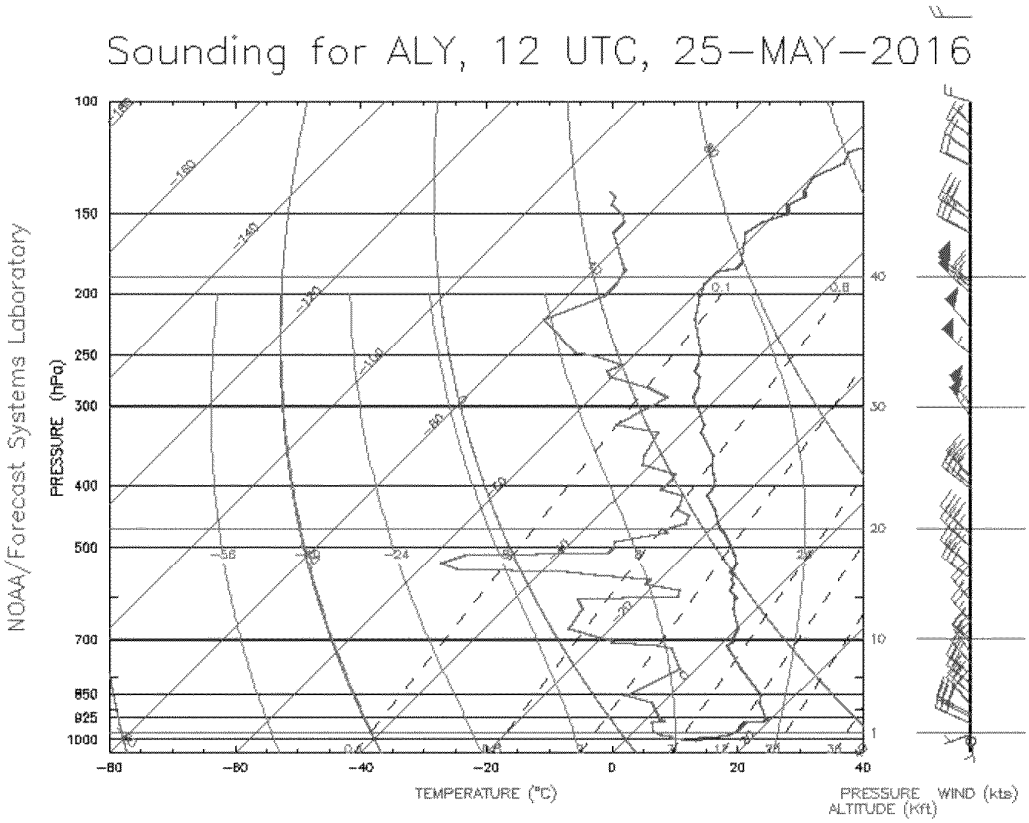

Figure 79. 12z ALY Sounding from May 25th, 2016

7.2 Similar Day Maps

An 850 mb height map (Figure 80) was generated for May 25th to create a reference pattern for comparison. This figure shows that an 850 mb ridgeline extended north to just west of Hudson Bay in Canada. With this pattern, source winds to Connecticut would be expected to originate in eastern Canada, which is generally air that is low in ozone precursors, barring any wildfires in the region. Figure 81 is the May 25th HYSPLIT trajectories showing the 500 and 1500 meter back trajectories originating near Lake Huron. Figures 82-86 represent closely matching 850 mb examples from 2012-2016 with the accompanying AQI maps for those days. In every one of those cases, the ozone levels were in the good to moderate range, in contrast to the elevated ozone levels seen on May 25th, 2016.

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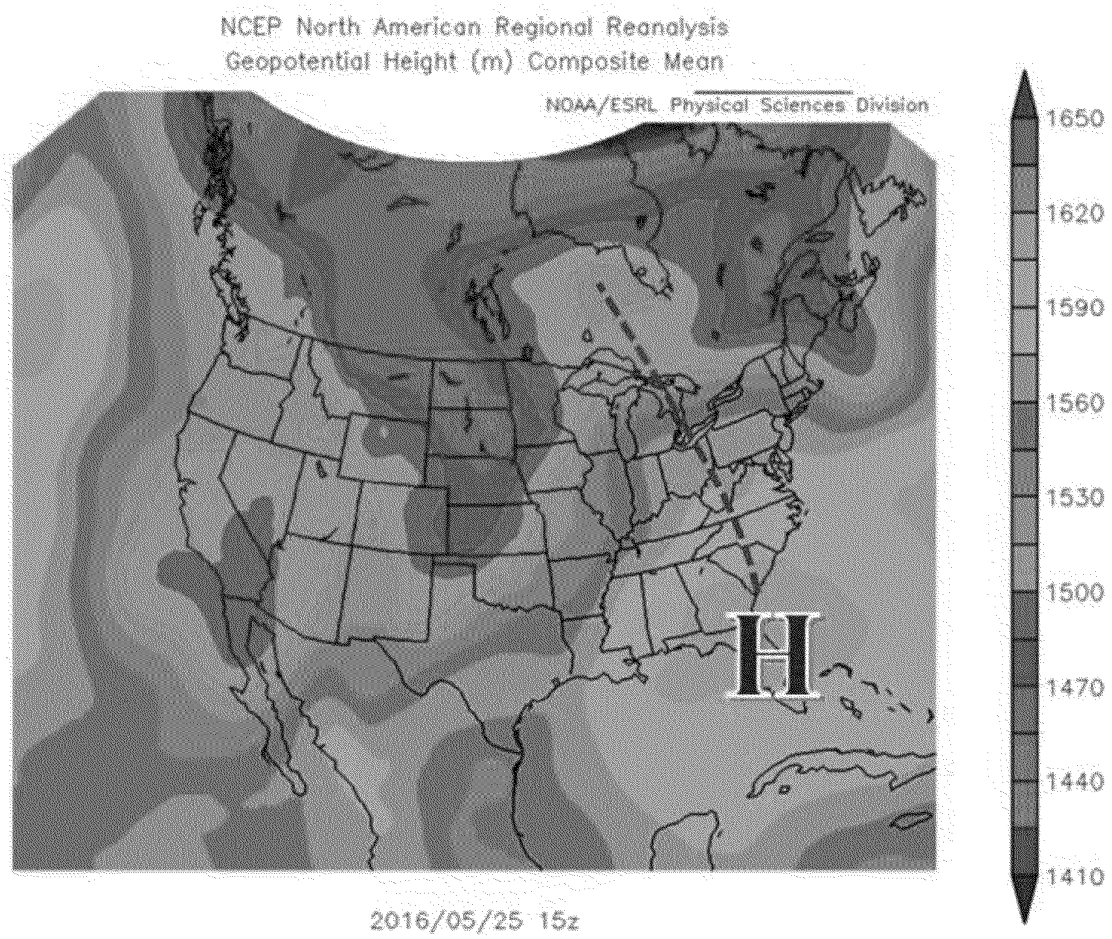

Figure 80. 850 mb Reference Pressure Pattern for May 25th, 2016

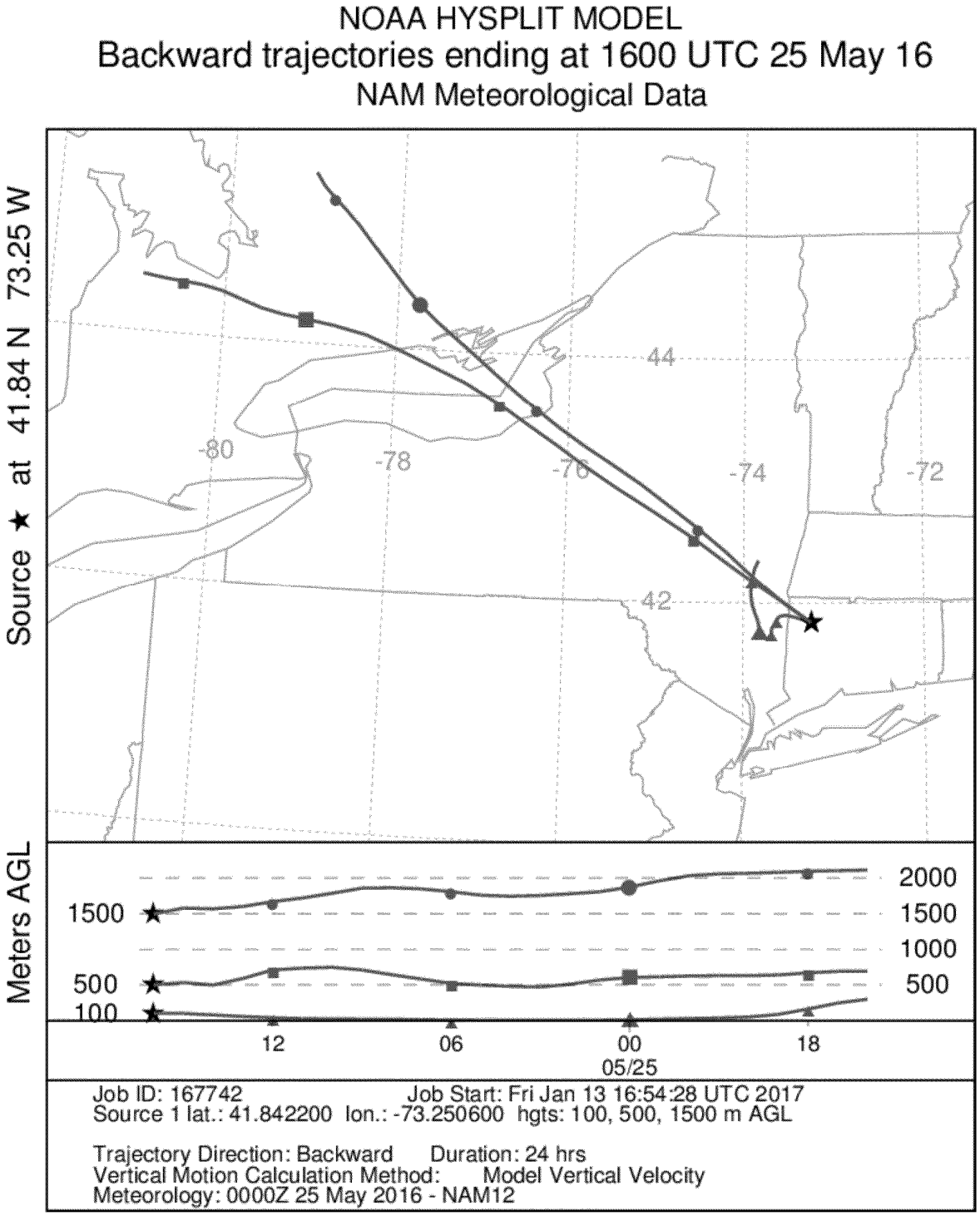

Figure 81. HYSPLIT Reference Trajectories from May 25th, 2016

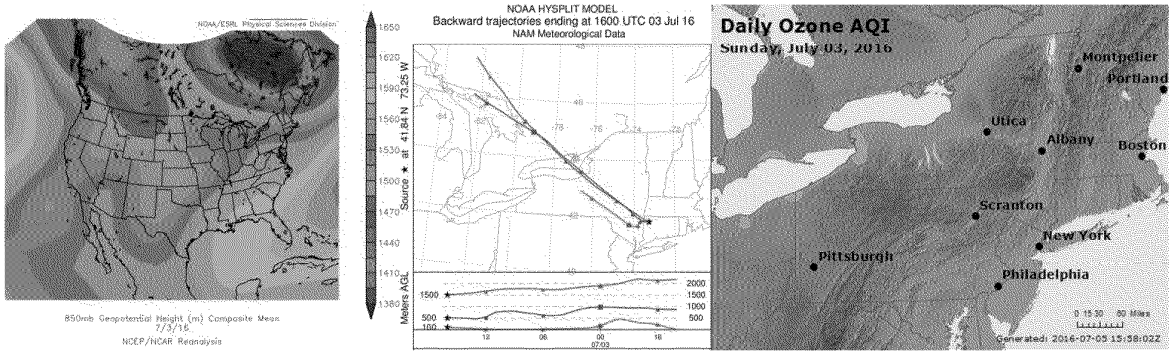

Figure 82. Matching 850 mb Pressure Pattern with Back Trajectories July 3, 2016

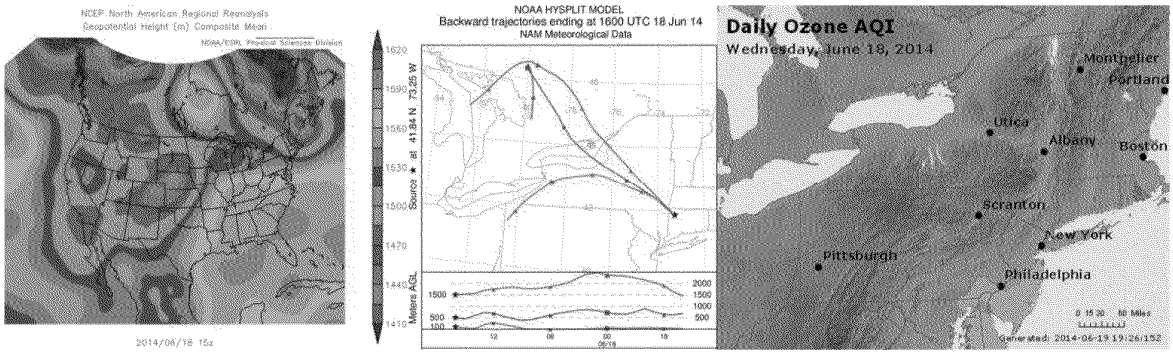

Figure 83. Matching 850 mb Pressure Pattern with Back Trajectories June 18, 2014.

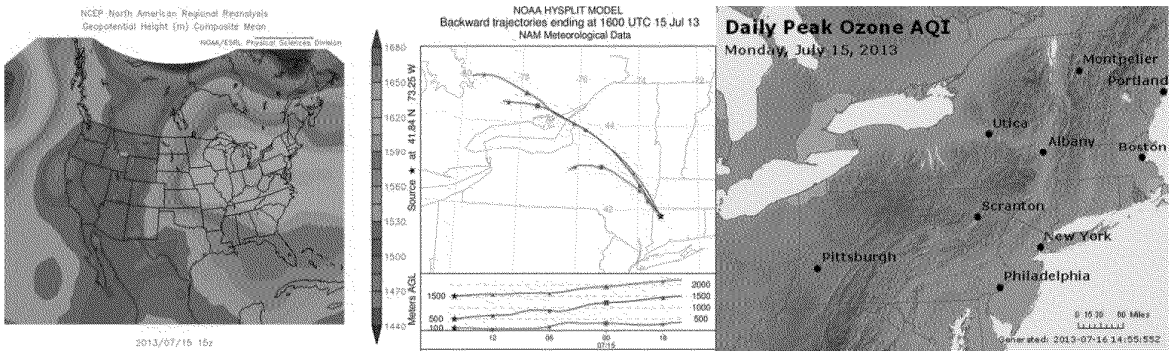

Figure 84. Matching 850 mb Pressure Pattern with Back Trajectories July 15, 2013.

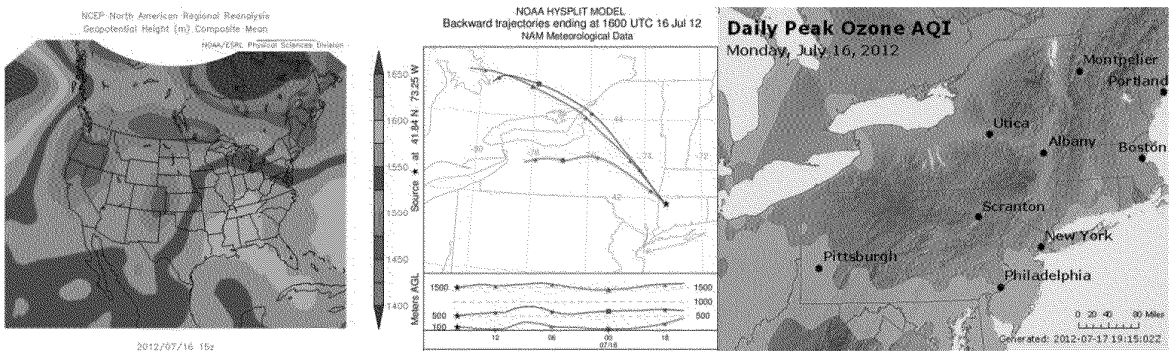

Figure 85. Matching 850 mb Pressure Pattern with Back Trajectories July 16, 2012.

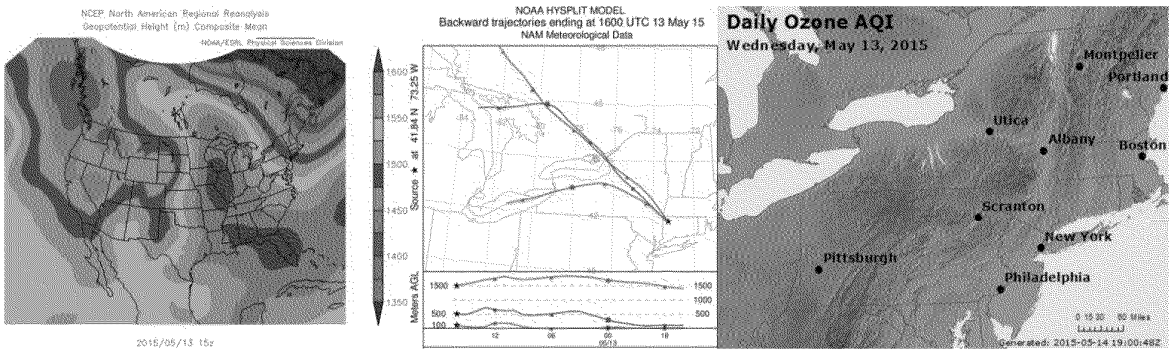

Figure 86. Matching 850 mb Pressure Pattern with Back Trajectories May 13, 2015

8. NOAA CMAQ MODEL PRED ICTIONS

CTDEEP air quality forecasters have relied upon the operational NOAA CMAQ ozone model for daily air quality forecasting. The NOAA CMAQ model v.4.6 ('the model') has used wildfire particulate emissions since the summer of 2014, however, gaseous wildfire emissions, which would have included ozone precursors, have not been input into the ozone forecast which would likely lead to under-prediction of wildfire induced ozone events. Although this model has issues about land/water interfaces and using the most up-to-date emissions inventory, it is generally a reliable tool for the air quality forecaster.

From the previous similar day analysis, August 29, 2016 was determined to have a similar weather pattern as May 25, 2016. Figure 87 shows the model output for the two days beside the observed AQI levels. It is widely recognized that the model over-estimates ozone concentrations in the northeast U.S. during the mid-summer, however, in the May 25th case, the model is greatly under-predicting the observed ozone levels.

Maryland Department of the Environment air quality staff analyzed gridded model output for May 2016 over the eastern U.S. domain and have plotted the model bias from the observed daily maximum 8-hour ozone average as interpolated isopleths. Since the model does not assimilate the gaseous smoke emissions into the ozone calculations, the model shows a strong negative bias over the region of the smoke plume. Figure 88 shows the model bias for May 25th, 2016, with many areas in the northeast U.S. exceeding a negative 25 ppb model bias. This was plotted without using the observation from the New Haven CT monitor, since it suffers from the NOx titration phenomenon where ambient ozone levels are almost always much lower than surrounding areas due to its proximity to I-95 and the Port of New Haven.

Hourly plots of observed ozone vs. modeled ozone are also presented for the May 25-26th, 2016 period for three of the monitors that are being requested for data exclusion (Figures 89-91). In every case, it shows that strong negative model bias during the day time hours, under-predicting peak ozone concentrations by as much as 30 ppb during the event. Predictions for the 24th are, as typical, nearer to observed ozone concentrations. The strength of this bias on such a large area indicates the magnitude of the impact that the plume likely had on the region.

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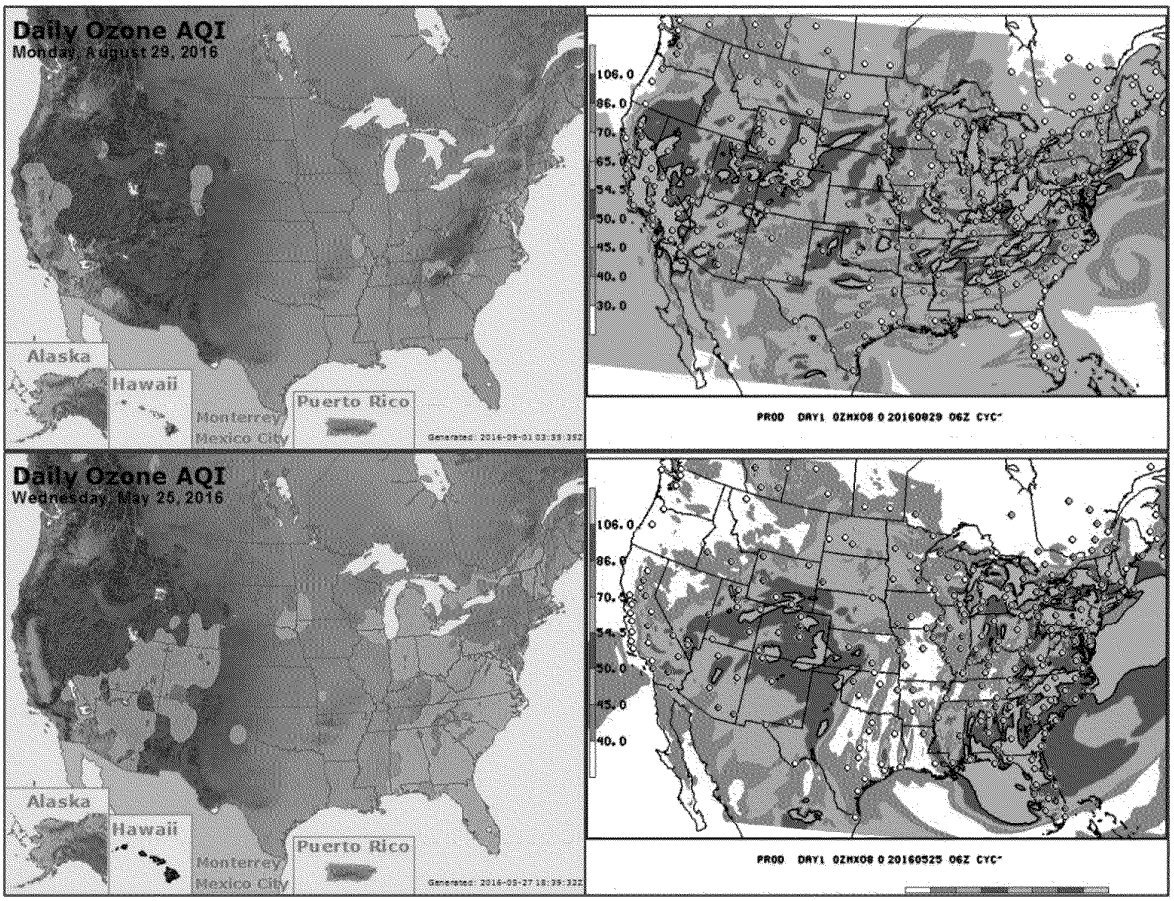

Figure 87. Comparing Similar Day Model Output from August 29th to May 25, 2016 with Observed AQI

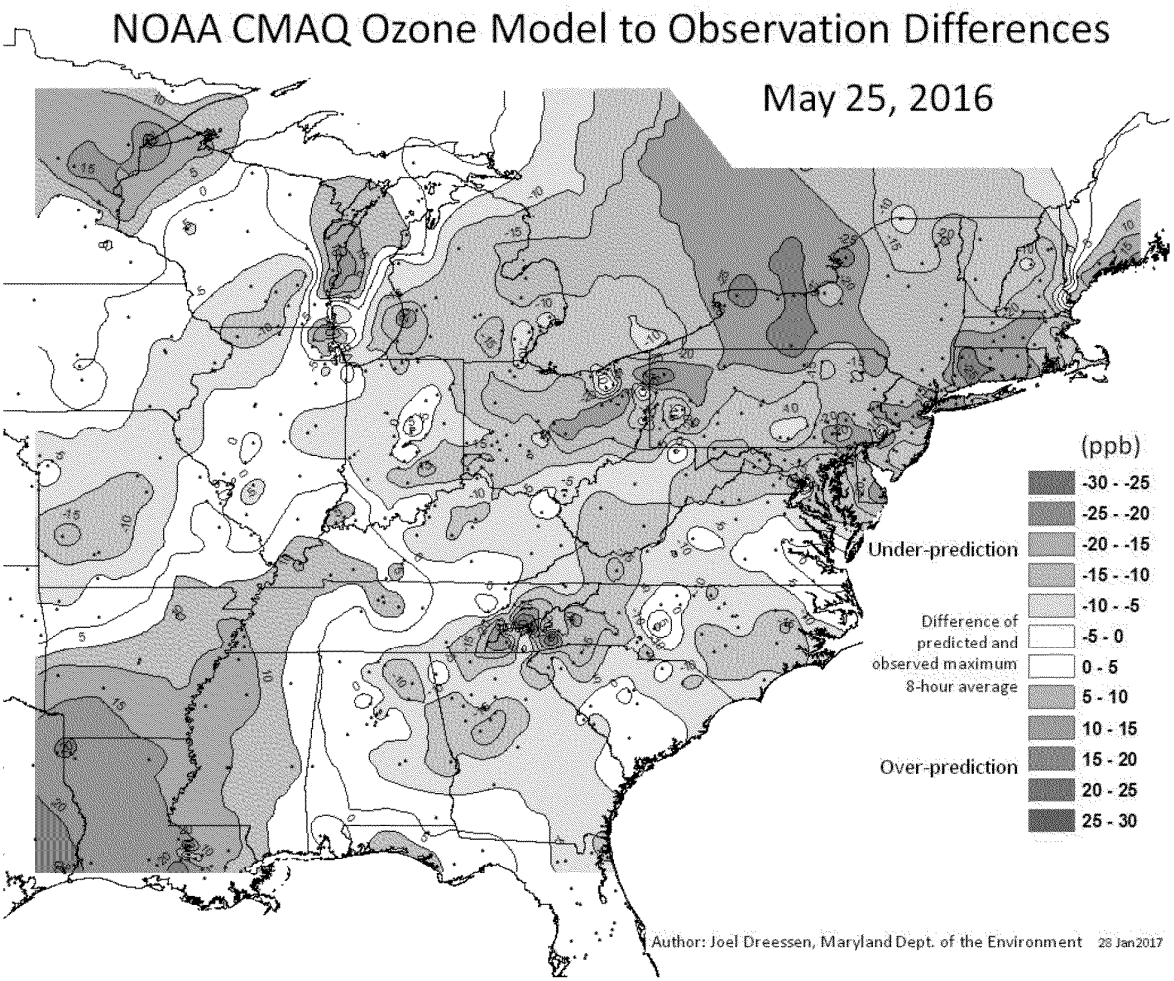

Figure 88. NOAA CMAQ Model Bias Isopleths for May 25, 2016

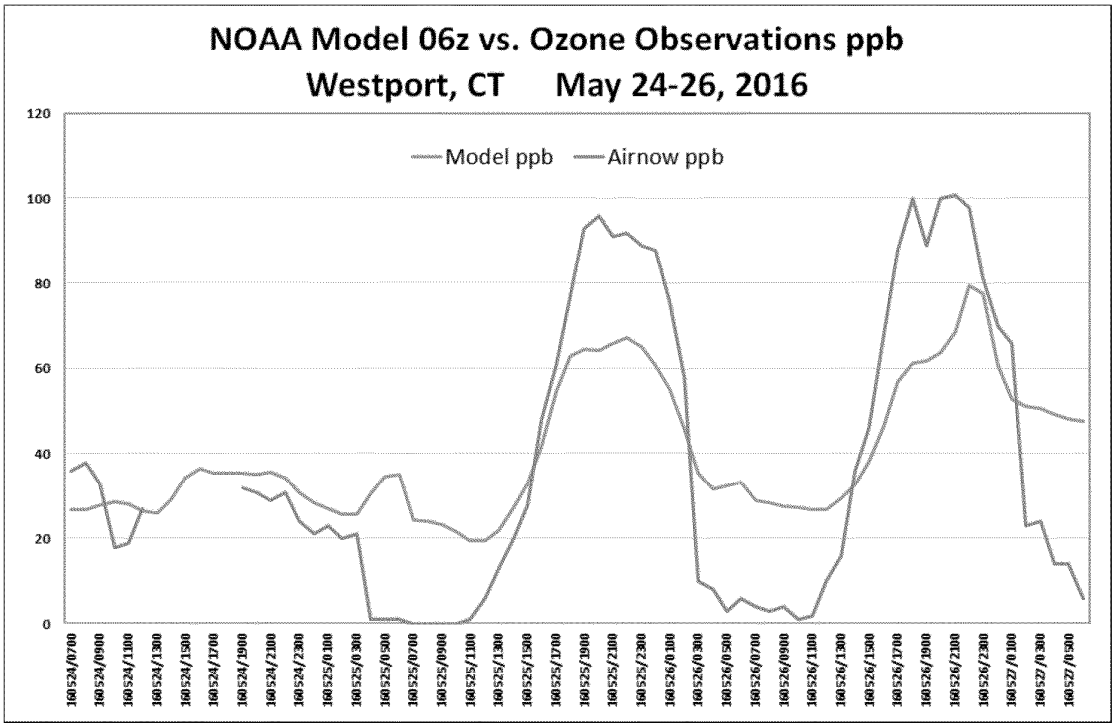

Figure 89. Westport CT NOAA Model vs. Observed Ozone, May 24-27, 2016

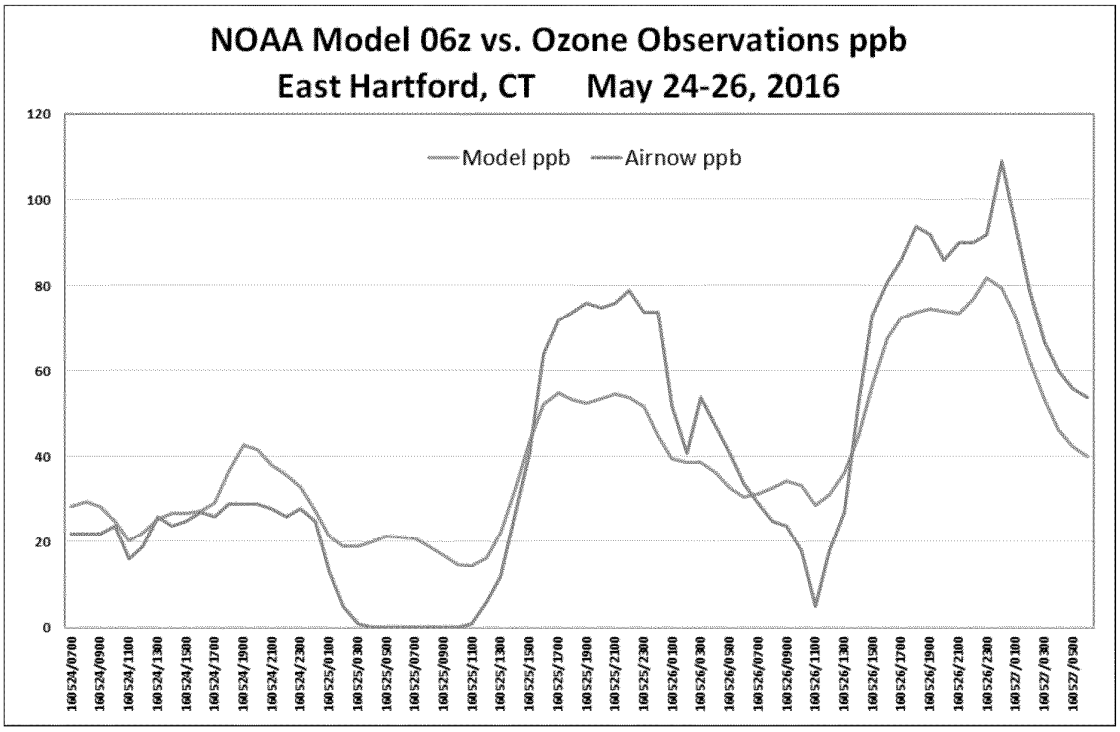

Figure 90. East Hartford NOAA Model vs. Observed Ozone, May 24-27, 2016

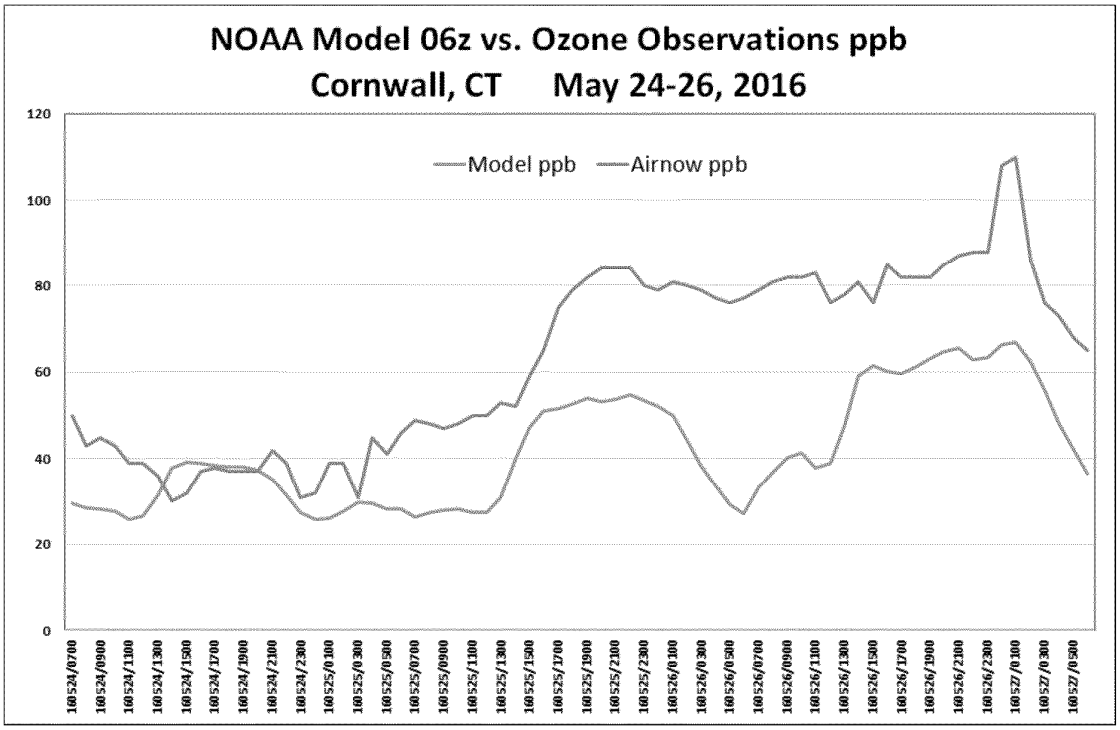

Figure 91. Cornwall CT NOAA Model vs. Observed Ozone, May 24-27, 2016

9. SUMMARY

Throughout May 2016 an intense and historically massive wildfire burned near Fort McMurray, Alberta Canada that generated a smoke plume which travelled thousands of miles. On May 25th, the wildfire plume, along with the ozone produced from it, was transported east and southeast to New England and the Mid-Atlantic States resulting in some of the highest ozone concentrations in the region for the summer of 2016.

Weather conditions in the northeastern United States were not conducive to ozone formation as the event initiated on May 24th and 25th and although conditions became more favorable for ozone formation after May 25th, it is evident from our analysis that that the wildfire plume had a significant effect on the ozone levels for several days. Figure 92 shows the movement of the ozone plume from the Great Lakes to the east coast from May 24th through its dissipation on May 29th.

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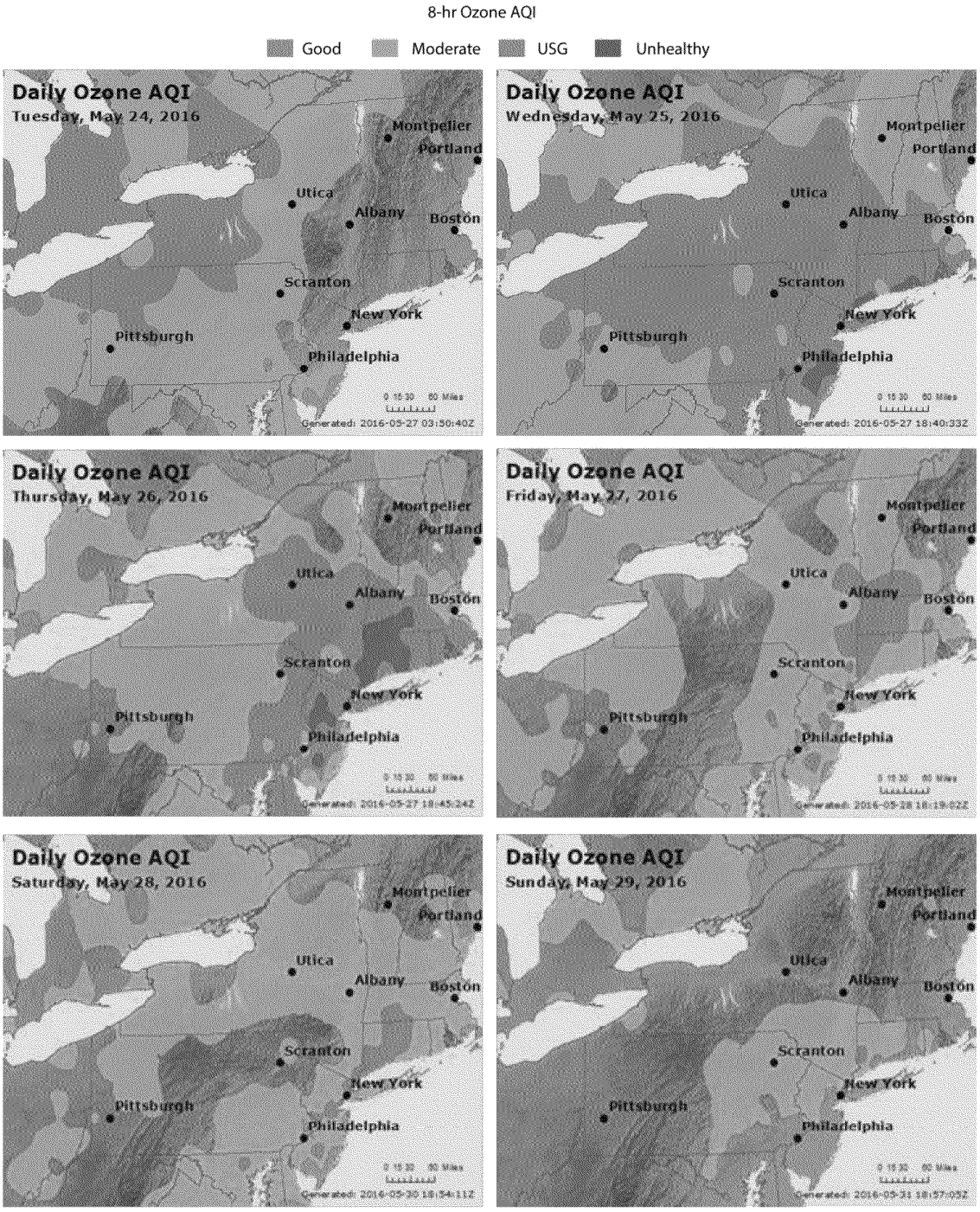


Figure 92. AQI Map of the Event.

Four monitors in Connecticut, Abington, Cornwall, East Hartford and Westport, were affected by the smoke plume in a regulatory meaningful way on May 25th and 26th. The effect was to the extent that one or both of these days at each of these four monitors were in the 99th percentile of five years of ozone season data. The movement of the ozone plume from the northwest into Connecticut was unusual and coincident with the travel of the smoke plume from the Fort McMurray fire. Furthermore, there were no sources other than the Fort McMurray fire to which the episode could be attributed. Review of days with similar meteorology indicate that exceedances were otherwise unlikely to occur. Analysis of the ozone predictive model indicates that the wildfire may have contributed 20 to 30 ppb to monitored ozone levels throughout the region. All evidence supports the position that the wildfire event affected air quality to the extent that it caused the ozone exceedances or caused them to be among the highest values recorded during the season.

Consistent with the Exceptional Events Rule (40CFR50.14) the data from the four monitors, Abington, Cornwall, East Hartford and Westport, for the days of May 25th and 26th should be excluded from any regulatory determinations. Figure 93 is a map showing the 2016 design values for Connecticut after the data exclusion for this exceptional event is approved.

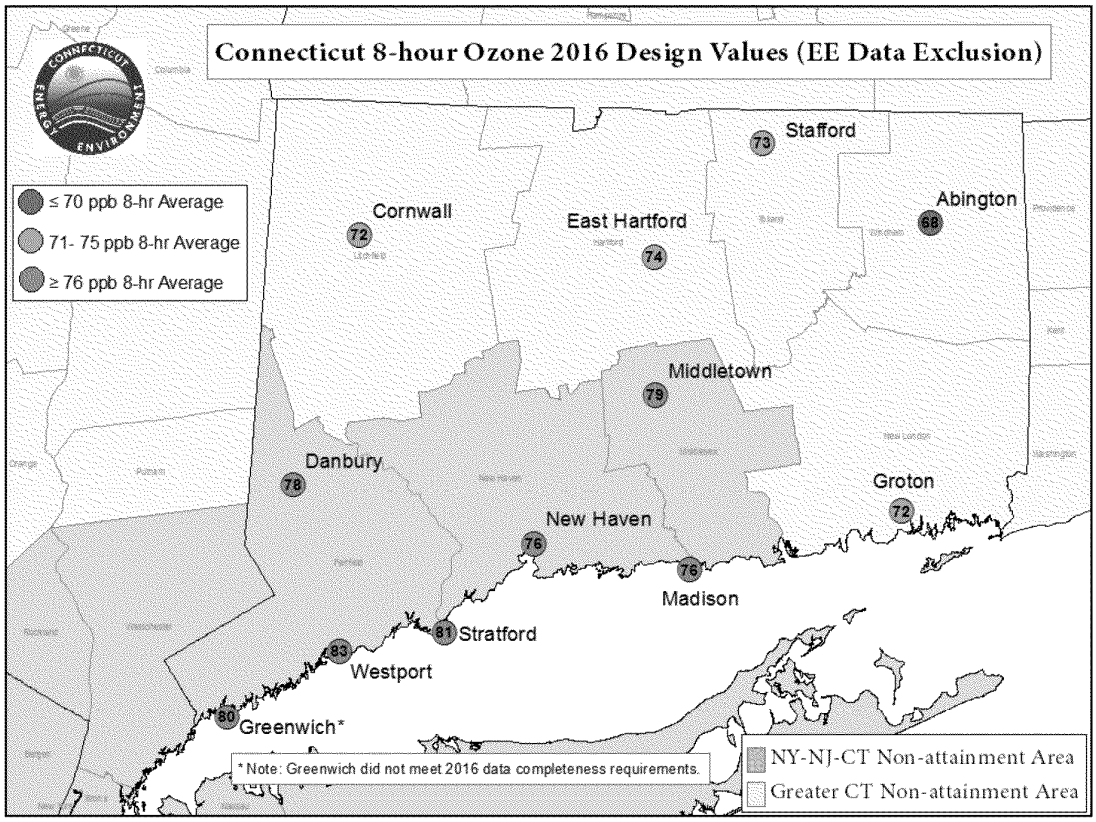


Figure 93. Map of 2016 Connecticut 8-hour Ozone design Values after Data Exclusion.

Q/d Analysis

EPA guidance [Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations, Final, EPA, September 2016] recommends conducting a Q/d analysis as a rough assessment of the ability of a wildfire to cause increased ozone concentrations. The Q/d analysis is simply a comparison of the ration of Q, the daily tons of VOC and NOx emitted from the fire, to d, the distance in kilometers from the fire to the point of concern. If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern.

EPA guidance indicates that a fire should have a Q/d in excess of 100 tons per day per kilometer (tpd/km) in order to be considered to have a clear causal impact on ozone. EPA developed this value based on analyses of four fires which occurred in 2011.

Estimate of Q

The emissions from the fire can be estimated using information from EPA's AP-42 Compilation of Air Emission Factors Section 13.1 Wildfires and Prescribed Burning. The equations given are as follows:

$F_i = P_i * L$ (Equation 1)
$E_i = F_i * A$ (Equation 2)

F_i = emission factor (mass of pollutant/unit area of forest consumed)
P_i = yield for pollutant "i" (mass of pollutant/unit mass of forest fuel consumed)
= 12 kg/Mg (24 lb/ton) for total hydrocarbon (as CH_4)
= 2 kg/Mg (4 lb/ton) for nitrogen oxides (NO_x)
L = fuel loading consumed (mass of forest fuel/unit land area burned)
A = land area burned
E_i = total emissions of pollutant "i" (mass pollutant)

Combining equations 1 and 2, we have:

$E_i = P_i * L * A$

Pi is given above for total hydrocarbons and for nitrogen oxides. The fuel loading is given in AP-42 for different regions of the United States and ranges from 9 to 60 tons per acre. Conservatively, we will estimate a low end emission rate using 10 tons per acre which is associated with North Central US conifer forests. Note that our results could increase by a factor of 6 were we to expect the high end of emissions.

The Alberta government reported that by June 10, 2016 the fire ultimately covered 589,995 hectares (1,457,909 acres) with a perimeter of 996 kilometers (618 miles). For reference, the total land area of Rhode Island is approximately 270,000 hectares.[1] The chart below indicates

[1] Any large area estimate can only be considered comprehensible if compared to the State of Rhode Island.

the total area covered by the fire as reported by the Alberta government[2]. During the week prior to the exceptional event in Connecticut the fire grew by approximately 60,000 hectares (148,263 acres).

Therefore, ignoring the smoldering of approximately 500,000 hectares we estimate the total hydrocarbon emissions from the week to be:

Ehc = 24 lbs of HC / ton of forest fuel consumed * 10 tons fuel / acre * 148,263 acres

Ehc = 35,583,120 pounds of HC

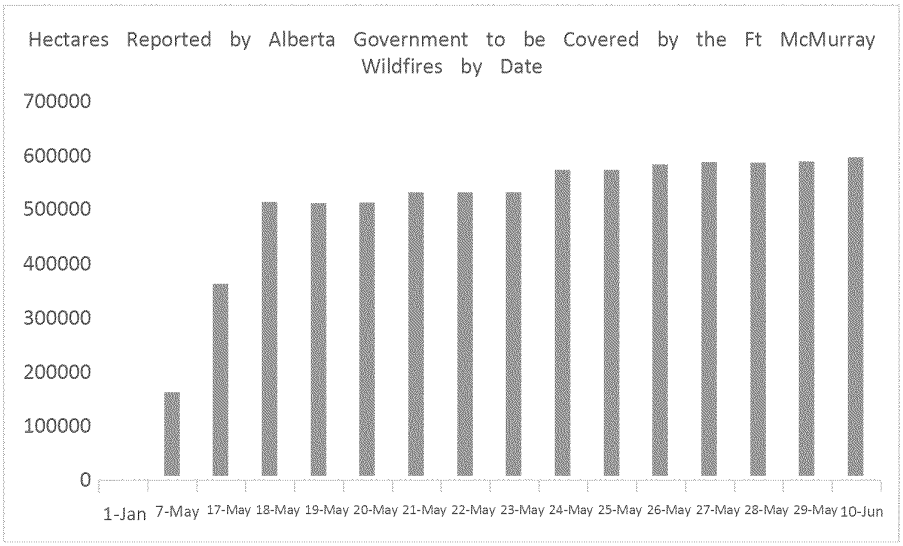
Ehc = 17,791 tons of HC emitted during the period from May 19 to May 24

Similarly for NOx:

Enox = 4 lbs of NOx / ton of forest fuel consumed * 10 tons fuel / acre * 148,263 acres

Enox = 5,930,520 pounds of NOx

Enox = 2,965 tons of NOx emitted during the period from May 19 to May 24



[2] https://www.alberta.ca/release.cfm?xID=41701E7ECBE35-AD48-5793-1642C499FF0DE4CF [Final Update 39: 2016 Wildfires (June 10 at 4:30 p.m.), Alberta Government]

Q is the total daily emission rate in tons per day of reactive hydrocarbons and nitrogen oxides. EPA recommends, in the exceptional events guidance, that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions become rHC = 0.6 * Ehc or 0.6 * 17,991 = 10,794 tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NOx emissions. Therefore the total rHC and NOx emissions over the period are 10794 + 2965, or 13,759 tons over the six days. On average this results in a daily emission rate, or Q, of 2293 tons per day.

Estimate of d

Based on the large distance, we will not present individual analyses for each monitor in Connecticut but estimate the distance from the Fort McMurray fire to the most distant point in Connecticut. We will therefore use a value of d of 3286 kilometers, the flight distance from Fort McMurray to Stonington, CT.

Q/d Estimate

Using the values determined above, Q/d then becomes 2293 tpd divided by 3286 km or 0.69 tpd/km. This value is well below the EPA recommended level of 100 tpd/km indicating clear causality.

{this table may be used to calculate Q/d – and will not appear in this form in the final}

acres	Ehc	Enox	Q	d	q/d	q/d per day	
148263	17791.56	2965.26	13640.2	3286	4.151003	0.691834	as explained above
1457909	174949.1	29158.18	134127.6	3286	40.8179		if the entire area burned in
	0	0	0	3286	0		
	0	0	0	3286	0		
	0	0	0	3286	0		
	0	0	0	3286	0		
	0	0	0	3286	0		

Taking a less conservative approach and using the maximum extent of the burn area over the life of the fire, the result would be a Q/d of 40.8 tpd/km. Still sufficiently below the EPA recommended threshold for establishing clear causality. Recalling that a worst case fuel loading would increase our results by a factor of six, Q/d would in this case result in 240 tpd/km and would indicate clear causality. While this approach might be justified by the ongoing smoldering of the peat, the intensity of the Fort McMurray fire, variability in the burn rate and

other factors, it is difficult to justify without further details that may only be obtained through estimates which introduce their own error.

Taking a slightly different approach we consider the basis for the EPA guidance and look at emissions from one of the four fires EPA relied on in developing their guidance. Appendix A2 of the EPA guidance indicates that EPA based their conclusions on 12 km grid CMAQ modeling of four 2011 multiday fires: Wallow, Waterhole, Big Hill and Flint Hills. Emissions from the fires were based on a program called SMARTFIRE. Using information available on the Wallow Fire, we approximate the emissions that might be calculated for the Fort McMurray fire.

The Wallow Fire burned in eastern Arizona and western New Mexico from May 29, 2011 through July 8, 2011 and burned 841 square miles (538,240 acres) by June 26th. The maximum daily emissions from that fire were reported as approximately 15,000 tons of rVOC and 1,000 tons of NOx. [Simulating Fire Event Impacts on Regional O3 and PM2.5 and Looking Forward Toward Evaluation, Kirk Baker, EPA October 5, 2015 and Using SOAS and related field study data for scientific and regulatory modeling, Kirk Baker, EPA, undated; both are slide presentations] If we scale this fire up by a factor of three to approximate the acreage burned in the Fort McMurray fire, then we have daily emissions as high as 45,000 tons for rVOC and 3,000 tons for NOx. These emissions produce a Q of 48,000 tpd and Q/d becomes 14.6 – still well below EPA expectation for causality.

Noting the wide variability in emissions estimates from different approaches, and as the Q/d method does not generally satisfy the expectation of a clear causal impact, we present other evidence demonstrating that the plume from the Fort McMurray fire caused elevated ozone levels in Connecticut.

From: Dupont, Bernadette (FHWA)
Location: WEBINAR
Importance: Normal
Subject: KY Air Quality Webinar
Start Date/Time: Mon 6/19/2017 2:00:00 PM
End Date/Time: Mon 6/19/2017 3:00:00 PM
AZ Ducey 6-6-17.pdf
tc2024i.pdf
TC 20-24.docx

;;;
REMINDER & NOTE: The new CMAQ applications have been attached to the meeting invitation.

KY's Air Quality Webinar

https://connectdot.connectsolutions.com/bernadettedupont/

Ex. 6 - Personal Privacy

AGENDA

1) EPA's June 7 Announcement re 2016 Ozone NAAQS– Dianna Myers, EPA-R4, Jane Spann (see attached letter)

2) KY's QA/QC data – Leslie Poff, KYDAQ

3) KY's Reformulated Gasoline (RFG) – Leslie Poff, KYDAQ

4) CMAQ - Jackie Jones

5) Others

Ex. 6 - Personal Privacy

E. SCOTT PRUITT
ADMINISTRATOR

June 6, 2017

The Honorable Doug Ducey
Governor of Arizona
State Capitol
1700 W. Washington Street
Phoenix, AZ 85007

Dear Governor Ducey:

I am writing to update you on the status of the U.S. Environmental Protection Agency's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. Pursuant to section 107(d)(1)(B) of the Clean Air Act (CAA), I am extending the deadline for promulgating initial area designations for the 2015 ozone NAAQS by one year. I have determined that there is insufficient information, and taking additional time is appropriate in order to consider completely all designation recommendations provided by state governors pursuant to CAA section 107(d)(1)(A) and to rely fully on the most recent air quality data. This additional time will also provide the Agency time to complete its review of the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states, localities and regulated entities. As part of the review process, the Agency is evaluating these issues primarily focusing on: fully understanding the role of background ozone levels; appropriately accounting for international transport; and, timely consideration of exceptional events demonstrations. Additionally, pursuant to language in the recently-enacted FY 2017 omnibus bill, I have established an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

States have made tremendous progress and significant investment cleaning up the air. Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased. I am committed to working with you and your local officials to effectively implement the ozone standard in a manner that is supportive of your air quality improvement efforts, without interfering with local decisions or impeding economic growth.

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This paper is printed with vegetable-oil-based inks and is 100-percent postconsumer recycled material, chlorine-free-processed and recyclable.

I appreciate the information you and your staff have shared with EPA already as part of this process. I am confident this progress will continue as we work together towards our shared goal of clean air, a robust economy and stronger, healthier communities. If you have questions or concerns, please contact me or your staff may contact Troy Lyons, Associate Administrator for the Office of Congressional and Intergovernmental Relations, at lyons.troy@epa.gov or (202) 564-4987.

Respectfully yours,

E. Scott Pruitt

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From: Sosnowski, Dave
Sent: Tue 5/2/2017 6:35:10 PM
Subject: OBD Stakeholder Call, Wednesday, 1 PM ET
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OBD_call_NOTES_011117.doc

Bi-monthly OBD Stakeholder Call

Wednesday, May 3, 2017, 1-2:00 PM ET

(Call-in number: Ex. 6 - Personal Privacy

Dear OBD Stakeholder Call Participant:

Attached above are the draft notes from our last call and the agenda for tomorrow's call.

Talk to you soon.

--Dave S.

Bi-monthly OBD Stakeholder Call
Wednesday, May 3, 2017, 1-2:00 PM ET
(Call-in number: Ex. 6 - Personal Privacy

Agenda Items

- Roll call by Region/State
- Notes from the January 11, 2017 OBD Stakeholder Call
- OBD Clearinghouse Update (Chris Woodhave, Weber)
- Status of the ozone NAAQS(s)
- Volkswagen Notice of Violation
- Miscellaneous Issues?
- Next OBD Stakeholder Call
    - June 28, 2017, 1:00 PM ET

Bi-monthly OBD Stakeholder Call
Wednesday, January 11, 2017, 1-2:00 PM ET

Ex. 6 - Personal Privacy

Agenda Items

- Roll call by Region/State
  - Region 1: MA, NH, CT
  - Region 2: Reema Loutan, NY, NJ
  - Region 3: PA
  - Region 4: Amanetta Somerville, Dale Aspy, Amber Davis, GA, NC, TN
  - Region 5: WI
  - Region 6: TX, LA
  - Region 7: MO
  - Region 8: CO
  - Region 9: CA, NV, AZ
  - Region 10: WA, ID
  - OTAQ: Dave Sosnowski
  - Others: ON, Weber State

- Notes from the November 16, 2016 OBD Stakeholder Call
  - No corrections or additions.

- OBD Clearinghouse Update (Chris Woodhave, Weber)
  - Chris reported that the new website is up and running and getting feedback from users.
  - The Clearinghouse is looking at additional updates suggested by users, including advanced search.
  - Chris noted that some have had trouble finding I/M Solutions presentations on the site. You need to navigate to the I/M Solutions web site from the Clearinghouse and them click the forum link, which will take you to where the presentations from previous I/M Solutions training forums are located.
  - Chris recommended that those who haven't done so already should check out the site and register. He noted that they've been adding new registrants daily.

- OBD Clearinghouse Recompetition
  - The review process of the applications received is underway.

- Status of the ozone NAAQS(s)
  - The proposed implementation rule was published in the Federal Register on November 17, 2016.
  - A webinar on the proposal, including Q&A, was held on Wednesday, December 7, 2016.

- The majority of the proposal continues previous practice during transition from one ozone NAAQS to another, with the proposal taking comment on a few additional options, including how and when to revoke the previous (2008) standard.

- Volkswagen Notice of Violation
  - Several media sources are reporting that VW's top manager for U.S. compliance was arrested by the FBI on a variety of charges, including violations of the Clean Air Act.
  - Sources are also reporting that VW and DOJ are nearing agreement to resolve the criminal investigation into the violations, including a plea of guilty from VW and the payment of over $4 billion in fines.
  - DOJ has not commented on these reports but is scheduled to conduct a press conference on the VW investigation today at 1:30 PM ET which will be streamed at www.JUSTICE.GOV/LIVE-STREAM.

- FAST-Act I/M Provision
  - The signed guidance has been sent to all call participants, along with other materials for today's call.
  - Dave noted that the prohibition against I/M testing of replica vehicles addressed in the FAST Act is binding on EPA, not the states, per EPA's Office of General Counsel, meaning that EPA cannot require states to test these vehicles or provide SIP credit to states that do.
  - A caller asked if these vehicles will have VINs and Dave noted that VINs are not under EPA's jurisdiction but rather are regulated by the Department of Transportation.

- Permanent DTCs (Allen Lyon, CARB)
  - Allen presented three slides providing background on permanent DTCs (PDTCs), including the MYs over which they were phased-in, how they differ from earlier DTCs (i.e., the latter can't be erased by scan tool or a battery disconnect, but only by the system itself after the source of the code has been corrected and confirmed) and why they were introduced (i.e., to address readiness uncertainty and to help catch fraud).
  - Allen also noted that as was the case with the introduction of OBDII and readiness, some OEMs have had implementation problems with PDTCs that will require test programs to be able to override the test system for certain makes and models with known issues. (Allen noted that they were seeing problems with several Chrysler models and perhaps 10 other makes/models and would be working to develop an exemptions list similar to those used for readiness which it would share with other states and the OBD Clearinghouse.)
  - Allen noted that most OEMs are implementing the requirement correctly and also stressed that CARB is still gathering data but has not begun passing or failing vehicles based upon PDTCs in the field.

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- Implementation guidance for using PDTCs in the field still need to be developed but such usage has the potential to cut the number of vehicles rejected or failed based on readiness only by maybe half.
- The PDTC requirement for vehicles under 14K GVWR was phased in from MY 2010 to 2012, with 100% coverage for the 2012 MY.
- Massachusetts noted that it has been collecting PDTC data for six months and noted that some older vehicles that have been reflashed seem to have the PDTCs cleared by the reflash. Mike McCarthy of CARB confirmed that that happens for some makes and models but not all.
- It was also noted that in addition to PDTCs, the data on "distance travelled since last cleared" will be useful in addressing the problem of excessive not-readiness.
- Lastly, it was noted that a car can be queried re: whether or not it supports PDTCs.

- Miscellaneous Issues?

- Next OBD Stakeholder Call
  - March 8, 2017, 1:00 PM ET

ED_001361_00022649

To: Boylan, James[James.Boylan@dnr.ga.gov]
Cc: Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Hays, Karen[Karen.Hays@dnr.ga.gov]; Kuoh, Dika[Dika.Kuoh@dnr.ga.gov]; Tian, Di[Di.Tian@dnr.ga.gov]; Munsey, Elisabeth[Elisabeth.Munsey@dnr.ga.gov]
From: Davis, Scott
Sent: Fri 9/23/2016 2:53:05 PM
Subject: Re: Georgia's Designation Recommendations for the 2015 Ozone NAAQS

Thanks Jim - we will follow up with any initial questions if needed.
Scott

Sent from my iPhone

On Sep 23, 2016, at 9:48 AM, Boylan, James <James.Boylan@dnr.ga.gov> wrote:

Dear Mr. Davis,

Please find attached Georgia's designation recommendations for the 2015 ozone NAAQS. EPD performed a detailed five factor analysis in accordance with U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards". In addition, EPD performed source contribution modeling with CAMx-APCA. Based on this analysis, EPD recommends that the following eight (8) counties be designated as nonattainment for the 2015 ozone NAAQS: Fulton, Gwinnett, DeKalb, Cobb, Bartow, Clayton, Henry, and Rockdale. The remaining 151 counties in Georgia are recommended as unclassifiable/attainment.

The attachments include:

- EPD Transmittal Letter,
- Attachments to EPD Transmittal Letter,
- EPD Ozone Designation Technical Analysis Document (TAD), and
- EPD Ozone Designation Modeling Technical Support Document (TSD).

A hard copy, DVD version (with all Appendices), and an external hard drive with all the photochemical modeling files (inputs, outputs, scripts) will be placed in the mail today. We look forward to your review and concurrence with our recommendations. Should you or

your staff have any questions, please feel free to contact me at (404) 363-7014.

Sincerely,

Jim Boylan

James W. Boylan, Ph.D.

Manager, Planning & Support Program

Georgia Department of Natural Resources

Environmental Protection Division - Air Protection Branch

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E-mail: James.Boylan@dnr.ga.gov

<GAEPD_2015_Ozone_Recommendation_Cover_Letter_Signed.pdf>

<GAEPD_2015_Ozone_Recommendation_Attachments.pdf>

<GAEPD_2015_Ozone_Recommendation_TAD.pdf>

<GA_EPD_Ozone_Designation_Modeling_TSD.pdf>

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From: Mitchell, Ken
Sent: Wed 11/2/2016 8:24:28 PM
Subject: ADDITIONAL INFO: Implementation of the 2015 Ozone NAAQS: State Implementation Plan (SIP) Requirements

R4 Air Directors:

Sorry for the follow-up email….I have a little more information to share.

In addition to the proposal and related resources (which you can see at the URL below), a webinar covering the contents of the proposed SIP Requirements Rule will be scheduled for early December 2016, with details forthcoming. Materials will not be distributed prior to the webinar but participants will have the opportunity to ask questions during the webinar.

Also….We anticipate publication of this proposed rule in the *Federal Register* in approximately two weeks.

If you have any questions, please feel free to contact me or Bob Lingard at (919) 541-5272 or at lingard.robert@epa.gov.

Kenneth L. Mitchell, Ph.D. | Special Assistant to the Director |
Air, Pesticides, and Toxics Management Division
U.S. Environmental Protection Agency | 61 Forsyth Street, SW | Atlanta, GA 30303
Voice: 404-562-9065 | Fax: 404-562-9066 | Email: mitchell.ken@epa.gov
Healthier Families, Cleaner Communities, A Stronger America

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Subject: Implementation of the 2015 Ozone NAAQS: State Implementation Plan (SIP) Requirements

Region 4 Air Directors:

On November 2, 2016, EPA proposed requirements for implementing the strengthened 2015 ozone NAAQS (the ''2015 ozone NAAQS'') that were promulgated on October 1, 2015. This proposed rule contains three main components:

1. Nonattainment area classification thresholds and the timing of attainment dates for each nonattainment area classification for the 2015 ozone NAAQS;

2. Options to revoke the 2008 ozone NAAQS and, where applicable, provide anti-backsliding requirements to help smooth the transition between the two standards for nonattainment areas; and

3. SIP requirements for states with nonattainment areas and states in an ozone transport region under the 2015 ozone NAAQS.

More information about this proposal can be found at: https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state

Written comments will be due on or before 60 days from the date of publication in the Federal Register.

Please let me know if you have any questions.

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To: hornback@metro4-sesarm.org[hornback@metro4-sesarm.org]; asatyal@pinellascounty.org[asatyal@pinellascounty.org]; barnetwm@forsyth.cc[barnetwm@forsyth.cc]; bcolby@chattanooga.gov[bcolby@chattanooga.gov]; bieleb@miamidade.gov[bieleb@miamidade.gov]; bob.rogers@shelbycountytn.gov[bob.rogers@shelbycountytn.gov]; brivera@aqm.co.knox.tn.us[brivera@aqm.co.knox.tn.us]; campbell@epchc.org[campbell@epchc.org]; clafontaine@mdeq.ms.gov[clafontaine@mdeq.ms.gov]; corey.m.masuca@jcdh.org[corey.m.masuca@jcdh.org]; danny.shea@huntsvilleal.gov[danny.shea@huntsvilleal.gov]; david.brigman@buncombecounty.org[david.brigman@buncombecounty.org]; dbaker@mdeq.ms.gov[dbaker@mdeq.ms.gov]; dika.kuoh@dnr.ga.gov[dika.kuoh@dnr.ga.gov]; ebenezer.gujjarlapudi@mecklenburgcountync.gov[ebenezer.gujjarlapudi@mecklenburgcountync.gov]; gonzaj@miamidade.gov[gonzaj@miamidade.gov]; hornback@metro4-sesarm.org[hornback@metro4-sesarm.org]; jason.howanitz@jcdh.org[jason.howanitz@jcdh.org]; Jason.rayfield@mecklenburgcountync.gov[Jason.rayfield@mecklenburgcountync.gov]; jeff.koerner@dep.state.fl.us[jeff.koerner@dep.state.fl.us]; john.finke@nashville.gov[john.finke@nashville.gov]; jonathan.stanton@jcdh.org[jonathan.stanton@jcdh.org]; karen.hays@dnr.ga.gov[karen.hays@dnr.ga.gov]; keith.talley@louisvilleky.gov[keith.talley@louisvilleky.gov]; laliddington@aqm.co.knox.tn.us[laliddington@aqm.co.knox.tn.us]; laxmana.tallam@flhealth.gov[laxmana.tallam@flhealth.gov]; leslie.rhodes@mecklenburgcountync.gov[leslie.rhodes@mecklenburgcountync.gov]; lfernandez@broward.org[lfernandez@broward.org]; lloydpb@forsyth.cc[lloydpb@forsyth.cc]; lwb@adem.alabama.gov[lwb@adem.alabama.gov]; mcwilliams@coj.net[mcwilliams@coj.net]; megan.green@mecklenburgcountync.gov[megan.green@mecklenburgcountync.gov]; melissal@coj.net[melissal@coj.net]; michael.abraczinskas@ncdenr.gov[michael.abraczinskas@ncdenr.gov]; michelle.b.walker@tn.gov[michelle.b.walker@tn.gov]; michelle.king@louisvilleky.gov[michelle.king@louisvilleky.gov]; mpognon@broward.org[mpognon@broward.org]; porterhj@dhec.sc.gov[porterhj@dhec.sc.gov]; quincy.styke@tn.gov[quincy.styke@tn.gov]; rachael.hamilton@louisvilleky.gov[rachael.hamilton@louisvilleky.gov]; raglanre@forsyth.cc[raglanre@forsyth.cc]; renee.parker@ocfl.net[renee.parker@ocfl.net]; roberma@miamidade.gov[roberma@miamidade.gov]; robinson@coj.net[robinson@coj.net]; rwg@adem.alabama.gov[rwg@adem.alabama.gov]; sean.alteri@ky.gov[sean.alteri@ky.gov]; sheila.holman@ncdenr.gov[sheila.holman@ncdenr.gov]; thompsrb@dhec.sc.gov[thompsrb@dhec.sc.gov]; cmaples@semtribe.com[cmaples@semtribe.com]; Darin Steen[darin.steen@catawbaindian.net]; jamilong@nc-cherokee.com[jamilong@nc-cherokee.com]; jerry.cain@choctaw.org[jerry.cain@choctaw.org]; kevind@miccosukeetribe.com[kevind@miccosukeetribe.com]; rmccullers@pci-nsn.gov[rmccullers@pci-nsn.gov]
Cc: Banister, Beverly[Banister.Beverly@epa.gov]; Kemker, Carol[Kemker.Carol@epa.gov]; Gettle, Jeaneanne[Gettle.Jeaneanne@epa.gov]; Fite, Mark[Fite.Mark@epa.gov]; Davis, Scott[Davis.ScottR@epa.gov]; Worley, Gregg[Worley.Gregg@epa.gov]; Rinck, Todd[Rinck.Todd@epa.gov]; Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Spann, Jane[Spann.Jane@epa.gov]
From: Mitchell, Ken
Sent: Wed 11/2/2016 7:23:19 PM
Subject: Implementation of the 2015 Ozone NAAQS: State Implementation Plan (SIP) Requirements

Region 4 Air Directors:

On November 2, 2016, EPA proposed requirements for implementing the strengthened 2015 ozone NAAQS (the ''2015 ozone NAAQS'') that were promulgated on October 1, 2015. This proposed rule contains three main components:

1. Nonattainment area classification thresholds and the timing of attainment dates for each nonattainment area classification for the 2015 ozone NAAQS;

2. Options to revoke the 2008 ozone NAAQS and, where applicable, provide anti-backsliding requirements to help smooth the transition between the two standards for nonattainment areas; and

3. SIP requirements for states with nonattainment areas and states in an ozone transport region under the 2015 ozone NAAQS.

More information about this proposal can be found at: https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state

Written comments will be due on or before 60 days from the date of publication in the Federal Register.

Please let me know if you have any questions.

Kenneth L. Mitchell, Ph.D. | Special Assistant to the Director |
Air, Pesticides, and Toxics Management Division
U.S. Environmental Protection Agency | 61 Forsyth Street, SW | Atlanta, GA 30303
Voice: 404-562-9065 | Fax: 404-562-9066 | Email: mitchell.ken@epa.gov
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To: hornback@metro4-sesarm.org[hornback@metro4-sesarm.org]; cmaples@semtribe.com[cmaples@semtribe.com]; Darin Steen[darin.steen@catawbaindian.net]; jamilong@nc-cherokee.com[jamilong@nc-cherokee.com]; jerry.cain@choctaw.org[jerry.cain@choctaw.org]; kevind@miccosukeetribe.com[kevind@miccosukeetribe.com]; rmccullers@pci-nsn.gov[rmccullers@pci-nsn.gov]; asatyal@pinellascounty.org[asatyal@pinellascounty.org]; barnetwm@forsyth.cc[barnetwm@forsyth.cc]; bieleb@miamidade.gov[bieleb@miamidade.gov]; bob.rogers@shelbycountytn.gov[bob.rogers@shelbycountytn.gov]; brivera@aqm.co.knox.tn.us[brivera@aqm.co.knox.tn.us]; campbell@epchc.org[campbell@epchc.org]; clafontaine@mdeq.ms.gov[clafontaine@mdeq.ms.gov]; colby_bob@chattanooga.gov[colby_bob@chattanooga.gov]; corey.m.masuca@jcdh.org[corey.m.masuca@jcdh.org]; danny.shea@huntsvilleal.gov[danny.shea@huntsvilleal.gov]; david.brigman@buncombecounty.org[david.brigman@buncombecounty.org]; dbaker@mdeq.ms.gov[dbaker@mdeq.ms.gov]; dika.kuoh@dnr.ga.gov[dika.kuoh@dnr.ga.gov]; ebenezer.gujjarlapudi@mecklenburgcountync.gov[ebenezer.gujjarlapudi@mecklenburgcountync.gov]; gonzaj@miamidade.gov[gonzaj@miamidade.gov]; hornback@metro4-sesarm.org[hornback@metro4-sesarm.org]; Jason.rayfield@mecklenburgcountync.gov[Jason.rayfield@mecklenburgcountync.gov]; jeff.koerner@dep.state.fl.us[jeff.koerner@dep.state.fl.us]; john.finke@nashville.gov[john.finke@nashville.gov]; jonathan.stanton@jcdh.org[jonathan.stanton@jcdh.org]; justin.b.green@dep.state.fl.us[justin.b.green@dep.state.fl.us]; karen.hays@dnr.ga.gov[karen.hays@dnr.ga.gov]; keith.talley@louisvilleky.gov[keith.talley@louisvilleky.gov]; laliddington@aqm.co.knox.tn.us[laliddington@aqm.co.knox.tn.us]; laxmana.tallam@flhealth.gov[laxmana.tallam@flhealth.gov]; leslie.rhodes@mecklenburgcountync.gov[leslie.rhodes@mecklenburgcountync.gov]; lfernandez@broward.org[lfernandez@broward.org]; lloydpb@forsyth.cc[lloydpb@forsyth.cc]; lwb@adem.alabama.gov[lwb@adem.alabama.gov]; melissal@coj.net[melissal@coj.net]; michael.abraczinskas@ncdenr.gov[michael.abraczinskas@ncdenr.gov]; michelle.b.walker@tn.gov[michelle.b.walker@tn.gov]; michelle.king@louisvilleky.gov[michelle.king@louisvilleky.gov]; quincy.styke@tn.gov[quincy.styke@tn.gov]; rachael.hamilton@louisvilleky.gov[rachael.hamilton@louisvilleky.gov]; raglanre@forsyth.cc[raglanre@forsyth.cc]; renee.parker@ocfl.net[renee.parker@ocfl.net]; roberma@miamidade.gov[roberma@miamidade.gov]; robinson@coj.net[robinson@coj.net]; rwg@adem.alabama.gov[rwg@adem.alabama.gov]; sean.alteri@ky.gov[sean.alteri@ky.gov]; sheila.holman@ncdenr.gov[sheila.holman@ncdenr.gov]; thompsrb@dhec.sc.gov[thompsrb@dhec.sc.gov]
Cc: Worley, Gregg[Worley.Gregg@epa.gov]; Rinck, Todd[Rinck.Todd@epa.gov]; Garver, Daniel[Garver.Daniel@epa.gov]; Brown, Ryan[Brown.Ryan@epa.gov]; Palmer, Darren[Palmer.Darren@epa.gov]; Gillam, Rick[Gillam.Rick@epa.gov]; Kemker, Carol[Kemker.Carol@epa.gov]; Banister, Beverly[Banister.Beverly@epa.gov]; Fite, Mark[Fite.Mark@epa.gov]; Gettle, Jeaneanne[Gettle.Jeaneanne@epa.gov]; Mitchell, Ken[Mitchell.Ken@epa.gov]; Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Davis, Scott[Davis.ScottR@epa.gov]; Berrios, Lisa[Berrios.Lisa@epa.gov]
From: Mitchell, Ken
Sent: Mon 9/19/2016 5:47:17 PM
Subject: Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations
Exceptional Events Guidance with Cover Memo Signed 9_16_16.pdf

Region 4 Air Directors:

Please find attached a memorandum (signed last Friday) titled, "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" and guidance document. Please let me know if you have any questions. Thanks.

Kenneth L. Mitchell, Ph.D. | Special Assistant to the Director |
Air, Pesticides, and Toxics Management Division
U.S. Environmental Protection Agency | 61 Forsyth Street, SW | Atlanta, GA 30303
Voice: 404-562-9065 | Fax: 404-562-9066 | Email: mitchell.ken@epa.gov
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To: McTeerToney, Heather[McTeerToney.Heather@epa.gov]
Cc: Davis, Scott[Davis.ScottR@epa.gov]; Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Bell, Tiereny[Bell.Tiereny@epa.gov]; Green, Justin B.[Justin.B.Green@dep.state.fl.us]
From: McLane, Preston
Sent: Mon 10/3/2016 1:01:32 PM
Subject: Florida Area Designations Recommendation - 2015 Ozone NAAQS
2016-09-30 EPA Comment-Green-Ozone NAAQS Area Designations.pdf
2015 Ozone Design Values.jpg

Dear Mrs. Toney,

Pursuant to Section 107(d)(1)(A) of the Clean Air Act, please find attached to this e-mail a letter reflecting the State of Florida's area designations recommendations for the 2015 revised primary eight-hour National Ambient Air Quality Standard (NAAQS) for ozone (O3). A hard copy of this letter has also been mailed to EPA Region 4.

The State of Florida recommends that the entire State of Florida be designated as "attainment" for the 2015 ozone NAAQS.

Florida bases this recommendation upon the most recent three years of ozone ambient air quality monitoring data (2013-2015), which show that Florida meets the revised standard of 75 parts per billion (see also attached diagram of design values statewide).

Florida understands that the EPA may ultimately designate areas using 2014-2016 air quality monitoring data, and the state is confident that the 2016 data will further support its recommendation of a statewide designation of attainment.

Florida gathers its data through a network of 57 ozone air quality monitors – 50% more monitors than the minimum required by federal law. Florida has produced a clear historical record of ozone concentration data sufficient to support the state's attainment designation. Overall, Florida's ozone values have been, and are expected to remain, well below the revised standard. These facts speak to the state's ongoing commitment to maintaining and enhancing air quality for the

benefit of its citizens and visitors.

Best regards,

- Preston

Preston McLane

Program Administrator

Division of Air Resource Management

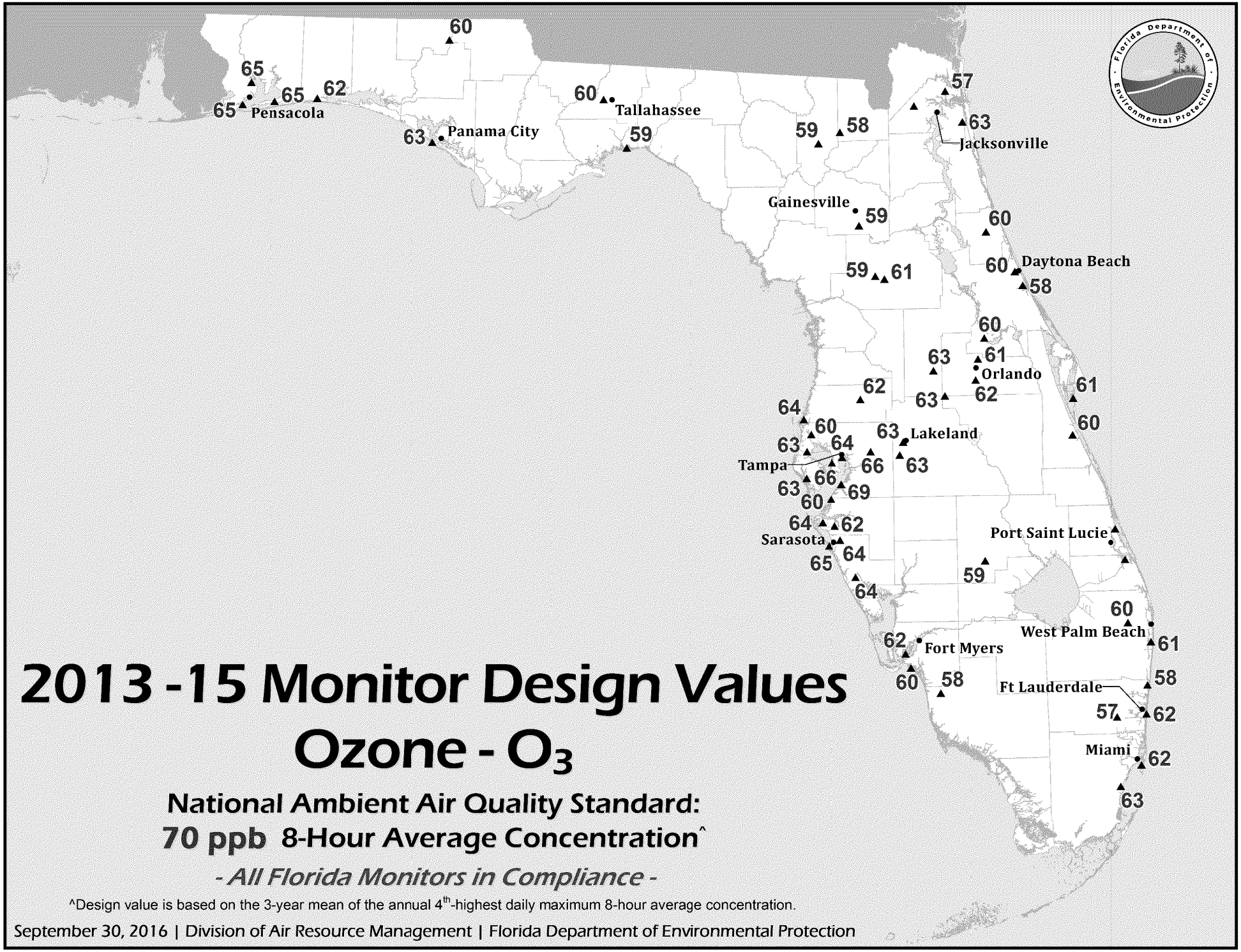
Florida Department of Environmental Protection

2600 Blair Stone Road, MS 5500

Tallahassee, Florida 32399-2400

Office: (850) 717-9089

Preston.McLane@dep.state.fl.us



2013 -15 Monitor Design Values

Ozone - O_3

National Ambient Air Quality Standard:

70 ppb 8-Hour Average Concentration^

- All Florida Monitors in Compliance -

^Design value is based on the 3-year mean of the annual 4th-highest daily maximum 8-hour average concentration.

