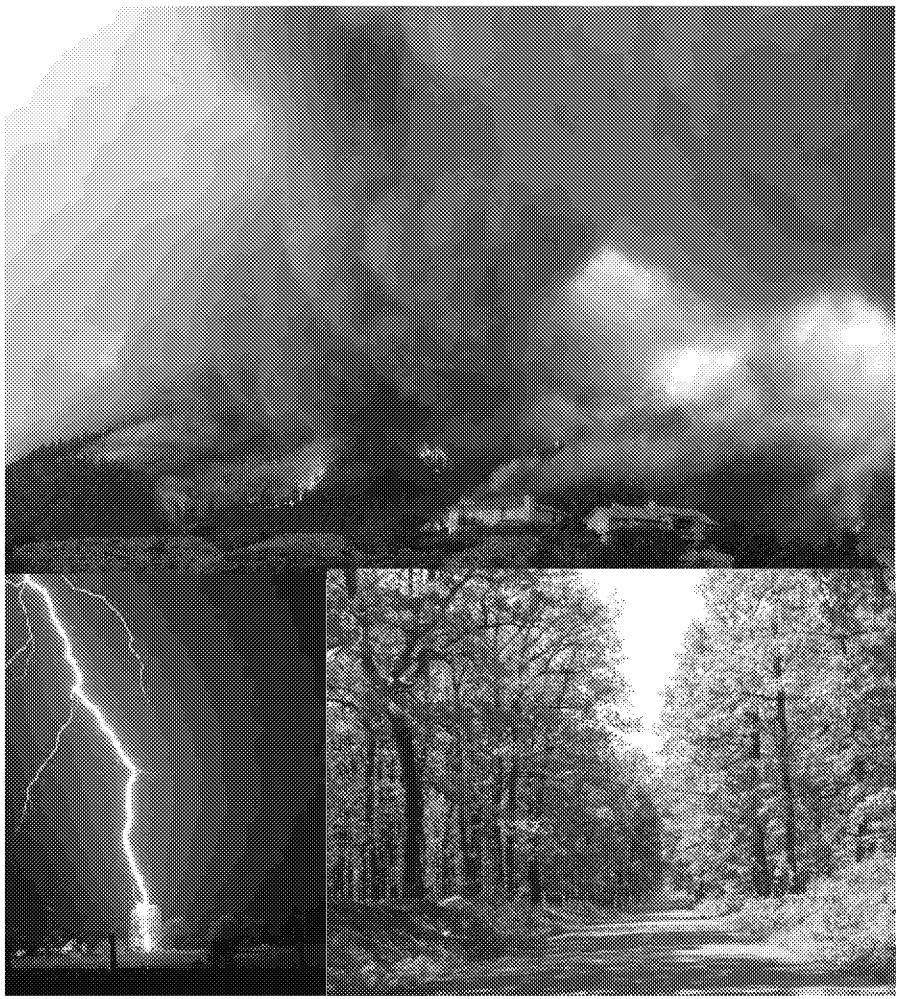
Update on Background Ozone Research

Region 8 State Air Directors Meeting

August 16, 2017

Definition of Background Ozone

- Background O_3 originates from natural sources and from anthropogenic international emissions of O_3 precursors:
  - Transport of O_3 from the stratosphere.
  - Natural O_3 precursors: biogenic VOC & NOx, wildfires, lightning.
  - Non US anthropogenic emissions of O_3 precursors.
- U.S. Background O_3 (USBO) can be estimated using air quality model simulations.
- Baseline O_3 is monitored O_3 at sites with little or no influence from recent anthropogenic U.S. emissions.



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Regulatory Relief Mechanisms for High Background O3

- EPA recognizes that, periodically, sources other than domestic anthropogenic emissions of ozone precursors can contribute appreciably to monitored ozone (O3) concentrations, and the Clean Air Act (CAA) provides some relief mechanisms for high background O3 events:
  - Exceptional Events: High background O3 events caused by stratospheric intrusion or wildfires can be excluded from the regulatory data if states or tribes submit an exceptional event demonstration and EPA concurs.
  - Section 179B of the CAA allows EPA to approve SIPs that do not show attainment and provides relief for failure to attain the NAAQS if an area would have attained but for international emissions.

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Regulatory Relief Mechanisms (continued)

- Section 182(h) of the CAA allows EPA to determine that a designated nonattainment area can be treated as a rural transport area if the area does not contain emission sources that make significant contributions to monitored O3 concentration in the area or other areas, and the area does not include and is not adjacent to a Metropolitan Statistical Area.

- **EPA, WRAP/WESTAR and States are coordinating research to develop methods to quantify sources of background O3 so that these regulatory relief mechanisms can be implemented when appropriate.**

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Stratospheric Intrusion Workgroup

- Workgroup meeting semi-monthly since 2012, include federal and state research and air quality management communities.
- Lin et al. (2015) show "more frequent late spring stratospheric intrusions when the polar jet meanders towards the western United States, such as occurs following strong La Niña winters."
- Few stratospheric O_3 events in 2015 and 2016 (during El Niño conditions) but winter 2016/17 had La Niña conditions, and 2017 has already had several possible intrusion events with maximum daily 8-hour (MD8) averages approaching or exceeding the NAAQS:
  - March 18: 95 ppb (87 ppb regulatory) at Mt Washington NH.
  - April 9: 74 ppb in Colorado Springs.
  - April 22: 82 ppb Gothic, CO; 80 ppb Navajo Lake, NM; 75 ppb Centennial, WY; and five others sites in UT, CO and NM exceed 70 ppb.
  - April 23: 71 ppb NREL, CO; 71 ppb Rocky Flats, CO
  - Several additional days with MD8 between 65 to 69 ppb.

