APPENDIX H
VENTURA COUNTY
WEIGHT OF EVIDENCE ASSESSMENT

Prepared for

Ventura County Air Pollution Control District
Ventura, California

By

California Air Resources Board
Planning and Technical Support Division
Sacramento, California

Ventura County Weight of Evidence Assessment

Introduction

Ventura County (County) is currently classified as a serious nonattainment area for the 2015 0.070 parts per million (ppm) federal 8-hour ozone standard (2015 ozone standard). For areas designated as moderate or above nonattainment for the 2015 ozone standard, photochemical modeling is a required element of the State Implementation Plan (SIP) to determine whether existing and planned control strategies provide the reductions needed to meet the 2015 ozone standard by the attainment deadline.

To address the uncertainties inherent to modeling assessments, U.S. Environmental Protection Agency (U.S. EPA) guidance, *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze,* recommends that supplemental analyses accompany all model attainment demonstrations. Further, U.S. EPA guidance indicates that as an area approaches the target attainment date, ambient air quality and emissions data become an increasingly important element in demonstrating progress toward air quality goals.

To complement regional photochemical modeling analyses included in the Ventura County SIP, the following Weight Of Evidence (WOE) demonstration includes detailed analyses of ambient ozone data, county level precursor emission trends, population exposure trends, and a discussion of conditions that contribute to exceedances of the 2015 ozone standard. Further, the rate of progress toward air quality goals was evaluated by considering trends in ozone design values, precursor emission reductions, the relationship between ozone air quality and past emission reductions, as well as taking into account the impact of wildfire emissions.

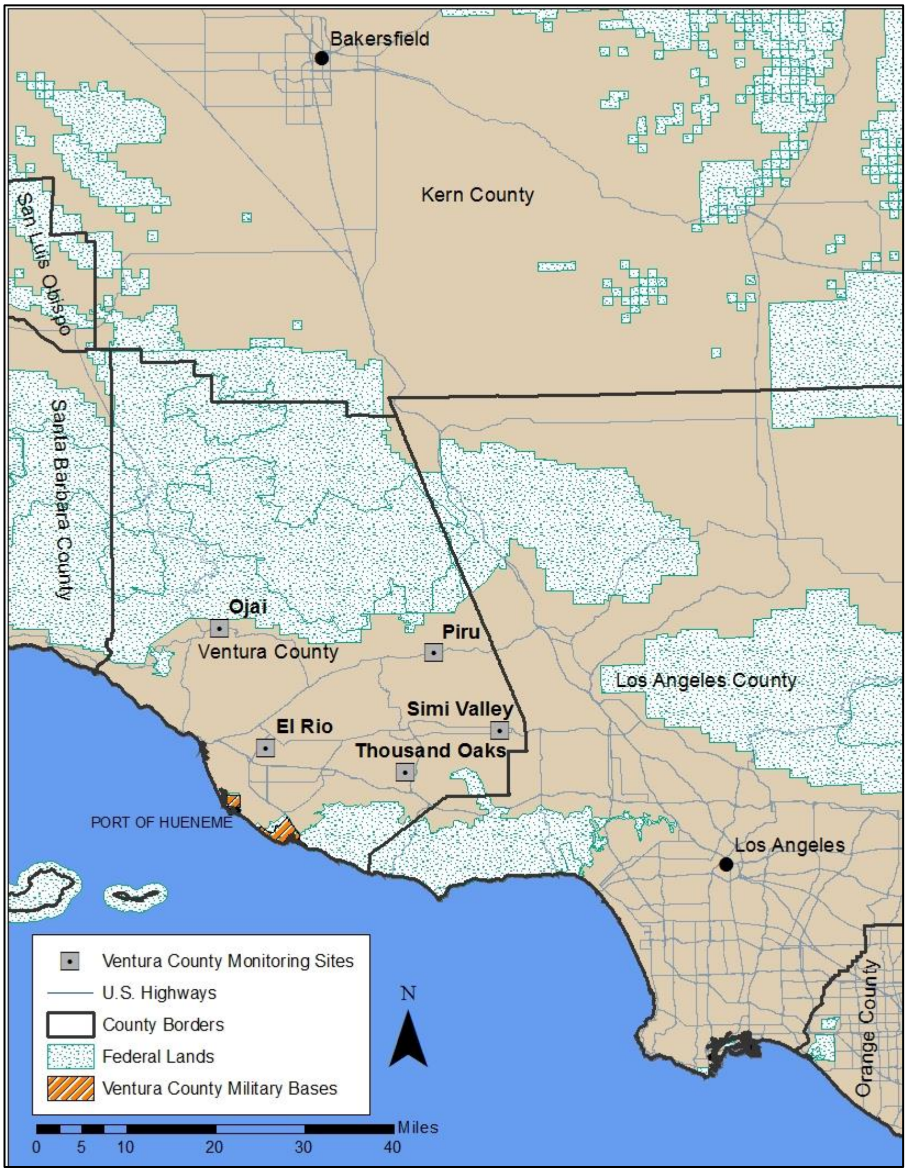
Photochemical modeling for Ventura County has demonstrated that all sites will meet the 2015 ozone standard by the 2026 attainment deadline for serious nonattainment areas. Air quality analyses show that measured ozone concentrations and emissions of ozone precursors in Ventura County have declined markedly over the last two decades and consistent with the modeling results, indicating that the County will meet the 2026 attainment date.

Area Description

Located in the South Central Coast Air Basin, Ventura County is west of Los Angeles County, south of Kern County, and east of Santa Barbara County. Figure H-1 shows the location of Ventura County. Nearly 850,000 people live in the County, making it the thirteenth most populous county in California. The largest employer is the U.S. military which hosts three facilities operating as Naval Base Ventura County (NBVC) and one Air National Guard base in Ventura County. The other major industries are agriculture, biotechnology, oil production, technology, and tourism.

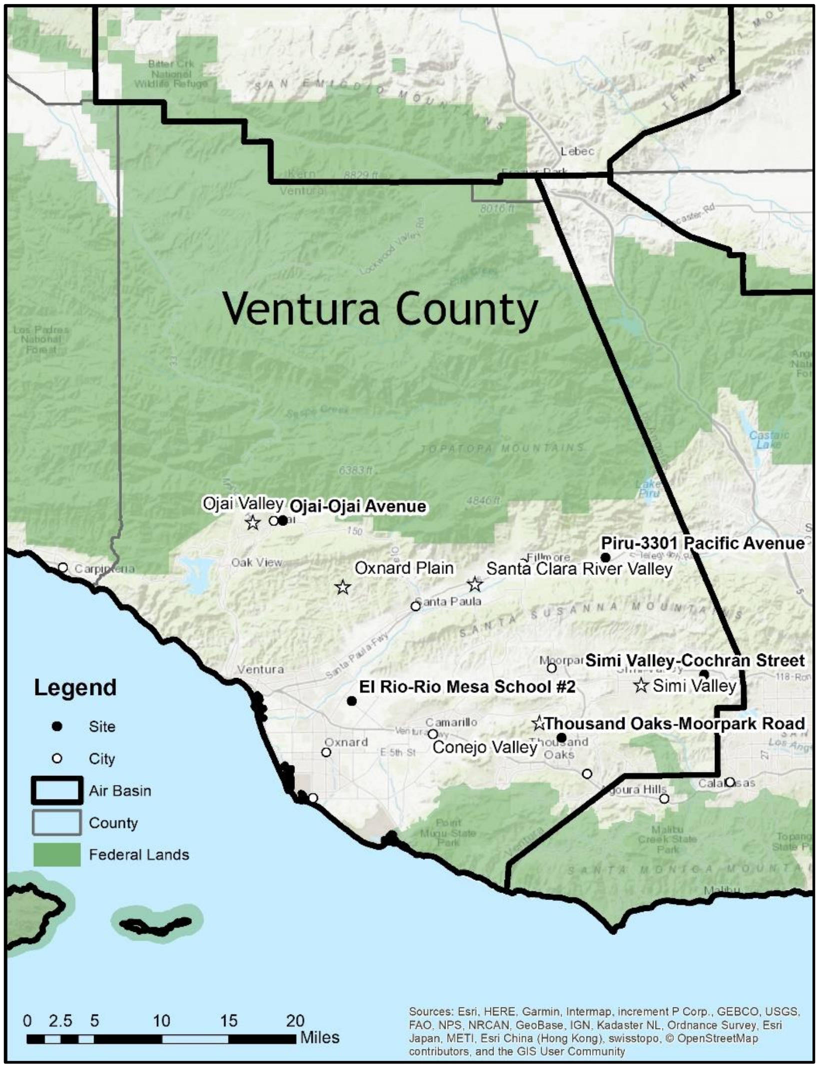
Ventura County encompasses 1,843 square miles. The northern portion of the County is comprised of the rural, mountainous Los Padres National Forest. The southern portion of the County is comprised of 42 miles of coastline that gives way to coastal plain and broad inland valleys. Most of the population resides in the southern portion of the County.

Figure H-1: Area Map of Ventura County and Surrounding Areas



The Ventura County Air Pollution Control District currently operates a network of five ozone monitoring sites, which are sited to represent the five distinct geographical areas of the southern portion of the County that are shown in Figure H-2. The coastal monitoring sites include El Rio and Thousand Oaks, which measure air quality that is representative of conditions in Ventura and the Oxnard Plain, and Conejo Valley, respectively. The inland monitoring sites include Ojai, Piru, and Simi Valley, which measure air quality that is representative of conditions in Ojai Valley, Santa Clara River Valley, and Simi Valley, respectively.

Figure H-2: Map of Geographical Regions in Ventura County and Locations of Representative Air Monitoring Sites



There is a large gradient in ozone concentrations between the coastal and inland areas due to the difference in prevailing meteorological conditions between these two areas. As shown in Table H-1, higher ozone concentrations measured at the inland monitoring sites drive Ventura County's serious nonattainment status. The nonattainment area is limited to the mainland portions of the County and does not include the Channel Islands.

Table H-1: Ozone Design Values at Ventura County Monitoring Sites

Site Name	AQS ID	Region	2019 Design Value (ppm)	2020 Design Value (ppm)	Meet 2015 Ozone Standard
Thousand Oaks	061110007	Conejo Valley	0.068	0.069	Yes
Piru	061110009	Santa Clara River Valley	0.071	0.070	Yes
Ojai	061111004	Ojai Valley	0.067	0.067	Yes
Simi Valley	061112002	Simi Valley	0.076	0.075	No
El Rio	061113001	Ventura and Oxnard Plain	0.060	0.061	Yes

Conceptual Model

Local emissions and transport of ozone and ozone precursors from neighboring areas, including the South Coast Air Basin, contribute to elevated ozone in Ventura County. The majority of days with elevated ozone concentrations occur during the late spring, summer, and early fall and, historically, under conditions that are conducive to photochemical production from accumulated local and regional precursor emissions.

In the spring, summer, and early fall, the predominant weather pattern in the coastal area of Ventura County consists of a persistent marine layer of clouds situated at 1,000 to 3,000 feet above sea level. The marine layer extends into the valleys in the southern portion of the County on most days, carried by a daily afternoon breeze that flows from the cooler coastal area into the warmer inland areas. Once the sun sets, air over the land cools faster than air over the ocean, which causes air to flow back toward the coastline at night. The east-to-west downward sloping terrain further promotes the flow of air from the valleys back toward the coastal plain at night. This sea/land breeze circulation pattern moves air masses back and forth over the same populated areas of the County, accumulating emissions with each pass. Ozone exceedances can occur when these recirculated emissions stagnate onshore.

Ventura County can intercept ozone and ozone precursor emissions from neighboring areas, including South Coast, under a variety of scenarios. Due to the terrain and predominant meteorological patterns in southern California, inland emissions will accumulate offshore, typically at night. During periods of offshore accumulation, emissions derived from Ventura County can intermingle with pollution derived from other regional source areas. When onshore flow resumes, air masses with accumulated, intermingled regional pollution will move inland and potentially impact air quality in Ventura County.

Alternatively, when areas of high pressure build over inland areas and areas of lower pressure persist over the ocean, offshore winds can develop and draw emissions from areas upwind into the County. Under this scenario, conditions are typically breezy along the coast with relatively stagnant conditions inland in the County which can cause ozone exceedances in the inland areas.

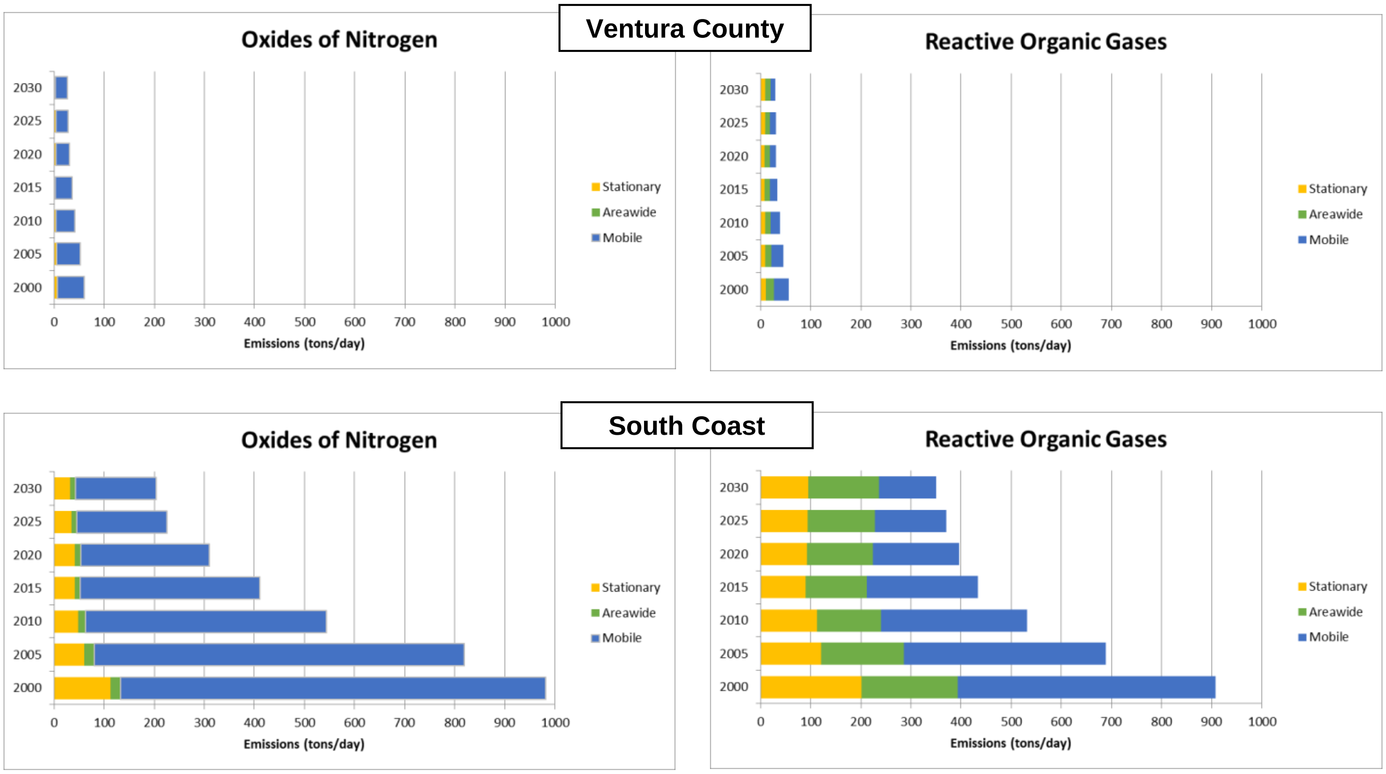
Air quality problems may also arise episodically due to regional wildfires. Certain meteorological conditions promote wildfire outbreaks. In the fall through spring, a system of high pressure can form east of Ventura County, over the Great Basin. During these months, temperatures throughout southern California are typically warmer than those in the Great Basin. At times, air flowing clockwise around the Great Basin high will be pushed westward through mountain passes and into southern California. The flow of air accelerates as it moves through mountain passes and into lower elevation areas of southern California. The descent from the mountain passes causes the air to warm and humidity to markedly decline. The resultant strong, warm, and dry easterly downslope flow is termed a Santa Ana wind. Santa Ana winds, although only typically lasting for a few days at a time, significantly increase the risk of wildfire in Ventura County and other areas of southern California. Wildfires, like other combustion sources, produce ozone precursors and can contribute to elevated ozone in adjacent and downwind areas. In the south central coast in particular, easterly winds can cause emissions from regional wildfires to accumulate offshore. When onshore flow resumes, these accumulated wildfire emissions can be recirculated into Ventura County and exacerbate air quality problems.

