ENCLOSURE: TECHNICAL SUPPORT DOCUMENT FOR EPA CONCURRENCE ON OZONE EXCEEDANCES MEASURED AT NREL (GOLDEN, COLORADO) ON SEPTEMBER 2 AND 4, 2018 AS EXCEPTIONAL EVENTS

In early September 2017, the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD) identified that wildfires in the Pacific Northwest of the United States may have caused exceedances of the 2008 ozone National Ambient Air Quality Standard (NAAQS) at the National Renewable Energy Laboratory (NREL) ozone monitoring site operated by the APCD in Golden, Colorado, on September 2 and 4, 2017. Under the Exceptional Events Rule (EER), air agencies can request the exclusion of event-influenced data, and the EPA can agree to exclude these data, from the data set used for certain regulatory decisions. The remainder of this document summarizes the EER requirements, the event and the EPA's review process.

EXCEPTIONAL EVENTS RULE REQUIREMENTS

The EPA promulgated the EER in 2007, pursuant to the 2005 amendment of Clean Air Act (CAA) Section 319. In 2016, the EPA finalized revisions to the EER. The 2007 EER and the 2016 revisions added 40 CFR 50.1(j)-(r); 50.14; and 51.930 to the Code of Federal Regulations (CFR). These sections contain definitions, criteria for approval by the EPA, procedural requirements and requirements for air agency demonstrations. The EPA reviews the information and analyses in the air agency's demonstration package using a weight of evidence approach and decides to concur or not concur. The demonstration must satisfy all of the EER criteria for the EPA to concur with excluding the air quality data from regulatory decisions.

Under 40 CFR 50.14(c)(3)(iv), the air agency demonstration to justify data exclusion must include:

A. "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);"
B. "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;"
C. "Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times" to support requirement (B) above;
D. "A demonstration that the event was both not reasonably controllable and not reasonably preventable;" and

E. "A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event."[1]

In addition, the air agency must meet several procedural requirements, including:

1. submission of an Initial Notification of Potential Exceptional Event and flagging of the affected data in the EPA's Air Quality System (AQS) as described in 40 CFR 50.14(c)(2)(i),
2. completion and documentation of the public comment process described in 40 CFR 50.14(c)(3)(v), and
3. implementation of any applicable mitigation requirements as described in 40 CFR 51.930.

For data influenced by exceptional events to be used in initial area designations, air agencies must also meet the initial notification and demonstration submission deadlines specified in Table 2 of 40 CFR 50.14. We include below a summary of the EER criteria, including those identified in 40 CFR 50.14(c)(3)(iv).

Regulatory Significance

The 2016 EER includes regulatory language that applies the provisions of CAA section 319 to a specific set of regulatory actions. As identified in 40 CFR 50.14(a)(1)(i), these regulatory actions include initial area designations and redesignations; area classifications; attainment determinations (including clean data determinations); attainment date extensions; findings of State Implementation Plan (SIP) inadequacy leading to a SIP call; and other actions on a case-by-case basis as determined by the Administrator. Air agencies and the EPA should discuss the regulatory significance of an exceptional events demonstration during the Initial Notification of Potential Exceptional Event prior to the air agency submitting a demonstration for the EPA's review.

Narrative Conceptual Model

The 2016 EER directs air agencies to submit, as part of the demonstration, a narrative conceptual model of the event that describes and summarizes the event in question and provides context for analyzing the required statutory and regulatory technical criteria. Air agencies may support the narrative conceptual model with summary tables or maps. For wildfire ozone events, the EPA recommends that the narrative conceptual model also discuss the interaction of emissions, meteorology, and chemistry of event and non-event ozone formation in the area, and, consistent with 40 CFR 50.14(a)(1)(i), describe the regulatory significance of the proposed data exclusion.

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[1] A natural event is further described in 40 CFR 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions."

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Clear Causal Relationship (CCR) and Supporting Analyses

The EPA considers a variety of evidence when evaluating whether there is a clear causal relationship between the specific event and the monitored exceedance or violation. For wildfire ozone events, air agencies should compare the ozone data requested for exclusion with historical concentrations at the air quality monitor to establish a clear causal relationship between the event and the monitored data. In addition to providing this information on the historical context for the event-influenced data, air agencies should further support the clear causal relationship criterion by providing evidence that the wildfire's emissions were transported to the monitor, and that the emissions from the wildfire influenced the monitored concentrations. In some cases, air agencies may need to provide evidence of the contribution of the wildfire's emissions to the monitored ozone exceedance or violation.

For wildfire ozone events, the EPA has published a guidance document[2] that describes three different tiers of analyses that can be applied to the "clear causal relationship" criterion within an air agency's exceptional events demonstration. This tiered approach recognizes that some wildfire impacts on ozone may be more clear and/or extreme and, therefore, require relatively less evidence to satisfy the rule requirements. If a wildfire/ozone event satisfies the key factors for either Tier 1 or Tier 2 clear causal analyses, then those analyses are the only analyses generally necessary to support the clear causal relationship criterion within an air agency's demonstration for that particular event. Other wildfire/ozone events not meeting Tier 1 or 2 criteria will be considered based on Tier 3 analyses.

- Tier 1: Wildfires that clearly influence monitored ozone exceedances or violations when they occur in an area or season that typically experiences lower ozone concentrations.
    - *Key Factor*: seasonality and/or distinctive level of the monitored ozone concentration. The event-related exceedance occurs during a time of year that typically has no exceedances, or is clearly distinguishable (*e.g.*, 5-10 ppb higher) from non-event exceedances.
    - In these situations, ozone impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.
- Tier 2: The wildfire event's ozone influences are higher than non-event related concentrations, and fire emissions compared to the fire's distance from the affected monitor indicate a clear causal relationship.
    - *Key Factor 1*: fire emissions and distance of fire(s) to affected monitoring station location(s). Calculated fire emissions of nitrogen oxides (NO_X) and reactive-volatile organic compounds (VOC) in tons per day (Q) divided by the distance from the fire to the monitoring station (D) should be equal to or greater than 100 tons per day/kilometers ($Q/D \geq 100$ tpd/km(tons per day/kilometer)). The EPA's

[2] *Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*, September 16, 2016 ("EPA's wildfire O_3 guidance document"); https://www.epa.gov/sites/production/files/2016-09/documents/exceptional_events_guidance_9-16-16_final.pdf.

wildfire ozone guidance document provides additional information on the calculation of Q/D.