September 30, 2016 | Division of Air Resource Management | Florida Department of Environmental Protection

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Florida Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Jonathan P. Steverson
Secretary

September 30, 2016

Mrs. Heather McTeer Toney
Regional Administrator
U.S. Environmental Protection Agency – Region 4
61 Forsyth Street
Atlanta, Georgia 30303-8960

Re: Area designations for the 2015 Ozone National Ambient Air Quality Standard for the State of Florida

Dear Mrs. Toney,

Pursuant to Section 107(d)(1)(A) of the Clean Air Act, the State of Florida recommends that the entire State of Florida be designated as " attainment" for the 2015 revised primary eight -hour National Ambient Air Quality Standard for ozone (O_3).

Florida bases this recommendation upon the most recent three years of ozone ambient air quality monitoring data (2013-2015), which show that Florida meets the revised standard of 75 parts per billion (see attached diagram of design values statewide). Florida understands that the Environmental Protection Agency may ultimately designate areas using 2014-2016 air quality monitoring data, and the state is confident that the 2016 data will further support its recommendation of a statewide designation of attainment.

Florida gathers its data through a network of 57 ozone air quality monitors – 50% more monitors than the minimum required by federal law. Florida has produced a clear historical record of ozone concentration data sufficient to support the state's attainment designation. Overall, Florida's ozone values have been, and are expected to remain, well below the revised standard. These facts speak to the state's ongoing commitment to maintaining and enhancing air quality for the benefit of its citizens and visitors.

If you have any questions about this recommendation, please contact Preston McLane at (850) 717-9089.

Sincerely,

Justin B. Green
Director, Division of Air Resource Management

Encl.

cc: Scott Davis, Chief, Air Planning Branch, EPA – Region 4
Paula Cobb, Deputy Secretary for Regulatory Programs, Florida DEP

To: Benjamin, Lynorae[benjamin.lynorae@epa.gov]
Cc: Munsey, Elisabeth[Elisabeth.Munsey@dnr.ga.gov]; Grodzinsky, Gil[Gil.Grodzinsky@dnr.ga.gov]; Davis, Scott[Davis.ScottR@epa.gov]; Wong, Richard[Wong.Richard@epa.gov]; Spann, Jane[Spann.Jane@epa.gov]
From: Boylan, James
Sent: Tue 10/4/2016 8:21:38 PM
Subject: RE: Removing Low RVP Gasoline in Atlanta

Thanks again for the information.

Jim

From: Benjamin, Lynorae [mailto:benjamin.lynorae@epa.gov]
Sent: Tuesday, October 04, 2016 4:17 PM
To: Boylan, James
Cc: Munsey, Elisabeth; Grodzinsky, Gil; Davis, Scott; Wong, Richard; Spann, Jane
Subject: RE: Removing Low RVP Gasoline in Atlanta

Yes… if we go with precedent. The 2015 standard is in effect as of October 1, 2015.

From: Boylan, James [mailto:James.Boylan@dnr.ga.gov]
Sent: Tuesday, October 04, 2016 3:22 PM
To: Benjamin, Lynorae <benjamin.lynorae@epa.gov>
Cc: Munsey, Elisabeth <Elisabeth.Munsey@dnr.ga.gov>; Grodzinsky, Gil <Gil.Grodzinsky@dnr.ga.gov>; Davis, Scott <Davis.ScottR@epa.gov>; Wong, Richard <Wong.Richard@epa.gov>; Spann, Jane <Spann.Jane@epa.gov>
Subject: RE: Removing Low RVP Gasoline in Atlanta

Lynorae,

Thanks for the information. Are you saying that if the Atlanta area is redesignated to attainment for the 2008 ozone NAAQS that we still would not be able to move forward with removing the low RVP requirements if we have any monitors in Atlanta above the 2015 ozone NAAQS (even though designations will not be done until October 1, 2017)? Please confirm.

Thanks!!

Jim

From: Benjamin, Lynorae [mailto:benjamin.lynorae@epa.gov]
Sent: Tuesday, October 04, 2016 3:09 PM
To: Boylan, James
Cc: Munsey, Elisabeth; Grodzinsky, Gil; Davis, Scott; Wong, Richard; Spann, Jane
Subject: RE: Removing Low RVP Gasoline in Atlanta

Hi Jim,

Thanks for your email. In order for the Administrator to use her (his) discretion to remove requirements, we have to consider the current standard (in this case the 2015 NAAQS) and whether there are violating monitors. I do not know of any case where this discretion has been used when there is a violating monitor. With regard to the hypothetical that you present on what a possible boundary is for the 2015 standard would be and what counties might be covered, we cannot speculate until the designations are done. As you know for designations, we have to consider counties with violating monitors AND those that CONTRIBUTE to the counties with the violating monitor. Please give me a call if you would like to discuss further but this is all we can tell you for now.

I hope your day is going well.

Lynorae

From: Boylan, James [mailto:James.Boylan@dnr.ga.gov]
Sent: Monday, October 03, 2016 7:26 PM
To: Benjamin, Lynorae <benjamin.lynorae@epa.gov>
Cc: Munsey, Elisabeth <Elisabeth.Munsey@dnr.ga.gov>; Grodzinsky, Gil <Gil.Grodzinsky@dnr.ga.gov>; Davis, Scott <Davis.ScottR@epa.gov>; Wong, Richard

<Wong.Richard@epa.gov>; Spann, Jane <Spann.Jane@epa.gov>
Subject: RE: Removing Low RVP Gasoline in Atlanta

Yes, there will be five monitors above the 2015 standard based on preliminary 2016 data. Does that mean we can't relax the RVP requirement in Atlanta? What if our new nonattainment area for the 2015 standard is smaller than the counties currently covered by the RVP requirement? In that case, can we relax the RVP requirements in the counties that are outside the new nonattainment area?

Jim

From: Benjamin, Lynorae [mailto:benjamin.lynorae@epa.gov]
Sent: Monday, October 03, 2016 6:03 PM
To: Boylan, James
Cc: Munsey, Elisabeth; Grodzinsky, Gil; Davis, Scott; Wong, Richard; Spann, Jane
Subject: Re: Removing Low RVP Gasoline in Atlanta

Hi Jim,

The question hinges on whether there is a violating monitor in the Atlanta area for the 2015 standard.

I hope your day is going well.

Sent from my iPhone

On Oct 3, 2016, at 5:28 PM, Boylan, James <James.Boylan@dnr.ga.gov> wrote:

Lynorae,

We would like to find out what is required to relax the lower RVP requirements in Atlanta from June 1 to September 15. Since EPA is moving forward with our ozone redesignation, we thought this would be a good time to remove this SIP requirement. Do you think a

conference call would be useful to help get us started?

Jim

James W. Boylan, Ph.D.

Manager, Planning & Support Program

Georgia Department of Natural Resources

Environmental Protection Division - Air Protection Branch

4244 International Parkway, Suite 120

Atlanta, GA 30354

Office: 404-363-7014 Fax: 404-363-7100

E-mail: James.Boylan@dnr.ga.gov

To: Davis, Scott[Davis.ScottR@epa.gov]; Benjamin, Lynorae[benjamin.lynorae@epa.gov]
Cc: Hays, Karen[Karen.Hays@dnr.ga.gov]; Kuoh, Dika[Dika.Kuoh@dnr.ga.gov]; Tian, Di[Di.Tian@dnr.ga.gov]; Munsey, Elisabeth[Elisabeth.Munsey@dnr.ga.gov]
From: Boylan, James
Sent: Fri 9/23/2016 1:48:10 PM
Subject: Georgia's Designation Recommendations for the 2015 Ozone NAAQS
GAEPD_2015_Ozone_Recommendation_Cover_Letter_Signed.pdf
GAEPD_2015_Ozone_Recommendation_Attachments.pdf
GAEPD_2015_Ozone_Recommendation_TAD.pdf
GA_EPD_Ozone_Designation_Modeling_TSD.pdf

Dear Mr. Davis,

Please find attached Georgia's designation recommendations for the 2015 ozone NAAQS. EPD performed a detailed five factor analysis in accordance with U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards". In addition, EPD performed source contribution modeling with CAMx-APCA. Based on this analysis, EPD recommends that the following eight (8) counties be designated as nonattainment for the 2015 ozone NAAQS: Fulton, Gwinnett, DeKalb, Cobb, Bartow, Clayton, Henry, and Rockdale. The remaining 151 counties in Georgia are recommended as unclassifiable/attainment.

The attachments include:

- EPD Transmittal Letter,
- Attachments to EPD Transmittal Letter,
- EPD Ozone Designation Technical Analysis Document (TAD), and
- EPD Ozone Designation Modeling Technical Support Document (TSD).

A hard copy, DVD version (with all Appendices), and an external hard drive with all the photochemical modeling files (inputs, outputs, scripts) will be placed in the mail today. We look forward to your review and concurrence with our recommendations. Should you or your staff have any questions, please feel free to contact me at (404) 363-7014.

Sincerely,

Jim Boylan

James W. Boylan, Ph.D.

Manager, Planning & Support Program

Georgia Department of Natural Resources

Environmental Protection Division - Air Protection Branch

4244 International Parkway, Suite 120

Atlanta, GA 30354

Office: 404-363-7014 Fax: 404-363-7100

E-mail: James.Boylan@dnr.ga.gov

Georgia's Nonattainment Area Designation Recommendations for the 2015 Ozone NAAQS – Modeling Technical Support Document –

EPA's designation guidance memo[1] states that source apportionment modeling can be used as part of the initial area designation process. The Georgia Environmental Protection Division (EPD) applied the Comprehensive Air Quality Model with eXtensions (CAMx)[2] with its Anthropogenic Precursor Culpability Assessment (APCA) tool to determine the contribution of each of the 39 counties in the Atlanta combined statistical area (CSA)[3] to the five violating ozone monitors in the Atlanta CSA. The five violating monitors were identified based on 2014-2016 preliminary ozone data and include: Confederate Avenue (Fulton county), McDonough (Henry county), Conyers (Rockdale county), South DeKalb (DeKalb county), and Gwinnett Tech (Gwinnett county). EPD used a similar approach with CAMx-APCA as EPA used for the proposed and final Cross-State Air Pollution Rule modeling[4] (hereafter, Transport Rule Modeling). The following sections describe how EPD conducted its 2011 base year modeling, 2017 future year modeling, and 2017 contribution modeling.

1. 2011 Base Year Modeling

Modeling Approach

EPD conducted 2011 CAMx modeling for the ozone season (April 1 to October 31) using 2011 meteorology and 2011 emissions. The EPD model set-up and inputs were similar to EPA's Transport Rule modeling. Also, EPD's model set-up and inputs were nearly identical to modeling performed by Georgia Tech for SESARM's Southeastern Modeling, Analysis, and Planning (SEMAP) project. A summary of configuration differences between the EPA, SESARM, and EPD modeling platforms is contained in Table 1.

Table 1. Configuration differences between the EPA, SESARM, and EPD modeling platforms.

	EPA	SESARM	EPD
WRFCAMx	WRFCAMx 4.0 beta	WRFCAMx 4.3	WRFCAMx 4.3
TUV	TUV4.8 (May 6, 2013 version)*	TUV4.8 (February 25, 2015 version)	TUV4.8 (February 25, 2015 version)
CAMx	CAMx v6.11 with modification for super-stepping routine for HMAX.	CAMx 6.11	CAMx 6.2

*Ramboll-Environ confirmed that there was an error in NO3_NO2.PHF file in the May 6, 2013 version.

[1] EPA, Guidance on the Area Designations for the 2015 Ozone National Ambient Air Quality Standards, https://www.epa.gov/ozone-designations/epa-guidance-area-designations-2015-ozone-naaqs

[2] Ramboll-Environ, CAMx Overview, http://www.camx.com/about/default.aspx

[3] EPD used the Atlanta CSA definition published by the Office of Budget and Management in February, 2013 that is available on the U.S. Census website (http://www.census.gov/population/metro/files/lists/2013/List1.xls).

[4] EPA, Proposed and Final Cross-State Air Pollution Rule, https://www.epa.gov/airmarkets/proposed-cross-state-air-pollution-update-rule and https://www.epa.gov/airmarkets/final-cross-state-air-pollution-rule-update.

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All CAMx versions were modified to read point-source formatted APCA emissions and override biogenic emissions as the region "1" to be consistent across platforms. The modeling inputs for the Transport Rule Modeling covered the continental U.S. (CONUS). These inputs were extracted for the SESARM and EPD modeling domains (Figures 1 and 2). The 2011 meteorological inputs were prepared using the official WRFCAMx utility (version 4.3) with Weather Research and Forecasting (WRF) model outputs developed for the Transport Rule Modeling. Ten days (March 22 – 31) were used as ramp-up days for 2011 modeling. Ozone column files and photolysis rates were prepared prior to the CAMx run with Ramboll-Environ's O3MAP utility released on May 6, 2013 and TUV utility (version 4.8). O3MAP requires ozone column data in text format and EPD used the Level 3 Ozone Monitoring Instrument (OMI) product. There was no missing data for the 2011 OMI dataset. 2011 initial and boundary conditions (IC/BCs) were developed using the SESARM modeling results. The SESARM modeling results were compared to EPA's Transport Rule modeling results and all differences were explained by the configuration differences shown in Table 1[5]. The EPD modeling results were compared with the SESARM modeling results (Figure 3) to evaluate impacts of the smaller EPD modeling domain and newer version of CAMx. The slope and r^2 values were 1.00 indicating insignificant differences between the two modeling platforms.

Figure 1. Domains for the Transport Rule Modeling (brown box), SESARM Modeling (orange box), and EPD Modeling (red box).

[5] Talat, O. and Hu, Y., Georgia Tech, SEMAP 2017 Ozone Projections and Sensitivity to NOx Emissions, Presented to SEMAP Air Quality Modeling Workgroup, August 15, 2016.

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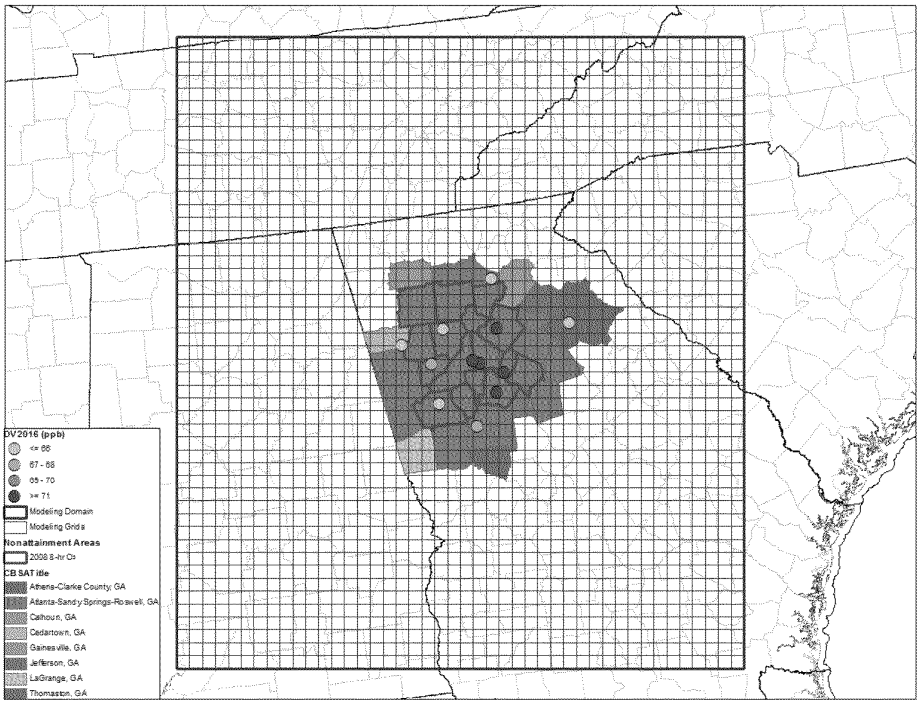

Figure 2. EPD's modeling domain and grids (red squares), preliminary 2014-2016 design values (colored circles), nonattainment areas for the 2008 ozone NAAQS (thick red outlines), and the Atlanta CSA broken down by CBSAs. All shaded counties were evaluated as part of the source contribution assessment.

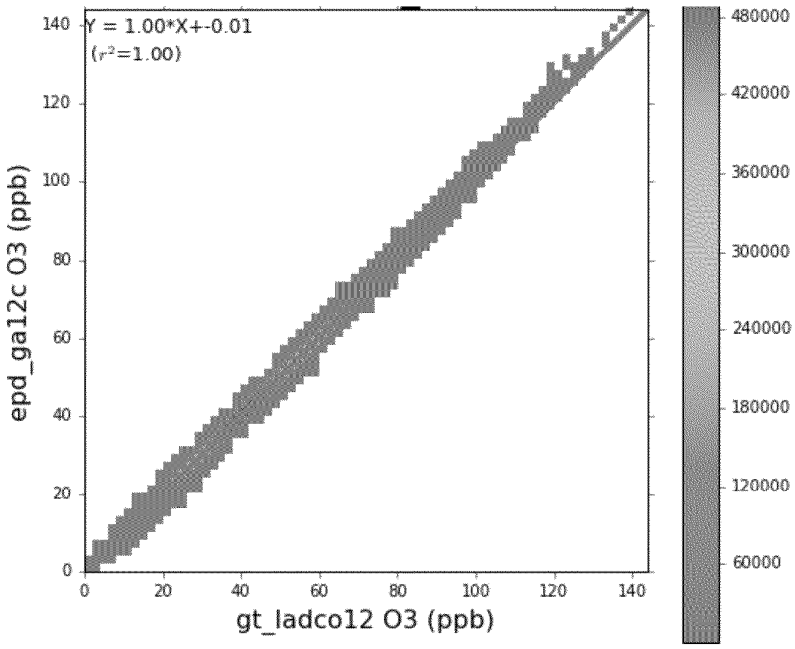

Figure 3. Comparison of 2011 CAMx modeling results between the SESARM and EPD modeling platforms. The color scale indicates the number of data points.

Model Performance Evaluation

Detailed model performance statistics listed below were calculated for the EPD CAMx modeling.

$$\text{Mean Observation} = \frac{\sum \square \square}{\square \square}$$

$$\text{Mean Prediction} = \frac{\sum \square \square}{\square \square}$$

$$\text{Mean Bias} = \frac{\sum(\square - \square \square)\square}{\square \square}$$

$$\text{Mean Gross Error} = \frac{\sum|\square - \square \square|\square}{\square \square}$$

$$\text{Normalized Mean Bias (NMB)} = 100\,\% \times \frac{\sum(\square - \square \square)\square}{\sum \square \square}$$

$$\text{Normalized Mean Error (NME)} = 100\,\% \times \frac{\sum|\square - \square \square|\square}{\sum \square \square}$$

N is the number of days when observed ozone concentrations are above the threshold, 60 ppb. *P* and *O* represent predicted ozone values and observed ozone values at each monitor for days above the performance statistics threshold.

At every monitor in the EPD modeling domain, NMB and NME were calculated for modeled daily maximum 8-hour ozone concentrations (MDA8O3, Figure 4) and daily maximum 1-hour ozone concentrations (MDA1O3, Figure 5). The EPD modeling with CAMx slightly over-predicted ozone concentrations at monitors in the Atlanta CSA. Detailed model performance statistics of MDA8O3 for Georgia monitors in the Atlanta CSA and outside Atlanta CSA are summarized in Table 2. NMB is less than ±15% for most monitors, except +15.6% for monitor 13-077-0002 in Coweta County and +15.2% for monitor 13-135-0002 in Gwinnett County. NME is less than 20% for all monitors in Georgia.

EPD also developed time series plots for MDA8O3 for the five ozone monitors violating the 2015 ozone NAAQS based on preliminary 2014-2016 design values (Figures 6 - 10). The ozone design value at the Confederate Avenue monitor is the highest in the Atlanta CSA. In general, EPD CAMx modeling over-predicted MDA8O3. EPD believes that the over-prediction on high ozone days will lead to higher modeled contributions compared to each county's actual contributions. Hence, the modeling results will be conservative (upper-bound) estimates of the contributions.

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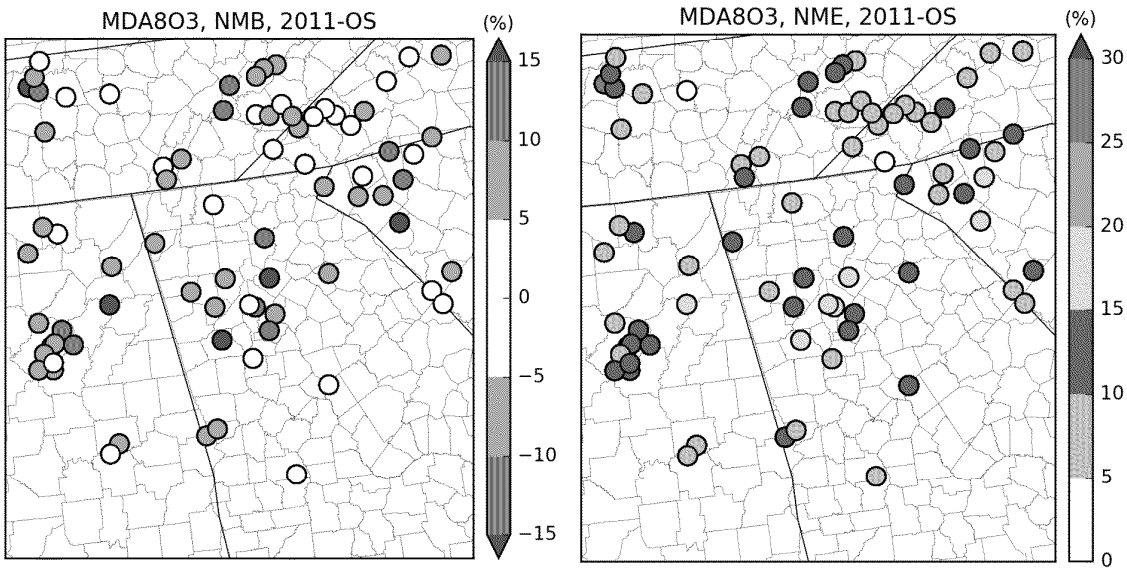

Figure 4. Normalized mean bias (left) and normalized mean error (right) of modeled daily maximum 8-hour ozone concentrations for the 2011 ozone season (April 1 to October 31). Cutoff = 60 ppb.

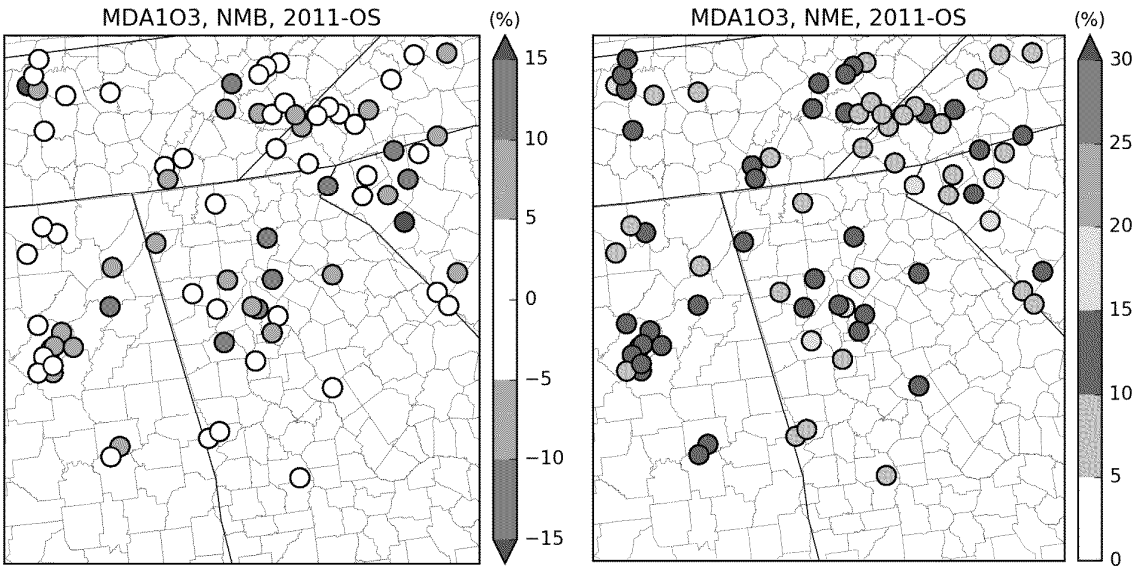

Figure 5. Normalized mean bias (left) and normalized mean error (right) of modeled daily maximum 1-hour ozone concentrations for the 2011 ozone season (April 1 to October 31). Cutoff = 60 ppb.

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Table 2. Model performance statistics of daily maximum 8-hour ozone for monitors in the Atlanta CSA and outside the Atlanta CSA in GA for the 2011 ozone season (April 1 - October 31). Cutoff = 60 ppb.

Area	AIRS _ID	N (#)	Mean Observation (ppb)	Mean Prediction (ppb)	Mean Bias (ppb)	Mean Gross Error (ppb)	Normalized Mean Bias (%)	Normalized Mean Error (%)
Atlanta CSA	13-059-0002	62	65.6	71.5	5.9	8.1	8.9	12.4
	13-067-0003	50	68.5	74.8	6.3	8.1	9.2	11.8
	13-077-0002	27	65.6	75.8	10.2	12.1	15.6	18.5
	13-085-0001	16	63.8	71.2	7.4	7.4	11.5	11.6
	13-089-0002	55	68.5	76.9	8.4	13.6	12.3	19.8
	13-097-0004	46	67.3	71.8	4.5	7.7	6.6	11.4
	13-121-0055	73	69.3	72.7	3.3	10.6	4.8	15.3
	13-135-0002	52	68.1	78.4	10.3	11.7	15.2	17.2
	13-151-0002	60	68.5	76.1	7.6	9.0	11.2	13.1
	13-223-0003	42	67.1	70.5	3.4	6.6	5.1	9.9
	13-231-9991	48	66.0	68.5	2.6	5.1	3.9	7.8
	13-247-0001	76	69.6	74.8	5.2	7.9	7.4	11.3
Outside Atlanta CSA in GA	13-021-0012	59	67.3	70.0	2.7	6.8	4.1	10.1
	13-055-0001	18	64.6	70.2	5.6	6.7	8.7	10.3
	13-073-0001	45	65.8	67.5	1.7	4.7	2.7	7.1
	13-213-0003	51	64.8	67.5	2.7	4.9	4.2	7.5
	13-215-0008	33	63.5	69.0	5.5	6.3	8.6	9.9
	13-245-0091	56	65.4	67.2	1.8	5.5	2.8	8.4
	13-261-1001	29	63.3	62.9	-0.4	4.3	-0.6	6.8

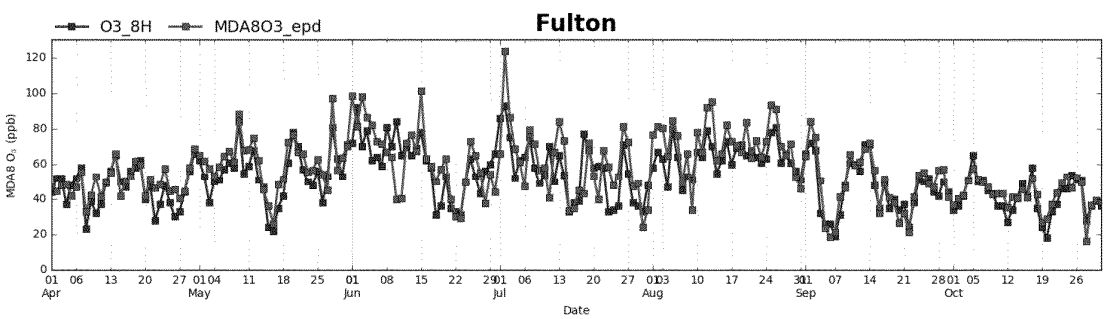

Figure 6. Time series of daily maximum 8-hour ozone concentrations at the Confederate Avenue monitor (13-121-0055) in Fulton County, GA.

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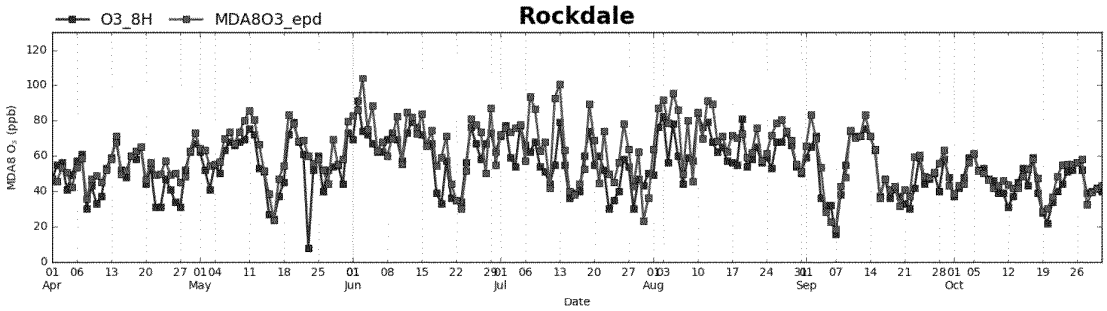

Figure 7. Time series of daily maximum 8-hour ozone concentrations at the Conyers monitor (13-247-0001) in Rockdale County, GA.

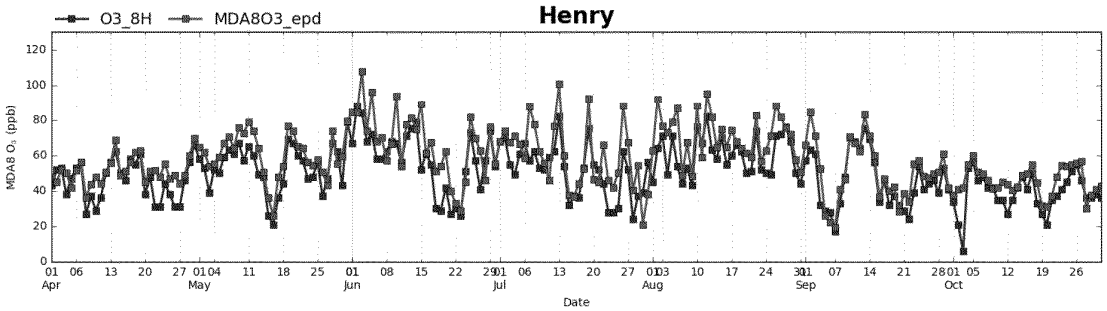

Figure 8. Time series of daily maximum 8-hour ozone concentrations at the McDonough monitor (13-151-0002) in Henry County, GA.

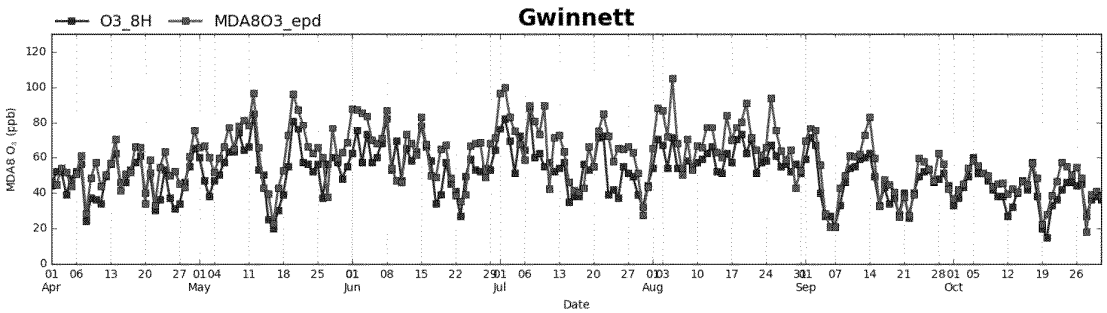

Figure 9. Time series of daily maximum 8-hour ozone concentrations at the Gwinnett Tech monitor (13-135-0002) in Gwinnett County, GA.

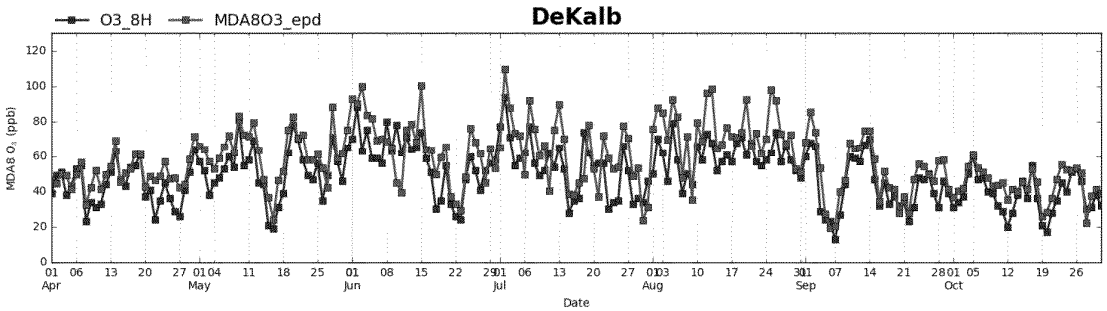

Figure 10. Time series of daily maximum 8-hour ozone concentrations at the South DeKalb monitor (13-089-0002) in DeKalb County, GA.

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2. 2017 Future Year Modeling

EPD conducted the 2017 future year modeling with CAMx-APCA for the ozone season using 2017 SESARM emissions and EPA 2011 meteorology. 2017 SESARM emissions were developed using the same emissions that were used for the Transport Rule modeling except that the 2017 Electrical Generating Units (EGU) emissions were updated for the SESARM states based on feedback from those states. SESARM applied scaling factors to emission records in EPA's 2017 or 2011 hourly point source emission input files to adjust EGU emissions to reflect SESARM states emission estimates for 2017.

EPD updated the 2017 emissions from seven EGU facilities in Georgia in the EPA "2017eh" inventory. The 2014 emissions which were reported by each facility and collected by Georgia EPD were used to represent 2017 emissions for most facilities, except SO_2, PM_{10}, and $PM_{2.5}$ emissions from Plant Scherer (Unit 1) and all emissions from Plant Yates (Units Y6BR and Y7BR).

- <u>SO_2, PM_{10}, and $PM_{2.5}$ emissions from Plant Scherer (Unit 1):</u>
  SO_2, PM_{10}, and $PM_{2.5}$ emissions from Plant Scherer (Unit 1) during 2014 were adjusted to reflect the impacts of flue gas desulfurization (FGD) controls which came online in May 2014 for Unit 1. The SO_2 emissions for Unit 1 were estimated by multiplying the 2014 NOx emission from Unit 1 by the ratio of total SO_2 emissions to total NOx emissions from Units 2-4. The PM_{10} and $PM_{2.5}$ emissions for Unit 1 were reduced by 50% according to the SESARM report[6].
- <u>All Emissions from Plant Yates (Units Y6BR and Y7BR):</u>
  These two units were converted from coal to natural gas boilers in 2015. According to Georgia Power, this facility will be run as a peaking unit with a 25% capacity factor (maximum). Therefore, EPD calculated its potential NOx emissions in 2017 using its potential usage, the nominal heat rate of 12 mmBtu/MWh, and the measured NOx emission rates after the conversion to natural gas (0.116 lbs/mmBtu for Unit Y6BR and 0.141 lbs/mmBtu for Unit Y7BR). For CO and VOC emissions, the maximum measured emission rates during May and June of 2015 were used. For SO_2, PM_{10} and $PM_{2.5}$, the AP-42 emission factors were used.

Next, a scaling ratio was calculated for each unit based on annual emissions. In most cases, the scaling ratio was calculated by dividing the EPD 2017 emissions by the EPA 2017 emissions. Then, the scaling ratio was applied to the EPA hourly 2017 EGU emissions to generate EPD hourly 2017 EGU emissions. For Plant Yates and Plant McIntosh, EPA 2017 emissions were zero. Therefore, the scaling ratio was calculated by dividing the EPD 2017 emissions by the EPA 2011 emissions. Then, the scaling ratio was applied to the EPA's hourly 2011 EGU emissions to generate EPD hourly 2017 EGU emissions. Table 3 shows Georgia's EGUs that were adjusted for SESARM and EPD modeling, adjustment approach, and scaling ratios used to adjust emissions. Table 4 shows the final adjusted emissions used for the 2017 SESARM and EPD modeling. The detailed calculations are contained in Appendix B (GA_EPD_Adjusted_EGU_Emissions.xlsx). The same 2017 modeling platform was also used for the APCA modeling described in the next chapter.

[6] AMEC, Development of the 2018 Projection Point Source Emission Inventory in the SESARM Region (Version 1.0).

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Table 3. Approach and scaling ratios used to adjust EPA 2017 EGU emissions for SESARM and EPD modeling.

Plant	ORIS ID	BOILER ID	Approach	CO Ratio	NH3 Ratio	NOx Ratio	PM10 Ratio	PM2.5 Ratio	SO2 Ratio	VOC Ratio
Plant Bowen	703	1BLR	Scale 2017 emissions	1.98	1.01	2.27	2.69	2.06	3.81	2.55
Plant Bowen	703	2BLR	Scale 2017 emissions	1.90	1.00	1.93	0.79	0.70	4.37	2.44
Plant Bowen	703	3BLR	Scale 2017 emissions	1.95	0.93	3.09	1.47	1.17	5.20	2.51
Plant Bowen	703	4BLR	Scale 2017 emissions	2.53	1.27	3.55	2.00	1.60	5.30	3.25
Plant Hammond	708	1	Scale 2017 emissions	0.08	0.00	0.26	0.16	0.18	0.03	0.15
Plant Hammond	708	2	Scale 2017 emissions	0.10	0.00	0.41	0.25	0.27	0.30	0.19
Plant Hammond	708	3	Scale 2017 emissions	0.11	0.00	0.36	0.22	0.24	0.07	0.20
Plant Hammond	708	4	Scale 2017 emissions	0.08	0.00	0.27	0.15	0.17	0.03	0.15
Plant Wansley	6052	1	Scale 2017 emissions	0.25	0.41	0.59	0.22	0.18	0.41	0.38
Plant Wansley	6052	2	Scale 2017 emissions	0.19	0.32	0.44	0.26	0.21	0.29	0.28
Plant Scherer	6257	1	Scale 2017 emissions	1.05	0.05	1.29	0.13	0.11	0.11	1.35
Plant Scherer	6257	2	Scale 2017 emissions	0.91	0.05	0.93	0.13	0.10	0.08	1.17
Plant Scherer	6257	3	Scale 2017 emissions	1.63	0.05	1.44	0.14	0.09	0.10	1.16
Plant Scherer	6257	4	Scale 2017 emissions	1.24	0.05	1.06	0.11	0.07	0.10	1.08
Plant Yates	728	Y6BR	Scale 2011 emissions	0.45	0.00	0.23	0.11	0.16	0.00	0.13
Plant Yates	728	Y7BR	Scale 2011 emissions	0.63	0.00	0.42	0.20	0.26	0.00	0.18
Plant McIntosh	6124	1	Scale 2011 emissions	4.43	0.00	4.06	4.97	4.52	3.28	4.44
Mid-Georgia Co-gen	55040	1	Scale 2017 emissions	0.04	0.02	0.10	6.72	10.97	0.00	0.41
Mid-Georgia Co-gen	55040	2	Scale 2017 emissions	0.05	0.02	0.11	7.54	12.31	0.00	0.46
Mid-Georgia Co-gen	55040	ST1	Scale 2017 emissions	0.03	0.00	0.02	0.68	1.10	0.00	0.10

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Table 4. Emission adjustment approach and emissions used for SESARM and EPD modeling.

Plant	ORIS ID	BOILER ID	Approach	CO Emissions	NH3 Emissions	NOx Emissions	PM10 Emissions	PM2.5 Emissions	SO2 Emissions	VOC Emissions
Plant Bowen	703	1BLR	Scale 2017 emissions	345.9	8.2	1643.0	307.6	235.6	1313.0	41.5
Plant Bowen	703	2BLR	Scale 2017 emissions	334.2	8.2	1477.0	90.9	80.1	1518.0	40.0
Plant Bowen	703	3BLR	Scale 2017 emissions	419.7	9.2	1666.0	207.1	165.2	2207.0	50.3
Plant Bowen	703	4BLR	Scale 2017 emissions	523.4	12.2	2273.0	272.5	216.7	2166.0	62.8
Plant Hammond	708	1	Scale 2017 emissions	17.0	0.0	181.0	25.2	20.4	32.0	2.0
Plant Hammond	708	2	Scale 2017 emissions	21.6	0.0	282.0	37.5	29.5	290.0	2.6
Plant Hammond	708	3	Scale 2017 emissions	22.1	0.0	238.0	32.9	26.5	59.0	2.6
Plant Hammond	708	4	Scale 2017 emissions	72.7	0.1	773.0	107.4	87.0	145.0	8.6
Plant Wansley	6052	1	Scale 2017 emissions	293.8	19.0	1200.0	135.1	111.6	1426.0	35.2
Plant Wansley	6052	2	Scale 2017 emissions	214.2	14.5	820.0	159.4	125.5	1017.0	25.6
Plant Scherer	6257	1	Scale 2017 emissions	829.2	1.9	3733.0	142.0	85.1	269.0	99.5
Plant Scherer	6257	2	Scale 2017 emissions	725.6	1.7	2872.0	142.5	82.8	198.0	87.0
Plant Scherer	6257	3	Scale 2017 emissions	1325.2	1.7	3584.0	140.8	81.9	253.0	88.7
Plant Scherer	6257	4	Scale 2017 emissions	986.5	1.7	3161.0	110.8	64.6	241.0	80.1
Plant Yates	728	Y6BR	Scale 2011 emissions	79.1	0.0	533.5	34.3	34.3	2.7	3.0
Plant Yates	728	Y7BR	Scale 2011 emissions	79.1	0.0	648.5	34.3	34.3	2.7	3.0
Plant McIntosh	6124	1	Scale 2011 emissions	36.4	0.0	1046.0	39.5	21.2	2267.0	4.3
Mid-Georgia Co-gen	55040	1	Scale 2017 emissions	9.6	0.4	18.0	5.7	5.7	0.0	2.3
Mid-Georgia Co-gen	55040	2	Scale 2017 emissions	10.7	0.4	19.0	6.4	6.4	0.0	2.6
Mid-Georgia Co-gen	55040	ST1	Scale 2017 emissions	5.6	0.0	4.0	0.6	0.6	0.0	0.6

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A comparison of total anthropogenic NOx emissions (2011 NEI, 2011 modeled, 2011 NEI with 2014 EGUs, and 2017 modeled) by county are included in Table 5. The 2011 NEI and 2011 modeled NOx emissions are nearly identical. However, there are some significant differences between the 2011 NEI with 2014 EGUs vs. the 2017 modeled emissions.

Table 5. Total anthropogenic NOx emissions by county in the Atlanta CSA.

County	2011 NEI_v2	2011 model	2011 w/ 2014 point	EPA 2017 model	EPD 2017 model
Fulton	23,881	23,497	23,110	14,932	14,932
Gwinnett	16,464	16,205	16,460	9,585	9,585
Cobb	16,259	16,045	13,622	8,493	8,493
DeKalb	14,648	14,433	14,546	8,307	8,307
Bartow	14,309	14,242	12,923	6,373	10,762
Clayton	10,536	10,454	10,622	8,067	8,067
Coweta	10,384	10,336	4,861	2,282	3,464
Henry	7,327	7,263	6,681	4,182	4,182
Hall	5,172	5,101	5,217	2,916	2,916
Carroll	4,300	4,249	4,302	2,551	2,551
Cherokee	4,207	4,147	4,275	2,519	2,519
Madison	3,992	3,981	2,411	2,080	2,080
Troup	3,732	3,695	3,748	2,215	2,215
Jackson	3,705	3,664	3,876	2,212	2,212
Forsyth	3,590	3,535	3,608	2,208	2,208
Heard	3,437	3,443	2,930	4,671	2,783
Gordon	3,336	3,305	3,344	2,086	2,086
Clarke	2,985	2,939	2,964	1,699	1,699
Douglas	2,976	2,935	2,976	1,694	1,694
Newton	2,913	2,874	2,904	1,628	1,628
Paulding	2,600	2,568	2,600	1,601	1,601
Walton	2,520	2,325	2,286	1,266	1,266
Morgan	2,313	2,296	2,218	1,590	1,590
Fayette	2,165	2,132	2,163	1,274	1,274
Barrow	2,118	2,088	2,130	1,172	1,172
Rockdale	2,045	2,020	2,050	1,188	1,188
Butts	1,817	1,805	1,817	1,246	1,246
Meriwether	1,671	1,660	1,729	1,188	1,188
Haralson	1,649	1,636	1,649	1,096	1,096
Spalding	1,633	1,611	1,632	877	877
Polk	1,529	1,505	1,455	858	858
Oconee	1,287	1,262	1,287	675	675
Upson	1,161	1,147	1,301	659	659
Pickens	1,029	1,014	1,030	564	564
Lamar	810	800	1,056	491	491
Dawson	712	702	712	396	396
Jasper	599	593	614	398	398
Pike	583	576	583	341	341
Oglethorpe	508	503	508	304	304
Total	186,905	184,588	174,202	107,883	111,566

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Table 6 shows that the majority of the differences are coming for on-road mobile emissions which show significant emission reductions between 2011 and 2017. Since the 2017 emissions are the closest emissions to the current emissions in 2016 and the EPA designations will be finalized in 2017, EPD feels it is most appropriate to use 2017 emission in the contribution modeling. The detailed calculations for Tables 5 and 6 are contained in Appendix C (2011_2017_Modeled_Emissions.xlsx).

Table 6. Total anthropogenic NOx emissions by source sector in the Atlanta CSA.

Sector	2011 NEI_v2	2011 model	2011 w/ 2014 point	EPA 2017 model	EPD 2017 model
Fires	785	785	785	785	785
Point	30,614	30,527	17,911	13,635	17,318
Area	14,891	14,886	14,886	13,776	13,776
On-road	111,803	109,876	109,876	59,280	59,280
Non-road	28,811	28,515	28,515	20,408	20,408

2017 initial and boundary conditions were developed using the SESARM modeling results. EPD's 2017 CAMx modeling results were compared with SESARM 2017 modeling results (Figure 11) to evaluate the impacts of using the smaller EPD modeling domain. Small differences between the SESARM and EPD modeling results (r^2=1.00, slope =1.00, intercept=0.01) indicates that the impacts of using a smaller modeling domain is insignificant.

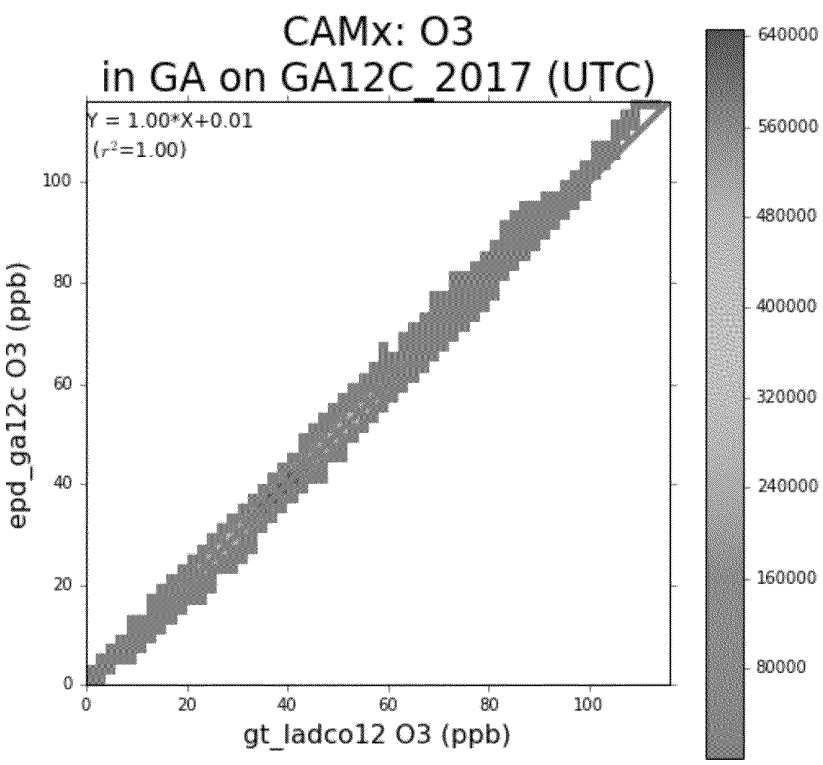

Figure 11. Comparison of 2017 CAMx modeling results between the SESARM and EPD modeling. The color scale indicates the number of data points.

2017 Future Design Values

EPD calculated the 2017 future design values by running the U.S. EPA's Modeled Attainment Test Software (MATS) version 2.6.1 following EPA's draft modeling guidance[7], except that EPD used the grid cell containing the monitor rather than the maximum in the 3x3 array. The 2017 ozone design values (DVF) were calculated by multiplying the 2011 5-year weighted ozone design value (DVC) by the relative response factor (RRF), where the RRF is the ratio of modeled 2011 MDA8O3 concentrations to modeled 2017 MDA8O3 concentrations at each modeling grid cell.

$$\mathrm{DVF} = \left(\frac{2017\ \mathrm{MDA8O3}}{2011\ \mathrm{MDA8O3}}\right) \square\ \mathrm{DVC}$$

Appendix A contains the detailed MATS run configuration. Table 7 summarizes the projected 2017 ozone design values estimated with the EPD modeling platform.

Table 7. Projected 2017 ozone design values.

Area	AIRS_ID	DVF2017	COUNTY
Atlanta CSA	13-059-0002	58.3	Clarke
	13-067-0003	64.6	Cobb
	13-077-0002	52.9	Coweta
	13-085-0001	56.5	Dawson
	13-089-0002	65.4	DeKalb
	13-097-0004	61.9	Douglas
	13121-0055	69.9	Fulton
	13-135-0002	64.8	Gwinnett
	13-151-0002	67.0	Henry
	13-223-0003	60.8	Paulding
	13-231-9991	60.5	Pike
	13-247-0001	64.8	Rockdale
Outside Atlanta CSA	13-021-0012	59.8	Bibb
	13-055-0001	57.0	Chattooga
	13-073-0001	59.1	Columbia
	13-213-0003	60.2	Murray
	13-215-0008	56.4	Muscogee
	13-245-0091	60.6	Richmond
	13-261-1001	57.6	Sumter

[7] EPA, 2014. Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze.

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3. Source Apportionment Modeling

Preparation of "Tagged" APCA Emissions Inputs

For 2017 APCA emission inputs, EPD conducted Sparse Matrix Object Kernel Emission (SMOKE, version 3.6.5) modeling to spatially and temporally allocate emissions into the EPD modeling grids, as well as speciate inventory pollutants to modeling species using the CB6r2 chemical mechanism (Figure 12). SMOKE was also run in source apportionment mode to tag anthropogenic emissions from each of the 39 counties in the Atlanta CSA as an individual source region; anthropogenic emissions from all other counties in the modeling domain were tagged as the "other" region, and emissions from biogenic sources, wildfires, and prescribed burning were tagged as the "biogenic" source group (Table 8). Biogenic and dust emissions were tagged as "1" and fire emissions were tagged as "42".

Low level emissions (e.g. onroad, nonroad, area etc.) were processed in SMOKE from county level data and spatially allocated to grid cells that overlap the county using spatial surrogates from the NEI 2011eh v2 platform. The resulting emissions received a source apportionment tag that corresponds to the source county. In the case where one grid cell overlaps multiple counties, that particular grid cell would contain separately tagged emissions from each of the overlapped counties according to the amounts of the total county emissions allocated by the spatial surrogates. This step takes place during emissions processing and thus eliminates the need to separate each county's emissions in a particular grid cell using area fractions within the air quality model which is less accurate.

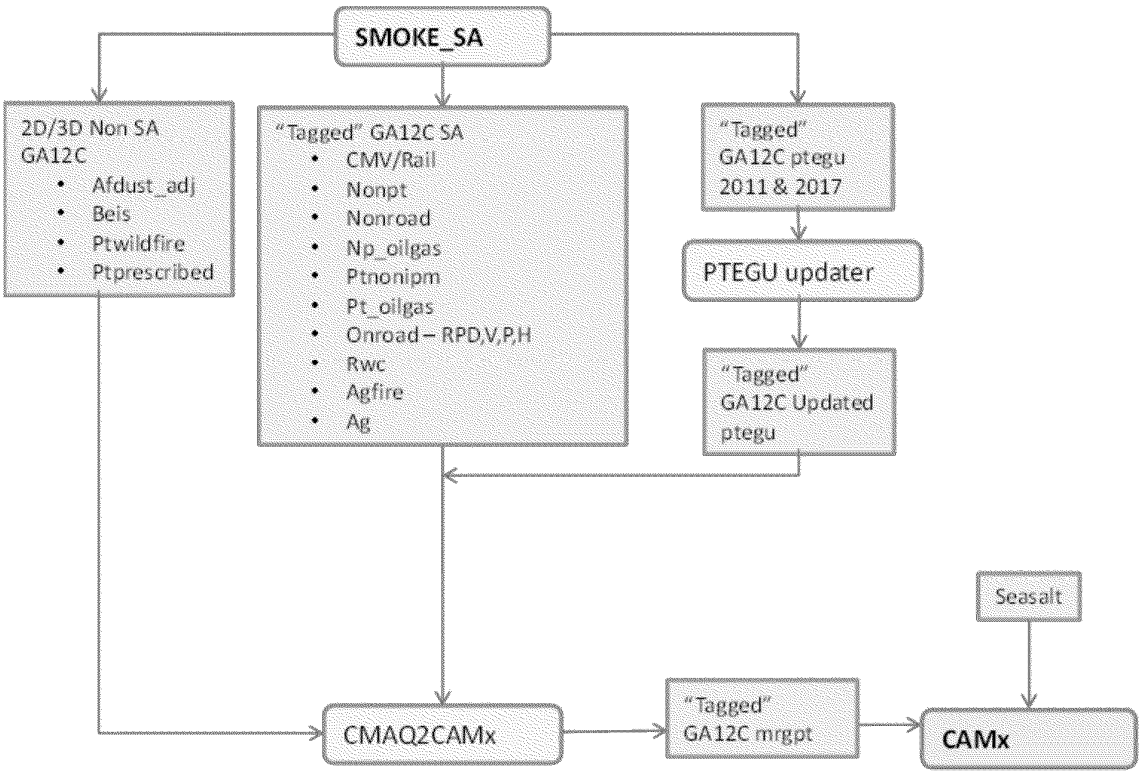

Figure 12. SMOKE processing procedures for CAMx-APCA modeling.

Table 8. County tag list for the CAMx-APCA modeling

Tag	County FIPS	County Name
2	"13059"	Clarke
3	"13195"	Madison
4	"13219"	Oconee
5	"13221"	Oglethorpe
6	"13013"	Barrow
7	"13015"	Bartow
8	"13035"	Butts
9	"13045"	Carroll
10	"13057"	Cherokee
11	"13063"	Clayton
12	"13067"	Cobb
13	"13077"	Coweta
14	"13085"	Dawson
15	"13089"	DeKalb
16	"13097"	Douglas
17	"13113"	Fayette
18	"13117"	Forsyth
19	"13121"	Fulton
20	"13135"	Gwinnett
21	"13143"	Haralson
22	"13149"	Heard
23	"13151"	Henry
24	"13159"	Jasper
25	"13171"	Lamar
26	"13199"	Meriwether
27	"13211"	Morgan
28	"13217"	Newton
29	"13223"	Paulding
30	"13227"	Pickens
31	"13231"	Pike
32	"13247"	Rockdale
33	"13255"	Spalding
34	"13297"	Walton
35	"13129"	Gordon
36	"13233"	Polk
37	"13139"	Hall
38	"13157"	Jackson
39	"13285"	Troup
40	"13293"	Upson
41	"0"	All Other Counties

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Source Contribution Calculation

Source contributions of each county in the Atlanta CSA were calculated following similar procedures used in the Transport Rule Modeling.

1) Calculate the average "high" 2017 MDA8 value by averaging 2017 MDA8 ozone concentrations (MDA8H) for days showing 2017 MDA8 ozone concentrations greater or equal to 71 ppb[8] at each monitor. If the number of days with 2017 MDA8 ozone concentrations over 71 ppb is less than five at any monitor, the top five 2017 MDA8 ozone concentrations are selected by lowering the threshold to 60 ppb. If a monitor does not have five days above or equal 60 ppb, contributions were not calculated at the monitor;
2) Calculate the 2017 8-hour ozone source contribution of each county for the grid cells containing ozone monitors using CAMx-APCA outputs. Daily 2017 8-hour ozone source contribution of each county for the days and hours were extracted corresponding to the days and hours used to compute the average "high" 2017 MDA8 value;
3) Calculate the average 2017 8-hour ozone source contribution (AOC) of each county at a monitor;
4) Calculate final source contribution of a county at a monitor by multiplying its AOC and the ratio of the 2017 future design value at the monitor and MDA8H at the monitor: County Contribution = AOC x (2017 DVF/MDA8H).

4. Results and Conclusions

Contributions of 39 counties in the Atlanta CSA to the five violating ozone monitors are summarized in Table 9. A contribution threshold of 1.0 ppb (after rounding at the second decimal place) was used to determine which counties significantly contribute to the violating monitors. The 1.0 ppb threshold was chosen because it is EPA's recently proposed significant impact level for single source PSD modeling[9]. The following counties had more than a 1.0 ppb impact on at least one violating ozone monitor: Fulton, Gwinnett, DeKalb, Cobb, Bartow, Clayton, and Henry.

[8] GA EPD used 71 ppb as the threshold compared with 76 ppb for the EPA's Transport Rule Modeling because GA EPD's goal is to estimate contributions for the 2015 Ozone NAAQS, 70 ppb, while the EPA's modeling was for the 2008 Ozone NAAQS, 75 ppb.

[9] EPA, 2016. Draft Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program.

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Table 9. Contributions of 39 counties in the Atlanta CSA to violating ozone monitors. Red values indicate more than 1.0 ppb contribution to a violating ozone monitor.

Monitor	Confederate Ave. (13-121-0055)	Conyers (13-247-0001)	McDonough (13-151-0002)	Gwinnett Tech (13-135-0002)	South DeKalb (13-089-0002)
Barrow	0.12	0.06	0.10	0.23	0.10
Bartow	**1.17**	0.77	0.97	**1.45**	0.96
Butts	0.04	0.07	0.14	0.02	0.04
Carroll	0.24	0.33	0.15	0.09	0.26
Cherokee	0.40	0.30	0.36	0.64	0.33
Clarke	0.08	0.03	0.10	0.09	0.08
Clayton	**3.54**	**4.22**	**3.85**	0.68	**3.26**
Cobb	**2.69**	**1.50**	**1.72**	**2.49**	**2.05**
Coweta	0.24	0.38	0.29	0.14	0.23
Dawson	0.03	0.03	0.03	0.04	0.03
DeKalb	**3.04**	**3.07**	**3.17**	**2.33**	**5.56**
Douglas	0.68	0.41	0.33	0.16	0.55
Fayette	0.21	0.31	0.40	0.07	0.18
Forsyth	0.29	0.26	0.24	0.78	0.24
Fulton	**8.74**	**4.12**	**4.07**	**3.92**	**5.98**
Gordon	0.15	0.11	0.14	0.07	0.13
Gwinnett	**1.71**	**1.93**	**1.60**	**8.25**	**1.58**
Hall	0.26	0.18	0.16	0.61	0.19
Haralson	0.07	0.10	0.03	0.04	0.09
Heard	0.14	0.26	0.16	0.09	0.15
Henry	0.55	**2.65**	**4.08**	0.26	0.88
Jackson	0.16	0.07	0.12	0.29	0.13
Jasper	0.01	0.01	0.03	0.01	0.01
Lamar	0.01	0.02	0.03	0.01	0.01
Madison	0.07	0.03	0.07	0.11	0.07
Meriwether	0.02	0.03	0.03	0.02	0.03
Morgan	0.06	0.02	0.08	0.03	0.06
Newton	0.17	0.29	0.34	0.06	0.21
Oconee	0.04	0.01	0.05	0.04	0.04
Oglethorpe	0.01	0.00	0.01	0.01	0.01
Paulding	0.35	0.20	0.22	0.20	0.29
Pickens	0.05	0.05	0.05	0.03	0.05
Pike	0.01	0.01	0.02	0.01	0.01
Polk	0.09	0.06	0.05	0.07	0.08
Rockdale	0.23	0.95	0.41	0.09	0.31
Spalding	0.04	0.10	0.15	0.03	0.05
Troup	0.03	0.04	0.04	0.03	0.04
Upson	0.01	0.01	0.01	0.01	0.01
Walton	0.16	0.09	0.20	0.14	0.17

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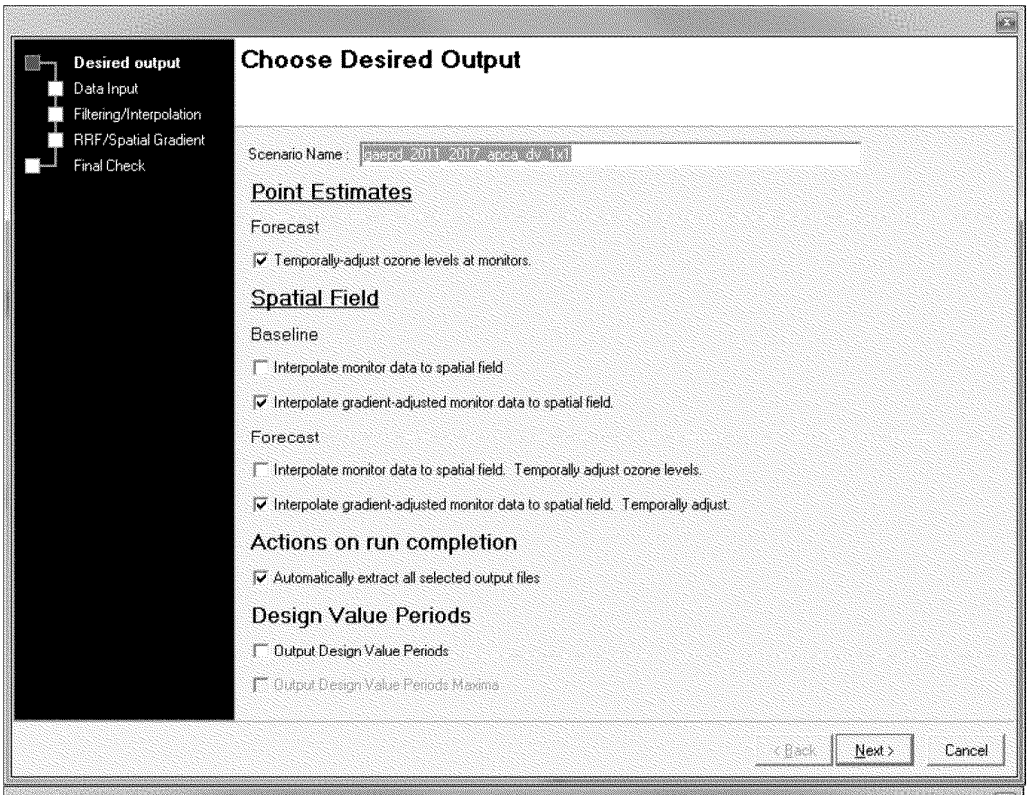
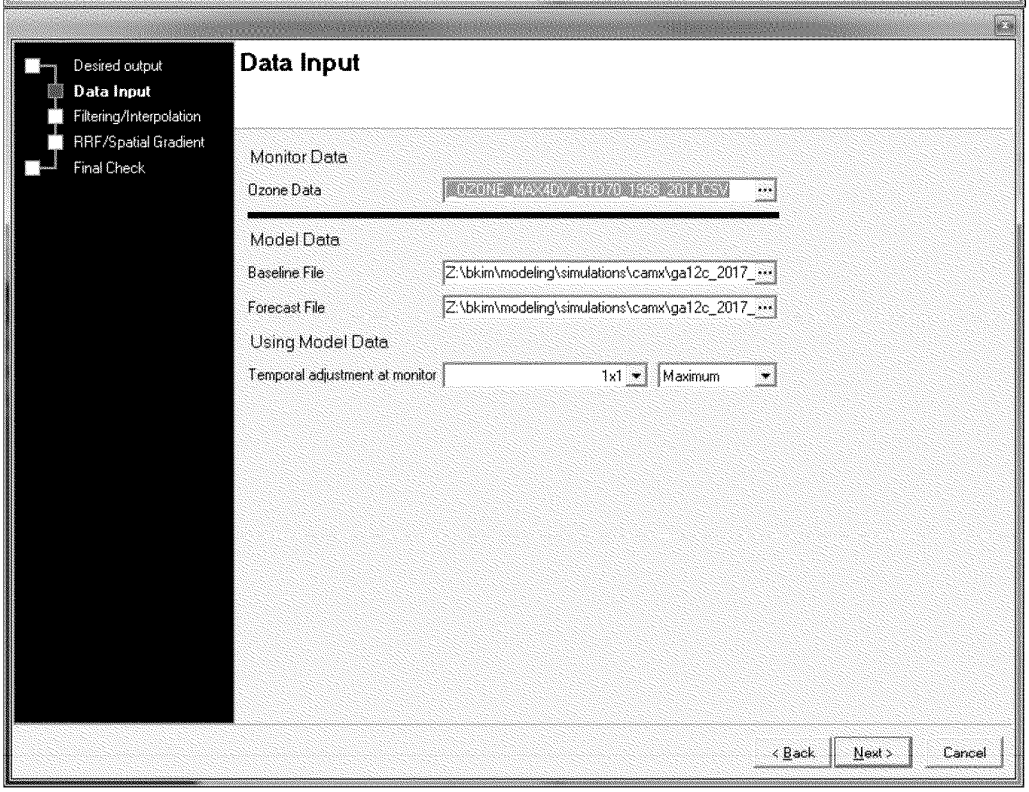
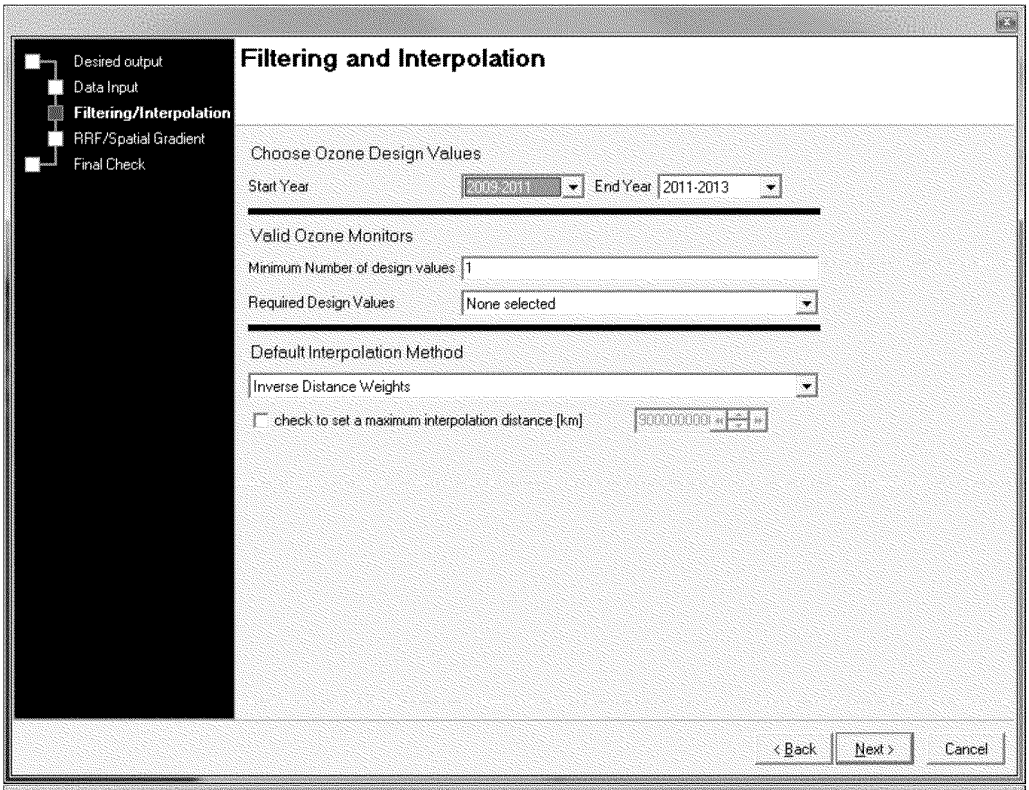
Appendix A. MATS Configuration for the 2017 design value projections.



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Data Input
Filtering/Interpolation
RRF/Spatial Gradient
Final Check
Filtering and Interpolation
Choose Ozone Design Values
Start Year
2009-2011
End Year
2011-2013
Valid Ozone Monitors
Minimum Number of design values
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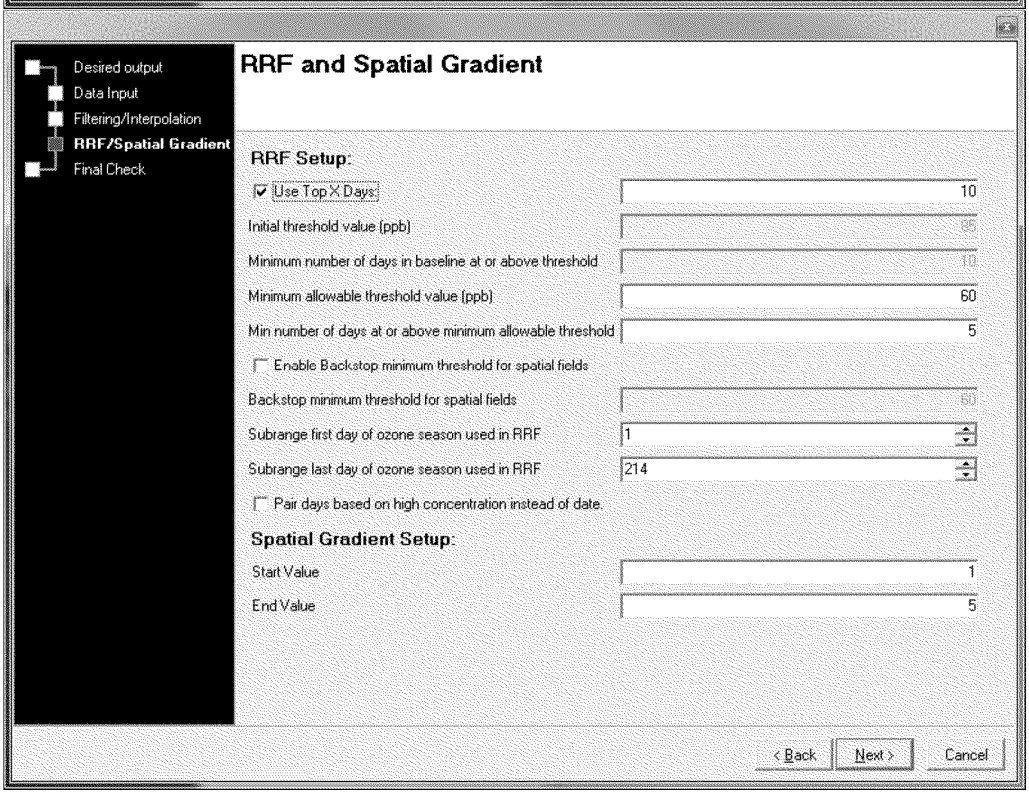
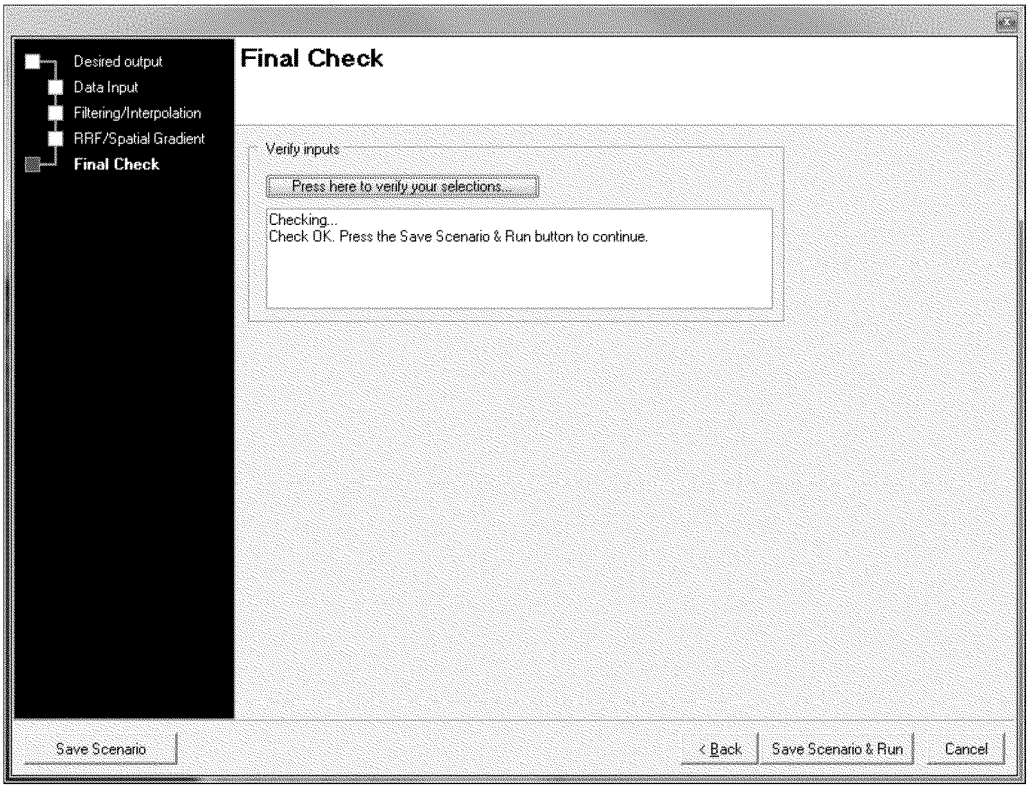
Required Design Values
None selected
Default Interpolation Method
Inverse Distance Weights
check to set a maximum interpolation distance [km]
< Back
Next >
Cancel


Desired output
Data Input
Filtering/Interpolation
RRF/Spatial Gradient
Final Check
RRF and Spatial Gradient
RRF Setup:
Use Top X Days:
10
Initial threshold value (ppb)
85
Minimum number of days in baseline at or above threshold
10
Minimum allowable threshold value (ppb)
60
Min number of days at or above minimum allowable threshold
5
Enable Backstop minimum threshold for spatial fields
Backstop minimum threshold for spatial fields
60
Subrange first day of ozone season used in RRF
1
Subrange last day of ozone season used in RRF
214
Pair days based on high concentration instead of date.
Spatial Gradient Setup:
Start Value
1
End Value
5
< Back
Next >
Cancel



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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

Table 1. EPD's designation recommendations for counties in Georgia.