Anthropogenic Emissions

Ozone precursor emissions in Ventura County, which include reactive organic gases (ROG) and oxides of nitrogen (NOx), are predominantly from mobile sources, as shown in Figure H-3. Data from the California Air Resources Board's (CARB) 2022 Ozone SIP Inventory for Summer (Version 1.01 with approved external adjustments and include SCC, OC1, OC2 out to 100 nautical miles) for Ventura County indicate that in 2021 mobile sources accounted for 88 percent of NOx emissions whereas areawide and stationary sources accounted for two percent and ten percent of NOx emissions, respectively. In contrast, mobile, areawide, and stationary sources accounted for 41 percent, 32 percent, and 27 percent of ROG emissions, respectively.

Although mobile sources dominate the emission inventory in Ventura County, emissions from a deep water port, agriculture, natural gas electric generation facilities, naval base operations, oil production and processing, and other industrial operations can also contribute to ozone formation in the County. Proximity to a much larger source of upwind precursor emission, South Coast, also contributes to the County's ozone formation. South Coast's emissions numbers (which reflect 2022 SIP Inventory v1.01 with external adjustments and include SCAB, OC1, OC2 out to 100 nautical miles) are included at the same scale as Ventura County for comparison purposes of the scale difference between the two areas.

Figure H-3: Inventory of Ventura County and South Coast Emissions



Data source: CARB 2022 Ozone SIP Inventory for summer (Version 1.01 with approved external adjustments)

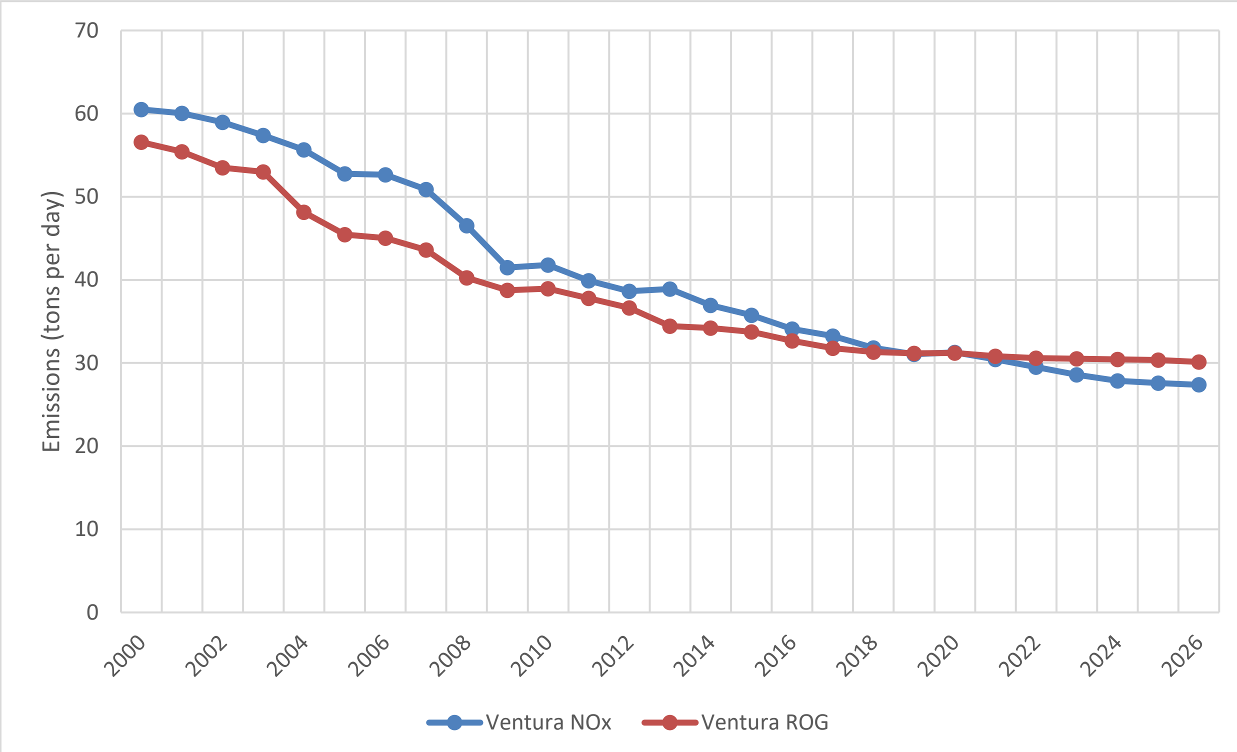
Significant reductions of ozone precursor emissions were achieved in the County between 2000 and 2021.

- Total NOx emissions declined by nearly 50 percent, and
- Total ROG emissions declined by nearly 46 percent.

Emissions from mobile sources, which contribute the largest magnitude of ozone precursors in the County, declined substantially between 2000 and 2021.

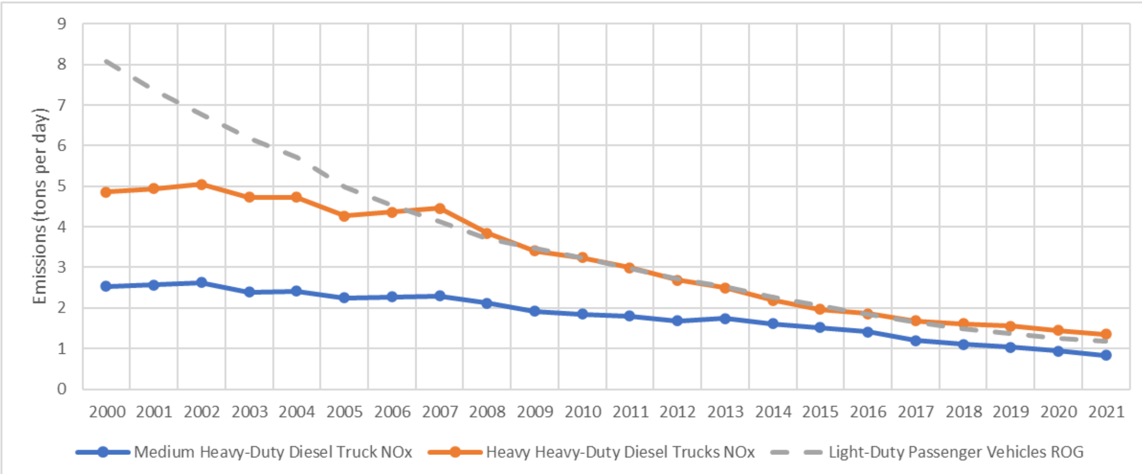
- Mobile source NOx emissions declined by nearly 50 percent, and
- Mobile source ROG emissions declined by nearly 59 percent.

Figure H-4: Inventory of Ventura County



As shown in Figure H-4, emissions have declined considerably in the County for both ROG and NOx and are expected to continue the same trend as additional approved controls and new controls come online. Additionally, in Ventura County the largest on-road mobile source subcategories in the NOx emission inventory are medium heavy-duty trucks and heavy heavy-duty diesel trucks, whereas light-duty passenger vehicles are the largest on-road mobile source subcategory in the ROG emission inventory. Statewide emission control programs targeting mobile sources have yielded substantial reductions in ozone precursor emissions in Ventura County. For example, CARB's adoption of regulations targeting various mobile sources of emissions such as heavy-duty trucks and buses and off-road equipment has led to marked progress in reducing NOx emissions As shown in Figure H-5, between 2000 and 2021, NOx emissions from medium and heavy heavy-duty diesel truck subcategories declined 67 percent and 72 percent, respectively. For the same period, ROG emissions from the light-duty passenger vehicle subcategory declined 85 percent.

Figure H-5: Emissions from the Largest Mobile Source Categories in Ventura County for 2000-2021



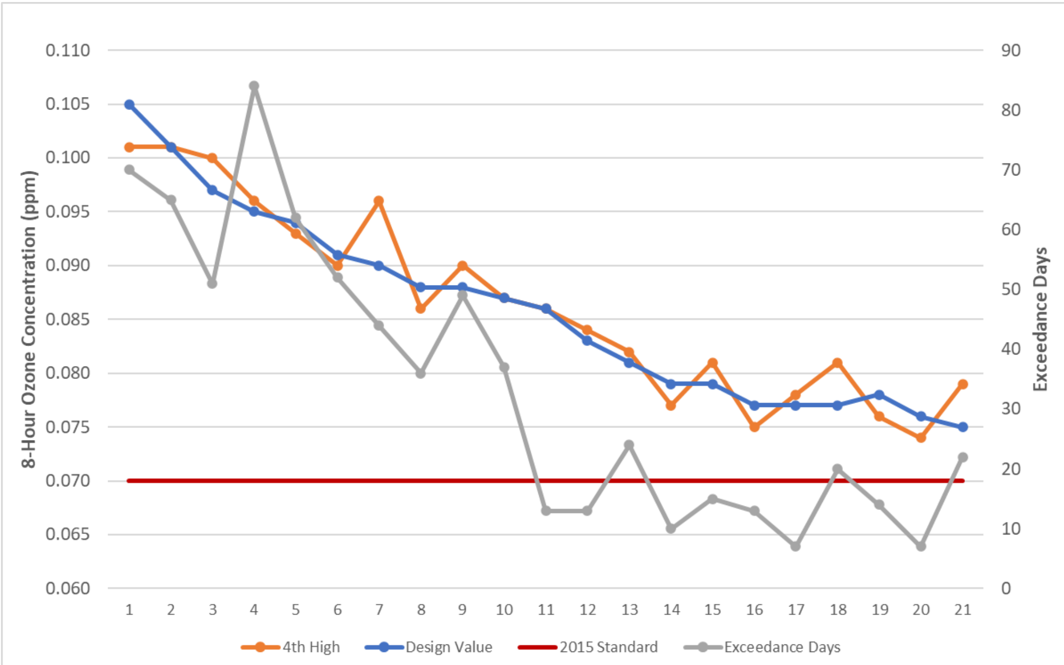
Emissions inventory projections for Ventura County indicate that ongoing implementation of current emission control programs will continue to yield reductions across many categories in the coming years. Between 2021 and 2026, in Ventura County, NOx emissions are projected to decline an additional 52 percent for medium heavy-duty diesel trucks. Emissions of NOx from heavy heavy-duty trucks are expected to decline an additional 54 percent between 2021 and 2026. Emissions of ROG from light-duty passenger vehicles are expected to decline an additional 25 percent between 2021 and 2026.

As described above, statewide programs, particularly those targeting emissions from mobile sources, have yielded significant reductions in emissions of ozone precursors in Ventura County. Although mobile sources account for the majority of ozone precursor emissions in Ventura County, marked reductions in emissions from areawide and stationary sources were also achieved between 2000 and 2021. NOx emissions from stationary and areawide sources declined by nearly 45 percent and 62 percent, respectively, between 2000 and 2021. Moreover, ROG emissions from stationary and areawide sources declined by 16 and nearly 39 percent, respectively, during this time period. In response to persistent reductions in ozone precursors, ozone air quality throughout Ventura County has improved markedly.

Ozone Air Quality

In response to declining emissions over the last 20 years, the frequency, magnitude, and spatial extent of ozone exceedances in Ventura County has significantly declined. As shown in Figure H-6, between 2000 and 2020, the number of ozone exceedance days in the County declined by nearly 69 percent, from 70 days to 22 days. Over this same period, the annual fourth highest daily maximum 8-hour concentration decreased from 0.101 to 0.079 ppm, a decrease of nearly 22 percent; and Ventura County's design value decreased by over 28 percent, from 0.105 to 0.075 ppm. Additionally, the decrease in the design value and fourth highest daily maximum have been included to reflect the concurrence by U.S. EPA of the exceptional events outlined by CARB for 2020.

Figure H-6: 2000 – 2020 Ventura County Ozone Statistics



In 2000, all sites in operation, except the El Rio monitoring site, exceeded the 2015 ozone standard but in response to declining precursor emissions, ozone air quality has been steadily improving over the last 20 years, as shown in Figure H-7. Four out of the five monitoring sites currently meet the 2015 ozone standard. The El Rio monitoring site has been in attainment since 1999. Thousand Oaks has been in attainment since 2013. Ojai attained the 2015 ozone standard in 2019, Piru just dropped below the standard in 2020, and Simi Valley is on track to attain the 2015 ozone standard within the next few years.

The time scale considered in the analyses of ambient measurements, 2000 to 2020, was selected to provide the most complete and representative sample of progress made toward air quality goals throughout Ventura County.

The site level data presented in Figure H-8 demonstrate the ongoing decrease in the frequency and magnitude of ozone exceedance days at Ventura County's design site over the last 20 years. In 2020, exceedances of the 2015 ozone standard occurred on 22 days throughout the county and exceedances occurred at all five sites. This was likely due to the exceptional wildfire emissions blanketing much of the state of California in 2020 and discussed later in this document. Even with the exceptional impact of the wildfire emissions, this is still significantly lower than in 2000, when the 0.070 ppm threshold was routinely exceeded at the three inland sites in operation at that time and saw 70 exceedance days countywide.

Figure H-7: Ozone Design Values at Ventura County Monitoring Sites

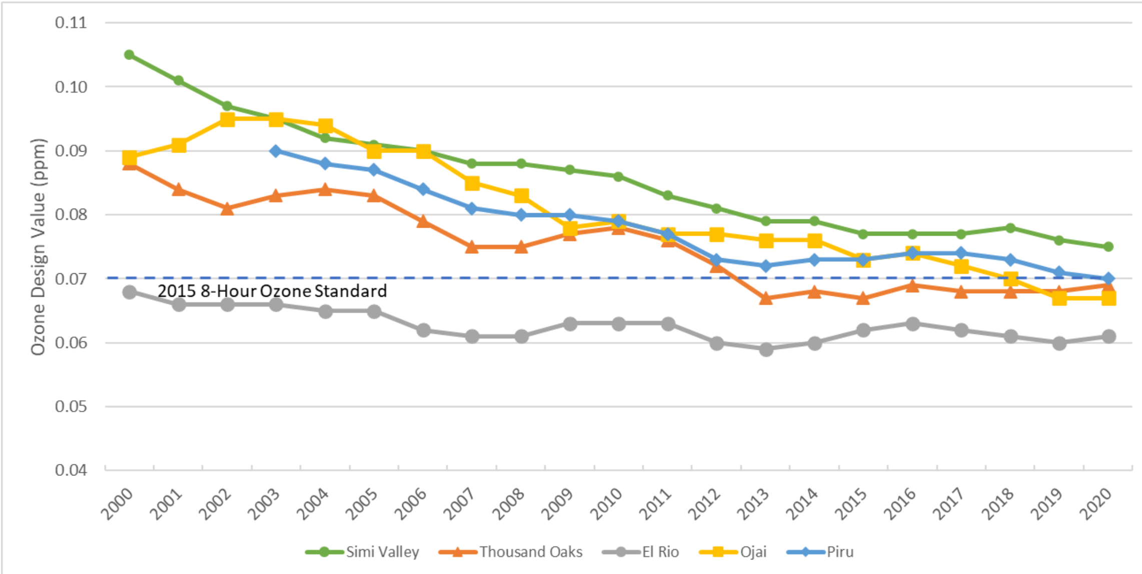
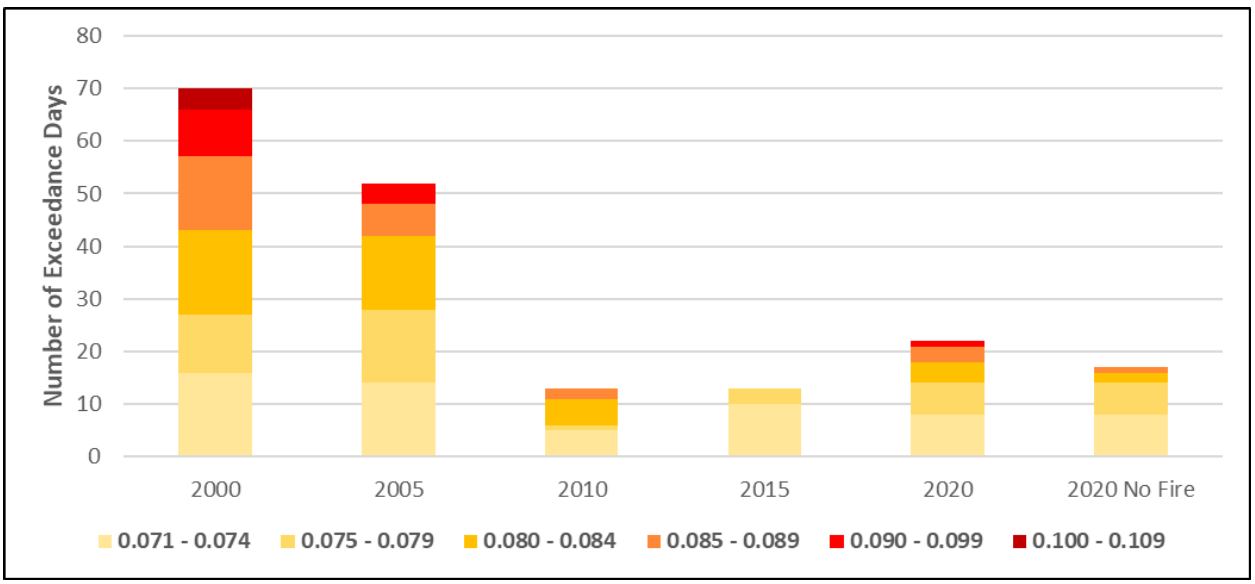