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Recent EPA activities related to background ozone

- Since promulgation of the new NAAQS, as part of outreach efforts with stakeholders regarding background O3 (BGO3) issues in the implementation process, EPA has:
  - Developed a BGO3 white paper:
    https://www.epa.gov/sites/production/files/2016-03/documents/whitepaper-bgo3-final.pdf
  - Organized BGO3 workshop in Feb 2016:
    https://www.epa.gov/sites/production/files/2016-03/documents/bgo3-high-level-summary.pdf
  - Opened a non-regulatory docket to allow additional comments on BGO3 and NAAQS implementation.
  - Organized a July 2016 call with WESTAR to discuss action items from WESTAR letter to the docket.
  - EPA staff are participating in critical review of background O3 sponsored by WRAP/WESTAR and the American Petroleum Institute and being led by Professor Dan Jaffe of the University of Washington.

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Upcoming EPA actions related to background O3

- Coming out of the EPA/WESTAR BGO3 discussions:
  - We are working to develop a collaborative workplan for the next 1-2 years that will focus on continued and improved efforts to characterize BGO3 in the western U.S.
    - Ideally, this effort would include EPA and western States, along with other Federal agencies, academics, and stakeholders (where appropriate).
  - At a minimum, this workplan will include efforts aimed at:
    - Global model intercomparison and evaluation,
    - Enhanced regional model evaluation, and
    - Attribution techniques aimed at estimating the contribution of individual sources that contribute BGO3.
  - The initial outputs of the workplan are expected to be discussed at a western air quality workshop in September 2017. This workshop will also serve as a launch pad for needed next-stage analyses.

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Upcoming EPA actions related to background O3

- At the same time EPA is also planning to:
  - Finalize our guidance on exceptional event demonstrations for wildfires and stratospheric intrusions.
  - Work with EPA ORD to make the hemispheric CMAQ model available to States as a tool for the generation of regional boundary conditions.
- In the 2015 NAAQS proposed implementation rule, EPA requested comments on issues related to 179B:
  - Should 179B provisions apply for border areas only?
  - Is there a need for technical guidance for implementing 179B?
  - Should RACM/RACT be required in 179B areas?

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Questions?

Additional Information

Background O3 Scientific Assessment

Western States Air Resources Council (WESTAR), Western Regional Air Partnership (WRAP), and American Petroleum Institute (API) are co-sponsoring a scientific assessment on background O_3 and future research needs. The assessment will consider current research to examine:

1. Sources of background O_3
2. Background O_3 as seen by observations
3. Background O_3 as seen by models
4. Reconciling observations and models
5. Temporal and spatial variations in background O_3
6. Research needs to improve our understanding of background O_3.

The assessment is focused on technical and scientific aspects of non-controllable O_3 sources (NCOS) that are relevant to policy, but will not directly address policy.

Broad participation by the O_3 research community and stakeholders is encouraged. The end result will be one or more peer-reviewed journal articles incorporating the results and discussions from the workshop.

Overview of the Denver Workshop March 28-29, 2017

- WESTAR/WRAP/API March 28-29, 2017 workshop in Denver was designed to:
  - Provide a forum for broader input to the assessment from all knowledgeable experts;
  - Provide a forum for discussion of key uncertainties;
  - Identify new methods and tools that the core group might not be aware of;
  - Identify specific scientific publications that we may have missed;
  - Make specific recommendations for future research that the committee should consider.
  - This effort is similar to the API-TCEQ background O3 review in 2011.

- Approximately 150 participants (~50% in-person/~50% online);
- ~18 oral presentations+ handful of posters;
- Extensive time for discussion. Agenda and presentations available at:

  https://www.wrapair2.org/pdf/BOSA_March_28-29_workshop_agenda.pdf

Denver Workshop: Key questions raised

1. Trends in O_3 are complex and depend on location and period of record. Can we reconcile observed trends with changes in domestic and international emissions, climate, wildfires, etc.? Explain why are there strong downward trends in California, but much weaker trends at other western sites.
2. Regional/urban scale modeling of O_3 depends critically on boundary conditions, so propagation of boundary uncertainties can cause significant problems. How can we improve boundary conditions for regional modeling?
3. USBO include stratospheric influence, biogenic precursors, wildfires and international transport. How can we improve our estimates of USBO on a daily basis?
4. Concern that models do not accurately predict wildfire contributions to O_3.
5. All models have uncertainties and biases. Can we develop an estimate of uncertainty for model derived estimates of USBO?
6. What are the assumptions made in using the "relative response" method to correct for model bias, and are these assumptions valid for addressing model bias in USBO?
7. Current satellites have little sensitivity to key species in the boundary layer. How can we better utilize current and future satellite data to improve estimates of O_3 sources?
8. What is the sensitivity of USBO to international emission changes?
9. How well do we understand local/controllable contributions to O_3?

BG O_3 Assessment: broad, draft recommendations

1. Continue to improve observation network:
   a) Low cost improvements;
   b) Improvements requiring larger investments;
2. Better coordination within and between experimentalists and modeling groups;
3. Improved use of existing data to evaluate our understanding of USBO, e.g. statistical relationships between tracers and meteorological conditions, etc.
4. Targeted studies on background O_3;
5. Continue to improve models;
6. Need better evaluation of models with observations that are most relevant to the application;
7. Need for planning and integration of future satellite observations;
8. Further development of integrated air quality management systems.