County Name	Designation Recommendation
Appling	Unclassifiable/Attainment
Atkinson	Unclassifiable/Attainment
Bacon	Unclassifiable/Attainment
Baker	Unclassifiable/Attainment
Baldwin	Unclassifiable/Attainment
Banks	Unclassifiable/Attainment
Barrow	Unclassifiable/Attainment
Bartow	**Nonattainment**
Ben Hill	Unclassifiable/Attainment
Berrien	Unclassifiable/Attainment
Bibb	Unclassifiable/Attainment
Bleckley	Unclassifiable/Attainment
Brantley	Unclassifiable/Attainment
Brooks	Unclassifiable/Attainment
Bryan	Unclassifiable/Attainment
Bulloch	Unclassifiable/Attainment
Burke	Unclassifiable/Attainment
Butts	Unclassifiable/Attainment
Calhoun	Unclassifiable/Attainment
Camden	Unclassifiable/Attainment
Candler	Unclassifiable/Attainment
Carroll	Unclassifiable/Attainment
Catoosa	Unclassifiable/Attainment
Charlton	Unclassifiable/Attainment
Chatham	Unclassifiable/Attainment
Chattahoochee	Unclassifiable/Attainment
Chattooga	Unclassifiable/Attainment
Cherokee	Unclassifiable/Attainment
Clarke	Unclassifiable/Attainment
Clay	Unclassifiable/Attainment
Clayton	**Nonattainment**
Clinch	Unclassifiable/Attainment
Cobb	**Nonattainment**
Coffee	Unclassifiable/Attainment
Colquitt	Unclassifiable/Attainment
Columbia	Unclassifiable/Attainment
Cook	Unclassifiable/Attainment
Coweta	Unclassifiable/Attainment
Crawford	Unclassifiable/Attainment
Crisp	Unclassifiable/Attainment
Dade	Unclassifiable/Attainment
Dawson	Unclassifiable/Attainment

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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

County Name	Designation Recommendation
Decatur	Unclassifiable/Attainment
DeKalb	**Nonattainment**
Dodge	Unclassifiable/Attainment
Dooly	Unclassifiable/Attainment
Doughtery	Unclassifiable/Attainment
Douglas	Unclassifiable/Attainment
Early	Unclassifiable/Attainment
Echols	Unclassifiable/Attainment
Effingham	Unclassifiable/Attainment
Elbert	Unclassifiable/Attainment
Emanuel	Unclassifiable/Attainment
Evans	Unclassifiable/Attainment
Fannin	Unclassifiable/Attainment
Fayette	Unclassifiable/Attainment
Floyd	Unclassifiable/Attainment
Forsyth	Unclassifiable/Attainment
Franklin	Unclassifiable/Attainment
Fulton	**Nonattainment**
Gilmer	Unclassifiable/Attainment
Glascock	Unclassifiable/Attainment
Glynn	Unclassifiable/Attainment
Gordon	Unclassifiable/Attainment
Grady	Unclassifiable/Attainment
Greene	Unclassifiable/Attainment
Gwinnett	**Nonattainment**
Habersham	Unclassifiable/Attainment
Hall	Unclassifiable/Attainment
Hancock	Unclassifiable/Attainment
Haralson	Unclassifiable/Attainment
Harris	Unclassifiable/Attainment
Hart	Unclassifiable/Attainment
Heard	Unclassifiable/Attainment
Henry	**Nonattainment**
Houston	Unclassifiable/Attainment
Irwin	Unclassifiable/Attainment
Jackson	Unclassifiable/Attainment
Jasper	Unclassifiable/Attainment
Jeff Davis	Unclassifiable/Attainment
Jefferson	Unclassifiable/Attainment
Jenkins	Unclassifiable/Attainment
Johnson	Unclassifiable/Attainment
Jones	Unclassifiable/Attainment
Lamar	Unclassifiable/Attainment

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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

County Name	Designation Recommendation
Lanier	Unclassifiable/Attainment
Laurens	Unclassifiable/Attainment
Lee	Unclassifiable/Attainment
Liberty	Unclassifiable/Attainment
Lincoln	Unclassifiable/Attainment
Long	Unclassifiable/Attainment
Lowndes	Unclassifiable/Attainment
Lumpkin	Unclassifiable/Attainment
McDuffie	Unclassifiable/Attainment
McIntosh	Unclassifiable/Attainment
Macon	Unclassifiable/Attainment
Madison	Unclassifiable/Attainment
Marion	Unclassifiable/Attainment
Meriwether	Unclassifiable/Attainment
Miller	Unclassifiable/Attainment
Mitchell	Unclassifiable/Attainment
Monroe	Unclassifiable/Attainment
Montgomery	Unclassifiable/Attainment
Morgan	Unclassifiable/Attainment
Murray	Unclassifiable/Attainment
Muscogee	Unclassifiable/Attainment
Newton	Unclassifiable/Attainment
Oconee	Unclassifiable/Attainment
Oglethorpe	Unclassifiable/Attainment
Paulding	Unclassifiable/Attainment
Peach	Unclassifiable/Attainment
Pickens	Unclassifiable/Attainment
Pierce	Unclassifiable/Attainment
Pike	Unclassifiable/Attainment
Polk	Unclassifiable/Attainment
Pulaski	Unclassifiable/Attainment
Putnam	Unclassifiable/Attainment
Quitman	Unclassifiable/Attainment
Rabun	Unclassifiable/Attainment
Randolph	Unclassifiable/Attainment
Richmond	Unclassifiable/Attainment
Rockdale	**Nonattainment**
Schley	Unclassifiable/Attainment
Screven	Unclassifiable/Attainment
Seminole	Unclassifiable/Attainment
Spalding	Unclassifiable/Attainment
Stephens	Unclassifiable/Attainment
Stewart	Unclassifiable/Attainment

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Attachments
Georgia's Designation Recommendations for the 2015 Ozone NAAQS

County Name	Designation Recommendation
Sumter	Unclassifiable/Attainment
Talbot	Unclassifiable/Attainment
Taliaferro	Unclassifiable/Attainment
Tattnall	Unclassifiable/Attainment
Taylor	Unclassifiable/Attainment
Telfair	Unclassifiable/Attainment
Terrell	Unclassifiable/Attainment
Thomas	Unclassifiable/Attainment
Tift	Unclassifiable/Attainment
Toombs	Unclassifiable/Attainment
Towns	Unclassifiable/Attainment
Treutlen	Unclassifiable/Attainment
Troup	Unclassifiable/Attainment
Turner	Unclassifiable/Attainment
Twiggs	Unclassifiable/Attainment
Union	Unclassifiable/Attainment
Upson	Unclassifiable/Attainment
Walker	Unclassifiable/Attainment
Walton	Unclassifiable/Attainment
Ware	Unclassifiable/Attainment
Warren	Unclassifiable/Attainment
Washington	Unclassifiable/Attainment
Wayne	Unclassifiable/Attainment
Webster	Unclassifiable/Attainment
Wheeler	Unclassifiable/Attainment
White	Unclassifiable/Attainment
Whitfield	Unclassifiable/Attainment
Wilcox	Unclassifiable/Attainment
Wilkes	Unclassifiable/Attainment
Wilkinson	Unclassifiable/Attainment
Worth	Unclassifiable/Attainment

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Table 2. 2013-2015 and preliminary 2014-2016 ozone design values in Georgia by Core Based Statistical Area (CBSA).

CBSA Name	County	AQS Site ID	Local Site Name	DV 2013-2015	DV 2014-2016*
Americas, GA	Sumter	13-261-1001	Leslie-Union High School	0.058	0.059
Athens-Clarke County, GA	Clarke	13-059-0002	Fire Station # 7	0.061	0.064
Atlanta-Sandy Springs-Marietta, GA	**Fulton**	13-121-0055	Confederate Avenue	**0.073**	**0.075**
	Rockdale	13-247-0001	Conyers	**0.072**	**0.074**
	Henry	13-151-0002	McDonough-County Extension Office	**0.071**	**0.074**
	Gwinnett	13-135-0002	Gwinnett Tech	0.069	**0.072**
	DeKalb	13-089-0002	South DeKalb	0.067	**0.071**
	Douglas	13-097-0004	W. Strickland Street	0.066	0.068
	Pike	13-231-9991	Georgia Station	0.066	0.068
	Cobb	13-067-0003	Kennesaw-National Guard	0.065	0.066
	Dawson	13-085-0001	Dawsonville, Georgia Forestry Commission	0.064	0.065
	Coweta	13-077-0002	Newnan	0.062	0.066
	Paulding	13-223-0003	Yorkville, King Farm	0.062	0.062
Augusta-Richmond County, GA-SC	Richmond	13-245-0091	Bungalow Road	0.061	0.062
	Columbia	13-073-0001	Evans-Riverside Park	0.060	0.060
Brunswick, GA	Glynn	13-127-0006	Risley Middle School	0.056	0.056
Columbus, GA-AL	Muscogee	13-215-0008	Columbus- Airport	0.061	0.062
Dalton, GA	Murray	13-213-0003	Fort Mountain	0.064	0.065
Macon, GA	Bibb	13-021-0012	Macon SE	0.063	0.065
Savannah, GA	Chatham	13-051-0021	Savannah-E. President Street	0.058	0.058
Summerville, GA	Chattooga	13-055-0001	Summerville-DNR Fish Hatchery	0.060	0.061

*The 2014-2016 preliminary design values are based on uncertified ozone data through August 21, 2016.

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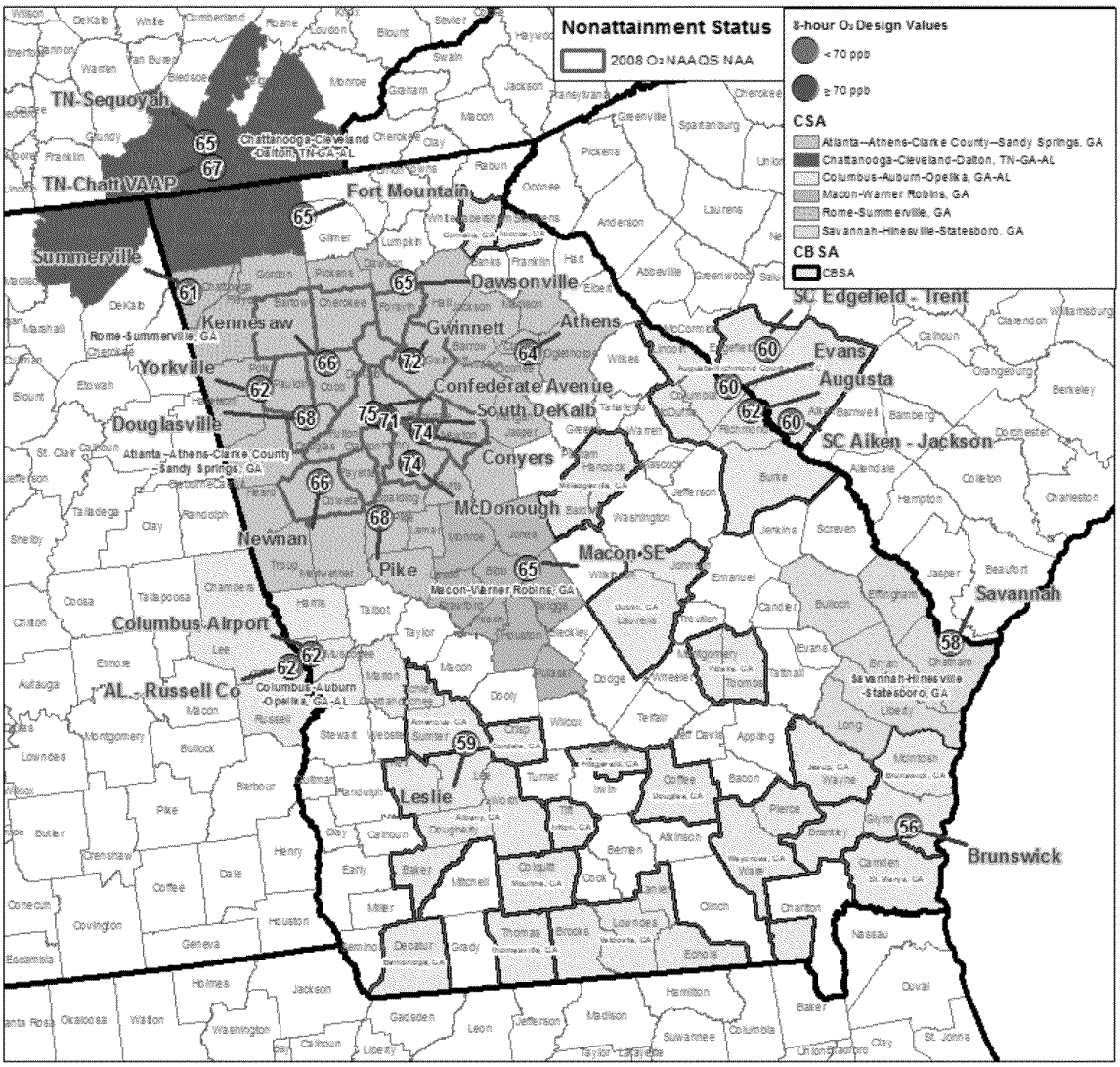

Figure 1. CSA and CBSA boundaries (CBSAs in CSAs are not shown) and preliminary 2014-2016 design values at ozone monitors in and around Georgia. Nonattainment area boundaries for the 2008 ozone NAAQS are outlined in purple.

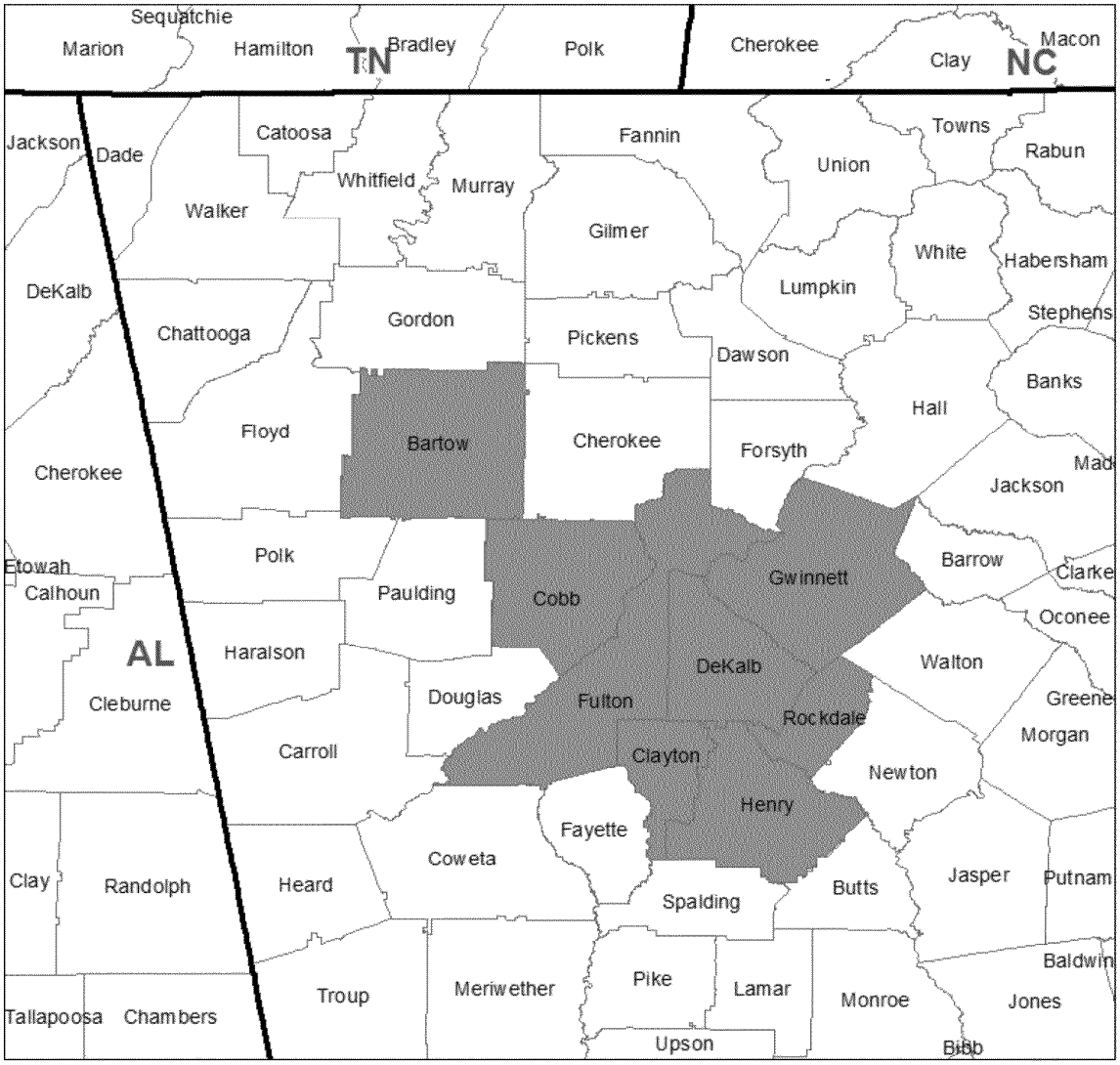

Figure 2: Map of eight counties (orange shading) in the Atlanta CSA recommended by EPD as nonattainment for the 2015 ozone NAAQS.

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Richard E. Dunn, Director

EPD Director's Office
2 Martin Luther King, Jr. Drive
Suite 1456, East Tower
Atlanta, Georgia 30334
404-656-4713

SEP 23 2016

Heather McTeer Toney
Regional Administrator
U.S. EPA, Region 4
61 Forsyth Street, S.W.
Atlanta, Georgia 30303-3104

Re: Georgia's Designation Recommendations for the 2015 Ozone NAAQS

Dear Ms. Toney:

On October 1, 2015, the United States Environmental Protection Agency (EPA) promulgated a revised National Ambient Air Quality Standard (NAAQS) for ozone. Section 107(d)(1) of the Clean Air Act requires each state to submit to EPA no later than one year following promulgation of a new or revised NAAQS, its designation recommendations for each area of the state as attainment, nonattainment, or unclassifiable under the standard. The Georgia Environmental Protection Division (EPD) developed designation recommendations in accordance with U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards".

The attached table (Table 1) provides EPD's recommendations for the designation status of each county in Georgia. Georgia's recommendations are based on 2013-2015 design values calculated using certified monitoring data and 2014-2016 design values calculated using preliminary 2016 ozone data. A list of 2013-2015 and preliminary 2014-2016 ozone design values for all monitors in Georgia is attached in Table 2. A spatial plot of the preliminary 2014-2016 ozone design values is attached in Figure 1. It can be seen from Figure 1 that the five Georgia monitors violating the 70 ppb NAAQS are all located in the Atlanta--Athens-Clarke County--Sandy Springs, GA Combined Statistical Area (CSA).

Based on a rigorous 5-factor analysis and source contribution photochemical grid modeling, EPD recommends that the following eight (8) counties be designated **nonattainment** for the 2015 ozone NAAQS (Figure 2):

- Bartow,
- Clayton,
- Cobb,
- DeKalb,
- Fulton,
- Gwinnett,
- Henry, and
- Rockdale.

In addition, EPD recommends that all other counties in Georgia be designated as **unclassifiable/attainment** for the 2008 ozone NAAQS. A detailed technical analysis to support our recommendations is attached.

If you have any questions or need more information, please contact James Boylan at James.Boylan@dnr.ga.gov or (404) 363-7014.

Sincerely,

Richard E. Dunn
Director

Attachments

c: Scott Davis, U.S. EPA Region 4
Lynorae Benjamin, U.S. EPA Region 4
Karen Hays, Branch Chief, Air Protection Branch

Georgia's Nonattainment Area Designation Recommendations for the 2015 Ozone NAAQS - Technical Analysis Document -

This document contains Georgia Environmental Protection Division's (EPD) technical analysis for designation recommendations for areas in Georgia for the 2015 ozone National Ambient Air Quality Standards (NAAQS). This analysis was conducted in accordance with U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards". This memo recommends evaluating five factors:

1. Air quality data
2. Emissions and emissions-related data
3. Meteorological data
4. Geography/topography
5. Jurisdictional boundaries

Each of the 159 counties in Georgia has been evaluated and recommended as unclassifiable/attainment or nonattainment based on the available information and data.

Air Quality Data and Potential Nonattainment Areas in Georgia

Federal Reference Method (FRM) measurements of ozone concentrations in Georgia, during the most recent three consecutive years (2013-2015), were analyzed and used to identify sites currently violating the 2015 ozone NAAQS of 0.070 ppm. These ozone measurements have been quality-assured and certified and are stored in EPA's Air Quality System (AQS) database. Design values (DV) were calculated for each monitor by averaging the fourth-highest daily maximum 8-hour average ozone concentrations for three consecutive years. If the 2013-2015 DV for a monitor is greater than 0.070 ppm, the monitor is violating the NAAQS.

According to the U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards":

> *"..Section I07(d) explicitly requires that the EPA designate as nonattainment not only the area that is violating the pertinent standard, but also those nearby areas that contribute to the violation in the violating area. After identifying each monitor that indicates a violation of the 2015 ozone NAAQS in an area, the EPA will determine which nearby areas contribute to the violation(s)."*

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"..for analyzing whether nearby areas contribute to a violating area. The EPA intends to consider information relevant to designations associated with the counties in the Combined Statistical Area (CSA) or, where appropriate, the Core Based Statistical Area (CBSA) in which the violating monitor(s) are located. The CSAs and CBSAs are delineated by the Office of Management and Budget (OMB) as part of their Metropolitan and Micropolitan Statistical Area program."

Of the 21 ozone monitors in Georgia, there are currently three (3) monitors in the Atlanta-Sandy Springs-Marietta, GA CBSA that are violating the 2015 ozone NAAQS (Table 1). Also, the 2013-2015 DVs in neighboring states were checked and no violating monitors were identified (Figure 1).

Table 1. 2013-2015 design values (DVs) at each ozone monitor in Georgia by CBSA. Counties in red are violating the 2015 ozone NAAQS based on 2013-2015 DVs.

CBSA Name	County	AQS Site ID	Local Site Name	2013-2015 DVs (ppm)
Americas, GA	Sumter	132611001	Leslie-Union High School	0.058
Athens-Clarke County, GA	Clarke	130590002	Fire Station # 7	0.061
Atlanta-Sandy Springs-Marietta, GA	**Fulton**	131210055	Confederate Avenue	**0.073**
	Rockdale	132470001	Monastery	**0.072**
	Henry	131510002	McDonough-County Extension Office	**0.071**
	Gwinnett	131350002	Gwinnett Tech	0.069
	DeKalb	130890002	South DeKalb	0.067
	Douglas	130970004	W. Strickland Street	0.066
	Pike	132319991	Georgia Station	0.066
	Cobb	130670003	Kennesaw-National Guard	0.065
	Dawson	130850001	Dawsonville, Georgia Forestry Commission	0.064
	Paulding	132230003	Yorkville, King Farm	0.062
	Coweta	130770002	Newnan	0.062
Augusta-Richmond County, GA-SC	Richmond	132450091	Bungalow Road	0.061
	Columbia	130730001	Evans-Riverside Park	0.060
Brunswick, GA	Glynn	131270006	Risley Middle School	0.056
Columbus, GA-AL	Muscogee	132150008	Columbus- Airport	0.061
Dalton, GA	Murray	132130003	Fort Mountain	0.064
Macon, GA	Bibb	130210012	Macon SE	0.063
Savannah, GA	Chatham	130510021	Savannah-E. President Street	0.058
Summerville, GA	Chattooga	130550001	Summerville-DNR Fish Hatchery	0.060

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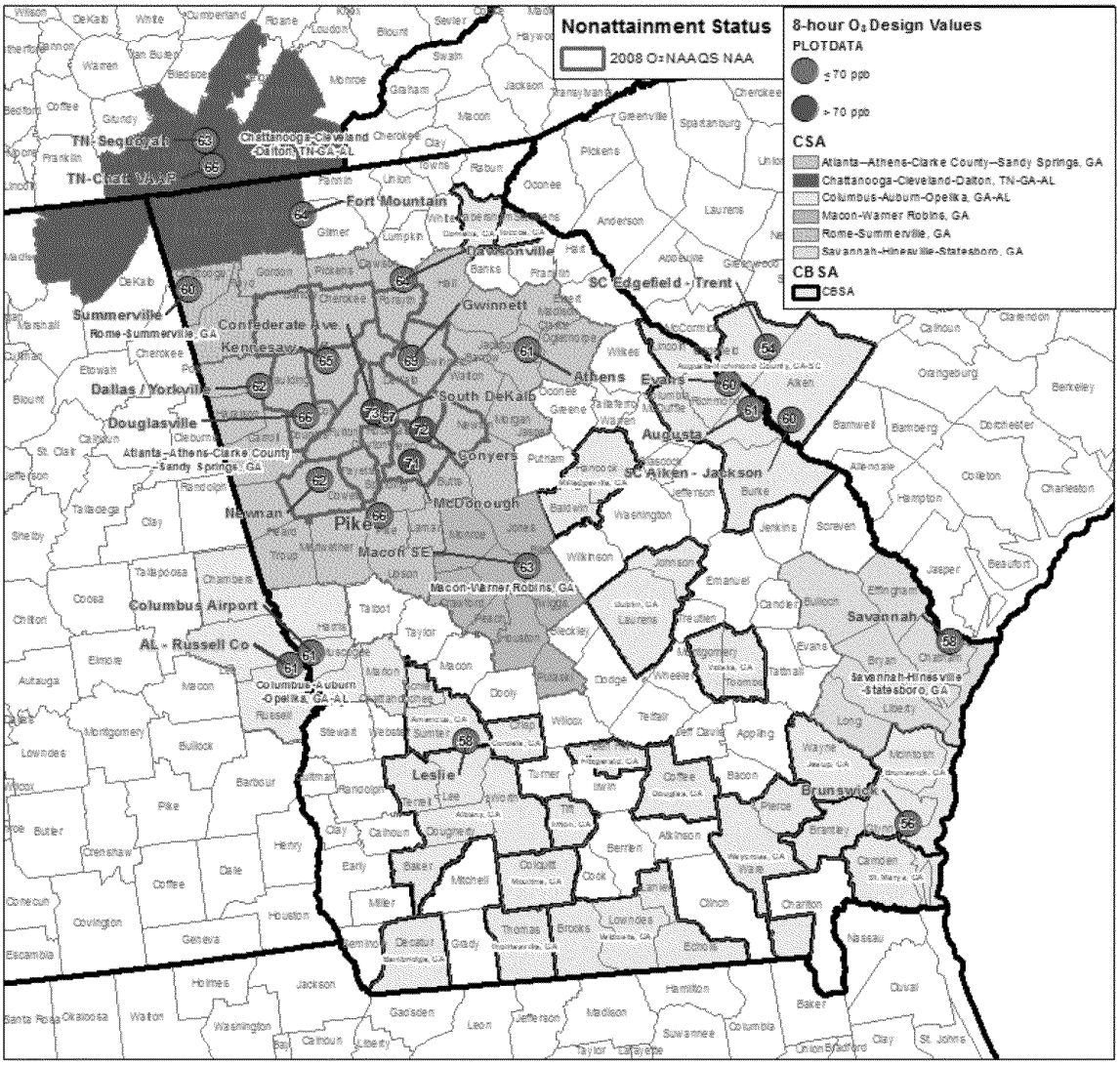

Figure 1. CSA and CBSA boundaries (CBSAs in CSAs are not shown) and 2013-2015 DVs at ozone monitors in and around Georgia. Nonattainment area boundaries for the 2008 ozone NAAQS are outlined in purple.

There are 39 counties (Table 2) in the Atlanta--Athens-Clarke County--Sandy Springs, GA CSA (Atlanta CSA). The Atlanta CSA includes the following CBSAs: Athens-Clarke County, Atlanta-Sandy Springs-Marietta, Calhoun, Cedartown, Gainesville, Jefferson, LaGrange, and Thomaston. All 39 counties in the Atlanta CSA were evaluated as potential nonattainment areas. The remaining 120 counties in Georgia have no violating monitors in their CBSAs. Therefore, no additional analysis will be performed for these counties and they will be recommended as unclassifiable/attainment.

Table 2. List of CBSAs and counties in the Atlanta CSA. Counties with violating monitors based on 2013-2015 DVs are marked in red.

CBSA Name	County Name and Federal Information Processing Standard (FIPS) code
Athens-Clarke County, GA	Clarke (13059), Madison (13195), Oconee (13219), Oglethorpe (13221)
Atlanta-Sandy Springs-Roswell, GA	Barrow (13013), Bartow (13015), Butts (13035), Carroll (13045), Cherokee (13057), Clayton (13063), Cobb (13067), Coweta (13077), Dawson (13085), DeKalb (13089), Douglas (13097), Fayette (13113), Forsyth (13117), **Fulton (13121)**, Gwinnett (13135), Haralson (13143), Heard (13149), **Henry (13151)**, Jasper (13159), Lamar (13171), Meriwether (13199), Morgan (13211), Newton (13217), Paulding (13223), Pickens (13227), Pike (13231), **Rockdale (13247)**, Spalding (13255), Walton (13297)
Calhoun, GA	Gordon (13129)
Cedartown, GA	Polk (13233)
Gainesville, GA	Hall (13139)
Jefferson, GA	Jackson (13157)
LaGrange, GA	Troup (13285)
Thomaston, GA	Upson (13293)

Five-Factor Analysis in the Atlanta CSA

The nonattainment area boundaries were evaluated using five factors as described in the U.S. EPA's February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards":

1. Air quality data
2. Emissions and emissions-related data
3. Meteorological data
4. Geography/topography
5. Jurisdictional boundaries

Factor 1: Air Quality Data

The 2013-2015 DVs at ozone monitors in Fulton, Henry, and Rockdale counties violate the 2015 ozone NAAQS. The preliminary 2016 ozone data indicate that monitors in Gwinnett and DeKalb will also violate the 2015 ozone NAAQS (Table 3). Therefore, these 5 counties with violating monitors will be recommended as nonattainment. The other 34 counties in the Atlanta CSA do not have a violating monitor. These counties were evaluated to determine whether or not they contribute to violations at the ozone monitors in Fulton, Henry, Rockdale, Gwinnett, and DeKalb.

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Table 3. 2013-2015 and preliminary 2014-2016 ozone design values in the Atlanta CSA.

County	AQS Site ID	Local Site Name	DV 2013-2015	DV 2014-2016*
Fulton	131210055	Confederate Avenue	0.073	0.075
Rockdale	132470001	Monastery	0.072	0.074
Henry	131510002	McDonough-County Extension Office	0.071	0.074
Gwinnett	131350002	Gwinnett Tech	0.069	0.072
DeKalb	130890002	South DeKalb	0.067	0.071
Douglas	130970004	W. Strickland Street	0.066	0.068
Pike	132319991	Georgia Station	0.066	0.068
Cobb	130670003	Kennesaw-National Guard	0.065	0.066
Dawson	130850001	Dawsonville, Georgia Forestry Commission	0.064	0.065
Coweta	130770002	Newnan	0.062	0.066
Paulding	132230003	Yorkville, King Farm	0.062	0.062
Clarke	130590002	Fire Station # 7	0.061	0.064

*The 2014-2016 preliminary design values are based on uncertified ozone data through August 21, 2016.

Factor 2: Emissions and Emissions-Related Data

EPD evaluated emissions of ozone precursors and other emissions-related data that provide information on areas contributing to the violating monitors.

NOx and VOC Emissions Data

EPD analyzed county-level emissions data for nitrogen oxides (NOx) and volatile organic compounds (VOCs) from the 2011 National Emissions Inventory (NEI)[1]. Most of the 2014 NEI data is still draft, but the 2014 point source emissions are very reliable since they matched the emissions that EPD submitted to EPA's Emissions Inventory System (EIS) for the 2014 NEI. Therefore, EPD replaced 2011 point source emissions data with 2014 point source emissions data. This is the best available data to represent recent NOx (Table 4) and VOC (Table 6) emission levels in the Atlanta CSA. In addition to the county-level emissions (tons per year, tpy), emission densities (tons per year per square mile, tpy/mile^2) were also calculated since all counties are not the same size geographically. Significant emissions levels in a nearby county may indicate the potential for that area to contribute to observed ozone violations. Percent of NOx (Table 5) and VOC (Table 7) emissions by source categories (including fire, nonpoint, nonroad, onroad, and point) are summarized by each county in the Atlanta CSA. Fire emissions include prescribed fires and wildfires. Nonpoint (area source) emissions include small-scale industrial, commercial, and residential sources that generate emissions. Nonroad vehicles do not typically operate on roads or highways and include agricultural equipment; construction and mining equipment; lawn and garden equipment; aircraft and airport equipment; locomotives; and commercial marine vessels. Onroad mobile emission sources consist of automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways. Point sources include Electric Generating Units (EGUs) and non-EGUs.

[1] Obtained from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.

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NOx emissions from 6 counties (Fulton, Gwinnett, DeKalb, Cobb, Bartow, and Clayton) are each higher than 10,000 tpy. Also, each of these counties has more than double (>100%) the CSA average NOx emissions, has a NOx emission density of more than 26 tpy/mi^2, and are more than 75% higher than the Atlanta CSA average NOx emission density. None of the other 33 counties in the Atlanta CSA meet any of these criteria. In total, NOx emissions from Fulton, Gwinnett, DeKalb, Cobb, Bartow, and Clayton account for 51.5% of all NOx emissions in the Atlanta CSA. The majority of the NOx emissions in Fulton (70.6%), Gwinnett (68.3%), DeKalb (76.8%), and Cobb (61.6%) come from on-road mobile sources. The NOx emissions in Bartow mostly come from on-road mobile (33.9%) and point (55.6%), some of which is attributed to Georgia Power's Plant Bowen. The NOx emissions in Clayton mostly come from on-road mobile (45.0%) and non-road mobile (55.6%), some of which is attributed to airport emissions from the Hartsfield-Jackson Atlanta International Airport.

Modeling studies have demonstrated that emission reductions of anthropogenic VOCs have a much smaller impact on daily 8-hour ozone concentrations in the Southeastern U.S. compared to NOx emissions[2]. In addition, GA EPD has demonstrated that the Atlanta area is strongly NOx limited as presented in the Atlanta 8-hour Ozone Attainment Demonstration submitted to EPA on October 21, 2009. For this reason, the VOC emission factor will account for a lower total percent of emissions than in our NOx analysis. VOC emissions from 4 counties (Fulton, Gwinnett, Cobb, and DeKalb) are each higher than 20,000 tpy. Also, each of these counties is more than 75% higher than the CSA average VOC emissions. Cobb, DeKalb, and Clayton have a VOC emission density of more than 65 tpy/mi^2, and are more than 65% higher than the Atlanta CSA average VOC emission density. None of the other 34 counties in the Atlanta CSA meet any of these criteria. In total, VOC emissions from Fulton, Gwinnett, DeKalb, Cobb, and Clayton account for 23.4% of all VOC emissions in the Atlanta CSA. The majority of the VOC emissions in Fulton (65.4%), Gwinnett (60.9%), Cobb (64.0%), DeKalb (62.2%), and Clayton (61.6%) come from nonpoint (area) sources.

[2] Odman M.T., Hu Y., Russell A.G., Hanedar A., Boylan J.W., and Brewer P.F., 2009, Quantifying the sources of ozone, fine particulate matter, and regional haze in the Southeastern United States,*Journal of Environmental Management*, 90, 3155–3168.

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Table 4. NO_X Emissions by county in the Atlanta CSA. Red values meet EPD thresholds.

County	NOx (tpy)	NOx % CSA Total	NOx % CSA Average	NOx Density (tpy/sq mi)	NOx Density % of CSA Average
Fulton	**23,218**	**13.0%**	**408.1%**	**43.48**	**194.9%**
Gwinnett	**16,576**	**9.3%**	**262.8%**	**37.93**	**157.2%**
DeKalb	**14,617**	**8.2%**	**219.9%**	**53.94**	**265.8%**
Cobb	**13,716**	**7.7%**	**200.2%**	**39.76**	**169.6%**
Bartow	**13,059**	**7.3%**	**185.8%**	**27.79**	**88.4%**
Clayton	**10,675**	**6.0%**	**133.6%**	**74.13**	**402.7%**
Henry	6,786	3.8%	48.5%	20.75	40.7%
Hall	5,347	3.0%	17.0%	12.46	-15.5%
Coweta	4,998	2.8%	9.4%	11.21	-24.0%
Carroll	4,464	2.5%	-2.3%	8.86	-39.9%
Cherokee	4,375	2.5%	-4.3%	10.08	-31.6%
Jackson	4,012	2.3%	-12.2%	11.70	-20.7%
Troup	3,884	2.2%	-15.0%	8.71	-40.9%
Forsyth	3,690	2.1%	-19.3%	14.94	1.3%
Gordon	3,469	1.9%	-24.1%	9.69	-34.3%
Douglas	3,046	1.7%	-33.3%	15.15	2.8%
Heard	3,031	1.7%	-33.7%	10.07	-31.7%
Clarke	3,027	1.7%	-33.8%	25.02	69.7%
Newton	3,017	1.7%	-34.0%	10.81	-26.7%
Paulding	2,688	1.5%	-41.2%	8.56	-42.0%
Madison	2,540	1.4%	-44.4%	8.88	-39.8%
Walton	2,424	1.4%	-47.0%	7.35	-50.2%
Morgan	2,364	1.3%	-48.3%	6.66	-54.8%
Fayette	2,240	1.3%	-51.0%	11.26	-23.7%
Barrow	2,229	1.3%	-51.2%	13.68	-7.2%
Rockdale	2,117	1.2%	-53.7%	16.04	8.8%
Butts	1,900	1.1%	-58.4%	10.10	-31.5%
Meriwethe	1,869	1.0%	-59.1%	3.70	-74.9%
Haralson	1,743	1.0%	-61.9%	6.16	-58.2%
Spalding	1,714	1.0%	-62.5%	8.57	-41.9%
Polk	1,562	0.9%	-65.8%	5.01	-66.1%
Upson	1,399	0.8%	-69.4%	4.27	-71.1%
Oconee	1,370	0.8%	-70.0%	7.37	-50.0%
Lamar	1,141	0.6%	-75.0%	6.13	-58.4%
Pickens	1,089	0.6%	-76.2%	4.67	-68.3%
Dawson	760	0.4%	-83.4%	3.55	-75.9%
Jasper	730	0.4%	-84.0%	1.96	-86.7%
Pike	674	0.4%	-85.2%	3.08	-79.1%
Oglethorpe	644	0.4%	-85.9%	1.46	-90.1%
Average	**4,569**			**14.75**	
Total	**178,201**	**100.0%**			

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Table 5. Percent of NO_X emissions by county and source categories in the Atlanta CSA.

County	Fires	Nonpoint	Nonroad	Onroad	Point
Fulton	0.0%	10.5%	17.0%	70.6%	1.9%
Gwinnett	0.0%	8.0%	23.7%	68.3%	0.0%
DeKalb	0.0%	8.9%	13.4%	76.8%	0.9%
Cobb	0.0%	13.8%	18.9%	61.6%	5.7%
Bartow	0.1%	6.5%	3.9%	33.9%	55.6%
Clayton	0.0%	4.1%	49.8%	45.0%	1.0%
Henry	0.1%	9.2%	13.1%	53.6%	24.0%
Hall	0.0%	9.7%	16.6%	70.5%	3.2%
Coweta	1.2%	11.3%	9.8%	52.3%	25.5%
Carroll	0.4%	9.8%	11.1%	77.9%	0.8%
Cherokee	0.1%	7.4%	23.0%	67.2%	2.3%
Jackson	0.1%	6.2%	9.6%	77.0%	7.2%
Troup	1.3%	16.1%	8.2%	73.0%	1.4%
Forsyth	0.0%	6.1%	27.0%	65.4%	1.4%
Gordon	0.1%	23.1%	7.7%	68.8%	0.2%
Douglas	0.1%	10.0%	12.4%	77.5%	0.0%
Heard	0.9%	4.2%	2.1%	10.1%	82.6%
Clarke	0.0%	9.8%	16.6%	66.1%	7.5%
Newton	0.6%	8.5%	15.0%	74.9%	1.0%
Paulding	0.2%	18.3%	15.3%	66.2%	0.0%
Madison	0.5%	11.7%	2.1%	28.1%	57.5%
Walton	0.5%	10.3%	16.6%	67.7%	4.8%
Morgan	1.9%	11.7%	6.6%	75.1%	4.8%
Fayette	0.0%	14.5%	21.6%	63.5%	0.3%
Barrow	0.1%	12.9%	10.4%	74.9%	1.8%
Rockdale	0.1%	9.5%	15.6%	72.2%	2.6%
Butts	0.8%	20.6%	4.9%	73.7%	0.0%
Meriwether	6.3%	33.4%	4.4%	44.4%	11.4%
Haralson	0.8%	18.9%	3.6%	76.7%	0.0%
Spalding	0.9%	12.0%	10.4%	76.7%	0.0%
Polk	1.0%	28.7%	7.6%	58.2%	4.5%
Upson	5.4%	13.6%	4.9%	42.4%	33.6%
Oconee	0.5%	11.3%	15.1%	73.1%	0.0%
Lamar	1.1%	12.5%	5.4%	59.3%	21.7%
Pickens	1.0%	10.4%	13.9%	74.3%	0.4%
Dawson	1.3%	10.1%	16.8%	71.8%	0.0%
Jasper	13.6%	25.8%	8.9%	47.7%	4.0%
Pike	5.9%	20.7%	9.4%	64.0%	0.0%
Oglethorpe	9.0%	26.1%	10.8%	54.2%	0.0%
All counties in CSA	**0.4%**	**10.6%**	**16.2%**	**62.7%**	**10.1%**

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Table 6. Anthropogenic VOC emissions by county in the Atlanta CSA. Red values meet EPD thresholds.

County	VOC (tpy)	VOC % CSA Total	VOC % CSA Average	VOC Density (tpy/sq mi)	VOC Density % CSA Average
Fulton	30,934	6.3%	147.3%	57.93	43.5%
Gwinnett	26,794	5.5%	114.2%	61.31	51.9%
Cobb	23,603	4.8%	88.7%	68.41	69.5%
DeKalb	21,988	4.5%	75.8%	81.14	101.0%
Hall	16,310	3.3%	30.4%	38.02	-5.8%
Meriwether	16,142	3.3%	29.0%	31.97	-20.8%
Troup	16,013	3.3%	28.0%	35.9	-11.1%
Bartow	15,601	3.2%	24.7%	33.19	-17.8%
Cherokee	15,509	3.2%	24.0%	35.73	-11.5%
Carroll	15,403	3.2%	23.1%	30.56	-24.3%
Coweta	14,826	3.0%	18.5%	33.24	-17.7%
Oglethorpe	13,694	2.8%	9.5%	30.98	-23.3%
Jasper	13,128	2.7%	4.9%	35.2	-12.8%
Upson	12,712	2.6%	1.6%	38.76	-4.0%
Paulding	11,592	2.4%	-7.3%	36.92	-8.6%
Morgan	11,579	2.4%	-7.4%	32.62	-19.2%
Henry	11,494	2.4%	-8.1%	35.15	-12.9%
Gordon	11,265	2.3%	-10.0%	31.47	-22.1%
Newton	11,071	2.3%	-11.5%	39.68	-1.7%
Polk	11,022	2.3%	-11.9%	35.33	-12.5%
Clayton	10,996	2.3%	-12.1%	76.36	89.1%
Heard	10,796	2.2%	-13.7%	35.87	-11.2%
Walton	10,651	2.2%	-14.9%	32.27	-20.1%
Forsyth	10,553	2.2%	-15.6%	42.72	5.8%
Haralson	10,351	2.1%	-17.3%	36.58	-9.4%
Jackson	10,230	2.1%	-18.2%	29.82	-26.1%
Douglas	9,660	2.0%	-22.8%	48.06	19.0%
Madison	8,938	1.8%	-28.5%	31.25	-22.6%
Pickens	8,649	1.8%	-30.9%	37.12	-8.1%
Fayette	8,554	1.8%	-31.6%	42.99	6.5%
Butts	8,162	1.7%	-34.8%	43.41	7.5%
Pike	8,059	1.7%	-35.6%	36.8	-8.9%
Clarke	7,829	1.6%	-37.4%	64.7	60.3%
Spalding	7,728	1.6%	-38.2%	38.64	-4.3%
Lamar	7,588	1.6%	-39.3%	40.8	1.0%
Dawson	7,555	1.5%	-39.6%	35.31	-12.6%
Barrow	7,132	1.5%	-43.0%	43.75	8.4%
Rockdale	7,010	1.4%	-44.0%	53.1	31.5%
Oconee	6,774	1.4%	-45.9%	36.42	-9.8%
Average	**12,510**			**40.37**	
Total	**487,894**	**100.0%**			

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Table 7. Percent of anthropogenic VOC emissions by county and source categories in the Atlanta CSA.

County	Fires	Nonpoint	Nonroad	Onroad	Point
Fulton	0.0%	65.4%	9.6%	24.2%	0.8%
Gwinnett	0.0%	60.9%	14.3%	24.6%	0.3%
Cobb	0.0%	64.0%	12.6%	21.4%	2.1%
DeKalb	0.0%	62.2%	6.2%	25.8%	5.8%
Hall	0.0%	73.7%	9.9%	13.8%	2.6%
Meriwether	1.5%	94.6%	1.3%	2.2%	0.4%
Troup	0.7%	84.6%	4.7%	6.6%	3.5%
Bartow	0.1%	81.3%	4.7%	11.6%	2.2%
Cherokee	0.1%	84.0%	5.4%	10.3%	0.2%
Carroll	0.2%	84.1%	2.8%	11.1%	1.8%
Coweta	0.8%	88.5%	2.4%	7.6%	0.6%
Oglethorpe	0.9%	97.0%	0.6%	1.5%	0.0%
Jasper	1.5%	95.3%	0.7%	1.6%	0.9%
Upson	1.2%	92.8%	0.6%	3.0%	2.4%
Paulding	0.1%	88.8%	2.4%	8.7%	0.0%
Morgan	0.8%	90.5%	2.2%	4.2%	2.3%
Henry	0.1%	75.9%	5.0%	15.2%	3.8%
Gordon	0.1%	86.4%	4.1%	8.9%	0.5%
Newton	0.3%	80.4%	3.5%	12.1%	3.6%
Polk	0.3%	91.6%	0.9%	5.1%	2.1%
Clayton	0.1%	61.6%	14.4%	22.0%	1.9%
Heard	0.5%	94.2%	0.9%	1.6%	2.9%
Walton	0.2%	85.3%	2.7%	10.8%	0.9%
Forsyth	0.0%	73.8%	12.4%	11.9%	1.9%
Haralson	0.3%	90.5%	0.6%	5.0%	3.7%
Jackson	0.1%	85.4%	1.8%	10.7%	2.0%
Douglas	0.1%	85.5%	2.5%	11.9%	0.0%
Madison	0.3%	91.3%	2.3%	4.7%	1.5%
Pickens	0.2%	91.7%	2.7%	5.3%	0.0%
Fayette	0.0%	82.0%	6.0%	11.1%	0.8%
Butts	0.4%	92.6%	1.2%	5.8%	0.0%
Pike	0.9%	93.2%	2.6%	3.3%	0.0%
Clarke	0.0%	80.0%	3.4%	16.3%	0.3%
Spalding	0.4%	86.3%	1.7%	10.8%	0.8%
Lamar	0.3%	92.0%	0.7%	4.0%	3.1%
Dawson	0.3%	94.0%	1.5%	4.2%	0.0%
Barrow	0.1%	82.9%	2.4%	13.8%	0.8%
Rockdale	0.1%	83.1%	3.7%	10.6%	2.5%
Oconee	0.2%	89.5%	2.0%	8.3%	0.0%
All counties in CSA	**0.3%**	**81.3%**	**5.0%**	**11.7%**	**1.6%**

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Population Density and VMT Data

EPD evaluated the population and vehicle use characteristics and trends in the Atlanta CSA. This information is a good indicator for nonpoint, on-road mobile, and non-road mobile source emissions. Areas of dense population and traffic usually are associated with higher nonpoint and mobile emissions, and may contribute to counties with violating ozone monitors. Rapid growth of population and VMT in a county indicates increasing integration with the core urban area.

2010 population data was obtained from the designation data provided by EPA[3]. 2013 population data was obtained from the Georgia statistics center[4]. Table 8 summarizes 2010 and 2013 population data, as well as population density and population trends. 2010 and 2013 population in five counties (Fulton, Gwinnett, Cobb, DeKalb, and Clayton) are each higher than 250,000 people. Fulton, Gwinnett, Cobb, DeKalb, and Clayton have a population density of more than 1,500 person/mi^2, and are more than triple (>200%) the CSA average population. The 2013-2010 increase in population is over 20,000 people in Fulton, Gwinnett, Cobb, and DeKalb which is more than 225% higher compared to the Atlanta CSA average. None of the other 34 counties in the Atlanta CSA meet any of these criteria. In total, population from Fulton, Gwinnett, DeKalb, Cobb, and Clayton account for 57.4% of all people in the Atlanta CSA.

2011 vehicle miles traveled (VMT) data was obtained from the designation data provided by EPA[2]. 2014 VMT data was developed by EPD as part of the 2014 NEI. Table 9 summarizes 2011 and 2014 VMT data. VMT from 6 counties (Fulton, Gwinnett, Cobb, DeKalb, Clayton, and Henry) are each higher than 2.2×10^9 miles for 2011 and higher than 2.4×10^9 miles for 2014. VMT from Fulton, Gwinnett, Cobb, DeKalb, Clayton, and Henry are each 30% higher compared to the Atlanta CSA average. None of the other 33 counties in the Atlanta CSA meet any of these criteria. In total, VMT from Fulton, Gwinnett, DeKalb, Cobb, Clayton, and Henry account for 60.8% of all VMT in the Atlanta CSA.

[3] Download from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data#F2.
[4] http://georgiastats.uga.edu

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Table 8. Population and growth in the Atlanta CSA. Red values meet EPD thresholds.

County	2010 Population	2013 Population	% CSA Total	2013 Density (pop/sq mi)	% CSA Average	2013-2010 Change	% CSA Change Average
Fulton	920,581	984,293	15.97%	1,843	261.5%	63,712	886.4%
Gwinnett	805,321	859,304	13.94%	1,966	285.6%	53,983	735.8%
Cobb	688,078	717,190	11.64%	2,079	307.7%	29,112	350.7%
DeKalb	691,893	713,340	11.58%	2,632	416.2%	21,447	232.1%
Clayton	259,424	264,220	4.29%	1,835	259.8%	4,796	-25.7%
Cherokee	214,346	225,106	3.65%	519	1.7%	10,760	66.6%
Henry	203,922	211,128	3.43%	646	26.6%	7,206	11.6%
Forsyth	175,511	195,405	3.17%	791	55.1%	19,894	208.0%
Hall	179,684	187,745	3.05%	438	-14.2%	8,061	24.8%
Paulding	142,324	146,950	2.38%	468	-8.2%	4,626	-28.4%
Douglas	132,403	136,379	2.21%	679	33.1%	3,976	-38.4%
Coweta	127,317	133,180	2.16%	299	-41.4%	5,863	-9.2%
Clarke	116,714	121,265	1.97%	1,002	96.5%	4,551	-29.5%
Carroll	110,527	112,355	1.82%	223	-56.3%	1,828	-71.7%
Fayette	106,567	108,365	1.76%	545	6.8%	1,798	-72.2%
Newton	99,958	102,446	1.66%	367	-28.0%	2,488	-61.5%
Bartow	100,157	101,273	1.64%	215	-57.7%	1,116	-82.7%
Rockdale	85,215	86,919	1.41%	658	29.1%	1,704	-73.6%
Walton	83,768	85,754	1.39%	260	-49.0%	1,986	-69.3%
Barrow	69,367	71,453	1.16%	438	-14.0%	2,086	-67.7%
Troup	67,044	69,053	1.12%	155	-69.6%	2,009	-68.9%
Spalding	64,073	63,829	1.04%	319	-37.4%	-244	-103.8%
Jackson	60,485	61,044	0.99%	178	-65.1%	559	-91.3%
Gordon	55,186	55,757	0.90%	156	-69.5%	571	-91.2%
Polk	41,475	41,183	0.67%	132	-74.1%	-292	-104.5%
Oconee	32,808	34,035	0.55%	183	-64.1%	1,227	-81.0%
Pickens	29,431	29,584	0.48%	127	-75.1%	153	-97.6%
Haralson	28,780	28,495	0.46%	101	-80.3%	-285	-104.4%
Madison	28,120	28,057	0.46%	98	-80.8%	-63	-101.0%
Upson	27,153	26,566	0.43%	81	-84.1%	-587	-109.1%
Butts	23,655	23,361	0.38%	124	-75.6%	-294	-104.6%
Dawson	22,330	22,686	0.37%	106	-79.2%	356	-94.5%
Meriwet	21,992	21,232	0.34%	42	-91.8%	-760	-111.8%
Lamar	18,317	17,959	0.29%	97	-81.1%	-358	-105.5%
Pike	17,869	17,796	0.29%	81	-84.1%	-73	-101.1%
Morgan	17,868	17,781	0.29%	50	-90.2%	-87	-101.3%
Oglethor	14,899	14,548	0.24%	33	-93.5%	-351	-105.4%
Jasper	13,900	13,601	0.22%	36	-92.8%	-299	-104.6%
Heard	11,834	11,558	0.19%	38	-92.5%	-276	-104.3%
Average	**151,546**	**158,005**		**509**		**6,459**	
Total	**5,910,296**	**6,162,195**	**100%**				

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Table 9. VMT data in the Atlanta CSA. Red values meet EPD thresholds.

County	2011 VMT (10^6)	2014 VMT (10^6)	% Total CSA	% CSA Average
Fulton	**12,222**	**13,389**	**18.79%**	**632.67%**
Gwinnett	**7,422**	**8,655**	**12.14%**	**373.61%**
Cobb	**6,617**	**8,029**	**11.27%**	**339.35%**
DeKalb	**7,644**	**7,956**	**11.16%**	**335.37%**
Clayton	**2,881**	**2,834**	**3.98%**	**55.06%**
Henry	**2,215**	**2,441**	**3.42%**	**33.56%**
Forsyth	1,690	2,124	2.98%	16.23%
Cherokee	1,872	2,119	2.97%	15.96%
Hall	1,762	2,067	2.90%	13.14%
Bartow	1,651	1,908	2.68%	4.42%
Douglas	1,588	1,758	2.47%	-3.82%
Coweta	1,460	1,699	2.38%	-7.02%
Carroll	1,249	1,602	2.25%	-12.31%
Paulding	940	1,179	1.65%	-35.48%
Newton	870	1,108	1.56%	-39.35%
Rockdale	985	1,089	1.53%	-40.40%
Fayette	888	1,040	1.46%	-43.09%
Clarke	952	1,038	1.46%	-43.22%
Jackson	930	1,026	1.44%	-43.87%
Troup	969	976	1.37%	-46.59%
Walton	698	906	1.27%	-50.42%
Barrow	704	858	1.20%	-53.04%
Gordon	798	773	1.08%	-57.69%
Spalding	550	677	0.95%	-62.93%
Oconee	478	477	0.67%	-73.90%
Morgan	465	457	0.64%	-75.01%
Polk	377	366	0.51%	-80.00%
Haralson	343	338	0.47%	-81.50%
Butts	333	334	0.47%	-81.70%
Pickens	315	315	0.44%	-82.79%
Meriwether	297	278	0.39%	-84.76%
Madison	287	265	0.37%	-85.48%
Dawson	220	232	0.32%	-87.33%
Lamar	248	226	0.32%	-87.65%
Upson	249	219	0.31%	-88.02%
Pike	168	158	0.22%	-91.33%
Oglethorpe	140	125	0.18%	-93.16%
Jasper	136	121	0.17%	-93.38%
Heard	124	107	0.15%	-94.13%
Average	1,634	1,827		
Total	63,736	71,268	100.00%	

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Factor 3: Meteorological Data

Meteorological impacts on violating monitors were evaluated using the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) modeling results provided by EPA[5].

24-hour back-trajectories were created for all exceedance days (> 70 ppb) at each violating ozone monitor from 2013-2014 (Figures 2 - 6). Back-trajectories were developed for three different heights: 1000 meters (green), 500 meters (blue), and 100-meters (red). For the South DeKalb monitor (13-089-0002), the majority of the back-trajectories pass over DeKalb, Fulton, and Cobb counties. For the Confederate Avenue monitor (13-121-0055), the majority of the back-trajectories pass over DeKalb, Fulton, Cobb, and Bartow counties. For the Gwinnett Tech monitor (13-135-0002), the majority of the back-trajectories pass over Gwinnett, DeKalb, and Fulton counties. For the McDonough monitor (13-151-0002), the majority of the back-trajectories pass over Henry, DeKalb, Fulton, Cobb, Clayton, and Bartow counties. For the Conyers monitor (13-247-0001), the majority of the back-trajectories pass over Rockdale, DeKalb, Fulton, and Cobb counties.

Factor 4: Geography/Topography

This factor did not play a significant role in this evaluation of the Atlanta CSA since it does not have any geographical or topographical barriers significantly limiting air pollution transport within its air shed.

Factor 5: Jurisdictional Boundaries

All counties discussed in this technical analysis are within Georgia and fall within the jurisdiction of GA EPD. The Atlanta-Sandy Springs-Gainesville CBSA has previously established nonattainment boundaries associated with both the 1-hour and the 8-hour ozone NAAQS (Table 10).

Table 10. Nonattainment counties associated with the 1-hour, 1997 8-hour, and the 2008 8-hour ozone standards.

Atlanta nonattainment boundary for the 1-hour ozone standard	Atlanta nonattainment boundary for the 1997 8-hour ozone standard	Atlanta nonattainment boundary for the 2008 8-hour ozone standard
Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale.	Barrow, Bartow, Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Newton, Paulding, Rockdale, Spalding, and Walton.	Bartow, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Newton, Paulding, and Rockdale.

[5] Download from https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data#F2.

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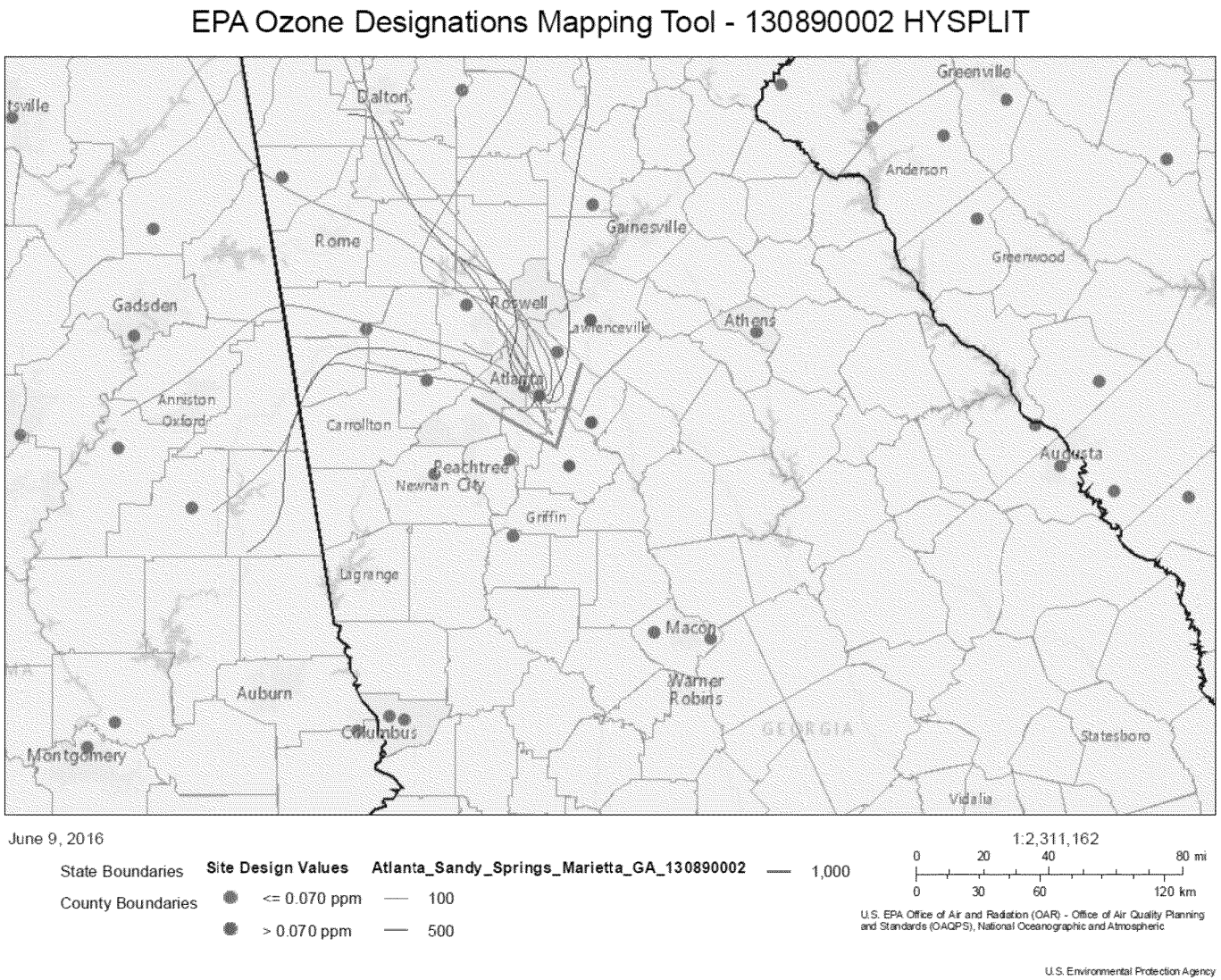

Figure 2. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the South DeKalb monitor (13-089-0002) in DeKalb County.

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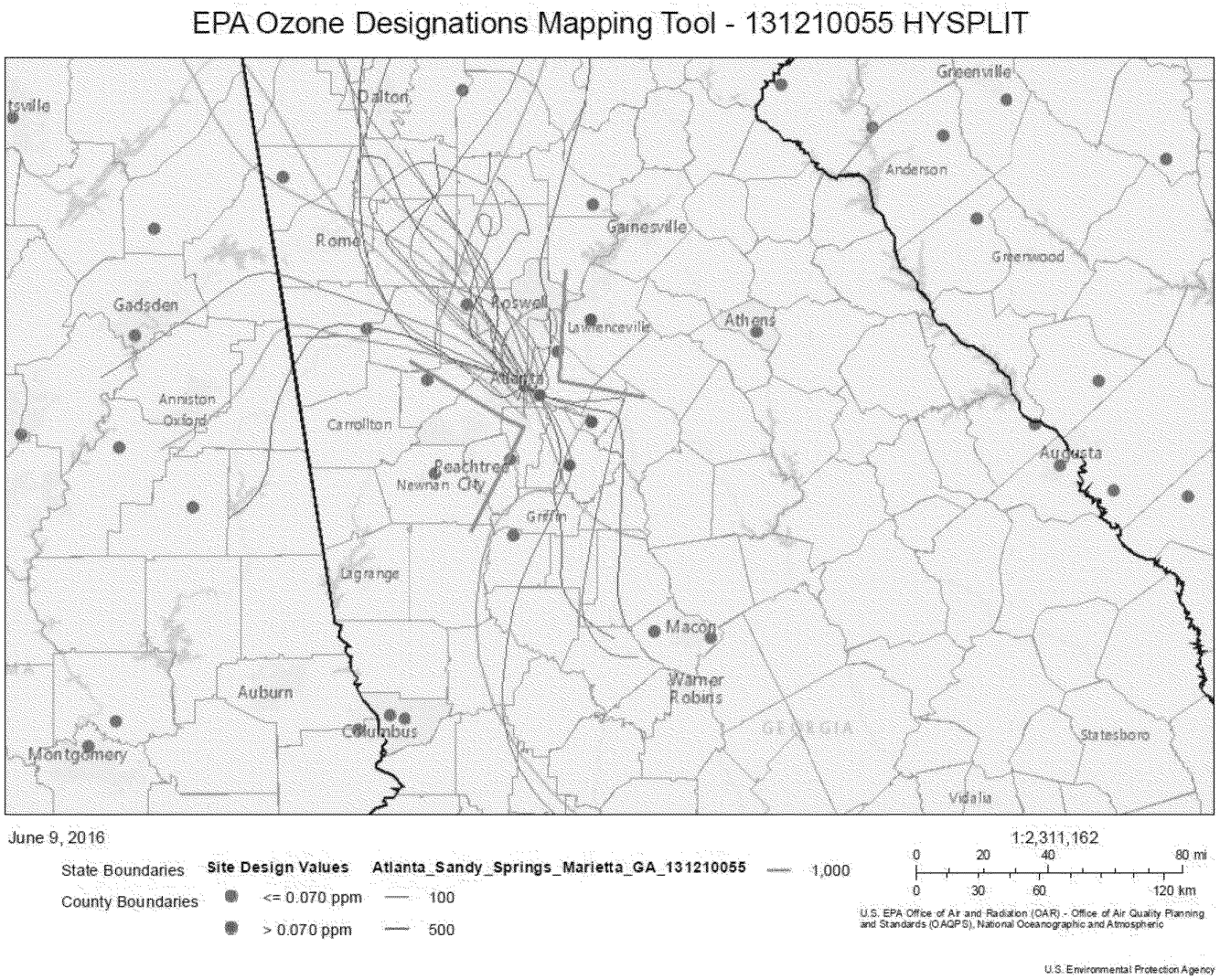

Figure 3. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the Confederate Avenue monitor (13-121-0055) in Fulton County.

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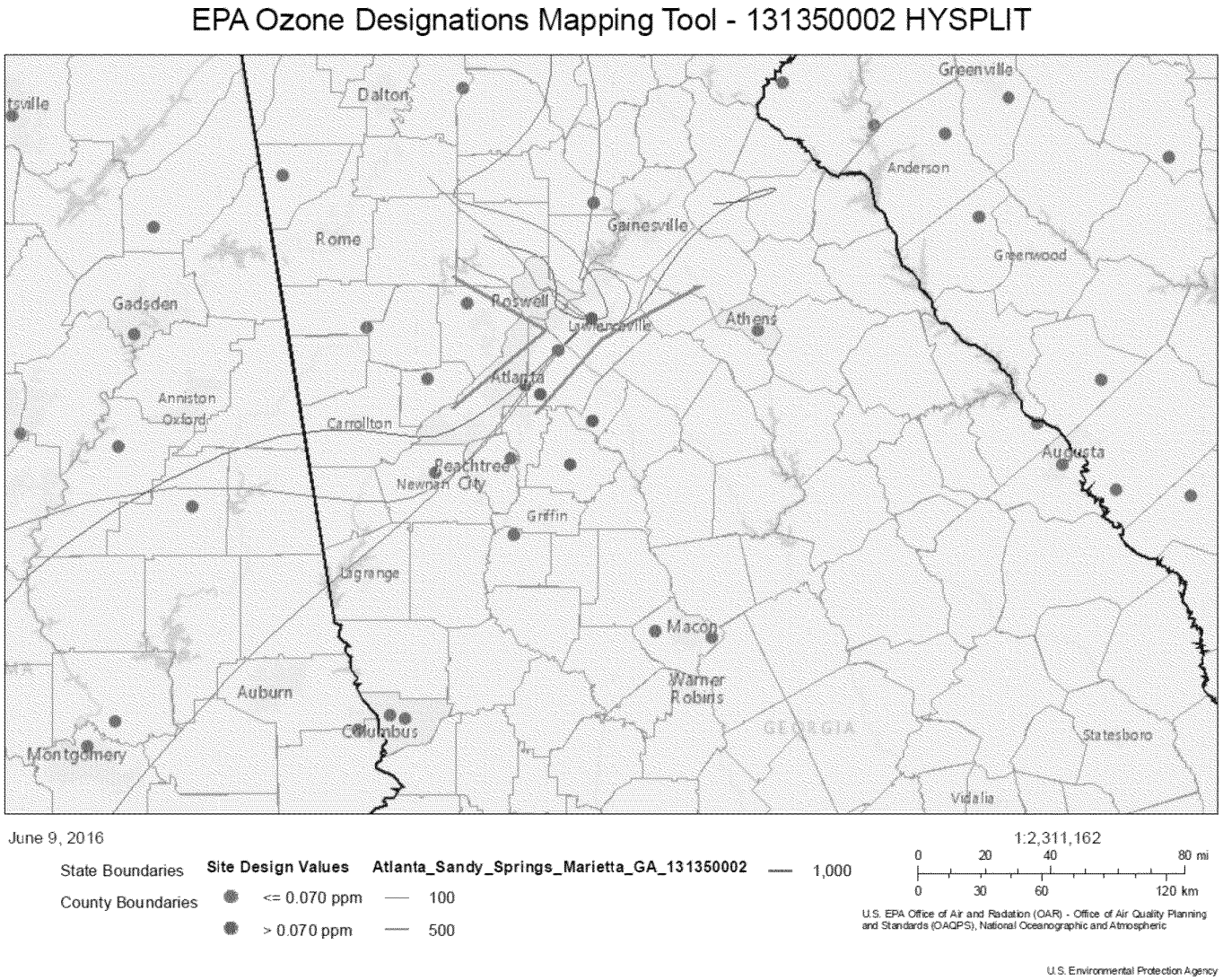

Figure 4. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the Gwinnett Tech monitor (13-135-0002) in Gwinnett County.

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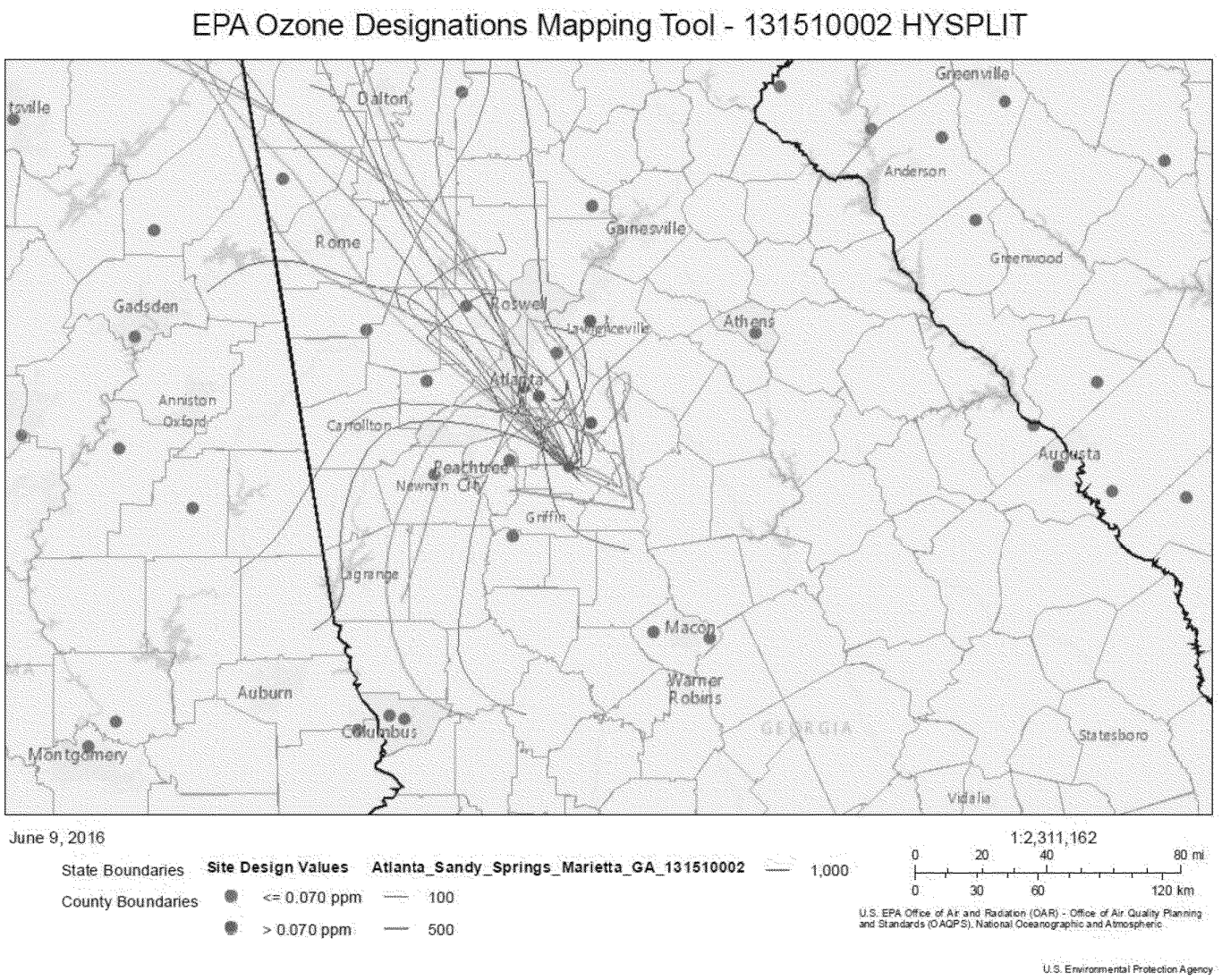

Figure 5. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the McDonough monitor (13-151-0002) in Henry County.

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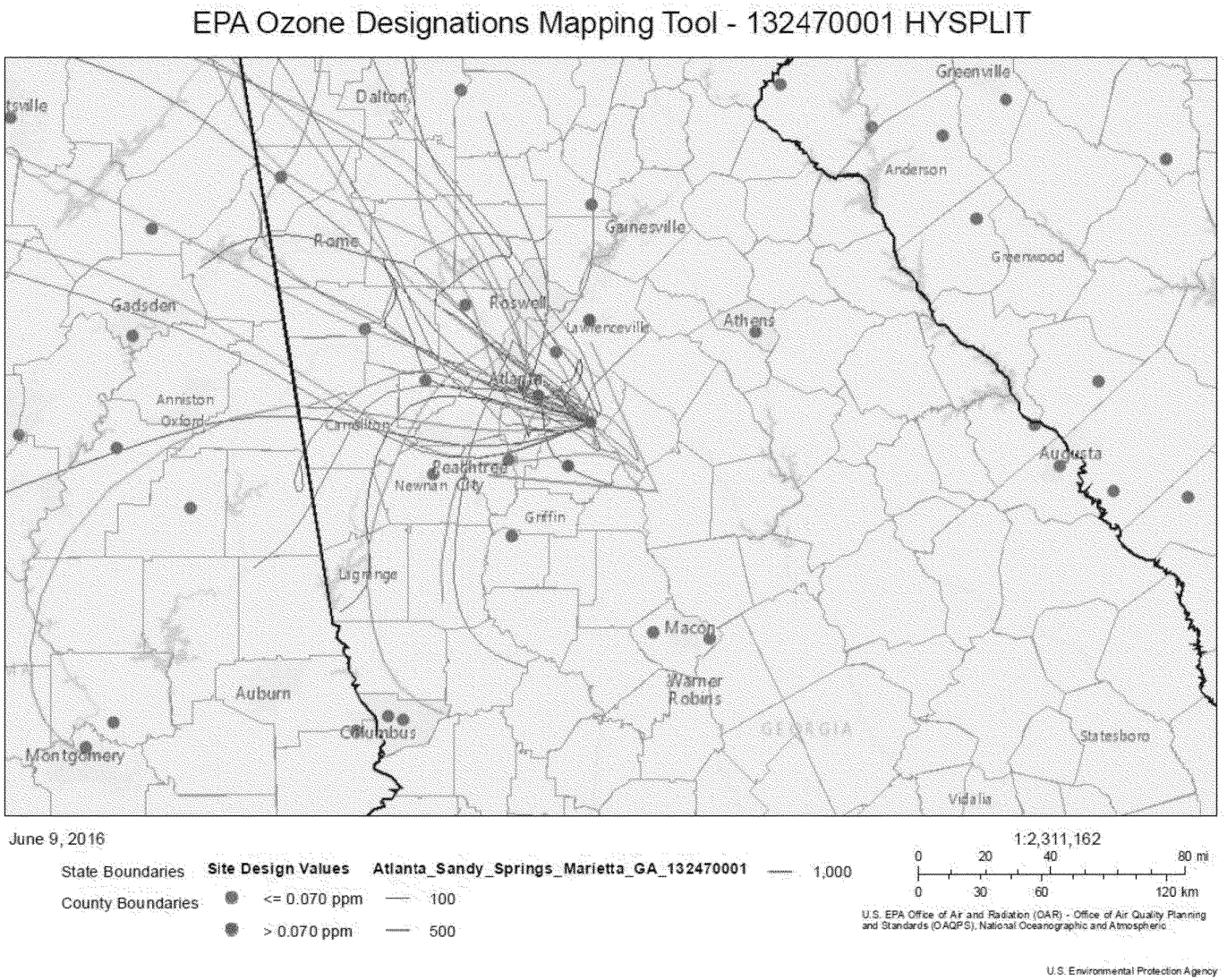

Figure 6. HYSPLIT modeling results for ozone exceedance days in 2013-2014 at the Conyers monitor (13-247-0001) in Rockdale County

Source Apportionment with CAMx-APCA

EPA's designation guidance memo states that source apportionment modeling can be used as part of the initial area designation process. EPD applied the Comprehensive Air Quality Model with eXtensions (CAMx) model[6] (version 6.2) with its Anthropogenic Precursor Culpability Assessment (APCA) tool to determine the contribution of each of the 39 counties in the Atlanta CSA to the five violating ozone monitors. EPD used a similar approach with CAMx-APCA as EPA used for the proposed Cross-State Air Pollution Rule modeling[7] (hereafter, Transport Rule Modeling).

EPD conducted the CAMx-APCA run for the ozone season from April 1 to October 31 using 2017 projected emissions and 2011 meteorology on a 12-km grid centered on the Atlanta CSA and covering most of Georgia and parts of neighboring states (Figure 7). The year 2017 was chosen since EPA's designations will be finalized by October 1, 2017 and high-quality modeling data used for EPA's Transport Rule Modeling was readily available. EPD also conducted 2011 modeling to evaluate model performance. EPD conducted Sparse Matrix Object Kernel Emission (SMOKE) modeling for 2017 emissions to tag anthropogenic emissions from each of the 39 counties in the Atlanta CSA as an individual source region; anthropogenic emissions from all other counties in the modeling domain were tagged as the "other" region, and emissions from biogenic sources, wildfires, and prescribed burning were tagged as the "biogenic" source group. The 2017 emissions used for the Transport Rule Modeling were updated to include more accurate 2017 EGU emission projections based on information that EPD sent to EPA as part of Georgia's comments on the Transport Rule NODA. Additional details on the SMOKE, CAMx, and CAMx-APCA modeling can be found in the attached modeling technical support document.

This modeling combines the first four factors discussed of the five-factor analysis into a single contribution value for each county (Table 11). A contribution threshold of 1.0 ppb was used to determine which counties significantly contribute to the violating monitors. The 1.0 ppb threshold was chosen because it is EPA's recently proposed significant impact level for single source PSD modeling[8]. The following counties had more than a 1.0 ppb impact on a violating ozone monitor: Fulton, Gwinnett, DeKalb, Cobb, Bartow, Clayton, and Henry.

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[6] Environ, CAMx Overview, http://www.camx.com/about/default.aspx

[7] EPA, Proposed Cross-State Air Pollution Update Rule, https://www.epa.gov/airmarkets/proposed-cross-state-air-pollution-update-rule

[8] EPA, 2016. Draft Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program.

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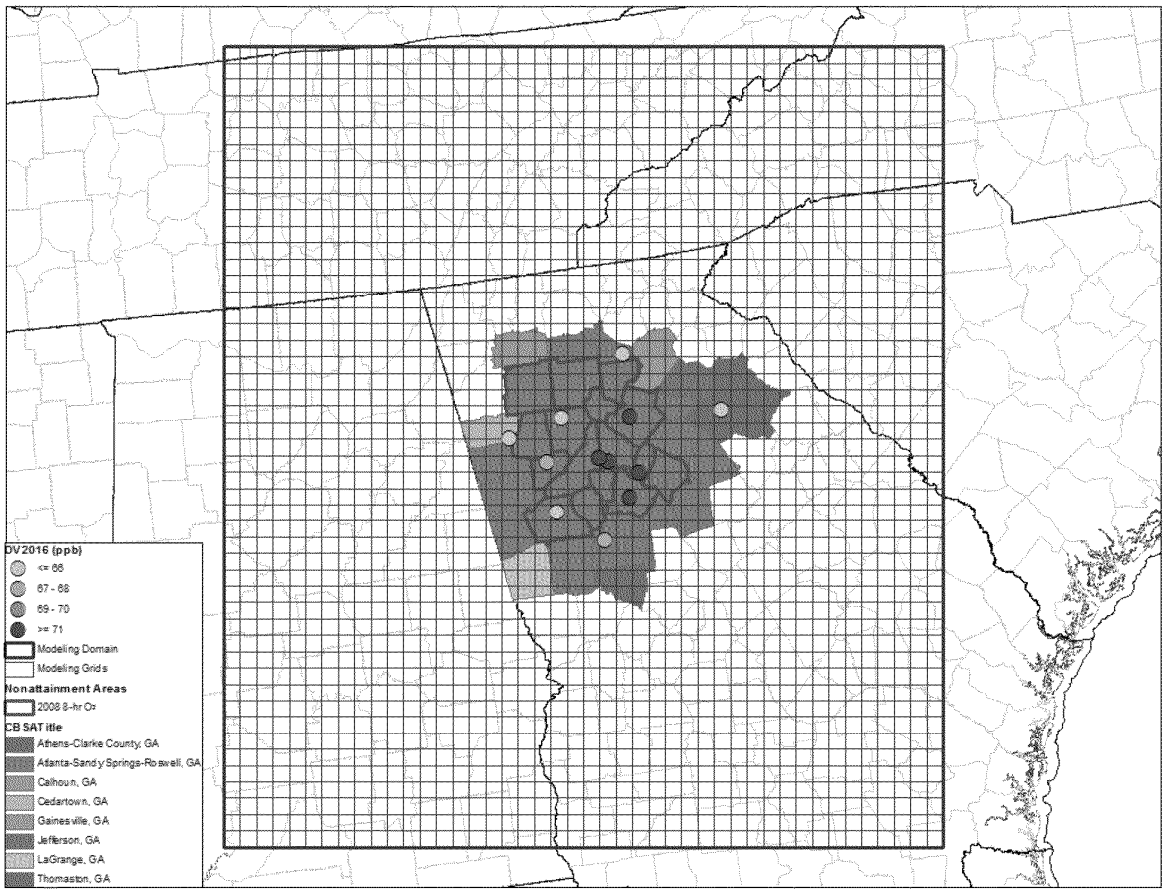

Figure 7. GA EPD's modeling domain for the source contribution assessment. Also shown are the preliminary 2014-2016 design values, nonattainment counties for the 2008 ozone NAAQS, and the Atlanta CSA broken down by CBSAs.