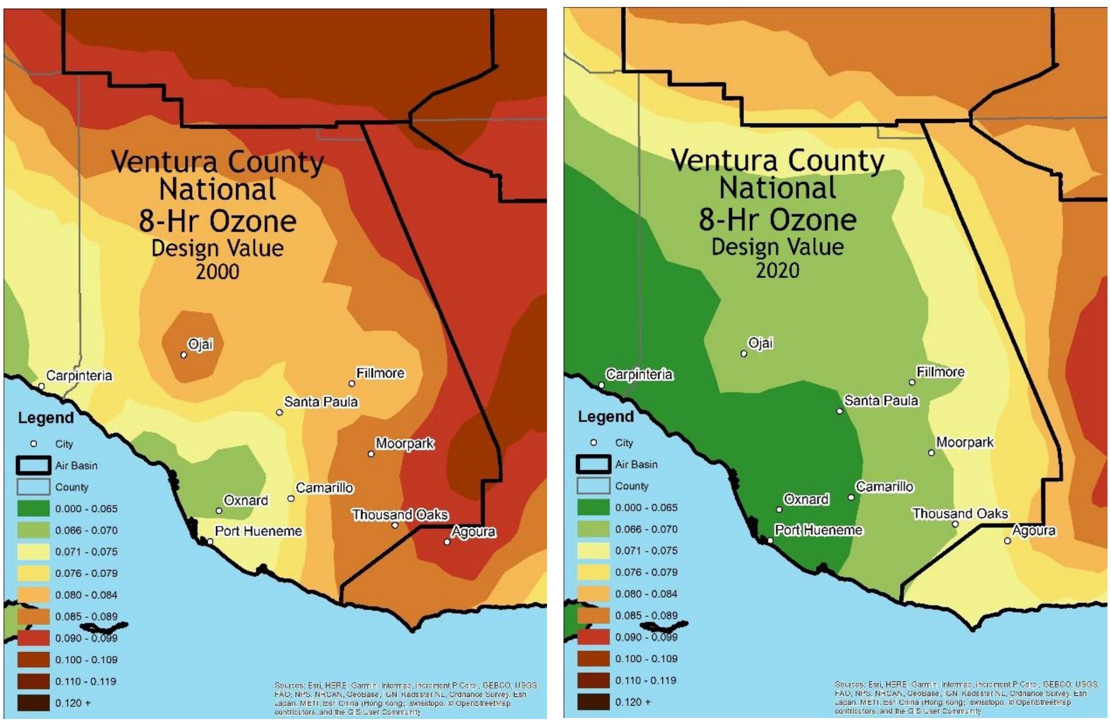
Figure H-8: Frequency and Magnitude of Exceedance Days at Ventura County Design Site (Simi Valley) in 2000, 2005, 2010, 2015, and 2020



At the Simi Valley monitoring site, which is positioned to capture the highest ozone concentrations in the County, the number of exceedance days declined by nearly 69 percent between 2000 and 2020. On exceedance days in 2000, maximum 8-hour ozone concentrations ranged from 0.071 to 0.108 ppm, up to 54 percent above the 2015 ozone standard. In contrast, maximum 8-hour ozone concentrations on exceedance days in 2020 ranged from 0.071 to 0.095 ppm, at most 36 percent above the 2015 ozone standard, and the highest days were eliminated from consideration based on exceptional event determinations.

As a result of the marked decline in the magnitude, frequency, and spatial extent of exceedances in Ventura County, the number of people exposed to elevated ozone has been reduced substantially. The contour maps in Figure H-9 illustrate the change in population exposure over the last 20 years. In 2000, the areas in Ventura County that met the 2015 ozone standard were limited to portions of the coast and inland areas adjacent to those coastal areas. Areas in the northern and eastern part of the County were more than 0.015 ppm above the 2015 ozone standard. In 2020, all of the coastal areas were in attainment with the 2015 ozone standard as well as a significant portion of the inland areas of the County. The contour maps indicate that the only inland areas yet to meet the 2015 ozone standard are within 0.005 ppm of the 0.070 ppm threshold.

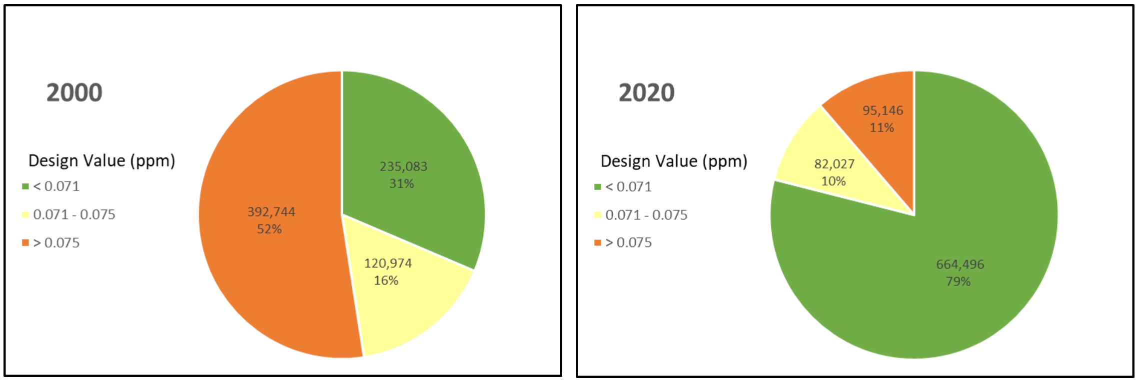
Figure H-9: Contour Maps Representing the Spatial Distribution of Ozone Air Quality in Ventura County for 2000 and 2020



Contour maps were developed using used inverse distance weighting (IDW) to spatially interpolate design values from sites throughout the State.

To evaluate changes in population exposure, spatial analysis tools were used to overlay county level census data with the previous design value contour maps. As shown in Figure H-10, between 2000 and 2020, the number of people residing in areas of the County that exceeded the 2015 ozone standard substantially declined. In 2020, 79 percent of the population resided in areas with air quality that met the 2015 ozone standard compared to 31 percent in 2000. Furthermore, although 21 percent of the population lives in areas that are above the 0.070 ppm threshold, the ozone levels are just slightly above the current standard.

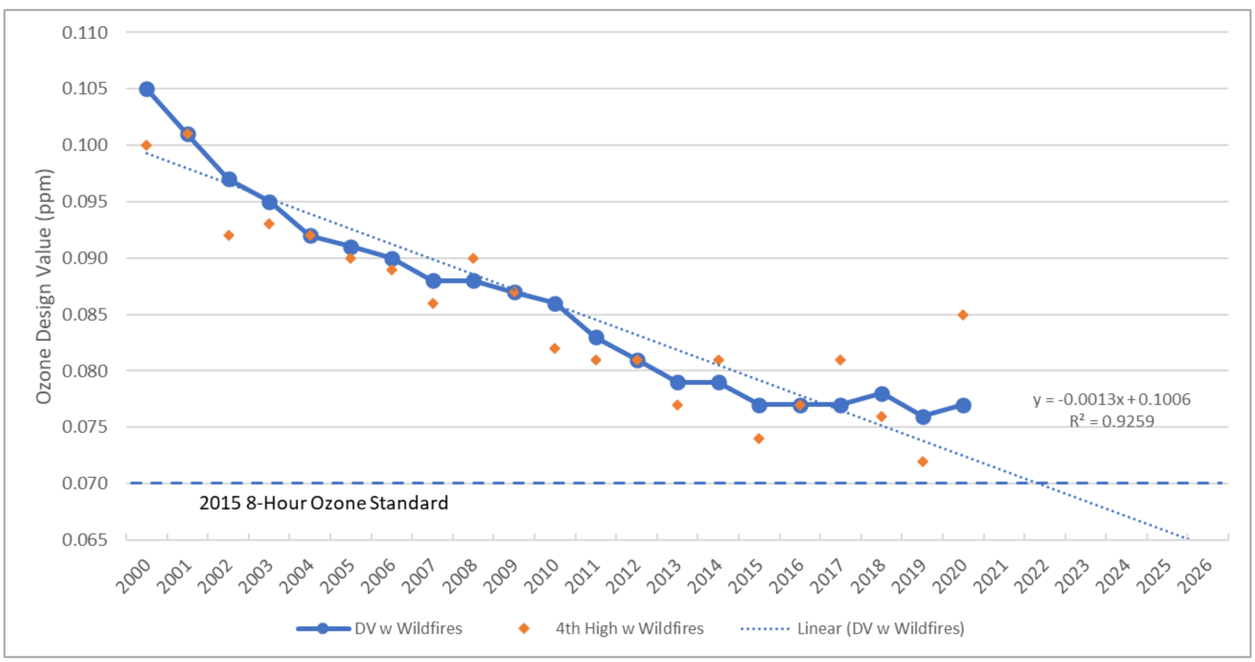
Figure H-10: Population Distribution by Ozone Design Value in 2000 and 2020



Based on 2000 U.S. Census population and 2000 Design Values *Based on 2020 U.S. Census population and 2020 Design Values*

Figure H-11 shows 8-hour ozone design value trends for Simi Valley, with wildfire impacted days, extended to the 2026 attainment deadline. The trends indicate that even while including wildfire impacts the area is anticipated to meet the 2015 ozone standard of 0.070 ppm by 2024 based solely on the design value trendline. While the year of attainment differs between modeling and the design value trendline, both indicate attainment no later than 2026.

Figure H-11: 8-hour Design Value Projections and 4th Highs with Wildfire days included



In summary, ozone air quality has improved throughout Ventura County in response to declining emissions of ozone precursors. The analyses presented above illustrate the extent of improvement over the last 20 years. Currently, four of the five monitoring sites meet the 2015 ozone standard. Simi Valley which has a 2020 design value that is still relatively close to the 2015 ozone standard even with the impact of wildfires, is continuing to make progress toward attainment. The ozone design value has improved at a consistent rate over the past 20 years indicating that Ventura County is on track to meet the 2026 attainment date.

Attainment Projections

I. Photochemical Modeling Results

In 2022, South Coast Air Quality Management District (AQMD) released results of the regional photochemical modeling assessment conducted for Ventura County, which are shown in Table H-2. Based on the implementation of existing control measures, the regional modeling analyses, and taking into account exceptional events approved by U.S. EPA as well as three additional wildfire-impacted days identified by Ventura County staff; taken together these indicate ozone design values at all sites in Ventura County will meet the 2015 ozone standard in 2026.

Table H-2: Regional Modeling Design Values and Projections of Design Site (Simi Valley) Design Value in 2026 (with 3 additional days, identified below, removed)

Site	2016	2017	2018	2019	2020	2026
Thousand Oaks	0.069	0.068	0.068	0.068	0.069	
Piru	0.074	0.074	0.073	0.071	0.070	
Ojai	0.074	0.072	0.070	0.067	0.067	
Simi Valley (Wildfire-impacted days removed)	0.076	0.076	0.076	0.076	0.075	0.070
El Rio	0.063	0.062	0.061	0.060	0.061	

To complement the regional photochemical modeling assessment, the following analyses were conducted to analyze the impact of additional days removed due to impact from wildfires on the projected future design values and ability to attain the standards.

Wildfire Analysis

I. General Information

A. Introduction

Over recent years from 2015-2020 extreme fuel conditions in California created extreme fire seasons. Almost all of California was affected with smoke and haze lingering for weeks. As expected, numerous monitoring sites in Ventura County recorded elevated particulate matter (PM) concentration levels, with many days above the National Ambient Air Quality Standards (NAAQS) for both $PM_{2.5}$ and PM_{10}. Ozone concentrations were also impacted. The wildfire smoke impact on air quality was particularly strong in 2018 and 2020 but was also impacted by local fires at times in other years.

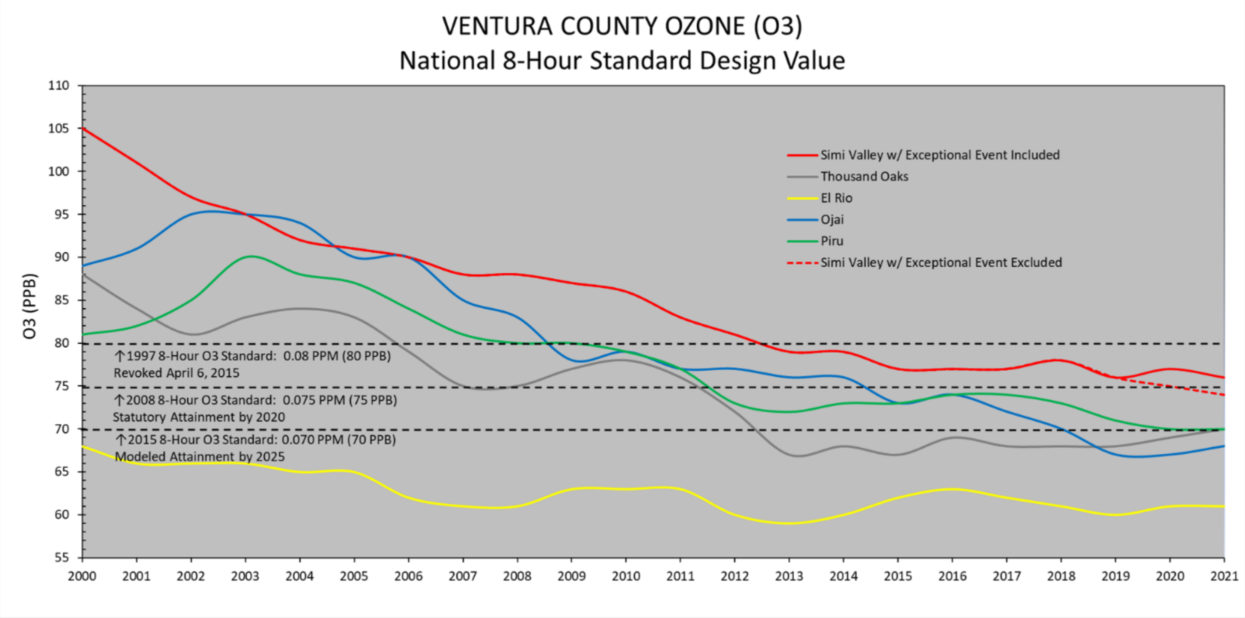
To project the ozone design value and therefore, designation status into the future a baseline eight-hour ozone design value is needed for modeling purposes. In the ideal modeling scenario, the baseline ozone design value would represent the true ozone concentrations in the county without influence from exceptional events such as wildfires.

The baseline design value in this section is calculated using the three NAAQS design value calculation for the period 2016-2020 and averaged. The design value calculations reflect eliminating five days impacted by fires in 2020 that were included in an official exceptional event filing and concurred with by U.S. EPA. Excerpts of that filing are included in Attachment H-1 and reference the wildfires involved, how they impacted the Simi Valley monitor and Ventura County, and the justification for why they should be considered exceptional events and removed from Design Value calculations. This section also focuses on three additional days impacted by wildfire.