  - *Key Factor 2*: comparison of the event-related ozone concentration with non-event related high ozone concentrations. The exceedance due to the exceptional event:
    - is in 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 (among those concentrations that have not already been excluded under the Exceptional Events Rule, if any).
  - In addition to the analysis required for Tier 1, the air agency should supply additional evidence to support the weight of evidence that emissions from the wildfire affected the monitored ozone concentration.
- Tier 3: The wildfire does not fall into the specific scenarios (i.e., does not meet the key factors) that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.
  - In addition to the analyses required for Tier 1 and Tier 2, an air agency may further support the clear causal relationship with additional evidence that the fire emissions caused the ozone exceedance.

Not Reasonably Controllable or Preventable (nRCP)

The EPA requires that air agencies establish that the event be both not reasonably controllable and not reasonably preventable at the time the event occurred. This requirement applies to both natural events and events caused by human activities; however, it is presumed that wildfires on wildland will satisfy both factors of the "not reasonably controllable or preventable" element unless evidence in the record clearly demonstrates otherwise.[3]

Natural Event or Event Caused by Human Activity That is Unlikely to Recur

According to the CAA and the EER, an exceptional event must be "an event caused by human activity that is unlikely to recur at a particular location *or* a natural event" (emphasis added). The 2016 EER includes in the definition of wildfire that "[a] wildfire that predominantly occurs on wildland is a natural event." Once an agency provides evidence that a wildfire on wildland occurred and demonstrates that there is a clear causal relationship between the measurement under consideration and the event, the EPA expects minimal documentation to satisfy the "human activity that is unlikely to recur at a particular location or a natural event" element. The EPA will address wildfires on other lands on a case-by-case basis.

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[3] A wildfire is defined in 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." Wildland is defined in 40 CFR 50.1(o) as "an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered."

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EPA REVIEW OF EXCEPTIONAL EVENTS DEMONSTRATION

The EPA Region 8 Air Program and the Colorado Air Pollution Control Division conducted a meeting on January 3, 2018, for the Initial Notification of Potential Exceptional Event for two exceedances of the 2008 ozone NAAQS at the NREL monitoring station within Jefferson County, Colorado, on September 2 and 4, 2017, at the CDPHE offices. The primary regulatory significance of the exceedances was expected to be the data's relevance to Colorado's eligibility for a 1-year extension of the moderate area attainment date. On June 4, 2018, the APCD submitted an exceptional events demonstration[4] for two exceedances of the 2008 ozone NAAQS at the NREL monitor on September 2 and 4, 2017.

Regulatory Significance

The EPA and the APCD determined that the exclusion of the two exceedances of the 2008 ozone NAAQS at the NREL monitor in September 2017, may have a regulatory significance for determining the eligibility of the Denver ozone nonattainment area for a 1-year extension of the moderate nonattainment area attainment date under CAA section 181(a)(5). Those ozone exceedances are summarized in Table 1. To qualify for a 1-year extension, all monitors in the Denver nonattainment area must show a 4th maximum in 2017 of 0.075 ppm or less.

Table 1 EPA 8-hour Ozone Exceedance Summary (2008 NAAQS)

Exceedance Date	Monitor/Station Name	AQS ID	Max. 8-hour Avg. Ozone (ppm)
September 2, 2017	NREL	08-059-0011	0.076 (4th max (tie), 2017)
September 4, 2017	NREL	08-059-0011	0.076 (4th max (tie), 2017)

Colorado's Narrative Conceptual Model

The Colorado demonstration provided a very detailed conceptual model, which included a narrative description of normal historical ozone formation within the Colorado northern front range communities in and around Denver, Colorado. It summarized location and elevation information for all existing monitors, local summertime climatological and meteorological patterns contributing to ozone formation, a summary map of local source regions for ozone exceedances using HYSPLIT trajectory analyses, and regional VOC and NO_X emission sources and quantities which contribute to non-event high ozone days. The conceptual model also presented historical ozone concentration statistics for September and for August 26-September 9 ozone for 2011-2016. The narrative conceptual model then summarized the meteorology, smoke observations, ozone and $PM_{2.5}$ data for the event days. The narrative conceptual model also summarized seasonal moisture and meteorological factors contributing to the extreme fire behavior observed in the Pacific Northwest in late August and early September 2017, and the wind patterns serving to transport smoke from that entire region into the Colorado northern front range communities the first week of September, along with satellite imagery showing that smoke

[4] *Exceptional Event Demonstration for Ozone on September 2 and 4, 2017*, Air Pollution Control Division, Colorado Department of Public Health and Environment, June 1, 2018.

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transport. The narrative conceptual model section of the demonstration concluded with a quote from the online newsletter *Wildfire Today*, summarizing the 2017 wildfire season through September 17, 2017:

> *Nationally, according to [National Interagency Fire Center] NIFC, 8.4 million acres have burned so far this year, which is 47 percent higher than the 10-year average to this date. Montana, which accounts for 1.2 million of those blackened acres, has been a focal point for seemingly endless fires producing staggering quantities of smoke. Combined with the smoke created by other fires in Idaho, Oregon, Washington, and northern California, the fouled air has affected residents across large sections of the country ... A spokesperson for Montana's Department of Natural Resources and Conservation, Angela Wells, said "the period from June to August was the hottest and driest on record in Montana, and our fire season started about a month earlier than it usually does."*[5]

Based on the information described above, the CDPHE demonstration meets the narrative conceptual model criterion of the EER.

Table 2 Documentation of Narrative Conceptual Model

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 2, 2017	Section 3.3.1, pp. 13-15 Section 3.3.2, pp. 16-33 Section 3.3.3, pp. 33-53 Figure 11c, p. 26 Figure 13c, p. 32 Figure 16c, p. 38 Figure 17c, p. 43	Sufficient	Yes
September 4, 2017	Section 3.3.1, pp. 13-15 Section 3.3.2, pp. 16-33 Section 3.3.3, pp. 33-53 Figure 11e, p. 28 Figure 13e, p. 33 Figure 16e, p. 40 Figure 17e, p. 45	Sufficient	Yes

Clear Causal Relationship

Colorado's demonstration included several analyses to support a clear causal relationship between the wildfire event and the monitored exceedances. These analyses are presented in Section 4 of Colorado's demonstration, as well as within the conceptual model (Section 3).