Table 11. Contributions of 39 counties in the Atlanta CSA to violating ozone monitors. Red values indicate more than 1.0 ppb contribution to a violating ozone monitor.

Monitor	Confederate Ave. (13-121-0055)	Conyers (13-247-0001)	McDonough (13-151-0002)	Gwinnett Tech (13-135-0002)	South DeKalb (13-089-0002)
Barrow	0.12	0.06	0.10	0.23	0.10
Bartow	**1.17**	0.77	0.97	**1.45**	0.96
Butts	0.04	0.07	0.14	0.02	0.04
Carroll	0.24	0.33	0.15	0.09	0.26
Cherokee	0.40	0.30	0.36	0.64	0.33
Clarke	0.08	0.03	0.10	0.09	0.08
Clayton	**3.54**	**4.22**	**3.85**	0.68	**3.26**
Cobb	**2.69**	**1.50**	**1.72**	**2.49**	**2.05**
Coweta	0.24	0.38	0.29	0.14	0.23
Dawson	0.03	0.03	0.03	0.04	0.03
DeKalb	**3.04**	**3.07**	**3.17**	**2.33**	**5.56**
Douglas	0.68	0.41	0.33	0.16	0.55
Fayette	0.21	0.31	0.40	0.07	0.18
Forsyth	0.29	0.26	0.24	0.78	0.24
Fulton	**8.74**	**4.12**	**4.07**	**3.92**	**5.98**
Gordon	0.15	0.11	0.14	0.07	0.13
Gwinnett	**1.71**	**1.93**	**1.60**	**8.25**	**1.58**
Hall	0.26	0.18	0.16	0.61	0.19
Haralson	0.07	0.10	0.03	0.04	0.09
Heard	0.14	0.26	0.16	0.09	0.15
Henry	0.55	**2.65**	**4.08**	0.26	0.88
Jackson	0.16	0.07	0.12	0.29	0.13
Jasper	0.01	0.01	0.03	0.01	0.01
Lamar	0.01	0.02	0.03	0.01	0.01
Madison	0.07	0.03	0.07	0.11	0.07
Meriwether	0.02	0.03	0.03	0.02	0.03
Morgan	0.06	0.02	0.08	0.03	0.06
Newton	0.17	0.29	0.34	0.06	0.21
Oconee	0.04	0.01	0.05	0.04	0.04
Oglethorpe	0.01	0.00	0.01	0.01	0.01
Paulding	0.35	0.20	0.22	0.20	0.29
Pickens	0.05	0.05	0.05	0.03	0.05
Pike	0.01	0.01	0.02	0.01	0.01
Polk	0.09	0.06	0.05	0.07	0.08
Rockdale	0.23	0.95	0.41	0.09	0.31
Spalding	0.04	0.10	0.15	0.03	0.05
Troup	0.03	0.04	0.04	0.03	0.04
Upson	0.01	0.01	0.01	0.01	0.01
Walton	0.16	0.09	0.20	0.14	0.17

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Summary and Recommendations

EPD performed a detailed analysis that considered EPA's five factors. In addition, EPD performed source contribution modeling with CAMx-APCA. A summary of the factors that were evaluated for the Atlanta CSA are contained in Table 12. Based on this analysis, EPD recommends that the following eight (8) counties be designated as **nonattainment** for the 2015 ozone NAAQS (Figure 8):

- **Fulton** (based on Factors 1, 2, 3, 5, and CAMx-APCA);
- **Gwinnett** (based on Factors 1, 2, 3, 5, and CAMx-APCA);
- **DeKalb** (based on Factors 1, 2, 3, 5, and CAMx-APCA);
- **Cobb** (based on Factors 2, 3, 5, and CAMx-APCA);
- **Bartow** (based on Factors 2, 3, 5, and CAMx-APCA);
- **Clayton** (based on Factors 2, 3, 5, and CAMx-APCA);
- **Henry** (based on Factors 1, 2, 3, 5, and CAMx-APCA); and
- **Rockdale** (based on Factors 1, 3, and 5).

The remaining 151 counties in Georgia are recommended as **unclassifiable/attainment**.

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Table 12. Summary of the Atlanta CSA counties exceeding EPD thresholds for various factors.

County	Air Quality Data (Factor 1)	NOx Emissions (Factor 2)	VOCs Emissions (Factor 2)	Population (Factor 2)	VMT (Factor 2)	HYSPLIT (Factor 3)	CAMx-APCA Source Contribution
Barrow							
Bartow		X				X	X
Butts							
Carroll							
Cherokee							
Clarke							
Clayton		X	X	X	X	X	X
Cobb		X	X	X	X	X	X
Coweta							
Dawson							
DeKalb	X	X	X	X	X	X	X
Douglas							
Fayette							
Forsyth							
Fulton	X	X	X	X	X	X	X
Gordon							
Gwinnett	X	X	X	X	X	X	X
Hall							
Haralson							
Heard							
Henry	X				X	X	X
Jackson							
Jasper							
Lamar							
Madison							
Meriweth							
Morgan							
Newton							
Oconee							
Oglethorp							
Paulding							
Pickens							
Pike							
Polk							
Rockdale	X					X	
Spalding							
Troup							
Upson							
Walton							

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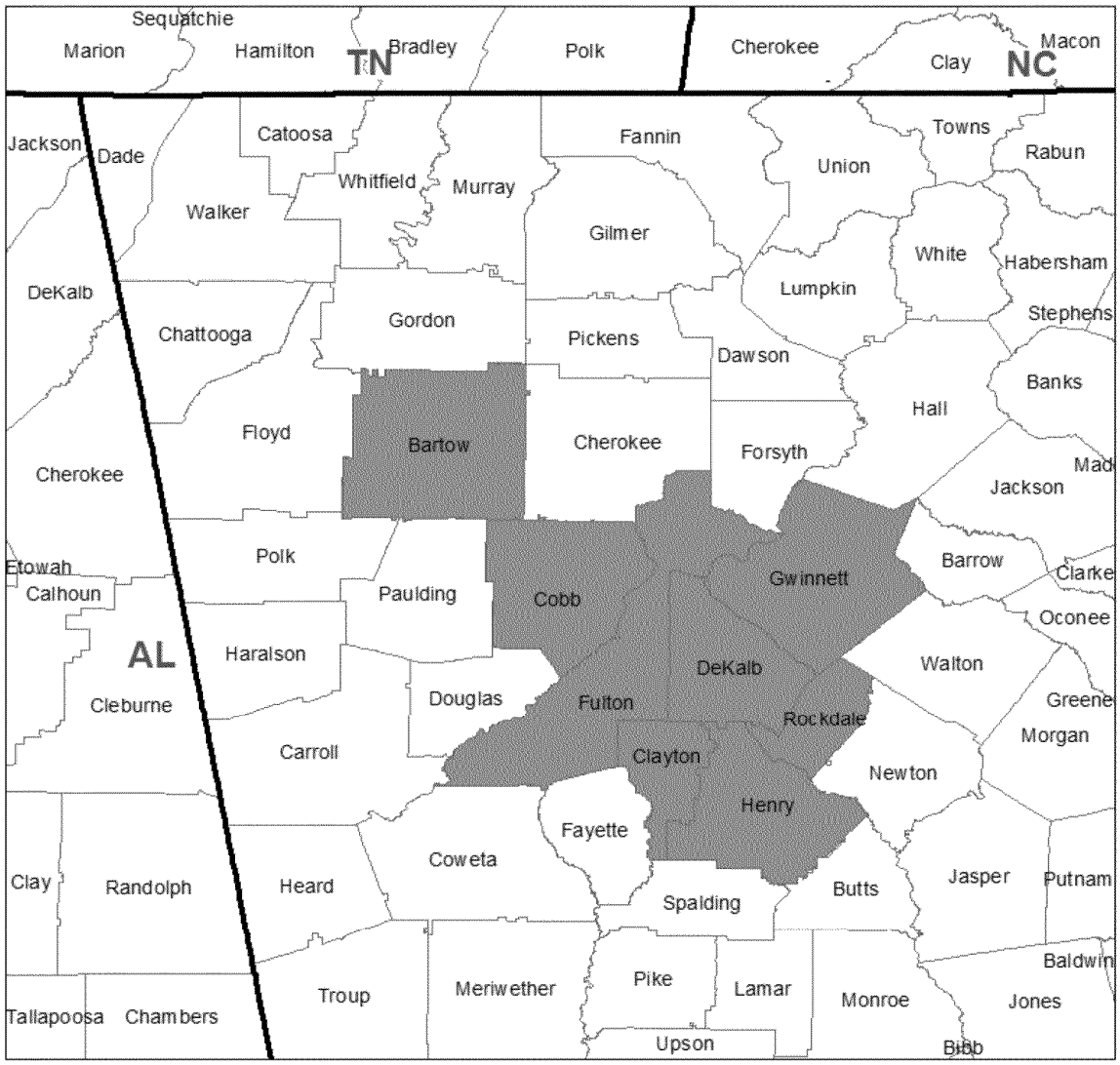

Figure 8. Map of eight counties (orange shading) in the Atlanta CSA recommended by EPD as nonattainment for the 2015 ozone NAAQS.

To: Gettle, Jeaneanne[Gettle.Jeaneanne@epa.gov]; Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Farngalo, Zuri[Farngalo.Zuri@epa.gov]; Davis, Scott[Davis.ScottR@epa.gov]
Cc: sean.alteri@ky.gov[sean.alteri@ky.gov]; Duff, Melissa (EEC)[melissa.duff@ky.gov]
From: Poff, Leslie
Sent: Fri 9/30/2016 5:55:05 PM
Subject: Kentucky 2015 Ozone Designation Recommendation
2016-9-30 Final 2015 O3 Kentucky Designation Recommendation.pdf

Good Afternoon,

Attached, please find Kentucky's recommendations regarding attainment and nonattainment designations and boundaries for the 2015 8-hour Ozone NAAQS, as required by Section 107(d)(1)(A) of the CAA. You should expect to receive a hard copy of this submittal by early next week. If you have questions, comments, or concerns, please let us know.

Sincerely,

Leslie Poff

Kentucky Division for Air Quality

300 Sower Blvd.

Frankfort, KY 40601
Phone: 502-782-6735

lesliem.poff@ky.gov

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ENERGY AND ENVIRONMENT CABINET

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September 30, 2016

Ms. Heather McTeer Toney
Regional Administrator
U.S. EPA, Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, Georgia 30303

Dear Ms. McTeer Toney:

On behalf of the Commonwealth of Kentucky, the Energy and Environment Cabinet (Cabinet) submits the following list of recommendations for areas in Kentucky as to whether the areas are considered attainment (meeting the standard), nonattainment (not meeting the standard) or unclassifiable (area cannot be classified as meeting or not meeting the standard on the basis of available information) relative to the 2015 Ozone National Ambient Air Quality Standard. The Cabinet's submittal is in accordance with Section 107 (d)(1)(A) of the Clean Air Act and follows the U.S. EPA the February 25, 2016 memorandum and guidance, *"Area Designations for the 2015 Revised Ozone National Ambient Air Quality Standard."*

The Cabinet's recommendation is consistent with the EPA memorandum and applies the five factors the U.S. EPA recommended as a framework for area-specific analyses to support final nonattainment area boundary recommendations. Based on 2013-2015 ambient air monitoring data, along with the U.S. EPA guidance, the Cabinet recommends "nonattainment" designations for partial county boundaries in Boone, Campbell, and Kenton counties. All other areas in the Commonwealth are recommended to be designated as "unclassifiable/attainment."

The Cabinet appreciates the opportunity to provide the attached boundary recommendations for Kentucky. If you have any questions or comments concerning this matter, please contact Mr. Sean Alteri, Director, Division for Air Quality, at (502)782-6541.

Sincerely,

Charles G. Snavely
Secretary

Kentucky 2015 Ozone NAAQS Designation Recommendations

County	Recommended Designation	County	Recommended Designation
Adair	Unclassifiable/Attainment	Fayette	Unclassifiable/Attainment
Allen	Unclassifiable/Attainment	Fleming	Unclassifiable/Attainment
Anderson	Unclassifiable/Attainment	Floyd	Unclassifiable/Attainment
Ballard	Unclassifiable/Attainment	Franklin	Unclassifiable/Attainment
Barren	Unclassifiable/Attainment	Fulton	Unclassifiable/Attainment
Bath	Unclassifiable/Attainment	Gallatin	Unclassifiable/Attainment
Bell	Unclassifiable/Attainment	Garrard	Unclassifiable/Attainment
Boone (partial)	Nonattainment	Grant	Unclassifiable/Attainment
Bourbon	Unclassifiable/Attainment	Graves	Unclassifiable/Attainment
Boyd	Unclassifiable/Attainment	Grayson	Unclassifiable/Attainment
Boyle	Unclassifiable/Attainment	Green	Unclassifiable/Attainment
Bracken	Unclassifiable/Attainment	Greenup	Unclassifiable/Attainment
Breathitt	Unclassifiable/Attainment	Hancock	Unclassifiable/Attainment
Breckinridge	Unclassifiable/Attainment	Hardin	Unclassifiable/Attainment
Bullitt	Unclassifiable/Attainment	Harlan	Unclassifiable/Attainment
Butler	Unclassifiable/Attainment	Harrison	Unclassifiable/Attainment
Caldwell	Unclassifiable/Attainment	Hart	Unclassifiable/Attainment
Calloway	Unclassifiable/Attainment	Henderson	Unclassifiable/Attainment
Campbell (partial)	Nonattainment	Henry	Unclassifiable/Attainment
Carlisle	Unclassifiable/Attainment	Hickman	Unclassifiable/Attainment
Carroll	Unclassifiable/Attainment	Hopkins	Unclassifiable/Attainment
Carter	Unclassifiable/Attainment	Jackson	Unclassifiable/Attainment
Casey	Unclassifiable/Attainment	Jefferson	Unclassifiable/Attainment
Christian	Unclassifiable/Attainment	Jessamine	Unclassifiable/Attainment
Clark	Unclassifiable/Attainment	Johnson	Unclassifiable/Attainment
Clay	Unclassifiable/Attainment	Kenton (partial)	Nonattainment
Clinton	Unclassifiable/Attainment	Knott	Unclassifiable/Attainment
Crittenden	Unclassifiable/Attainment	Knox	Unclassifiable/Attainment
Cumberland	Unclassifiable/Attainment	LaRue	Unclassifiable/Attainment
Daviess	Unclassifiable/Attainment	Laurel	Unclassifiable/Attainment
Edmonson	Unclassifiable/Attainment	Lawrence	Unclassifiable/Attainment
Elliot	Unclassifiable/Attainment	Lee	Unclassifiable/Attainment
Estill	Unclassifiable/Attainment	Leslie	Unclassifiable/Attainment

County	Recommended Designation	County	Recommended Designation
Letcher	Unclassifiable/Attainment	Owen	Unclassifiable/Attainment
Lewis	Unclassifiable/Attainment	Owsley	Unclassifiable/Attainment
Lincoln	Unclassifiable/Attainment	Pendleton	Unclassifiable/Attainment
Livingston	Unclassifiable/Attainment	Perry	Unclassifiable/Attainment
Logan	Unclassifiable/Attainment	Pike	Unclassifiable/Attainment
Lyon	Unclassifiable/Attainment	Powell	Unclassifiable/Attainment
McCracken	Unclassifiable/Attainment	Pulaski	Unclassifiable/Attainment
McCreary	Unclassifiable/Attainment	Robertson	Unclassifiable/Attainment
McLean	Unclassifiable/Attainment	Rockcastle	Unclassifiable/Attainment
Madison	Unclassifiable/Attainment	Rowan	Unclassifiable/Attainment
Magoffin	Unclassifiable/Attainment	Russell	Unclassifiable/Attainment
Marion	Unclassifiable/Attainment	Scott	Unclassifiable/Attainment
Marshall	Unclassifiable/Attainment	Shelby	Unclassifiable/Attainment
Martin	Unclassifiable/Attainment	Simpson	Unclassifiable/Attainment
Mason	Unclassifiable/Attainment	Spencer	Unclassifiable/Attainment
Meade	Unclassifiable/Attainment	Taylor	Unclassifiable/Attainment
Menifee	Unclassifiable/Attainment	Todd	Unclassifiable/Attainment
Mercer	Unclassifiable/Attainment	Trigg	Unclassifiable/Attainment
Metcalfe	Unclassifiable/Attainment	Trimble	Unclassifiable/Attainment
Monroe	Unclassifiable/Attainment	Union	Unclassifiable/Attainment
Montgomery	Unclassifiable/Attainment	Warren	Unclassifiable/Attainment
Morgan	Unclassifiable/Attainment	Washington	Unclassifiable/Attainment
Muhlenberg	Unclassifiable/Attainment	Wayne	Unclassifiable/Attainment
Nelson	Unclassifiable/Attainment	Webster	Unclassifiable/Attainment
Nicholas	Unclassifiable/Attainment	Whitley	Unclassifiable/Attainment
Ohio	Unclassifiable/Attainment	Wolfe	Unclassifiable/Attainment
Oldham	Unclassifiable/Attainment	Woodford	Unclassifiable/Attainment

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Introduction

On October 1, 2015, the U.S. Environmental Protection Agency (EPA) promulgated a revised National Ambient Air Quality Standard (NAAQS) for the 8-hour ozone standard from the previous 0.075 ppm (80 FR 65292). Both the primary and secondary standards were lowered to 0.070 parts per million (ppm). The primary standard provides public health protection, particularly for vulnerable populations such as children, older adults, people with asthma and other lung diseases and others with adverse health effects. The secondary standard provides public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation and buildings. The EPA based this decision on current health research associated with ozone exposure, which identified that the 2008 ozone standard was not sufficient in protecting public health and welfare.

Under section 107(d) of the Clean Air Act (CAA), states are required to submit area designation recommendations to the EPA no later than one year after promulgation of the new or revised NAAQS. The date of the required submission by states for the current ozone standard is October 1, 2016. This document presents the Kentucky Energy and Environment Cabinet's recommendations regarding attainment and nonattainment designations and boundaries for the 2015 ozone NAAQS, as required by Section 107(d)(1)(A) of the CAA.

The EPA issued an attachment in their February 25, 2016 memorandum "Area Designations for the 2015 Ozone National Ambient Air Quality Standards." The attachment provided five factors the EPA recommended as a framework for area-specific analyses to support nonattainment area boundary recommendations and final boundary determinations. The factors are:

1. Air quality data
2. Emissions and emissions-related data
3. Meteorological data
4. Geography/topography
5. Jurisdictional boundaries

These factors were used to evaluate whether an area should be designated as attainment (meeting the standard), nonattainment (not meeting the standard) or unclassifiable (area cannot be classified as meeting or not meeting the standard on the basis of available information).

Kentucky has ozone monitors located in 30 counties throughout the State. Examination of the 2013-2015 design values indicated that one (1) monitor is not attaining the revised 8-hour ozone NAAQS. The design value for the monitor located in Campbell County, Kentucky is 0.071 ppm which is above the 2015 ozone standard. All other monitors in Kentucky are attaining the standard based on certified and quality assured data for 2013-2015.

The EPA guidance states that a nonattainment area must include not only the violating monitor, but any surrounding areas that may be contributing to the violating monitor as well. In Kentucky, the violating monitor is located in Campbell County, which is part of the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA). The Cincinnati, OH-KY-IN CBSA encompasses three states and fifteen counties. It includes Dearborn, Ohio, and Union Counties in Indiana; Brown, Butler, Clermont, Hamilton and Warren Counties in Ohio; and Boone,

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Bracken, Campbell, Gallatin, Grant, Kenton and Pendleton Counties in Kentucky. Figure 1 shows the Kentucky counties located in the Cincinnati, OH-KY-IN CBSA.

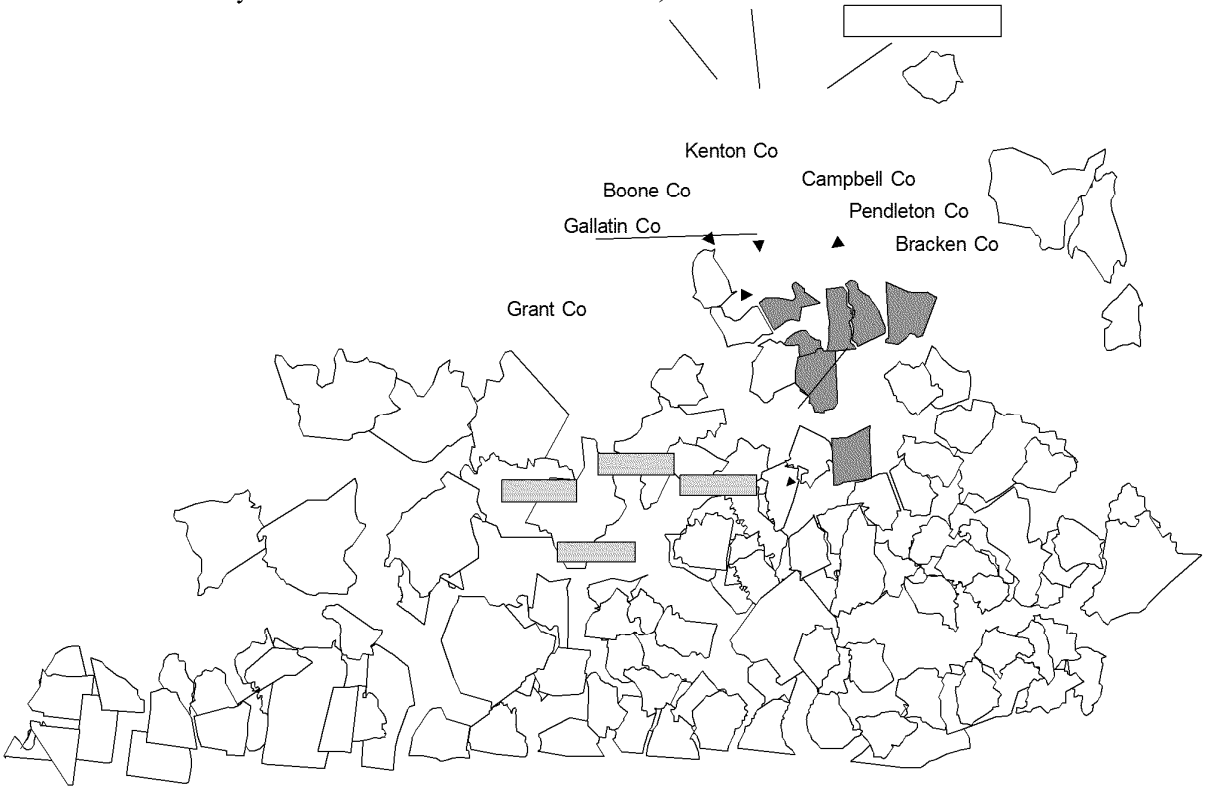

Figure 1: Kentucky Portion of the Cincinnati, OH-KY-IN CBSA

Designation Recommendation

Based on certified and quality assured ozone monitoring data for 2013-2015, and using the EPA recommended factors for analysis, Kentucky recommends portions of the following Kentucky counties be designated as nonattainment for the revised 8-hour ozone standard: Boone, Campbell, and Kenton. Kentucky recommends a designation of unclassifiable/attainment for the remaining counties in the state. Kentucky is not making recommendations regarding counties in Indiana or Ohio.

The following sections of this document provide a description and discussion of Kentucky's application of the five factors from the EPA's guidance in determination of the recommended nonattainment and unclassifiable/attainment areas. Also included, are the specific census tracts for Boone, Campbell, and Kenton counties for the partial nonattainment area.

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Boone County, KY

Air Quality

Pursuant to 40 CFR 50:19 (b) and (d) the 8-hour primary and secondary NAAQS are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, as determined in accordance with Appendix U of Part 50. The Boone County ozone monitor (21-015-0003) shows the 3-year average (2013-2015) of the annual fourth-highest daily maximum 8-hour average ozone concentration is 0.061 parts per million, which achieves the 8-hour ozone National Ambient Air Quality Standard (NAAQS – 0.070 ppm).

Table 1 provides a summary of the annual fourth-highest daily maximum 8-hour average ozone concentrations recorded at monitors located in the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA), for 2013-2015. Not all counties in the Cincinnati, OH-KY-IN CBSA have monitors for ozone. Monitor values included in Table 1 only reflect those monitors that were operational during the 2013 to 2015 design value period. Only the monitor in Campbell County, KY indicates a design value above the revised ozone NAAQS for the CBSA.

Table 1
Cincinnati, OH-KY-IN CBSA
3-year Average* of Annual 8-hour concentrations for Ozone

County/Site	AQS Code	Annual 4th High (ppm)			Design Value (ppm)
		2013	2014	2015	
Kentucky					
Boone	21-015-0003	0.059	0.062	0.062	0.061
Campbell	21-037-3002	0.072	0.071	0.071	0.071
Ohio					
Butler	39-017-0004	0.068	0.070	0.070	0.069
Butler	39-017-0018	0.068	0.069	0.070	0.069
Butler	39-017-9991	0.069	0.069	0.068	0.068
Clermont	39-025-0022	0.066	0.068	0.070	0.068
Hamilton	39-061-0006	0.069	0.070	0.072	0.070
Hamilton	39-061-0010	0.064	0.073	0.070	0.069
Hamilton	39-061-0040	0.069	0.069	0.071	0.069
Warren	39-165-0007	0.067	0.071	0.071	0.069

*NAAQS 8-hour (3 year average of the 4th max value). 0.070ppm
n/a indicates no monitor data for that county.

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Emissions and Emissions-Related Data

The U.S. EPA requires an emissions inventory to be developed in order to identify the level of emissions in a specific area and adjacent regions that may have contributed to an ozone violation. The EPA Ozone Designations Mapping Tool was used to obtain 2011 NEI v2 emissions inventory data. The 2011 NEI v2 is the latest available national emissions inventory data and is the source of the point, non-point, on-road, non-road and event emissions, and was used to evaluate Boone County's impact on the violating monitor. VOC and NOx emissions, by category, are provided in Tables 2 and 3.

Table 2
2011 NEI VOC Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	VOC					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	1019.03	3708.82	1156.27	960.74	210.59	**7055.45**
Bracken	13.41	2604.87	143.77	98.86	0.0	**2860.91**
Campbell	160.58	2658.31	785.96	260.64	0.0	**3865.49**
Gallatin	87.39	1872.80	230.24	95.01	49.75	**2335.19**
Grant	79.78	3246.13	422.24	239.93	2.86	**3990.94**
Kenton	232.80	3289.76	1405.33	418.90	0.0	**5346.79**
Pendleton	127.59	3137.17	227.50	44.20	80.48	**3616.94**
KY Total	**1720.58**	**20517.86**	**4371.31**	**2118.28**	**343.68**	**29071.71**
INDIANA						
Dearborn	1573.32	3500.17	752.90	152.55	144.58	**6123.52**
Ohio	0.01	1571.07	111.12	30.63	46.31	**1759.14**
Union	0.00	1500.88	127.38	218.28	0.00	**1846.54**
IN Total	**1573.33**	**6572.12**	**991.40**	**401.46**	**190.89**	**9729.20**
OHIO						
Brown	28.90	4558.87	969.87	111.49	24.69	**5693.82**
Butler	1146.62	6081.24	4556.78	1076.33	0.0	**12860.97**
Clermont	180.86	5500.53	2654.57	719.53	0.0	**9055.49**
Hamilton	978.46	10759.16	10490.15	2734.21	0.0	**24961.98**
Warren	262.03	4760.18	2741.38	812.53	0.0	**8576.12**
OH Total	**2596.87**	**31659.98**	**21412.75**	**5454.09**	**24.69**	**61148.38**
Total Emissions	**5890.78**	**58749.96**	**26775.46**	**7973.83**	**559.26**	**99949.29**

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Table 3
2011 NEI NO_x Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	NOx					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	3569.19	801.83	3455.45	682.30	21.32	**8530.09**
Bracken	3.72	469.43	267.93	72.38	0.0	**813.46**
Campbell	82.95	666.79	1583.28	247.83	0.0	**2580.85**
Gallatin	609.76	357.34	832.85	42.53	5.00	**1847.48**
Grant	13.00	510.39	1590.13	96.12	0.28	**2209.92**
Kenton	147.17	818.13	3449.61	521.34	0.0	**4936.25**
Pendleton	949.22	350.98	385.47	77.48	7.90	**1771.05**
KY Total	**5375.01**	**3974.89**	**11564.72**	**1739.98**	**34.50**	**22689.10**
INDIANA						
Dearborn	6530.65	296.72	1610.93	196.33	6.62	**8641.25**
Ohio	0.00	76.65	164.59	28.77	2.75	**272.76**
Union	0.00	190.63	226.35	135.37	0.00	**552.35**
IN Total	**6530.65**	**564.00**	**2001.87**	**360.47**	**9.37**	**9466.36**
OHIO						
Brown	4.40	383.53	1288.36	254.07	2.39	**1932.75**
Butler	3989.32	1962.75	7108.70	1569.52	0.0	**14630.29**
Clermont	16000.81	592.15	4374.25	833.68	0.0	**21800.89**
Hamilton	9664.54	3798.10	19232.85	3145.46	0.0	**35840.95**
Warren	569.13	799.42	4743.52	1189.90	0.0	**7301.97**
OH Total	**30228.20**	**7535.95**	**36747.68**	**6992.63**	**2.39**	**81506.85**
Total Emissions	**42133.86**	**12074.84**	**50314.27**	**9093.08**	**46.26**	**113662.31**

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Table 4
VOC Emissions as % of Total VOC Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	16.6	17.5	39.4	35.3	**25.4**
Butler, OH	19.5	9.9	17.1	13.9	**13.1**
Clermont, OH	3.1	8.9	10.0	9.3	**9.2**
Warren, OH	4.4	7.7	10.3	10.5	**8.7**
Boone, KY	17.3	6.5	4.3	12.4	**7.2**
Dearborn, IN	27.0	5.7	2.8	2.0	**6.2**
Brown, OH	0.5	7.4	3.6	1.4	**5.8**
Kenton, KY	4.0	5.7	5.3	5.4	**5.5**
Grant, KY	1.4	5.3	1.6	3.1	**4.1**
Campbell, KY	2.7	4.3	2.9	3.4	**3.9**
Pendleton, KY	2.2	5.1	0.9	0.6	**3.7**
Bracken, KY	0.2	4.6	0.5	1.3	**2.9**
Gallatin, KY	1.5	3.3	0.9	1.2	**2.4**
Ohio. IN	0.0	2.6	0.4	0.4	**1.8**
Union, IN	0.0	2.6	0.5	2.7	**1.8**

Table 5
NOx Emissions as % of Total NOx Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	22.9	32.0	38.4	35.1	**31.4**
Clermont, OH	38.0	5.0	8.7	9.3	**19.1**
Butler, OH	9.5	16.5	14.2	17.5	**12.8**
Dearborn, IN	15.5	2.5	3.2	2.2	**7.6**
Boone, KY	8.5	6.7	6.9	7.6	**7.5**
Warren, OH	1.4	6.7	9.5	13.3	**6.4**
Kenton, KY	0.4	6.9	6.9	5.8	**4.3**
Campbell, KY	0.2	5.6	3.2	2.8	**2.3**
Grant, KY	3.1	4.3	3.2	1.1	**1.9**
Brown, OH	0.0	3.2	2.6	2.8	**1.7**
Gallatin, KY	1.4	3.0	1.7	0.5	**1.6**
Pendleton, KY	2.3	3.0	0.8	0.9	**1.5**
Bracken, KY	0.0	4.0	0.5	0.8	**0.7**
Union, IN	0.0	0.8	1.5	1.5	**0.5**
Ohio. IN	0.0	0.6	0.3	0.3	**0.2**

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Point Sources

Table 2 indicates 2011 point source emissions of VOC in Boone County were 1,019.03 tpy. Total VOC point source emissions from the Cincinnati, OH-KY-IN CBSA were 5,890.78 tpy. Boone County only accounts for approximately 17.3% of the total VOC point source emissions in the CBSA. Table 4 shows the percentages of VOC emissions for point sources in the CBSA, by county.

As seen in Table 3, point source emissions of NO_X in Boone County were estimated to be 3,569.19 tpy in 2011, which represents 8.5% of the total 42,133.86 tpy of the overall NO_X point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for point sources in the CBSA, by county.

Non-Point (Area) Emissions

Table 2 shows that non-point (or "area") VOC emissions in Boone County were estimated to be 3,708.82 tpy for 2011, which represents approximately 6.5% of the total 57,249.08 tpy of the overall VOC non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-point sources in the CBSA, by county.

As seen in Table 3, non-point NOx emissions from Boone County were estimated at 801.83 tpy in 2011, which represents approximately 6.7% of the total 11,884.21 tpy of the overall NOx non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NOx emissions for non-point sources in the CBSA, by county.

On-Road Mobile

As indicated in Table 2, on-road mobile source VOC emissions from Boone County were estimated to be 1,156.27 tpy in 2011, which represents approximately 4.3% of the total 26,648.08 tpy of the overall VOC on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for on-road mobile sources in the CBSA, by county.

As seen in Table 3, on-road mobile source NO_x emissions from Boone County were estimated at 3,455.45 tpy in 2011, which represents approximately 6.9% of the total 50,087.92 tpy of the overall NO_x on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for on-road mobile sources in the CBSA, by county.

Based on 2014 information obtained from the U.S Census Website, http://onthemap.ces.gov, the commuting traffic from other counties into Boone County is 71.0%, while the commuting traffic from Boone County into other counties is 61.1%.

Table 6 below provides Vehicle Miles Travelled (VMT) for all areas within the Cincinnati, OH-KY-IN CBSA for the year 2011. The counties within the Ohio portion of the CBSA contribute to the majority of VMT within the CBSA. Although Boone County is not the main contributor to VMT, it does

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contribute a significant number of VMT within the CBSA. High VMT is associated with urban areas and linked with motor vehicle emissions that may contribute to ozone formation.

Table 6
2011 VMT Totals, Cincinnati, OH-KY-IN CBSA

	2011 VMT Totals
Kentucky	
Boone County	1,558,794,112
Bracken County	104,160,119
Campbell County	1,010,009,434
Gallatin County	245,765,593
Grant County	529,145,674
Kenton County	1,720,886,038
Pendleton County	184,074,537
KY Total	5,352,835,507
Ohio	
Brown County	468,171,663
Butler County	3,099,030,997
Clermont County	1,951,343,156
Hamilton County	9,004,357,566
Warren County	2,139,774,797
OH Total	16,662,678,179
Indiana	
Dearborn County	690,348,611
Ohio County	71,591,617
Union County	105,444,221
IN Total	867,384,449
Total VMT for CBSA	22,882,898,135

Non-Road Mobile Sources

As listed in Table 2, non-road mobile source VOC emissions from Boone County were estimated at 960.74 tpy in 2011, which represents approximately 12.4% of the total 7755.55 tpy of the overall VOC non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-road mobile sources in the CBSA, by county.

As seen in Table 3, non-road mobile source NO_x emissions from Boone County were estimated at 682.30 tpy in 2011, which represents approximately 7.6% of the total 8,957.71 tpy of the overall NO_x non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for non-road mobile sources in the CBSA, by county.

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Comparison of Total Emissions

A comparison of total emissions across the entire Cincinnati, OH-KY-IN CBSA was performed using data from the Ozone Designations Mapping Tool. The percentages shown in last column in both Tables 4 and 5 demonstrate that the majority of VOC and NO_X emissions within the Cincinnati, OH-KY-IN CBSA come from the Ohio portion of the CBSA.

Population

Based on U.S. Census Bureau estimates for 2015, there are 127,712 persons living in Boone County (Refer to table 7). This represents approximately 519.1 persons per square mile. The population of Boone County is approximately 13.3% rural with the remaining 86.7% living in incorporated areas. The largest cities in Boone County are Florence and Union.

Boone County's population from 2010 to 2015 *increased* by approximately 7.5% (118,811 to 127,712). For the entire Cincinnati, OH-KY-IN CBSA, Boone County represents approximately 5.9% of the total population in the CBSA and 29**%** of the Kentucky portion of the CBSA (Refer to table 8).

Table 7
Northern Kentucky Area Population
Growth Data

County	Census 2010	2015*	% Growth 2010 - 2015
Boone	118,811	127,712	7.5%
Bracken	8,488	8,321	-2.0%
Campbell	90,336	92,066	1.9%
Gallatin	8,589	8,636	0.5%
Grant	24,662	24,757	0.4%
Kenton	159,720	165,012	3.3%
Pendleton	14,877	14,408	-3.1%

*U.S. Census Bureau estimates.

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Table 8
2015 Population
Cincinnati, OH-KY-IN CBSA

CBSA Estimated Population	2015*	2015 Population Density (1,000 per square mile)	% of Total	
Kentucky			**of KY Portion**	**of CBSA**
Boone County	127,712	0.52	29.0%	5.9%
Bracken County	8,321	0.04	1.9%	0.5%
Campbell County	92,066	0.61	20.9%	4.3%
Gallatin County	8,636	0.09	2.0%	0.4%
Grant County	24,757	0.10	5.6%	1.2%
Kenton County	165,012	1.03	37.4%	7.6%
Pendleton County	14,408	0.05	3.3%	0.7%
KY Total	440,912	--	100%	20.6%
Ohio			**of OH Portion**	
Brown County	43,839	0.09	2.7%	2.0%
Butler	376,353	0.81	22.8%	17.4%
Clermont County	201,973	0.45	12.2%	9.4%
Hamilton County	807,598	1.99	48.8%	37.4%
Warren County	224,469	0.56	13.6%	10.4%
OH Total	1,654,232	--	100%	76.7%
Indiana			**of IN Portion**	
Dearborn County	49,455	0.16	79.0%	2.3%
Ohio County	5,938	0.07	9.5%	0.3%
Union County	7,182	0.04	11.5%	0.3%
IN Total	62,575	--	100%	2.9%
Total Estimated Population	2,157,719	--	100%	100%

*U.S. Census Bureau estimates.

Areas of dense population and high VMT can display elevated nonpoint and on-road source emissions. As seen in Tables 2 and 3, two of the sectors with the highest emission contribution are from nonpoint (VOC) and on-road (NOx). This correlation indicates that VMT and population density within Boone County may be contributing to violating monitors within the CBSA.

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Meteorological Information

Wind speed and wind direction data collected at the Cincinnati-Northern Kentucky Airport (NWS Station 93814) for the period 2013-2015 shows that the majority of the time the wind in the area came from the southwest and typically from 2.1-3.6 miles per hour (Refer to figure 1). According to Kentucky Mesonet (http://www.kymesonet.org/), the average high temperature for July for the period 2013-2015 was 90.1° F and the average low temperature for July was 53.7° F. The average July precipitation for the same period (2013-2015) was 4.63 inches.

Figure 1: Wind Rose Average 2013-2015 March 1st - October 31st

Several 48-hour back trajectory HYSPLITS for Kentucky have been included in Section 8 for days in 2013-2015 when the 8-hour ambient monitoring concentration for ozone had their highest readings. These HYSPLITS show that for the majority of the time the air column does come from the southwest which indicates that the emission levels from Boone County may be affecting the violating monitor located in Campbell County.

Geography and Topography

Boone County is part of the Cincinnati, OH-KY-IN CBSA and has a land area of 246 square miles. Located on the banks of the Ohio River, Boone County lies to the west of Kenton County, to the north of Grant County, to the northeast of Gallatin County, and to the southwest of Cincinnati, Ohio. The lowest elevation is 455 feet, the normal pool level of the Ohio River. Maximum local relief, 435 feet, is at the

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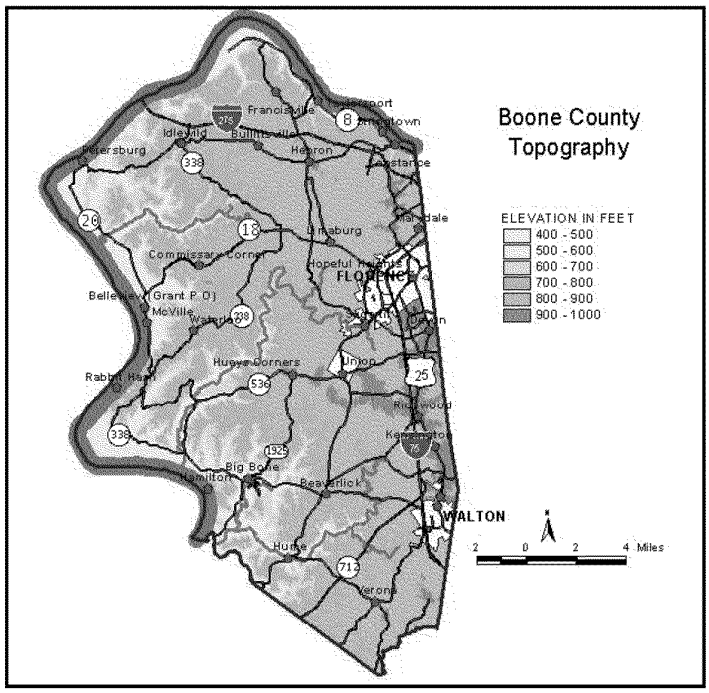
bluffs and steep slopes of the Ohio River at Constance. Local reliefs of 300 to 400 feet are found elsewhere along the Ohio. The highest elevation (greater than 964 feet) appears to be on a ridge midway between Walton and Kensington.

Most of the county is a moderately to deeply dissected upland of the Outer Bluegrass Region. Local relief away from the river is commonly 100 to 200 feet. Some of the ridges between tributary valleys are flat-topped, particularly in the north-central part of the county, where elevations range from 800 to 900 feet. Many of these areas are the sites of local development, such as the Greater Cincinnati-Northern Kentucky Airport.

Boone County does not have any geographical or topographical distinctions that interfere with air pollution transport. Therefore, this factor is not a significant part of the overall analysis.

Figure 2: Boone County Topography



Jurisdictional Boundaries

The authority for air quality planning in the Boone County area resides with the Kentucky Energy and Environment Cabinet. Transportation planning for Boone County is performed by the Ohio, Kentucky, and Indiana Regional Council of Governments (OKI). Historically, portions of Boone, Campbell, and Kenton counties have been designated as nonattainment. These Kentucky counties along with Butler, Clermont, Clinton, Hamilton, Warren, Ohio and Dearborn, Indiana were designated nonattainment for the 1997 and 2008 ozone standards. The 2008 ozone standard nonattainment area was confined to specific census tracts in the northern part of Boone, Campbell and Kenton counties.

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Conclusion and Recommendation

Boone County, based on 2013-2015 ozone monitoring data, is meeting the 8-hour ozone standard with a 3-year average of 0.061 parts per million.

As seen in Table 9, Boone County's VOC and NOx emissions are relatively less than other counties located within the Cincinnati, OH-KY-IN CBSA. Boone County contributes approximately:

- 7.1% of the total VOC emissions
- 7.5% of the total NO_x emissions

Table 9
VOC and NO_x Percentages for
Cincinnati, OH-KY-IN CBSA (2011 NEI)

County	VOC %	NO_X %
KENTUCKY		
Boone	7.1	7.5
Bracken	2.9	0.7
Campbell	3.8	2.3
Gallatin	2.3	1.6
Grant	4.0	1.9
Kenton	5.3	4.3
Pendleton	3.6	1.6
KY Total	**29.0%**	**19.9%**
OHIO		
Brown	5.7	1.7
Butler	12.9	12.9
Clermont	9.1	19.2
Hamilton	25.0	31.6
Warren	8.6	6.4
OH Total	**61.3%**	**71.8**
INDIANA		
Dearborn	6.1	7.6
Ohio	1.8	0.2
Union	1.8	0.5
IN Total	**9.7%**	**8.3%**
Total Emissions %	**100.0%**	**100.0%**

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The ozone monitor in Boone County is attaining the 2015 8-hour ozone NAAQS. There are no distinguishable geographical or topographical elements that would affect VOC or NOx levels. The emission contributions from Boone County are not as significant as other areas within the CBSA. The dominating factors that influence Boone County's contribution to the violating monitor within the area involve population, VMT and commuting traffic. Figure 3 shows 2010 Census Tracts for Boone County. Data gathered from EPA's Ozone Mapping Tool was used to analyze which portions of Boone County could be contributing to the violating monitor in Campbell County based on high population areas. Although Boone County does not have the highest population within the CBSA, the significant VMT levels along with commuting patterns suggest that there is a large urban population that leads to increased on-road and nonpoint source emissions. Due to the wind direction coming from the southwest the majority of the time, the emissions from Boone may be contributing to the violating monitor in Campbell County, KY. Therefore, it is suggested that a portion of Boone County be designated as "nonattainment" for the 2015 8-hour ozone NAAQS. Specifically, the following census tracts within Boone County should be designated as nonattainment: 702, 703.01, 703.04, 703.05, 703.06, 703.07, 703.08, 703.09, 704.01, 704.02, 705.01, 705.02, and 706.03.

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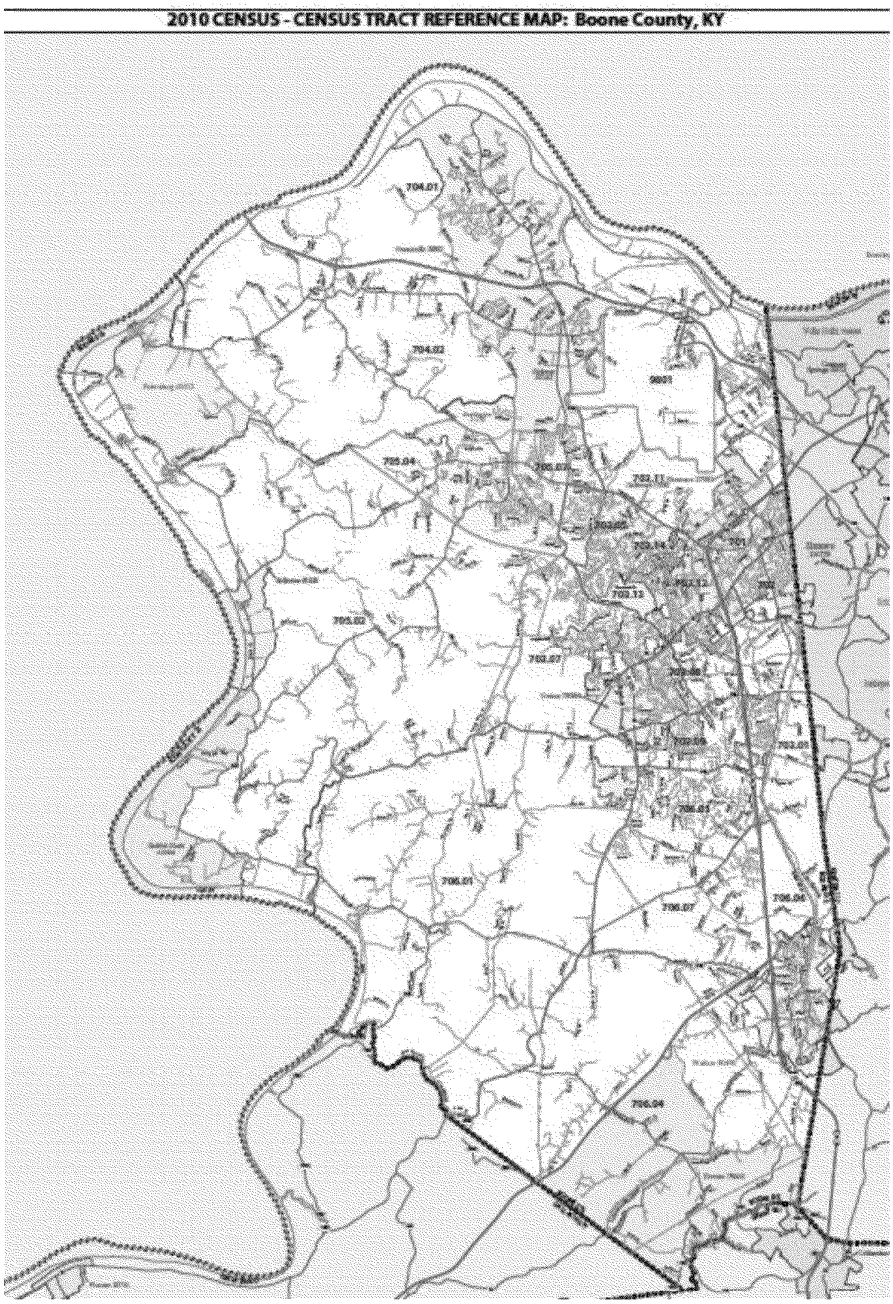
Figure 3: 2010 Census Tracts for Boone County, KY



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Bracken County, KY

Air Quality

Pursuant to 40 CFR 50:19 (b) and (d) the 8-hour primary and secondary NAAQS are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, as determined in accordance with Appendix U of Part 50. Currently, there is no ozone monitor located in Bracken County.

Ozone air monitoring data and design values for 2013-2015 for the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA) were retrieved from https://www.epa.gov/air-trends/air-quality-design-values#report. Per the EPA website, "The design values shown here are computed using Federal Reference Method or equivalent data reported by State, Tribal, and Local monitoring agencies to EPA's Air Quality System (AQS) as of June 24, 2016." Table 1 provides a summary of the annual fourth-highest daily maximum 8-hour average ozone concentrations recorded at monitors located in the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA), for 2013-2015. Not all counties in the Cincinnati, OH-KY-IN CBSA have monitors for ozone. Monitor values included in Table 1 only reflect those monitors that were operational during the 2013 to 2015 design value period. Only the monitor in Campbell County, KY indicates a design value above the revised ozone NAAQS for the CBSA.

Table 1
Cincinnati, OH-KY-IN CBSA
3-year Average* of Annual 8-hour concentrations for Ozone

County/Site	AQS Code	Annual 4th High (ppm)			Design Value (ppm)
		2013	2014	2015	
Kentucky					
Boone	21-015-0003	0.059	0.062	0.062	0.061
Campbell	21-037-3002	0.072	0.071	0.071	0.071
Ohio					
Butler	39-017-0004	0.068	0.070	0.070	0.069
Butler	39-017-0018	0.068	0.069	0.070	0.069
Butler	39-017-9991	0.069	0.069	0.068	0.068
Clermont	39-025-0022	0.066	0.068	0.070	0.068
Hamilton	39-061-0006	0.069	0.070	0.072	0.070
Hamilton	39-061-0010	0.064	0.073	0.070	0.069
Hamilton	39-061-0040	0.069	0.069	0.071	0.069
Warren	39-165-0007	0.067	0.071	0.071	0.069

*NAAQS 8-hour (3 year average of the 4th max value). 0.070ppm
n/a indicates no monitor data for that county.

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Emissions and Emissions-Related Data

The U.S. EPA requires an emissions inventory to be developed in order to identify the level of emissions in a specific area and adjacent regions that may have contributed to an ozone violation. The EPA Ozone Designations Mapping Tool was used to obtain 2011 NEI v2 emissions inventory data. The 2011 NEI v2 is the latest available national emissions inventory data and is the source of the point, non-point, on-road, non-road and event emissions, and was used to evaluate Bracken County's impact on the violating monitor. VOC and NOx emissions, by category, are provided in Tables 2 and 3.

Table 2
2011 NEI VOC Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	VOC (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	1019.03	3708.82	1156.27	960.74	210.59	**7055.45**
Bracken	13.41	2604.87	143.77	98.86	0.0	**2860.91**
Campbell	160.58	2658.31	785.96	260.64	0.0	**3865.49**
Gallatin	87.39	1872.80	230.24	95.01	49.75	**2335.19**
Grant	79.78	3246.13	422.24	239.93	2.86	**3990.94**
Kenton	232.80	3289.76	1405.33	418.90	0.0	**5346.79**
Pendleton	127.59	3137.17	227.50	44.20	80.48	**3616.94**
KY Total	**1720.58**	**20517.86**	**4371.31**	**2118.28**	**343.68**	**29071.71**
INDIANA						
Dearborn	1573.32	3500.17	752.90	152.55	144.58	**6123.52**
Ohio	0.01	1571.07	111.12	30.63	46.31	**1759.14**
Union	0.00	1500.88	127.38	218.28	0.00	**1846.54**
IN Total	**1573.33**	**6572.12**	**991.40**	**401.46**	**190.89**	**9729.20**
OHIO						
Brown	28.90	4558.87	969.87	111.49	24.69	**5693.82**
Butler	1146.62	6081.24	4556.78	1076.33	0.0	**12860.97**
Clermont	180.86	5500.53	2654.57	719.53	0.0	**9055.49**
Hamilton	978.46	10759.16	10490.15	2734.21	0.0	**24961.98**
Warren	262.03	4760.18	2741.38	812.53	0.0	**8576.12**
OH Total	**2596.87**	**31659.98**	**21412.75**	**5454.09**	**24.69**	**61148.38**
Total Emissions	**5890.78**	**58749.96**	**26775.46**	**7973.83**	**559.26**	**99949.29**

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Table 3
2011 NEI NO_x Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	NOx (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	3569.19	801.83	3455.45	682.30	21.32	**8530.09**
Bracken	3.72	469.43	267.93	72.38	0.0	**813.46**
Campbell	82.95	666.79	1583.28	247.83	0.0	**2580.85**
Gallatin	609.76	357.34	832.85	42.53	5.00	**1847.48**
Grant	13.00	510.39	1590.13	96.12	0.28	**2209.92**
Kenton	147.17	818.13	3449.61	521.34	0.0	**4936.25**
Pendleton	949.22	350.98	385.47	77.48	7.90	**1771.05**
KY Total	**5375.01**	**3974.89**	**11564.72**	**1739.98**	**34.50**	**22689.10**
INDIANA						
Dearborn	6530.65	296.72	1610.93	196.33	6.62	**8641.25**
Ohio	0.00	76.65	164.59	28.77	2.75	**272.76**
Union	0.00	190.63	226.35	135.37	0.00	**552.35**
IN Total	**6530.65**	**564.00**	**2001.87**	**360.47**	**9.37**	**9466.36**
OHIO						
Brown	4.40	383.53	1288.36	254.07	2.39	**1932.75**
Butler	3989.32	1962.75	7108.70	1569.52	0.0	**14630.29**
Clermont	16000.81	592.15	4374.25	833.68	0.0	**21800.89**
Hamilton	9664.54	3798.10	19232.85	3145.46	0.0	**35840.95**
Warren	569.13	799.42	4743.52	1189.90	0.0	**7301.97**
OH Total	**30228.20**	**7535.95**	**36747.68**	**6992.63**	**2.39**	**81506.85**
Total Emissions	**42133.86**	**12074.84**	**50314.27**	**9093.08**	**46.26**	**113662.31**

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Table 4
VOC Emissions as % of Total VOC Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	16.6	17.5	39.4	35.3	**25.4**
Butler, OH	19.5	9.9	17.1	13.9	**13.1**
Clermont, OH	3.1	8.9	10.0	9.3	**9.2**
Warren, OH	4.4	7.7	10.3	10.5	**8.7**
Boone, KY	17.3	6.5	4.3	12.4	**7.2**
Dearborn, IN	27.0	5.7	2.8	2.0	**6.2**
Brown, OH	0.5	7.4	3.6	1.4	**5.8**
Kenton, KY	4.0	5.7	5.3	5.4	**5.5**
Grant, KY	1.4	5.3	1.6	3.1	**4.1**
Campbell, KY	2.7	4.3	2.9	3.4	**3.9**
Pendleton, KY	2.2	5.1	0.9	0.6	**3.7**
Bracken, KY	0.2	4.6	0.5	1.3	**2.9**
Gallatin, KY	1.5	3.3	0.9	1.2	**2.4**
Ohio. IN	0.0	2.6	0.4	0.4	**1.8**
Union, IN	0.0	2.6	0.5	2.7	**1.8**

Table 5
NOx Emissions as % of Total NOx Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	22.9	32.0	38.4	35.1	**31.4**
Clermont, OH	38.0	5.0	8.7	9.3	**19.1**
Butler, OH	9.5	16.5	14.2	17.5	**12.8**
Dearborn, IN	15.5	2.5	3.2	2.2	**7.6**
Boone, KY	8.5	6.7	6.9	7.6	**7.5**
Warren, OH	1.4	6.7	9.5	13.3	**6.4**
Kenton, KY	0.4	6.9	6.9	5.8	**4.3**
Campbell, KY	0.2	5.6	3.2	2.8	**2.3**
Grant, KY	3.1	4.3	3.2	1.1	**1.9**
Brown, OH	0.0	3.2	2.6	2.8	**1.7**
Gallatin, KY	1.4	3.0	1.7	0.5	**1.6**
Pendleton, KY	2.3	3.0	0.8	0.9	**1.5**
Bracken, KY	0.0	4.0	0.5	0.8	**0.7**
Union, IN	0.0	0.8	1.5	1.5	**0.5**
Ohio. IN	0.0	0.6	0.3	0.3	**0.2**

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Point Sources

Table 2 indicates 2011 point source emissions of VOC in Bracken County were 13.41 tpy. Total VOC point source emissions from the Cincinnati, OH-KY-IN CBSA were 5,890.78 tpy. Bracken County only accounts for approximately 0.2% of the total VOC point source emissions in the CBSA. Table 4 shows the percentages of VOC emissions for point sources in the CBSA, by county.

As seen in Table 3, point source emissions of NO_x in Bracken County were estimated to be 3.72 tpy in 2011, which represents 0.01% of the total 42,133.86 tpy of the overall NO_x point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for point sources in the CBSA, by county.

Non-Point (Area) Emissions

Table 2 shows that non-point (or "area") VOC emissions in Bracken County were estimated to be 2,604.87 tpy for 2011, which represents approximately 4.6% of the total 57,249.08 tpy of the overall VOC non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-point sources in the CBSA, by county.

As seen in Table 3, non-point NOx emissions from Bracken County were estimated at 469.43 tpy in 2011, which represents approximately 4.0% of the total 11,884.21 tpy of the overall NOx non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NOx emissions for non-point sources in the CBSA, by county.

On-Road Mobile

As indicated in Table 2, on-road mobile source VOC emissions from Bracken County were estimated to be 143.77 tpy in 2011, which represents approximately 0.5% of the total 26,648.08 tpy of the overall VOC on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for on-road mobile sources in the CBSA, by county.

As seen in Table 3, on-road mobile source NO_x emissions from Bracken County were estimated at 267.93 tpy in 2011, which represents approximately 0.5% of the total 50,087.92 tpy of the overall NO_x on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for on-road mobile sources in the CBSA, by county.

Based on 2014 information obtained from the U.S Census Website, http://onthemap.ces.gov, the commuting traffic from other counties into Bracken County is 49.7%, while the commuting traffic from Bracken County into other counties is 72.6%.

Table 6 below provides Vehicle Miles Travelled (VMT) for all areas within the Cincinnati, OH-KY-IN CBSA for the year 2011. The counties within the Ohio portion of the CBSA contribute to the majority of VMT within the CBSA. Bracken County's VMT is significantly lower compared to other counties within the CBSA.

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Table 6
2011 VMT Totals, Cincinnati, OH-KY-IN CBSA

	2011 VMT Totals
Kentucky	
Boone County	1,558,794,112
Bracken County	104,160,119
Campbell County	1,010,009,434
Gallatin County	245,765,593
Grant County	529,145,674
Kenton County	1,720,886,038
Pendleton County	184,074,537
KY Total	5,352,835,507
Ohio	
Brown County	468,171,663
Butler County	3,099,030,997
Clermont County	1,951,343,156
Hamilton County	9,004,357,566
Warren County	2,139,774,797
OH Total	16,662,678,179
Indiana	
Dearborn County	690,348,611
Ohio County	71,591,617
Union County	105,444,221
IN Total	867,384,449
Total VMT for CBSA	22,882,898,135

Non-Road Mobile Sources

As listed in Table 2, non-road mobile source VOC emissions from Bracken County were estimated at 98.86 tpy in 2011, which represents approximately 1.3% of the total 7,755.55 tpy of the overall VOC non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-road mobile sources in the CBSA, by county.

As seen in Table 3, non-road mobile source NO_x emissions from Bracken County were estimated at 72.38 tpy in 2011, which represents approximately 0.8% of the total 8,957.71 tpy of the overall NO_x non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for non-road mobile sources in the CBSA, by county.

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Comparison of Total Emissions

A comparison of total emissions across the entire Cincinnati, OH-KY-IN CBSA was performed using data from the EPA Ozone Designations Mapping Tool. The percentages shown in last column in both Tables 4 and 5 demonstrate that the majority of VOC and NOx emissions within the Cincinnati, OH-KY-IN CBSA come from the Ohio portion of the CBSA.

Population

Based on U.S. Census Bureau estimates for 2015, there are 8,321 persons living in Bracken County (Refer to Table 7). This represents approximately 40.99 persons per square mile. The population of Bracken County is approximately 100% rural with few people living in incorporated areas. The largest cities in Bracken County are Augusta and Brooksville.

Bracken County's population from 2010 to 2015 *decreased* by 2.0% (8,488 to 8,321). For the entire Cincinnati, OH-KY-IN CBSA, Bracken County represents approximately 0.4% of the total population in the CBSA and 1.9% of the Kentucky portion of the CBSA (Refer to table 8).

Table 7
Northern Kentucky Area Population
Growth Data

County	Census 2010	2015*	%Growth 2010 - 2015
Boone	118,811	127,712	7.5%
Bracken	8,488	8,321	-2.0%
Campbell	90,336	92,066	1.9%
Gallatin	8,589	8,636	0.5%
Grant	24,662	24,757	0.4%
Kenton	159,720	165,012	3.3%
Pendleton	14,877	14,408	-3.1%

*U.S. Census Bureau estimates.

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Table 8
2015 Population
Cincinnati, OH-KY-IN CBSA

CBSA Estimated Population	2015*	2015 Population Density (1,000 per square mile)	% of Total	
Kentucky			**of KY Portion**	**of CBSA**
Boone County	127,712	0.52	29.0%	5.9%
Bracken County	8,321	0.04	1.9%	0.5%
Campbell County	92,066	0.61	20.9%	4.3%
Gallatin County	8,636	0.09	2.0%	0.4%
Grant County	24,757	0.10	5.6%	1.2%
Kenton County	165,012	1.03	37.4%	7.6%
Pendleton County	14,408	0.05	3.3%	0.7%
KY Total	440,912	--	100%	20.6%
Ohio			**of OH Portion**	
Brown County	43,839	0.09	2.7%	2.0%
Butler	376,353	0.81	22.8%	17.4%
Clermont County	201,973	0.45	12.2%	9.4%
Hamilton County	807,598	1.99	48.8%	37.4%
Warren County	224,469	0.56	13.6%	10.4%
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IN Total	62,575	--	100%	2.9%
Total Estimated Population	2,157,719	--	100%	100%

*U.S. Census Bureau estimates.

Areas of dense population and high VMT can display elevated nonpoint and on-road source emissions. As seen in Tables 2 and 3, two of the sectors with the highest emission contribution are from nonpoint for both VOC and NOx. However, Bracken County emissions are significantly lower compared to other areas within the CBSA.

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Meteorological Information

Wind speed and wind direction data collected at the Cincinnati-Northern Kentucky Airport (NWS Station 93814) for the period 2013-2015 shows that the majority of the time the wind in the area came from the southwest and typically from 2.1-3.6 miles per hour (Refer to figure 1). According to Kentucky Mesonet (http://www.kymesonet.org/), the average high temperature for July for the period 2013-2015 was 91.9° F and the average low temperature for July was 55.5° F. The average July precipitation for the same period (2013-2015) was 4.65 inches.

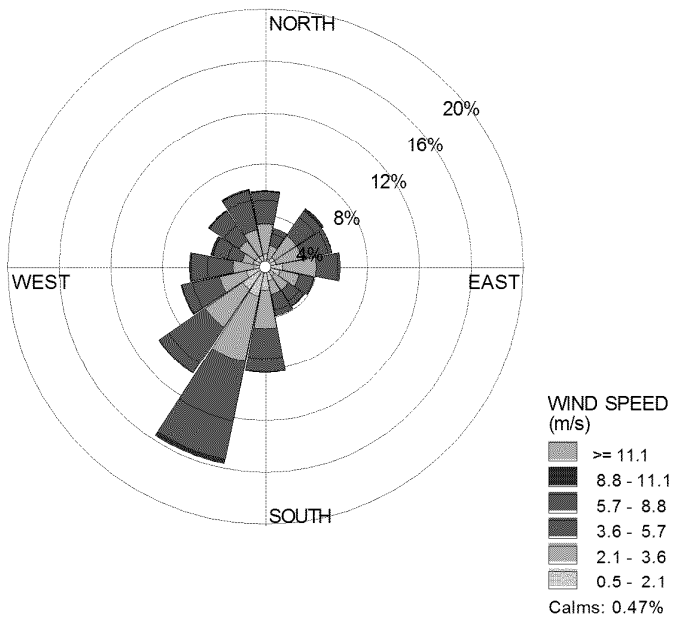

Figure 1: Wind Rose Average 2013-2015 March 1st - October 31st

Several 48-hour back trajectory HYSPLITS for Kentucky have been included in Section 8 for days in 2013-2015 when the 8-hour ambient monitoring concentration for ozone had their highest readings. As seen in the HYSPLITS, the position of Bracken County relative to Campbell County, along with predominant winds being from the southwest, show that Bracken County is not impacting the violating monitor in Campbell County.

Geography and Topography

Bracken County is part of the Cincinnati, OH-KY-IN CBSA and has a land area of 203 square miles. Located on the banks of the Ohio River, Bracken County lies to the east of Pendleton County, west of Mason County, north of Robertson County, and south of Clermont County, Ohio. The lowest point in Bracken County is 455 feet. Floodplains along the river are narrow to nonexistent with elevations

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ranging from 490 to 510 feet. The highest elevations (940 to 980) in the county are found along the drainage divide between Licking River and the small creeks that flow directly into the Ohio River.

Figure 2 shows the topography of Bracken County. Bracken County does not have any geographical or topographical distinctions that interfere with air pollution transport. Therefore, this factor is not a significant part of the overall analysis.

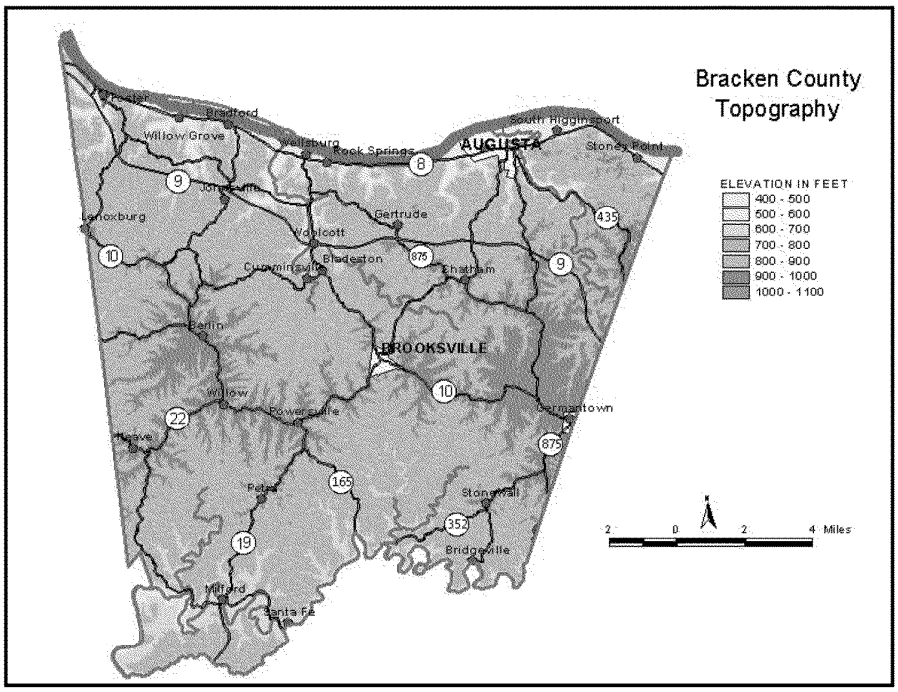

Figure 2: Bracken County Topography

Jurisdictional Boundaries

The authority for air quality planning in the Bracken County area resides with the Kentucky Energy and Environment Cabinet. Transportation planning for Bracken County is performed by the Kentucky Transportation Cabinet. Historically, portions of Boone, Campbell, and Kenton counties have been designated as nonattainment. These Kentucky counties along with Butler, Clermont, Clinton, Hamilton, Warren, Ohio and Dearborn, Indiana were designated nonattainment for the 1997 and 2008 ozone standards. The 2008 ozone standard nonattainment area was confined to specific census tracts in the northern part of Boone, Campbell and Kenton counties.

Conclusion and Recommendation

There were no ozone monitors located in Bracken County for the 2013-2015 monitoring period.

As seen in Table 9, Bracken County's VOC and NOx emissions are minimal, especially when compared to other counties located within the Cincinnati, OH-KY-IN CBSA. Bracken County contributes approximately:

- 2.9% of the total VOC emissions
- 0.7% of the total NO_x emissions

The emissions from Bracken are negligible and do not significantly contribute to the 8-hour ozone standard in the Cincinnati, OH-KY-IN CBSA.

Table 9
VOC and NO_x Percentages for
Cincinnati, OH-KY-IN CBSA (2011 NEI)

County	VOC %	NO_X %
KENTUCKY		
Boone	7.1	7.5
Bracken	2.9	0.7
Campbell	3.8	2.3
Gallatin	2.3	1.6
Grant	4.0	1.9
Kenton	5.3	4.3
Pendleton	3.6	1.6
KY Total	**29.0%**	**19.9%**
OHIO		
Brown	5.7	1.7
Butler	12.9	12.9
Clermont	9.1	19.2
Hamilton	25.0	31.6
Warren	8.6	6.4
OH Total	**61.3%**	**71.8**
INDIANA		
Dearborn	6.1	7.6
Ohio	1.8	0.2
Union	1.8	0.5
IN Total	**9.7%**	**8.3%**
Total Emissions %	**100.0%**	**100.0%**

Data gathered for Bracken County and reviewed using EPA's five factor analysis demonstrates that Bracken County is not contributing to the violating monitor in Campbell County. Therefore, Kentucky recommends that Bracken County be designated as "unclassifiable/attainment" for the 2015 8-hour ozone NAAQS.

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Campbell County, KY

Air Quality

Pursuant to 40 CFR 50:19 (b) and (d) the 8-hour primary and secondary NAAQS are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, as determined in accordance with Appendix U of Part 50. The ozone monitor for Campbell County (AQS ID: 21-037-3002) recorded a 3-year average from 2013-2015 of 0.071 ppm. The 8-Hour Ozone National Ambient Air Quality Standard (NAAQS) is set at a level of 0.070 ppm, showing this county is in violation of the standard.

Table 1 provides a summary of the annual fourth-highest daily maximum 8-hour average ozone concentrations recorded at monitors located in the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA), for 2013-2015. Not all counties in the Cincinnati, OH-KY-IN CBSA have monitors for ozone. Monitor values included in Table 1 only reflect those monitors that were operational during the 2013 to 2015 design value period. Only the monitor in Campbell County, KY indicates a design value above the revised ozone NAAQS for the CBSA.

Table 1
Cincinnati, OH-KY-IN CBSA
3-year Average* of Annual 8-hour concentration for Ozone

County/Site	AQS Code	Annual 4th High (ppm)			Design Value (ppm)
		2013	2014	2015	
Kentucky					
Boone	21-015-0003	0.059	0.062	0.062	0.061
Campbell	21-037-3002	0.072	0.071	0.071	0.071
Ohio					
Butler	39-017-0004	0.068	0.070	0.070	0.069
Butler	39-017-0018	0.068	0.069	0.070	0.069
Butler	39-017-9991	0.069	0.069	0.068	0.068
Clermont	39-025-0022	0.066	0.068	0.070	0.068
Hamilton	39-061-0006	0.069	0.070	0.072	0.070
Hamilton	39-061-0010	0.064	0.073	0.070	0.069
Hamilton	39-061-0040	0.069	0.069	0.071	0.069
Warren	39-165-0007	0.067	0.071	0.071	0.069

*NAAQS 8-hour (3 year average of the 4th max value). 0.070ppm
n/a indicates no monitor data for that county.

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Emissions and Emissions-Related Data

The U.S. EPA requires an emissions inventory to be developed in order to identify the level of emissions in a specific area and adjacent regions that may have contributed to an ozone violation. The EPA Ozone Designations Mapping Tool was used to obtain 2011 NEI v2 emissions inventory data. The 2011 NEI v2 is the latest available national emissions inventory data and is the source of the point, non-point, on-road, non-road and event emissions, and was used to evaluate Campbell County's impact on the violating monitor. VOC and NOx emissions, by category, are provided in Tables 2 and 3.

Table 2
2011 NEI VOC Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	VOC					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	1019.03	3708.82	1156.27	960.74	210.59	**7055.45**
Bracken	13.41	2604.87	143.77	98.86	0.0	**2860.91**
Campbell	160.58	2658.31	785.96	260.64	0.0	**3865.49**
Gallatin	87.39	1872.80	230.24	95.01	49.75	**2335.19**
Grant	79.78	3246.13	422.24	239.93	2.86	**3990.94**
Kenton	232.80	3289.76	1405.33	418.90	0.0	**5346.79**
Pendleton	127.59	3137.17	227.50	44.20	80.48	**3616.94**
KY Total	**1720.58**	**20517.86**	**4371.31**	**2118.28**	**343.68**	**29071.71**
INDIANA						
Dearborn	1573.32	3500.17	752.90	152.55	144.58	**6123.52**
Ohio	0.01	1571.07	111.12	30.63	46.31	**1759.14**
Union	0.00	1500.88	127.38	218.28	0.00	**1846.54**
IN Total	**1573.33**	**6572.12**	**991.40**	**401.46**	**190.89**	**9729.20**
OHIO						
Brown	28.90	4558.87	969.87	111.49	24.69	**5693.82**
Butler	1146.62	6081.24	4556.78	1076.33	0.0	**12860.97**
Clermont	180.86	5500.53	2654.57	719.53	0.0	**9055.49**
Hamilton	978.46	10759.16	10490.15	2734.21	0.0	**24961.98**
Warren	262.03	4760.18	2741.38	812.53	0.0	**8576.12**
OH Total	**2596.87**	**31659.98**	**21412.75**	**5454.09**	**24.69**	**61148.38**
Total Emissions	**5890.78**	**58749.96**	**26775.46**	**7973.83**	**559.26**	**99949.29**

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Table 3
2011 NEI NO_x Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	NOx					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	3569.19	801.83	3455.45	682.30	21.32	**8530.09**
Bracken	3.72	469.43	267.93	72.38	0.0	**813.46**
Campbell	82.95	666.79	1583.28	247.83	0.0	**2580.85**
Gallatin	609.76	357.34	832.85	42.53	5.00	**1847.48**
Grant	13.00	510.39	1590.13	96.12	0.28	**2209.92**
Kenton	147.17	818.13	3449.61	521.34	0.0	**4936.25**
Pendleton	949.22	350.98	385.47	77.48	7.90	**1771.05**
KY Total	**5375.01**	**3974.89**	**11564.72**	**1739.98**	**34.50**	**22689.10**
INDIANA						
Dearborn	6530.65	296.72	1610.93	196.33	6.62	**8641.25**
Ohio	0.00	76.65	164.59	28.77	2.75	**272.76**
Union	0.00	190.63	226.35	135.37	0.00	**552.35**
IN Total	**6530.65**	**564.00**	**2001.87**	**360.47**	**9.37**	**9466.36**
OHIO						
Brown	4.40	383.53	1288.36	254.07	2.39	**1932.75**
Butler	3989.32	1962.75	7108.70	1569.52	0.0	**14630.29**
Clermont	16000.81	592.15	4374.25	833.68	0.0	**21800.89**
Hamilton	9664.54	3798.10	19232.85	3145.46	0.0	**35840.95**
Warren	569.13	799.42	4743.52	1189.90	0.0	**7301.97**
OH Total	**30228.20**	**7535.95**	**36747.68**	**6992.63**	**2.39**	**81506.85**
Total Emissions	**42133.86**	**23980.5**	**50314.27**	**9093.08**	**46.26**	**113662.31**

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Table 4
VOC Emissions as % of Total VOC Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	16.6	17.5	39.4	35.3	**25.4**
Butler, OH	19.5	9.9	17.1	13.9	**13.1**
Clermont, OH	3.1	8.9	10.0	9.3	**9.2**
Warren, OH	4.4	7.7	10.3	10.5	**8.7**
Boone, KY	17.3	6.5	4.3	12.4	**7.2**
Dearborn, IN	27.0	5.7	2.8	2.0	**6.2**
Brown, OH	0.5	7.4	3.6	1.4	**5.8**
Kenton, KY	4.0	5.7	5.3	5.4	**5.5**
Grant, KY	1.4	5.3	1.6	3.1	**4.1**
Campbell, KY	2.7	4.3	2.9	3.4	**3.9**
Pendleton, KY	2.2	5.1	0.9	0.6	**3.7**
Bracken, KY	0.2	4.6	0.5	1.3	**2.9**
Gallatin, KY	1.5	3.3	0.9	1.2	**2.4**
Ohio. IN	0.0	2.6	0.4	0.4	**1.8**
Union, IN	0.0	2.6	0.5	2.7	**1.8**

Table 5
NOx Emissions as % of Total NOx Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	22.9	32.0	38.4	35.1	**31.4**
Clermont, OH	38.0	5.0	8.7	9.3	**19.1**
Butler, OH	9.5	16.5	14.2	17.5	**12.8**
Dearborn, IN	15.5	2.5	3.2	2.2	**7.6**
Boone, KY	8.5	6.7	6.9	7.6	**7.5**
Warren, OH	1.4	6.7	9.5	13.3	**6.4**
Kenton, KY	0.4	6.9	6.9	5.8	**4.3**
Campbell, KY	0.2	5.6	3.2	2.8	**2.3**
Grant, KY	3.1	4.3	3.2	1.1	**1.9**
Brown, OH	0.0	3.2	2.6	2.8	**1.7**
Gallatin, KY	1.4	3.0	1.7	0.5	**1.6**
Pendleton, KY	2.3	3.0	0.8	0.9	**1.5**
Bracken, KY	0.0	4.0	0.5	0.8	**0.7**
Union, IN	0.0	0.8	1.5	1.5	**0.5**
Ohio. IN	0.0	0.6	0.3	0.3	**0.2**

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Point Sources

Table 2 indicates 2011 point source emissions of VOC in Campbell County were 160.58 tpy. Total VOC point source emissions from the Cincinnati, OH-KY-IN CBSA were 5,890.78 tpy. Campbell County only accounts for approximately 2.7% of the total VOC point source emissions in the CBSA. Table 4 shows the percentages of VOC emissions for point sources in the CBSA, by county.