Wildfire impacted ozone values on many more than eight days between 2016-2020, however staff included information about three days in this section to suggest these three days were strongly impacted by wildfire smoke. Additionally, these three days have a modeling significance because excluding these three values from the baseline design value suggests Ventura County can meet the 2015 ozone standard by 2026 for the Simi valley monitoring site. Ozone data in Ventura County is showing downward trends and excellent progress towards achieving the 2015 ozone standard by 2026. In fact, in 2020 the County met the 2008 0.075 ppm federal 8-hour ozone standard with a design value of 0.075 ppm after removing the five wildfire-impacted exceptional event days that were concurred by U.S. EPA. Figure H-12 below shows the 8-hour design value by site in Ventura County from 2000 to 2021 and the overall downward trend.

This section utilizes a combination of enhanced imagery, meteorological conditions/discussion, and $PM_{2.5}$ data as an indicator of the potential presence of smoke to support the conclusion that ozone values on these three days had influence from wildfires. Again, we would like to stress that additional days are available that could also be excluded but staff did not find it necessary to include it in this section.

Figure H-12 Ventura County 2015 Ozone Standard Design Value Progress 2001-2021



B. Ozone Exceedances 2016-2020

Table H-3 – 2016-2020 ten highest Eight Hour ozone Values recorded at Simi Valley – Cochran Street (06-111-2002):

Ten Highest Eight Hour Ozone Values by Year

2020	DATE	RANK	2019	DATE	RANK	2018	DATE	RANK	2017	DATE	RANK	2016	DATE	RANK
0.095	3-Oct	1	0.078	5-Oct	1	0.092	7-Aug	1	0.094	8-Jul	1	0.083	27-Jun	1
0.086	18-Aug	2	0.075	6-Oct	2	0.080	7-Jul	2	0.091	30-Aug	2	0.082	3-Jun	2
0.086	2-Oct	3	0.074	14-Sep	3	0.077	9-Sep	3	0.085	2-Sep	3	0.078	23-Jul	3
0.085	4-Sep	4	0.072	14-Aug	4	0.076	10-Apr	4	0.081	2-Aug	4	0.077	4-Jun	4
0.084	15-Oct		0.072	25-Sep		0.076	25-Jul		0.081	29-Aug		0.073	29-Jun	
0.082	21-Aug		0.071	11-Jun		0.075	12-Jun		0.077	2-May		0.072	2-Jun	
0.081	8-May		0.071	6-Aug		0.075	8-Jul		0.077	6-Jul		0.071	29-Jul	
0.080	4-Oct		0.070	10-Jun		0.075	26-Jul		0.077	7-Jul		0.070	18-Apr	
0.079	7-May		0.070	13-Jul		0.073	27-Jul		0.077	1-Aug		0.070	22-Jul	
0.079	18-Sep		0.069	15-Aug		0.073	27-Sep		0.076	26-Aug		0.070	30-Aug	

Table H-4 - 2016-2020 ten highest Eight Hour ozone Values recorded at Simi Valley – Cochran Street (06-111-2002) excluding days impacted by wildfire:

Ten Highest Eight Hour Ozone Values by Year Excluding Days Impacted by Wildfire														
2020	DATE	RANK	2019	DATE	RANK	2018	DATE	RANK	2017	DATE	RANK	2016	DATE	RANK
0.095	3-Oct		0.078	5-Oct	1	0.092	7-Aug		0.094	8-Jul	1	0.083	27-Jun	1
0.086	18-Aug		0.075	6-Oct	2	0.080	7-Jul	1	0.091	30-Aug	2	0.082	3-Jun	2
0.086	2-Oct		0.074	14-Sep	3	0.077	9-Sep	2	0.085	2-Sep	3	0.078	23-Jul	
0.085	4-Sep	1	0.072	14-Aug	4	0.076	10-Apr	3	0.081	2-Aug	4	0.077	4-Jun	3
0.084	15-Oct	2	0.072	25-Sep		0.076	25-Jul		0.081	29-Aug		0.073	29-Jun	4
0.082	21-Aug		0.071	11-Jun		0.075	12-Jun	4	0.077	2-May		0.072	2-Jun	
0.081	8-May	3	0.071	6-Aug		0.075	8-Jul		0.077	6-Jul		0.071	29-Jul	
0.080	4-Oct		0.070	10-Jun		0.075	26-Jul		0.077	7-Jul		0.070	18-Apr	
0.079	7-May	4	0.070	13-Jul		0.073	27-Jul		0.077	1-Aug		0.070	22-Jul	
0.079	18-Sep		0.069	15-Aug		0.073	27-Sep		0.076	26-Aug		0.070	30-Aug	

C. Baseline Design Value 2016-2020

Table H-5 Ozone Baseline Design Value Calculations

4th Highest Adjusted 2016-2020		
2020	0.079	
2019	0.072	
2018	0.075	
D.V.	0.07533	0.07533
2019	0.072	
2018	0.075	
2017	0.081	
D.V.	0.07600	0.07600
2018	0.075	
2017	0.081	
2016	0.073	
D.V.	0.07633	0.07633
Baseline Average		0.07589
RRF	0.934	0.07088
Truncated		0.070

II. July 23, 2016 Weighted Evidence

On July 22, 2016, the Sand Fire started in Los Angeles County. It burned 41,432 acres and was extinguished on August 3, 2016. The 24-Hour concentration of $PM_{2.5}$ was 23 percent higher than the annual mean at the Simi Valley site for the same year.

A. Introduction and Meteorology

Southern California was sitting under a very strong dome of high pressure, at approximately 592 dm (decameters). At the surface, there was a mix of light offshore and onshore winds, which allowed for transport of smoke from the Sand Fire to enter Simi Valley. This is evident with the surface winds and $PM_{2.5}$ concentrations recorded at Simi Valley. The satellite image below also shows the rest of Ventura County under the influence of smoke. The onshore winds transported smoke from other parts of the county into Simi Valley as well.

B. National Weather Service Spot Forecast Discussion

FXUS66 KLOX 231813
AFDLOX
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE LOS ANGELES/OXNARD CA
1113 AM PDT SAT JUL 23, 2016
.SYNOPSIS...
Weakening high pressure aloft will shift to and persist over the four
corners next week. This will lead to one more hot day today with
temperatures cooling to near normal Sunday with little change in
temperatures for much of next week. High pressure across the four
corners area may support an influx of monsoon moisture with
showers and thunderstorms possible at times next week.

.SHORT TERM...(TDY-MON)
An unusual high temperature record was set last night at SBA
airport. A hot lower atmosphere combined with strong sundowner winds
brought record heat to SBA airport before 1 AM PDT (midnight PST).
The temperature soared to 94 degrees around 1243 AM PDT (1143 PM
PST) which broke the record for the calendar day (standard time) of
July 22nd. The record high of 94 exceeded the record of 92 degrees
set in 1960.

Clear skies covered much of the forecast area this morning, except
for patchy low clouds and dense fog early for the SBA County Central
Coast into the Santa Ynez Valley, and areas of smoke from the Sand Fire
which spread out of the Newhall area into the L.A. Basin last night
into this morning due to northerly winds. The smoke layer over L.A.

will spread off to the northeast and out of the area this afternoon.
Otherwise, mostly sunny skies will prevail across the forecast area.
There were lingering gusty northerly winds over the foothills and mtns this
morning, but will turn onshore this afternoon. Strong upper level
high with 500 mb heights around 595 to 596 dm will persist over
SoCal today, helping to build the heat to dangerous levels again for
the valleys and lower mtns of VTU/L.A. Counties. Highs of 100 to 110
can be expected for the most part for these areas, with heat index
values reaching 100 to 105 at times. The Excessive Heat Warning will
continue thru 8 PM this evening for the vlys/lower mtns of VTU/L.A.
Counties.

.FIRE WEATHER... 23/900 AM.
Red flag warning remains in effect for the mountains in Santa
Barbara, Ventura, and Los Angeles Counties, as well as the Santa
Barbara County South Coast in the foothill areas through Midnight
tonight, due to gusty winds, extremely low relative humidity, and
hot temperatures. Widespread humidity's in single digits and
teens can be expected.

Winds around the Sand Fire will linger from the north this
morning, but is expected to turn southwest by 1 PM this afternoon.
Mixing levels are forecast to be up to 12000 feet this afternoon,
with good plume development expected.

C. Air Quality Alert Issued for Santa Clarita

The SCAQMD issued an air quality alert for the Santa Clarita which is near Simi Valley to the East. Periods of smoke influence pushed into Simi Valley in the afternoon identified by the highlighted portion of the above NWS discussion and elevated $PM_{2.5}$ values observed at the station in the afternoon. Ozone values increased in the afternoon corresponding with the increase in observed $PM_{2.5}$ values.

Air quality alert for Santa Clarita, San Gabriel Valley

The Sand Fire burns in the Angeles National Forest Sunday July 24th, 2016 under a Red Flag Warning high high winds.
STUART PALLEY FOR KPCC

KPCC Staff | August 1, 2016

D. July 23, 2016 Raw Data

The Table H-6 below shows the hourly values for: Ozone, $PM_{2.5}$, Wind Direction, and Wind Speed from the Simi Valley monitoring site on July 23, 2016 during the Sand Fire. The 24-Hour concentration of $PM_{2.5}$ was 83 percent higher than the annual mean at the Simi Valley site for the same year. Figure H-13 shows a satellite image of the impacts.

Table H-6 Hourly Data: Simi Valley July 23rd, 2016

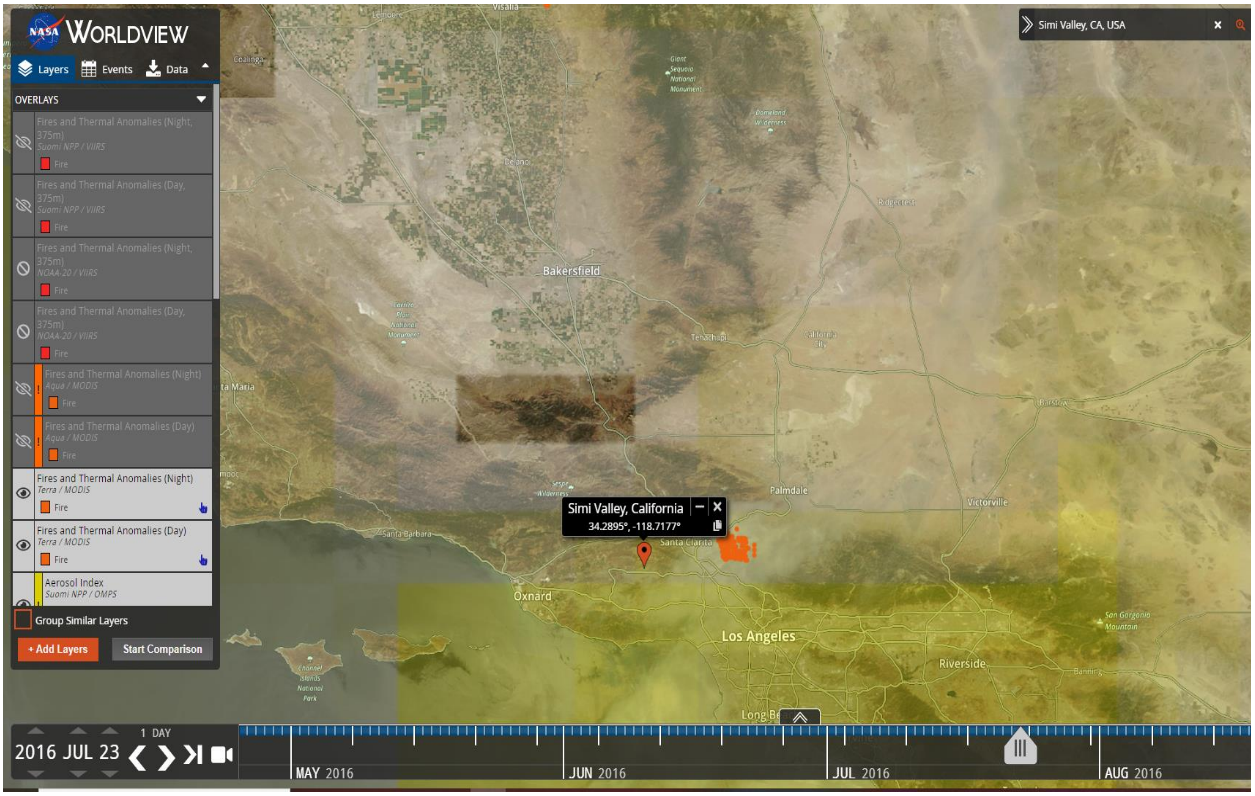
Ventura County Air Pollution Control District

Daily Summary Report - 7/23/2016

Site: Simi Valley-Cochran Street Interval: 001h

	LC25	O3	WD-S	WS-S
Time	UG/M3	PPB	DEG	m/s
00:00	-1.	53.	246.	2.1
01:00	3.	<	284.	2.4
02:00	3.	55.	272.	3.
03:00	2.	47.	233.	1.2
04:00	3.	31.	80.	1.2
05:00	4.	24.	119.	1.1
06:00	5.	27.	133.	.7
07:00	3.	38.	257.	1.5
08:00	2.	47.	276.	1.8
09:00	4.	55.	282.	1.3
10:00	16.	73.	123.	2.
11:00	24.	84.	255.	2.9
12:00	21.	93.	253.	3.8
13:00	19.	88.	269.	4.7
14:00	20.	79.	266.	4.1
15:00	17.	76.	265.	3.9
16:00	10.	73.	218.	3.6
17:00	13.	63.	121.	4.3
18:00	19.	48.	118.	4.7
19:00	16.	41.	117.	4.3
20:00	15.	47.	110.	4.1
21:00	16.	42.	114.	3.8
22:00	21.	39.	118.	2.9
23:00	9.	47.	121.	2.8
Average	11	55	194	2.8
Max	24.	93.	284.	4.7

Figure H-13 Satellite Imagery of Aerosols – MODIS Fire & Thermal Anomalies MOD14 w/ Aerosol Index – July 23, 2016



E. July 23, 2016 Summary

Based on the above discussion, it is clear that July 23, 2016 is a day that was heavily impacted by smoke from a nearby wildfire; as evidenced by the proximity of said fire, wind flow patterns transporting smoke inland to the Simi Valley site, increased $PM_{2.5}$ values out of the norm for the site, and a commensurate increase in ozone values. As such, it should not be included in the calculation of baseline ozone modeling design value from which modeled future design values are calculated.

III. July 25, 2018 Weighted Evidence

In July 2018, many fires were burning throughout California, including the Ferguson Fire and the Cranston Fire. The 24-Hour concentration of $PM_{2.5}$ was 125 percent higher than the annual mean at the Simi Valley site for the same year.

A. Introduction and Meteorology

The Ferguson Fire started on July 13, 2018 in Mariposa County. It burned 96,901 acres and was extinguished on August 18, 2018. The Cranston Fire started on July 25, 2018 in Riverside County. It burned 13,139 acres and was extinguished on August 10, 2018. Southern California was sitting under a very strong dome of high pressure, at approximately 595 dm. At the surface, onshore gradient set up for less late night/early morning offshore flow, resulting in six hours of offshore flow. This allowed for smoke from the Cranston Fire to enter Simi Valley. There were also about three hours late night/early morning of northwesterly flow, allowing for smoke from the Ferguson Fire to enter Simi Valley. This is evident with the surface winds and $PM_{2.5}$ concentrations recorded at Simi Valley.

B. July 25, 2018 Raw Data

Table H-7 below shows the hourly values for: Ozone, $PM_{2.5}$, Wind Direction, and Wind Speed from the Simi Valley monitoring site on July 25, 2018 during multiple California fires. Figure H-14 shows the relationship between PM2.5 and ozone from July 25, 2018, to August 15, 2018. Figure H-15 shows a satellite image of aerosols on July 25, 2018.