[5] Gabbert, Bill, "Looking back at NIFC's June prediction for August-September wildfire activity," *Wildfire Today*, September 17, 2017, http://wildfiretoday.com/2017/09/17/looking-back-at-nifcs-june-prediction-for-august-september-wildfire-activity/.

Comparison with historical concentrations

Colorado evaluated the ozone concentration for September 2 and 4, 2017, (both 0.076 ppm) and compared the data to historical statistics for all September data and for data from August 26 to September 9 (a 14-day period centered on the event days) using data from 2011 through 2016. Colorado found that the data were above the 99th percentile when considering all September data, and equal to the 99th percentile considering just August 26 to September 9. At NREL, however, the EPA found that only one prior September data point was above the level of the 2008 ozone NAAQS (a value of 0.076 ppm recorded on September 5, 1995) in the period from 1993 through 2016. In other words, September ozone as high as that seen at NREL in September 2017, had not been seen in the previous 22 years. In the same period, 8 days at NREL had ozone above 0.075 ppm between August 26 and 31 in the years 1993-2017.

Tier 1: Key Factor

The information above suggests that the 2 days in September 2017, with ozone at 0.076 ppm had only one September precedent, but that values that high or higher occur 8 times more often just 1 week earlier, in late August, than in the first week of September. The EPA has concluded that the 2 days in September 2017, do not conclusively meet the Tier 1 criteria of the EPA's wildfire ozone guidance document.

Tier 2: Key Factors

Colorado evaluated emissions and distance to significant upwind fires contributing smoke to the Denver urban area on September 2 and 4, 2017. For September 2, four very large fires located 556 to 670 km upwind (346 to 416 miles) burned a total of 105,630 acres on August 31, 2017, and 71,101 acres on September 3. Trajectory and wind speed data presented by Colorado indicated that smoke from these fires transported into northeast Colorado throughout September 2 and September 4, 2017. Using quantitative emission estimates for these fires for August 31, and September 1, 2017, resulted in a Q/D quantity of 225.5 tpd/km for the Denver area on September 2. Similar calculations for September 2 and 3, including emission estimates for a total of 24 fires at upwind distances of 195 to 1,577 km resulted in a Q/D quantity of 109.2 tpd/km for September 4. Both ozone exceedances days therefore meet the criterion for the first key factor for using Tier 2 demonstration elements of the EPA's wildfire ozone guidance document.

In addition to Q/D, key factor 2 for the Tier 2 analysis is that the data be either at or above the 99th percentile for historical ozone data, or be one of the 4 highest ozone values in the year. The 0.076 ppm days in September 2017, are above the 99th percentile for all 2011-2016 September data, at the 99th percentile for August 26-September 9 data in 2011-2016, and are tied as the 4th highest day recorded at NREL in 2017. The data therefore meets the key factor 2 criteria. Table 3 shows that the flagged days are identical at 0.076 ppm and are tied as the 4th of the nine highest 8-hour ozone concentrations recorded at the NREL monitoring station in 2017. The table includes the 6th through 9th values to show that these values are all lower than the flagged values, and will tie as the 4th maximum at 0.074 ppm if the flagged values receive concurrence from the EPA.

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Table 3 First through Ninth High 8-hour Ozone, NREL Monitor, 2017

Date	Ozone Concentration (ppm)
July 27, 2017	0.081
July 24, 2017	0.078
August 18, 2017	0.077
September 2, 2017	0.076
September 4, 2017	0.076
June 7, 2017	0.074
June 8, 2017	0.074
August 22, 2017	0.074
August 29, 2017	0.074

With the key factors for a tier 2 analysis met, the EPA's wildfire ozone guidance document indicates that the elements shown in Table 4 should be included in a clear causal demonstration.

Table 4 Clear Causal Relationship Technical Demonstration Components Recommended for Tier 1 and Tier 2 Demonstrations

Tier 1 Analyses Should Include	Tier 2 Analyses Should Include
Comparison of the fire-influenced exceedance with historical concentrations	Comparison of the fire-influenced exceedance with historical concentrations
Evidence that the fire and monitor(s) meet the key factor	Evidence that the fire and monitor(s) meet the key factors (#1 and #2)
Evidence of transport of fire emissions from fire to the monitor (one of these): • Trajectories linking fire with the monitor (forward and backward), considering height of trajectories • Satellite evidence in combination with surface measurements	Evidence of transport of fire emissions from fire to the monitor (one of these): • Trajectories linking fire with the monitor (forward and backward), considering height of trajectories • Satellite evidence in combination with surface measurements
	Evidence that the fire emissions affected the monitor (one of these): • Visibility impacts (satellite or photo) • Changes in supporting ground level measurements • Satellite NO_X enhancements • Differences in spatial/temporal patterns

Evidence of transport of wildfire emissions from the wildfire to the monitor

The Colorado demonstration provided fire emission summaries for the days immediately prior to and including the September 2 and 4, 2017 event days, and HYSPLIT trajectory analyses, satellite imagery and satellite derived Hazard Mapping System (HMS) smoke plume maps to demonstrate that smoke from the identified fires was transported to the impacted monitor. The

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demonstration also provided regional $PM_{2.5}$ data to show that elevated $PM_{2.5}$ coincided with the identified smoke plumes, and aethelometer ($PM_{2.5}$ carbon speciation) data, indicating that the elevated $PM_{2.5}$ data was due to smoke and that smoke was present at ground level, and not just in air layers aloft. The demonstration also included national synoptic scale weather maps showing high pressure over the southwest United States from August 31 through September 4, 2017, inducing clockwise wind flow around the high-pressure system, with northwesterly winds transporting smoke from the Pacific Northwest to eastern Colorado throughout the period.

Overall, the trajectory analysis, satellite imagery, meteorological data and evidence of smoke reaching the ground show that emissions from the wildfires in the Pacific Northwest were transported to the Denver northern front range area of Colorado and the NREL monitoring station on both exceedance days.