As seen in Table 3, point source emissions of NO_x in Campbell County were estimated to be 82.95 tpy in 2011, which represents 0.2% of the total 42,133.86 tpy of the overall NO_x point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for point sources in the CBSA, by county.

Non-Point (Area) Emissions

Table 2 shows that non-point (or "area") VOC emissions in Campbell County were estimated to be 2,658.31 tpy for 2011, which represents approximately 4.6% of the total 57,249.08 tpy of the overall VOC non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-point sources in the CBSA, by county.

As seen in Table 3, non-point NOx emissions from Campbell County were estimated at 666.79 tpy in 2011, which represents approximately 5.6% of the total 11,884.21 tpy of the overall NOx non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NOx emissions for non-point sources in the CBSA, by county.

On-Road Mobile

As indicated in Table 2, on-road mobile source VOC emissions from Campbell County were estimated to be 785.96 tpy in 2011, which represents approximately 2.9% of the total 26,648.08 tpy of the overall VOC on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for on-road mobile sources in the CBSA, by county.

As seen in Table 3, on-road mobile source NO_x emissions from Campbell County were estimated at 1,583.28 tpy in 2011, which represents approximately 3.2% of the total 50,087.92 tpy of the overall NO_x on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for on-road mobile sources in the CBSA, by county.

Based on 2014 information obtained from the U.S. Census website, http://onthemap.ces.census.gov/, the commuting traffic from other counties into Campbell County is 65.9% while the commuting traffic from Campbell County into other counties is 78.0%.

Table 6 below provides Vehicle Miles Travelled (VMT) for all areas within the Cincinnati, OH-KY-IN CBSA for the year 2011. The counties within the Ohio portion of the CBSA contribute to the majority of VMT within the CBSA. Although Campbell County is not the main contributor to VMT, it does

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contribute a significant number of VMT within the CBSA. High VMT is associated with urban areas and linked with motor vehicle emissions that may contribute to ozone formation.

Table 6
2011 VMT Totals, Cincinnati, OH-KY-IN CBSA

	2011 VMT Totals
Kentucky	
Boone County	1,558,794,112
Bracken County	104,160,119
Campbell County	1,010,009,434
Gallatin County	245,765,593
Grant County	529,145,674
Kenton County	1,720,886,038
Pendleton County	184,074,537
KY Total	5,352,835,507
Ohio	
Brown County	468,171,663
Butler County	3,099,030,997
Clermont County	1,951,343,156
Hamilton County	9,004,357,566
Warren County	2,139,774,797
OH Total	16,662,678,179
Indiana	
Dearborn County	690,348,611
Ohio County	71,591,617
Union County	105,444,221
IN Total	867,384,449
Total VMT for CBSA	22,882,898,135

Non-Road Mobile Sources

As listed in Table 2, non-road mobile source VOC emissions from Campbell County were estimated at 260.64 tpy in 2011, which represents approximately 3.4% of the total 7,755.55 tpy of the overall VOC non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-road mobile sources in the CBSA, by county.

As seen in Table 3, non-road mobile source NO_x emissions from Campbell County were estimated at 247.83 tpy in 2011, which represents approximately 2.8% of the total 8,957.71 tpy of the overall NO_x non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for non-road mobile sources in the CBSA, by county.

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Comparison of Total Emissions

A comparison of total emissions across the entire Cincinnati, OH-KY-IN CBSA was performed using data from the Ozone Designations Mapping Tool. The percentages shown in last column in both Tables 4 and 5 demonstrate that the majority of VOC and NOx emissions within the Cincinnati, OH-KY-IN CBSA come from the Ohio portion of the CBSA.

Population

Based on U.S. Census Bureau estimates for 2015, there are 92,066 persons living in Campbell County (Refer to Table 7). This represents approximately 597 persons per square mile. The population of Campbell County is approximately 15.3% rural with the remaining 84.7% living in incorporated areas. The largest cities in Campbell County are Newport and Ft. Thomas.

Campbell County's population from 2010 to 2015 *increased* by 1.9% (90,336 to 92,066). For the entire Cincinnati, OH-KY-IN CBSA, Campbell County represents approximately 4.2% of the total population in the CBSA and 20.9% of the Kentucky portion of the CBSA (Refer to Table 8).

Table 7
Northern Kentucky Area Population
Growth Data

County	Census 2010	2015*	%Growth 2010 - 2015
Boone	118,811	127,712	7.5%
Bracken	8,488	8,321	-2.0%
Campbell	90,336	92,066	1.9%
Gallatin	8,589	8,636	0.5%
Grant	24,662	24,757	0.4%
Kenton	159,720	165,012	3.3%
Pendleton	14,877	14,408	-3.1%

*U.S. Census Bureau estimates.

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Table 8
2015 Population
Cincinnati, OH-KY-IN CBSA

CBSA Estimated Population	2015*	2015 Population Density (1,000 per square mile)	% of Total	
Kentucky			**of KY Portion**	**of CBSA**
Boone County	127,712	0.52	29.0%	5.9%
Bracken County	8,321	0.04	1.9%	0.5%
Campbell County	92,066	0.61	20.9%	4.3%
Gallatin County	8,636	0.09	2.0%	0.4%
Grant County	24,757	0.10	5.6%	1.2%
Kenton County	165,012	1.03	37.4%	7.6%
Pendleton County	14,408	0.05	3.3%	0.7%
KY Total	440,912	--	100%	20.6%
Ohio			**of OH Portion**	
Brown County	43,839	0.09	2.7%	2.0%
Butler	376,353	0.81	22.8%	17.4%
Clermont County	201,973	0.45	12.2%	9.4%
Hamilton County	807,598	1.99	48.8%	37.4%
Warren County	224,469	0.56	13.6%	10.4%
OH Total	1,654,232	--	100%	76.7%
Indiana			**of IN Portion**	
Dearborn County	49,455	0.16	79.0%	2.3%
Ohio County	5,938	0.07	9.5%	0.3%
Union County	7,182	0.04	11.5%	0.3%
IN Total	62,575	--	100%	2.9%
Total Estimated Population	2,157,719	--	100%	100%

*U.S. Census Bureau estimates.

Areas of dense population and high VMT can display elevated nonpoint and on-road source emissions. As seen in Tables 2 and 3, two of the sectors with the highest emission contribution are from nonpoint (VOC) and on-road (NOx). This correlation indicates that VMT and population density within Campbell County may be contributing to violating monitors within the CBSA.

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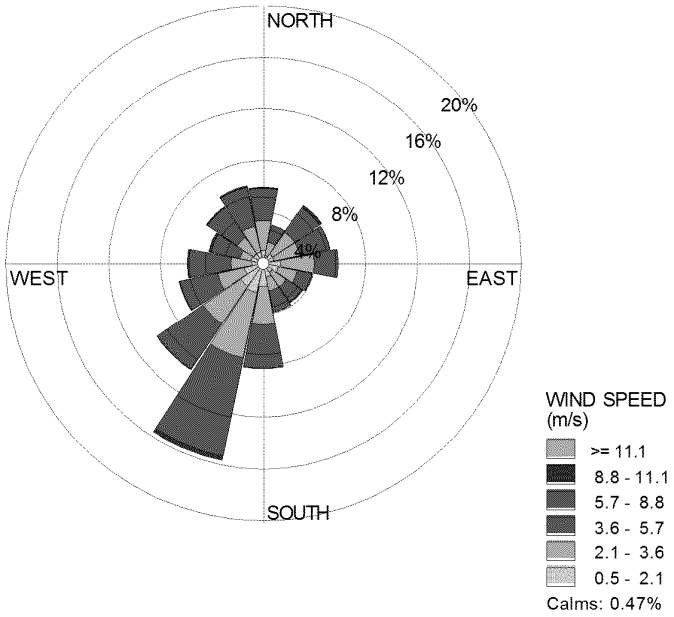
Meteorological Information

Wind speed and wind direction data collected at the Cincinnati-Northern Kentucky Airport (NWS Station 93814) for the period 2013-2015 shows that the majority of the time the wind in the area came from the southwest and typically from 2.1-3.6 miles per hour (Refer to Figure 1). According to Kentucky Mesonet (http://www.kymesonet.org/), the average high temperature for July for the period 2013-2015 was 91.9° F and the average low temperature for July was 55.5° F. The average July precipitation for the same period (2013-2015) was 4.7 inches.

Figure 1: Wind Rose Average 2013-2015 March 1st - October 31st



Several 48-hour back trajectory HYSPLITS for Kentucky have been included in section 8 for days in 2013-2015 when the 8-hour ambient monitoring concentration for ozone had their highest readings. These HYSPLITS show which direction the air column is coming from for the majority of the time and what areas may be affecting the violating monitor within Campbell County.

Geography and Topography

Campbell County is part of the Cincinnati, OH-KY-IN Metropolitan Statistical Area (CBSA) and has a land area of 151 square miles. Located on the banks of the Ohio River, Campbell County lies to the east of Kenton County, Kentucky, to the north of Pendleton County, Kentucky and to the southeast of Cincinnati, Ohio.

The area is bound by the Ohio River to the east and north and the Licking River to the west. Flat areas are small and relatively scarce. The community elevations are as follows: Alexandria is the county seat

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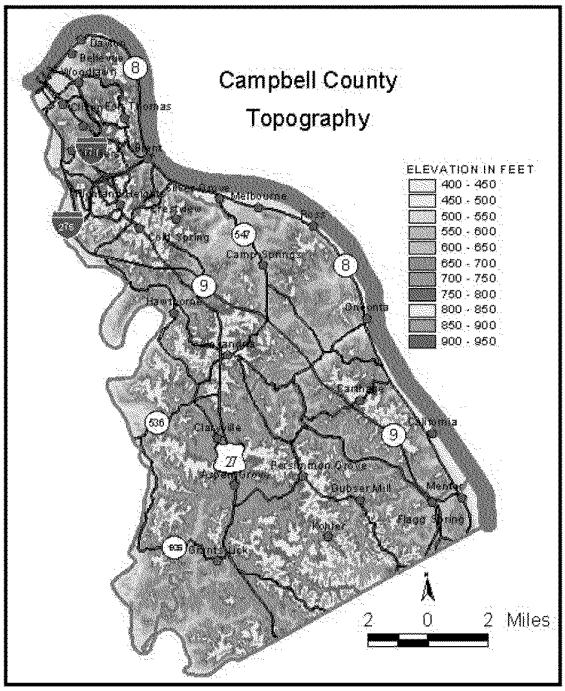
at 823 feet; Bellevue, 545 feet; Dayton, 515 feet; Fort Thomas, 810 feet and Newport, 514 feet. The highest elevation in the county is 920 feet, located at a ridge that sits on the divide of the Ohio and Licking Rivers at the county's southern boundary. The lowest elevation is 455 feet, where the Ohio and Licking Rivers are conjunct.

Campbell County does not have any geographical or topographical distinctions that interfere with air pollution transport. Therefore, this factor is not a significant part of the overall analysis.

Figure 2: Campbell County Topography Map



Jurisdictional Boundaries

The authority for air quality planning in the Campbell County area resides with the Kentucky Energy and Environment Cabinet. Transportation planning for Campbell County is performed by the Ohio, Kentucky, and Indiana Regional Council of Governments (OKI). Historically, portions of Boone, Campbell, and Kenton counties have been designated as nonattainment. These Kentucky counties along with Butler, Clermont, Clinton, Hamilton, Warren, Ohio, and Dearborn, Indiana were designated nonattainment for the 1997 and 2008 ozone standards. The 2008 ozone standard nonattainment area was confined to specific census tracts in the northern part of Boone, Campbell and Kenton counties.

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Conclusion and Recommendation

A three-year-average (2013-2015) of 0.071 parts per million shows Campbell County is in violation of the 8-hour ozone standard.

As seen in Table 9, Campbell County's VOC and NOx emissions are relatively less than other counties located within the Cincinnati, OH-KY-IN CBSA. Campbell County contributes approximately:

- 3.9% of the total VOC emissions
- 2.3% of the total NO_x emissions

The emissions from Campbell do not significantly contribute to the ozone violations of the 8-hour standard in the Cincinnati, OH-KY-IN CBSA.

Table 9
VOC and NO_x Percentages for
Cincinnati, OH-KY-IN CBSA (2011 NEI)

County	VOC %	NO_X %
KENTUCKY		
Boone	7.1	7.5
Bracken	2.9	0.7
Campbell	3.8	2.3
Gallatin	2.3	1.6
Grant	4.0	1.9
Kenton	5.3	4.3
Pendleton	3.6	1.6
KY Total	**29.0%**	**19.9%**
OHIO		
Brown	5.7	1.7
Butler	12.9	12.9
Clermont	9.1	19.2
Hamilton	25.0	31.6
Warren	8.6	6.4
OH Total	**61.3%**	**71.8**
INDIANA		
Dearborn	6.1	7.6
Ohio	1.8	0.2
Union	1.8	0.5
IN Total	**9.7%**	**8.3%**
Total Emissions %	**100.0%**	**100.0%**

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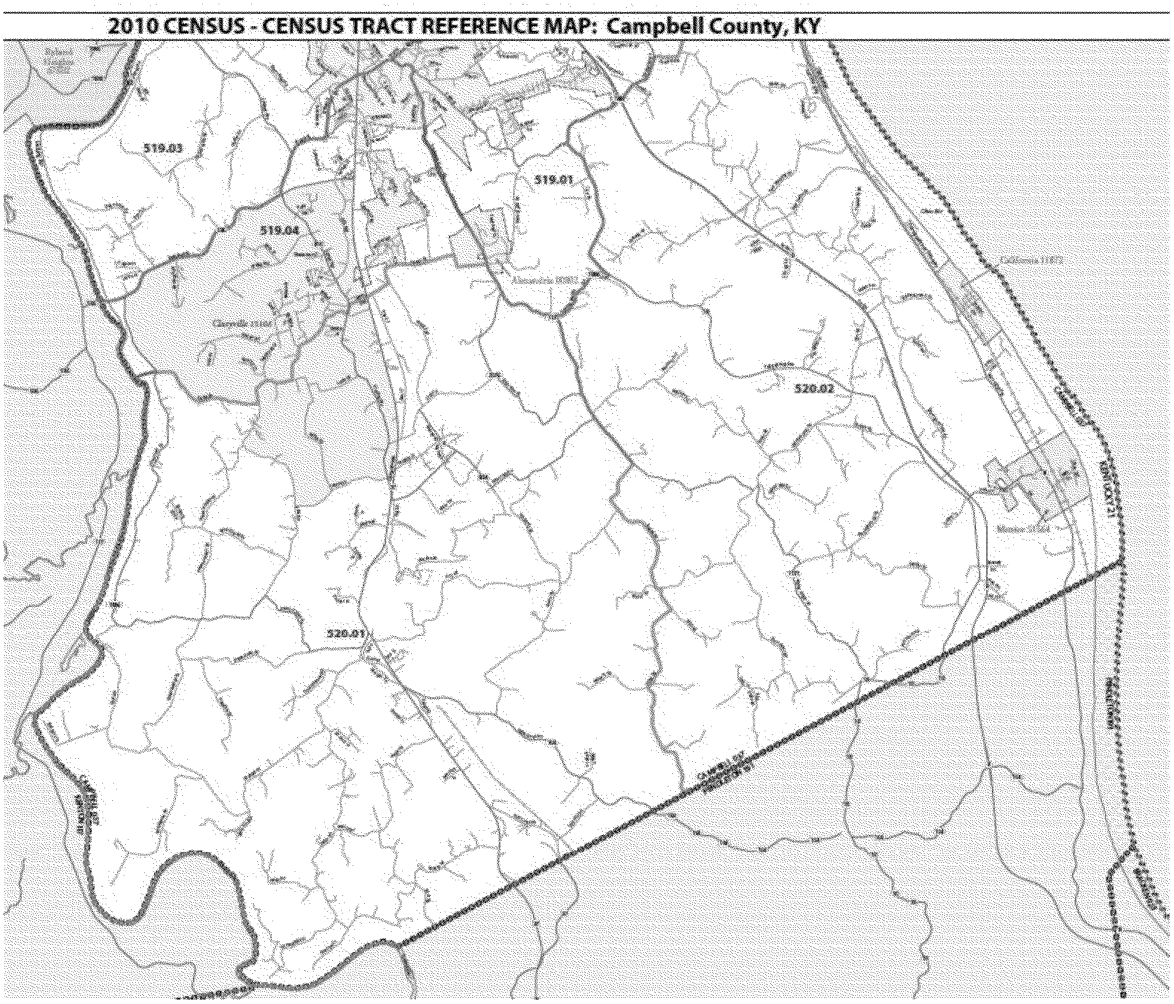
There are no distinguishable geographical or topographical elements that would affect VOC or NOx levels. The emission contributions in Campbell County are not as significant as other areas within the CBSA. Figure 3a shows 2010 Census Tracts For the northern portion of Campbell County. Figure 3b shows the southern portion of Campbell County, with the 2010 Census Tracts identified, as well. The EPA Ozone Mapping Tool map was used to analyze which portions of Campbell County could be contributing to the violating monitor based on high population areas. Although Campbell County does not have the highest population within the CBSA, the significant VMT levels along with commuting patterns suggest that there is a large urban population that leads to increased on-road and nonpoint source emissions. It is suggested that a portion of Campbell County be designated as "nonattainment" for the 2015 8-hour ozone NAAQS. Specifically, the following census tracts within Campbell County should be designated as nonattainment: 501, 502, 503, 504, 505, 506, 511.01, 511.02, 512, 513, 519.01, 519.03, 519.04, 521, 522, 523.01, 523.02, 524, 525, 526, 528, 529, 530, and 531.

Figure 3a: 2010 Census Tracts for northern Campbell County

Figure 3b: 2010 Census Tracts for southern Campbell County



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Gallatin County, KY

Air Quality

Pursuant to 40 CFR 50:19 (b) and (d) the 8-hour primary and secondary NAAQS are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, as determined in accordance with Appendix U of Part 50. For the 2013-2015 monitoring period, there were no ozone monitors located in Gallatin County.

Table 1 provides a summary of the annual fourth-highest daily maximum 8-hour average ozone concentrations recorded at monitors located in the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA), for 2013-2015. Not all counties in the Cincinnati, OH-KY-IN CBSA have monitors for ozone. Monitor values included in Table 1 only reflect those monitors that were operational during the 2013 to 2015 design value period. Only the monitor in Campbell County, KY indicates a design value above the revised ozone NAAQS for the CBSA.

Table 1
Cincinnati, OH-KY-IN CBSA
3-year Average* of Annual 8-hour concentrations for Ozone

County/Site	AQS Code	Annual 4th High (ppm)			Design Value (ppm)
		2013	2014	2015	
Kentucky					
Boone	21-015-0003	0.059	0.062	0.062	0.061
Campbell	21-037-3002	0.072	0.071	0.071	0.071
Ohio					
Butler	39-017-0004	0.068	0.070	0.070	0.069
Butler	39-017-0018	0.068	0.069	0.070	0.069
Butler	39-017-9991	0.069	0.069	0.068	0.068
Clermont	39-025-0022	0.066	0.068	0.070	0.068
Hamilton	39-061-0006	0.069	0.070	0.072	0.070
Hamilton	39-061-0010	0.064	0.073	0.070	0.069
Hamilton	39-061-0040	0.069	0.069	0.071	0.069
Warren	39-165-0007	0.067	0.071	0.071	0.069

*NAAQS 8-hour (3 year average of the 4th max value). 0.070ppm
n/a indicates no monitor data for that county.

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Emissions and Emissions-Related Data

The U.S. EPA requires an emissions inventory to be developed in order to identify the level of emissions in a specific area and adjacent regions that may have contributed to an ozone violation. The EPA Ozone Designations Mapping Tool was used to obtain 2011 NEI v2 emissions inventory data. The 2011 NEI v2 is the latest available national emissions inventory data and is the source of the point, non-point, on-road, non-road and event emissions, and was used to evaluate Gallatin County's impact on the violating monitor. VOC and NOx emissions, by category, are provided in Tables 2 and 3.

Table 2
2011 NEI VOC Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	VOC					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	1019.03	3708.82	1156.27	960.74	210.59	**7055.45**
Bracken	13.41	2604.87	143.77	98.86	0.0	**2860.91**
Campbell	160.58	2658.31	785.96	260.64	0.0	**3865.49**
Gallatin	87.39	1872.80	230.24	95.01	49.75	**2335.19**
Grant	79.78	3246.13	422.24	239.93	2.86	**3990.94**
Kenton	232.80	3289.76	1405.33	418.90	0.0	**5346.79**
Pendleton	127.59	3137.17	227.50	44.20	80.48	**3616.94**
KY Total	**1720.58**	**20517.86**	**4371.31**	**2118.28**	**343.68**	**29071.71**
INDIANA						
Dearborn	1573.32	3500.17	752.90	152.55	144.58	**6123.52**
Ohio	0.01	1571.07	111.12	30.63	46.31	**1759.14**
Union	0.00	1500.88	127.38	218.28	0.00	**1846.54**
IN Total	**1573.33**	**6572.12**	**991.40**	**401.46**	**190.89**	**9729.20**
OHIO						
Brown	28.90	4558.87	969.87	111.49	24.69	**5693.82**
Butler	1146.62	6081.24	4556.78	1076.33	0.0	**12860.97**
Clermont	180.86	5500.53	2654.57	719.53	0.0	**9055.49**
Hamilton	978.46	10759.16	10490.15	2734.21	0.0	**24961.98**
Warren	262.03	4760.18	2741.38	812.53	0.0	**8576.12**
OH Total	**2596.87**	**31659.98**	**21412.75**	**5454.09**	**24.69**	**61148.38**
Total Emissions	**5890.78**	**58749.96**	**26775.46**	**7973.83**	**559.26**	**99949.29**

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Table 3
2011 NEI NO_x Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	NOx					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	3569.19	801.83	3455.45	682.30	21.32	**8530.09**
Bracken	3.72	469.43	267.93	72.38	0.0	**813.46**
Campbell	82.95	666.79	1583.28	247.83	0.0	**2580.85**
Gallatin	609.76	357.34	832.85	42.53	5.00	**1847.48**
Grant	13.00	510.39	1590.13	96.12	0.28	**2209.92**
Kenton	147.17	818.13	3449.61	521.34	0.0	**4936.25**
Pendleton	949.22	350.98	385.47	77.48	7.90	**1771.05**
KY Total	**5375.01**	**3974.89**	**11564.72**	**1739.98**	**34.50**	**22689.10**
INDIANA						
Dearborn	6530.65	296.72	1610.93	196.33	6.62	**8641.25**
Ohio	0.00	76.65	164.59	28.77	2.75	**272.76**
Union	0.00	190.63	226.35	135.37	0.00	**552.35**
IN Total	**6530.65**	**564.00**	**2001.87**	**360.47**	**9.37**	**9466.36**
OHIO						
Brown	4.40	383.53	1288.36	254.07	2.39	**1932.75**
Butler	3989.32	1962.75	7108.70	1569.52	0.0	**14630.29**
Clermont	16000.81	592.15	4374.25	833.68	0.0	**21800.89**
Hamilton	9664.54	3798.10	19232.85	3145.46	0.0	**35840.95**
Warren	569.13	799.42	4743.52	1189.90	0.0	**7301.97**
OH Total	**30228.20**	**7535.95**	**36747.68**	**6992.63**	**2.39**	**81506.85**
Total Emissions	**42133.86**	**23980.5**	**50314.27**	**9093.08**	**46.26**	**113662.31**

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Table 4
VOC Emissions as % of Total VOC Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	16.6	17.5	39.4	35.3	**25.4**
Butler, OH	19.5	9.9	17.1	13.9	**13.1**
Clermont, OH	3.1	8.9	10.0	9.3	**9.2**
Warren, OH	4.4	7.7	10.3	10.5	**8.7**
Boone, KY	17.3	6.5	4.3	12.4	**7.2**
Dearborn, IN	27.0	5.7	2.8	2.0	**6.2**
Brown, OH	0.5	7.4	3.6	1.4	**5.8**
Kenton, KY	4.0	5.7	5.3	5.4	**5.5**
Grant, KY	1.4	5.3	1.6	3.1	**4.1**
Campbell, KY	2.7	4.3	2.9	3.4	**3.9**
Pendleton, KY	2.2	5.1	0.9	0.6	**3.7**
Bracken, KY	0.2	4.6	0.5	1.3	**2.9**
Gallatin, KY	1.5	3.3	0.9	1.2	**2.4**
Ohio. IN	0.0	2.6	0.4	0.4	**1.8**
Union, IN	0.0	2.6	0.5	2.7	**1.8**

Table 5
NOx Emissions as % of Total NOx Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	22.9	32.0	38.4	35.1	**31.4**
Clermont, OH	38.0	5.0	8.7	9.3	**19.1**
Butler, OH	9.5	16.5	14.2	17.5	**12.8**
Dearborn, IN	15.5	2.5	3.2	2.2	**7.6**
Boone, KY	8.5	6.7	6.9	7.6	**7.5**
Warren, OH	1.4	6.7	9.5	13.3	**6.4**
Kenton, KY	0.4	6.9	6.9	5.8	**4.3**
Campbell, KY	0.2	5.6	3.2	2.8	**2.3**
Grant, KY	3.1	4.3	3.2	1.1	**1.9**
Brown, OH	0.0	3.2	2.6	2.8	**1.7**
Gallatin, KY	1.4	3.0	1.7	0.5	**1.6**
Pendleton, KY	2.3	3.0	0.8	0.9	**1.5**
Bracken, KY	0.0	4.0	0.5	0.8	**0.7**
Union, IN	0.0	0.8	1.5	1.5	**0.5**
Ohio. IN	0.0	0.6	0.3	0.3	**0.2**

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Point Sources

Table 2 indicates 2011 point source emissions of VOC in Gallatin County were 87.39 tpy. Total VOC point source emissions from the Cincinnati, OH-KY-IN CBSA were 5,890.78 tpy. Gallatin County only accounts for approximately 1.5% of the total VOC point source emissions in the CBSA. Table 4 shows the percentages of VOC emissions for point sources in the CBSA, by county.

As seen in Table 3, point source emissions of NO_x in Gallatin County were estimated to be 609.76 tpy in 2011, which 1.4% of the total 42,133.86 tpy of the overall NO_x point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for point sources in the CBSA, by county.

Non-Point (Area) Emissions

Table 2 shows that non-point (or "area") VOC emissions in Gallatin County were estimated to be 1,872.80 tpy for 2011, which represents approximately 3.3% of the total 57,249.08 tpy of the overall VOC non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-point sources in the CBSA, by county.

As seen in Table 3, non-point NOx emissions from Gallatin County were estimated at 357.34 tpy in 2011, which represents approximately 3.0% of the total 11,884.21 tpy of the overall NOx non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NOx emissions for non-point sources in the CBSA, by county.

On-Road Mobile

As indicated in Table 2, on-road mobile source VOC emissions from Gallatin County were estimated to be 230.24 tpy in 2011, which represents approximately 0.9% of the total 26,648.08 tpy of the overall VOC on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for on-road mobile sources in the CBSA, by county.

As seen in Table 3, on-road mobile source NO_x emissions from Gallatin County were estimated at 832.85 tpy in 2011, which represents approximately 1.7% of the total 50,087.92 tpy of the overall NO_x on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for on-road mobile sources in the CBSA, by county.

Based on 2014 information obtained from the U.S Census Website, http://onthemap.ces.gov, the commuting traffic from other counties into Gallatin County is 70.5% while the commuting traffic from Gallatin County into other counties is 80.0%.

Table 6 below provides Vehicle Miles Travelled (VMT) for all areas within the Cincinnati, OH-KY-IN CBSA for the year 2011. The counties within the Ohio portion of the CBSA contribute to the majority of VMT within the CBSA. Gallatin County's VMT is significantly lower compared to other counties within the CBSA.

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Table 6
2011 VMT Totals, Cincinnati, OH-KY-IN CBSA

	2011 VMT Totals
Kentucky	
Boone County	1,558,794,112
Bracken County	104,160,119
Campbell County	1,010,009,434
Gallatin County	245,765,593
Grant County	529,145,674
Kenton County	1,720,886,038
Pendleton County	184,074,537
KY Total	5,352,835,507
Ohio	
Brown County	468,171,663
Butler County	3,099,030,997
Clermont County	1,951,343,156
Hamilton County	9,004,357,566
Warren County	2,139,774,797
OH Total	16,662,678,179
Indiana	
Dearborn County	690,348,611
Ohio County	71,591,617
Union County	105,444,221
IN Total	867,384,449
Total VMT for CBSA	22,882,898,135

Non-Road Mobile Sources

As listed in Table 2, non-road mobile source VOC emissions from Gallatin County were estimated at 95.01 tpy in 2011, which represents approximately 1.2% of the total 7,755.55 tpy of the overall VOC non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-road mobile sources in the CBSA, by county.

As seen in Table 3, non-road mobile source NO_x emissions from Gallatin County were estimated at 42.53 tpy in 2011, which represents approximately 0.5% of the total 8,957.71 tpy of the overall NO_x non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for non-road mobile sources in the CBSA, by county.

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Comparison of Total Emissions

A comparison of total emissions across the entire Cincinnati, OH-KY-IN CBSA was performed using data from the Ozone Designations Mapping Tool. The percentages shown in last column in both Tables 4 and 5 demonstrate that the majority of VOC and NOx emissions within the Cincinnati, OH-KY-IN CBSA come from the Ohio portion of the CBSA

Population

Based on U.S. Census Bureau estimates for 2015, there are 8,636 persons living in Gallatin County (Refer to table 7). This represents approximately 88.1 persons per square mile. The population of Gallatin County is approximately 100% rural with few people living in incorporated areas. The largest cities in Gallatin County are Warsaw and Glencoe.

Gallatin County's population from 2010 to 2015 *increased* by approximately 0.5% (8,589 to 8,636). For the entire Cincinnati, OH-KY-IN CBSA, Gallatin County represents less than 0.4% of the total population in the CBSA and 2.0% of the Kentucky portion of the CBSA. (Refer to Table 8)

Table 7
Northern Kentucky Area Population
Growth Data

County	Census 2010	2015*	%Growth 2010 - 2015
Boone	118,811	127,712	7.5%
Bracken	8,488	8,321	-2.0%
Campbell	90,336	92,066	1.9%
Gallatin	8,589	8,636	0.5%
Grant	24,662	24,757	0.4%
Kenton	159,720	165,012	3.3%
Pendleton	14,877	14,408	-3.1%

*U.S. Census Bureau estimates.

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Table 8
2015 Population
Cincinnati, OH-KY-IN CBSA

CBSA Estimated Population	2015*	2015 Population Density (1,000 per square mile)	% of Total	
Kentucky			**of KY Portion**	**of CBSA**
Boone County	127,712	0.52	29.0%	5.9%
Bracken County	8,321	0.04	1.9%	0.5%
Campbell County	92,066	0.61	20.9%	4.3%
Gallatin County	8,636	0.09	2.0%	0.4%
Grant County	24,757	0.10	5.6%	1.2%
Kenton County	165,012	1.03	37.4%	7.6%
Pendleton County	14,408	0.05	3.3%	0.7%
KY Total	440,912	--	100%	20.6%
Ohio			**of OH Portion**	
Brown County	43,839	0.09	2.7%	2.0%
Butler	376,353	0.81	22.8%	17.4%
Clermont County	201,973	0.45	12.2%	9.4%
Hamilton County	807,598	1.99	48.8%	37.4%
Warren County	224,469	0.56	13.6%	10.4%
OH Total	1,654,232	--	100%	76.7%
Indiana			**of IN Portion**	
Dearborn County	49,455	0.16	79.0%	2.3%
Ohio County	5,938	0.07	9.5%	0.3%
Union County	7,182	0.04	11.5%	0.3%
IN Total	62,575	--	100%	2.9%
Total Estimated Population	2,157,719	--	100%	100%

*U.S. Census Bureau estimates.

Areas of dense population and high VMT can display elevated nonpoint and on-road source emissions. As seen in Tables 2 and 3, two of the sectors with the highest emission contribution are from nonpoint for both VOC and NOx. However, Gallatin County emissions are low compared to other areas within the CBSA.

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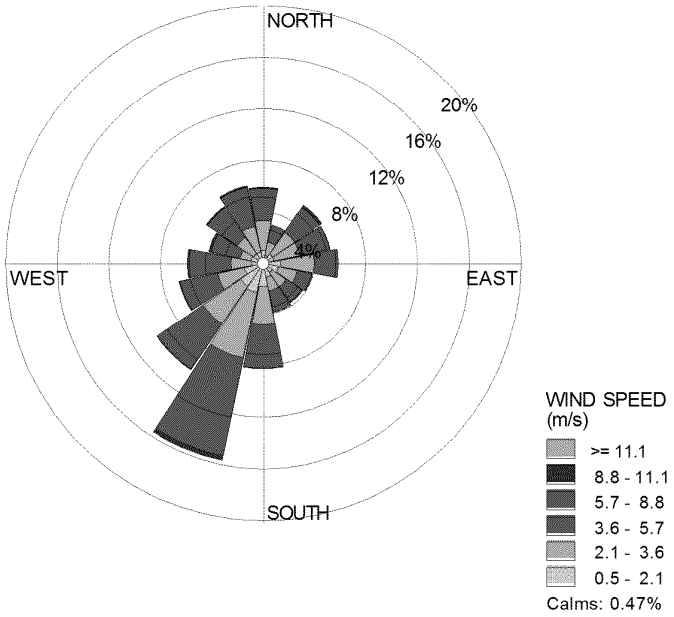
Meteorological Information

Wind speed and wind direction data collected at the Cincinnati-Northern Kentucky Airport (NWS Station 93814) for the period 2013-2015 shows that the majority of the time the wind in the area came from the southwest and typically from 2.1-3.6 miles per hour (Refer to figure 1). According to Kentucky Mesonet (http://www.kymesonet.org/), the average high temperature for July for the period 2013-2015 was 91.9° F and the average low temperature for July was 55.5° F. The average July precipitation for the same period (2013-2015) was 4.65 inches.

Figure 1: Wind Rose Average 2013-2015 March 1st - October 31st



Several 48-hour back trajectory HYSPLITS for Kentucky have been included in Section 8 for days in 2013-2015 when the 8-hour ambient monitoring concentration for ozone had their highest readings. The HYSPLITS show that there is potential for Gallatin County to affect the violating monitor in Campbell County. However, Gallatin County's emissions are so low that there is no significant impact.

Geography and Topography

Gallatin County is part of the Cincinnati, OH-KY-IN Metropolitan Statistical Area (CBSA) and has a land area of 98 square miles. Located on the banks of the Ohio River, Gallatin County lies to the southwest of Boone County, northeast of Carroll County, and to the north of Owen County. The lowest elevations (420 to 520 feet) in the county are found along the Ohio River and the highest elevations (750-920 feet) are found in the southwestern corner of the county.

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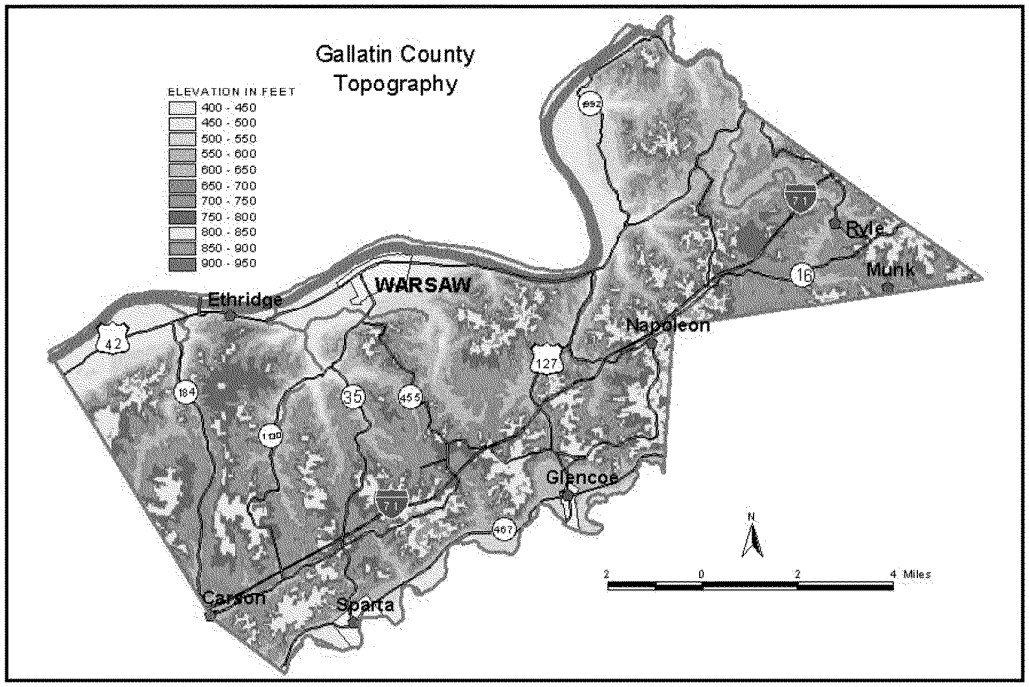
Gallatin County does not have any geographical or topographical distinctions that interfere with air pollution transport. Therefore, this factor is not a significant part of the overall analysis.

Figure 2: Gallatin County Topography Map



Jurisdictional Boundaries

The authority for air quality planning in the Gallatin County area resides with the Kentucky Energy and Environment Cabinet. Transportation planning for Gallatin County is performed by the Kentucky Transportation Cabinet. Historically, portions of Boone, Campbell, and Kenton counties have been designated as nonattainment. These Kentucky counties along with Butler, Clermont, Clinton, Hamilton, Warren, Ohio, and Dearborn, Indiana were designated nonattainment for the 1997 and 2008 ozone standards. The 2008 ozone standard nonattainment area was confined to specific census tracts in the northern part of Boone, Campbell and Kenton counties.

Conclusion and Recommendation

There were no ozone monitors located in Gallatin County for the 2013-2015 monitoring period.

As seen in Table 9, Gallatin County's VOC and NOx emissions are insignificant when compared to other counties located within the Cincinnati, OH-KY-IN CBSA. Gallatin County contributes approximately:

- 2.4% of the total VOC emissions
- 1.6% of the total NO_x emissions

The emissions from Gallatin are negligible and do not contribute to the ozone violations of the 8-hour standard in the Cincinnati, OH-KY-IN CBSA.

Table 9
VOC and NO_x Percentages for
Cincinnati, OH-KY-IN CBSA (2011 NEI)

County	VOC %	NO_X %
KENTUCKY		
Boone	7.1	7.5
Bracken	2.9	0.7
Campbell	3.8	2.3
Gallatin	2.3	1.6
Grant	4.0	1.9
Kenton	5.3	4.3
Pendleton	3.6	1.6
KY Total	**29.0%**	**19.9%**
OHIO		
Brown	5.7	1.7
Butler	12.9	12.9
Clermont	9.1	19.2
Hamilton	25.0	31.6
Warren	8.6	6.4
OH Total	**61.3%**	**71.8**
INDIANA		
Dearborn	6.1	7.6
Ohio	1.8	0.2
Union	1.8	0.5
IN Total	**9.7%**	**8.3%**
Total Emissions %	**100.0%**	**100.0%**

Data gathered for Gallatin County and reviewed using EPA's five factor analysis demonstrates that Gallatin County is not contributing to the violating monitor in Campbell County. Therefore, Kentucky recommends that Gallatin County be designated as "unclassifiable/attainment" for the revised 2015 8-hour ozone NAAQS.

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Grant County, KY

Air Quality

Pursuant to 40 CFR 50:19 (b) and (d) the 8-hour primary and secondary NAAQS are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, as determined in accordance with Appendix U of Part 50. Currently, there is no ozone monitor located in Grant County.

Table 1 provides a summary of the annual fourth-highest daily maximum 8-hour average ozone concentrations recorded at monitors located in the Cincinnati, OH-KY-IN Metropolitan Statistical Area (MSA), for 2013-2015. Not all counties in the Cincinnati, OH-KY-IN MSA have monitors for ozone. Monitor values included in Table 1 only reflect those monitors that were operational during the 2013 to 2015 design value period. Only the monitor in Campbell County, KY indicates a design value above the revised ozone NAAQS for the MSA.

Table 1
Cincinnati, OH-KY-IN MSA
3-year Average* of Annual 8-hour concentrations for Ozone

County/Site	AQS Code	Annual 4th High (ppm)			Design Value (ppm)
		2013	2014	2015	
Kentucky					
Boone	21-015-0003	0.059	0.062	0.062	0.061
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Butler	39-017-0004	0.068	0.070	0.070	0.069
Butler	39-017-0018	0.068	0.069	0.070	0.069
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*NAAQS 8-hour (3 year average of the 4th max value). 0.070ppm
N/A indicates no monitor data for that county.

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Emissions and Emissions Related Data

The U.S. EPA requires an emissions inventory to be developed in order to identify the level of emissions in a specific area and adjacent regions that may have contributed to an ozone violation. The EPA Ozone Designations Mapping Tool was used to obtain 2011 NEI v2 emissions inventory data. The 2011 NEI v2 is the latest available national emissions inventory data and is the source of the point, non-point, on-road, non-road and event emissions, and was used to evaluate Bracken County's impact on the violating monitor. VOC and NOx emissions, by category, are provided in Tables 2 and 3.

Table 2
2011 NEI VOC Emissions (tpy)
Cincinnati, OH-KY-IN MSA

County	VOC (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	1019.03	3708.82	1156.27	960.74	210.59	**7055.45**
Bracken	13.41	2604.87	143.77	98.86	0.0	**2860.91**
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OHIO						
Brown	28.90	4558.87	969.87	111.49	24.69	**5693.82**
Butler	1146.62	6081.24	4556.78	1076.33	0.0	**12860.97**
Clermont	180.86	5500.53	2654.57	719.53	0.0	**9055.49**
Hamilton	978.46	10759.16	10490.15	2734.21	0.0	**24961.98**
Warren	262.03	4760.18	2741.38	812.53	0.0	**8576.12**
OH Total	**2596.87**	**31659.98**	**21412.75**	**5454.09**	**24.69**	**61148.38**
Total Emissions	**5890.78**	**58749.96**	**26775.46**	**7973.83**	**559.26**	**99949.29**

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Table 3
2011 NEI NO_x Emissions (tpy)
Cincinnati, OH-KY-IN MSA

County	NOx (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	3569.19	801.83	3455.45	682.30	21.32	**8530.09**
Bracken	3.72	469.43	267.93	72.38	0.0	**813.46**
Campbell	82.95	666.79	1583.28	247.83	0.0	**2580.85**
Gallatin	609.76	357.34	832.85	42.53	5.00	**1847.48**
Grant	13.00	510.39	1590.13	96.12	0.28	**2209.92**
Kenton	147.17	818.13	3449.61	521.34	0.0	**4936.25**
Pendleton	949.22	350.98	385.47	77.48	7.90	**1771.05**
KY Total	**5375.01**	**3974.89**	**11564.72**	**1739.98**	**34.50**	**22689.10**
INDIANA						
Dearborn	6530.65	296.72	1610.93	196.33	6.62	**8641.25**
Ohio	0.00	76.65	164.59	28.77	2.75	**272.76**
Union	0.00	190.63	226.35	135.37	0.00	**552.35**
IN Total	**6530.65**	**564.00**	**2001.87**	**360.47**	**9.37**	**9466.36**
OHIO						
Brown	4.40	383.53	1288.36	254.07	2.39	**1932.75**
Butler	3989.32	1962.75	7108.70	1569.52	0.0	**14630.29**
Clermont	16000.81	592.15	4374.25	833.68	0.0	**21800.89**
Hamilton	9664.54	3798.10	19232.85	3145.46	0.0	**35840.95**
Warren	569.13	799.42	4743.52	1189.90	0.0	**7301.97**
OH Total	**30228.20**	**7535.95**	**36747.68**	**6992.63**	**2.39**	**81506.85**
Total Emissions	**42133.86**	**23980.5**	**50314.27**	**9093.08**	**46.26**	**113662.31**

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Table 4
VOC Emissions as % of Total VOC Emissions
Cincinnati, OH-KY-IN MSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	16.6	17.5	39.4	35.3	**25.4**
Butler, OH	19.5	9.9	17.1	13.9	**13.1**
Clermont, OH	3.1	8.9	10.0	9.3	**9.2**
Warren, OH	4.4	7.7	10.3	10.5	**8.7**
Boone, KY	17.3	6.5	4.3	12.4	**7.2**
Dearborn, IN	27.0	5.7	2.8	2.0	**6.2**
Brown, OH	0.5	7.4	3.6	1.4	**5.8**
Kenton, KY	4.0	5.7	5.3	5.4	**5.5**
Grant, KY	1.4	5.3	1.6	3.1	**4.1**
Campbell, KY	2.7	4.3	2.9	3.4	**3.9**
Pendleton, KY	2.2	5.1	0.9	0.6	**3.7**
Bracken, KY	0.2	4.6	0.5	1.3	**2.9**
Gallatin, KY	1.5	3.3	0.9	1.2	**2.4**
Ohio. IN	0.0	2.6	0.4	0.4	**1.8**
Union, IN	0.0	2.6	0.5	2.7	**1.8**

Table 5
NOx Emissions as % of Total NOx Emissions
Cincinnati, OH-KY-IN MSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	22.9	32.0	38.4	35.1	**31.4**
Clermont, OH	38.0	5.0	8.7	9.3	**19.1**
Butler, OH	9.5	16.5	14.2	17.5	**12.8**
Dearborn, IN	15.5	2.5	3.2	2.2	**7.6**
Boone, KY	8.5	6.7	6.9	7.6	**7.5**
Warren, OH	1.4	6.7	9.5	13.3	**6.4**
Kenton, KY	0.4	6.9	6.9	5.8	**4.3**
Campbell, KY	0.2	5.6	3.2	2.8	**2.3**
Grant, KY	3.1	4.3	3.2	1.1	**1.9**
Brown, OH	0.0	3.2	2.6	2.8	**1.7**
Gallatin, KY	1.4	3.0	1.7	0.5	**1.6**
Pendleton, KY	2.3	3.0	0.8	0.9	**1.5**
Bracken, KY	0.0	4.0	0.5	0.8	**0.7**
Union, IN	0.0	0.8	1.5	1.5	**0.5**
Ohio. IN	0.0	0.6	0.3	0.3	**0.2**

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Point Sources

Table 2 indicates 2011 point source emissions of VOC in Grant County were 79.78 tpy in 2011. Total VOC point source emissions from the Cincinnati, OH-KY-IN MSA were 5,890.78 tpy. Grant County only accounts for approximately 1.4% of the total VOC point source emissions in the MSA. Table 4 shows the percentages of VOC emissions for point sources in the MSA, by county.

As seen in Table 3, point source emissions of NO_x in Grant County were estimated to be 13.00 tpy in 2011, which represents 0.03% of the total 42,133.86 tpy of the overall NO_x point source emissions from the Cincinnati, OH-KY-IN MSA. Table 5 shows the percentages of NO_x emissions for point sources in the MSA, by county.

Non-Point (Area) Emissions

Table 2 shows that non-point (or "area") VOC emissions in Grant County were estimated at 3,246.13 tpy in 2011, which represents approximately 5.7% of the total 57,249.08 tpy of the overall VOC area source emissions from the Cincinnati, OH-KY-IN MSA. Table 4 shows the percentages of VOC emissions for non-point sources in the MSA, by county.

As seen in Table 3, non-point NOx emissions from Grant County were estimated at 510.39 tpy in 2011, which represents approximately 4.3% of the total 11,884.21 tpy of the overall NO_x non-point source emissions from the Cincinnati, OH-KY-IN MSA. Table 5 shows the percentages of NOx emissions for non-point sources in the MSA, by county.

On-Road Mobile

As indicated in Table 2, on-road mobile source VOC emissions from Grant County were estimated to be 422.24 tpy in 2011, which represents approximately 1.6% of the total 26,648.08 tpy of the overall VOC on-road mobile source emissions from the Cincinnati, OH-KY-IN MSA. Table 4 shows the percentages of VOC emissions for on-road mobile sources in the MSA, by county.

As seen in Table 3, on-road mobile source NO_x emissions from Grant County were estimated at 1,590.13 tpy in 2011, which represents approximately 3.2% of the total 50,087.92 tpy of the overall NO_x on-road mobile source emissions from the Cincinnati, OH-KY-IN MSA. Table 5 shows the percentages of NO_x emissions for on-road mobile sources in the MSA, by county.

Based on 2014 information obtained from the U.S. Census website, http://onthemap.ces.census.gov/, the commuting traffic from other counties into Grant County is 54.4% while the commuting traffic from Grant County into other counties is 79.2%.

Table 6 below provides Vehicle Miles Travelled (VMT) for all areas within the Cincinnati, OH-KY-IN MSA for the year 2011. The counties within the Ohio portion of the MSA contribute to the majority of VMT within the MSA. Grant County's VMT is low compared to other counties within the MSA.

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Table 6
2011 VMT Totals, Cincinnati, OH-KY-IN MSA

	2011 VMT Totals
Kentucky	
Boone County	1,558,794,112
Bracken County	104,160,119
Campbell County	1,010,009,434
Gallatin County	245,765,593
Grant County	529,145,674
Kenton County	1,720,886,038
Pendleton County	184,074,537
KY Total	5,352,835,507
Ohio	
Brown County	468,171,663
Butler County	3,099,030,997
Clermont County	1,951,343,156
Hamilton County	9,004,357,566
Warren County	2,139,774,797
OH Total	16,662,678,179
Indiana	
Dearborn County	690,348,611
Ohio County	71,591,617
Union County	105,444,221
IN Total	867,384,449
Total VMT for MSA	22,882,898,135

Non-Road Mobile Sources

As seen in Table 2, non-road mobile source VOC emissions from Grant County were estimated at 239.93 tpy in 2011, which represents approximately 3.1% of the total 7,755.55 tpy of the overall VOC non-road mobile source emissions from the Cincinnati, OH-KY-IN MSA. Table 4 shows the percentages of VOC emissions for non-road mobile sources in the MSA, by county.

As seen in Table 3, non-road mobile source NO_x emissions from Grant County were estimated at 96.12 tpy in 2011, which represents approximately 1.1% of the total 8,957.71 tpy of the overall NO_x non-road mobile source emissions from the Cincinnati, OH-KY-IN MSA. Table 5 shows the percentages of NO_x emissions for non-road mobile sources in the MSA, by county.

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Comparison of Total Emissions

A comparison of total emissions across the entire Cincinnati, OH-KY-IN MSA was performed using data from the EPA Ozone Designations Mapping Tool. The percentages shown in last column in both Tables 4 and 5 demonstrate that the majority of VOC and NOx emissions within the Cincinnati, OH-KY-IN MSA come from the Ohio portion of the MSA.

Population

Based on U.S. Census Bureau estimates for 2015, there are 24,757 persons living in Grant County (Refer to table 7). This represents approximately 95.6 persons per square mile. The population of Grant County is approximately 65.0% rural with the remaining 35.0% living in incorporated areas. The largest cities in Grant County are Williamstown and Crittenden.

Grant County's population from 2010-2015 *increased* by approximately 0.4%. For the entire Cincinnati, OH-KY-IN MSA, Grant County represents approximately 1.2% of the total population in the MSA and 6% of the Kentucky portion of the MSA. (Refer to table 8)

Table 7
Northern Kentucky Area Population
Growth Data

County	Census 2010	2015*	%Growth 2010 - 2015
Boone	118,811	127,712	7.5%
Bracken	8,488	8,321	-2.0%
Campbell	90,336	92,066	1.9%
Gallatin	8,589	8,636	0.5%
Grant	24,662	24,757	0.4%
Kenton	159,720	165,012	3.3%
Pendleton	14,877	14,408	-3.1%

*U.S. Census Bureau estimates.

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Table 8
2015 Population
Cincinnati, OH-KY-IN MSA

MSA Estimated Population	2015*	2015 Population Density (1,000 per square mile)	% of Total	
Kentucky			**of KY Portion**	**of MSA**
Boone County	127,712	0.52	29.0%	5.9%
Bracken County	8,321	0.04	1.9%	0.5%
Campbell County	92,066	0.61	20.9%	4.3%
Gallatin County	8,636	0.09	2.0%	0.4%
Grant County	24,757	0.10	5.6%	1.2%
Kenton County	165,012	1.03	37.4%	7.6%
Pendleton County	14,408	0.05	3.3%	0.7%
KY Total	440,912	--	100%	20.6%
Ohio			**of OH Portion**	
Brown County	43,839	0.09	2.7%	2.0%
Butler	376,353	0.81	22.8%	17.4%
Clermont County	201,973	0.45	12.2%	9.4%
Hamilton County	807,598	1.99	48.8%	37.4%
Warren County	224,469	0.56	13.6%	10.4%
OH Total	1,654,232	--	100%	76.7%
Indiana			**of IN Portion**	
Dearborn County	49,455	0.16	79.0%	2.3%
Ohio County	5,938	0.07	9.5%	0.3%
Union County	7,182	0.04	11.5%	0.3%
IN Total	62,575	--	100%	2.9%
Total Estimated Population	2,157,719	--	100%	100%

*U.S. Census Bureau estimates.

Areas of dense population and high VMT can display elevated nonpoint and on-road source emissions. As seen in Tables 2 and 3, two of the sectors with the highest emission contribution are from nonpoint for both VOC and NOx. However, Grant County emissions are low compared to other areas within the MSA.

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Meteorology

Wind speed and wind direction data collected at Cincinnati-Northern Kentucky Airport (NWS Station 93814) for the period 2013-2015 shows that the majority of the time the wind in the area came from the southwest and typically from 2.1-3.6 miles per hour (Refer to figure 12). According to Kentucky Mesonet (http://www.kymesonet.org/), the average high temperature for July for the area from 2013 through 2015 was 91.9°F; the average low was 55.5°F. The average precipitation for the same period was 4.65 inches.

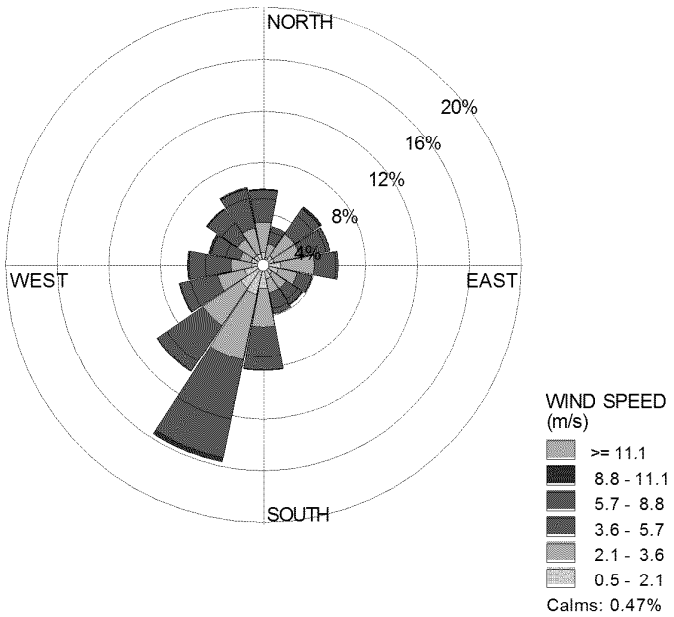

Figure 1: Wind Rose Average 2013-2015 March 1st - October 31st

Several 48-hour back trajectory HYSPLITS for Kentucky have been included in Section 8 for days in 2013-2015 when the 8-hour ambient monitoring concentration for ozone had their highest readings. The HYSPLITS show that there is potential for Grant County to affect the violating monitor in Campbell County. However, Grant County's emissions are so low that there is no significant impact.

Geography and Topography

Grant County is part of the Cincinnati, OH-KY-IN MSA and has a land area of 259 square miles. Located in the central part of Northern Kentucky, Gallatin County lies to the west of Pendleton County, north of Scott County, northeast of Owen County and south of Boone County. Elevations above 900 feet are common. The highest elevation is recorded at 1,000 feet, where Eagle and Three Forks Creeks have a drainage divide. The lowest elevation is 530 feet, where Eagle Creek, the largest stream in the county, exits the county. The community elevations are as follows: Williamstown, the county seat, is

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974 feet; Corinth, 980 feet; Crittenden, 920 feet; Dry Ridge, 958 feet, Jonesville, 914 feet; Mount Zion, 925 feet.

Figure 2 shows the topography of Grant county. Grant County does not have any geographical or topographical distinctions that interfere with air pollution transport. Therefore, this factor is not a significant part of the overall analysis.

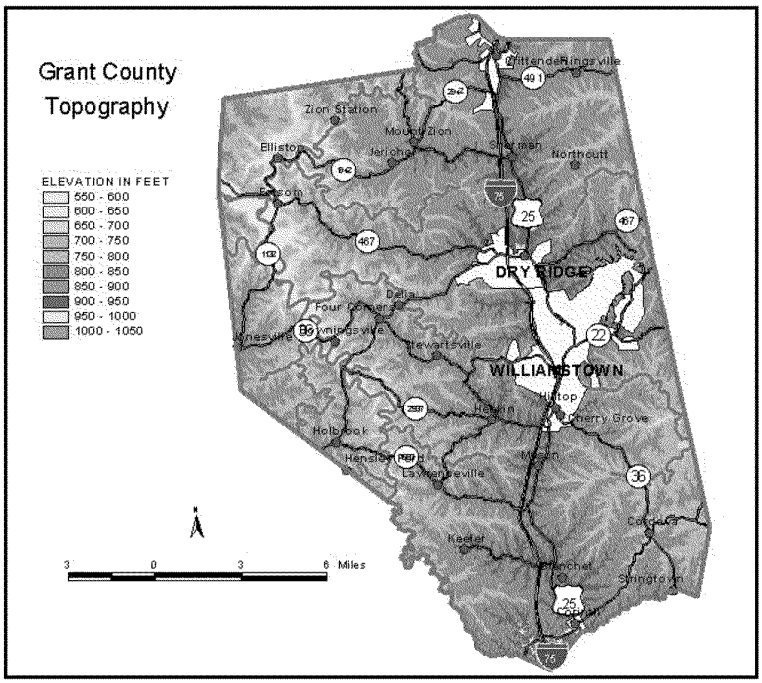

Figure 2: Grant County Topographic Map

Jurisdictional Boundaries

The authority for air quality planning in the Grant County area resides with the Kentucky Energy and Environment Cabinet. Transportation planning for Grant County is performed by the Kentucky Transportation Cabinet. Historically, portions of Boone, Campbell, and Kenton counties have been designated as nonattainment. These Kentucky counties along with Butler, Clermont, Clinton, Hamilton, Warren, Ohio, and Dearborn, Indiana were designated nonattainment for the 1997 and 2008 ozone standards. The 2008 ozone standard nonattainment area was confined to specific census tracts in the northern part of Boone, Campbell and Kenton counties.

Conclusion and Recommendation

There were no ozone monitors located in Grant County for the 2013-2015 monitoring period.

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As seen in Table 9 below, Grant County's VOC and NOx emissions are insignificant when compared to other counties located within the Cincinnati, OH-KY-IN MSA. Grant County contributes approximately:

- 4.1% of the total VOC emissions
- 1.9% of the total NO_x emissions

The emissions from Grant do not contribute to the ozone violation of the 8-hour standard in the Cincinnati, OH-KY-IN MSA.

Table 7: VOC and NO_x Percentages for Cincinnati, OH-KY-IN MSA (2011 NEI)

County	VOC %	NO_X %
KENTUCKY		
Boone	7.1	7.5
Bracken	2.9	0.7
Campbell	3.8	2.3
Gallatin	2.3	1.6
Grant	4.0	1.9
Kenton	5.3	4.3
Pendleton	3.6	1.6
KY Total	**29.0%**	**19.9%**
OHIO		
Brown	5.7	1.7
Butler	12.9	12.9
Clermont	9.1	19.2
Hamilton	25.0	31.6
Warren	8.6	6.4
OH Total	**61.3%**	**71.8**
INDIANA		
Dearborn	6.1	7.6
Ohio	1.8	0.2
Union	1.8	0.5
IN Total	**9.7%**	**8.3%**
Total Emissions %	**100.0%**	**100.0%**

Data gathered for Grant County and reviewed using EPA's five factor analysis demonstrates that Grant County is not contributing to the violating monitor in Campbell County. Therefore, Kentucky recommends that Grant County be designated as "unclassifiable/attainment" for the 2015 8-hour ozone NAAQS.

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Kenton County, KY

Air Quality

Pursuant to 40 CFR 50:19 (b) and (d) the 8-hour primary and secondary NAAQS are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, as determined in accordance with Appendix U of Part 50. For the 2013-2015 monitoring period, there were no ozone monitors located in Kenton County.

Ozone air monitoring data and design values for 2013-2015, for the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA), were retrieved from https://www.epa.gov/air-trends/air-quality-design-values#report. Per the EPA website, "The design values shown here are computed using Federal Reference Method or equivalent data reported by State, Tribal, and Local monitoring agencies to EPA's Air Quality System (AQS) as of June 24, 2016." Table 1 provides a summary of both the 2013-2015 design values and the annual fourth-highest daily maximum 8-hour average ozone concentrations recorded at monitors located in the Cincinnati, OH-KY-IN CBSA for 2013-2015. Not all counties in the Cincinnati, OH-KY-IN CBSA have monitors for ozone. Monitor values included in Table 1 only reflect those monitors that were operational during the 2013 to 2015 design value period. Only the monitor in Campbell County, KY indicates a design value above the revised ozone NAAQS for the CBSA.

Table 1
Cincinnati, OH-KY-IN CBSA
3-year Average* of Annual 8-hour concentrations for Ozone

County/Site	AQS Code	Annual 4th High (ppm)			Design Value (ppm)
		2013	2014	2015	
Kentucky					
Boone	21-015-0003	0.059	0.062	0.062	0.061
Campbell	21-037-3002	0.072	0.071	0.071	0.071
Ohio					
Butler	39-017-0004	0.068	0.070	0.070	0.069
Butler	39-017-0018	0.068	0.069	0.070	0.069
Butler	39-017-9991	0.069	0.069	0.068	0.068
Clermont	39-025-0022	0.066	0.068	0.070	0.068
Hamilton	39-061-0006	0.069	0.070	0.072	0.070
Hamilton	39-061-0010	0.064	0.073	0.070	0.069
Hamilton	39-061-0040	0.069	0.069	0.071	0.069
Warren	39-165-0007	0.067	0.071	0.071	0.069

*NAAQS 8-hour (3 year average of the 4th max value). 0.070ppm
n/a indicates no monitor data for that county.

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Emissions and Emissions-Related Data

The U.S. EPA requires an emissions inventory to be developed in order to identify the level of emissions in a specific area and adjacent regions that may have contributed to an ozone violation. The EPA Ozone Designations Mapping Tool was used to obtain 2011 NEI v2 emissions inventory data. The 2011 NEI v2 is the latest available national emissions inventory data and is the source of the point, non-point, on-road, non-road and event emissions, and was used to evaluate Kenton County's impact on the violating monitor. VOC and NOx emissions, by category, are provided in Tables 2 and 3.

Table 2
2011 NEI VOC Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	VOC (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	1019.03	3708.82	1156.27	960.74	210.59	**7055.45**
Bracken	13.41	2604.87	143.77	98.86	0.0	**2860.91**
Campbell	160.58	2658.31	785.96	260.64	0.0	**3865.49**
Gallatin	87.39	1872.80	230.24	95.01	49.75	**2335.19**
Grant	79.78	3246.13	422.24	239.93	2.86	**3990.94**
Kenton	232.80	3289.76	1405.33	418.90	0.0	**5346.79**
Pendleton	127.59	3137.17	227.50	44.20	80.48	**3616.94**
KY Total	**1720.58**	**20517.86**	**4371.31**	**2118.28**	**343.68**	**29071.71**
INDIANA						
Dearborn	1573.32	3500.17	752.90	152.55	144.58	**6123.52**
Ohio	0.01	1571.07	111.12	30.63	46.31	**1759.14**
Union	0.00	1500.88	127.38	218.28	0.00	**1846.54**
IN Total	**1573.33**	**6572.12**	**991.40**	**401.46**	**190.89**	**9729.20**
OHIO						
Brown	28.90	4558.87	969.87	111.49	24.69	**5693.82**
Butler	1146.62	6081.24	4556.78	1076.33	0.0	**12860.97**
Clermont	180.86	5500.53	2654.57	719.53	0.0	**9055.49**
Hamilton	978.46	10759.16	10490.15	2734.21	0.0	**24961.98**
Warren	262.03	4760.18	2741.38	812.53	0.0	**8576.12**
OH Total	**2596.87**	**31659.98**	**21412.75**	**5454.09**	**24.69**	**61148.38**
Total Emissions	**5890.78**	**58749.96**	**26775.46**	**7973.83**	**559.26**	**99949.29**

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Table 3
2011 NEI NO_x Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	NOx (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	3569.19	801.83	3455.45	682.30	21.32	**8530.09**
Bracken	3.72	469.43	267.93	72.38	0.0	**813.46**
Campbell	82.95	666.79	1583.28	247.83	0.0	**2580.85**
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Kenton	147.17	818.13	3449.61	521.34	0.0	**4936.25**
Pendleton	949.22	350.98	385.47	77.48	7.90	**1771.05**
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Union	0.00	190.63	226.35	135.37	0.00	**552.35**
IN Total	**6530.65**	**564.00**	**2001.87**	**360.47**	**9.37**	**9466.36**
OHIO						
Brown	4.40	383.53	1288.36	254.07	2.39	**1932.75**
Butler	3989.32	1962.75	7108.70	1569.52	0.0	**14630.29**
Clermont	16000.81	592.15	4374.25	833.68	0.0	**21800.89**
Hamilton	9664.54	3798.10	19232.85	3145.46	0.0	**35840.95**
Warren	569.13	799.42	4743.52	1189.90	0.0	**7301.97**
OH Total	**30228.20**	**7535.95**	**36747.68**	**6992.63**	**2.39**	**81506.85**
Total Emissions	**42133.86**	**12074.84**	**50314.27**	**9093.08**	**46.26**	**113662.31**

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Table 4
VOC Emissions as % of Total VOC Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	16.6	17.5	39.4	35.3	**25.4**
Butler, OH	19.5	9.9	17.1	13.9	**13.1**
Clermont, OH	3.1	8.9	10.0	9.3	**9.2**
Warren, OH	4.4	7.7	10.3	10.5	**8.7**
Boone, KY	17.3	6.5	4.3	12.4	**7.2**
Dearborn, IN	27.0	5.7	2.8	2.0	**6.2**
Brown, OH	0.5	7.4	3.6	1.4	**5.8**
Kenton, KY	4.0	5.7	5.3	5.4	**5.5**
Grant, KY	1.4	5.3	1.6	3.1	**4.1**
Campbell, KY	2.7	4.3	2.9	3.4	**3.9**
Pendleton, KY	2.2	5.1	0.9	0.6	**3.7**
Bracken, KY	0.2	4.6	0.5	1.3	**2.9**
Gallatin, KY	1.5	3.3	0.9	1.2	**2.4**
Ohio. IN	0.0	2.6	0.4	0.4	**1.8**
Union, IN	0.0	2.6	0.5	2.7	**1.8**

Table 5
NOx Emissions as % of Total NOx Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	22.9	32.0	38.4	35.1	**31.4**
Clermont, OH	38.0	5.0	8.7	9.3	**19.1**
Butler, OH	9.5	16.5	14.2	17.5	**12.8**
Dearborn, IN	15.5	2.5	3.2	2.2	**7.6**
Boone, KY	8.5	6.7	6.9	7.6	**7.5**
Warren, OH	1.4	6.7	9.5	13.3	**6.4**
Kenton, KY	0.4	6.9	6.9	5.8	**4.3**
Campbell, KY	0.2	5.6	3.2	2.8	**2.3**
Grant, KY	3.1	4.3	3.2	1.1	**1.9**
Brown, OH	0.0	3.2	2.6	2.8	**1.7**
Gallatin, KY	1.4	3.0	1.7	0.5	**1.6**
Pendleton, KY	2.3	3.0	0.8	0.9	**1.5**
Bracken, KY	0.0	4.0	0.5	0.8	**0.7**
Union, IN	0.0	0.8	1.5	1.5	**0.5**
Ohio. IN	0.0	0.6	0.3	0.3	**0.2**

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Point Source

Table 2 indicates 2011 point source emissions of VOC in Kenton County were estimated at 232.80 tpy in 2011. Total VOC point source emissions from the Cincinnati, OH-KY-IN CBSA were 5,890.78 tpy. Kenton County accounts for approximately 4.0% of the total 5 VOC point source emissions in the CBSA. Table 4 shows the percentages of VOC emissions for point sources in the CBSA, by county.

As seen in Table 3, point source NO_x emissions from Kenton County were estimated at 147.17 tpy in 2011, which represents approximately 0.4% of the total 42,133.86 tpy of the overall NO_x point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for point sources in the CBSA, by county.

Non-Point (Area) Emissions

Table 2 shows that non-point (or "area") VOC emissions in Kenton County were estimated at 3,289.76 tpy in 2011, which represents approximately 5.7% of the total 57,249.08 tpy of the overall VOC non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-point sources in the CBSA, by county.

As seen in Table 3, non-point NO_x emissions from Kenton County were estimated at 818.13 tpy in 2011, which represents approximately 6.9% of the total 11,884.21 tpy of the overall NO_x non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NOx emissions for non-point sources in the CBSA, by county.

On-Road Sources

As indicated in Table 2, on-road mobile source VOC emissions from Kenton County were estimated at 1,405.33 tpy in 2011, which represents approximately 5.3% of the total 26,648.08 tpy of the overall VOC on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA.

As seen in Table 3, on-road mobile source NO_x emissions from Kenton County were estimated at 3,449.61 tpy in 2011, which represents approximately 6.9% of the total 50,087.92 tpy of the overall NO_x on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for on-road mobile sources in the CBSA, by county.

Based on 2014 information obtained from the U.S Census Website, http://onthemap.ces.gov, the commuting traffic from other counties into Kenton County is 64.1% while the commuting traffic from Kenton County into other counties is 72.3%.

Table 6 below provides Vehicle Miles Travelled (VMT) for all areas within the Cincinnati, OH-KY-IN CBSA for the year 2011. The counties within the Ohio portion of the CBSA contribute to the majority of VMT. Although Kenton County is not the main contributor to VMT, it does contribute a significant number of VMT within the CBSA. High VMT is associated with urban areas and linked with motor vehicle emissions that may contribute to ozone formation.

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Table 6
2011 VMT Totals, Cincinnati, OH-KY-IN CBSA

	2011 VMT Totals
Kentucky	
Boone County	1,558,794,112
Bracken County	104,160,119
Campbell County	1,010,009,434
Gallatin County	245,765,593
Grant County	529,145,674
Kenton County	1,720,886,038
Pendleton County	184,074,537
KY Total	5,352,835,507
Ohio	
Brown County	468,171,663
Butler County	3,099,030,997
Clermont County	1,951,343,156
Hamilton County	9,004,357,566
Warren County	2,139,774,797
OH Total	16,662,678,179
Indiana	
Dearborn County	690,348,611
Ohio County	71,591,617
Union County	105,444,221
IN Total	867,384,449
Total VMT for CBSA	22,882,898,135

Non-Road Mobile Sources

As seen in Table 2, non-road mobile source VOC emissions from Kenton County were estimated at 418.90 tpy in 2011, which represents approximately 5.4% of the total 7,755.55 tpy of the overall VOC non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-road mobile sources in the CBSA, by county.

As shown in Table 3, non-road mobile source NO_x emissions from Kenton County were estimated at 521.34 tpy in 2011, which represents approximately 5.8% of the total 8,957.71 tpy of the overall NO_x non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for non-road mobile sources in the CBSA, by county.

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Comparison of Total Emissions

A comparison of total emissions across the entire Cincinnati, OH-KY-IN CBSA was performed using data from the EPA Ozone Designations Mapping Tool. The percentages shown in last column in both Tables 4 and 5 demonstrate that the majority of VOC and NOx emissions within the Cincinnati, OH-KY-IN CBSA come from the Ohio portion of the CBSA.

Population

Based on 2015 from the U.S. Census Bureau, there are 165,012 persons living in Kenton County. (Refer to table 7) This represents approximately 1,018.6 persons per square mile. The population of Kenton County is approximately 7% rural with the remaining 93% living in incorporated areas. The largest cities in Kenton County are Covington and Independence.

Kenton County's population from 2010-2015 *increased* approximately 3.3%. For the entire Cincinnati, OH-KY-IN CBSA, Kenton County represents approximately 7.6% of the total population in the CBSA and 37.4% of the Kentucky portion of the CBSA. (Refer to table 8)

Table 7
Northern Kentucky Area Population
Growth Data

County	Census 2010	2015*	%Growth 2010 - 2015
Boone	118,811	127,712	7.5%
Bracken	8,488	8,321	-2.0%
Campbell	90,336	92,066	1.9%
Gallatin	8,589	8,636	0.5%
Grant	24,662	24,757	0.4%
Kenton	159,720	165,012	3.3%
Pendleton	14,877	14,408	-3.1%

*U.S. Census Bureau estimates.

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Table 8
2015 Population
Cincinnati, OH-KY-IN CBSA

CBSA Estimated Population	2015*	2015 Population Density (1,000 per square mile)	% of Total	
Kentucky			**of KY Portion**	**of CBSA**
Boone County	127,712	0.52	29.0%	5.9%
Bracken County	8,321	0.04	1.9%	0.5%
Campbell County	92,066	0.61	20.9%	4.3%
Gallatin County	8,636	0.09	2.0%	0.4%
Grant County	24,757	0.10	5.6%	1.2%
Kenton County	165,012	1.03	37.4%	7.6%
Pendleton County	14,408	0.05	3.3%	0.7%
KY Total	440,912	--	100%	20.6%
Ohio			**of OH Portion**	
Brown County	43,839	0.09	2.7%	2.0%
Butler	376,353	0.81	22.8%	17.4%
Clermont County	201,973	0.45	12.2%	9.4%
Hamilton County	807,598	1.99	48.8%	37.4%
Warren County	224,469	0.56	13.6%	10.4%
OH Total	1,654,232	--	100%	76.7%
Indiana			**of IN Portion**	
Dearborn County	49,455	0.16	79.0%	2.3%
Ohio County	5,938	0.07	9.5%	0.3%
Union County	7,182	0.04	11.5%	0.3%
IN Total	62,575	--	100%	2.9%
Total Estimated Population	2,157,719	--	100%	100%

*U.S. Census Bureau estimates.

Areas of dense population and high VMT can display elevated nonpoint and on-road source emissions. As seen in Tables 2 and 3, two of the sectors with the highest emission contribution are from nonpoint (VOC) and on-road (NOx). This correlation indicates that VMT and population density within Kenton County may be contributing to the violating monitor within the CBSA.

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Meteorological Information

Wind speed and wind direction data collected at the Cincinnati-Northern Kentucky Airport (NWS Station 93814) for the period 2013-2015 shows that the majority of the time the wind in the area came from the southwest and typically from 2.1-3.6 miles per hour (Refer to figure 1). According to Kentucky Mesonet (http://www.kymesonet.org/), the average high temperature for July for the period 2013-2015 was 90.1° F and the average low temperature for July was 53.7° F. The average July precipitation for the same period (2013-2015) was 4.63 inches.

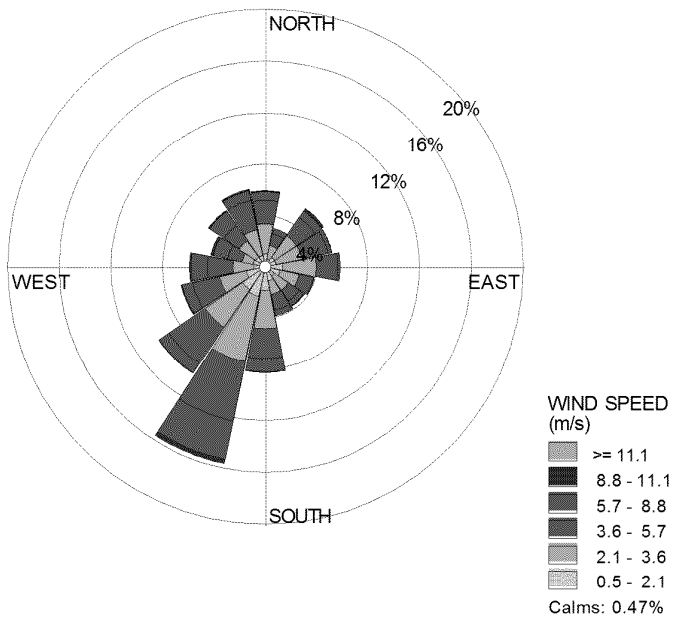

Figure 1: Wind Rose Average 2013-2015 March 1st - October 31st

Several 48-hour back trajectory HYSPLITS for Ohio and Kentucky have been included in Section 8 for days in 2013-2015 when the 8-hour ambient monitoring concentration for ozone had their highest readings. These HYSPLITS show that, for the majority of the time, the air column does come from the south-southwest. Therefore, the low emission levels from Kenton County do not affect the violating monitor located in Campbell County.

Geography and Topography

Kenton County is part of the Cincinnati, OH-KY-IN CBSA and has a land area of 162 square miles. Located on the banks of the Ohio River, Kenton County lies west of Campbell County, east of Boone County, and to the south of Cincinnati, Ohio. Kenton County is well dissected by numerous small streams that flow into the Licking and Ohio Rivers. Hilly terrain predominates and few flat areas are

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present. The highest elevation is 960 feet, located on the divide between Banklick and Cruises Creeks near the Kenton-Boone County line.

Kenton County does not have any geographical or topographical distinctions that interfere with air pollution transport. Therefore, this factor is not a significant part of the overall analysis.