Table H-7 Hourly Data: Simi Valley July 25th, 2018

Ventura County Air Pollution Control District

Daily Summary Report - 7/25/2018

Site: Simi Valley-Cochran Street Interval: 001h

	LC25	O3	WD-S	WS-S
Time	UG/M3	PPB	DEG	m/s
00:00	11.	27.	344.	1.1
01:00	14.	<	95.	1.7
02:00	13.	19.	337.	1.4
03:00	17.	11.	292.	1.7
04:00	18.	7.	270.	1.5
05:00	21.	9.	258.	1.
06:00	21.	10.	184.	.6
07:00	18.	24.	233.	.6
08:00	20.	44.	252.	1.4
09:00	15.	65.	272.	2.1
10:00	19.	78.	267.	3.2
11:00	21.	80.	269.	4.1
12:00	17.	76.	261.	4.3
13:00	16.	78.	260.	4.
14:00	20.	78.	275.	4.
15:00	15.	77.	267.	3.6
16:00	14.	74.	265.	3.2
17:00	15.	70.	256.	2.9
18:00	14.	60.	259.	2.6
19:00	17.	48.	257.	1.7
20:00	16.	39.	250.	.7
21:00	17.	29.	90.	1.1
22:00	14.	33.	114.	2.9
23:00	16.	36.	112.	3.4
Average	17	46	239	2.3
Max	21.	80.	344.	4.3

Figure H-14 July 25, 2018 and August 7, 2018 $PM_{2.5}$ and Ozone Relationship

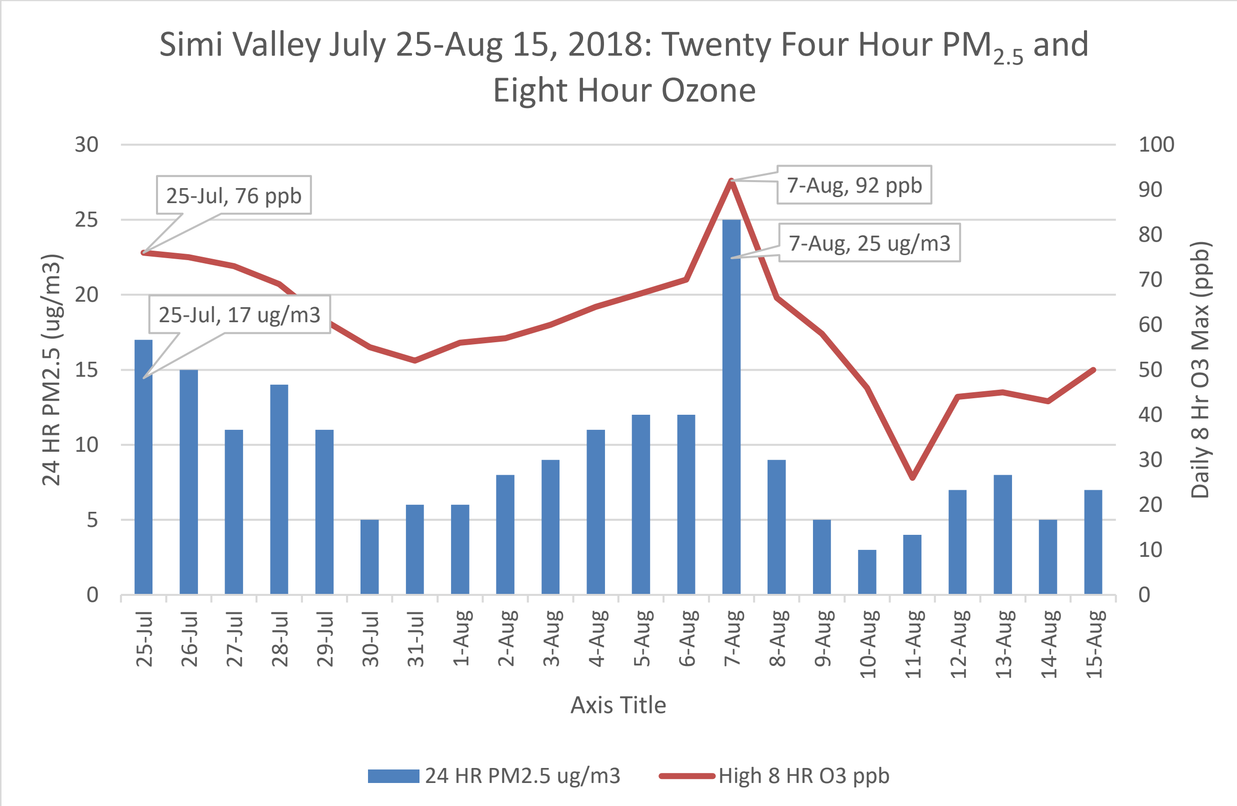
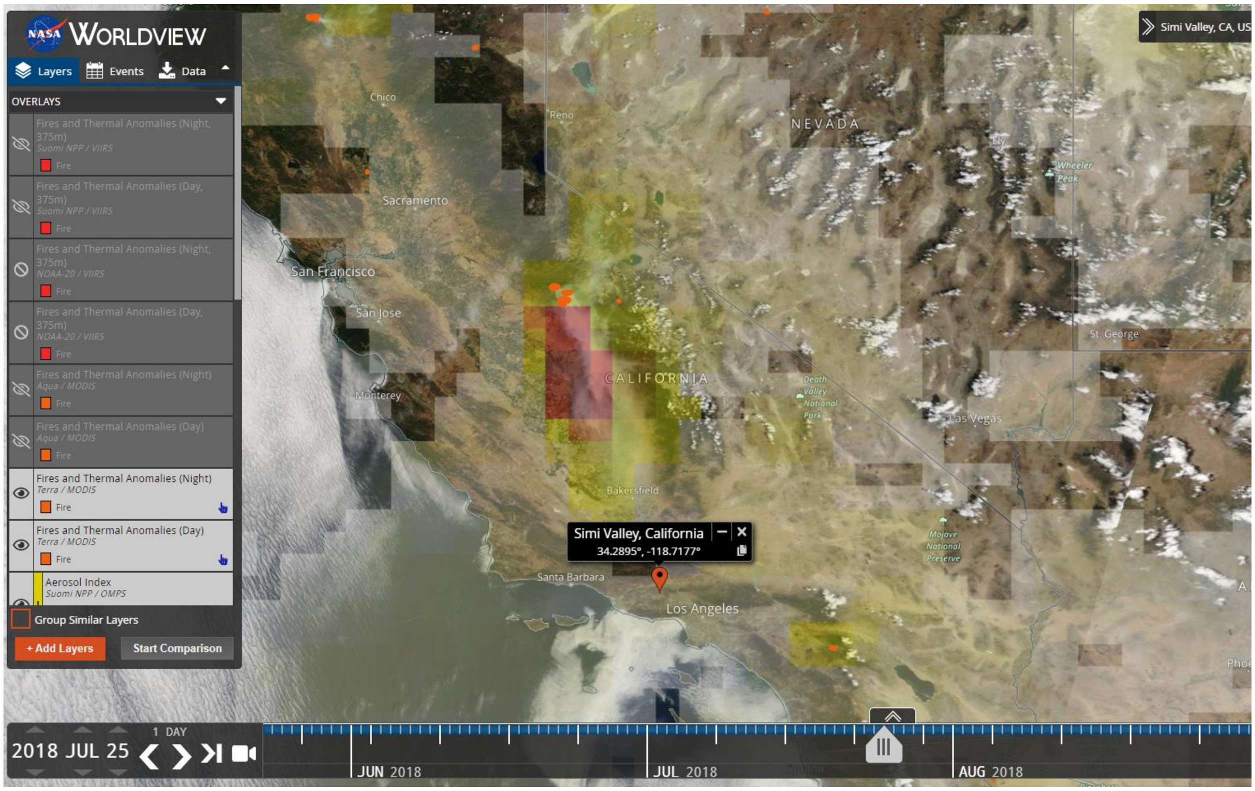


Figure H-15 Satellite Imagery of Aerosols – MODIS Fire & Thermal Anomalies MOD14 w/ Aerosol Index – July 25, 2018



C. July 25, 2018 Summary

Based on the above discussion, it is clear that July 25, 2018 is a day that was heavily impacted by smoke from nearby wildfires; as evidenced by proximity of said fires, wind flow patterns transporting smoke inland to the Simi Valley site, increased $PM_{2.5}$ values out of the norm for the site, and a commensurate increase in ozone values. As such, it should not be included in the calculation of baseline ozone modeling design value from which modeled future design values are calculated.

IV. August 7, 2018 Weighted Evidence

On August 7, 2018, many fires were burning throughout California, including the Mendocino Complex Fire, the Donnell Fire, the Ferguson Fire, and the Cranston Fire as well as others. These fires and the number of acres burned are shown in Table H-8 below.

Table H-8 Summary of Major Active California Wildfires During August 7, 2018

Fire Name	Start Date	Acres Burned	County
Holy	8/6/2018	23,136	Orange, Riverside
Ferguson	7/13/2018	96,901	Mariposa
Donnell	8/1/2018	36,450	Tuolumne
Mendocino Complex	7/27/2018	459,123	Mendocino, Lake, Colusa, Glenn
Cranston	7/25/2018	13,139	Riverside
Total		**628,749**	

A. Introduction and Meteorology

On August 7, 2018, many fires were burning throughout California, including the Mendocino Complex Fire, the Donnell Fire, the Ferguson Fire, and the Cranston Fire. Southern California was sitting under a strong dome of high pressure, at approximately 590 dm. At the surface, a mild offshore wind pattern existed which would allow for late night/early morning offshore winds with a light sea breeze during the afternoon hours. This pattern allowed for smoke to travel through Simi Valley towards the coast during the late night and early morning hours. The afternoon sea breeze allowed for the smoke to return into Simi Valley. This is evident with the surface winds and $PM_{2.5}$ concentrations recorded at Simi Valley.

B. August 7, 2018 Raw Data

Table H-9 shows the hourly values for: Ozone, $PM_{2.5}$, Wind Direction, and Wind Speed from the Simi Valley monitoring site on August 7, 2018 during multiple California fires. Figure H-16 shows a satellite image of aerosols on August 7, 2018.

Table H-9 Hourly Data: Simi Valley August 7th, 2018

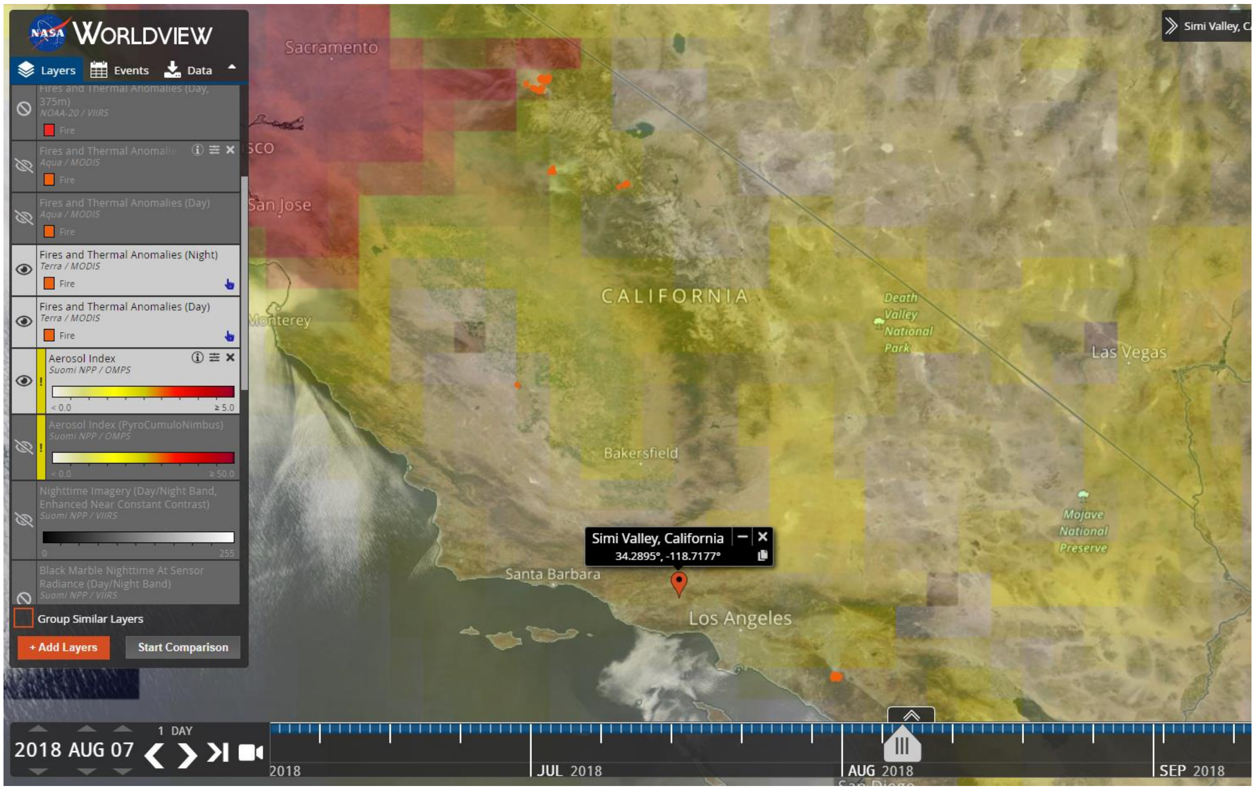
Ventura County Air Pollution Control District

Daily Summary Report - 8/7/2018

Site: Simi Valley-Cochran Street Interval: 001h

	LC25	O3	WD-S	WS-S
Time	UG/M3	PPB	DEG	m/s
00:00	17.	36.	84.	1.
01:00	17.	<	84.	.9
02:00	23.	33.	84.	.9
03:00	25.	28.	76.	.8
04:00	30.	19.	49.	.9
05:00	35.	8.	113.	1.
06:00	28.	13.	102.	.8
07:00	37.	37.	93.	.8
08:00	38.	71.	111.	2.4
09:00	31.	85.	149.	2.9
10:00	33.	94.	268.	3.6
11:00	31.	101.	263.	4.7
12:00	24.	99.	266.	4.5
13:00	24.	97.	268.	5.3
14:00	17.	92.	272.	5.
15:00	26.	88.	275.	3.6
16:00	21.	86.	266.	3.1
17:00	22.	83.	255.	3.6
18:00	20.	78.	256.	2.4
19:00	28.	75.	211.	1.1
20:00	28.	54.	80.	.6
21:00	24.	41.	70.	1.1
22:00	15.	68.	110.	3.5
23:00	13.	66.	114.	4.7
Average	25	63	163	2.5
Max	38.	101.	275.	5.3

Figure H-16 Satellite Imagery of Aerosols - MODIS Fire & Thermal Anomalies MOD14 w/ Aerosol Index – August 7, 2018



C. August 7, 2018 Summary

Based on the above discussion, it is clear that August 7, 2018 is a day that was heavily impacted by smoke from nearby wildfires; as evidenced by proximity and sheer number of said fires and their acreage, wind flow patterns transporting smoke offshore with a return onshore via a sea breeze allowing it to return to the Simi Valley site, increased $PM_{2.5}$ values well out of the norm for the site, and a commensurate increase in ozone values. As such, it should not be included in the calculation of baseline ozone modeling design value from which modeled future design values are calculated.

Summary

This WOE demonstration evaluated ambient air quality and emission trends to complement the regional photochemical modeling analyses conducted to evaluate Ventura County's progress toward meeting the 2026 attainment date. Control measures implemented in the County through federal, State, and local programs have led to a substantial decline in emissions of ozone precursors and a substantial improvement in ozone air quality. Between 2000 and 2021, total NOx emissions in Ventura County declined by nearly 50 percent and total ROG emissions declined by 45 percent. Moreover, between 2000 and 2020, the number of exceedance days in the County declined by nearly 69 percent and the design value decreased by over 28 percent, from 0.105 ppm to 0.075 ppm. In 2020, four out of five monitoring sites in the County met the 2015 ozone standard.

Ventura County is currently classified as a serious nonattainment area, for the 2015 8-hour Ozone Standard of 0.070 ppm, with a 2026 attainment date. Downward trends among nearly all emission categories, as well as historical ozone metrics trending downward, and wildfire impact analysis which when combined with regional photochemical modeling results, conducted by South Coast AQMD, produce adjusted design value projections indicating that the area is on track to attain the 2015 ozone standard by 2026.

References

U.S. EPA *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze*, December 2014.

Appendix H Attachment 1: Submitted Exceptional Event Analysis

The following discussion, data, tables, and figures are excerpted from the "Exceptional Events Demonstration for Ozone Exceedances: Southern California 2020 Wildfire Events" submittal sent to U.S. EPA in support of removing five wildfire impacted days in Ventura County. These exceptional event dates were subsequently approved by the U.S. EPA on May 4, 2022. Relevant Table, Figure, and other numbering have been kept for reference. Original report may be accessed on the CARB website at *https://ww2.arb.ca.gov/our-work/programs/state-and-federal-area-designations/exceptional-events* for additional detail.