Evidence that the wildfire emissions affected the monitor

The Colorado demonstration provided graphs of normal and extreme seasonal and diurnal historical ozone patterns, showing that both September 2 and 4, 2017 at NREL were outliers in terms of ozone concentration for the time of year, and had ozone formation unusually early in the day within the diurnal profiles. Data were provided with similar conclusions for monitors across the Denver north front range ozone nonattainment area, even though only the NREL data had regulatory significance. Those unusually high ozone readings coincided with some of the highest September $PM_{2.5}$ readings historically observed in the area, indicative of smoke; Colorado had only recorded two prior $PM_{2.5}$ exceedances in September, both of which also had wildfire smoke causes. This constitutes evidence of unusual readings in supporting ground level measurements, in comparison with nonevent days from the same season.

In addition, the Colorado demonstration provided imagery on September 2 and 4, along with historical clear day images, from the CDPHE Visibility Standards Index monitoring site in downtown Denver, showing significant visibility impairment from smoke on those days.

Additional Evidence that the Fire Emissions Caused the Ozone Exceedance

Additional evidence that fire emissions caused a flagged ozone exceedance, beyond that provided by Colorado in response to the EPA's wildfire ozone guidance document for a tier 2 clear causal demonstration, is a tier 3 requirement of the EPA's wildfire ozone guidance document. Since Colorado met the key factors for a tier 2 analysis, additional evidence was not included in Colorado's tier 2 level demonstration. The EPA evaluated sub-hourly (1-minute average) ozone and $PM_{2.5}$ data collected by Colorado after accessing the data from the internal CDPHE data server. The data examined are included herein as Appendix A. This sub-hourly data is not delivered to the EPA AQS database, but retained by CDPHE.

In the Colorado ambient monitoring network, ozone and $PM_{2.5}$ are only rarely measured at the same location. In the Denver metro area, this occurs at the downtown Denver CAMP and La Casa (NCore) monitoring stations, and at the Chatfield Reservoir monitoring station located about 15 miles south-southwest of the downtown monitors. Only ozone is measured at the NREL monitoring station.

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On both September 2 and September 4, 2017, the Chatfield Reservoir $PM_{2.5}$ and ozone monitors recorded simultaneous rapid rises in concentration. On September 2, 2017, Chatfield Reservoir $PM_{2.5}$ increased from about 26 to about 48 μg/m^3 and ozone increased from about 35 to about 60 ppb between 8:15 and 8:45 am, MST. On September 4, similar increases occurred, with $PM_{2.5}$ increasing from about 24 to about 124 μg/m^3 and ozone increasing from about 65 to about 110 ppb between 1:30 and 2:00 pm MST. Also on September 4, the CAMP and La Casa monitors displayed similar simultaneous increases between 1:00 and 1:15 pm. While NREL does not measure $PM_{2.5}$, it also showed a rapid increase in ozone between 1:00 and 1:15 pm. The initial and final $PM_{2.5}$ and ozone conditions for these rapid rises are summarized in Table 5, and the data plots of the 1-minute data are shown in Appendix A.

Table 5 Simultaneous Rapid Increases in $PM_{2.5}$ and Ozone in the Denver Metro Area on September 2 and 4, 2017

Date	Site	Initial Time	Final Time	Initial $PM_{2.5}$ (μg/m^3)	Final $PM_{2.5}$ (μg/m^3)	Initial Ozone (ppb)	Final Ozone (ppb)	$PM_{2.5}$ increase rate (μg/m^3/hr)	Ozone increase rate (ppb/hr)
Sept. 2, 2017	Chatfield Reservoir	8:15 pm	8:30 pm	26	48	35	60	44	50
Sept. 4, 2017	Chatfield Reservoir	1:30 pm	2:00 pm	24	124	65	110	200	90
	CAMP	1:00 pm	1:15 pm	17	60	70	87	172	68
	La Casa	1:00 pm	1:15 pm	20	53	70	90	132	80
	NREL	1:00 pm	1:15 pm	NA	NA	72	105	NA	132

These rapid, simultaneous large increases in $PM_{2.5}$ and ozone strongly suggest that a heavily polluted air mass was arriving at the monitor inlets, and with very large $PM_{2.5}$ increases, this is almost certainly a parcel with very high smoke loading. The simultaneous increase in ozone with the increase in $PM_{2.5}$ indicates that the ozone was present in the arriving smoke plume, and not generated independently from other, non-wildfire local sources.

Clear Causal Relationship Conclusion

The analysis included in the demonstration, plus the additional data provided by the EPA in Appendix A sufficiently demonstrate a clear causal relationship between emissions generated by numerous Pacific Northwest wildfires and the exceedances on September 2 and 4, 2017, at the NREL monitor. Table 6 summarizes the relevant analyses.

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Table 6 Clear Causal Relationship and the Supporting Analysis

Tier 2 Analyses Should Include	Demonstration Citation	Quality of Evidence	Criterion Met?
Comparison of the fire-influenced exceedance with historical concentrations	3.2.3, pp. 12-13 3.3., pp. 13-15 4.2.3, pp. 83-96	Sufficient	Yes
		Sufficient	Yes
Evidence that the fire and monitor(s) meet the key factors (#1 and #2)	9/2: 4.2.1, pp. 55-68	Sufficient	Yes
	9/4: 4.2.2, pp. 69-82	Sufficient	Yes
Evidence of transport of fire emissions from fire to the monitor (<u>one</u> of these): • Trajectories linking fire with the monitor (forward and backward), considering height of trajectories • Satellite evidence in combination with surface measurements	9/2: 4.2.1, pp. 55-68	Sufficient (both demonstrated)	Yes
	9/4: 4.2.2, pp. 69-82	Sufficient (both demonstrated)	Yes
Evidence that the fire emissions affected the monitor (<u>one of these</u>): • Visibility impacts (satellite or photo) • Changes in supporting ground level measurements • Satellite NO_x enhancements • Differences in spatial/temporal patterns	9/2: 4.2.1, pp. 55-68	Sufficient (3 of 4 demonstrated)	Yes
	9/4: 4.2.2, pp. 69-82	Sufficient (3 of 4 demonstrated)	Yes
Additional Evidence	Appendix A herein	Sufficient	Yes

Not Reasonably Controllable or Preventable

The EER presumes that wildfire events on wildland are not reasonably controllable or preventable [40 CFR 50.14(b)(4)]. Colorado's demonstration provided evidence that the wildfire event meets the relevant definition of wildfire at 40 CFR 50.1(n). Specifically, CDPHE states that "Based on the documentation provided in Section 4 and Appendix C of this submittal, of the twenty-eight wildfires discussed in this petition, twenty-four were caused by lightning or a natural cause and four have an unknown cause, while all of the wildfires occurred on wildland." Therefore, the documentation provided sufficiently demonstrates that the event was not reasonably controllable and not reasonably preventable.