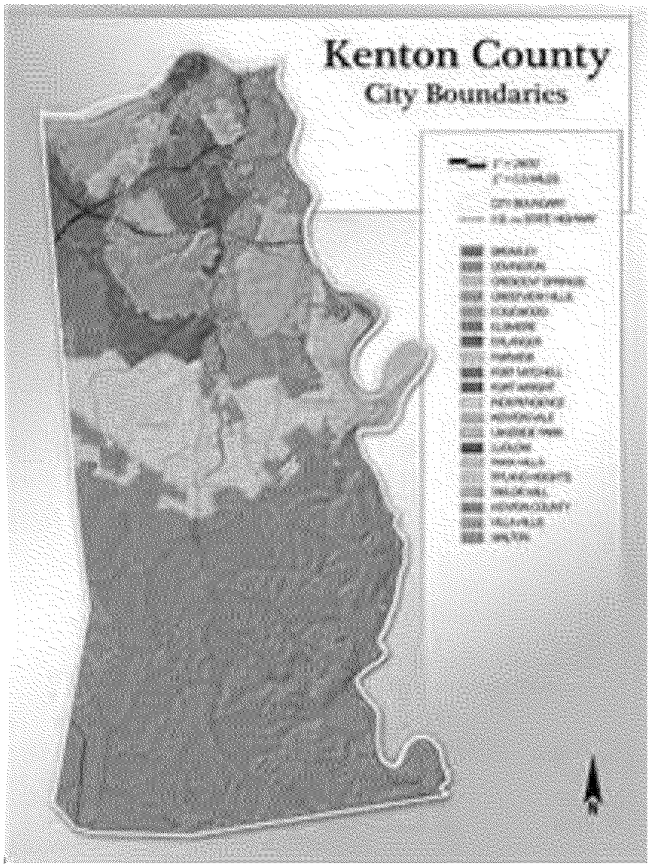

Figure 2: Kenton County Topography Map

Jurisdictional Boundaries

The authority for air quality planning in the Kenton County area resides with the Kentucky Energy and Environment Cabinet. Transportation planning for Kenton County is performed by the Ohio, Kentucky, and Indiana Regional Council of Governments (OKI). Historically, portions of Boone, Campbell, and Kenton counties have been designated as nonattainment. These Kentucky counties along with Butler, Clermont, Clinton, Hamilton, Warren, Ohio and Dearborn, Indiana, were designated nonattainment for the 1997 and 2008 ozone standards. The 2008 ozone standard nonattainment area was confined to specific census tracts in the northern part of Boone, Campbell and Kenton counties.

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Conclusion and Recommendation

For the 2013-2015 monitoring period, there were no ozone monitors located in Kenton County.

As seen in Table 9 below, Kenton County's VOC and NOx emissions are relatively less than other counties located within the Cincinnati, OH-KY-IN CBSA. Kenton County contributes approximately:

- 5.5% of the total VOC emissions
- 4.4% of the total NO_x emissions

Table 9
VOC and NO_x Percentages for
Cincinnati, OH-KY-IN CBSA (2011 NEI)

County	VOC %	NO_X %
KENTUCKY		
Boone	7.1	7.5
Bracken	2.9	0.7
Campbell	3.8	2.3
Gallatin	2.3	1.6
Grant	4.0	1.9
Kenton	5.3	4.3
Pendleton	3.6	1.6
KY Total	**29.0%**	**19.9%**
OHIO		
Brown	5.7	1.7
Butler	12.9	12.9
Clermont	9.1	19.2
Hamilton	25.0	31.6
Warren	8.6	6.4
OH Total	**61.3%**	**71.8**
INDIANA		
Dearborn	6.1	7.6
Ohio	1.8	0.2
Union	1.8	0.5
IN Total	**9.7%**	**8.3%**
Total Emissions %	**100.0%**	**100.0%**

There are no distinguishable geographical or topographical elements that would affect VOC or NOx levels in Kenton County. The emission contributions from Kenton County are not as significant as other areas within the CBSA. The dominating factors that influence Kenton County's contribution to the violating monitor within the area involve population, VMT and commuting traffic.

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2010 Census Tract data gathered from EPA's Ozone Mapping Tool was used to analyze which portion of Kenton County could be contributing to the violating monitor in Campbell County based on high population areas. Although Kenton County does not have the highest population within the CBSA, the significant VMT levels along with commuting patterns suggest that there is a large urban population that leads to increased on-road and nonpoint source emissions. Additionally, due to winds from the southwest the majority of the time, the emissions from Kenton may be contributing to the violating monitor in Campbell County, KY.

Based on all available data, Kentucky recommends that the northern portion of Kenton County be designated as nonattainment for the 2015 8-hour ozone NAAQS. Specifically, the following census tracts within Kenton County should be designated as nonattainment: 603, 607, 609, 610, 611, 612, 613, 614, 616, 636.03, 636.04, 636.05, 636.06, 638, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655.01, 655.02, 656, 657, 658, 659, 668, 669, 670, and 671.

Figures 3a and 3b contain the census tracts listed above for the partial area of Kenton County recommended for "nonattainment" designation.

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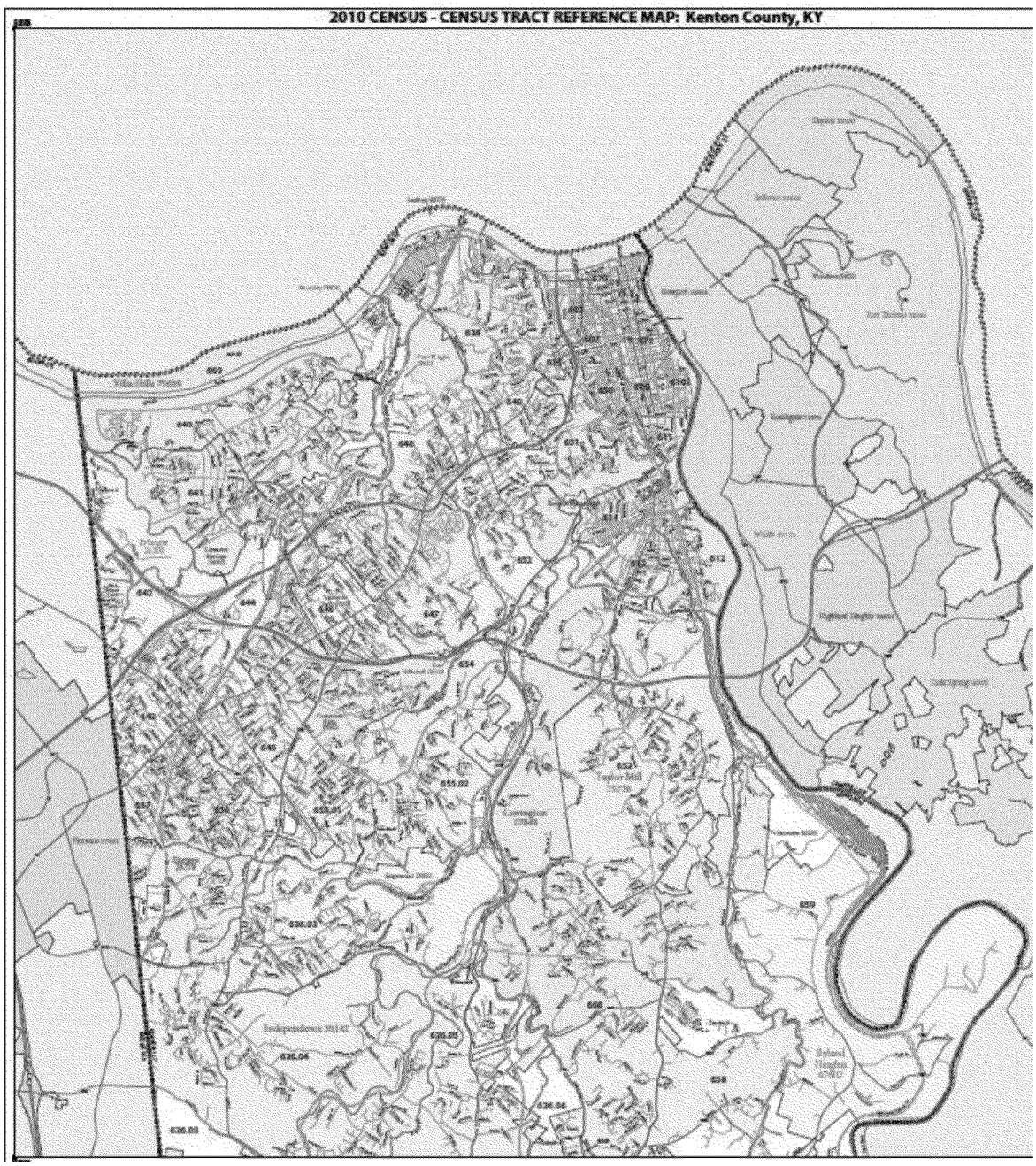

Figure 3a: Northern portion of Kenton County, KY

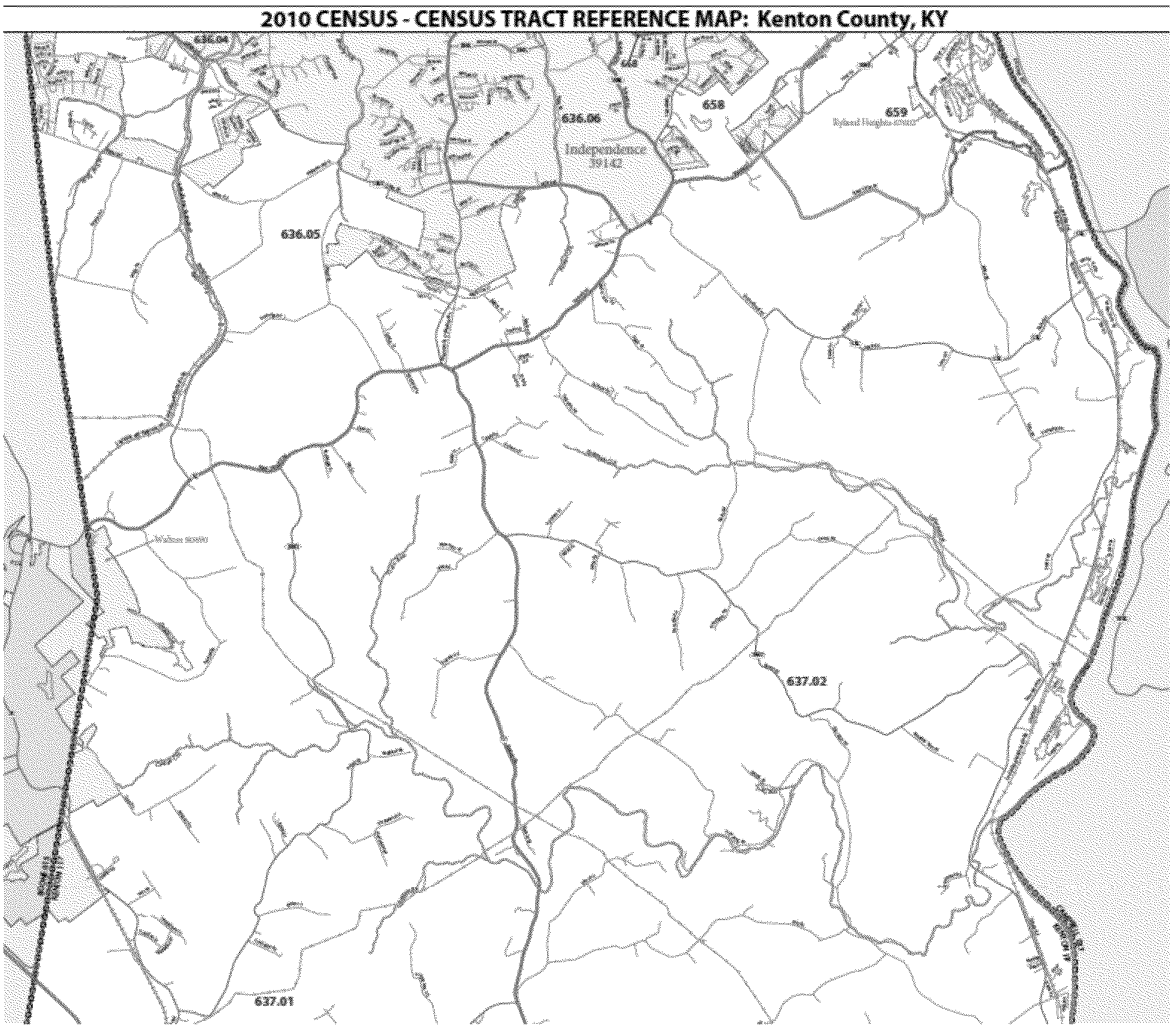

Figure 3b: Southern portion of Kenton County, KY

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Pendleton County, KY

Air Quality

Pursuant to 40 CFR 50:19 (b) and (d) the 8-hour primary and secondary NAAQS are met at an ambient air quality monitoring site when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to 0.070 ppm, as determined in accordance with Appendix U of Part 50. Currently, there is no ozone monitor located in Pendleton County.

Ozone air monitoring data and design values for 2013-2015 for the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA) were retrieved from https://www.epa.gov/air-trends/air-quality-design-values#report. Per the EPA website, "The design values shown here are computed using Federal Reference Method or equivalent data reported by State, Tribal, and Local monitoring agencies to EPA's Air Quality System (AQS) as of June 24, 2016." Table 1 provides a summary of the annual fourth-highest daily maximum 8-hour average ozone concentrations recorded at monitors located in the Cincinnati, OH-KY-IN Core Based Statistical Area (CBSA), for 2013-2015. Not all counties in the Cincinnati, OH-KY-IN CBSA have monitors for ozone. Monitor values included in Table 1 only reflect those monitors that were operational during the 2013 to 2015 design value period. Only the monitor in Campbell County, KY indicates a design value above the revised ozone NAAQS for the CBSA.

Table 1
Cincinnati, OH-KY-IN CBSA
3-year Average* of Annual 8-hour concentrations for Ozone

County/Site	AQS Code	Annual 4th High (ppm)			Design Value (ppm)
		2013	2014	2015	
Kentucky					
Boone	21-015-0003	0.059	0.062	0.062	0.061
Campbell	21-037-3002	0.072	0.071	0.071	0.071
Ohio					
Butler	39-017-0004	0.068	0.070	0.070	0.069
Butler	39-017-0018	0.068	0.069	0.070	0.069
Butler	39-017-9991	0.069	0.069	0.068	0.068
Clermont	39-025-0022	0.066	0.068	0.070	0.068
Hamilton	39-061-0006	0.069	0.070	0.072	0.070
Hamilton	39-061-0010	0.064	0.073	0.070	0.069
Hamilton	39-061-0040	0.069	0.069	0.071	0.069
Warren	39-165-0007	0.067	0.071	0.071	0.069

*NAAQS 8-hour (3 year average of the 4th max value). 0.070ppm
n/a indicates no monitor data for that county.

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Emissions and Emissions-Related Data

The U.S. EPA requires an emissions inventory to be developed in order to identify the level of emissions in a specific area and adjacent regions that may have contributed to an ozone violation. The EPA Ozone Designations Mapping Tool was used to obtain 2011 NEI v2 emissions inventory data. The 2011 NEI v2 is the latest available national emissions inventory data and is the source of the point, non-point, on-road, non-road and event emissions, and was used to evaluate Pendleton County's impact on the violating monitor. VOC and NOx emissions, by category, are provided in Tables 2 and 3.

Table 2
2011 NEI VOC Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	VOC (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	1019.03	3708.82	1156.27	960.74	210.59	**7055.45**
Bracken	13.41	2604.87	143.77	98.86	0.0	**2860.91**
Campbell	160.58	2658.31	785.96	260.64	0.0	**3865.49**
Gallatin	87.39	1872.80	230.24	95.01	49.75	**2335.19**
Grant	79.78	3246.13	422.24	239.93	2.86	**3990.94**
Kenton	232.80	3289.76	1405.33	418.90	0.0	**5346.79**
Pendleton	127.59	3137.17	227.50	44.20	80.48	**3616.94**
KY Total	**1720.58**	**20517.86**	**4371.31**	**2118.28**	**343.68**	**29071.71**
INDIANA						
Dearborn	1573.32	3500.17	752.90	152.55	144.58	**6123.52**
Ohio	0.01	1571.07	111.12	30.63	46.31	**1759.14**
Union	0.00	1500.88	127.38	218.28	0.00	**1846.54**
IN Total	**1573.33**	**6572.12**	**991.40**	**401.46**	**190.89**	**9729.20**
OHIO						
Brown	28.90	4558.87	969.87	111.49	24.69	**5693.82**
Butler	1146.62	6081.24	4556.78	1076.33	0.0	**12860.97**
Clermont	180.86	5500.53	2654.57	719.53	0.0	**9055.49**
Hamilton	978.46	10759.16	10490.15	2734.21	0.0	**24961.98**
Warren	262.03	4760.18	2741.38	812.53	0.0	**8576.12**
OH Total	**2596.87**	**31659.98**	**21412.75**	**5454.09**	**24.69**	**61148.38**
Total Emissions	**5890.78**	**58749.96**	**26775.46**	**7973.83**	**559.26**	**99949.29**

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Table 3
2011 NEI NO_x Emissions (tpy)
Cincinnati, OH-KY-IN CBSA

County	NOx (tons per year)					
	Point	Non-point	On-road	Non-road	Event	Total
KENTUCKY						
Boone	3569.19	801.83	3455.45	682.30	21.32	**8530.09**
Bracken	3.72	469.43	267.93	72.38	0.0	**813.46**
Campbell	82.95	666.79	1583.28	247.83	0.0	**2580.85**
Gallatin	609.76	357.34	832.85	42.53	5.00	**1847.48**
Grant	13.00	510.39	1590.13	96.12	0.28	**2209.92**
Kenton	147.17	818.13	3449.61	521.34	0.0	**4936.25**
Pendleton	949.22	350.98	385.47	77.48	7.90	**1771.05**
KY Total	**5375.01**	**3974.89**	**11564.72**	**1739.98**	**34.50**	**22689.10**
INDIANA						
Dearborn	6530.65	296.72	1610.93	196.33	6.62	**8641.25**
Ohio	0.00	76.65	164.59	28.77	2.75	**272.76**
Union	0.00	190.63	226.35	135.37	0.00	**552.35**
IN Total	**6530.65**	**564.00**	**2001.87**	**360.47**	**9.37**	**9466.36**
OHIO						
Brown	4.40	383.53	1288.36	254.07	2.39	**1932.75**
Butler	3989.32	1962.75	7108.70	1569.52	0.0	**14630.29**
Clermont	16000.81	592.15	4374.25	833.68	0.0	**21800.89**
Hamilton	9664.54	3798.10	19232.85	3145.46	0.0	**35840.95**
Warren	569.13	799.42	4743.52	1189.90	0.0	**7301.97**
OH Total	**30228.20**	**7535.95**	**36747.68**	**6992.63**	**2.39**	**81506.85**
Total Emissions	**42133.86**	**12074.84**	**50314.27**	**9093.08**	**46.26**	**113662.31**

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Table 4
VOC Emissions as % of Total VOC Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	16.6	17.5	39.4	35.3	**25.4**
Butler, OH	19.5	9.9	17.1	13.9	**13.1**
Clermont, OH	3.1	8.9	10.0	9.3	**9.2**
Warren, OH	4.4	7.7	10.3	10.5	**8.7**
Boone, KY	17.3	6.5	4.3	12.4	**7.2**
Dearborn, IN	27.0	5.7	2.8	2.0	**6.2**
Brown, OH	0.5	7.4	3.6	1.4	**5.8**
Kenton, KY	4.0	5.7	5.3	5.4	**5.5**
Grant, KY	1.4	5.3	1.6	3.1	**4.1**
Campbell, KY	2.7	4.3	2.9	3.4	**3.9**
Pendleton, KY	2.2	5.1	0.9	0.6	**3.7**
Bracken, KY	0.2	4.6	0.5	1.3	**2.9**
Gallatin, KY	1.5	3.3	0.9	1.2	**2.4**
Ohio. IN	0.0	2.6	0.4	0.4	**1.8**
Union, IN	0.0	2.6	0.5	2.7	**1.8**

Table 5
NOx Emissions as % of Total NOx Emissions
Cincinnati, OH-KY-IN CBSA

County	Point	Non Point	On-Road	Non-Road	Total MSA
Hamilton, OH	22.9	32.0	38.4	35.1	**31.4**
Clermont, OH	38.0	5.0	8.7	9.3	**19.1**
Butler, OH	9.5	16.5	14.2	17.5	**12.8**
Dearborn, IN	15.5	2.5	3.2	2.2	**7.6**
Boone, KY	8.5	6.7	6.9	7.6	**7.5**
Warren, OH	1.4	6.7	9.5	13.3	**6.4**
Kenton, KY	0.4	6.9	6.9	5.8	**4.3**
Campbell, KY	0.2	5.6	3.2	2.8	**2.3**
Grant, KY	3.1	4.3	3.2	1.1	**1.9**
Brown, OH	0.0	3.2	2.6	2.8	**1.7**
Gallatin, KY	1.4	3.0	1.7	0.5	**1.6**
Pendleton, KY	2.3	3.0	0.8	0.9	**1.5**
Bracken, KY	0.0	4.0	0.5	0.8	**0.7**
Union, IN	0.0	0.8	1.5	1.5	**0.5**
Ohio. IN	0.0	0.6	0.3	0.3	**0.2**

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Point Sources

Table 2 indicates 2011 point source emissions of VOC in Pendleton County were estimated at 127.59 tpy. Total VOC point source emissions from the Cincinnati, OH-KY-IN CBSA were 5,890.78 tpy. Pendleton County represents approximately 2.2% of the total VOC point source emissions in the CBSA. Table 4 shows the percentages of VOC emissions for point sources in the CBSA, by county.

As seen in Table 3, point source NO_x emissions from Pendleton County were estimated at 949.22 tpy in 2011, which represents approximately 2.3% of the total 42,133.86 tpy of the overall NO_x point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for point sources in the CBSA, by county.

Non-Point (Area) Emissions

Table 2 shows that non-point (or "area") VOC emissions in Pendleton County were estimated to be 3,137.17 tpy in 2011, which represents approximately 5.5% of the total 57,249.08 tpy of the overall VOC non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-point sources in the CBSA, by county.

As seen in Table 3, non-point NO_x emissions from Pendleton County were estimated at 350.98 tpy in 2011, which represents approximately 3.0% of the total 11,884.21 tpy of the overall NO_x non-point source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NOx emissions for non-point sources in the CBSA, by county.

On-Road Mobile

As indicated in Table 2, on-road mobile source VOC emissions from Pendleton County were estimated at 227.50 tpy in 2011, which represents approximately 0.9% of the total 26,648.08 tpy of the overall VOC on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for on-road mobile sources in the CBSA, by county.

As seen in Table 3, on-road mobile source NO_x emissions from Pendleton County were estimated to be 385.47 tpy in 2011, which represents approximately 0.8% of the total 50,087.92 tpy of the overall NO_x on-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for on-road mobile sources in the CBSA, by county.

Based on 2014 information obtained from the U.S. Census website, http://onthemap.ces.census.gov/, the commuting traffic from other counties into Pendleton County is 48.4% while the commuting traffic from Pendleton County into other counties is 81.4%.

Table 6 below provides Vehicle Miles Travelled (VMT) for all areas within the Cincinnati, OH-KY-IN CBSA for the year 2011. The counties within the Ohio portion of the CBSA contribute to the majority of VMT within the CBSA. Pendleton County's VMT is significantly lower compared to other counties within the CBSA.

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Table 6
2011 VMT Totals, Cincinnati, OH-KY-IN CBSA

	2011 VMT Totals
Kentucky	
Boone County	1,558,794,112
Bracken County	104,160,119
Campbell County	1,010,009,434
Gallatin County	245,765,593
Grant County	529,145,674
Kenton County	1,720,886,038
Pendleton County	184,074,537
KY Total	5,352,835,507
Ohio	
Brown County	468,171,663
Butler County	3,099,030,997
Clermont County	1,951,343,156
Hamilton County	9,004,357,566
Warren County	2,139,774,797
OH Total	16,662,678,179
Indiana	
Dearborn County	690,348,611
Ohio County	71,591,617
Union County	105,444,221
IN Total	867,384,449
Total VMT for CBSA	22,882,898,135

Non-Road Mobile Sources

As listed in Table 2, non-road mobile source VOC emissions from Pendleton County were estimated at 44.20 tpy in 2011, which represents approximately 0.6% of the total 7,755.55 tpy of the overall VOC non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 4 shows the percentages of VOC emissions for non-road mobile sources in the CBSA, by county.

As seen in Table 3, non-road mobile source NO_x emissions from Pendleton County were estimated at 77.48 tpy in 2011, which represents approximately 0.9% of the total 8,957.71 tpy of the overall NO_x non-road mobile source emissions from the Cincinnati, OH-KY-IN CBSA. Table 5 shows the percentages of NO_x emissions for non-road mobile sources in the CBSA, by county.

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Comparison of Total Emissions

A comparison of total emissions across the entire Ohio, Kentucky, and Indiana CBSA was performed using data from the EPA Ozone Designations Mapping Tool. The percentages shown in last column in both Tables 4 and 5 demonstrate that the majority of VOC and NOx emissions within the Cincinnati, OH-KY-IN CBSA come from the Ohio portion of the CBSA.

Population

Based on U.S. Census Bureau estimates for 2015, there are 14,408 persons living in Pendleton County. (Refer to table 7) This represents approximately 51.5 persons per square mile. The population of Pendleton County is approximately 100% rural with few people living in incorporated areas. The largest cities in Pendleton County are Falmouth and Butler.

Pendleton County's population from 2010 to 2015 *decreased* by approximately -3.1%. For the entire Cincinnati, OH-KY-IN CBSA, Pendleton County represents approximately 0.7% of the total population in the CBSA and 3.5% of the Kentucky portion of the CBSA. (Refer to table 8)

Table 7
Northern Kentucky Area Population
Growth Data

County	Census 2010	2015*	%Growth 2010 - 2015
Boone	118,811	127,712	7.5%
Bracken	8,488	8,321	-2.0%
Campbell	90,336	92,066	1.9%
Gallatin	8,589	8,636	0.5%
Grant	24,662	24,757	0.4%
Kenton	159,720	165,012	3.3%
Pendleton	14,877	14,408	-3.1%

*U.S. Census Bureau estimates.

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Table 8
2015 Population
Cincinnati, OH-KY-IN CBSA

CBSA Estimated Population	2015*	2015 Population Density (1,000 per square mile)	% of Total	
Kentucky			**of KY Portion**	**of CBSA**
Boone County	127,712	0.52	29.0%	5.9%
Bracken County	8,321	0.04	1.9%	0.5%
Campbell County	92,066	0.61	20.9%	4.3%
Gallatin County	8,636	0.09	2.0%	0.4%
Grant County	24,757	0.10	5.6%	1.2%
Kenton County	165,012	1.03	37.4%	7.6%
Pendleton County	14,408	0.05	3.3%	0.7%
KY Total	440,912	--	100%	20.6%
Ohio			**of OH Portion**	
Brown County	43,839	0.09	2.7%	2.0%
Butler	376,353	0.81	22.8%	17.4%
Clermont County	201,973	0.45	12.2%	9.4%
Hamilton County	807,598	1.99	48.8%	37.4%
Warren County	224,469	0.56	13.6%	10.4%
OH Total	1,654,232	--	100%	76.7%
Indiana			**of IN Portion**	
Dearborn County	49,455	0.16	79.0%	2.3%
Ohio County	5,938	0.07	9.5%	0.3%
Union County	7,182	0.04	11.5%	0.3%
IN Total	62,575	--	100%	2.9%
Total Estimated Population	2,157,719	--	100%	100%

*U.S. Census Bureau estimates.

Areas of dense population and high VMT can display elevated nonpoint and on-road source emissions. As seen in Tables 2 and 3, two of the sectors with the highest emission contribution are from nonpoint for both VOC and NOx. However, Pendleton County emissions are low compared to other areas within the CBSA.

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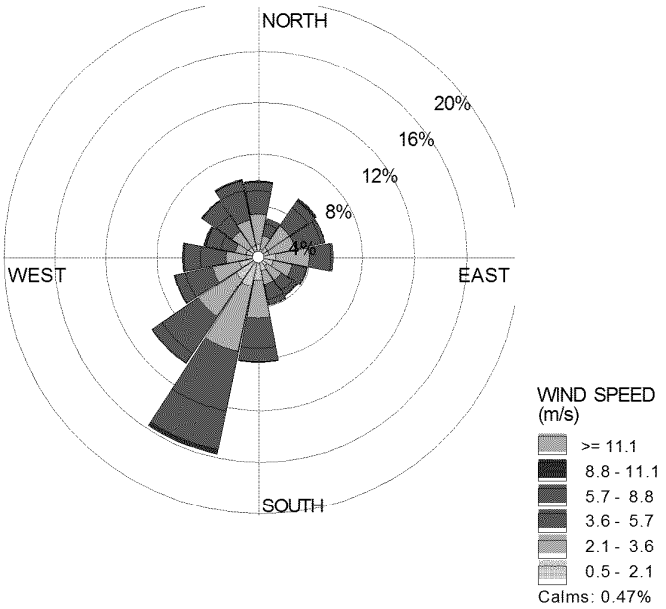
Meteorology

Wind speed and wind direction data collected at the Cincinnati-Northern Kentucky Airport (NWS Station 93814) for the period 2013-2015 shows that the majority of the time the wind in the area came from the southwest and typically from 2.1-3.6 miles per hour (Refer to figure 1). According to Kentucky Mesonet (http://www.kymesonet.org/), the average high temperature for July for the area from 2013 through 2015 was 91.9°F; the average low was 55.5°F. The average precipitation for the same period was 4.65 inches.

Figure 1: Wind Rose Average 2013-2015 March 1st - October 31st



Several 48-hour back trajectory HYSPLITS for Kentucky have been included in Section 8 for days in 2013-2015 when the 8-hour ambient monitoring concentration for ozone had their highest readings. As seen in the HYSPLITS, the position of Pendleton County relative to Campbell County along with predominant winds being from the southwest show that Pendleton County is not impacting the violating monitor in Campbell County.

Geography and Topography

Pendleton County is part of the Cincinnati, OH-KY-IN CBSA and has a land area of 280 square miles. Located in the central part of Northern Kentucky, Pendleton County lies directly south of Kenton and Campbell Counties and to the east of Grant County, Kentucky. The terrain is rolling and hilly. The Licking River makes broad loops ranging from 100 to 200 feet below the upland. The valley bottom is mainly where flat areas are found. The highest elevation is 960 feet, at a ridge adjoining Ky. 22 near the Pendleton-Bracken County line. The lowest elevation is 455 feet, in Carntown. Community elevations

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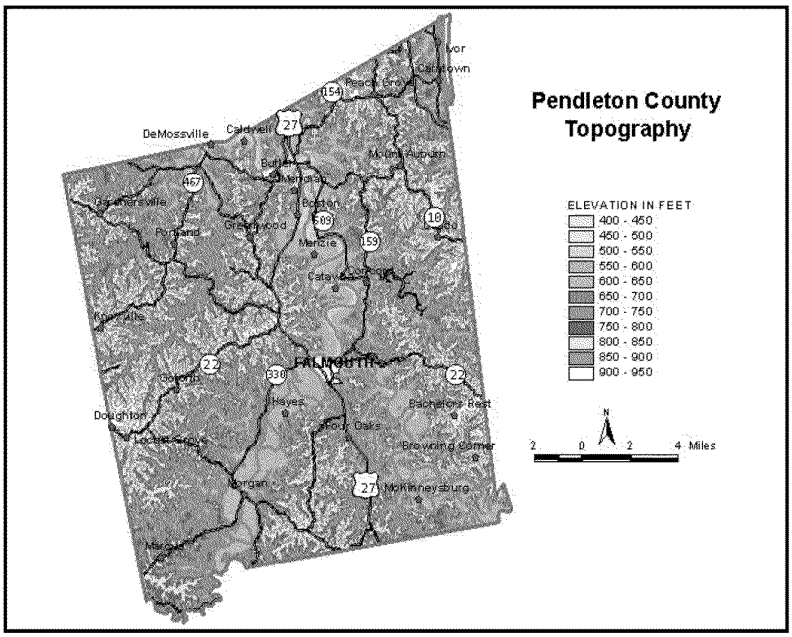
are as follows: Falmouth, the county seat, at 558 feet; Butler, 540 feet; DeMossville, 521 feet; Gardnersville, 882 feet.

Figure 2 shows the topography of Pendleton County. Pendleton County does not have any geographical or topographical distinctions that interfere with air pollution transport. Therefore, this factor is not a significant part of the overall analysis.

Figure 2: Pendleton County Topographic Map



Jurisdictional Boundaries

The authority for air quality planning in the Pendleton County area resides with the Kentucky Energy and Environment Cabinet. Transportation planning for Pendleton County is performed by the Kentucky Transportation Cabinet. Historically, portions of Boone, Campbell, and Kenton counties have been designated as nonattainment. These Kentucky counties along with Butler, Clermont, Clinton, Hamilton, Warren, Ohio, and Dearborn, Indiana were designated nonattainment for the 1997 and 2008 ozone standards. The 2008 ozone standard nonattainment area was confined to specific census tracts in the northern part of Boone, Campbell and Kenton counties.

Conclusion and Recommendation

There were no ozone monitors located in Pendleton County for the 2013-2015 monitoring period.

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As seen in Table 9 below, Pendleton County's VOC and NOx emissions are insignificant compared to other counties located within the Cincinnati, OH-KY-IN CBSA. Pendleton County contributes approximately:

- 3.6% of the total VOC emissions
- 1.6% of the total NO_x emissions

The emissions from Pendleton are negligible and do not significantly contribute to the 8-hour ozone standard in the Cincinnati, OH-KY-IN CBSA.

Table 9
VOC and NO_x Percentages for
Cincinnati, OH-KY-IN CBSA (2011 NEI)

County	VOC %	NO_X %
KENTUCKY		
Boone	7.1	7.5
Bracken	2.9	0.7
Campbell	3.8	2.3
Gallatin	2.3	1.6
Grant	4.0	1.9
Kenton	5.3	4.3
Pendleton	3.6	1.6
KY Total	**29.0%**	**19.9%**
OHIO		
Brown	5.7	1.7
Butler	12.9	12.9
Clermont	9.1	19.2
Hamilton	25.0	31.6
Warren	8.6	6.4
OH Total	**61.3%**	**71.8**
INDIANA		
Dearborn	6.1	7.6
Ohio	1.8	0.2
Union	1.8	0.5
IN Total	**9.7%**	**8.3%**
Total Emissions %	**100.0%**	**100.0%**

Data gathered for Pendleton County and reviewed using EPA's five factor analysis demonstrates that Pendleton County is not contributing to the violating monitor in Campbell County. Therefore, Kentucky recommends that Pendleton County be designated as "unclassifiable/attainment" for the 2015 8-hour ozone NAAQS.

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Back Trajectory Analysis Prepared by the Kentucky Division for Air Quality

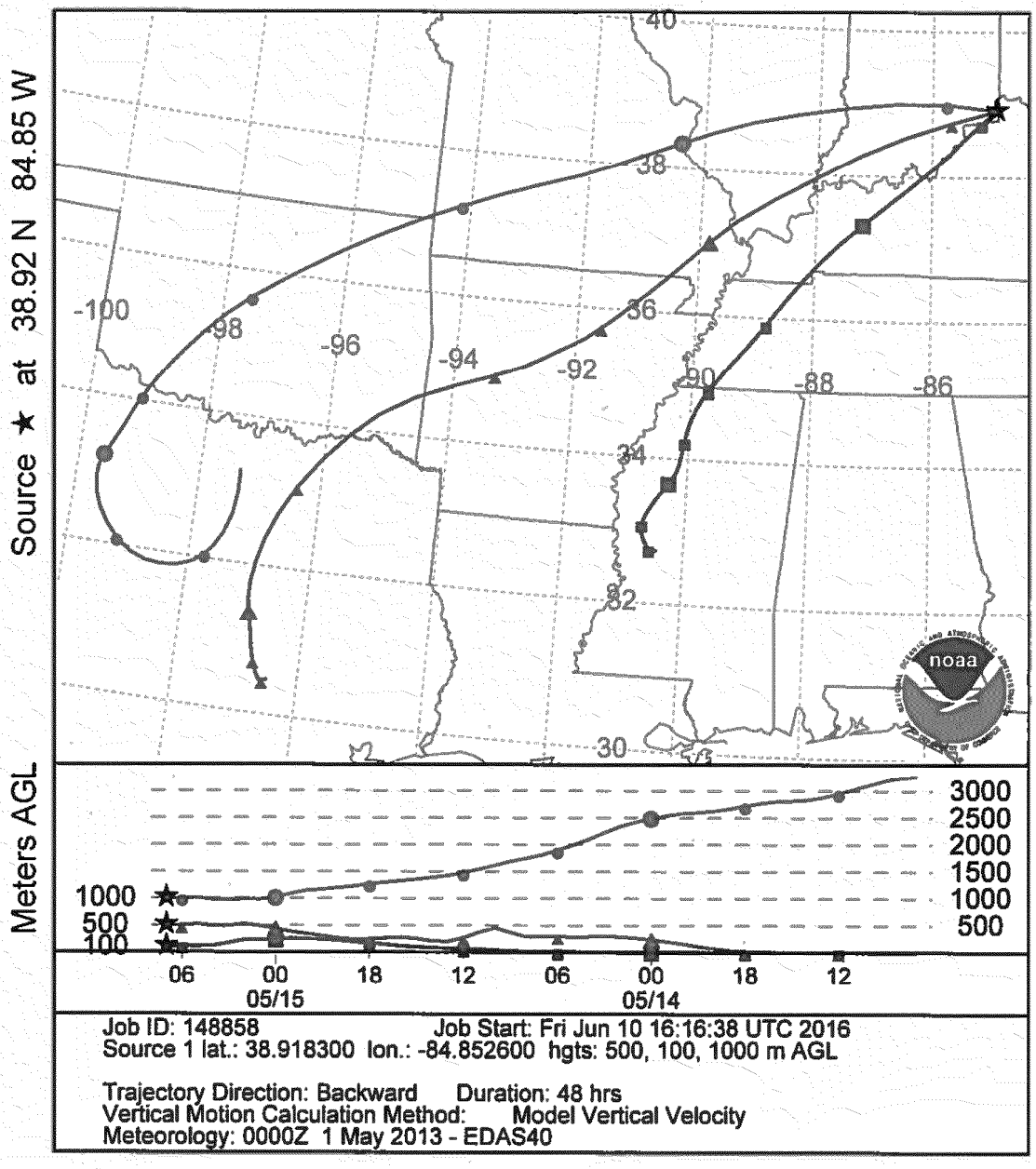
For the Boone County, Kentucky Ozone Monitor

Using NOAA's HYSPLIT Trajectory Model

East Bend (Boone County) Ozone Monitor (AQS: 21-015-0003)
2013 8-Hour Average Top Four Maximum Values

Date	Start Hour (EST)	8-Hour Reading (PPM)	
05/15/2013	11	.071	
08/29/2013	11	.062	
05/14/2013	12	.060	
04/05/2013	11	.059	(4th Max)

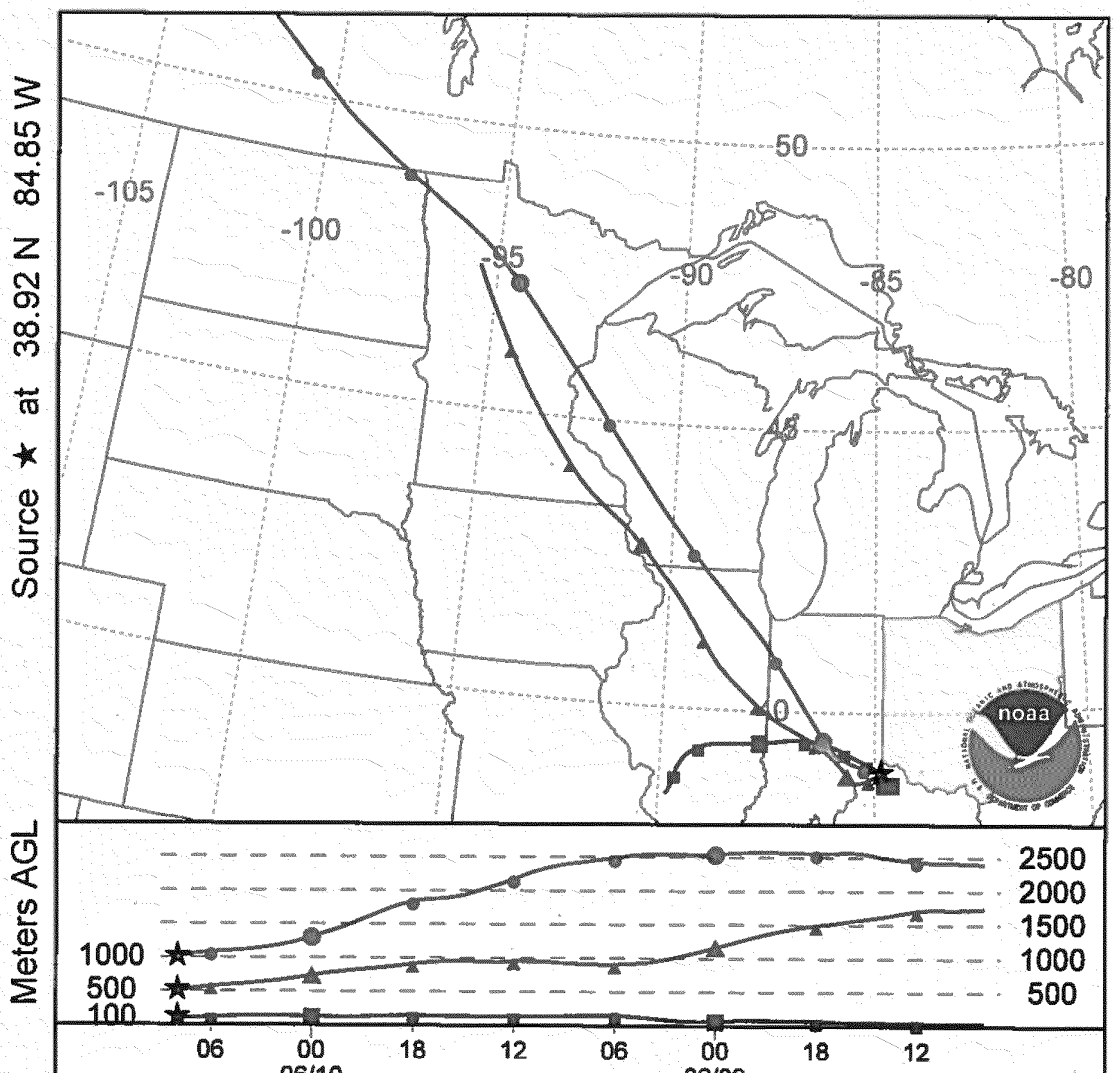
NOAA HYSPLIT MODEL
Backward trajectories ending at 0700 UTC 15 May 13
EDAS Meteorological Data



East Bend (Boone County) Ozone Monitor (AQS: 21-015-0003)
2015 8-Hour Average Top Four Maximum Values

Date	Start Hour (EST)	8-Hour Reading (PPM)	
06/10/2015	12	.071	
05/06/2015	11	.069	
07/25/2015	11	.062	
09/04/2015	11	.062	(4th Max)

NOAA HYSPLIT MODEL
Backward trajectories ending at 0800 UTC 10 Jun 15
EDAS Meteorological Data



Job ID: 148996 Job Start: Fri Jun 10 16:21:48 UTC 2016
Source 1 lat.: 38.918300 lon.: -84.852600 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 1 Jun 2015 - EDAS40

Back Trajectory Analysis Prepared by the Kentucky Division for Air Quality

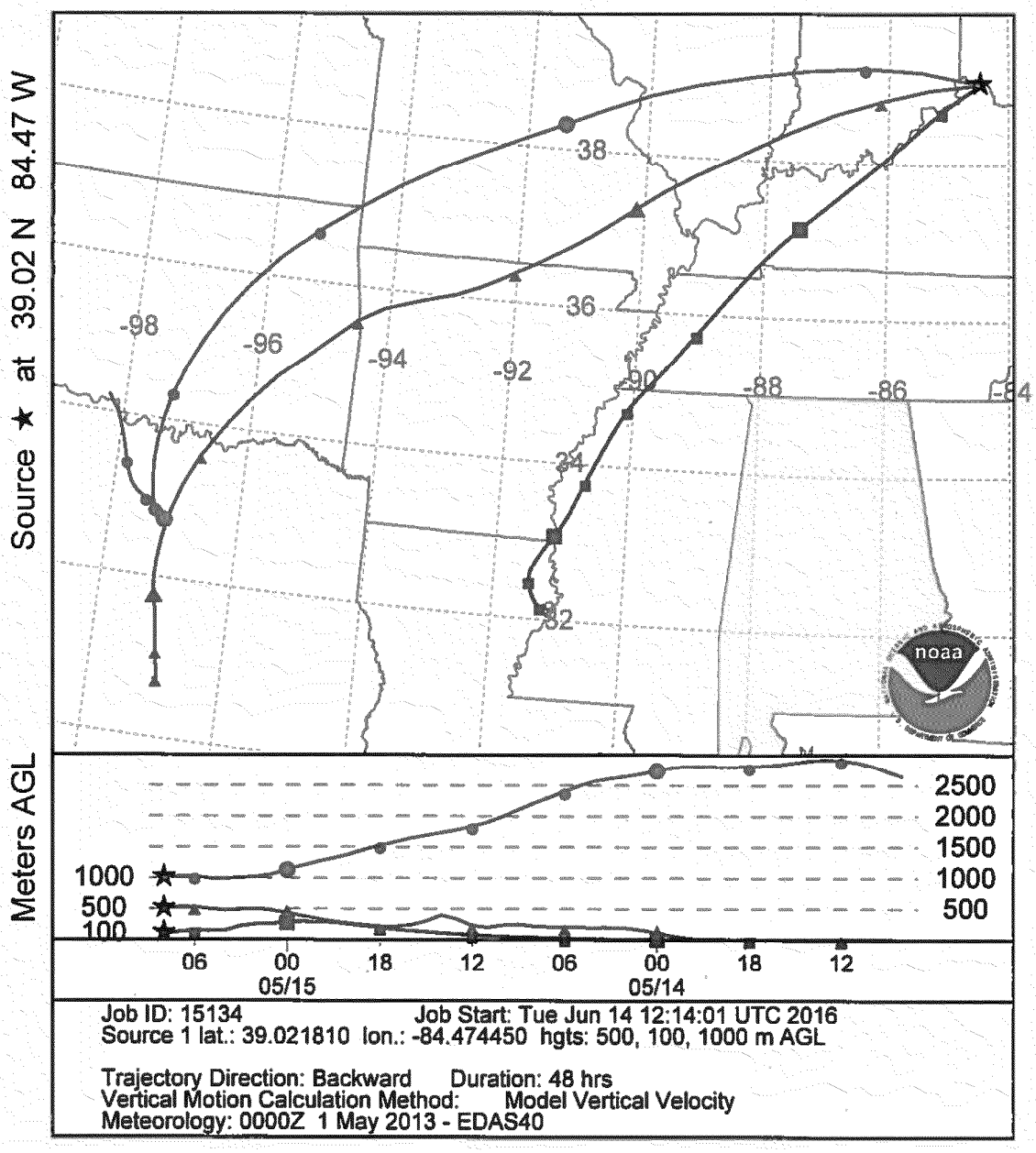
For the Campbell County, Kentucky Ozone Monitor

Using NOAA's HYSPLIT Trajectory Model

Highland Heights (Campbell County) Ozone Monitor (AQS: 21-037-3002)
2013 8-Hour Average Top Four Maximum Values

Date	Start Hour (EST)	8-Hour Reading (PPM)	
05/15/2013	12	.079	
08/19/2013	12	.076	
09/08/2013	11	.072	
09/11/2013	13	.072	(4th Max)

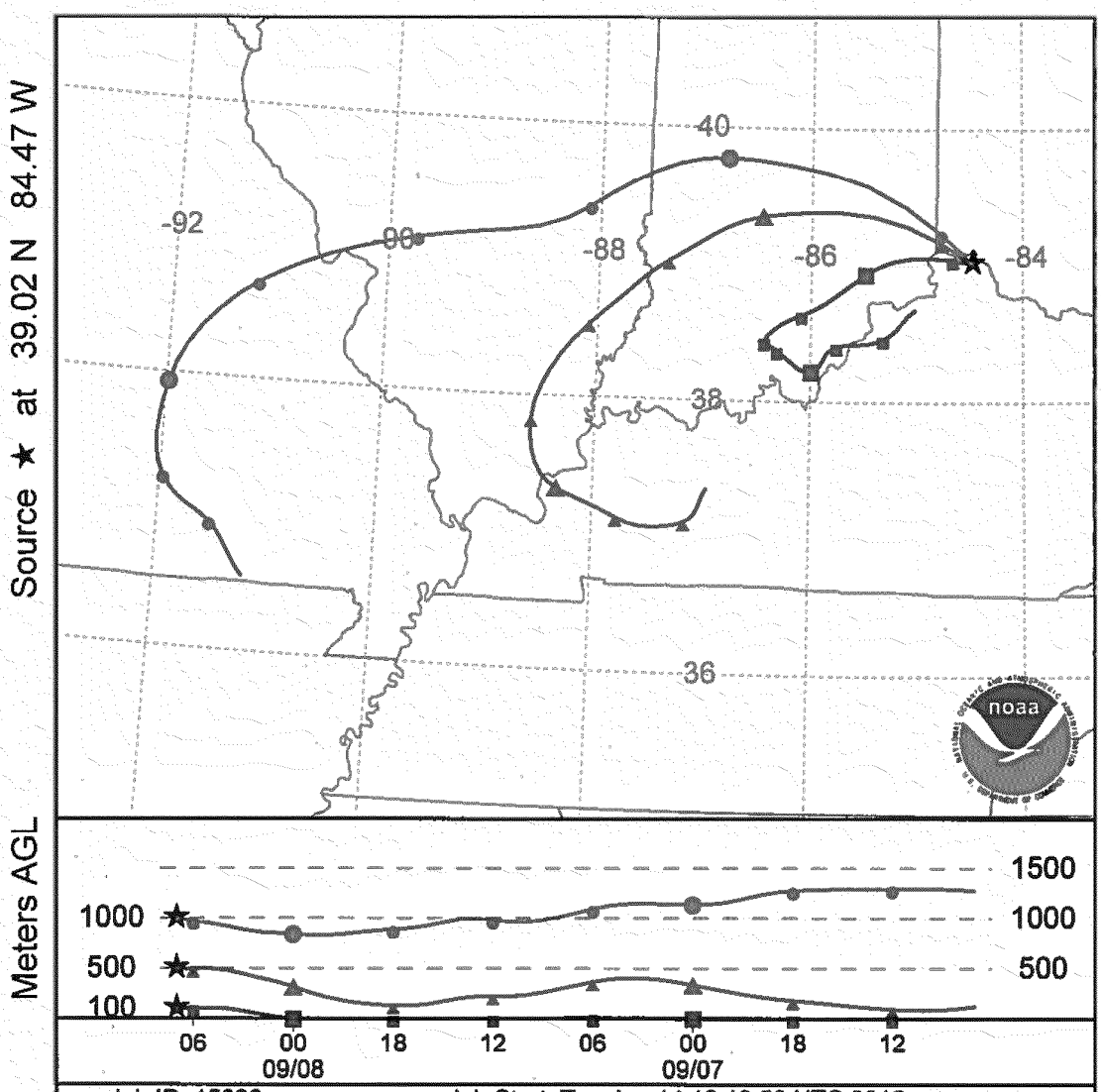
NOAA HYSPLIT MODEL
Backward trajectories ending at 0800 UTC 15 May 13
EDAS Meteorological Data



Job ID: 15134 Job Start: Tue Jun 14 12:14:01 UTC 2016
Source 1 lat.: 39.021810 lon.: -84.474450 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 1 May 2013 - EDAS40

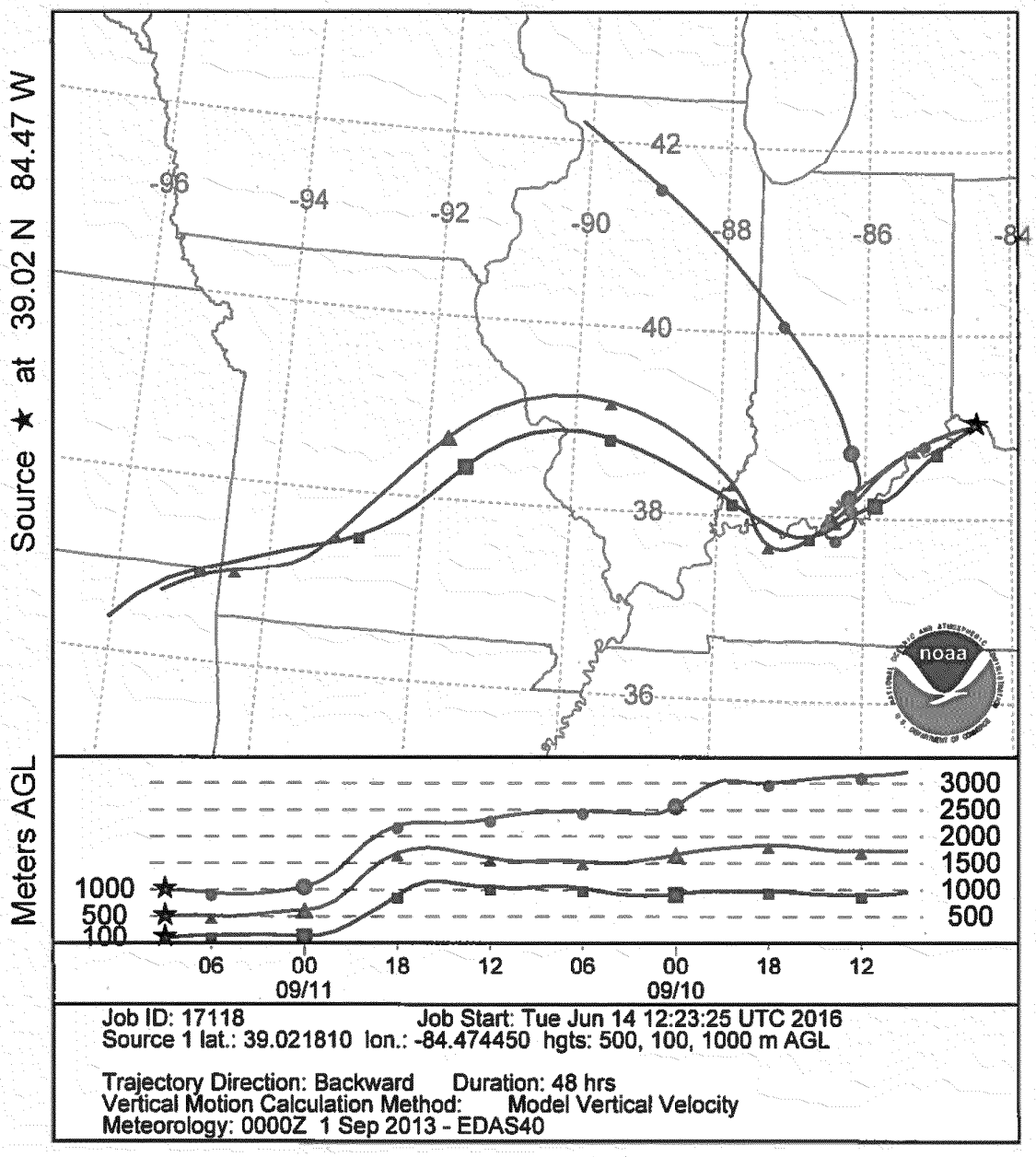
NOAA HYSPLIT MODEL
Backward trajectories ending at 0700 UTC 08 Sep 13
EDAS Meteorological Data



Job ID: 15826 Job Start: Tue Jun 14 12:19:58 UTC 2016
Source 1 lat.: 39.021810 lon.: -84.474450 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 1 Sep 2013 - EDAS40

NOAA HYSPLIT MODEL
Backward trajectories ending at 0900 UTC 11 Sep 13
EDAS Meteorological Data



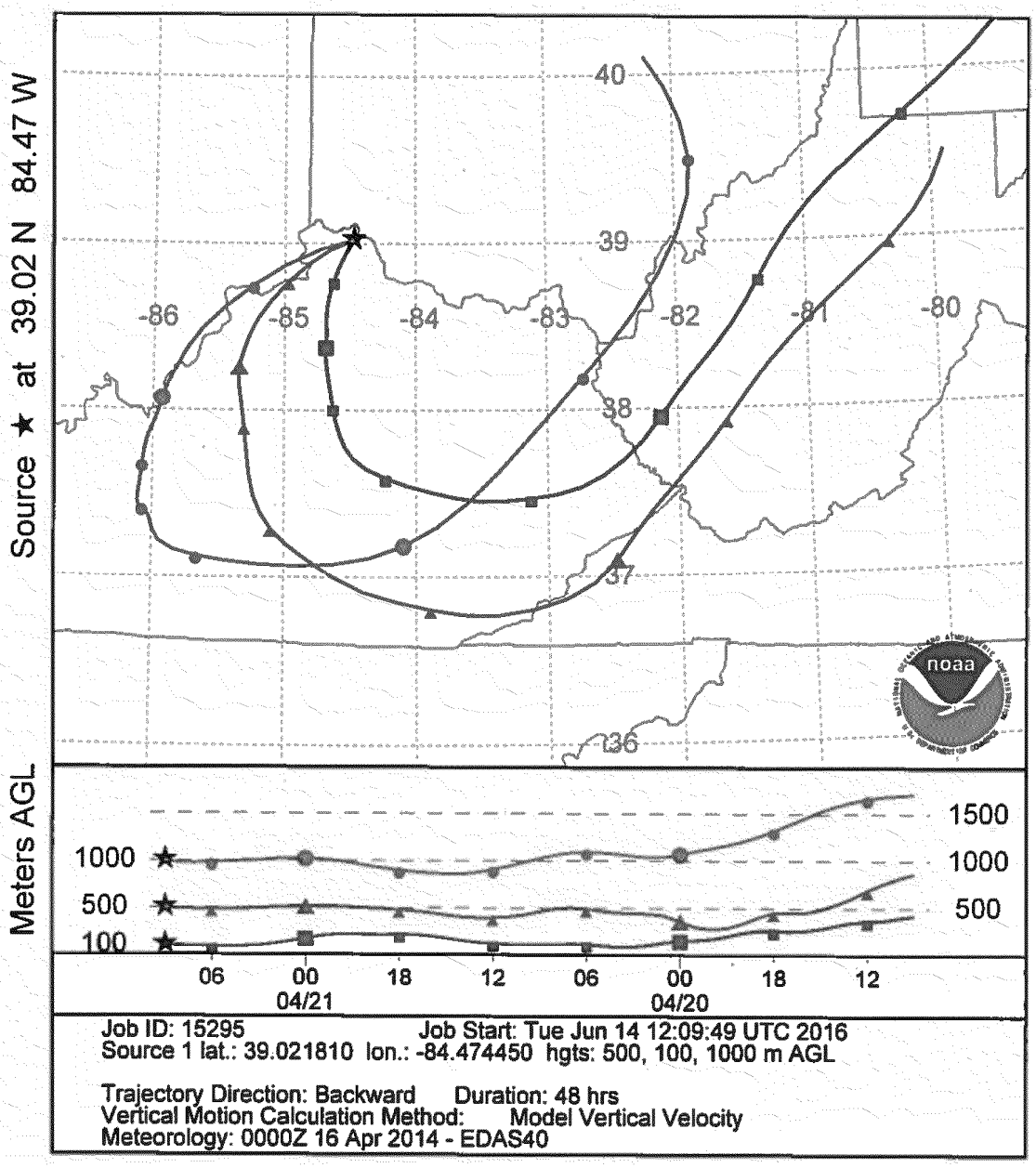
Job ID: 17118 Job Start: Tue Jun 14 12:23:25 UTC 2016
Source 1 lat.: 39.021810 lon.: -84.474450 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 1 Sep 2013 - EDAS40

Highland Heights (Campbell County) Ozone Monitor (AQS: 21-037-3002)
2014 8-Hour Average Top Four Maximum Values

Date	Start Hour (EST)	8-Hour Reading (PPM)	
07/11/2014	12	.074	
08/04/2014	11	.074	
07/12/2014	11	.072	
04/21/2014	13	.071	(4th Max)

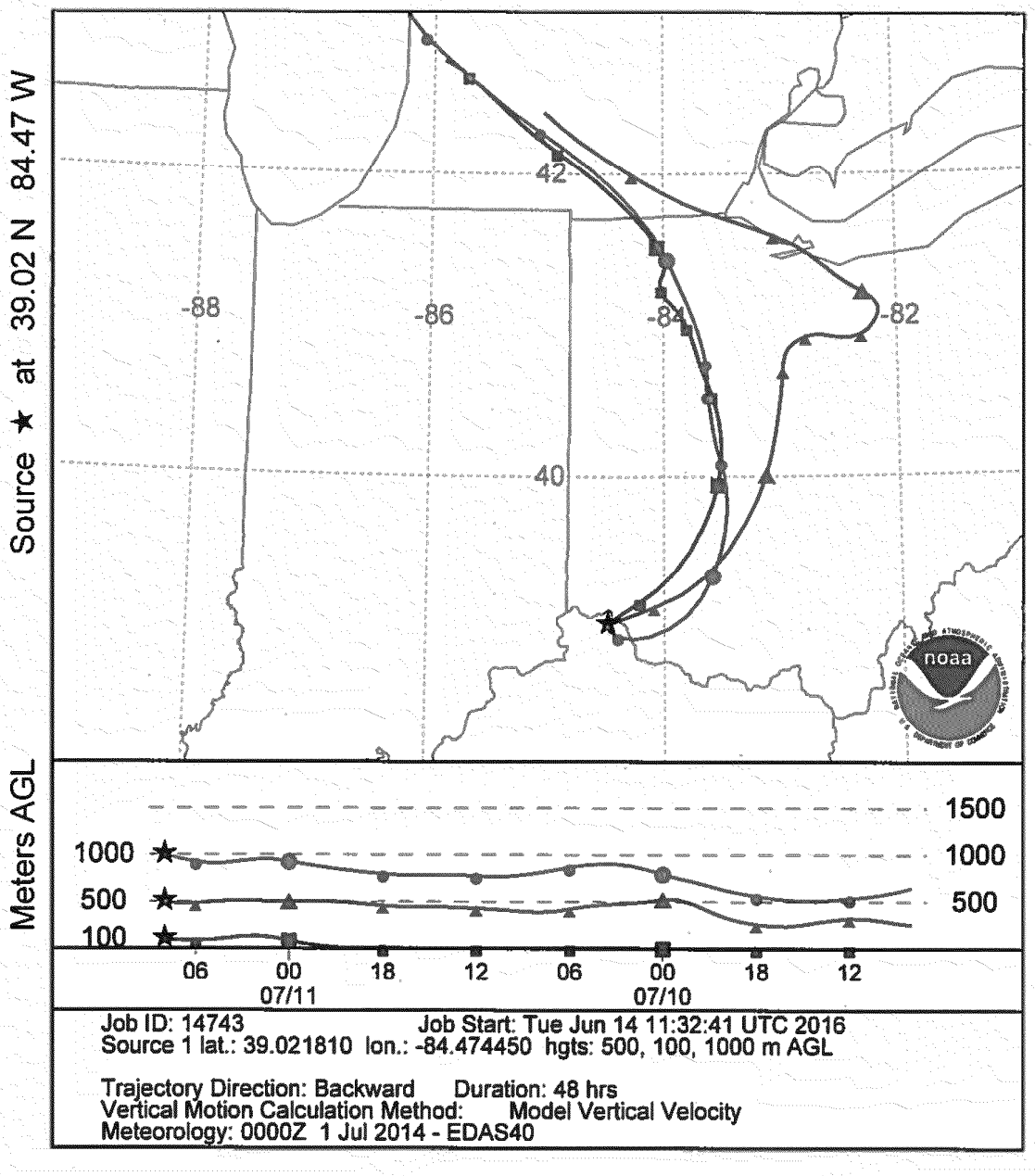
NOAA HYSPLIT MODEL
Backward trajectories ending at 0900 UTC 21 Apr 14
EDAS Meteorological Data



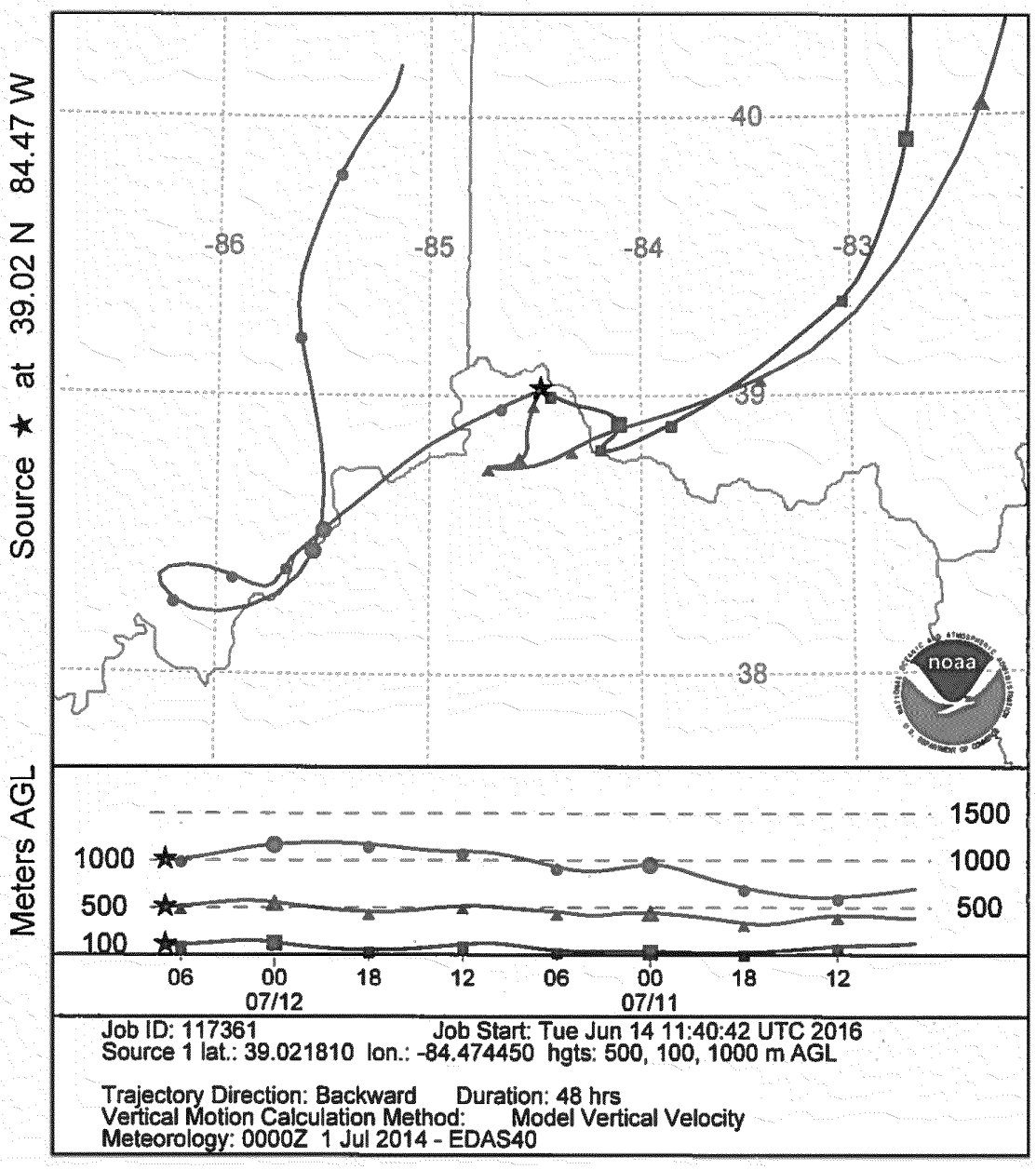
Job ID: 15295 Job Start: Tue Jun 14 12:09:49 UTC 2016
Source 1 lat.: 39.021810 lon.: -84.474450 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 16 Apr 2014 - EDAS40

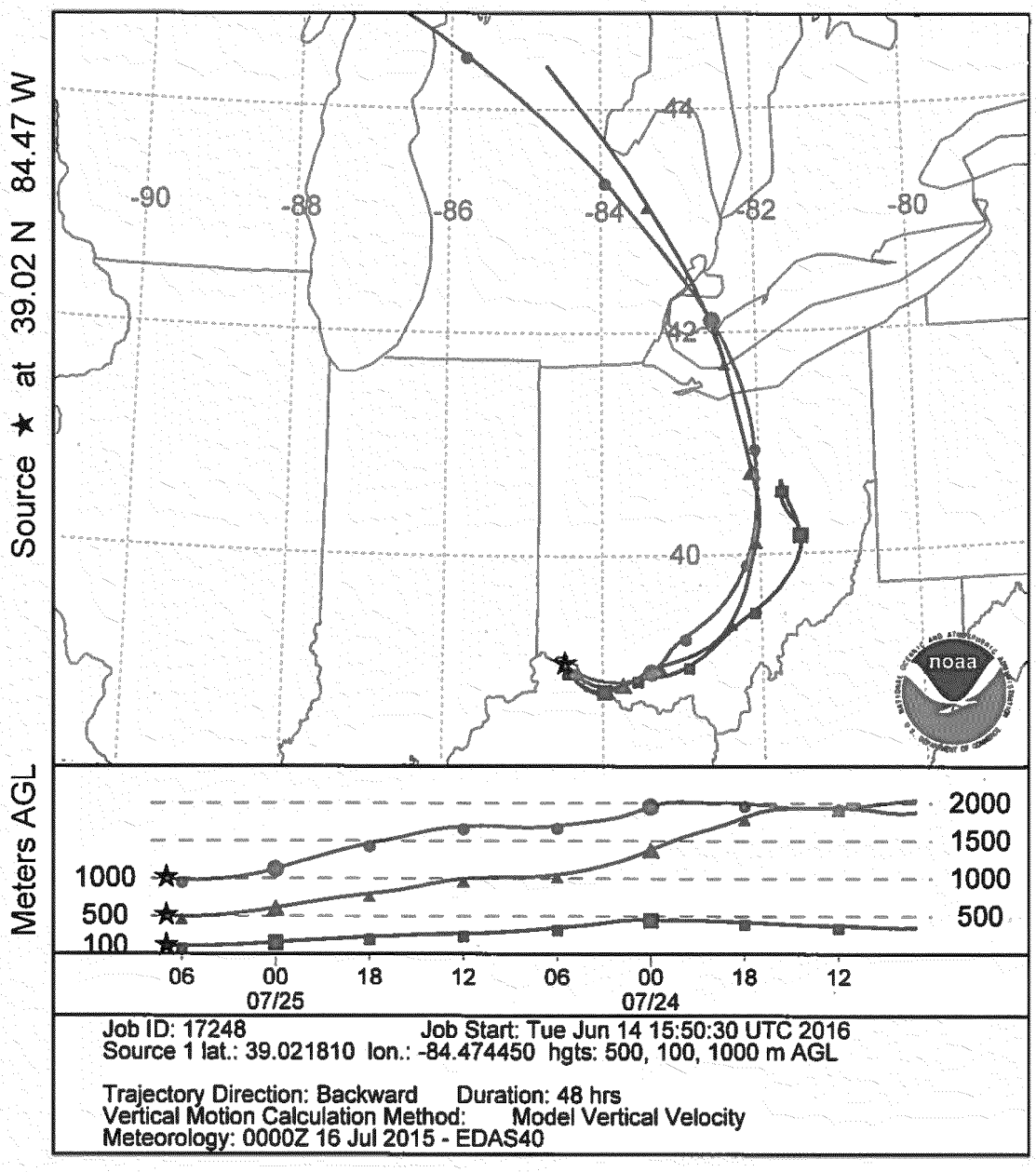
NOAA HYSPLIT MODEL
Backward trajectories ending at 0800 UTC 11 Jul 14
EDAS Meteorological Data



NOAA HYSPLIT MODEL
Backward trajectories ending at 0700 UTC 12 Jul 14
EDAS Meteorological Data



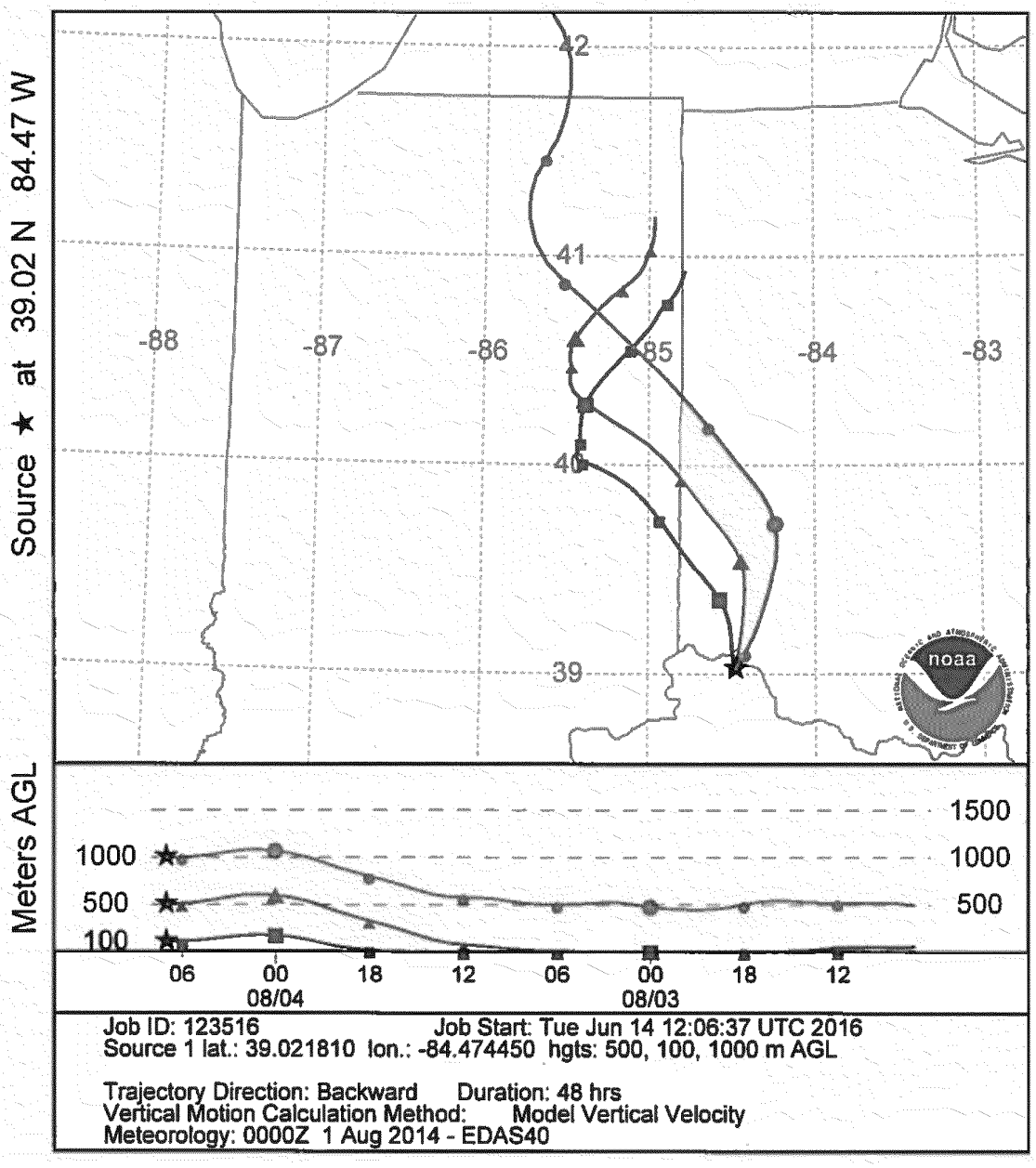
NOAA HYSPLIT MODEL
Backward trajectories ending at 0700 UTC 25 Jul 15
EDAS Meteorological Data



Job ID: 17248 Job Start: Tue Jun 14 15:50:30 UTC 2016
Source 1 lat.: 39.021810 lon.: -84.474450 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 16 Jul 2015 - EDAS40

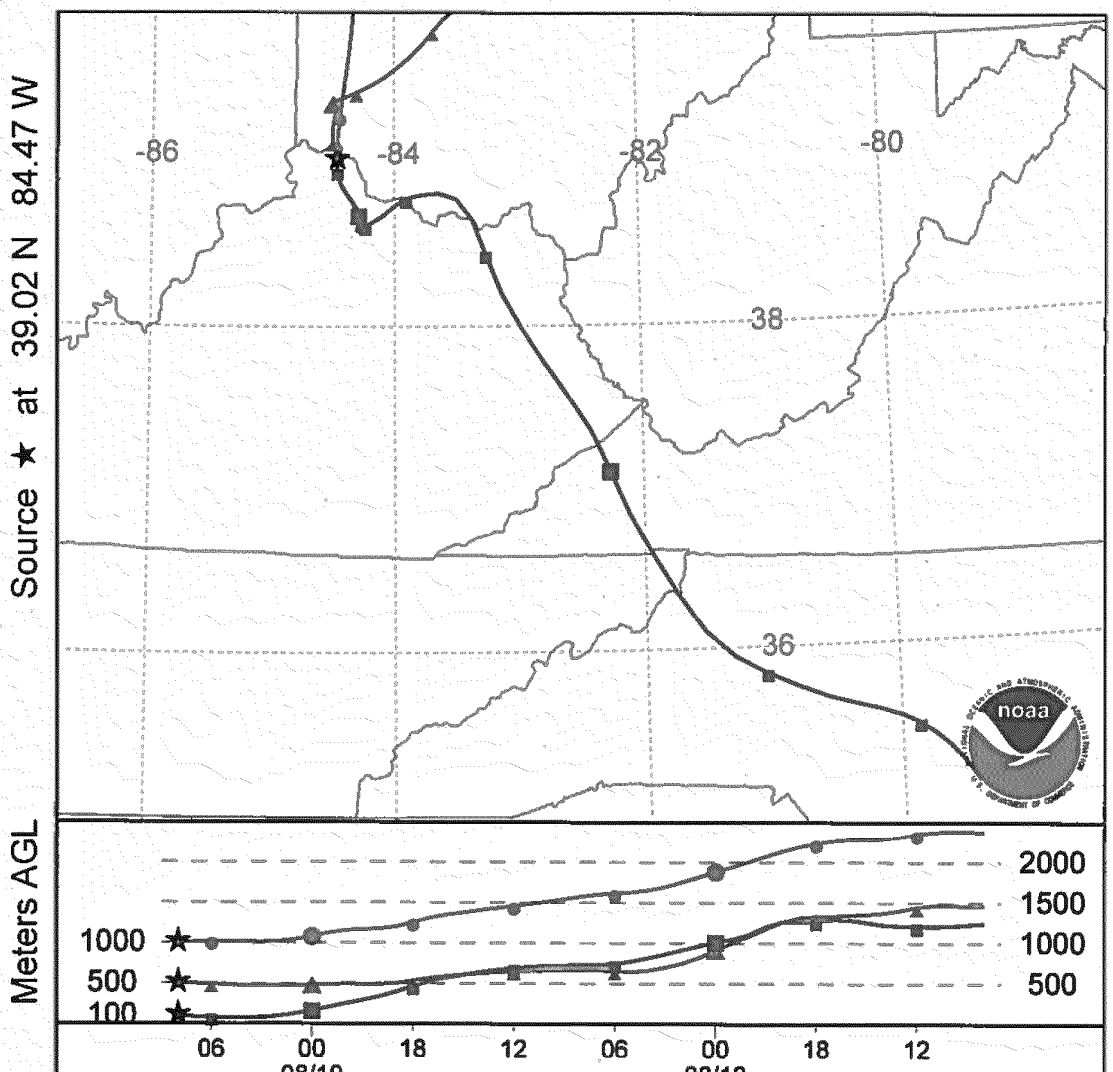
NOAA HYSPLIT MODEL
Backward trajectories ending at 0700 UTC 04 Aug 14
EDAS Meteorological Data