I. Overview/Introduction

C. Actions Requested

Although a significant number of ozone nonattainment areas were impacted by the historic 2020 wildfires, not all areas have upcoming regulatory determinations applicable under the revised Exceptional Events Rule (EER). The California Air Resources Board (CARB) is submitting this Exceptional Event demonstration to U.S. EPA for days in the summer and fall of 2020 that impacted the entirety of the ozone nonattainment area of Ventura County. In accordance with the U.S. EPA interpretation of the Exceptional Event Rule only the dates necessary to reach attainment are submitted in this demonstration, although other days could also qualify. The submitted days will affect the upcoming attainment year determinations for the pertinent 2008 and 2015 ozone NAAQS for areas which have otherwise met the level of the standards (Figure I-1, Table I-1). The specific exceedances of the standards requested for concurrence at monitors in Ventura County are listed in Table I-2.

Figure I-1: 8-hour Ozone Design Values at Simi Valley

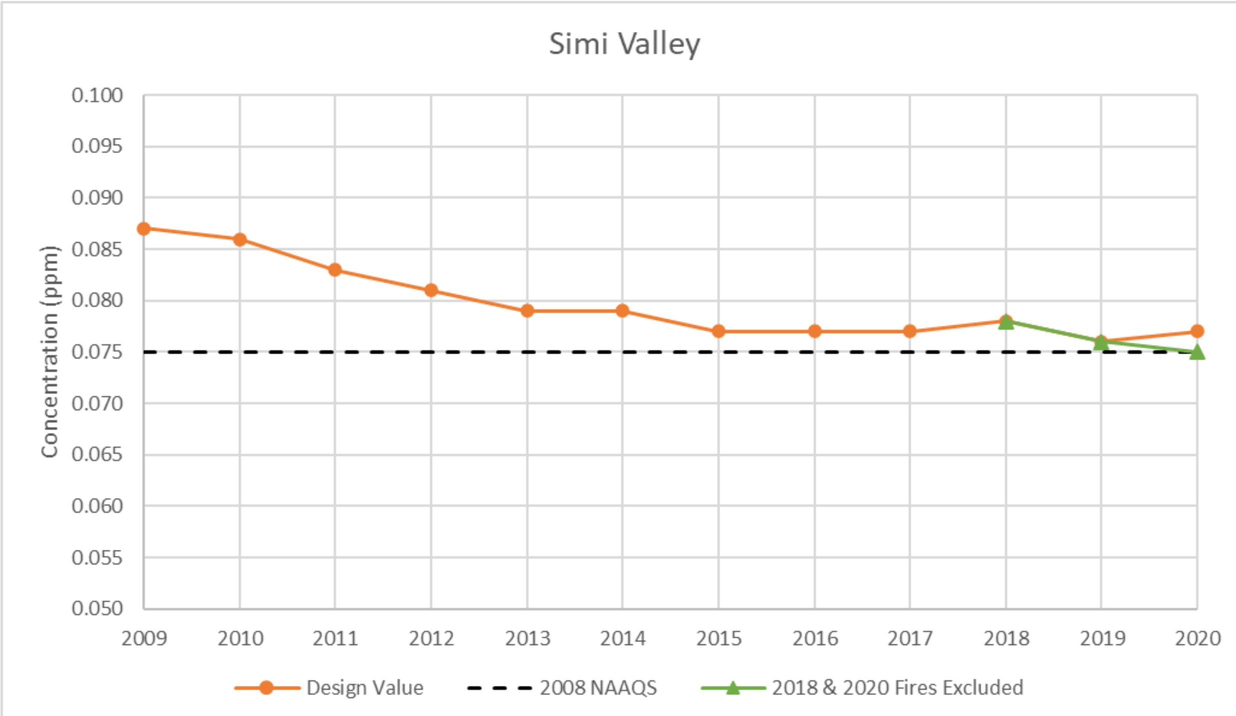


Table I-1: 8-hour Ozone Design Values with and without U.S. EPA Concurrence (2018 and 2020 Events)

Design Value without Concurrence of 2018 nor 2020 Demonstrations

Site	2018	2019	2020
Simi Valley*	0.078	0.076	0.077

Design Values with Concurrence of both 2018 and 2020 Demonstrations

Site	2018	2019	2020
Simi Valley*	0.078	0.076	0.075

* 8-hour design value for 2008 (0.075 ppm) NAAQS

Table I-2: Summary of 2020 8-Hour Ozone Exceedances Influenced by Wildland Fires

Air District	Monitoring Site	AQS ID	POC	Date	8-Hour Concentration (ppm)
Ventura	Simi Valley	06-111-2002	1	8/18/2020	0.086
Ventura	Simi Valley	06-111-2002	1	8/21/2020	0.082
Ventura	Simi Valley	06-111-2002	1	10/2/2020	0.086
Ventura	Simi Valley	06-111-2002	1	10/3/2020	0.095
Ventura	Simi Valley	06-111-2002	1	10/4/2020	0.080

II. Background

A. Characteristics of Non-Event Ozone Formation

Ground-level ozone is formed by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (ROG or VOC) in the presence of heat and sunlight. A more detailed discussion for each of the areas is provided below.

1. Ventura County (Simi Valley)

Based on historic, non-event ozone monitoring data for the previous 5 years, below are the characteristics of ozone levels throughout the year in Simi Valley.

- January through March: Generally lowest ozone concentrations during the year because of cooler temperatures, shorter days, and unsettled weather patterns.
- April through June: Transitional period between spring and summer when elevated 8-hour ozone concentrations are unusual but can occur at times when meteorological conditions are favorable for ozone formation, especially when a Pacific ridge of high pressure settles in the area.
- June through August: Typically, highest ozone concentrations caused by a ridge of high pressure over the southwestern United States influencing the area. Smoke from an early wildfire season can impact ozone concentrations as well.
- September through October: Ozone concentrations typically begin to decrease as temperatures and solar radiation decrease. Santa Ana wind events (offshore winds) begin to dominate the region, which leads to elevated ozone levels with the return of onshore winds (post Santa Ana's).
- November through December: Ozone concentrations are typically low during these months because of cooler temperatures, shorter days, and unsettled weather patterns.

The highest ozone values at Simi Valley occur during the ozone season from April through October, with exceedances during the remainder of the year extremely rare. Ozone concentrations at Simi Valley typically peak midday (Figure II-1) and are lowest in the mid-morning. Daily calibration checks frequently occurred in the overnight hours during 2015-2019, so data for hour

1 was excluded from the calculation of percentiles. 1-hour ozone concentrations for the event days (Figure II-2) indicate that ozone concentrations were significantly above the 95 percentile during peak hours.

Figure II-1: Typical April-October 1-Hour Ozone Diurnal Pattern at Simi Valley (2015-2019)

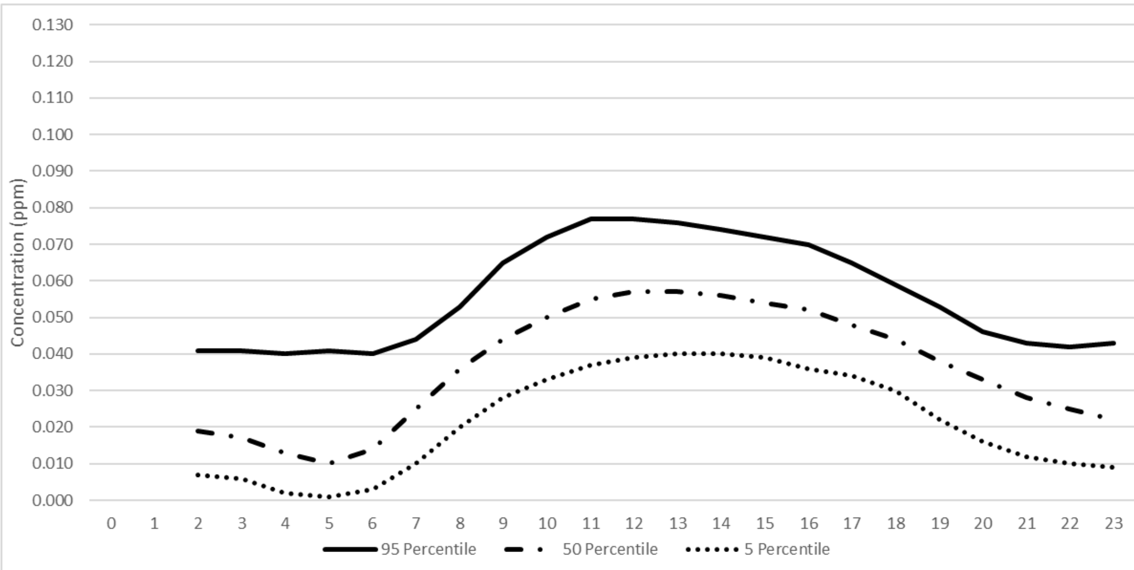
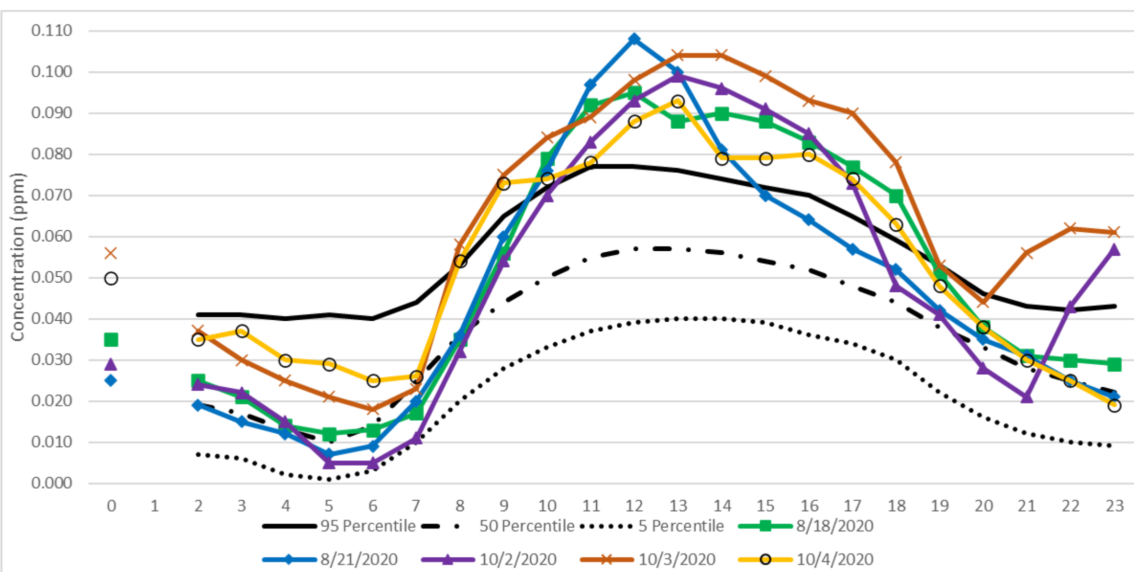


Figure II-2: 1-Hour Ozone Concentrations during Event Days compared to May-November 2015-2019 Percentiles at Simi Valley



B. Characteristics of Event Ozone Formation

Although wildfires occur in California every year, the number of wildfires and the amount of acreage burned has increased substantially, from a 5-year average of less than 5,000 fires burning 200,000 acres as of 2017,[1] to the prior record 7,948 incidents and 1,975,086 acres burned in 2018,[2] to the new record 9,917 incidents and 4,257,863 acres burned in 2020.[3] The impact of these wildfires on air quality has been dramatic. Smoke from large fires has caused high concentrations of PM and ozone, especially in the western United States.[4] Wildfires generate large amount of ozone precursors including NOx and ROG which can contribute to elevated ozone levels in California. However, there are large variations in the amount of emissions (depending on the fuel type and combustion temperature), plume heights, smoke density, and meteorological conditions during different wildfires, and all these factors can significantly impact subsequent ozone production.[5] In addition, the amount of ozone within a smoke plume also varies with distance from the fire.[6] Due to the titration by NO from fire emissions and the blocking of sunlight by PM emissions, which hinders photochemical reactions, ozone concentrations near active fires are sometimes even lower relative to baseline concentrations. As the ozone precursors transport downwind along with the other air pollutants such as PM, ozone is produced within the smoke plume which could result in ozone exceedances at the surface in downwind areas. Research studies found that distant wildfires can raise ground-level ozone concentrations to unhealthy levels even at large distances from the fire location.[7]

III. Narrative Conceptual Model

The Narrative Conceptual Model describes the events causing the exceedances or violations seen at the monitor and includes a discussion of how the events led to concentrations above the NAAQS during August 18 to 21 and September 30 to October 4 of 2020.

A. Wildfire Information

2020 was another extreme year for wildfires, with numerous wildfires active during the time of the exceedances discussed in this demonstration (Figure III-1, Table III-1); although not all wildfires impacted each monitor on any given day. Hot and dry conditions at the surface combined with mid-level moisture resulted in elevated instability during parts of August and

[1] CalFire, *2017 Statistics and Events (5 year average)*, last accessed 8/20/21. *https://www.fire.ca.gov/stats-events/*
[2] CalFire, 2018 Incident Archive, last accessed 11/17/21. *https://www.fire.ca.gov/incidents/2018/*
[3] CalFire, 2020 Statistics and Events, last accessed 11/17/21. *https://www.fire.ca.gov/stats-events/*
[4] Gong et al., 2017; Laing and Jaffe, 2019; Mass and Ovens, 2019; Jaffe et al., 2020
[5] Jaffe and Wigder, 2012; Faloona et al., 2020
[6] Faloona et al., 2020
[7] Pfister et al., 2008

early September. The ensuing thunderstorms ignited multiple wildfires, resulting in smoke that accumulated throughout California. The accumulating smoke layers made identification of the impact of individual wildfires difficult. The majority of these fires, and all of the megafires, occurred on wildland or in the urban/wildland interface.

Figure III-1: Impacted Monitors and Active Major Wildfires, August 18-October 4, 2020

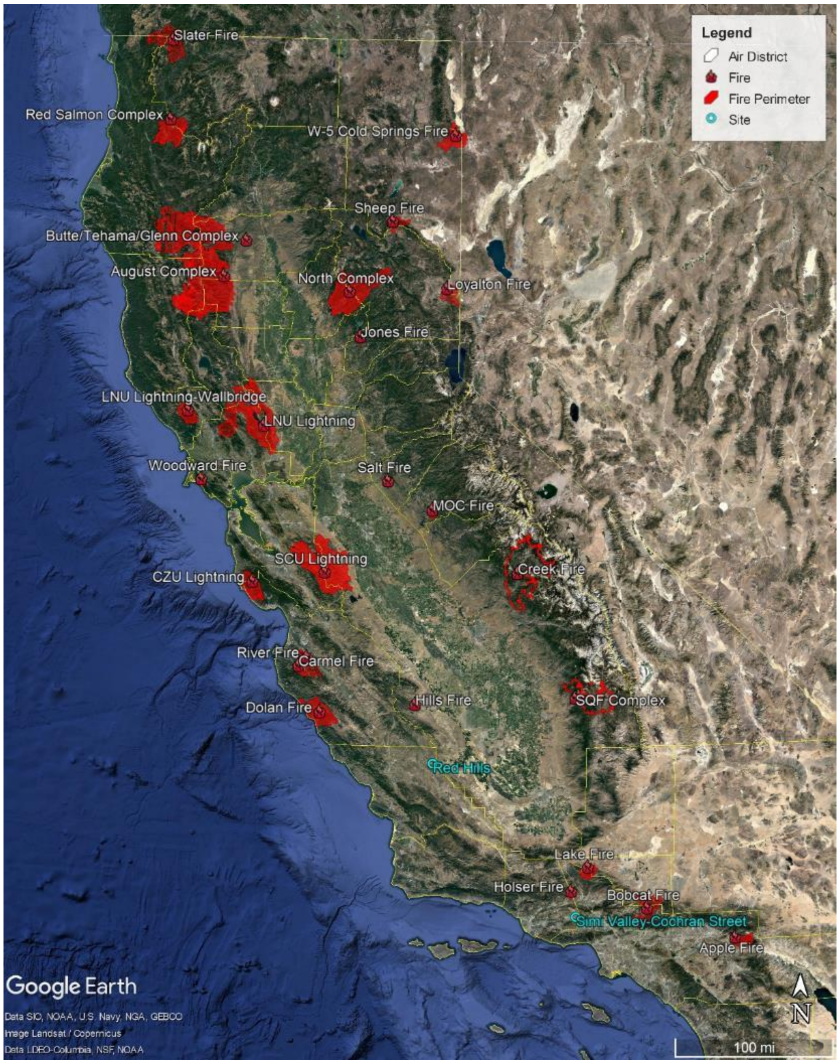


Table III-1: Major wildfires active during August 18-October 4, 2020 events

Fire	Source	Start Date	Containment	Latitude	Longitude	Total Acres
Red Salmon Complex	Lightning	7/27/2020	11/23/2020	41.16800	-123.40700	144,698
Lake Fire	Lightning	8/12/2020	9/28/2020	34.67900	-118.45200	31,089
Hills Fire	Lightning	8/15/2020	8/24/2020	36.09876	-120.42734	2,121