Table 7 Documentation of not Reasonably Controllable or Preventable

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 2, 2017	6.0, p. 105 Table 11, p. 68 Appendix C	Sufficient	Yes
September 4, 2017	6.0, p. 105 Table 12, p. 82 Appendix C	Sufficient	Yes

Natural Event or Event Caused by Human Activity That is Unlikely to Recur

The definition of "wildfire" at 40 CFR 50.1(n) states, "A wildfire that predominantly occurs on wildland is a natural event." CDPHE's demonstration includes documentation that the event meets the definition of a wildfire and occurred predominantly on wildland. CDPHE has therefore shown that the event was a natural event.

Table 8 Documentation of Natural Event

Exceedance Date	Demonstration Citation	Quality of Evidence	Criterion Met?
September 2, 2017	5.0, p. 104 Table 11, p. 68 Appendix C	Sufficient	Yes
September 4, 2017	5.0, p. 104 Table 12, p. 82 Appendix C	Sufficient	Yes

Schedule and Procedural Requirements

In addition to technical demonstration requirements, 40 CFR 50.14(c) and 40 CFR 51.930 specify schedule and procedural requirements an air agency must follow to request data exclusion. Table 9 outlines the EPA's evaluation of these requirements.

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Table 9 Schedules and Procedures

Criterion	Reference	Demonstration Citation	Criterion Met?
Did the agency provide prompt public notification of the event?	40 CFR 50.14 (c)(1)(i)	Appendix D, p. 218-221	Yes
Did the agency submit an Initial Notification of Potential Exceptional Event and flag the affected data in EPA's Air Quality System (AQS)?	40 CFR 50.14 (c)(2)(i)	Letter, Oct. 24, 2017, Gregory Harshfield, CDPHE, to Richard Payton, EPA Region 8; Meeting at CDPHE Jan. 3, 2018; AQS flag and initial description applied Nov. 20, 2017.	Yes
Did the initial notification and demonstration submittals meet the deadlines for data influenced by exceptional events for use in initial area designations, if applicable? Or the deadlines established by the EPA during the Initial Notification of Potential Exceptional Events process, if applicable?	40 CFR 50.14 Table 2 40 CFR 50.14 (c)(2)(i)(B)	Letter, Oct. 24, 2017 (initial notification); June 4, 2018 (demonstration submittal).	Yes
Was the public comment process followed and documented? • Did the agency document that the comment period was open for a minimum of 30 days? • Did the agency submit to the EPA any public comments received? • Did the state address comments disputing or contradicting factual evidence provided in the demonstration?	40 CFR 50.14 (c)(3)(v)	7.0, Appendix E (of demonstration), p. 222-239.	Yes
Has the agency met requirements regarding submission of a mitigation plan, if applicable?	40 CFR 51.930(b)	Mitigation plan not yet due.	NA

CONCLUSION

The EPA has reviewed the documentation provided by CDPHE to support claims that smoke from wildfires in the Pacific Northwest caused exceedances of the 2008 8-hour ozone standard at the NREL monitoring site on September 2 and 4, 2017. The EPA has determined that the flagged exceedances at NREL on these days satisfy the exceptional event criteria: the event was a natural event, which affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedance, and was not reasonably controllable or preventable. The EPA has also determined that CDPHE has satisfied the procedural requirements for data exclusion.

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Appendix A Additional Evidence that the Fire Emissions Caused the Ozone Exceedance, Compiled by the EPA[6]