Job ID: 123516 Job Start: Tue Jun 14 12:06:37 UTC 2016
Source 1 lat.: 39.021810 lon.: -84.474450 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 1 Aug 2014 - EDAS40

NOAA HYSPLIT MODEL
Backward trajectories ending at 0800 UTC 19 Aug 13
EDAS Meteorological Data



Job ID: 19048 Job Start: Tue Jun 14 12:16:56 UTC 2016
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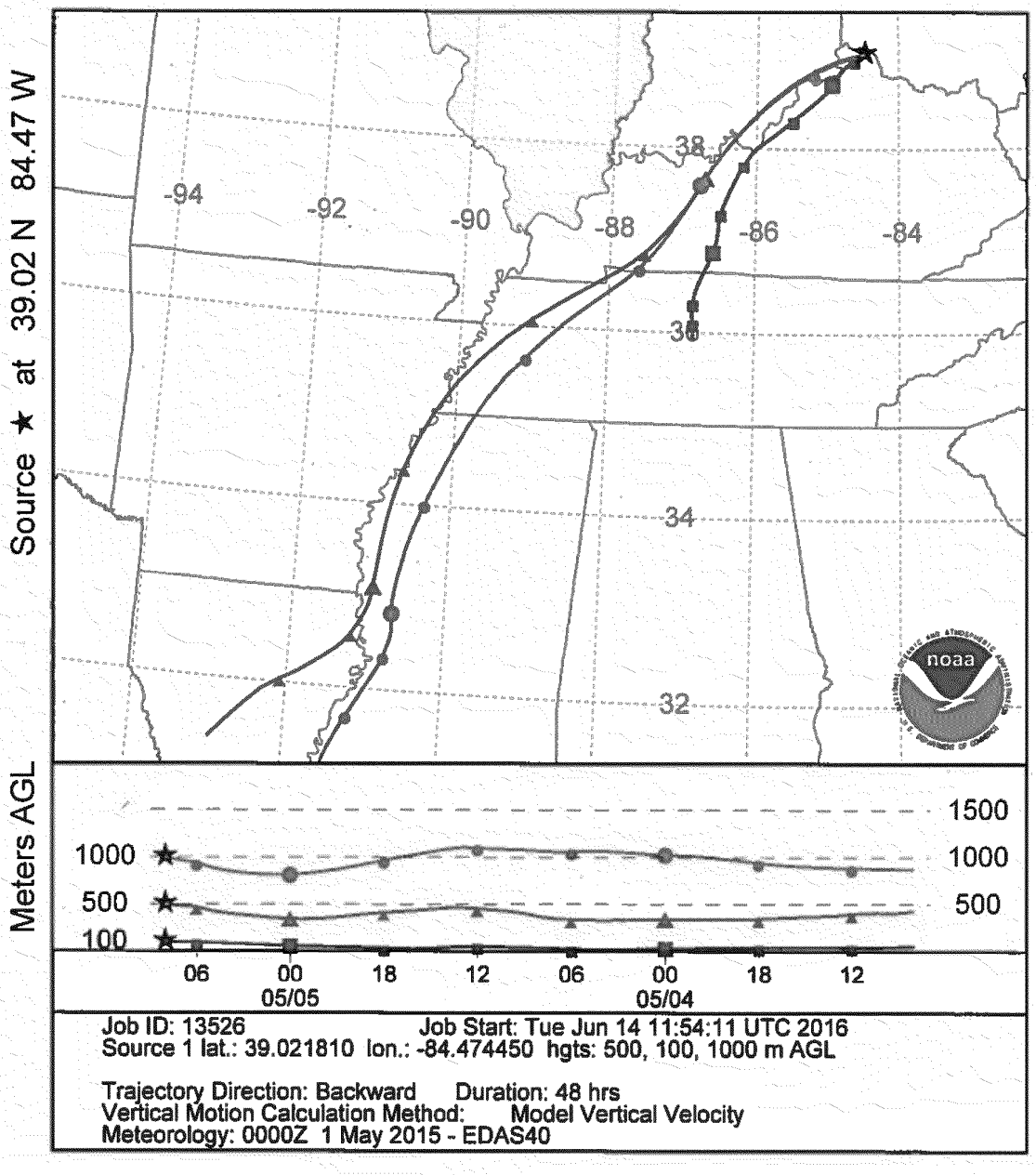
Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 16 Aug 2013 - EDAS40

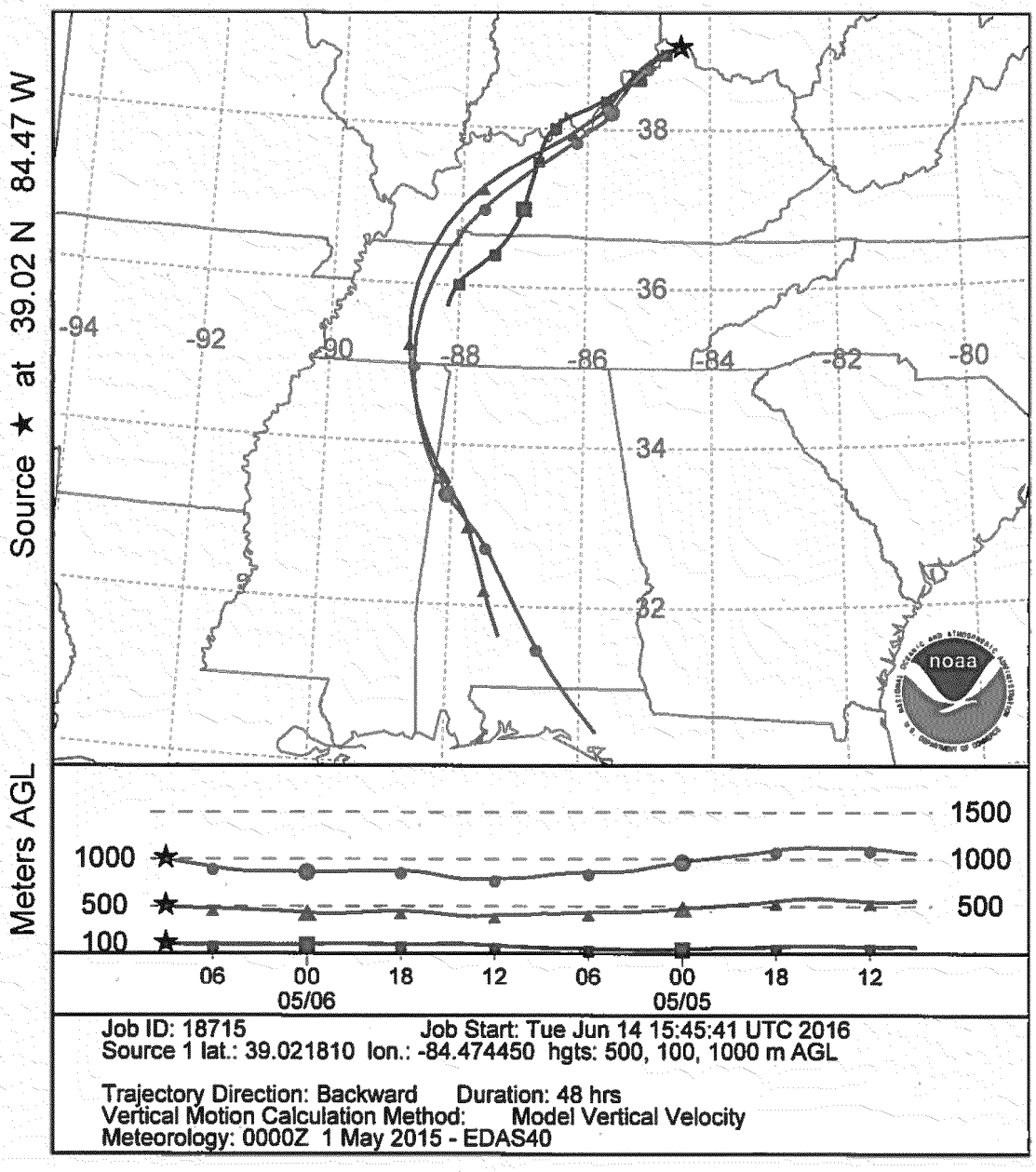
Highland Heights (Campbell County) Ozone Monitor (AQS: 21-037-3002)
2015 8-Hour Average Top Four Maximum Values

Date	Start Hour (EST)	8-Hour Reading (PPM)	
05/06/2015	13	.079	
07/25/2015	11	.078	
06/10/2015	12	.077	
05/05/2015	12	.071	(4th Max)

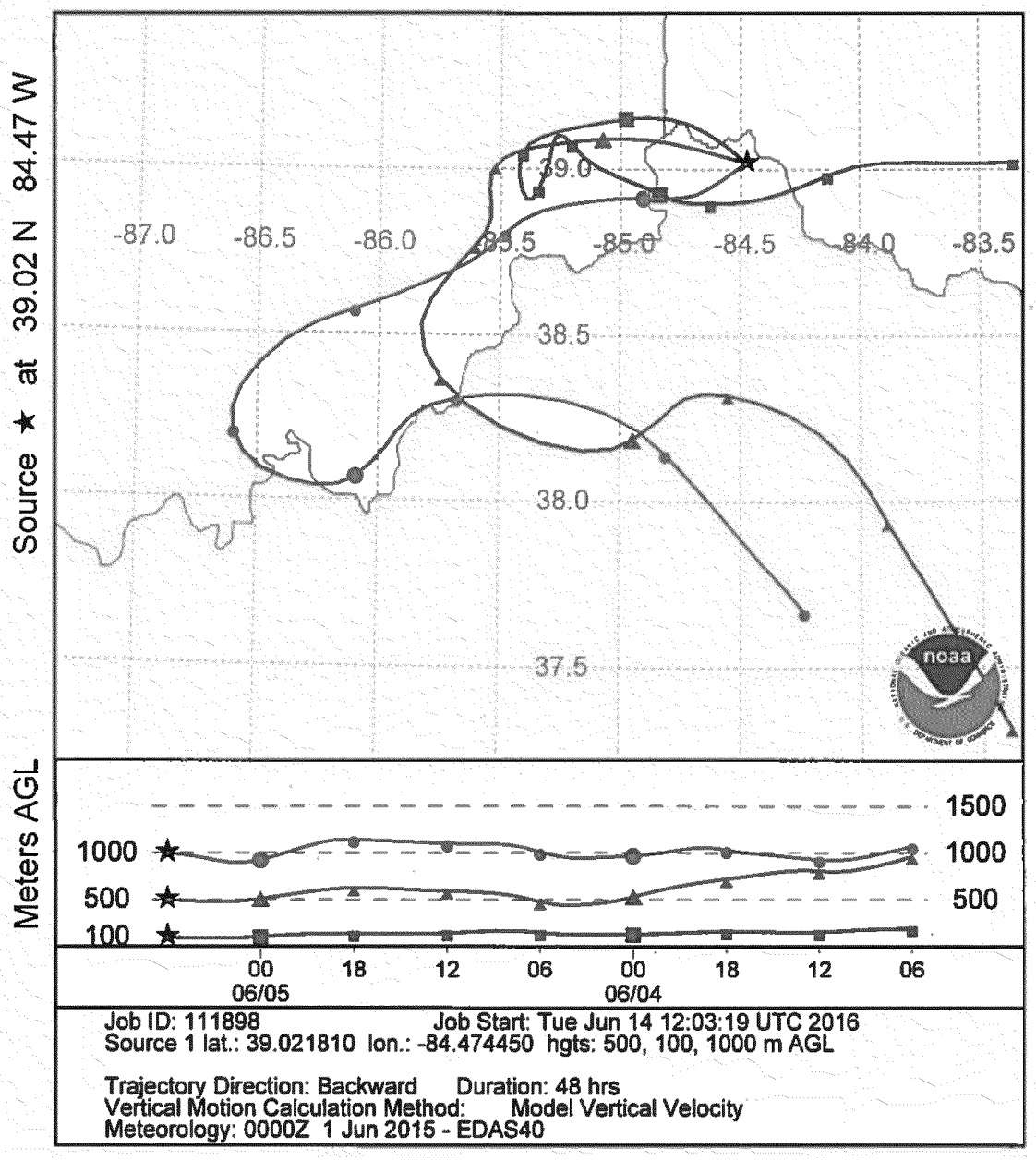
NOAA HYSPLIT MODEL
Backward trajectories ending at 0800 UTC 05 May 15
EDAS Meteorological Data



NOAA HYSPLIT MODEL
Backward trajectories ending at 0900 UTC 06 May 15
EDAS Meteorological Data



NOAA HYSPLIT MODEL
Backward trajectories ending at 0600 UTC 05 Jun 15
EDAS Meteorological Data



Job ID: 111898 Job Start: Tue Jun 14 12:03:19 UTC 2016
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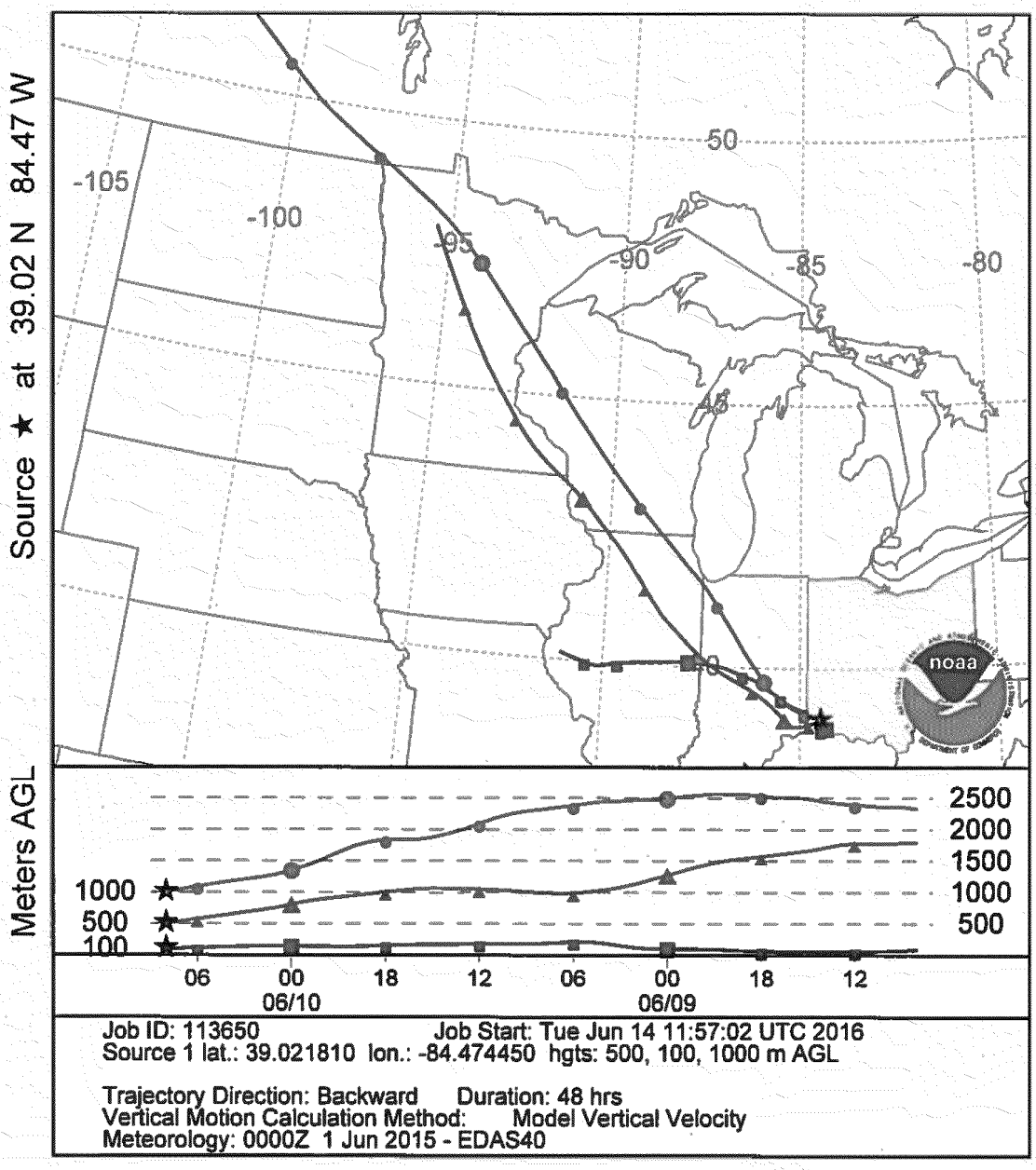
Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 1 Jun 2015 - EDAS40

NOAA HYSPLIT MODEL
Backward trajectories ending at 0800 UTC 10 Jun 15
EDAS Meteorological Data



Job ID: 113650 Job Start: Tue Jun 14 11:57:02 UTC 2016
Source 1 lat.: 39.021810 lon.: -84.474450 hgts: 500, 100, 1000 m AGL

Trajectory Direction: Backward Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 1 Jun 2015 - EDAS40

To: Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Akers, Brad[Akers.Brad@epa.gov]
Cc: reecemc@dhec.sc.gov[reecemc@dhec.sc.gov]; thompsrb@dhec.sc.gov[thompsrb@dhec.sc.gov]; Brown, Robbie[brownrj@dhec.sc.gov]; Basil, Elizabeth[basilej@dhec.sc.gov]; Frost, Keith[frostrk@dhec.sc.gov]; Mack, Robin[mackrs@dhec.sc.gov]; flynntj@dhec.sc.gov[flynntj@dhec.sc.gov]
From: Wall, Mary Peyton
Sent: Fri 9/30/2016 2:10:39 PM
Subject: SC Ozone Area Designation Recommendation Letter
SC_Area_Designations_2016_Ozone_FINAL.pdf

Lynorae and Brad-

Please see the attached ozone area designation recommendation letter for South Carolina for the 2015 ozone NAAQS from Director Heigel to Regional Administrator McTeer Toney. The ozone air monitoring sites in SC met the NAAQS design values; however, two monitors did not meet the data completeness requirement. Included with the letter is a data analysis to address the incomplete data and demonstrate that the missing data were from days that were not conducive to ozone formation. The hard copies are being mailed today. Please let me know if you have any questions.

Thank you,

Mary Peyton

Mary Peyton D. Wall
Section Manager, Air Regulation and SIP Management
S.C. Dept. of Health & Environmental Control
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September 30, 2016

Heather McTeer Toney
Regional Administrator
US EPA Region 4
Atlanta Federal Center
61 Forsyth Street, S.W.
Atlanta, GA 30303-8909

Re: South Carolina Recommendation for 2015 Ozone NAAQS Area Designation

Dear Ms. Toney:

I am writing this letter in response to the United States Environmental Protection Agency's (EPA's) request to submit area recommendations for the revised ozone National Ambient Air Quality Standard (NAAQS) established by the EPA in accordance with 80 *Federal Register* 65292, published on October 26, 2015.

The Clean Air Act Section 107(d)(1) provides that, "By such date as the Administrator may reasonably require, but not later than one year after promulgation of a new or revised NAAQS for any pollutant under section 109, the Governor of each state shall submit to the Administrator a list of all areas (or portions thereof) in the state that should be designated as nonattainment, attainment, or unclassifiable for the new NAAQS..." Accordingly, Governors must submit their initial ozone designations to the EPA no later than October 1, 2016 (80 FR 65292).

Attached to this letter is an analysis to address the incomplete data at two monitoring stations in South Carolina, which attained the ozone NAAQS, but did not meet the minimum data completeness requirements as outlined in Title 40, Code of Federal Regulations (CFR), Part 50, Appendix U. Appendix U requires the average data completeness to meet 90 percent. The data completeness calculations showed that the North Spartanburg (45-083-0009) and Ashton (45-029-0002) monitoring stations achieved 89 percent average data completeness for the years 2013-2015. In accordance with section 4(c) of Appendix U, this analysis shows that the missing data occurred on days that were not conducive to ozone concentrations above the level of the NAAQS. We ask that the EPA approve the attached analysis and deem the design values as valid.

Based on the attached ambient air monitoring data and data completeness analysis, I am pleased to report that South Carolina complies with the revised ozone NAAQS. On behalf of Governor Nikki R. Haley, I am recommending that each county in the State of South Carolina be separately designated as "attainment" for the revised ozone NAAQS.

S.C. Department of Health and Environmental Control
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Should you have any questions regarding our recommendation, please contact Rhonda B. Thompson, PE, Chief, Bureau of Air Quality, at (803) 898-4391 or by email at thompsrb@dhec.sc.gov.

Sincerely,

Catherine E. Heigel

cc: Myra C. Reece, Director, Environmental Affairs, SCDHEC
Rhonda B. Thompson, PE, Chief, Bureau of Air Quality, SCDHEC

Attachments: South Carolina Ozone Design Values – 2015
Incomplete Ozone Data Handling for the North Spartanburg Fire Station #2 and Ashton Ambient Air Monitoring Sites

South Carolina 4th highest MDA8 and Design Value for 2013-2015

Site ID	Site Name (County)	2013 4th highest MDA8 (ppm)	2014 4th highest MDA8 (ppm)	2015 4th highest MDA8 (ppm)	2013-2015 Design Value (ppm)	Meets 0.070 ppm NAAQS	Design Value Valid?
45-001-0001	Due West (Abbeville)	0.056	0.059	0.055	**0.056**	Yes	Yes
45-003-0003	Jackson (Aiken)	0.061	0.062	0.057	**0.060**	Yes	Yes
45-007-0005	Big Creek (Anderson)	0.057	0.060	0.063	**0.060**	Yes	Yes
45-015-0002	Bushy Park (Berkeley)	0.058	0.060	0.054	**0.057**	Yes	Yes
45-019-0046	Cape Romain (Charleston)	0.059	0.059	0.054	**0.057**	Yes	Yes
45-021-0002	Cowpens* (Cherokee)	0.060	0.066	0.065	**0.063**	Yes	Yes
45-025-0001	Chesterfield (Chesterfield)	0.058	0.059	0.059	**0.058**	Yes	Yes
45-029-0002	Ashton (Colleton)	0.050	0.059	0.054	**0.054**	Yes	**See Note 1**
45-031-0003	Pee Dee (Darlington)	0.059	0.063	0.061	**0.061**	Yes	Yes
45-037-0001	Trenton (Edgefield)	0.048	0.055	0.061	**0.054**	Yes	Yes
45-045-0016	Hillcrest (Greenville)	0.063	0.062	0.067	**0.064**	Yes	Yes
45-045-1003	Famoda Farm* (Greenville)	0.060	0.062	0.064	**0.062**	Yes	Yes
45-073-0001	Long Creek (Oconee)	0.053	0.064	0.060	**0.059**	Yes	Yes
45-077-0002	Clemson (Pickens)	0.060	0.062	0.064	**0.062**	Yes	Yes
45-077-0003	Wolf Creek (Pickens)	0.058	0.058	0.063	**0.059**	Yes	Yes
45-079-0007	Parklane (Richland)	0.053	0.056	0.056	**0.055**	Yes	Yes
45-079-0021	Congaree Bluff (Richland)	0.055	0.056	0.055	**0.055**	Yes	Yes
45-079-1001	Sandhill (Richland)	0.061	0.065	0.062	**0.062**	Yes	Yes
45-083-0009	N.Spartanburg Fire Sta. #2 (Spartanburg)	0.065	0.065	0.067	**0.065**	Yes	**See Note 1**
45-091-0006	York (York)	0.061	0.056	0.061	**0.059**	Yes	Yes

Notes: 1) These Design Values do not meet data completeness requirements found in 40 CFR Part 50, Appendix U and the attached data analysis addresses those design values. 2) Monitors marked with " * " were terminated at the end of the 2015 ozone monitoring season. The terminations were approved by the EPA.

Incomplete Ozone Data Handling for the North Spartanburg Fire Station #2 and Ashton Ambient Air Monitoring Sites.

Introduction

On October 1, 2015, the Administrator of the Environmental Protection Agency (EPA) signed a Final Rule setting the new primary and secondary ozone National Ambient Air Quality Standard (NAAQS) to 0.070 ppm, later published in 80 FR 65292. The previous ozone standard was 0.075 ppm. No changes to the form of the metric were promulgated, and it remains based on the maximum daily 8-hour average (MDA8). Promulgation of the NAAQS triggers Clean Air Act (CAA) Section 107(d)(1), requiring the Governor of each state (or his/her designee) to submit recommendations for the classification of each area within that state not later than one year after promulgation. If the EPA disagrees with the State's recommendations, a notification letter is sent detailing the proposed changes and inviting the State to submit further data and explanations in support of the original recommendations. This notification letter must be given no later than 120 days prior to the promulgation of the designation, and it is commonly referred to as the "120-day letter." The CAA requires area designation to be finalized by October 1, 2017, for the new NAAQS except, in a case in which there is insufficient information to make a designation, this deadline may be extended by one year at the Administrator's discretion (CAA 107(d)(1)(B)(i)).

The EPA has established criteria for air quality data collection, verification and evaluation. Appendix U to 40 CFR Part 50 was promulgated through publication on October 26, 2015 (80 FR 65458). This regulation sets forth requirements for ozone data selection, reporting, handling and comparisons to the new ozone NAAQS. Among these are requirements in Section 4(b) for data completeness for the purpose of calculating a valid 3-year ozone Design Value (see text of the section on page 2). Each annual 4th highest MDA8 must be based on valid data from at least 75% of the days during the ozone monitoring season, and the 3-year Design Value must be based on valid data from at least 90% of the days during the previous three ozone monitoring seasons. If either of these criteria is not met, there are two alternatives: 1) the Administrator may defer area designation for an additional year in order to meet the criterion, or 2) the state may demonstrate, in accordance with Section 4(c) and subject to EPA approval, that "meteorological conditions on missing days were not conducive to concentrations above the NAAQS." (See text of this section on page 2)

In 2015, the South Carolina Department of Health and Environmental Control (Department) operated 20 ozone air monitoring sites throughout the state. During that year, the Ashton (45-029-0002) ozone monitor, near Orangeburg, and the North Spartanburg Fire Station #2 (NSFS) (45-083-0009) ozone monitor met the NAAQS with 0.054 and 0.065 parts per million

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design values, respectively, but did not meet the data completeness requirement. During 2015, both the cited monitors produced valid data for 82% of the ozone season monitoring days, which met the minimum 75% annual requirement; however, over the 3-year averaging period (2013-2015), 89% of the total ozone monitoring season days have valid data for both monitors, which fails to meet the minimum 90% criterion.

In accordance with Appendix U to 40 CFR Part 50, Section 4(c), the following analysis is intended to demonstrate to the EPA that the missing 2013 - 2015 MDA8 data were from days when meteorological data would convince an informed observer that the 2015 Ozone NAAQS would not have been exceeded at the given site. Finally, our analysis will use a regression analysis of monitors near NSFS to predict ozone concentrations for the missing days to ensure that the three year design value meets the NAAQS. The Department is requesting concurrence from the EPA to count some of the missing days toward the minimum data completeness requirement in section 4(b). The Department is seeking concurrence with more dates than are necessary for the 2013 – 2015 period to ensure that there is sufficient data completeness available for the final designation decision based on data from 2014 – 2016. All computer programming code used to generate the analysis will be provided to the EPA Region 4 office to assist with their decision making.

Regulatory requirements for the treatment of data

The regulations in 40 CFR Part 50, Appendix U, Section 4(b) and (c) address missing data. It specifies:

> *(b) A design value greater than the level of the NAAQS is always considered to be valid. A design value less than or equal to the level of the NAAQS must meet minimum data completeness requirements in order to be considered valid. These requirements are met for a 3-year period at a site if valid daily maximum 8-hour average O_3 concentrations are available for at least 90% of the days within the O_3 monitoring season, on average, for the 3-year period, with a minimum of at least 75% of the days within the O_3 monitoring season in any one year.*
>
> *(c) When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the NAAQS. Missing days assumed less than the level of the NAAQS are counted for the purpose of meeting the minimum data completeness requirements, subject to the approval of the appropriate Regional Administrator.*

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Identification of missing days

Data for the years 2013 - 2015 were used to calculate the Ashton and NSFS's 2015 3-year ozone design values. For the Ashton ozone monitor, data completeness was 94 percent for the year 2013, 90 percent for 2014, and 82 percent for 2015. The data completeness for the 2013-2015 3-year ozone design value was 89 percent. For the NSFS ozone monitor, data completeness was 91 percent in 2013, 93 percent in 2014, and 82 percent in 2015. The data completeness for the 2013-2015 3-year ozone design value was 89 percent. Since neither Ashton nor NSFS met the 3-year ozone design value requirement of 90 percent data completeness, the Department has chosen to evaluate the meteorological conditions for the days of missing data to determine whether they can be counted for the purpose of meeting the minimum data completeness requirements.

Missing days for the Ashton ozone monitor

The first step for the identification of valid missing data which are assumed less than the NAAQS is to determine the number of missing days for the Ashton and the NSFS ozone monitors. In 2013, the Ashton monitor had 12 days not meeting the minimum data completeness requirements, with the majority of missing data occurring in April and June. For 2014, the Ashton monitor had 21 days of missing data, with the majority of the missing data occurring in July. For 2015, there were 39 days of missing data, with the majority of the missing days occurring in July and August (see Figure 1).

Figure 1: Ashton missing data by year and month

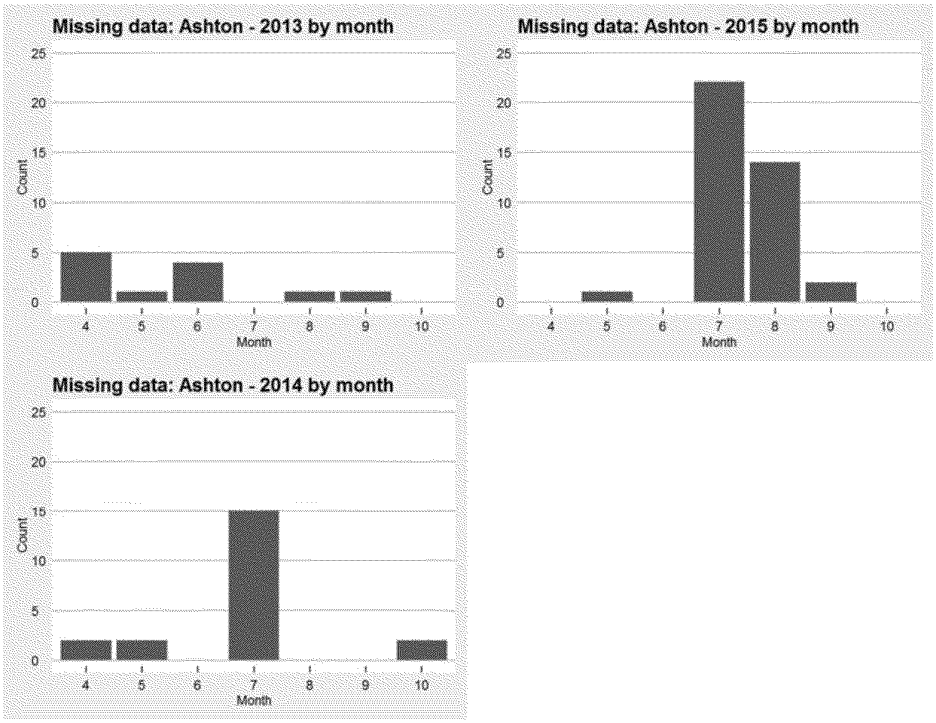
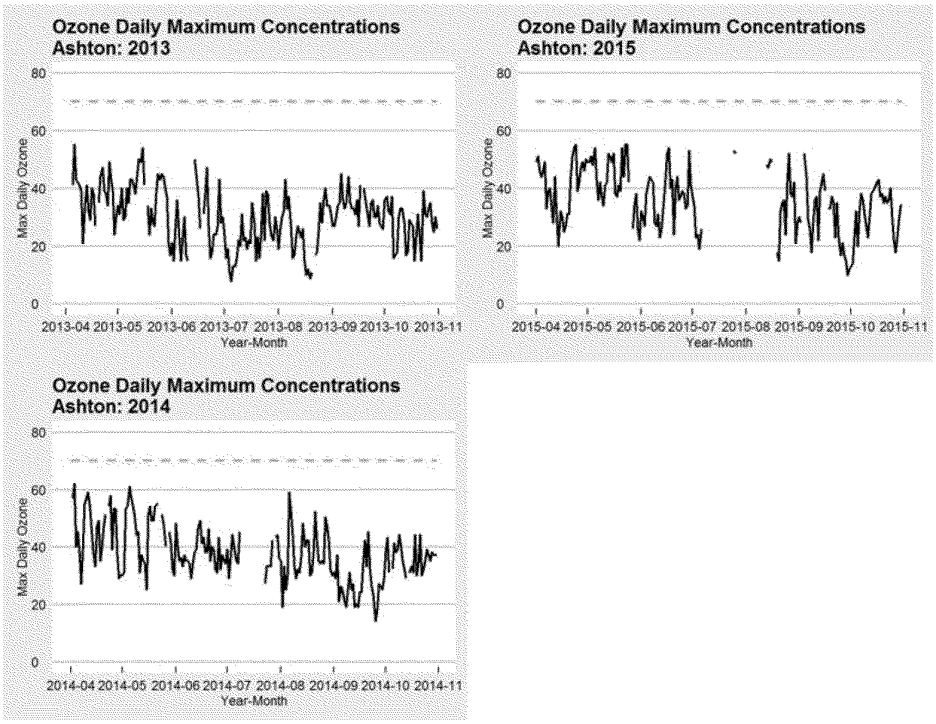


Figure 2 presents the MDA8 for 2013 - 2015 which shows that there were no values greater than 70 parts per billion (ppb). However, there is missing data during the middle of the summer in 2014 and 2015 when ozone production could potentially be at its highest.

Figure 2: Ashton MDA8 by year



Missing days for the NSFS ozone monitoring station

For the NSFS ozone monitor, Figure 3 shows that in 2013 there were 19 missing days, with the majority occurring in July. In 2014, there were 14 missing days, with most of the missing days occurring in April, May, and June. In 2015, there were 38 missing days, with the majority occurring in October. An examination of the MDA8 (Figure 4) for each year comprising the design value show that there was only one exceedance of 70 ppb in 2013.

Figure 3: NSFS missing data by year and month

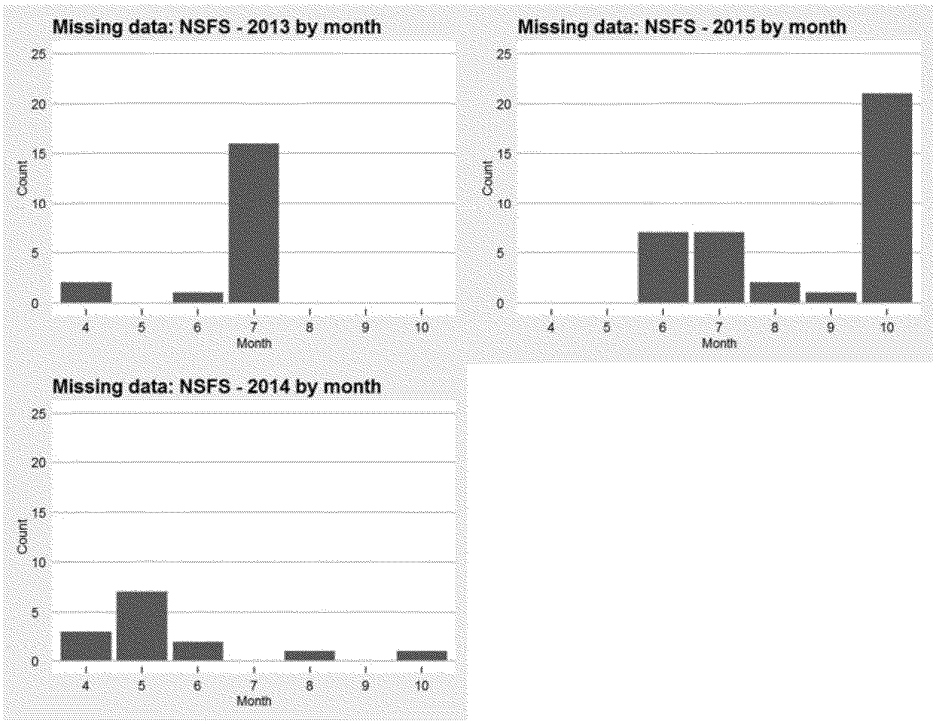
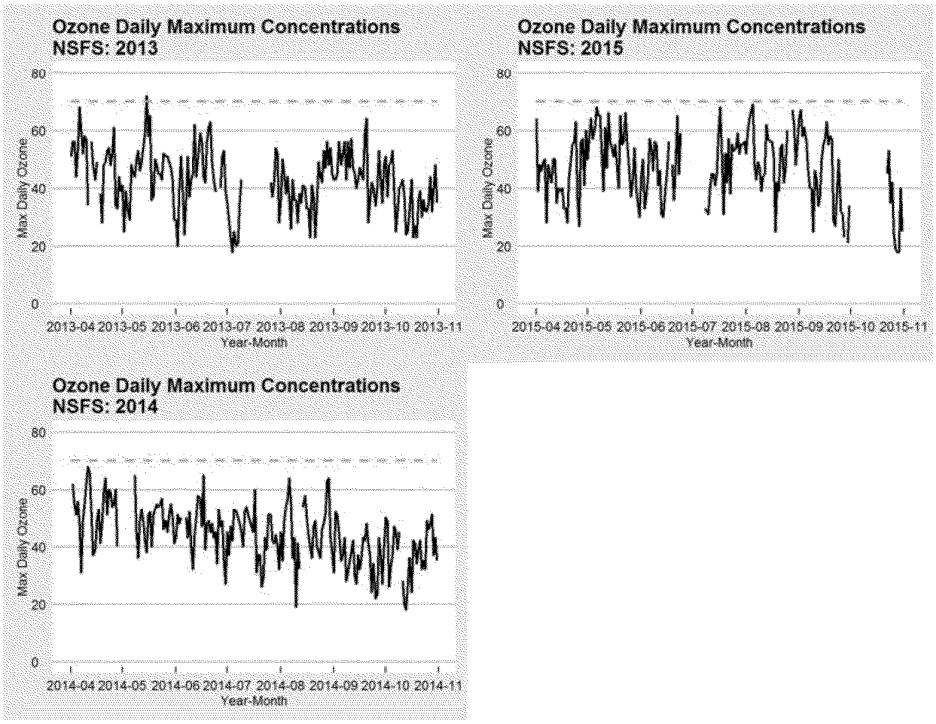


Figure 4: NSFS MDA8 by year



Selection of Days to waive

The Department first looked to see which meteorological conditions are not conducive to ozone formation to demonstrate that missing days occurred on days not conducive to ozone formation. The most important meteorological conditions to ozone formation in South Carolina are maximum daily temperature, mid-day (1000 – 1600 EST) relative humidity, temperature difference (daily maximum-daily minimum), and afternoon (1300 – 1600 EST) wind speed. These parameters were selected based on a paper (Cox & Chu, 1996) used to develop the EPA's Trends in Ozone Adjusted for Weather Conditions (US EPA, n.d.)

After identification of meteorological conditions, a prediction of the incomplete design values was conducted to further demonstrate that both monitors would continue to meet the Ozone NAAQS. Due to a lack of nearby monitors close to the Ashton site, a "brute-force" technique was used by substituting 100 percent of the missing days with the highest monthly MDA8 over the last five years and recalculating the design value. Since there were many nearby monitors near the NSFS site, a nonparametric linear regression was used to develop substituted values for 100 percent of the missing data. A bootstrap analysis was used to estimate the variability in the predictions and to ensure that the design value remained below the level of the Ozone NAAQS.

Meteorological conditions and missing data for the Ashton ozone monitor

There are no ozone monitors near the Ashton monitoring site to draw comparisons. The Department used Ashton ozone data and meteorological data from the Orangeburg Municipal Airport (KOGB) to examine meteorological conditions that were conducive to ozone formation. There were no exceedances of the ozone NAAQS from 2011 – 2015. However, some ozone is formed under similar meteorological conditions as other sites (high maximum temperatures, low afternoon wind speeds, and low mid-day relative humidity).

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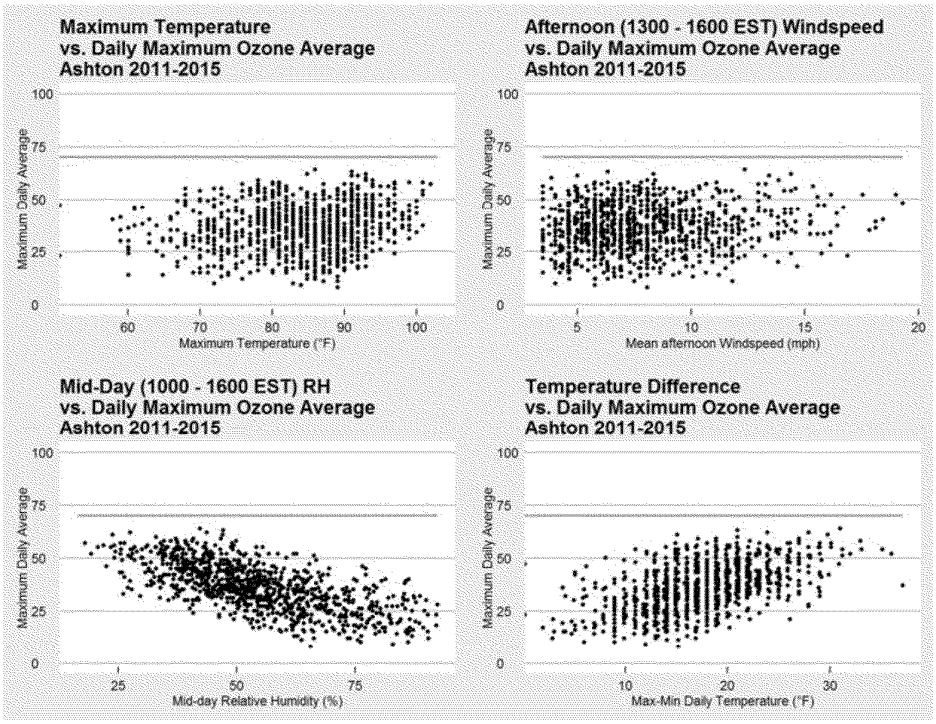
Figure 5: KOGB meteorological conditions vs. ozone



The Department applied a "brute-force" technique by substituting the highest daily maximum ozone concentration by month for the years 2011 - 2015 to determine the number of days for which to seek a waiver. The Department believes this is a conservative approach to demonstrate that even under a worst-case scenario, the design value at the Ashton would not have exceeded the ozone NAAQS.

Data from 2006 – 2015 at the Ashton ozone monitor was evaluated in order to determine the highest daily maximum ozone average.

Table 1: Highest monthly MDA8 2006 - 2015

Month	Highest Daily Maximum Average (ppb)
April	62
May	64
June	63
July	58
August	61
September	55
October	47

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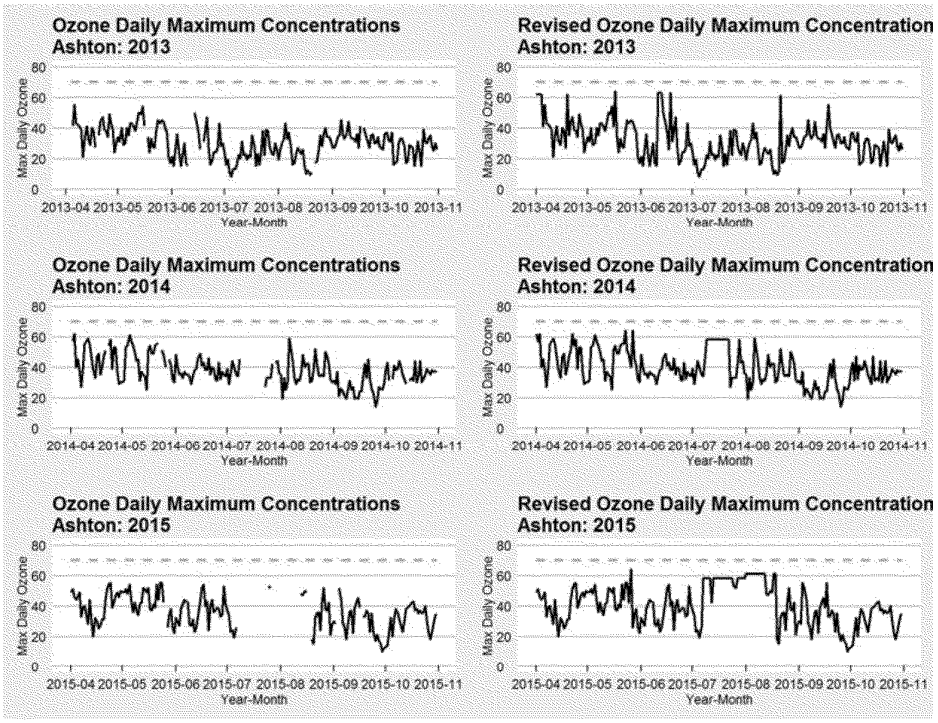
These monthly maximums were then substituted for all missing data for 2013 – 2015. The time series graphic of the pre- and post-substitution show no exceedances of the NAAQS in 2015.

Figure 6: Ashton MDA8 pre and post data substitution



The design values were then recalculated for Ashton for all missing days. This conservative approach shows that under the worst-case scenario, Ashton design values are expected to still meet the ozone NAAQS with a recalculated design value of 62 ppb. Therefore, the Department will flag all missing ozone data for 2013 – 2015 and request concurrence from the EPA to deem the incomplete design value as being "complete".

Table 2: Pre- and post-data substitution design value calculation for Ashton

Year	Pre-substituted 4th high (ppb)	Data Completeness (%)	Post-substituted 4th high (ppb)	Data Completeness
2013	50	94	63	100
2014	59	90	62	100
2015	54	82	61	100
DV	54	89	62	100

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Table 3: Ashton dates requested for waiver

Date		
4/1/2013	4/1/2014	5/26/2015
4/2/2013	4/22/2014	7/7/2015
4/3/2013	5/23/2014	7/8/2015
4/4/2013	5/27/2014	7/9/2015
4/19/2013	7/9/2014	7/10/2015
5/17/2013	7/10/2014	7/11/2015
6/11/2013	7/11/2014	7/13/2015
6/12/2013	7/12/2014	7/14/2015
6/13/2013	7/13/2014	7/15/2015
6/18/2013	7/14/2014	7/16/2015
8/21/2013	7/15/2014	7/17/2015
9/18/2013	7/16/2014	7/18/2015
	7/17/2014	7/19/2015
	7/18/2014	7/20/2015
	7/19/2014	7/21/2015
	7/20/2014	7/22/2015
	7/21/2014	7/23/2015
	7/22/2014	7/24/2015
	7/28/2014	7/27/2015
	10/4/2014	7/28/2015
	10/14/2014	7/29/2015
		7/30/2015
		7/31/2015
		8/1/2015
		8/2/2015
		8/3/2015
		8/4/2015
		8/5/2015
		8/6/2015
		8/7/2015
		8/8/2015
		8/9/2015
		8/10/2015
		8/11/2015
		8/12/2015
		8/17/2015
		8/18/2015
		9/3/2015
		9/17/2015

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Meteorological conditions and missing data for the North Spartanburg Fire Station #2 ozone monitor

To understand meteorological conditions that are conducive to ozone formation for the NSFS monitor, the Department obtained the MDA8 ozone concentrations from the close by Clemson CMS (45-077-0002), Big Creek (45-007-0005), Hillcrest (45-045-0016), and Cowpens (45-021-0002) monitoring stations. These sites were selected because they form a cluster of sites surrounding the I-85 corridor in the Upstate of South Carolina. The Department selected meteorological data from the Greenville-Spartanburg International Airport (KGSP) for 2011 – 2015.

Scatterplots between the MDA8 at the monitoring sites and selected meteorological variables show that ozone formation is conducive when maximum daily temperature is greater than 87ºF, mid-day relative humidity is less than 57.3%, afternoon wind speed is less than 14 mph, and temperature difference is greater than 20ºF. In the preceding 5 years, the ozone MDA8 exceeded the level of the ozone NAAQS under these meteorological conditions. Table 4 shows the missing days at NSFS that meet these conditions.

Figure 7: KGSP meteorological conditions vs. ozone

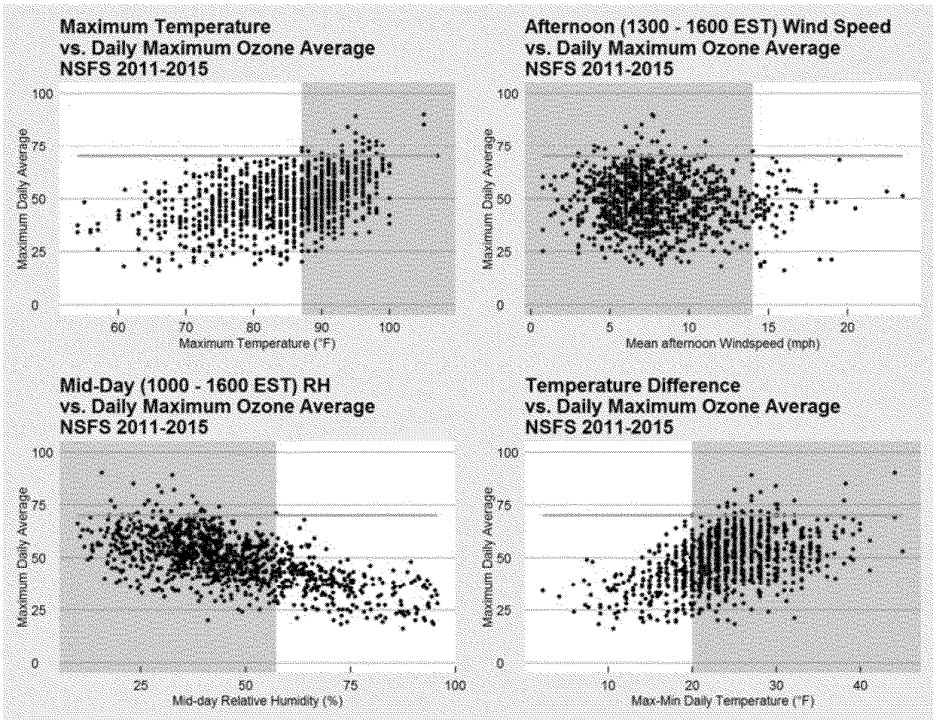

Table 4: NSFS dates requested for waiver

Date

Date		
4/12/2013	4/30/2014	7/2/2015
7/10/2013	5/1/2014	7/3/2015
7/11/2013		7/4/2015
7/14/2013		7/5/2015
7/15/2013		9/28/2015
7/20/2013		10/2/2015
		10/3/2015
		10/4/2015
		10/5/2015
		10/11/2015

Ozone regression analysis

A linear regression analysis of missing data at NSFS was conducted to serve as an additional "weight of evidence" that the site will attain the 2015 Ozone NAAQS based on data collected from 2013 – 2015. This analysis estimates the missing samples at NSFS by using a linear regression model and bootstrapping to estimate the design value for a "complete" data set in 2015. See page 12 for more information about bootstrapping.

Step 1: Organize data and perform linear regression between incomplete site and candidate sites

The Theil-Sen regression method was chosen to develop the statistical model (Team, R Core, 2016), (Maindonald & Braun, 2015), (Komsta, 2013) to predict missing ambient ozone concentrations at NSFS from monitoring conducted at other nearby candidate sites over the past five years. The Theil-Sen regression is a nonparametric linear model and is typically less likely to be influenced by outliers than a least squares linear regression (Hollander & Wolfe, 1999, pp. 415-457). Linear regressions were developed for all candidate sites which had at least 920 sample pairs (which is approximately 75% data completion over the five year period), a Spearman's Rank Correlation Coefficient of at least 0.80, and a minimum of 75% data completeness for the candidate site in 2015.

Step 2: Select the best candidate site as the predictor site

The best candidate site was selected based on an earlier analysis (EPA Region 4, 2015). Summary statistics for the models using each of the potential predictor sites are shown in Table 5, ranked by Spearman's Rank Correlation Coefficient and Root Mean Square Error (RMSE), with the best predictor site listed first in the table. Based on the criteria listed in Step 1, the correlation and RMSE results suggest that the Cowpens National Battlefield site (45-021-0002) is the best predictor site for NSFS (Spearman correlation: 0.94, RMSE=4.10 ppb). These results indicate a strong linear relationship between the two sites. A plot of the Theil-Sen regression model and paired data from both sites is in Figure 8.

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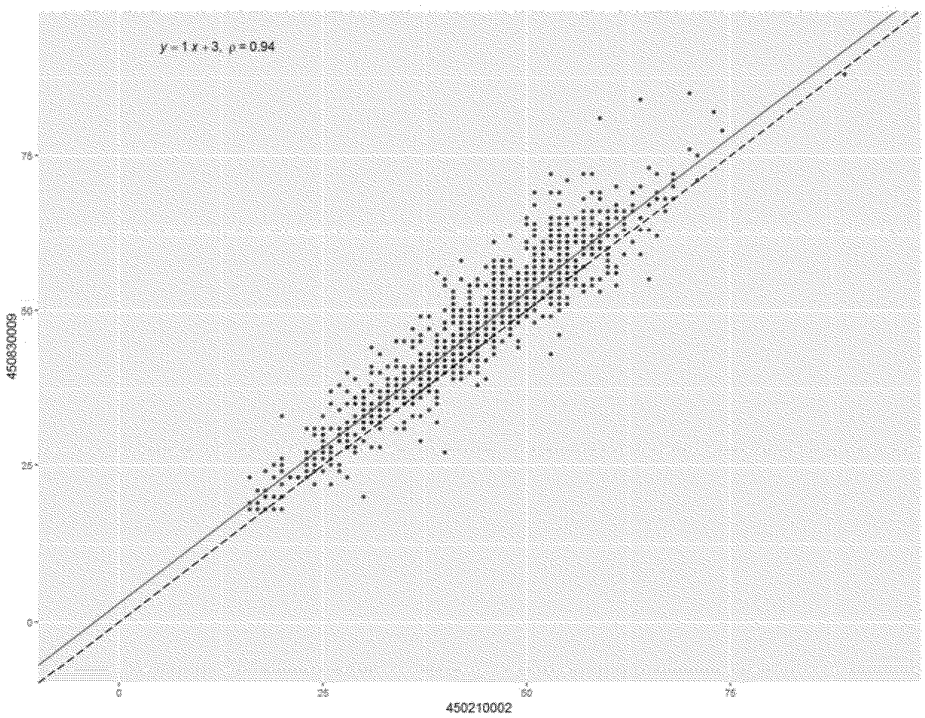
Table 5: Model statistics

Incomplete Site	Predictor Site	n Sample Pairs	Minimum Pairs Met	Theil Slope	Theil Intercept	Spearman ρ	Theil RMSE (ppb)
450830009	450210002	963	Yes	1	3.00	0.94	4.10
450830009	450070005	961	Yes	1	5.00	0.91	4.90
450830009	450450016	945	Yes	1	2.00	0.89	5.27
450830009	450770002	968	Yes	1	3.22	0.89	5.47

Figure 8: Correlation plot and Theil-Sen regression between Cowpens and NSFS) sites, using ozone data (ppb) from 2011-2015



Step 3: Calculate a test design value

Next, a test 2013 – 2015 design value was calculated using the combination of collected and estimated samples. This procedure produced a design value of 69 ppb, which is below the level of the 2015 Ozone NAAQS.

Step 4: Bootstrapping Analysis

A bootstrapping analysis was conducted to determine the variance around the predicted design value to provide further evidence that the design value would have been below the level of the 2015 Ozone NAAQS if the monitor had complete data. Bootstrapping is a

statistical procedure that resamples a dataset to estimate the variance of a statistic, in this case the design value. The following procedure was used:

a. Residuals were calculated from the Theil-Sen regression model.
b. For each missing sample that was estimated in Step 2, a regression residual was randomly selected with replacement from the pool of residuals and added (or subtracted, in the case of a negative residual) to the estimated value.
c. Repeat (b) 10,000 times
d. For each of the 10,000 runs, the predicted 3-year design value was calculated as in Step 3.

The resulting 10,000 predicted design values are interpreted as an approximate probability distribution of the design values at the incomplete site, had it collected complete data. The distribution of the resulting bootstrap design values is show in Figure 9, and detailed in Table 6. None of the bootstrap runs show a design value greater than the level of the NAAQS. Based on this evidence, the Department believes that the NSFS monitor would not have exceeded the level of the NAAQS had it collected complete data from 2013 – 2015.

Figure 9: Bootstrap results for modeled 2013-2015 design values

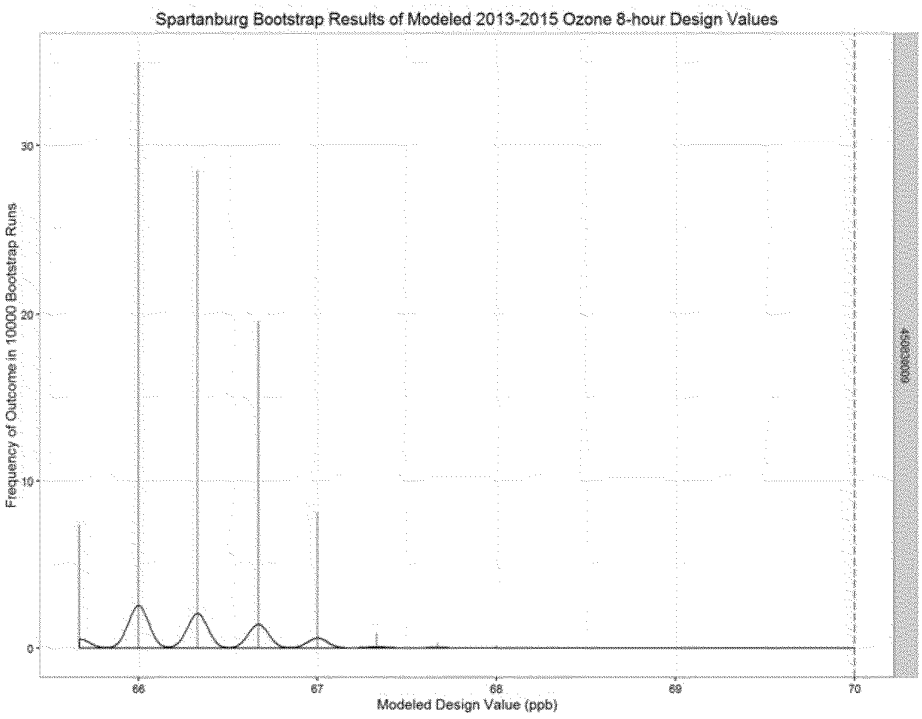


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Table 6: Bootstrap results

Incomplete Site	Predictor Site	Bootstrap Runs	Predicted DV (ppb)	95% Confidence Interval (ppb)	Max Bootstrapped DV (ppb)
450830009	450210002	10,000	66	Lower: 64.34 Upper: 65.67	68.67

Conclusions and Recommendations

All monitors which operated in South Carolina between 2013 and 2015 and collected a complete data set attained the 2015 Ozone NAAQS. The Ashton and NSFS monitoring sites did not have sufficient data to have a complete design value. This analysis provides evidence that there was a minimal chance that the monitors could have exceeded the 2015 Ozone NAAQS. A “brute force” analysis at Ashton showed that under a worst-case scenario, the design value would have remained well below the level of the NAAQS. A meteorological analysis, combined with a regression analysis to predict an ozone design value, demonstrates that NSFS would have attained the Ozone NAAQS. The Department recommends that EPA approve our request to deem the design values for Ashton and NSFS ozone monitors as complete by concurring with the dates selected in Tables 3 and 4 as occurring on days not conducive to ozone concentrations above the NAAQS in accordance with Appendix U to 40 CFR Part 50.

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Works Cited

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From: Sosnowski, Dave
Sent: Mon 5/1/2017 10:46:47 AM
Subject: Draft Notes and Call for Agenda Items
OBD_call_NOTES_011117.doc

Dear OBD Stakeholder Call Participant:

Attached to this email are the draft notes from our last call. If you have any edits or corrections, please email them to me no later than Tuesday, noon ET, May 2, 2017. Also, if you have any suggested agenda items for this week's call (scheduled for Wednesday, 1 pm ET, May 3, 2017) please send them to me by the same deadline.

Thanks,

Dave S.

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From: Sosnowski, Dave
Sent: Mon 3/6/2017 1:26:53 PM
Subject: Call for agenda items for the OBD Stakeholder Call
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Dear OBD Stakeholders:

This week, Wednesday, March 8, 2017, at 1 pm ET, we've got our bimonthly OBD Stakeholder call scheduled. If you have any suggested agenda items for the call, please send them to me via email no later than COB Tuesday, March 7, 2017. I've also attached draft notes from our last call. If you have any corrections, additions, or deletions for the attached notes, please send them to me by the same deadline (i.e., COB tomorrow).

--Dave Sosnowski

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From: Sosnowski, Dave
Sent: Wed 1/11/2017 2:55:48 PM
Subject: Resend: Materials for today's OBD Stakeholder Call
Permanent DTCs.pptx
OBD_call_agenda_011117.doc
OBD_call_NOTES_111616.doc
FAST-Act_IM_guidance.pdf

Apologies for the multiple emails. This is a resend of an earlier message I've recalled because an incorrect attachment was included. This message includes all the

attachments intended for today's call. My apologies for any inconvenience I may have caused.

--Original Message—

Bi-monthly OBD Stakeholder Call

Wednesday, January 11, 2017, 1-2:00 PM ET

Ex. 6 - Personal Privacy

Dear OBD Stakeholder Call Participant:

Attached to this email are the notes from the last call in November, the agenda for today's call, some slides for a discussion on Permanent DTCs and a copy of the FAST-Act I/M guidance referenced as forthcoming on previous calls. Please note that in my solicitation for agenda items sent out on Monday, there is a typo in the conference code. The number listed above and on the agenda are correct.

Talk to you at 1 pm ET.

--Dave S.

To: Acevedo, Frank[acevedo.francisco@epa.gov]; alo@azdeq.gov[alo@azdeq.gov]; alyons@arb.ca.gov[alyons@arb.ca.gov]; am3@azdeq.gov[am3@azdeq.gov]; Aspy, Dale[Aspy.Dale@epa.gov]; Beesonhk@muni.org[Beesonhk@muni.org]; Benjamin, Lynorae[benjamin.lynorae@epa.gov]; brian.phillips@ncdenr.gov[brian.phillips@ncdenr.gov]; Brown, Steven[Brown.Steven@epa.gov]; Buss, Jeffrey[Buss.Jeffrey@epa.gov]; charles.williams@dc.gov[charles.williams@dc.gov]; Christopher.Bovee@wisconsin.gov[Christopher.Bovee@wisconsin.gov]; christopherwoodhave@weber.edu[christopherwoodhave@weber.edu]; chuck.dachroeden@dnr.mo.gov[chuck.dachroeden@dnr.mo.gov]; Chuck.Upton@dca.ca.gov[Chuck.Upton@dca.ca.gov]; coffer.jerry@deq.state.or.us[coffer.jerry@deq.state.or.us]; craig.woleader@state.ma.us[craig.woleader@state.ma.us]; David.Alspaugh@epa.ohio.gov[David.Alspaugh@epa.ohio.gov]; Davis, Gregory[Davis.Gregory@epa.gov]; bill.wanschura@dep.state.nj.us[bill.wanschura@dep.state.nj.us]; dthompso@arb.ca.gov[dthompso@arb.ca.gov]; dtrostle@state.pa.us[dtrostle@state.pa.us]; Edgar.Gilmore@tceq.texas.gov[Edgar.Gilmore@tceq.texas.gov]; ewendt@co.weber.ut.us[ewendt@co.weber.ut.us]; eyvonne.parkerbair@ct.gov[eyvonne.parkerbair@ct.gov]; frank.stevenson@dem.ri.gov[frank.stevenson@dem.ri.gov]; Gab_Clinciu@dca.ca.gov[Gab_Clinciu@dca.ca.gov]; gaenglis@gw.dec.state.ny.us[gaenglis@gw.dec.state.ny.us]; Garcia, Ariel[Garcia.Ariel@epa.gov]; grklein@deq.virginia.gov[grklein@deq.virginia.gov]; gsmith@dmv.nv.gov[gsmith@dmv.nv.gov]; icox@mva.maryland.gov[icox@mva.maryland.gov]; lhatt@dmv.nv.gov[lhatt@dmv.nv.gov]; James.Goldstene@bcsh.ca.gov[James.Goldstene@bcsh.ca.gov]; Jeff.Kennedy@dep.state.nj.us[Jeff.Kennedy@dep.state.nj.us]; Jennifer.Jakubauskas@dos.nh.gov[Jennifer.Jakubauskas@dos.nh.gov]; jjclyne@gw.dec.state.ny.us[jjclyne@gw.dec.state.ny.us]; john.getsie@ct.gov[john.getsie@ct.gov]; jlee@dmv.nv.gov[jlee@dmv.nv.gov]; john.s.flemmi@state.ma.us[john.s.flemmi@state.ma.us]; joyce.fiore@dem.ri.gov[joyce.fiore@dem.ri.gov]; jray461@ecy.wa.gov[jray461@ecy.wa.gov]; jthomas7@weber.edu[jthomas7@weber.edu]; kathleen.field@maryland.gov[kathleen.field@maryland.gov]; kkishbaugh@pa.gov[kkishbaugh@pa.gov]; kmshiffe@gw.dec.state.ny.us[kmshiffe@gw.dec.state.ny.us]; ksatterfield@dmv.nv.gov[ksatterfield@dmv.nv.gov]; kswa461@ecy.wa.gov[kswa461@ecy.wa.gov]; laura.merrill@state.ma.us[laura.merrill@state.ma.us]; Laurie.benallo@state.co.us[Laurie.benallo@state.co.us]; lewis.dubose@nashville.gov[lewis.dubose@nashville.gov]; Loutan, Reema[Loutan.Reema@epa.gov]; marc.bennett@state.ma.us[marc.bennett@state.ma.us]; Marc.Corrigan@state.tn.us[Marc.Corrigan@state.tn.us]; Mark.Canning@dnr.state.ga.us[Mark.Canning@dnr.state.ga.us]; Mark.Ingrum@dep.state.nj.us[Mark.Ingrum@dep.state.nj.us]; mark.wert@state.ma.us[mark.wert@state.ma.us]; Mark_Duewel@dca.ca.gov[Mark_Duewel@dca.ca.gov]; mfitzgerald@des.state.nh.us[mfitzgerald@des.state.nh.us]; Michael.Abraczinskas@ncmail.net[Michael.Abraczinskas@ncmail.net]; michaels@state.pa.us[michaels@state.pa.us]; Mike.Riggleman@epa.state.oh.us[Mike.Riggleman@epa.state.oh.us]; mmccarth@arb.ca.gov[mmccarth@arb.ca.gov]; Mooney, John[Mooney.John@epa.gov]; mrowe@spokanecleanair.org[mrowe@spokanecleanair.org]; nancy.seidman@state.ma.us[nancy.seidman@state.ma.us]; nkruger@4cleanair.org[nkruger@4cleanair.org]; Pam_Earl@dnr.state.ga.us[Pam_Earl@dnr.state.ga.us]; paul.hedglin@dca.ca.gov[paul.hedglin@dca.ca.gov]; paul.vana@state.co.us[paul.vana@state.co.us]; paul.gordey@ncdenr.gov[paul.gordey@ncdenr.gov]; peter.mar@ontario.ca[peter.mar@ontario.ca]; powers, marilyn[powers.marilyn@epa.gov]; Ralph.Bitter@dep.state.nj.us[Ralph.Bitter@dep.state.nj.us]; rebecca.ohler@des.nh.gov[rebecca.ohler@des.nh.gov]; Rehn, Brian[rehn.brian@epa.gov]; richard.swartz@dnr.mo.gov[richard.swartz@dnr.mo.gov]; richard.olin@deq.virginia.gov[richard.olin@deq.virginia.gov];

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From: Sosnowski, Dave
Sent: Wed 1/11/2017 1:08:47 PM
Subject: Today's OBD Stakeholder Call, Agenda and other materials
OBD_call_NOTES_111616.doc
Permanent DTCs.pptx
FAST-Act_IM_guidance.pdf
120816_IM_Call_Notes.doc

Bi-monthly OBD Stakeholder Call

Wednesday, January 11, 2017, 1-2:00 PM ET

Ex. 6 - Personal Privacy

Dear OBD Stakeholder Call Participant:

Attached to this email are the notes from the last call in November, the agenda for today's call, some slides for a discussion on Permanent DTCs and a copy of the FAST-Act I/M guidance referenced as forthcoming on previous calls. Please note that in my solicitation for agenda items sent out on Monday, there is a typo in the conference code. The number listed above and on the agenda are correct.

Talk to you at 1 pm ET.

--Dave S.

Bi-monthly OBD Stakeholder Call
Wednesday, January 11, 2017, 1-2:00 PM ET
Ex. 6 - Personal Privacy

Agenda Items

- Roll call by Region/State
  - Region 1: MA, NH, CT
  - Region 2: Reema Loutan, NY, NJ
  - Region 3: PA
  - Region 4: Amanetta Somerville, Dale Aspy, Amber Davis, GA, NC, TN
  - Region 5: WI
  - Region 6: TX, LA
  - Region 7: MO
  - Region 8: CO
  - Region 9: CA, NV, AZ
  - Region 10: WA, ID
  - OTAQ: Dave Sosnowski
  - Others: ON, Weber State

- Notes from the November 16, 2016 OBD Stakeholder Call
  - No corrections or additions.

- OBD Clearinghouse Update (Chris Woodhave, Weber)
  - Chris reported that the new website is up and running and getting feedback from users.
  - The Clearinghouse is looking at additional updates suggested by users, including advanced search.
  - Chris noted that some have had trouble finding I/M Solutions presentations on the site. You need to navigate to the I/M Solutions web site from the Clearinghouse and them click the forum link, which will take you to where the presentations from previous I/M Solutions training forums are located.
  - Chris recommended that those who haven't done so already should check out the site and register. He noted that they've been adding new registrants daily.

- OBD Clearinghouse Recompetition
  - The review process of the applications received is underway.

- Status of the ozone NAAQS(s)
  - The proposed implementation rule was published in the Federal Register on November 17, 2016.
  - A webinar on the proposal, including Q&A, was held on Wednesday, December 7, 2016.

- The majority of the proposal continues previous practice during transition from one ozone NAAQS to another, with the proposal taking comment on a few additional options, including how and when to revoke the previous (2008) standard.

- Volkswagen Notice of Violation
  - Several media sources are reporting that VW's top manager for U.S. compliance was arrested by the FBI on a variety of charges, including violations of the Clean Air Act.
  - Sources are also reporting that VW and DOJ are nearing agreement to resolve the criminal investigation into the violations, including a plea of guilty from VW and the payment of over $4 billion in fines.
  - DOJ has not commented on these reports but is scheduled to conduct a press conference on the VW investigation today at 1:30 PM ET which will be streamed at www.JUSTICE.GOV/LIVE-STREAM.

- FAST-Act I/M Provision
  - The signed guidance has been sent to all call participants, along with other materials for today's call.
  - Dave noted that the prohibition against I/M testing of replica vehicles addressed in the FAST Act is binding on EPA, not the states, per EPA's Office of General Counsel, meaning that EPA cannot require states to test these vehicles or provide SIP credit to states that do.
  - A caller asked if these vehicles will have VINs and Dave noted that VINs are not under EPA's jurisdiction but rather are regulated by the Department of Transportation.

- Permanent DTCs (Allen Lyon, CARB)
  - Allen presented three slides providing background on permanent DTCs (PDTCs), including the MYs over which they were phased-in, how they differ from earlier DTCs (i.e., the latter can't be erased by scan tool or a battery disconnect, but only by the system itself after the source of the code has been corrected and confirmed) and why they were introduced (i.e., to address readiness uncertainty and to help catch fraud).
  - Allen also noted that as was the case with the introduction of OBDII and readiness, some OEMs have had implementation problems with PDTCs that will require test programs to be able to override the test system for certain makes and models with known issues. (Allen noted that they were seeing problems with several Chrysler models and perhaps 10 other makes/models and would be working to develop an exemptions list similar to those used for readiness which it would share with other states and the OBD Clearinghouse.)
  - Allen noted that most OEMs are implementing the requirement correctly and also stressed that CARB is still gathering data but has not begun passing or failing vehicles based upon PDTCs in the field.

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- Implementation guidance for using PDTCs in the field still need to be developed but such usage has the potential to cut the number of vehicles rejected or failed based on readiness only by maybe half.
- The PDTC requirement for vehicles under 14K GVWR was phased in from MY 2010 to 2012, with 100% coverage for the 2012 MY.
- Massachusetts noted that it has been collecting PDTC data for six months and noted that some older vehicles that have been reflashed seem to have the PDTCs cleared by the reflash. Mike McCarthy of CARB confirmed that that happens for some makes and models but not all.
- It was also noted that in addition to PDTCs, the data on "distance travelled since last cleared" will be useful in addressing the problem of excessive not-readiness.
- Lastly, it was noted that a car can be queried re: whether or not it supports PDTCs.

- Miscellaneous Issues?

- Next OBD Stakeholder Call
  - March 8, 2017, 1:00 PM ET

ED_001361_00022838

Bi-monthly OBD Stakeholder Call
Wednesday, January 11, 2017, 1-2:00 PM ET
Ex. 6 - Personal Privacy

Agenda Items

- Roll call by Region/State
  - Region 1: MA, NH, CT
  - Region 2: Reema Loutan, NY, NJ
  - Region 3: PA
  - Region 4: Amanetta Somerville, Dale Aspy, Amber Davis, GA, NC, TN
  - Region 5: WI
  - Region 6: TX, LA
  - Region 7: MO
  - Region 8: CO
  - Region 9: CA, NV, AZ
  - Region 10: WA, ID
  - OTAQ: Dave Sosnowski
  - Others: ON, Weber State

- Notes from the November 16, 2016 OBD Stakeholder Call
  - No corrections or additions.

- OBD Clearinghouse Update (Chris Woodhave, Weber)
  - Chris reported that the new website is up and running and getting feedback from users.
  - The Clearinghouse is looking at additional updates suggested by users, including advanced search.
  - Chris noted that some have had trouble finding IM Solutions presentations on the site. You need to navigate to the I/M Solutions web site from the Clearinghouse and them click the forum link, which will take you to where the presentations from previous I/M Solutions training forums are located.
  - Chris recommended that those who haven't done so already should check out the site and register. He noted that they've been adding new registrants daily.

- OBD Clearinghouse Recompetition
  - The review process of the applications received is underway.

- Status of the ozone NAAQS(s)
  - The proposed implementation rule was published in the Federal Register on November 17, 2016.
  - A webinar on the proposal, including Q&A, was held on Wednesday, December 7, 2016.

- The majority of the proposal continues previous practice during transition from one ozone NAAQS to another, with the proposal taking comment on a few additional options, including how and when to revoke the previous (2008) standard.

- Volkswagen Notice of Violation
  - Several media sources are reporting that VW's top manager for U.S. compliance was arrested by the FBI on a variety of charges, including violations of the Clean Air Act.
  - Sources are also reporting that VW and DOJ are nearing agreement to resolve the criminal investigation into the violations, including a plea of guilty from VW and the payment of over $4 billion in fines.
  - DOJ has not commented on these reports but is scheduled to conduct a press conference on the VW investigation today at 1:30 PM ET which will be streamed at www.JUSTICE.GOV/LIVE-STREAM.

- FAST-Act I/M Provision
  - The signed guidance has been sent to all call participants, along with other materials for today's call.
  - Dave noted that the prohibition against I/M testing of replica vehicles addressed in the FAST Act is binding on EPA, not the states, per EPA's Office of General Counsel, meaning that EPA cannot require states to test these vehicles or provide SIP credit to states that do.
  - A caller asked if these vehicles will have VINs and Dave noted that VINs are not under EPA's jurisdiction but rather are regulated by the Department of Transportation.

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  - March 8, 2017, 1:00 PM ET

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Bi-monthly OBD Stakeholder Call
Wednesday, January 11, 2017, 1-2:00 PM ET

Ex. 6 - Personal Privacy

Agenda Items

- Roll call by Region/State
- Notes from the November 16, 2016 OBD Stakeholder Call
- OBD Clearinghouse Update (Chris Woodhave, Weber)
- OBD Clearinghouse Recompetition
- Status of the ozone NAAQS(s)
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- FAST-Act I/M Provision
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- Next OBD Stakeholder Call
    - March 8, 2017, 1:00 PM ET

Bi-monthly OBD Stakeholder Call
Wednesday, November 16, 2016, 1-2:00 PM ET

Ex. 6 - Personal Privacy

Agenda Items

- Roll call by Region/State
  - Region 1: MA, CT
  - Region 2: Reema Loutan, NY, NJ
  - Region 3: PA, MD
  - Region 4: Dale Aspy, GA, NC
  - Region 5: OH, WI
  - Region 6: TX, LA
  - Region 7: MO
  - Region 8: UT
  - Region 9: CA, NV, AZ
  - Region 10: WA, ID
  - OTAQ: Dave Sosnowski
  - Others: ON, Weber State

- Notes from the July 27, 2016 OBD Stakeholder Call
  - No comments, corrections, or additions.

- OBD Clearinghouse Update
  - A new item on BMW on an oxygen sensor readiness issue and the necessary software update has been added.
  - The beta testing for the new web site is done.
    - Weber got a lot of good comments and suggestions and is working to address and incorporate them.
    - The new site is scheduled for launch in the first week of December.
    - Staff are currently working to make sure that visitors to the old site are redirected to the new site.

- OBD Clearinghouse Recompetition
  - The RFP announcing the competition was posted on the OAR grants web site and grants.gov in September 2016 with a deadline for submitting an "intent to apply" of October 11, 2016.
  - The deadline for submitting a proposal to grants.gov was October 28, 2016, which has now passed.
  - The project officer for the grant competition is in the process of convening a review panel.

- Status of the ozone NAAQS(s)

- EPA is being sued by environmentalists for either not acting to approve or disapprove certain ozone area SIP submissions or for not making findings of failure to submit for SIPs that are overdue for the 2008 ozone standard.
- One issue that came up during discussions of the suit was whether or not states with existing I/M programs for a previous ozone standard that would be separately required to adopt an I/M program based upon their classification for the 2008 ozone standard need to certify as part of a notice-and-comment public process that the existing program is adequate to meet I/M requirements for the new standard.
- After much discussion, it was concluded that such a certification is, indeed, required, that it can be as simple as a statement in the attainment demonstration for the 2008 standard (no need for a separate I/M SIP submission).
- States with any concerns should work with their respective regions.
- Lastly, the proposed implementation rule for the 2015 ozone standard has been signed by the Administrator, posted to the EPA web site, and is awaiting *Federal Register* publication.