Fire	Source	Start Date	Containment	Latitude	Longitude	Total Acres
CZU Lightning Complex (Including Warnella Fire)	Lightning	8/16/2020	9/22/2020	37.17162	-122.22275	86,509
August Complex (includes Doe Fire)	Lightning	8/16/2020	11/11/2020	39.77600	-122.67300	1,032,648
River Fire	Lightning	8/16/2020	9/4/2020	36.60239	-121.62161	48,088
LNU Lightning Complex (includes Hennessey, Gamble, 15-10, Spanish, Markley, 13-4, 11-16, Walbridge)	Lightning	8/17/2020	10/2/2020	38.48193	-122.14864	363,220
Holser Fire	Investigating	8/17/2020	9/6/2020	34.43876	-118.75897	3,000
North Complex Fire	Lightning	8/18/2020	12/3/2020	39.69072	-121.22718	318,935
Salt Fire	Investigating	8/18/2020	8/24/2020	38.02792	-120.76326	1,789
Woodward Fire	Investigating	8/18/2020	10/2/2020	38.01809	-122.83670	4,929
Carmel Fire	Vehicle	8/18/2020	9/4/2020	36.44630	-121.68181	6,905
SCU Lightning Complex	Lightning	8/18/2020	10/1/2020	37.43944	-121.30435	396,624
Dolan Fire	Unknown	8/19/2020	12/31/2020	36.12300	-121.60200	124,924
SQF Complex Fire (Includes Castle Fire and Shotgun Fire)	Lightning	8/19/2020	1/6/2021	36.25500	-118.49700	174,178
Creek Fire	Investigating	9/4/2020	12/24/2020	37.19147	-119.26118	379,895
Bobcat Fire	Investigating	9/6/2020	11/8/2020	39.24465	-117.96484	115,796

The August Complex[8] fire started as 38 separate fires, most of which were small (Figures/Tables removed for brevity). The four main fires were the Doe, Tatham, Glade and Hull fires, which merged by August 30. The fires began from lightning strikes on August 16 and 17, 2020 and actively burned in Mendocino, Shasta-Trinity, and Six Rivers National Forests. The fires burned 1,032,648 acres, 935 structures, and caused one death before full containment on November 15, 2020. The August Complex fire is the largest fire complex in recorded California history[9].

The Butte/Tehama/Glenn Lightning Complex[10] fire included the Elkhorn and Hopkins fires and began on August 19, 2020 due to lighting and actively burned in Tehama and Glenn counties. By September 9, the Elkhorn and Hopkins fires had merged with the August Complex, forming the North Zone of the August Complex, and dropping the Butte/Tehama/Glenn Fire from 66,959 acres to 19,069 acres. The Butte/Tehama/Glenn Lightning Complex was fully contained on October 9, 2020.

The LNU Lightning Complex[11] fire (Figures/Tables removed for brevity) started as many small separate fires. The main fires were the Hennessey fire, which merged with the Gamble Green, Markley, Spanish, and Morgan fires burning 305,651 acres, as well as the Walbridge, and Meyers fires. These fires began due to lightning on August 16 and 17, 2020 and actively burned in six counties: Solano, Napa, Sonoma, Yolo, Lake, and Colusa. The fires burned on the hills surrounding several large cities including Napa, Fairfield, and Vacaville and burned 363,220 acres, 1,491 structures, and lead to six confirmed fatalities before full containment on October 2, 2020. The LNU lighting complex is the 6th largest California wildfire in recorded history[12].

CZU Lightning Complex[13] fire (Figures/Tables removed for brevity) started as many small fires including the Warnella fire and three fires that would become the northern edge of the CZU complex. The Northern edge fires merged, a few days after they began, due to changing wind patterns and quickly grew to over 40,000 acres. These fires began due to a lightning strike on August 16, 2020 and actively burned in Butano and Big Basin Redwoods state parks in San Mateo and Santa Cruz counties. The fires burned 86,509 acres, destroyed 1,490 structures, damaged an

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[8]August Complex, accessed 10/11/2021. *https://www.fire.ca.gov/incidents/2020/8/16/august-complex-includes-doe-fire/*

[9]Top 20 Largest California Wildfires, accessed 10/11/2021. *https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf*

[10] Butte/Tehama/Glenn Lightning Complex. *https://www.fire.ca.gov/incidents/2020/8/19/butte-tehama-glenn-lightning-complex-tehama-glenn-zone/*

[11] Solano County 2020 LN Lightning Complex Fire. Accessed 10/11/2021. *https://www.solanocounty.com/depts/rm/lnu_fire_cleanup_n_rebuilding/default.asp*

[12] *https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf*

[13] CZU Lightning Complex (Including Warnella Fire). *https://www.fire.ca.gov/incidents/2020/8/16/czu-lightning-complex-including-warnella-fire/*

additional 140 structures, and lead to one confirmed fatality before being fully contained on September 22, 2020.

River Fire[14] (Figures/Tables removed for brevity) began due to a lightning strike on August 16, 2020 and actively burned in a wildland urban interface zone within Monterey County. The fire burned 48,088 acres, destroyed 30 structures, and damaged 13 before full containment on September 4, 2020.

Carmel Fire[15] (Figures/Tables removed for brevity) began on August 18, 2020 due to a vehicle malfunction and actively burned in a wildland urban interface zone within Monterey County. The fire burned 6,905 acres, destroyed 73 structures, and damaged 7 before full containment on September 4, 2020.

SCU Lightning Complex[16] (Figures/Tables removed for brevity) began as the Deer, Canyon, and Santa Clara fires, by August 26 the Deer fire was fully contained and the Canyon and Santa Clara fires merged. These fires began from lightning strikes on August 18, 2020 and actively burned in the Diablo mountain range in Santa Clara, Alameda, Contra Costa, San Joaquín, and Stanislaus counties. The fires burned 396,624 acres, destroyed 222 structures, and damaged 26 before full containment on October 1, 2020. The SCU Lighting complex is the 4th largest California wildfire in recorded history[17].

Creek Fire[18] (Figures/Tables removed for brevity) began on September 4, 2020 with the source currently under investigation. Within the first four days of starting the Creek Fire grew anywhere between 20,000 to 50,000 acres due to the strong winds in the area. The fire activity burned in the Sierra National Forest in Fresno and Madera counties, burning 379,895 acres and destroying 853 structures, including many homes in Big Creek, before full containment on December 24, 2020. The creek fire is the 5th largest California wildfire and the 2nd largest single California wildfire in recorded history[19].

North Complex Fire[20] (Figures/Tables removed for brevity) began during a lightning strike on August 17, 2020 and actively burned in Plumas National Forest in Plumas, Butte, and Yuba counties. By September 5, 2020 all the individual fires had been contained except for the Claremont and Bear fires. These two fires merged on September 5, 2020 and due to strong winds rapidly grew spreading to the Southwest and leveling the towns of Berry Creek and Feather Falls. The fires burned 318,935 acres, damaging or destroying 2,352 structures, and causing 15 fatalities

[14] River Fire. *https://www.fire.ca.gov/incidents/2020/8/16/river-fire/*
[15] Carmel Fire. *https://www.fire.ca.gov/incidents/2020/8/18/carmel-fire/*
[16] SCU Lightning Complex. *https://www.fire.ca.gov/incidents/2020/8/18/scu-lightning-complex/*
[17] *https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf*
[18] Creek Fire. *https://www.fire.ca.gov/incidents/2020/9/4/creek-fire/*
[19] *https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf*
[20] North Complex Fire. *https://inciweb.nwcg.gov/incident/6997/*

before full containment on December 3, 2020. The North Complex Fire is the 7th largest California wildfire in recorded history[21].

Woodward Fire[22] (Figures/Tables removed for brevity) began during a lightning strike on August 17, 2020 and was initially named the 4-5 Fire and on August 18, 2020 a second fire initially named the 4-6 Fire was found nearby, these were later renamed to the Woodward Fire[23]. These fires quickly grew due to winds and actively burned in the Point Reyes National Seashore. The fires burned 4,929 before full containment on October 1, 2020.

SQF Complex Fire[24] (Figures/Tables removed for brevity) began as the Castle and Shotgun fires during a lightning strike on August 19, 2020. The Castle fire actively burned in Sequoia National Forest and Giant Sequoia National Monument, Inyo National Forest, Sequoia National Park, lands managed by the Bureau of Land Management, State, County, and private lands with the Shotgun fire actively burning in the Golden Trout Wilderness and Sequoia National Forest. The fires burned 174,178 acres and destroyed 228 structures before full containment on January 5, 2021.

Hills Fire[25] (Figures/Tables removed for brevity) began on August 15, 2020 during a lightning strike. The fire actively burned in the wildland urban interface zone within Fresno County. The Hills fire burned 2,121 acres and caused one fatality before being fully contained on August 24, 2020.

Holser Fire[26] (Figures/Tables removed for brevity) began on August 17, 2020 as a bush fire with the source of the fire still unknown. The fire actively burned in Piru Canyon in Ventura County, approximately 12 miles north of the Simi Valley monitor, and burned 3,000 acres before being fully contained on September 9, 2020.

Lake Fire[27] (Figures/Tables removed for brevity) began on August 12, 2020 during a lightning strike. The fire actively burned in the Angeles National Forest in Los Angeles County. The Lake Fire burned 31,089 acres, destroyed 33 structures, damaged 6 structures, and destroyed 21 outbuildings before being fully contained on September 29, 2020.

Bobcat Fire[28] (Figures/Tables removed for brevity) began on September 6, 2020 with the source of the fire still unknown. The fire actively burned chaparral, brush, and timber near Cogswell Dam

[21] *https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf*
[22] Woodward Fire. *https://www.nps.gov/pore/learn/management/firemanagement_woodwardfire.htm*
[23] National Park Service. Point Reyes – National Seashore California. *https://www.nps.gov/pore/learn/management/firemanagement_woodwardfire.htm*
[24] SQF Complex Fire. *https://inciweb.nwcg.gov/incident/7048/*
[25] Cal Fire – Hills Fire. *https://www.fire.ca.gov/incidents/2020/8/15/hills-fire/*
[26] Cal Fire – Holser Fire. *https://www.fire.ca.gov/incidents/2020/8/17/holser-fire/*
[27] Cal Fire – Lake Fire. *https://fire.ca.gov/incidents/2020/8/12/lake-fire/*
[28] Inciweb – Bobcat Fire. *https://inciweb.nwcg.gov/incident/7152/*

in Angeles National Forest in Los Angeles County. The Bobcat Fire burned 115,796 acres, destroyed 171 structures before being last updated at 92% contained on October 19, 2020.

Dolan Fire[29] (Figures/Tables removed for brevity) began on August 19, 2020 with the source of the fire still unknown. The fire actively burned in state parks and animal sanctuaries in Monterey County and burned 124,924 acres before being fully contained on December 31, 2020.

Salt Fire[30] (Figures/Tables removed for brevity) began on August 18, 2020 due to a source that is under investigation and actively burned near the Salt Springs Valley Reservoir in a wildland urban interface zone within Calaveras County. The fire burned 1,789 acres before full containment on August 24, 2020.

Red Salmon Complex[31] (Figures/Tables removed for brevity) began during a lightning strike on July 27, 2020 and was comprised of the Red and Salmon fires. These fires actively burned in Six Rivers National Forest, Shasta Trinity National Forest, Klamath National Forest, and Hoopa Valley Reservation. The fires burned 144,698 acres before full containment on November 17, 2020.

These fires occurred in areas that meet the definition of wildland which is "an area in which human activity and development is essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered." Wildlands can include forestland, shrubland, grassland, and wetlands and includes lands that are predominantly wildland, such as land in the wildland-urban interface, as specified in the preamble of the Exceptional Events Rule.[32] (Figures removed for brevity) indicate these areas with the fire perimeters outlined in red.

B. Summary of Event

A series of large wildfires were ignited across California from mid-August to early October 2020. The majority of these fires occurred in the northern and central portions of the State, including the August Complex, which burned 1,032,648 acres and resulted in one fatality; the SCU Lightning Complex, which burned 396,624 acres; and the North Complex Fire, which burned 318,935 acres and resulted in fifteen fatalities. On August 22, 2020, a national disaster was first declared for the State of California,[33] due to the extensive wildfires burning there.[34]

The following section provides evidence of the impact of these exceptional events on the Simi Valley ozone monitors from August 18 to August 21, and September 30 to October 4, 2020.

[29] Dolan Fire. *https://inciweb.nwcg.gov/incident/7018/*
[30] Salt Fire. *https://www.fire.ca.gov/incidents/2020/8/18/salt-fire/*
[31] Red Salmon Complex - *https://inciweb.nwcg.gov/incident/6891/*
[32] 81 FR 68248
[33] 85 FR 53428, *Presidential Declaration of a Major Disaster for the State of California*, dated 8/22/20
[34] FEMA, *California Wildfires and High Winds, DR-4558-CA.* *https://www.fema.gov/disaster/4558*

Presented as phases of the event, the evidence shows the source wildfires that collectively contributed emissions impacting these sites in the South Central Coast Air Basin.

NOAA's HYSPLIT[35] model was used to determine simple back-trajectories showing the path that an air parcel took for a specified period of time (here, 36 hours), starting at each monitor at times of peak concentrations on each day. Three height levels (red: 100 meters (m); blue: 500m; green: 1000m) were used to indicate transport near the surface and in the upper atmosphere.

The HYSPLIT model was also used to indicate how emissions from the wildfires were transported toward the monitor (forward trajectory). Trajectories in this section are shown from the fire(s) estimated to have the highest contribution. The trajectories were initiated from each major fire at 12z (04PST). These model runs provide insight into the most likely center path a parcel of air (and smoke) from each fire would take in the 36 hours after the 12z start time. This provides a simplified understanding of smoke transport from a fire across the region, connecting these wildfires with smoke seen in satellite imagery, and indicating potential correlations at a site through analysis of parcel transport timing and backwards trajectories when they overlap. These forward trajectories, overlaid on satellite images from the SUOMI NPP / VIIRS[36] platform using Google Earth, provide a visual analysis of the smoke emitting from the fires and impacting the monitors.

Google Earth was used as a platform to combine the HYSPLIT back-trajectories and the NOAA Hazard and Mapping System (HMS) Fire and Smoke Product[37] smoke layers and fire locations. The back-trajectories for each monitor shown in the following sections traced back from the time of the maximum ozone concentration in the exceeding 8-hour period. Since different monitors will have maximum concentrations at different times, a table of the monitoring sites presented in the back-trajectory figures is included, indicating in both PST and UTC, the hours each trajectory began. Back-trajectories from the hour of the maximum ozone concentration in the exceeding 8-hour period for all exceptional event dates that are requested in this document are included in Appendix D.

The HYSPLIT trajectory model results, as well as Suomi satellite layers from the NASA Worldview application, and HMS smoke plume analyses, show impacts from multiple California wildfires dispersed throughout the northern and central portions of the State. Although the model results can show potential influence from specific fires, they do not always show the cumulative effect of continuing wildfire emissions that impacted California from August to early November.

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[35] HYbrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT)

[36] NASA Worldview, *https://worldview.earthdata.nasa.gov/. Last accessed 11/16/21*

[37] NOAA Satellite Smoke Text Product, *https://www.ssd.noaa.gov/PS/FIRE/smoke.html. Last accessed 11/17/21*

1. August 18-21, 2020

Strong 500 mb high pressure centered over the Great Basin area of Nevada and Utah and southwestern United States (Figure removed for brevity) provided for very hot temperatures across California, including the inland portions of Ventura County. Some monsoonal moisture moved into interior California with strong atmospheric dynamics favorable for convection, generated thunderstorms that initiated several wildfires in very dry vegetation during August 16-18. These wildfires rapidly spread and grew due to strong winds and low surface humidity across much of the region, causing increased smoke coverage and thickness while impacting surface locations across the State. Upper-level low pressure off the coast of Canada slowly pushes into the northwestern United States with a series of weak troughs moving onshore. This gradually erodes high pressure influence in the northwest United States but leaves southern California hot with above normal temperatures. Near Simi Valley, the Holser Fire (started August 12) and Lake Fire (started August 17) both rapidly grew in size by over 3,000 acres each during the evening August 17 through August 18, eschewing smoke in and near Ventura County and impacting Simi Valley on August 18. The Lake Fire contributed to smoke at Simi Valley when the wind shifted during morning August 18 and brought smoke southward from the Lake Fire, which mixed down into the valley during early August 18, as indicated by trajectory (Figure removed for brevity).