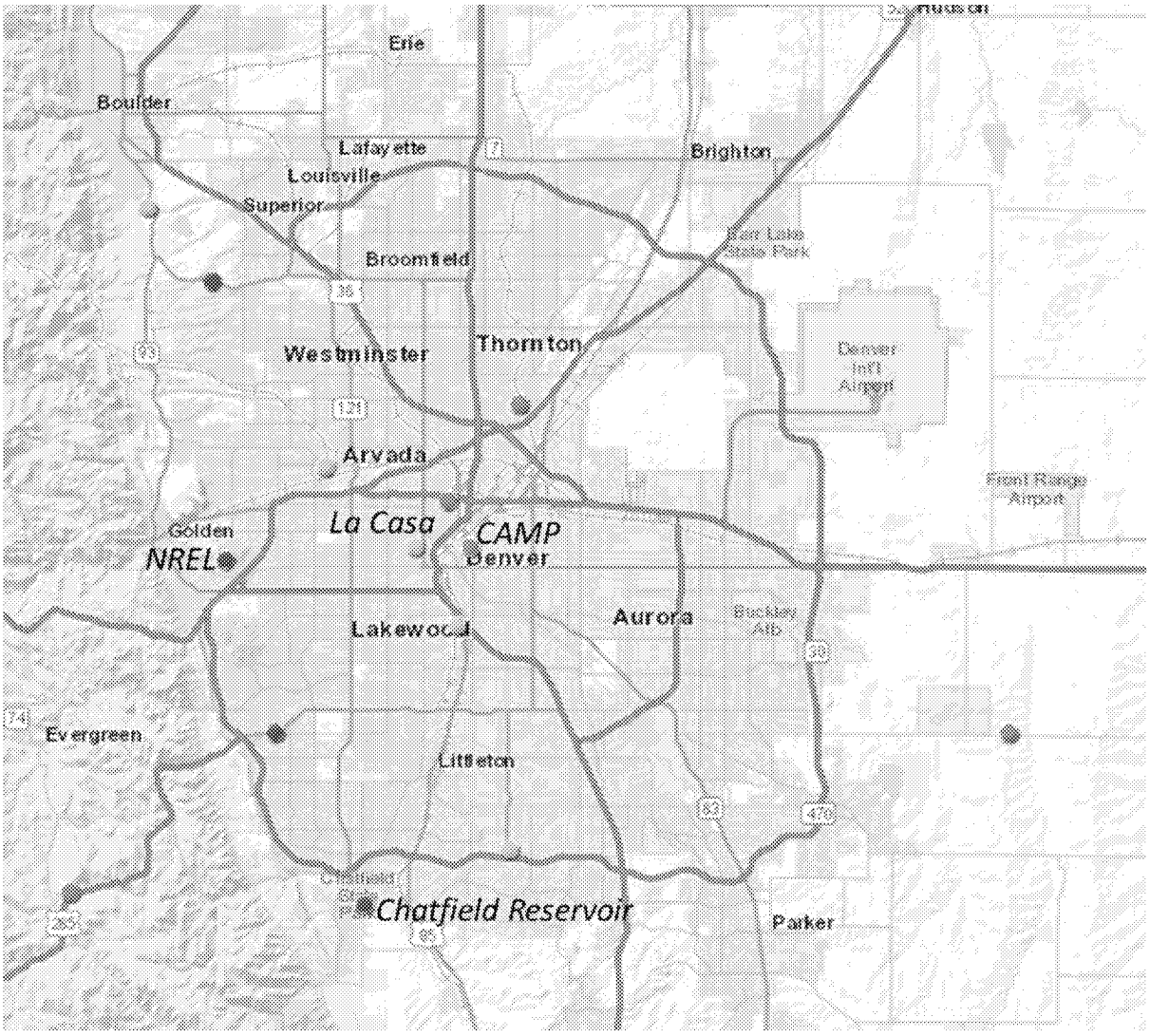


Figure A-1 Map of the Denver Metro Area, Showing the Locations of the CAMP, La Casa, Chatfield Reservoir and NREL Monitoring Stations

[6] All figures in Appendix A were prepared by the EPA with data provided by CDPHE.

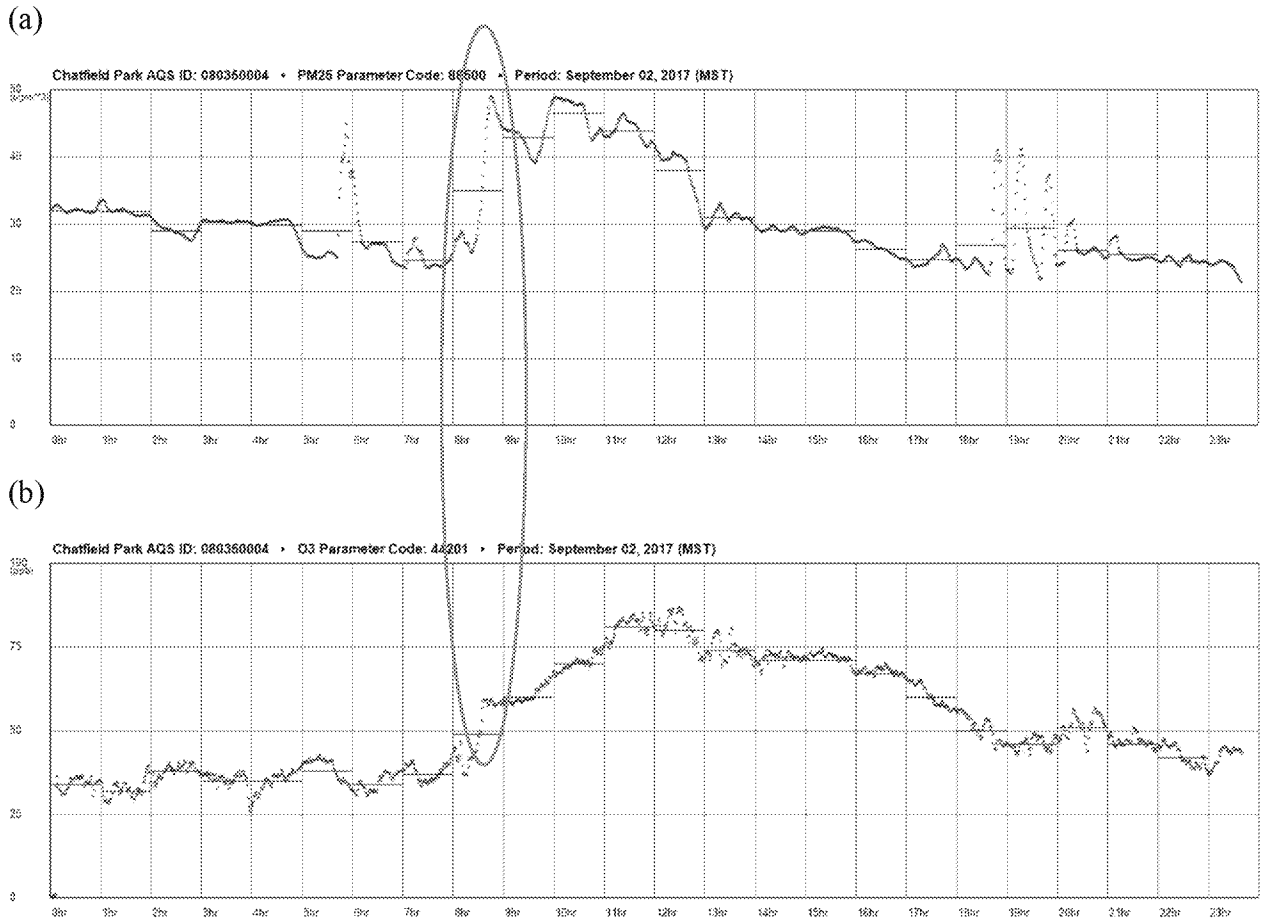
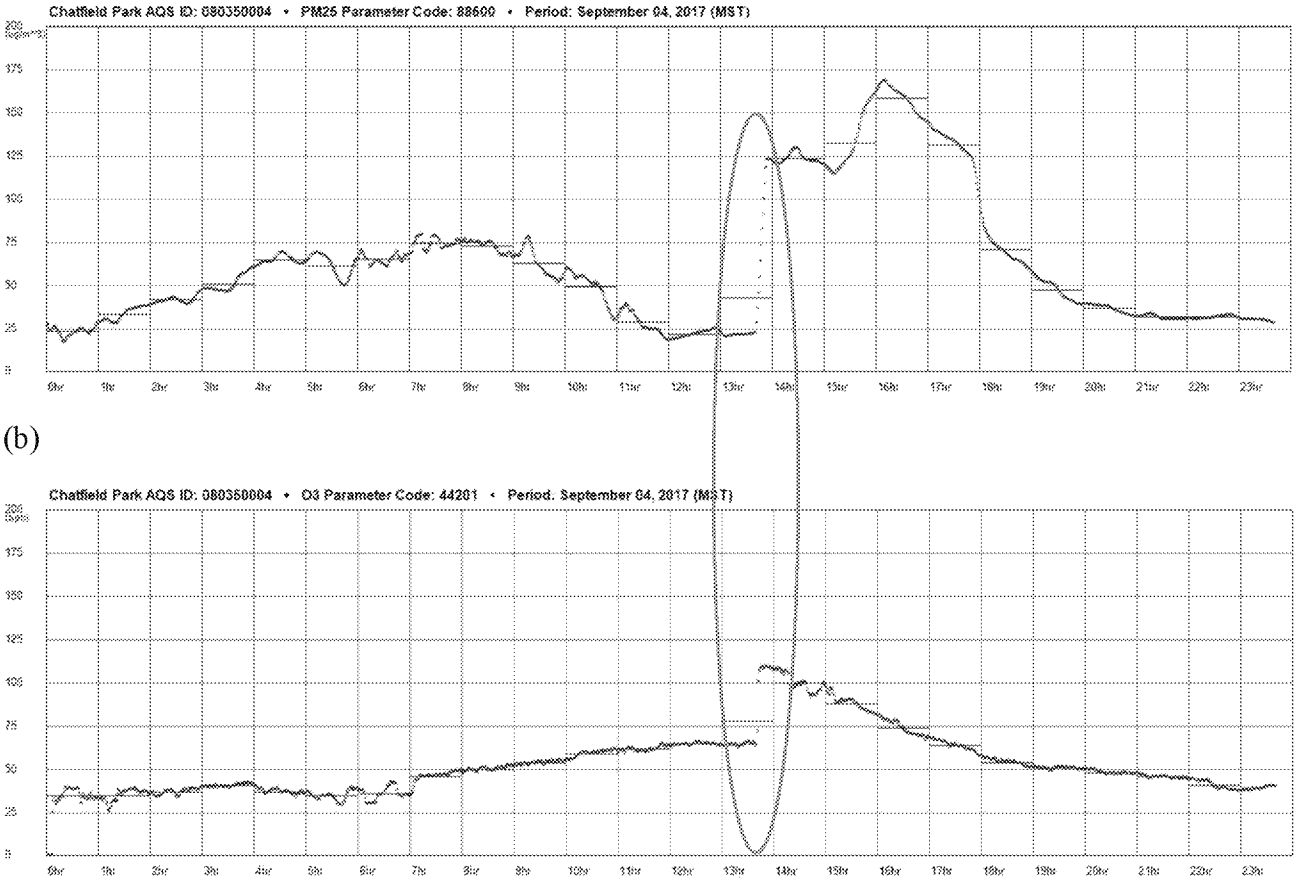