- Volkswagen Notice of Violation
  - The comment period for the proposed settlement for the 2.0 liter VWs has closed and the judge has issued his approval, opening the door for owners of affected vehicles to sell them back to VW or opt to have them fixed if a fix is approved.
  - In addition, the settlement includes nearly $5 billion in funding to help mitigate the environmental damage the vehicles have already done and are projected to do, including substantial sums to spur ZEV adoption.
  - The settlement does not address the approximately 85,000 3.0-liter diesel vehicles sold in the US which have been found to also include defeat devices, including models like Porsche Cayenne, Volkswagen Touareg, and Audi Q7. Separate settlement talks for these vehicles are ongoing, though on Tuesday it was reported in the media that there is an agreement in principle that would involve reprogramming a large of the vehicles and buying back the approximately 20,000 vehicles that cannot be fixed.
  - Lastly, there has been significant press about CARB's discovery that some gasoline and diesel fueled Audi models may be producing substantially different levels of carbon dioxide when being tested under laboratory conditions versus being driven on the road.

- FAST-Act I/M Provision
  - A policy memo addressing the I/M provisions in the FAST-Act regarding the testing of replica vehicles has been drafted and is awaiting signature.
  - The short version is that EPA cannot approve I/M SIPs that claim credit for testing these vehicles as part of an I/M program.
  - Currently approved I/M SIPs that include these vehicles as part of the I/M subject fleet and claim credit for testing them will need to be amended to address this exclusion whenever the programs next have a reason to revise their I/M SIPs.

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- States that opt to test these vehicles nevertheless, under the states' own authority are not barred from doing so; they just cannot claim SIP credit from such testing in their I/M SIP.

- Miscellaneous Issues?
  - Issues were raised by several call participants regarding unusual imported and replica vehicles
    - Georgia mentioned that they have seen perhaps 6 replica vehicles in the program.
    - Missouri has seen a "noble manufacture vehicle" which had the body and chassis imported separately, no OBD, and a 1995 MY chassis that it wasn't sure how to test or even if it should be tested.
    - Georgia mentioned that vehicles without OBD default to tailpipe testing in the state and Missouri indicated that's not an option in their program because there is no tailpipe testing anymore in Missouri.
    - Texas mentioned that it is seeing several Japanese vehicles with 11 digit VINs (Dave mentioned that VIN is the jurisdiction of DOT).
    - Texas asked about the liability issues associated with replica vehicles that may not be subject to safety standards under the FAST Act.
      - Dale in Region 4 mentioned that vehicles like the Noble are actually probably sturdier than your typical vehicle, including stainless steel reinforced frames and carbon fiber body.

- Next OBD Stakeholder Call
  - January 11, 2017, 1:00 PM ET

ED_001361_00022846

Bi-monthly OBD Stakeholder Call
Wednesday, November 16, 2016, 1-2:00 PM ET

Ex. 6 - Personal Privacy

Agenda Items

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- Next OBD Stakeholder Call
  - January 11, 2017, 1:00 PM ET

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To: McLane, Preston[Preston.McLane@dep.state.fl.us]; Read, Hastings[Hastings.Read@dep.state.fl.us]; Cindy.Phillips@dep.state.fl.us[Cindy.Phillips@dep.state.fl.us]
From: Bell, Tiereny
Sent: Tue 12/6/2016 9:36:57 PM
Subject: FW: WEBINAR ANNOUNCEMENT: Proposed Rule: Implementation of the 2015 O3 NAAQS

Hello Preston and FDEP Staff,

Just a reminder, **Wednesday December 7, 2016 2-3:30pm (EDT)**, there will be a webinar on the *Proposed Rule for Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area Classifications and State Implementation Plan Requirements*. Please see the instructions below. If you have any questions or concerns please feel free to contact me.

All The Best,

Tiereny Bell | Life Scientist | U.S. Environmental Protection Agency

Region 4 | Air, Pesticides & Toxics Management Division | Air Planning and Implementation Branch|

Air Regulatory Management Section

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61 Forsyth St. SW | Atlanta, GA 30303

404.562.9088 | bell.tiereny@epa.gov

For distribution to Regions, State, Local and Tribal Air Agencies, communities, industry, environmental groups, and the general public:

Webinar: **PROPOSED RULE: IMPLEMENTATION OF THE 2015 NATIONAL AMBIENT AIR QUALITY STANDARDS FOR OZONE: NONATTAINMENT AREA CLASSIFICATIONS AND STATE IMPLEMENTATION PLAN REQUIREMENTS**

Date: Wednesday, December 7, 2016
Time: 2:00 – 3:30 PM Eastern Time
Intended Audience: Regions, State, Local, and Tribal Air Agencies, communities, industry, environmental groups, and the general public
Link to Join Webinar: https://epawebconferencing.acms.com/nonattainment-sip

Description: On November 2, 2016, the U.S. Environmental Protection Agency proposed requirements that would apply to state, local, and tribal air agencies for implementing the 2015 National Ambient Air Quality Standards (NAAQS) for ground-level ozone. The EPA revised both the health-based and welfare-based standards for ozone on October 1, 2015. This proposed action largely retains and updates the implementing regulations that apply for the 2008 ozone NAAQS, for purposes of the 2015 ozone standards, which creates stability in the planning process. This action also proposes two options for revoking the 2008 ozone NAAQS. The EPA is also seeking comment on a number of additional topics, including: (1) managing emissions from wildfires and wildland prescribed fires; (2) transportation conformity and general conformity; (3) contingency measures; (4) international transport and background ozone; and (5) additional policies for achieving emissions reductions. This webinar is intended to provide highlights of the proposed rule and address clarifying questions. To download a copy of the proposed rule or for more information go to https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state.

Logistics: You will listen to the audio via your computer. We highly recommend running a connect test on your system before logging into the webinar to ensure that the proper add-ins are enabled and the audio is working properly:
http://admin.adobeconnect.com/common/help/en/support/meeting_test.htm.

To: Dallas_Baker@deq.state.ms.us[Dallas_Baker@deq.state.ms.us]
Cc: Connie Simmons[CSimmons@mdeq.ms.gov]; Keith Head[KHead@mdeq.ms.gov]; Elliott Bickerstaff[ebickerstaff@mdeq.ms.gov]; Melissa_Fortenberry@deq.state.ms.us[Melissa_Fortenberry@deq.state.ms.us]
From: Bell, Tiereny
Sent: Tue 12/6/2016 9:22:37 PM
Subject: FW: WEBINAR ANNOUNCEMENT: Proposed Rule: Implementation of the 2015 O3 NAAQS

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Tiereny Bell | Life Scientist | U.S. Environmental Protection Agency

Region 4 | Air, Pesticides & Toxics Management Division | Air Planning and Implementation Branch|

Air Regulatory Management Section

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To: hornback@metro4-sesarm.org[hornback@metro4-sesarm.org]; asatyal@pinellascounty.org[asatyal@pinellascounty.org]; barnetwm@forsyth.cc[barnetwm@forsyth.cc]; bcolby@chattanooga.gov[bcolby@chattanooga.gov]; bieleb@miamidade.gov[bieleb@miamidade.gov]; bob.rogers@shelbycountytn.gov[bob.rogers@shelbycountytn.gov]; brivera@aqm.co.knox.tn.us[brivera@aqm.co.knox.tn.us]; campbell@epchc.org[campbell@epchc.org]; clafontaine@mdeq.ms.gov[clafontaine@mdeq.ms.gov]; corey.m.masuca@jcdh.org[corey.m.masuca@jcdh.org]; danny.shea@huntsvilleal.gov[danny.shea@huntsvilleal.gov]; david.brigman@buncombecounty.org[david.brigman@buncombecounty.org]; dbaker@mdeq.ms.gov[dbaker@mdeq.ms.gov]; dika.kuoh@dnr.ga.gov[dika.kuoh@dnr.ga.gov]; ebenezer.gujjarlapudi@mecklenburgcountync.gov[ebenezer.gujjarlapudi@mecklenburgcountync.gov]; gonzaj@miamidade.gov[gonzaj@miamidade.gov]; hornback@metro4-sesarm.org[hornback@metro4-sesarm.org]; jason.howanitz@jcdh.org[jason.howanitz@jcdh.org]; Jason.rayfield@mecklenburgcountync.gov[Jason.rayfield@mecklenburgcountync.gov]; jeff.koerner@dep.state.fl.us[jeff.koerner@dep.state.fl.us]; john.finke@nashville.gov[john.finke@nashville.gov]; jonathan.stanton@jcdh.org[jonathan.stanton@jcdh.org]; karen.hays@dnr.ga.gov[karen.hays@dnr.ga.gov]; keith.talley@louisvilleky.gov[keith.talley@louisvilleky.gov]; laliddington@aqm.co.knox.tn.us[laliddington@aqm.co.knox.tn.us]; laxmana.tallam@flhealth.gov[laxmana.tallam@flhealth.gov]; leslie.rhodes@mecklenburgcountync.gov[leslie.rhodes@mecklenburgcountync.gov]; lfernandez@broward.org[lfernandez@broward.org]; lloydpb@forsyth.cc[lloydpb@forsyth.cc]; lwb@adem.alabama.gov[lwb@adem.alabama.gov]; mcwilliams@coj.net[mcwilliams@coj.net]; megan.green@mecklenburgcountync.gov[megan.green@mecklenburgcountync.gov]; melissal@coj.net[melissal@coj.net]; michael.abraczinskas@ncdenr.gov[michael.abraczinskas@ncdenr.gov]; michelle.b.walker@tn.gov[michelle.b.walker@tn.gov]; michelle.king@louisvilleky.gov[michelle.king@louisvilleky.gov]; mpognon@broward.org[mpognon@broward.org]; porterhj@dhec.sc.gov[porterhj@dhec.sc.gov]; quincy.styke@tn.gov[quincy.styke@tn.gov]; Rachael Hamilton[Rachael.Hamilton@louisvilleky.gov]; raglanre@forsyth.cc[raglanre@forsyth.cc]; renee.parker@ocfl.net[renee.parker@ocfl.net]; roberma@miamidade.gov[roberma@miamidade.gov]; robinson@coj.net[robinson@coj.net]; rwg@adem.alabama.gov[rwg@adem.alabama.gov]; sean.alteri@ky.gov[sean.alteri@ky.gov]; sheila.holman@ncdenr.gov[sheila.holman@ncdenr.gov]; thompsrb@dhec.sc.gov[thompsrb@dhec.sc.gov]; cmaples@semtribe.com[cmaples@semtribe.com]; Darin Steen[darin.steen@catawbaindian.net]; jamilong@nc-cherokee.com[jamilong@nc-cherokee.com]; jerry.cain@choctaw.org[jerry.cain@choctaw.org]; kevind@miccosukeetribe.com[kevind@miccosukeetribe.com]; rmccullers@pci-nsn.gov[rmccullers@pci-nsn.gov]
Cc: Banister, Beverly[Banister.Beverly@epa.gov]; Kemker, Carol[Kemker.Carol@epa.gov]; Gettle, Jeaneanne[Gettle.Jeaneanne@epa.gov]; Benjamin, Lynorae[benjamin.lynorae@epa.gov]; Davis, Scott[Davis.ScottR@epa.gov]; Worley, Gregg[Worley.Gregg@epa.gov]; Rinck, Todd[Rinck.Todd@epa.gov]; Ceron, Heather[Ceron.Heather@epa.gov]; Berrios, Lisa[Berrios.Lisa@epa.gov]; Spann, Jane[Spann.Jane@epa.gov]
From: Mitchell, Ken
Sent: Tue 11/15/2016 9:29:42 PM
Subject: WEBINAR ANNOUNCEMENT: Proposed Rule: Implementation of the 2015 O3 NAAQS

Region 4 Air Directors….

Please see below for information on a webinar for the proposed rule related to implementation of the 2015 O3 NAAQS. Please let me know if you have any questions:

Kenneth L. Mitchell, Ph.D. | Special Assistant to the Director |
Air, Pesticides, and Toxics Management Division
U.S. Environmental Protection Agency | 61 Forsyth Street, SW | Atlanta, GA 30303
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Healthier Families, Cleaner Communities, A Stronger America

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Webinar: PROPOSED RULE: IMPLEMENTATION OF THE 2015 NATIONAL A MBIENT AIR QUALITY STANDARDS FOR OZONE: NONATTAINMENT AREA CLA SSIFICATIONS AND STATE IMPLEMENTATION PLAN REQUIREMENTS

Date: Wednesday, December 7, 2016

Time: 2:00 – 3:30 PM Eastern Time

Intended Audience: Regions, State, Local, and Tribal Air Agencies, communities, industry, environmental groups, and the general public

Link to Join Webinar: https://epawebconferencing.acms.com/nonattainment-sip

Description: On November 2, 2016, the U.S. Environmental Protection Agency proposed requirements that would apply to state, local, and tribal air agencies for implementing the 2015 National Ambient Air Quality Standards (NAAQS) for ground-level ozone. The EPA revised both the health-based and welfare-based standards for ozone on October 1, 2015. This proposed action largely retains and updates the implementing regulations that apply for the 2008 ozone NAA QS, for purposes of the 2015 ozone standards, which creates stability in the planning process. This action also proposes two options for revoking the 2008 ozone NAAQS. The EPA is also seeking comment on a number of additional topics, including: (1) managing emissions from wildfires and wildland prescribed fires; (2) transportation conformity and general conformity; (3) contingency measures; (4) international transport and background ozone; and (5) additional policies for achieving emissions reductions. This webinar is intended to provide highlights of the proposed rule and address clarifying questions. To download a copy of the proposed rule or for more information go to https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state.

Logistics: You will listen to the audio via your computer. We highly recommend running a connect test on your system before logging into the webinar to ensure that the proper add-ins are enabled and the audio is working properly:

http://admin.adobeconnect.com/common/help/en/support/meeting_test.htm.

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From: Dupont, Bernadette (FHWA)
Sent: Wed 6/21/2017 4:19:57 PM
Subject: Minutes from the June 19th KY AQ Webinar
Press Release.pdf
Minutes - June 19, 2017.pdf
CMAQ Final Rule.pdf

Good afternoon,

Attached are the minutes from the AQ webinar held on Monday, June 19, 2018, and the 6-slides on the CMAQ final rule.

Also attached a press release about the CMAQ program.

If there are any corrections to the minutes, please let me know. Thanks.

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From: Dupont, Bernadette (FHWA)
Sent: Mon 1/30/2017 10:02:09 PM
Subject: INFORMATION: FHWA Air Quality and Sustainable Transport Highlights—December 2016-January 2017 Issue
FHWA-HEP-17-031 - Highlights - Dec 2016-Jan 2017.pdf

Good Afternoon,

The purpose of this message is to inform you that the December 2016 – January 2017, issue of the FHWA *Air Quality and Sustainable Transport Highlights* is available.

The Highlights provide the latest news and information on transportation related air quality and sustainability activities, including information on transportation conformity, resiliency, and other related activities.

Items of interest in this issue include:

- The US EPA posted the Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area Classifications and State Implementation Plan Requirements in the Federal Register

- The National Transportation Institute (NTI) announced upcoming Introduction to Transportation Conformity training courses

Past issues of the Air Quality and Conformity Highlights are available at:
http://www.fhwa.dot.gov/environment/air_quality/conformity/highlights/

Past issues of the Sustainable Transport Newsletter are available at:
https://www.fhwa.dot.gov/environment/sustainability/newsletter/index.cfm

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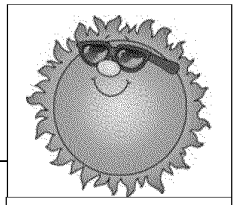
KY Air Quality Webinar

Monday, June 19, 2017 @ 10:00 AM



Summer 2017:
June 21-Sept 22

MINUTES

1. **Welcome** –Bernadette Dupont , FHWA-KY

2. **2015 Ozone NAAQS** – Kelly Sheckler, EPA-R4
The designations originally expected in October 2017, have been postponed for one year.

3. **KY's QA/QC Data –** Leslie Poff, KYDAQ
The 2013-2015 3-Yr average of the 4th highest daily max, 8hr shows Campbell County in violation at .071. Preliminary review of the 2014-2016 data for Jefferson County shows a violation of 0.074.

4. **Redesignation Request –** Leslie Poff, KYDAQ
The comment period on EPA's proposed rule to redesignate NKY to attainment for the 2008 8-hr ozone standard. EPA received no comments and the final rule should be published in the near future.

5. **Reformulated Gasoline Program –** Leslie Poff, KYDAQ
KYEEC sent a petition to USEPA requesting to opt-out of the reformulated gasoline (RFG) program in N. KY (Boone, Campbell, Kenton). Studies have shown that RFG doesn't reduce emissions significantly. APCD is considering a similar action for Louisville (Jefferson, Oldham).

6. **Stage II Program** – Kelly Sheckler, EPA-R4
Effective November 2016, KY canceled their Stage II program for gasoline stations. New gasoline stations will no longer be required to have Stage II equipment, all others are required to remove those systems by Dec 31, 2018.

7. **VIN Data** – Justin Harrod, KYTC-Planning
KY's 2016 VIN data is ready and will be distributed soon.

8. **Volkswagen Settlement** – Lona Brewer
The VW settlement has 3 parts: consumer, nationwide (promoting zero emission vehicles, and states. The last provides money to the states for 10 eligible types of projects. KY will receive $20+ M based on the number of VW registered in the State. $19+M for 1.0 L engine, and $1.3+M for 3 L diesel engines. A Trustee has been named. Once the Trustee announces the Effect Date, then States have 15 days to submit their plans on how to spend the money. KY is working on their plan now, and actively seeking public participation, developing a list of projects, and determining the benefits of those projects.
KY website: http://eec.ky.gov/Pages/Volkswagen-Settlement.aspx
EPA's websites: https://www.epa.gov/vw; and
www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement

9. **CMAQ Projects** – Jackie Jones, KYTC – OLP
KYTC anticipates a new funding cycle to start at the beginning of July and last for 6 wks. Please use the revised application form. Also under consideration is a standardized method for calculating emissions for all projects under review. FHWA just conducted a "State of the Practice" review on CMAQ and has shared that report. It is attached. The Atlanta Regional Council created a program that calculates emissions. http://atlantaregional.org/congestion-mitigation-and-air-quality-program-cmaq/ Denver and the Kansas City MPO use it for their CMAQ applications.

10. **CMAQ Performance Measures** – Bernadette Dupont, FHWA-KY
See attached presentation.

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- John Ballantyne, KY
- Frank Burkett, OH
- Bernadette Dupont, KY
- Chandra Inglis-Smith, WV
- Antonio Johnson, IN
- Joyce Newland, IN
- Leigh Oesterling, OH
- Greg Rawlings, KY
- Mike Roberts, RC
- Sean Santella, TN

INDOT
- Frank Baukert, INDOT
- Jay Mitchell, INDOT

KYTC
- Daniel Burgin, DEA
- Ed Harding, OIT
- Justin Harrod, Planning
- Tonya Higdon, Planning
- Barry House, Planning
- Jackie Jones, OLP
- Eric Perez, Transportation Delivery
- Lynn Soporowski, Planning
- Thomas Witt, Planning

ODOT
- Caroline Griffith
- Dave Moore

TDOT
- Deborah Fleming

WVDOT
- Paul Mattox
- Tim Sedosky

GUEST SPEAKER

- Lona Brewer, KYEEC

Announcements:

1) **STAQS 2017 – August 29-30, 2017 in Arlington, TX**
To register go to: www.nctcog.org/STAQS2017-DFW

2) FHWA has a new website that evaluates strategies for reducing energy consumption and GHG emissions.
https://www.planning.dot.gov/fhwa_tool/default.aspx

December 2016/January 2017

Air Quality and Sustainable Transportation Highlights

Prepared by the Office of Natural Environment
Federal Highway Administration

U.S. Department of Transportation
Federal Highway Administration

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Announcements and Recent Events

Final Appendix W Rulemaking: Replacement of CALINE3

On December 20, 2016, the U.S. EPA signed a final rule that revises the Guideline on Air Quality Models. The Guideline provides EPA-recommended models and other techniques, as well as guidance for their use, for predicting ambient concentrations of air pollutants. The U.S. EPA is finalizing replacement of CALINE3 with AERMOD as the preferred Appendix A model for refined mobile source applications including fine particle pollution ($PM_{2.5}$, PM_{10}) and carbon monoxide (CO) hot-spot analyses. The transition period for the use of AERMOD for these refined modeling applications was extended to 3 years and the use of CAL3QHC for CO screening analyses was retained. The effective date is March 21, 2017. For more information, including a copy of the final rule, a fact sheet, a Technical Support Document (TSD), and EPA contact information, see https://www3.epa.gov/ttn/scram/appendix_w-2016.htm.

FHWA Sessions on Air Quality and Sustainability at the 2017 Transportation Research Board Annual Meeting

FHWA Office of Planning, Environment, and Realty (HEP) staff participated in several sessions related to air quality and sustainable transportation at the 96th Transportation Research Board Annual Meeting, which was held January 8-12, 2017, in Washington, DC.

- The *Innovations in Emission and Air Quality Modeling and Measurement* session presented new approaches in transportation air quality modeling and monitoring. These included new tools (e.g., Unmanned Aerial Vehicle), emerging technologies (e.g., Connected and Autonomous Vehicles), and new applications (e.g., using noise barriers to mitigate project-level air pollution).
- The *Sustainability in Geological and Geoenvironmental Engineering* session addressed the desire to initiate a "paradigm shift" in the way that transportation design engineers, planners, and other transportation professionals think about sustainability and how to incorporate it into their daily practices.
- *Advances in Emission and Air Quality Modeling* focused on modelling of light- and heavy-duty vehicle emissions at various scales with the objective of improving emission estimates through analysis of the effect speed inputs. Air quality effects of heavy-duty vehicle movements were also presented.

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- *Tracking Progress in DOTs' Rapid Shift Areas* discussed the indicators needed or that are working for governments making the de-carbonization, health, access for all, electric vehicle, automated vehicle, and shared vehicle transitions. Starter sets of indicators were presented and distributed.
- The *Transportation Performance Management: The Final Rules for Pavement, Bridges and System Performance* session included a presentation and discussion on CMAQ performance measures.
- The *Planning for Climate Change: Adaptation, Resilience, and Mitigation* poster session showcased successful approaches to vulnerability assessments and adaptation evaluation from 2013-2015 FHWA climate resilience pilot program.
- The *Current Issues in Transportation and Air Quality* poster session highlighted cutting edge research in air quality modeling and analysis.
- The *Current Issues in Transportation-Related Noise and Vibration* poster session highlighted the latest research in transportation and noise issues.
- *Lessons Learned for Incorporating Climate Change into Transportation Engineering: Synthesis* presented a sample of FHWA-conducted case studies that demonstrate lessons learned for four disciplines: coastal engineering, inland hydrology, geotechnology, and pavement engineering. The session also briefly introduced the newest guidance that FHWA has released on this topic.
- The *Alternative Fuel and Advanced Technology Vehicles: Keeping Up with Rapidly Changing Technology Options* workshop discussed the use of advanced vehicle technologies and alternative fuel use in a rapidly changing environment. The technology to support these vehicles and fueling infrastructure has rapidly evolved over the last 5 years and will continue to do so in the future. The workshop provided an overview of some of the technology options available today and provided a preview of some of the newer innovations that could shape the transportation sector in the future.
- The *FHWA Office of Planning, Congestion Mitigation and Air Quality Improvement Program – CMAQ* booth highlighted the work of the Air Quality and Noise Abatement Team administering air quality and noise programs designed to lessen the impacts of transportation related noise and exhaust emissions.
- The *Sustainable Transportation and Resilience* booth showcased FHWA's sustainability self-assessment tool, INVEST, and FHWA tools to help state, regional, and local agencies reduce transportation greenhouse gas emissions and prepare the U.S. transportation system for the impacts of climate change.

U.S. Environmental Protection Agency Proposes 2015 Ozone Standard Implementation Rule

On November 17, 2016, the U.S. Environmental Protection Agency (U.S. EPA) posted the proposed rule *Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area Classifications and State Implementation Plan Requirements* in the Federal Register. The U.S. EPA is proposing nonattainment area classification thresholds and implementation requirements for the strengthened 2015 ozone national ambient air quality standards (NAAQS) that were promulgated on

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October 1, 2015. The proposal is largely an update to the implementing regulations previously promulgated for the 2008 ozone NAAQS, and the U.S. EPA proposes to retain without significant revision the majority of those provisions to implement the 2015 ozone NAAQS. The proposal addresses the timing of attainment dates for each nonattainment area classification and a range of nonattainment area state implementation plan (SIP) requirements for the 2015 ozone NAAQS. The proposed SIP requirements pertain to attainment demonstrations, reasonable further progress (RFP) and associated milestone demonstrations, reasonably available control technology (RACT), reasonably available control measures (RACM), major nonattainment new source review (NNSR), emission inventories, the timing of required SIP submissions, and compliance with emission control measures in the SIP. The proposed rule also addresses the revocation of the 2008 ozone NAAQS, anti-backsliding requirements that would apply when the 2008 ozone NAAQS are revoked, and reconsideration of the ozone NAAQS interprecursor trading (IPT) provisions. The U.S. EPA is proposing two alternative options for revocation of the 2008 ozone NAAQS: 1) revoke the 2008 ozone NAAQS for all areas and purposes one year after designations for the 2015 NAAQS are effective or 2) revoke the 2008 ozone NAAQS only in areas designated attainment for the 2008 NAAQS at time of its revocation, and later for areas upon re-designation to attainment for the 2008 or 2015 NAAQS. The comment period for the proposed rule closes on February 13, 2017. More information about the proposed rule can be found at https://www.epa.gov/ozone-pollution/implementation-2015-national-ambient-air-quality-standards-naaqs-ozone-state.

U.S. EPA Posts Update to MOVES2014a

The U.S. EPA posted an update to MOVES2014a in November 2016. The update fixes issues with the MOVES Fuel Wizard and updates emission rates for dioxins and furans. The Fuel Wizard is a tool, accessible via the Fuels tab in the County and Project Data Managers, which allows users to create gasoline fuels that are not represented in the default on-road fuel supply. The U.S. EPA recommends that the Fuel Wizard be used whenever any of the following fuel properties of gasoline and gasoline-ethanol blends are changed in the Fuel Formulation. The Fuel Wizard updates other gasoline properties to account for the changes entered by the user. The U.S. EPA discovered an error in the Fuel Wizard that, in some cases, can result in incorrect adjustments to fuel formulations when users change the ethanol content of the fuel. The effects of these adjustments on emissions are small, but the U.S. EPA recommends that MOVES users who plan to use the Fuel Wizard install and use the update to MOVES2014a for all future work. In addition, emission rates for dioxins and furans from on-road and non-road vehicles are now reported in absolute mass, rather than in terms of toxic equivalency.

Meetings, Conferences, and Workshops

16th Transportation Research Board National Transportation Planning Applications Conference

Planning is underway for the 16th TRB National Transportation Planning Applications Conference. It will be held in Raleigh, North Carolina, on May 14-18, 2017, at the Sheraton Hotel, Downtown Raleigh. The conference focuses on providing opportunities to showcase new transportation planning techniques and methods emphasizing practical, innovative, and timely technical and policy approaches to transportation planning. Presentations, workshops, discussion sessions, and tutorials are all expected to be a part of the 2017 program, continuing the focus on practical, innovative, and timely techniques for solving planning problems. Additional conference details and registration information will be forthcoming in early 2017.

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2017 International Conference on Ecology and Transportation Livability

The Transportation Research Board is co-sponsoring the *2017 International Conference on Ecology and Transportation* on May 14-18, 2017, in Salt Lake City, Utah. The conference is designed to explore the broad range of ecological issues related to transportation systems in the areas of development, policy, and administration as a means to help enhance project development processes and the ecological sustainability of transportation systems.

2017 Southern Transportation and Air Quality Summit (STAQS)

The 2017 Southern Transportation and Air Quality Summit (STAQS) will be held at the North Central Texas Council of Governments (NCTCOG) in Arlington, Texas on August 29-30, 2017. Registration information and conference details will be made available soon.

Reminders

Congestion Mitigation and Air Quality Improvement Program Emission Reductions Calculator Updated

The FHWA Office of Natural Environment has developed a series of tools to provide technical support and resources for the implementation of the Congestion Mitigation and Air Quality Improvement (CMAQ) Program. CMAQ project justifications, as well as annual reporting, require the development of reliable air quality benefit estimates. Realizing that every potential project sponsor may not have the capacity for developing independent air quality benefit estimates, the FHWA has undertaken the initiative of developing a series of spreadsheet-based tools to facilitate the calculation of representative air quality benefit data. This CMAQ Emission Reductions Calculator is offered only as an additional resource to assist DOTs, MPOs, and project sponsors in the project justification process. Agencies and individuals using an existing methodology to generate emissions benefit information are welcome to continue their current practice. The first module, focused on traffic flow improvements, is available on the FHWA CMAQ Emissions Calculator Toolkit webpage and was updated in December 2016. The second module, Advanced Diesel Truck/Engine Technologies, was posted in January 2017. For more information, please contact Mark Glaze at Mark.Glaze@dot.gov or (202) 366-4053.

FHWA Updated Interim Guidance on Mobile Source Air Toxics Analysis in NEPA Documents

The Federal Highway Administration (FHWA) released the Updated Interim Guidance for Mobile Source Air Toxic (MSAT) Analysis in National Environmental Policy Act (NEPA) Documents. Beginning October 7, 2016, project sponsors should use MOVES2014 to conduct emissions analysis for NEPA purposes. The guidance provides a tiered approach for analyzing MSAT in NEPA documents. For more information, please contact Victoria Martinez at Victoria.Martinez@dot.gov or (787) 771-2524.

FHWA Designates Alternative Fuel Corridors

On November 3, the FHWA announced 55 routes as alternative fuel corridors. The fuel designations include electric, hydrogen, propane, and natural gas, as directed in the FAST Act. Corridors were designated as either "signage-ready" (there are sufficient facilities to warrant signage along the corridor) or "signage-pending" (currently there are insufficient facilities available to warrant signage). The designations follow a July 22 Federal Register Notice seeking corridor nominations and will serve as the

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basis for a national network that can grow in the future. More information is available on FHWA's Alternative Fuel Corridor website.

FHWA Releases Updated Greenhouse Gas Emissions Reduction Policy Analysis Tool

The FHWA recently released an updated version of EERPAT, the Energy and Emissions Reduction Policy Analysis Tool. EERPAT is an integrated, state-level modeling system designed specifically to evaluate strategies for reducing surface transportation greenhouse gas emissions. The new version of the tool (v3.0) has an improved graphical user interface that provides a simplified method for interacting with the tool for those users who are not proficient in the R software language. The redesigned EERPAT website now includes example applications of the tool from three state DOTs: Maryland, Vermont, and Washington. The tool is available at the FHWA EERPAT website.

Recording Available: FHWA Webinar on CEQ Climate Change Guidance

The FHWA posted a recording of the agency's October 4, 2016, webinar on the White House Council on Environmental Quality (CEQ)'s *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews*. The webinar provided an overview of the CEQ's climate change guidance and presented suggestions for approaches to address the guidance during NEPA reviews. To view the recording, go to the FHWA Climate Adaptation Webinars webpage.

FHWA Publishes Nonattainment Area Maps for $PM_{2.5}$ 2012 Standard

On September 20, 2016, the FHWA posted maps of areas designated nonattainment for the 2012 NAAQS for $PM_{2.5}$. These maps are available for review and download at https://www.fhwa.dot.gov/environment/air_quality/conformity/maps/pm25_2012/.

MOVES Model Review Work Group

The U.S. EPA initiated a Federal Advisory Committee Act MOVES Model Review Work Group to provide input on the development of the next official version of MOVES, expected to be released in 2018 at the earliest. Presentations and meeting summaries are available on the Work Group website: https://www.epa.gov/moves/federal-advisory-committee-act-faca-moves-model-review-work-group.

U.S. EPA Guidance on Revocation of 1997 $PM_{2.5}$ NAAQS

In October 2016, the U.S. EPA published guidance on revocation of the 1997 NAAQS for $PM_{2.5}$. The guidance describes how the revocation of the 1997 primary annual $PM_{2.5}$ NAAQS will be implemented and when transportation conformity stops applying for this NAAQS. It fulfills a commitment the EPA made in November 2015 to provide additional information once the EPA finalized the $PM_{2.5}$ state implementation plan (SIP) requirements rule. An FHWA FAQ on revocation of the standard will be forthcoming. The U.S. EPA guidance is available at https://www.epa.gov/sites/production/files/2016-10/documents/420b16072.pdf.

U.S. EPA Publishes Revisions to Exceptional Events Guidelines

On October 3, 2016, the U.S. EPA published revisions to its "exceptional events" guidelines in the *Federal Register*, giving potential challengers 60 days to appeal to the U.S. Court of Appeals for the

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District of Columbia Circuit. The rules are intended to spell out the conditions under which states can effectively get a pass for air pollution violations stemming from wildfires, stratospheric ozone intrusions, and other forces outside their control. The final Exceptional Events Rule contains procedural requirements, requirements for air agency demonstrations, criteria for EPA's approval of the exclusion of event-influenced air quality data, and requirements for air agencies to take appropriate and reasonable actions to protect public health from exceedances or violations of the NAAQS. States had complained that the current application process, dating to 2007, is costly and cumbersome. To review the guidelines, please visit https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0229-0135.

Revision to the Near-Road NO_2 Minimum Monitoring Requirements NPRM

On May 16, 2016, the U.S. EPA proposed revisions to the minimum monitoring requirements for near-road nitrogen dioxide (NO_2) monitoring by removing the existing requirements for near-road NO_2 monitoring stations in Core Based Statistical Areas (CBSAs) having populations between 500,000 and 1,000,000 persons, that were due by January 1, 2017. Current near-road NO_2 monitoring data indicate air quality levels in the near-road environment are well below the NAAQS for the oxides of nitrogen. In light of this information, and due to the relationship between population, traffic, and expected NO_2 concentrations in the near-road environment, it is anticipated that measured near-road NO_2 concentrations in the relatively smaller CBSAs would exhibit similar, and more likely, lower concentrations, than what is being measured in larger urban areas. For more information, see https://www.gpo.gov/fdsys/pkg/FR-2016-05-16/pdf/2016-11507.pdf.

Training Opportunities

National Transit Institute (NTI) Introduction to Transportation Conformity Course Scheduled

The NTI's Introduction to Transportation Conformity course is scheduled for January 31-February 2, 2017, in Houston and March 28-30, 2017, in Salt Lake City. The 2.5-day course will present basic information about transportation conformity requirements and the relationship of the transportation and air quality planning processes. Registration can be made via NTI's website.

U.S. DOT Every Place Counts: Leadership Academy Releases Transportation Toolkit

The U.S. Department of Transportation launched the *Every Place Counts: Leadership Academy* to help demystify the transportation process for planners, community leaders, and the public at large. Several new Leadership Academy resources, including a Transportation Toolkit, Quick Guide, and Facilitator Guide, are now available for download. These resources are meant to provide interested individuals with the resources to host Leadership Academies in their own communities. The resources are available at https://www.transportation.gov/leadershipacademy.

Transportation Research Board Straight to Recording for All: Climate Resilient and Sustainable Transportation - Strategic Economic and Financial Management Challenges and Opportunities with FAST Act

The TRB recorded a series of videos in September 2016 that illustrate how transportation agencies can comply with new requirements under the FAST Act. Specifically, these videos discuss how highway and transit projects can adjust to extreme weather events with regards to economic and management

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decisions. The videos are available on-demand at no cost at http://www.trb.org/Environment/Blurbs/175113.aspx.

CMAQ 101 Training

The FHWA posted a 27-minute YouTube video on the CMAQ program. The video provides a basic introduction to the program, how CMAQ funds are distributed to states, and the types of projects eligible for the CMAQ program. The training is available at https://www.youtube.com/watch?v=XKXcs0WtNHA&feature=youtu.be. For more information about the CMAQ program, please contact Mark Glaze at mark.glaze@dot.gov or (202) 366-4053.

Air Quality Planning Web Course Available at No Cost

The National Highway Institute (NHI) Air Quality Planning web-based training series is designed for transportation practitioners. It includes four modules: Clean Air Act Overview (FHWA-NHI-142068), State Implementation Plan (SIP) and Transportation Control Measure (TCM) Requirements and Policies (FHWA-NHI-142069), SIP Development Process (FHWA-NHI-142070), and Transportation Conformity (FHWA-NHI-142071). All courses are free. For more information, visit http://www.nhi.fhwa.dot.gov/ and search Air Quality Planning or look for the specific course number. Please contact Karen Perritt at (202) 366-9066, or Karen.Perritt@dot.gov with any questions or comments.

MOVES2014a Training Materials

The U.S. EPA posted updated training materials and schedule for the MOVES2014a two-day hands-on training course at https://www.epa.gov/moves/moves-training-sessions. On the same webpage, the U.S. EPA also posted an abbreviated version of the MOVES2014a course materials used as a one-day training course. MOVES users who did not attend a previous hands-on training session can use the "MOVES2014 Training Materials" as a self-taught course.

MySQL Training for MOVES Model Users

Two training opportunities are available for MOVES model users. A three-hour webinar provides an introduction to MySQL Query Browser and MOVES interface. A six-hour training over two days will enable users to do MySQL programming and to write their own MySQL scripts and to manipulate MySQL databases including MOVES input and outputs. For more information or to schedule training, please contact Paul Heishman at Paul.Heishman@dot.gov.

FHWA Resource Center Training Activities

FHWA's Resource Center Air Quality Technical Services Team is available to offer MOVES training, and information is available at the Resource Center website.

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Contacts

FHWA Headquarters Air Quality and Transportation Conformity Team

- Cecilia Ho, Cecilia.Ho@dot.gov (202) 366-9862, Team Leader
- Mark Glaze, Mark.Glaze@dot.gov (202) 366-4053
- David Kall, David.Kall@dot.gov (202) 366-6276
- Victoria Martinez, Victoria.Martinez@dot.gov (787) 771-2524
- Karen Perritt, Karen.Perritt@dot.gov (202) 366-9066

FHWA Headquarters Sustainable Transport and Climate Change Team

- Mike Culp, Michael.Culp@dot.gov, (202) 366-9229, Team Leader
- John Davies, JohnG.Davies@dot.gov, (202) 366-6039
- Connie Hill Galloway, Connie.Hill@dot.gov, (804) 775-3378
- Tina Hodges, Tina.Hodges@dot.gov, (202) 366-4287
- Heather Holsinger, Heather.Holsinger@dot.gov, (202) 366-6263
- Rob Hyman, Robert.Hyman@dot.gov, (202) 366-5843
- Rob Kafalenos, Robert.Kafalenos@dot.gov, (202) 366-2079
- Becky Lupes, Rebecca.Lupes@dot.gov, (202) 366-7808
- Diane Turchetta, Diane.Turchetta@dot.gov, (202) 493-0158

FHWA Resource Center Air Quality Team

Past issues of the *Air Quality and Transportation Conformity Highlights* are available on FHWA's website: http://www.fhwa.dot.gov/environment/air_quality/conformity/highlights/. Past issues of the *Transportation and Climate Change Newsletter* are available on FHWA's website: http://www.fhwa.dot.gov/environment/climate_change/newsletter/

Please e-mail Victoria.Martinez@dot.gov with any suggestions for future issues.

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ENVIRONMENTAL MANAGEMENT COMMISSION
FISCAL NOTE FOR PROPOSED AMENDMENT AND READOPTION TO THE OZONE NATIONAL AMBIENT AIR QUALITY STANDARDS RULE

Rule Adoptions:	None
Rule Amendments / Readoption:	15A NCAC 02D .0405, Ozone
Rule Repeals:	None
Rule Topic:	Revisions to Ozone Standards
DEQ Division:	Division of Air Quality
Agency Contact:	Joelle Burleson, Rule Development Branch Supervisor Division of Air Quality (DAQ) (919) 707-8720 Joelle.Burleson@ncdenr.gov
Analyst:	Matthew Davis, Environmental Specialist Division of Air Quality (DAQ) (919) 707-8707 Matthew.Davis@ncdenr.gov
Impact Summary:	State government: Minimal Local government: No Substantial impact: No Private Sector: Unlikely
Statutory Authority:	G.S. 143-215.3(a)(1); 143-215.107(a)(3).
Necessity:	To update and readopt the ambient standards for Ozone in Rule 15A NCAC 02D .0405, Ozone. These proposed rule changes are necessary to comply with federal regulations.

I. Certificate of Federal Requirement

The United States Environmental Protection Agency (USEPA) strengthened its primary and secondary National Ambient Air Quality Standards (NAAQS) for ground-level ozone on October 1, 2015. Primary standards provide public health protection, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The USEPA recently determined that the 2008 primary and secondary ground-level ozone standard of 0.075 parts per million (ppm) is not adequate to protect public health and welfare from known or anticipated adverse effects. Based

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on its review of the air quality criteria for ozone and related photochemical oxidants and NAAQS, USEPA revised the primary and secondary ground-level ozone standard to 0.070 ppm pursuant to Clean Air Act (CAA) Sections 108 and 109.

The ozone monitoring season has been expanded by one month to ensure compliance with the 2008 and 2015 ozone NAAQS, and to ensure citizens are alerted when ozone reaches levels of concern. However, th e indicators, forms, and averaging times (the annual fourth -highest daily maximum 8-hour concentration, averaged over 3 consecutive years) have been retained. There are currently 4 ozone monitors operating year-round which will not be affected by the rule. However, there are labor costs for incorporating the one -month change to several existing ozone monitors. Labor for each monitor is approximately $270 each month ($30/hr, for 3 hours, over 3 days). This new regulation will affect 26 existing monitors, so there's a new total labor cost of approximately $7,020. No new monitors will be installed, and there's no additional cost for electricity or audits to existing units. The monitoring season changes are effective January 1, 2017.

In accordance with the requirements outlined in G.S. §150B-19.1(g) and §150B-21.3A, the DAQ is proposing to amendand readopt rule 15A NCAC 02D .0405, Ozone. The amendment is identical to 40 CFR 50.19 that the DAQ is required to implement in accordance with CAA section 107(a): "Each State shall have the primary responsibility for assuring air quality within the entire geographic area comprising such State by submitting an implementation plan for such State which will specify the manner in which national primary and secondary ambient air quality standards will be achieved and maintained within each air quality control region in such State."

The primary benefit of this set of amendments is to address applicability consistent with the requirements of the CAA and ensure approval of the state implementation plan (SIP) by USEPA. Without the proposed rule change, USEPA will not be able to approve the current version of the plan. If the state does not have a plan that meets federal requirements, the USEPA approval can require corrective action within required timeframes or implement a federal implementation plan (FIP) for North Carolina. A FIP may require solutions that are not the best to fit a particular area and are less preferable than having a state-controlled program.

The USEPA intends to provide final air quality designations by October 1, 2017. Based on the 2013 – 2015 certified ambient monitoring data, the design values for all ozone monitors in North Carolina are below the revised 2015 8 -hour ozone NAAQS. [1] In addition, for 2016, bas ed on preliminary data recorded through September 11, the design values for all ozone monitors in North Carolina are below the revised 2015 ozone standard.[2] Therefore, North Carolina is recommending that all counties in North Carolina be designated as "Attainment" for the revised 8 -hour ozone standard. As such, the DAQ anticipates unlikely private sector and minimal state impacts.

[1] NCDEQ. Division of Air Quality. Ozone Design Values for 2013 – 2015 in NC Counties https://deq.nc.gov/node/83248/

[2] NCDEQ. Division of Air Quality. Preliminary Ozone Design Values for 2014 – 2016 in NC Counties https://ncdenr.s3.amazonaws.com/s3fs-public/Air%20Quality/planning/attainment/mapping/NC_Ozone%20_Design_Values_2014_2016.jpg

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II. Conclusion

The DAQ does not expect NC counties to exceed the new ozone standard in the foreseeable future. Over the past decade, NC has implemented substantial, progressive emissions reductions that have resulted in statewide attainment of the 1997 8-hour and 2008 8-hour ozone standards. NC has historically accomplished attainment of the ozone NAAQS within CAA timelines through hard work with local, state, and federal partners. The partnerships allow for effective planning for optimum control measures or strategies to bringing an area into attainment and maintain the area in compliance with the federal standards. Currently, ozone concentrations in NC are attaining the 1997, 2008, and 2015 primary and secondary standards.

No direct economic impacts are expected for state or local governments if the ozone standard is exceeded. This is especially true since NC's final and preliminary design values[1,2] are attaining the 2015 standard. However, indirect impacts to industry may occur in the unlikely event that the state is designated nonattainment based on 2017 ozone season data. The impacts may include new requirements for facilities to install air pollution control equipment or may have various operational limits. If such control measures are needed, the DAQ would initiate rulemaking consistent with the timelines codified in the CAA; and in the process, seek approval from the EMC and the stakeholder community. Also, several voluntary measures may be implemented such as utilizing mass transit, riding bikes, carpool lanes, reducing vehicle idling, alter fuel formulations, and other various methods to reduce pollutants.

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To: Pepple, Karl[Pepple.Karl@epa.gov]
From: Pascale.Warren@deq.idaho.gov
Sent: Wed 10/5/2016 8:02:02 PM
Subject: 2015 O3 designation recommendation

Hi Karl- Just checking in to see if Region 10 has received Idaho's Ozone designation recommendation letter as the deadline to submit is nearly there. I believe we submitted the letter in early September.

Thank you,

Pascale Warren

Airshed Management Analyst

Idaho Department of Environmental Quality

(208) 373-0586

To: Pepple, Karl[Pepple.Karl@epa.gov]; Koprowski, Paul[Koprowski.Paul@epa.gov]
From: STOCUM Jeffrey
Sent: Tue 9/13/2016 12:56:51 AM
Subject: Oregon Ozone NAAQS designation Letter 2016 DRAFT
Oregon Ozone NAAQS designation Letter2016cs.docx

Hi Karl,

I've attached the revised version of Oregon's Ozone NAAQS submittal letter. Thanks for finding the previous one, that was very helpful to update for the current situation. Please let me know if this covers what is needed in the communication from our Governor and I can start the routing process. Thanks for any guidance you can provide.

Jeffrey

Jeffrey Stocum / Air Quality Technical Services Manager / Environmental Solutions Division

Phone: 503-229-5506 / email: stocum.jeffrey@deq.state.or.us

September 12, 2016

Dennis McLerran
Regional Administrator
U.S. EPA, Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

Re: Recommendations for Ozone Area Designations

Dear Mr. McLerran:

I am pleased to present to you my recommendations for attainment and nonattainment air quality designations in the State of Oregon for the revised eight-hour ozone National Ambient Air Quality Standard (NAAQS), as required in the Final Rule published on October 26, 2015 in the Federal Register.

Based on the most recent three years of quality-assured, federal reference monitoring data collected in 2013, 2014, and 2015, all areas in Oregon are in compliance with the revised ozone public health standard. Therefore, in accordance with US EPA guidance, I recommend all counties in the state of Oregon, including all tribal lands, be designated "attainment/unclassifiable".

I would like to acknowledge that all of our former ozone nonattainment areas continue working to maintain clean air. In particular, the efforts and strategies implemented in the Portland Metro area have been critical in ensuring they would meet the revised and more protective ozone standard.

If you have any questions, please contact David Collier, Manager, Air Quality Planning, Department of Environmental Quality, at (503) 229-5177.

Sincerely,

Kate Brown
Governor

cc: Oregon Department of Environmental Quality
Lane Regional Air Protection Authority

Tim Hamlin, Director, Office of Air and Waste
Debra Suzuki, Manager, Air Planning Unit

To: cindy.heil@alaska.gov[cindy.heil@alaska.gov]; mary anderson[Mary.Anderson@deq.idaho.gov]; COLLIER David[david.collier@state.or.us]; Pritchett, Nancy (ECY)[npri461@ECY.WA.GOV]; Alberich, Jason (ECY) (jalb461@ECY.WA.GOV)[jalb461@ECY.WA.GOV]
Cc: Pepple, Karl[Pepple.Karl@epa.gov]
From: Suzuki, Debra
Sent: Wed 6/7/2017 3:38:26 PM
Subject: FW: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations
AZ Ducey 6-6-17.pdf

Fyi. I just learned that these letters were sent out to Governors yesterday.

Thanks,

Debra

From: U.S. EPA Media Relations [mailto:no-replysubscriptions@epa.gov]
Sent: Tuesday, June 06, 2017 3:33 PM
To: Holsman, Marianne <Holsman.Marianne@epa.gov>
Subject: EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

CONTACT:
press@epa.gov

FOR IMMEDIATE RELEASE
June 6, 2017

EPA to Extend Deadline for 2015 Ozone NAAQS Area Designations

WASHINGTON – U.S. Environmental Protection Agency (EPA) Administrator Scott Pruitt sent a letter to governors today to inform them of EPA's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. EPA is extending the deadline for promulgating initial area designations, by one year, for the 2015 ozone NAAQS.

"States have made tremendous progress and significant investment cleaning up the air. We will continue to work with states to ensure they are on a path to compliance," **said Administrator Scott Pruitt.**

The National Ambient Air Quality Standard (NAAQS) for ground-level ozone is an outdoor air regulation under the Clean Air Act. As part of the process to determine what areas of the

country are able to meet the current air quality standards, states are currently submitting their proposals for area designations under the 70 parts per billion (ppb) standard, which was lowed from 75 ppb in 2015. Areas designated as being in "nonattainment" of the standard face consequences, including: increased regulatory burdens, restrictions on infrastructure investment, and increased costs to businesses.

EPA is giving states more time to develop air quality plans and EPA is looking at providing greater flexibility to states as they develop their plans. And, pursuant to the language in the recently-enacted FY2017 Omnibus funding bill, Administrator Pruitt is establishing an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

Additionally, the Agency is taking time to better understand some lingering, complicated issues so that air attainment decisions can be based on the latest and greatest information. This additional time will also provide the agency time to review the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states and localities. The Agency is evaluating these issues, primarily focused on:

- Fully understanding the role of background ozone levels;
- Appropriately accounting for international transport,
- And, timely consideration of exceptional events demonstrations.

"We share the goal of clean air, a robust economy and stronger, healthier communities. We are committed to working with states and local officials to effectively implement the ozone standard in a manner that is supportive of air quality improvement efforts without interfering with local decisions or impeding economic growth," **said Administrator Pruitt.**

Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased.

R107

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Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington, DC 20460 United States

E. SCOTT PRUITT
ADMINISTRATOR

June 6, 2017

The Honorable Doug Ducey
Governor of Arizona
State Capitol
1700 W. Washington Street
Phoenix, AZ 85007

Dear Governor Ducey:

I am writing to update you on the status of the U.S. Environmental Protection Agency's efforts related to the National Ambient Air Quality Standards (NAAQS) for ozone promulgated in October 2015. Pursuant to section 107(d)(1)(B) of the Clean Air Act (CAA), I am extending the deadline for promulgating initial area designations for the 2015 ozone NAAQS by one year. I have determined that there is insufficient information, and taking additional time is appropriate in order to consider completely all designation recommendations provided by state governors pursuant to CAA section 107(d)(1)(A) and to rely fully on the most recent air quality data. This additional time will also provide the Agency time to complete its review of the 2015 ozone NAAQS, prior to taking this initial implementation step.

Although the new ozone standard was set on October 1, 2015, there remains a host of complex issues that could undermine associated compliance efforts by states, localities and regulated entities. As part of the review process, the Agency is evaluating these issues primarily focusing on: fully understanding the role of background ozone levels; appropriately accounting for international transport; and, timely consideration of exceptional events demonstrations. Additionally, pursuant to language in the recently-enacted FY 2017 omnibus bill, I have established an Ozone Cooperative Compliance Task Force to develop additional flexibilities for states to comply with the ozone standard.

States have made tremendous progress and significant investment cleaning up the air. Since 1980, total emissions of the six principal air pollutants have dropped by 63 percent and ozone levels have declined by 33 percent. Despite the continued improvement of air quality, costs associated with compliance of the ozone NAAQS have significantly increased. I am committed to working with you and your local officials to effectively implement the ozone standard in a manner that is supportive of your air quality improvement efforts, without interfering with local decisions or impeding economic growth.

1200 PENNSYLVANIA AVE. NW • MAIL CODE 1101A • WASHINGTON, DC 20460 • (202) 564-4700 • FAX: (202) 501-1450

This paper is printed with vegetable-oil-based inks and is 100-percent postconsumer recycled material, chlorine-free-processed and recyclable.

I appreciate the information you and your staff have shared with EPA already as part of this process. I am confident this progress will continue as we work together towards our shared goal of clean air, a robust economy and stronger, healthier communities. If you have questions or concerns, please contact me or your staff may contact Troy Lyons, Associate Administrator for the Office of Congressional and Intergovernmental Relations, at lyons.troy@epa.gov or (202) 564-4987.

Respectfully yours,

E. Scott Pruitt

To: Whitman.Richard@deq.state.or.us[Whitman.Richard@deq.state.or.us]; David Collier[david.collier@state.or.us]; merlyn@lrapa.org[merlyn@lrapa.org]
From: Pepple, Karl
Sent: Wed 11/9/2016 3:35:59 PM
Subject: letter RE. OR ozone designation recommendations
Brown, Governor, 2015 revised ozone national designations, 10.24.2016.pdf

Good morning,

Please see the attached letter.

Have a great day

KP

Karl Pepple, Ph.D., Q.E.P.
Region X
U. S. EPA
206.553.1778
pepple.karl@epa.gov

To: Pascale.Warren@deq.idaho.gov[Pascale.Warren@deq.idaho.gov]
From: Pepple, Karl
Sent: Thur 10/6/2016 4:00:42 PM
Subject: RE: 2015 O3 designation recommendation

Pascale,

Yes, we received it – thank you for checking. Our acknowledgement letter is being processed.

Have a great day

KP

From: Pascale.Warren@deq.idaho.gov [mailto:Pascale.Warren@deq.idaho.gov]
Sent: Wednesday, October 05, 2016 1:02 PM
To: Pepple, Karl <Pepple.Karl@epa.gov>
Subject: 2015 O3 designation recommendation

Hi Karl- Just checking in to see if Region 10 has received Idaho's Ozone designation recommendation letter as the deadline to submit is nearly there. I believe we submitted the letter in early September.

Thank you,

Pascale Warren

Airshed Management Analyst

Idaho Department of Environmental Quality

(208) 373-0586

To: STOCUM Jeffrey[jeffrey.g.stocum@state.or.us]; Koprowski, Paul[Koprowski.Paul@epa.gov]
From: Pepple, Karl
Sent: Tue 9/13/2016 7:54:48 PM
Subject: RE: Oregon Ozone NAAQS designation Letter 2016 DRAFT

Hello Jeff,

The letter looks good. I showed it to some colleagues. Two comments:

1) The same person that recommended adding the phrase "…including all tribal lands" now recommends removing it. Sorry about that.

2) The order of the phrase is "unclassifiable/attainment" rather than the other way around. This is a very minor item.

Let me know if you have any questions

KP

From: STOCUM Jeffrey [mailto:jeffrey.g.stocum@state.or.us]
Sent: Monday, September 12, 2016 5:57 PM
To: Pepple, Karl <Pepple.Karl@epa.gov>; Koprowski, Paul <Koprowski.Paul@epa.gov>
Subject: Oregon Ozone NAAQS designation Letter 2016 DRAFT

Hi Karl,

I've attached the revised version of Oregon's Ozone NAAQS submittal letter. Thanks for finding the previous one, that was very helpful to update for the current situation. Please let me know if this covers what is needed in the communication from our Governor and I can start the routing process. Thanks for any guidance you can provide.

Jeffrey

Jeffrey Stocum / Air Quality Technical Services Manager / Environmental Solutions Division

Phone: 503-229-5506 / email: stocum.jeffrey@deq.state.or.us

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF THE REGIONAL ADMINISTRATOR

OCT 24 2016

The Honorable Kate Brown
Governor of Oregon
254 State Capital
Salem, Oregon 97301-4047

Dear Governor Brown:

Thank you for your letter dated September 29, 2016, providing recommendations for designating areas in your state for the purposes of attaining the 2015 revised ozone national ambient air quality standards.

Your letter is an important step toward providing citizens in your state with critical information about air pollution levels in their communities. We will carefully review these recommendations and work with the Oregon Department of Environmental Quality in determining the final area designations. We plan to announce our intended designations no later than 120 days prior to finalizing the designations. The U.S. Environmental Protection Agency expects to finalize the designations no later than October 1, 2017.

We look forward to working with Oregon in the coming months on this important issue. If you have any questions, please do not hesitate to call Tim Hamlin, Director, Office of Air and Waste. You can reach Tim by phone at (206) 553-1563 or by email at hamlin.tim@epa.gov.

Sincerely,

Dennis J. McLerran
Regional Administrator

cc: Mr. Richard Whitman
Interim Director, ODEQ

Mr. David Collier
Manager, Air Quality Planning, ODEQ

Mr. Merlyn Hough
Director, Lane Regional Air Protection Agency

To: scott.cardno@huntsvilleal.gov[scott.cardno@huntsvilleal.gov]; jason.howanitz@jcdh.org[jason.howanitz@jcdh.org]; corey.m.masuca@jcdh.org[corey.m.masuca@jcdh.org]; jonathan.stanton@jcdh.org[jonathan.stanton@jcdh.org]; lfernandez@broward.org[lfernandez@broward.org]; mpognon@broward.org[mpognon@broward.org]; campbell@epchc.org[campbell@epchc.org]; melissal@coj.net[melissal@coj.net]; robinson@coj.net[robinson@coj.net]; mcwilliams@coj.net[mcwilliams@coj.net]; Bernardo Bieler[bieleb@miamidade.gov]; gonzaj@miamidade.gov[gonzaj@miamidade.gov]; roberma@miamidade.gov[roberma@miamidade.gov]; renee.parker@ocfl.net[renee.parker@ocfl.net]; laxmana.tallam@flhealth.gov[laxmana.tallam@flhealth.gov]; asatyal@pinellascounty.org[asatyal@pinellascounty.org]; Rachael Hamilton[Rachael.Hamilton@louisvilleky.gov]; michelle.king@louisvilleky.gov[michelle.king@louisvilleky.gov]; keith.talley@louisvilleky.gov[keith.talley@louisvilleky.gov]; david.brigman@buncombecounty.org[david.brigman@buncombecounty.org]; barnetwm@forsyth.cc[barnetwm@forsyth.cc]; lloydpb@forsyth.cc[lloydpb@forsyth.cc]; raglanre@forsyth.cc[raglanre@forsyth.cc]; ebenezer.gujjarlapudi@mecklenburgcountync.gov[ebenezer.gujjarlapudi@mecklenburgcountync.gov]; Jason.rayfield@mecklenburgcountync.gov[Jason.rayfield@mecklenburgcountync.gov]; leslie.rhodes@mecklenburgcountync.gov[leslie.rhodes@mecklenburgcountync.gov]; bcolby@chattanooga.gov[bcolby@chattanooga.gov]; laliddington@aqm.co.knox.tn.us[laliddington@aqm.co.knox.tn.us]; brivera@aqm.co.knox.tn.us[brivera@aqm.co.knox.tn.us]; john.finke@nashville.gov[john.finke@nashville.gov]; bob.rogers@shelbycountytn.gov[bob.rogers@shelbycountytn.gov]; larry.smith@shelbycountytn.gov[larry.smith@shelbycountytn.gov]; lwb@adem.alabama.gov[lwb@adem.alabama.gov]; rwg@adem.alabama.gov[rwg@adem.alabama.gov]; jeff.koerner@dep.state.fl.us[jeff.koerner@dep.state.fl.us]; preston.mclane@dep.state.fl.us[preston.mclane@dep.state.fl.us]; karen.hays@dnr.ga.gov[karen.hays@dnr.ga.gov]; dika.kuoh@dnr.ga.gov[dika.kuoh@dnr.ga.gov]; sean.alteri@ky.gov[sean.alteri@ky.gov]; Melissa Duff[melissa.duff@ky.gov]; clafontaine@mdeq.ms.gov[clafontaine@mdeq.ms.gov]; michael.abraczinskas@ncdenr.gov[michael.abraczinskas@ncdenr.gov]; Michael Pjetraj[michael.pjetraj@ncdenr.gov]; porterhj@dhec.sc.gov[porterhj@dhec.sc.gov]; thompsrb@dhec.sc.gov[thompsrb@dhec.sc.gov]; michelle.b.walker@tn.gov[michelle.b.walker@tn.gov]; quincy.styke@tn.gov[quincy.styke@tn.gov]; thomas.ballou@deq.virginia.gov[thomas.ballou@deq.virginia.gov]; michael.dowd@deq.virginia.gov[michael.dowd@deq.virginia.gov]; michael.kiss@deq.virginia.gov[michael.kiss@deq.virginia.gov]; laura.m.crowder@wv.gov[laura.m.crowder@wv.gov]; william.f.durham@wv.gov[william.f.durham@wv.gov]
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From: John Hornback
Sent: Fri 5/5/2017 9:20:55 PM
Subject: Draft spring Region 4 grants/planning (air directors') meeting Jun 6-8 Atl
Air Dir Mtg Spring 2017 Agenda V1 170505.docx

Attached please find the first cut of the agenda for our spring meeting. Several points to

make about the agenda but first a reminder to register on our web site if you have not done so. (Anna and Chet – it's not necessary for you to register.)

1. The small group meeting is open to 2-3 staff at the choosing of Jerry Campbell, President of Metro 4. Typically the President or designee, the Vice President or designee, and Lynne Liddington have attended on behalf of the locals.

2. Small group agenda topics are still being determined except for the Monitoring TSA/Data discussions which are a certainty.

3. There is additional time granted for sidebar discussions at breaks and the end of the day. We've not packed the agenda quite as tightly to provide more flexibility and comfortable amounts of time to network.

4. There are many opportunities for local and state agency directors and/or staff to suggest places on the agenda for presenting their perspectives. Let me know if you would like to be a panelist for any of the sessions.

5. There will be opportunities for general feedback and questions during all sessions.

6. There are opportunities to suggest expanded or contracted sessions and addition of sessions if warranted. We especially have some flexibility on the last morning. If there is an item you would like added, please suggest it along with the desired length and potential speaker(s).

7. Board meeting agendas and support materials will be distributed in coming weeks.

8. On Wednesday night, June 7, Carol Kemker has graciously offered her home for a cookout and relaxation. We will give detailed information later including directions and best transportation alternatives. We will "pass the hat" to help her offset the costs. I will be making a substantial contribution personally to defray overall costs of the evening.

Please offer suggestions ASAP so we can tweak the agenda as necessary and send it back out to you quickly. I suggest that everyone plan to attend the full meeting if possible, recognizing that there are some whose travel logistics require leaving a bit early on Thursday. Please avoid that if possible but I understand if it is necessary.

I'm looking forward to a productive meeting and hope to see you soon. John.

John E. Hornback

Executive Director

Metro 4/SESARM

205 Corporate Center Dr Ste D

Stockbridge GA 30281-7383

404-361-4000 (office)

770-605-3059 (cell)

To: Kenny, Shannon[Kenny.Shannon@epa.gov]; Cabrera.misael@azdeq.gov[Cabrera.misael@azdeq.gov]; Banister, Beverly[Banister.Beverly@epa.gov]; Weber, Rebecca[Weber.Rebecca@epa.gov]; Williamson, Anahita[Williamson.Anahita@epa.gov]; Robbins, Chris[Robbins.Chris@epa.gov]; Wayland, Richard[Wayland.Richard@epa.gov]; Gonzalez, Robin[Gonzalez.Robin@epa.gov]; Alexandra Dunn[adunn@ecos.org]; John Mitchell[jmitchell@kdheks.gov]
Cc: Michael Keyack[Keyack.Michael@azdeq.gov]; Tara Ousley[Ousley.Tara@azdeq.gov]; Grossarth, Shari[Grossarth.Shari@epa.gov]; Heffelfinger, John[Heffelfinger.John@epa.gov]; Debell, Kevin[debell.kevin@epa.gov]; LaFaire, MaryAnn[lafaire.maryann@epa.gov]; Owen McAleer (omcaleer@ecos.org)[omcaleer@ecos.org]
From: Shaw, Nena
Sent: Wed 1/25/2017 12:56:28 PM
Subject: Article on President Trump and Environmental Permitting

All – I wanted to make sure you all saw the article below from Inside EPA today. Yesterday, the President met with automobile CEOs. He spoke about environmental regulations and, specifically, speeding up permitting generally with a specific focus on the Air program. While this is not surprising, it is good to know that we are thinking along the same lines. Best, Nena

Daily News

Trump Pledges Rapid Permitting Amid Industry Push For Air Permit Reform

January 24, 2017

President Donald Trump is vowing to speed up the environmental permitting process for industry, promising “a short process” where most applications will be approved quickly, amid a broader industry push for streamlining of the air permitting program that critics say hinders industrial development and slows economic growth.

Speaking to car industry CEOs at the White House Jan. 24, Trump pledged to remove environmental regulatory hurdles that slow down industrial projects and hinder job growth. Trump said that some in industry “go many, many years and they can’t get their environmental permit over something that nobody ever heard of before, and it’s crazy,” according to news reports.

Calling the current situation “out of control,” Trump said, “we’re going to make it a short process and we’re going to either give you your permits or not, but you’ll know quickly and generally speaking we’ll be giving you the permits.” The president promised to be “very friendly” to permit applicants.

While Trump did not delve into the details of environmental permitting, his remarks come as industry figures are pushing the White House to raise the profile of permitting issues. Although lower-profile than other issues, such as greenhouse gas regulations, permitting problems can raise roadblocks to industrial expansion. This contradicts Trump's stated goal of an industrial jobs revival and should be addressed, sources say.

One industry lawyer said that, given the preponderance of other environmental issues that the new administration and Congress wants to deal with first, the permitting question had, until now, seemed to be on the back burner.

In the air policy world, the number one issue that requires attention is the new source review (NSR) air permit program, which can raise significant hurdles to industrial expansion, sources say. NSR reform has not been a priority for EPA in recent years, and the issue received little attention during the election campaign, but it is “still significant and very important to fix,” the lawyer says.

However, if Trump carries through his campaign goal of reviving U.S. manufacturing, “NSR would once again be a big issue,” the source says. “Eventually NSR is going to move up the list.”

Air Act Reforms

Leading industry figures are floating ideas for how the administration and Congress can improve the situation. Think tank Resources for the Future (RFF) is outlining ideas for reform of Clean Air Act permitting that could enable industrial growth.

In their paper titled “EPA's New Source Review Program: Time for Reform?” published in the January issue of the *Environmental Law Reporter*, legal and policy experts Art Fraas, John Graham and Jeff Holmstead set out ideas for EPA and Congress to change the NSR air permit program to spur industrial development. Their ideas range from seemingly simple administrative steps to more far-reaching legislative reforms that face higher hurdles.

RFF researcher Fraas retired from a long career in the federal government in 2008, culminating as chief of the natural resources, energy and agriculture branch of the White House Office of Management and Budget's Office of Information and Regulatory Affairs (OIRA). Graham was OIRA chief under President George W. Bush, and is now dean of the Indiana University School of Public and Environmental Affairs.

Holmstead served as head of EPA's air office during the Bush administration and is now a partner at the Bracewell law firm. He was floated as a possible candidate for the EPA deputy administrator position, but is understood to no longer be in the running for that post after criticism from conservative groups over his past positions acknowledging human-caused climate change as a problem.

The NSR program and its close relative, the Prevention of Significant Deterioration (PSD) program, require new and modified major sources of air pollution to obtain permits to limit their air emissions. NSR applies in areas designated “nonattainment” with EPA's national ambient air quality standards (NAAQS), while PSD applies in areas designated attainment.

Industry and GOP critics have for years criticized aspects of the program as implemented by EPA. Industrial sources applying for permits must demonstrate that their projects will not compromise attainment of NAAQS, but EPA in the past has been slow to publish implementation rules and guidelines for permitting, following the release of a new or updated NAAQS.

This complicates life for industry, as permit applicants are unsure how to

demonstrate their projects will comply with new NAAQS, critics say.

A case in point is EPA's ozone NAAQS of 70 parts per billion (ppb) finalized in 2015, tougher than the prior standard of 75 ppb. EPA has proposed, but not finalized, an implementation rule guiding states on how to craft their state implementation plans, required by the air law to show how states will meet the new standard.

Further, as NAAQS standards have become tougher, permitting has also become tougher, especially in areas classed as nonattainment. In certain circumstances, for example, permit applicants must purchase “offsets” from other pollution sources to mitigate their increased emissions. But this can be difficult, or even impossible, in areas where offsets are in short supply, or simply not available. The result is a serious constraint on economic development, EPA's critics say.

Novel Solutions

In their paper, the authors note these problems and others, and suggest some novel solutions. One problem the Trump EPA could address itself is the overly conservative assumptions that they say EPA includes in its air quality modeling guidelines. These assumptions result in overestimates of likely pollution from projects, needlessly triggering costly permitting and pollution control requirements, the authors say.

“EPA’s current modeling guidance requires deterministic air quality models using the maximum allowable emissions rate and the maximum allowable operating conditions for each averaging time. It also requires the use of modeling assumptions that yield the maximum impact on air quality” in calculating background air quality, “including the effect of other sources in the area,” they write.

“However, sources typically operate well below their maximum allowable emission rates, and it would be highly unusual for all the sources in an area to be emitting at their highest allowable rates at the same time -- and during a period when weather conditions would maximize the ambient impacts of their emissions. As a result, EPA’s current modeling guidance substantially overstates the ambient air quality effects of a potential new source.”

EPA should therefore adopt “probabilistic” modeling techniques instead, they say, to more accurately reflect real-world conditions.

EPA could further help address the scarcity of offsets by making it easier to obtain offsets from areas outside the nonattainment area in question, they argue. To date, EPA has required complex modeling demonstrations to show how this will benefit the nonattainment area in question, but the agency's own research has shown how ozone and fine particulate matter (PM2.5), in particular, are transported across state lines.

“EPA and states could in many cases rely on the long-range transport studies that EPA has already done to show that emissions from 28 states contribute to ozone and fine PM [nonattainment] in many other states. Even where EPA has not already done such modeling, companies seeking to rely on out-of-area offsets should be able to employ similar studies to justify the use of such offsets. This reform would not address all the concerns about current offset requirements, but it would significantly expand the pool of potential offsets in many parts of the country (especially in rural areas) while still achieving the program’s environmental goals,” the authors say.

They further suggest that EPA treat sources consistently that have permit applications pending when NAAQS are tightened, ensuring that “reasonably complete” applications are processed under the older NAAQS under grandfathering provisions. EPA has not done so consistently in the past, they say, creating problems obtaining permits for sources -- sometimes requiring sources in areas newly deemed nonattainment to obtain an NSR permit with offsets, rather than a less onerous PSD permit without them.

Also, “one of the most important reforms EPA could make is simply to make sure that the necessary implementation rules, guidance, and air quality models are already in place when a revised NAAQS comes into effect. This would require a commitment of EPA resources that the Agency has so far not been willing to make, but it certainly could be done,” they say.

Legislative Changes

On the congressional side, the authors suggest more far-reaching changes to NSR/PSD permitting, both calling for “emissions fees” in lieu of existing requirements and suggesting, as a “narrow” fix, a substitution of the fees for emissions offsets.

“We propose a narrow statutory reform that could address these issues while still obtaining most or perhaps even more of the environmental benefits of the current program: allow permit applicants to pay emissions fees in lieu of meeting the current offset requirements, and require the state or local environmental agency to use these fees to pay for or subsidize emissions reductions that the agency believes will do the most good in terms of reducing environmental risks,” they say.

A broader reform could see emissions fees “replace the entire NSR permitting program with a system of industrial emissions fees. The fees could be based on the projected per ton cost of controlling different pollutants, or they could instead be damage-based.”

Damage-based fees “could vary based on geographic location, insofar as reasonable estimates of damages are available. Different fees would be applied to different pollutants, based on the best available knowledge of their relative toxicity to human health and the environment. Emissions near population centers would likely be assessed a higher fee

than emissions in rural areas.”

While a fee-based approach would eliminate much of the delay and uncertainty inherent in NSR permitting, its rests on the assumption that there are safe levels of pollution that regulators could deem acceptable. The authors admit that this assumption has increasingly been called into question by environmentalists backing tougher NAAQS. In recent NAAQS reviews, scientists have tended to find adverse health effects from ever-lower levels of pollution.

Other Priorities

The industry legal source says, however, that although air permitting issues are hugely important, they are far down the list of priorities for the Trump administration and GOP-controlled Congress right now. Other more pressing issues, such as scrapping EPA's Clean Power Plan for greenhouse gas reductions from power plants, are now seen as more urgent, the source says.

Calling the RFF paper “provocative,” the source says that “a lot of things in the paper will never happen,” but nevertheless welcomes the paper as a starting point for conversation. The out-of-area offsets proposal, for example, could run into trouble if offsets are sought from other states, given the Trump EPA's likely emphasis on states' rights, the source says.

Of all the ideas in the paper, the emissions fee proposal is “very, very unlikely” during Trump's first term, given the need to broadly reopen the Clean Air Act to revision. This would then open the law to multiple, potentially conflicting reform efforts, the source says. “Do you have the political will? It is a very high bar,” the source says. -- *Stuart Parker* (sparker@iwpnews.com)

Related News | Air |

198446

Nena Shaw

Acting Office Director, Office of Strategic Environmental Management

Office of Policy

(C) 202-564-5106

EPA Employees: click the link to find a broad array of information on the

"Sustainability Community of Practice" SharePoint site

https://usepa.sharepoint.com/sites/OA_Community/Sustainability/SitePages/Home2.aspx

Region 4 Grants/Planning Meeting
June 6-8, 2017
Atlanta, Georgia
Agenda

Tuesday, June 6, 2017 Morning Session		
8:00 a.m.	**SESARM Board of Directors Meeting** *Rhonda Thompson (SC), Chair*	Agenda to be distributed later
9:00 a.m.	**Small Group Meeting** *State directors* *Local agency representatives* *EPA Region 4 APTMD staff* *Anna Wood (EPA OAQPS) (invited)*	TSA Lean Initiative discussion Other topics to be distributed later
10:15 a.m.	**Break**	
10:30 a.m.	**Small Group Meeting (cont.)**	
11:30 a.m.	**Lunch**	

Tuesday, June 6, 2017 Afternoon Session		
12:00 noon	**Registration**	
1:15 p.m.	**Welcome** *John Hornback (Metro 4/SESARM)*	• Introductions • Agenda review • Logistics
1:30 p.m.	**Standards and Implementation** *Anna Wood (OAQPS)*	• NAAQS development updates • Implementation discussions • Regional haze expectations and schedule • Transport Issues and analyses • Other Issues • State/Local feedback/Q&A
2:30 p.m.	**Break**	
3:00 p.m.	**Southeast Wildfire Experiences** *State and Local Agencies*	• Experiences and lessons learned from 2016 fires • Implications for 2017 and beyond
3:30 p.m.	**Exceptional Events** *Gregg Worley, Todd Rinck (APTMD)* *Anna Wood, Beth Palma (OAQPS)*	• When exceptional event demonstrations are needed • Expectations for demonstrations • State/Local feedback/Q&A
4:15 p.m.	**Meeting adjourns for the day**	
4:30 p.m.	**Metro 4 Board of Directors and Membership Meeting** *Jerry Campbell (Hillsborough County FL), President*	Agenda to be distributed later

Wednesday, June 7, 2017 Morning Session		
8:30 a.m.	**EPA Region 4 APTMD Director Welcome and Report** *Beverly Banister (APTMD)*	• Region 4 updates & staff changes • National priorities and implications for agencies • Budget updates for 2017 and 2018 • State/Local feedback/Q&A
9:00 a.m.	**Modeling Support and Updates** *Gregg Worley, Todd Rinck and staff (APTMD)*	• Summary of SO_2 Data Requirements Rule modeling • Appendix W status • State/Local feedback/Q&A
9:30 a.m.	**Monitoring Update for Region 4** *Gregg Worley, Todd Rinck (APTMD)* *Laura Ackerman (SESD)*	• 2017 annual network plan submittal • Air monitoring workshop follow-up • Feedback on monitoring equipment replacement efforts – discussion and feedback • PAMS update • State/Local feedback/Q&A
10:15 a.m.	**Break**	
10:45 a.m.	**TSAs and Monitoring Data Quality** *Jeaneanne Gettle, Laura Ackerman (SESD)* *DeAnna Oser, Georgia* *TBD, Forsyth County NC*	• Report on status of TSA Lean Initiative • Feedback from participants • Update on process improvements • Next steps • State/Local feedback/Q&A
11:15 a.m.	**Stationary Source Regulatory Update – Clean Air Act Sections 111, 112, and 129** *Beverly Spagg, Ken Mitchell, Todd Russo, Dick Dubose & Staff (APTMD)*	• Placeholder • State/Local feedback/Q&A
11:45 a.m.	**Lunch**	

Wednesday, June 7, 2017 Afternoon Session		
1:30 p.m.	**Great Smoky Mountains Water Quality Impairment and Air Emissions Linkages** *Jim Renfro, National Park Service*	• Observations on atmospheric deposition and stream acidification • Modeling and long-term prognosis • Collaboration with states • State/Local feedback/Q&A
2:30 p.m.	**Break**	
3:00 p.m.	**Smoke Summit III** *Scott Davis and Rick Gillam (APTMD)* *State participants*	• Recap of recent workshop • Next steps • State/Local feedback/Q&A
3:30 p.m.	**NAAQS and SIPs Updates and Issues for Region 4** *Scott Davis and Lynorae Benjamin (APTMD)*	• NAAQS updates • SO_2 designations update • 4-Year SIP plans update • State/Local feedback/Q&A
4:30 p.m.	**Meeting adjourns for the day**	
5:30 p.m.	**Evening reception and cookout** *Hosted by Carol Kemker and family*	Directions to Carol's house to follow. Status of likely attendance requested.

Thursday, June 8, 2017 Morning Session		
8:30 a.m.	**Grants and Funding** *Carol Kemker, Stuart Perry & Staff (APTMD)*	• Budget status for FY17 • FY 2018 funding outlook • Grant allocation process • Grant funding status and next steps • Grant policy updates/initiatives • Scheduling, work plan expectations, and holdbacks • MJO funding update for Metro 4 and SESARM • State/Local feedback/Q&A
9:15 a.m.	**Ports Initiative Update** *Amber Davis (APTMD)*	• Ports Initiative update • State/Local feedback/Q&A
9:30 a.m.	**Permitting Update** *Scott Davis, Heather Ceron (APTMD)*	• Permit program updates • Report from recent Permit Workshop • State/Local feedback/Q&A
10:30 a.m.	**Break**	
11:00 a.m.	**State/Local Agency Sharing –** *APTMD and State/Local agencies*	• Roundtable of other issues facing states/locals
11:30 a.m.	**Closing Remarks** *John Hornback, Doug Carson*	• Training update – 2017 status and 2018 needs • Future program manager workshops • Future director meetings – dates/locations • Member agency special project needs
12:00 p.m.	**Meeting concludes**	