Figure A-2 Chatfield Reservoir 1-minute $PM_{2.5}$ (a) and ozone (b) data, September 2, 2017, with simultaneous 22 μg/m^3 $PM_{2.5}$ increase and 25 ppb ozone increase between 8:15 and 8:45 am.

(a)



(b)

Figure A-3 Chatfield Reservoir 1-minute $PM_{2.5}$ (a) and ozone (b) data, September 4, 2017, with simultaneous 100 μg/m^3 $PM_{2.5}$ increase and 45 ppb ozone increase between 1:30 and 2:00 pm.

(a)

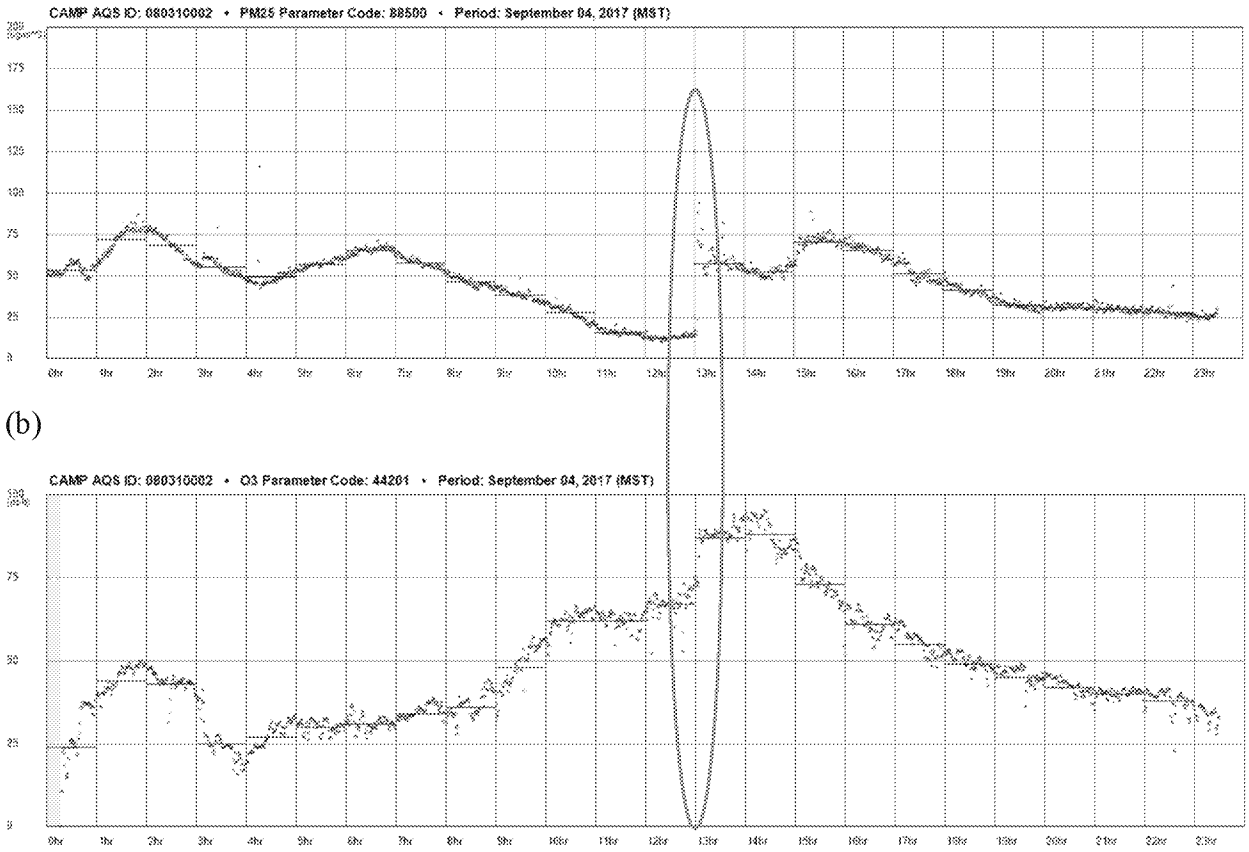


Figure A-4 CAMP 1-minute $PM_{2.5}$ (a) and ozone (b) data, September 4, 2017, with simultaneous 43 μg/m^3 $PM_{2.5}$ increase and 17 ppb ozone increase between 1:00 and 1:15 pm.

(a)

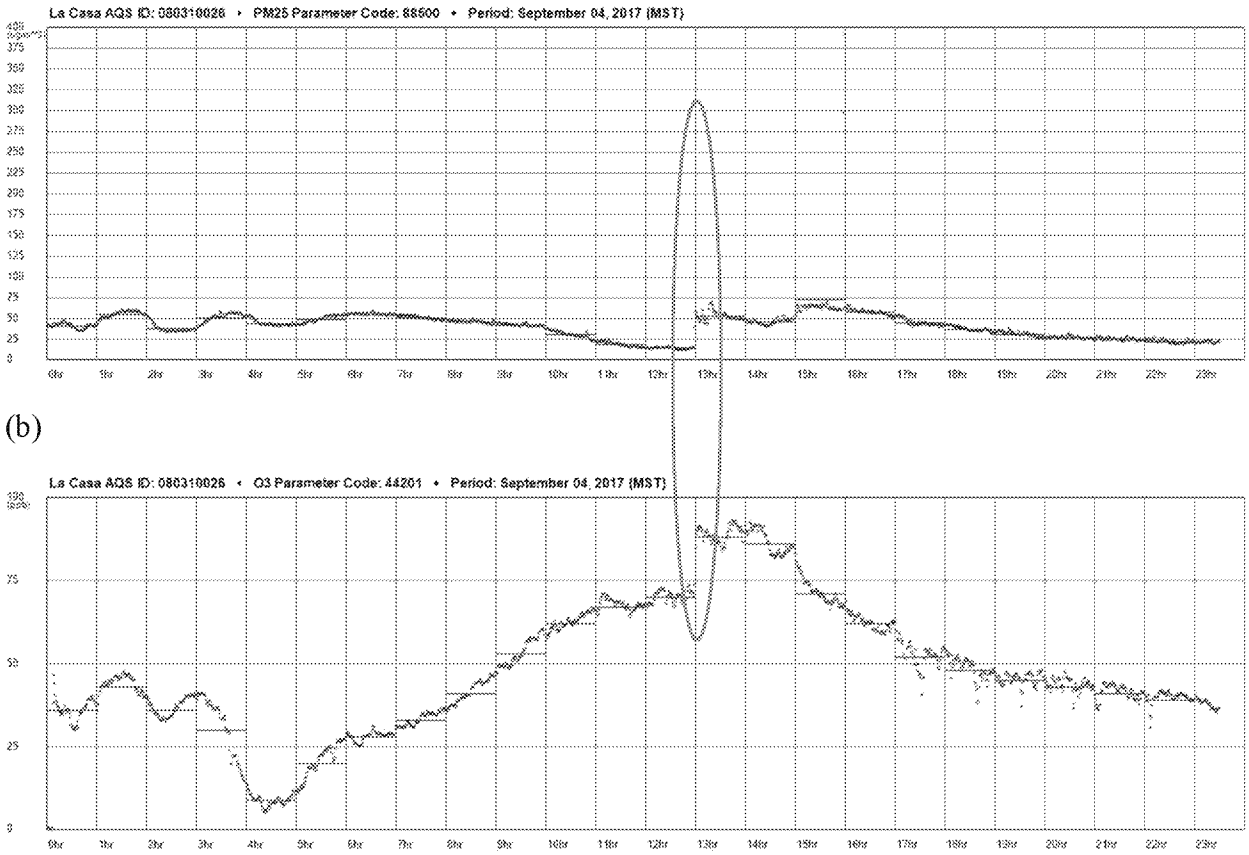


Figure A-5 La Casa 1-minute $PM_{2.5}$ (a) and ozone (b) data, September 4, 2017, with simultaneous 33 $\mu g/m^3$ $PM_{2.5}$ increase and 20 ppb ozone increase between 1:00 and 1:15 pm.

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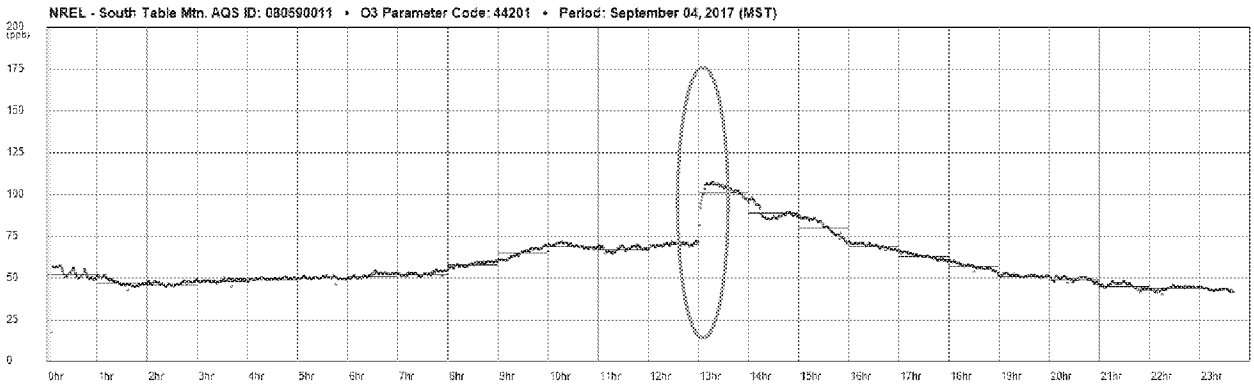

Figure A-6 NREL 1-minute ozone data ($PM_{2.5}$ not monitored), September 4, 2017, with 30 ppb ozone increase between 1:00 and 1:15 pm.