2. September 30-October 4, 2020

Strong 500mb high pressure influence extended from Mexico to the Canadian border, which provided for hot and dry surface conditions across much of the western United States, including California, as shown in (Figure removed for brevity). These weather conditions promoted high ozone concentrations which were further elevated by transported smoke emissions with associated ozone and precursors from multiple wildfires across the state. During late September, conditions were also favorable for Santa Ana winds which stimulated the spread of any nearby wildfires, further increased wildfire emissions, and broadly spread wildfire smoke across California. The National Weather Service advised of wildfire smoke and haze which impacted the forecast area, including Simi Valley, during this period (NWS Area Forecast Discussions in Appendix C). Along the south-central California coastline, a weak prevailing offshore/onshore diurnal pattern set up and provided for light offshore breezes that pulled air from the San Joaquin Valley and South Coast through Ventura County with warm overnight temperatures during the night. Then during the day, light onshore breezes brought this air back onshore causing a buildup of pollutants near the coast.

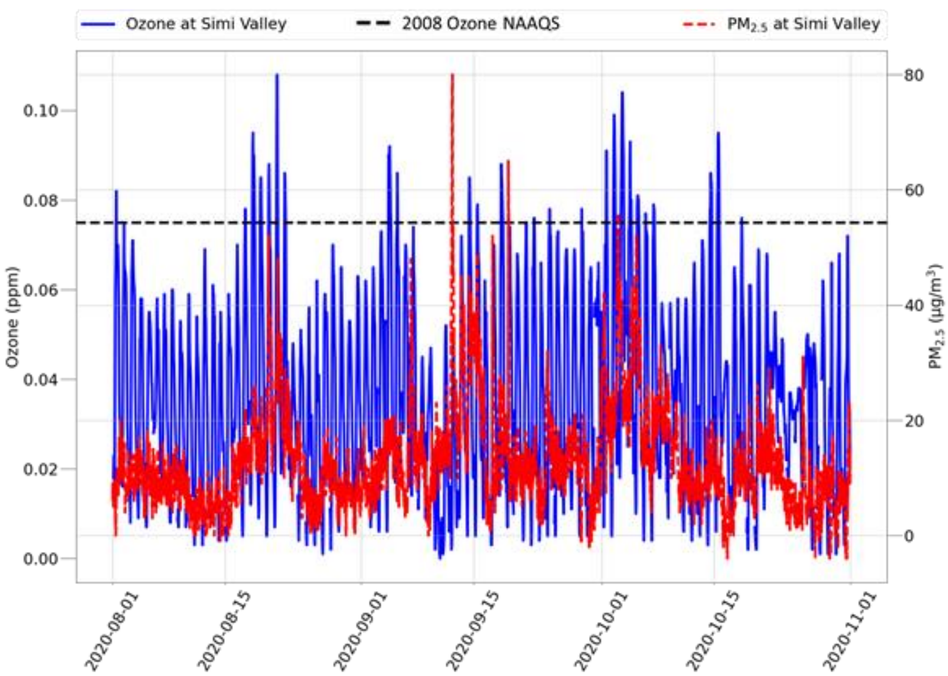
C. Event Related Concentrations and Long-Term Trends

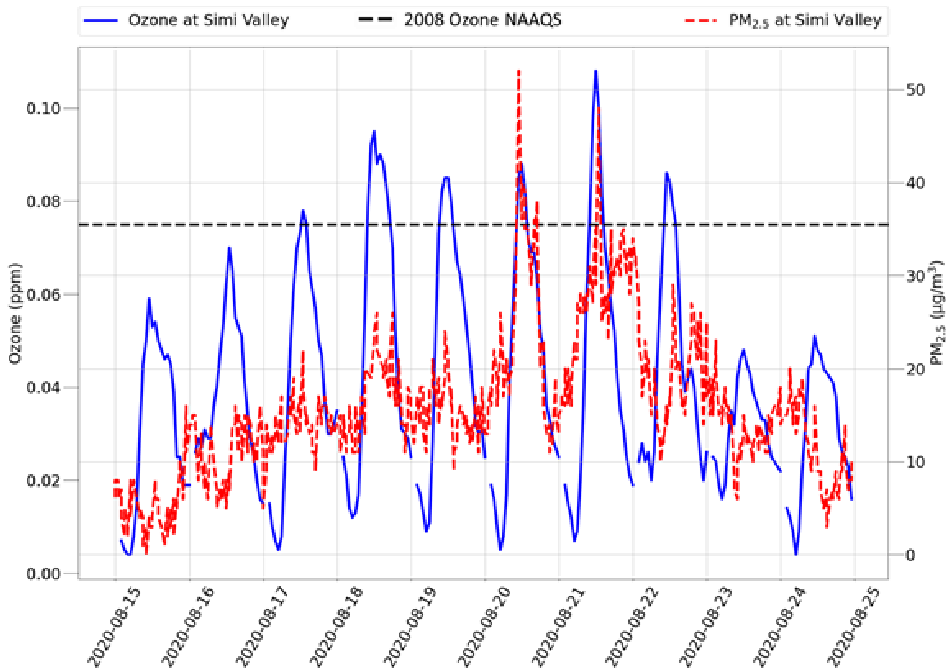
2. Ventura County (Simi Valley)

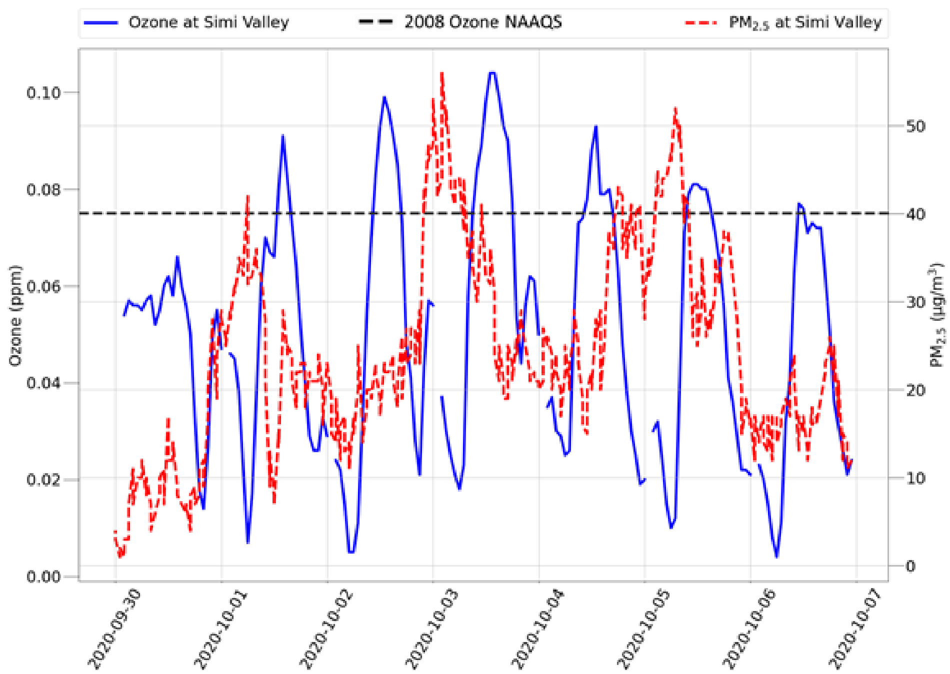
Multiple wildfires impacted the City of Simi Valley during the periods of concern, where winds generally transported wildfire smoke and ozone precursors from the Lake, Holser, CZU Lightning Complex, River, LNU Lightning Complex, Salt, Woodward, Carmel, SCU Lightning Complex, Dolan, Bobcat, SQF Complex, and Creek wildfires in California. These wildfire emissions caused elevated ozone concentrations at the Simi Valley monitoring site. Additionally, the smoke from the August Complex, Butte/Tehama/Glenn Complex, Red Salmon, North Complex, and Jones fires from northern California may have been transported to the area and contributed to ozone concentrations during some days. Elevated $PM_{2.5}$ concentrations and associated timing support the presence of wildfire smoke in the City of Simi Valley.

Figure III-2 shows the ozone and $PM_{2.5}$ concentration encompassing August, September, and October (top), a zoomed in range of August 15 to August 25 (center) and a zoomed in range of September 30 to October 7, 2020 (bottom), which includes the requested exceptional events listed in (Table removed for brevity). The timing of relative $PM_{2.5}$ elevated concentrations show strong connections with ozone increases and prolonged elevated concentrations. All the event periods show a consistent relationship between high $PM_{2.5}$ and elevated ozone values which is supportive of a strong influence by wildfire smoke.

Figure III-2: 1-hour Ozone and 1-hour PM2.5 Concentrations







Recent trends show a general decrease in 8-hour ozone design values at the Simi Valley monitoring site as shown in Figure III-3 while the annual 4th highs (Figure III-4) have shown a downwards trend during the past twelve years. The trend fit for design values is very strong. The 2020 8-hour ozone design value did not follow this trend, being above the standard. Concurrence of the requested exceptional event dates would bring the area into attainment of the 2008 ozone standard based on the adjusted 2020 8-hour ozone design value, as anticipated with the historical trend line.

Figure III-3: 8-hour Ozone Design Values with Trend at Simi Valley

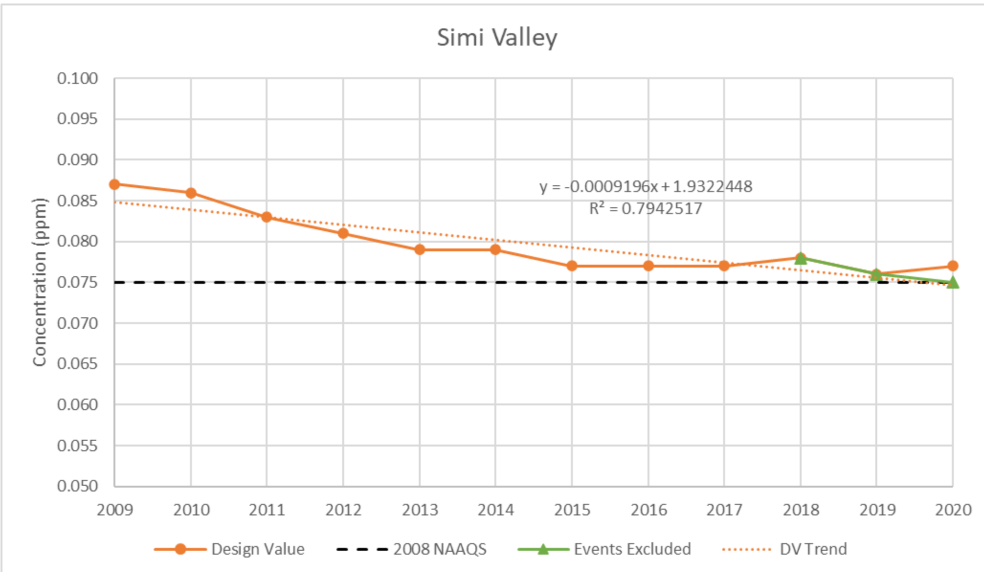
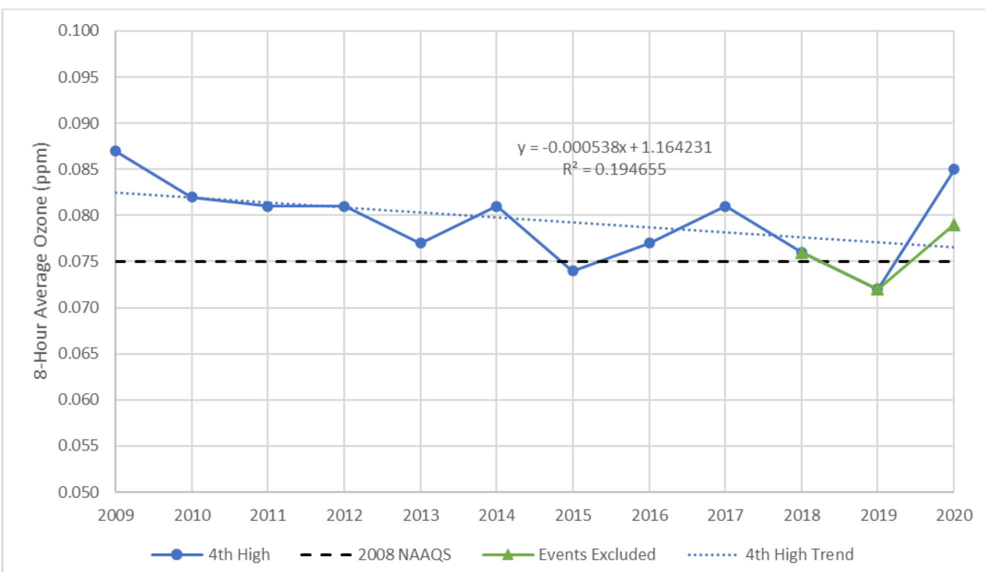


Figure III-4: Annual 4th High 8-Hour Average Ozone with Trend at Simi Valley



D. Meteorological Conditions

2. Simi Valley / Ventura County

Table III-2: Maximum Daily Values of Ozone, Temperature, and Wind Speed on Exceptional Event and Surrounding Days, 8/15-8/24/2020, at Simi Valley Monitoring Site

Date	8/15	8/16	8/17	8/18*	8/19	8/20	8/21*	8/22	8/23	8/24
1hr Ozone (ppm)	0.060	0.067	0.069	0.082	0.073	0.083	0.126	0.082	0.062	0.050
8hr Ozone (ppm)	0.050	0.057	0.067	0.086	0.076	0.074	0.082	0.070	0.041	0.045
Temperature (ºF)	102.6	96.8	93.6	103.8	97.9	97.0	97.0	95.5	90.9	84.7
Wind Speed (mph)	10.3	13.0	9.8	10.5	10.1	9.4	8.5	11.2	11.4	9.8

* Denotes Exceptional Event Dates Requested for Data Exclusion

Table III-3: Maximum Daily Values of Ozone, Temperature, and Wind Speed on Exceptional Event and Surrounding Days, 9/30-10/6/2020, at Simi Valley Monitoring Site

Date	9/30	10/1	10/2*	10/3*	10/4*	10/5	10/6
1hr Ozone (ppm)	0.066	0.091	0.099	0.104	0.093	0.081	0.077
8hr Ozone (ppm)	0.058	0.074	0.086	0.095	0.080	0.077	0.070
Temperature (ºF)	103.8	104.0	98.4	95.9	95.9	93.7	91.0
Wind Speed (mph)	11.6	10.5	9.6	8.9	9.4	9.6	10.3

* Denotes Exceptional Event Dates Requested for Data Exclusion

Table III-2 shows the daily values for the event period of August 15 to August 24, 2020. Maximum temperatures were generally in the 90s throughout most of the event with August 15 being over 100ºF and temperatures cooling off into the 80s on August 24, 2020. Maximum daily resultant wind speeds were generally light to moderate with ranging from 8-13 mph. Maximum ozone concentration varied significantly with a range of 76 ppb and 45 ppb for the 1-hour and 8-hour ozone, respectively. Comparing August 21 with August 15, ozone concentrations were much higher while temperature was lower and wind speed slightly lower on August 21, indicating the day was likely complicated but unlikely to lead to such an extreme ozone concentration under normal conditions. Comparing August 18 with August 15, ozone concentrations were much higher while the high temperature was slightly warmer and exhibited similar wind speeds during August 18 which would be expected to lead to higher ozone concentrations but probably not as high as was measured.

Table III-3 shows the daily values for the event period of September 30 to October 6, 2020. Maximum temperatures were generally in the 90s throughout the event, with September 30 and October 1 being over 100ºF. Maximum daily resultant wind speeds were generally light to moderate with ranging from 8-11 mph. Maximum ozone concentration varied significantly with a range of 38 ppb and 37 ppb for the 1-hour and 8-hour averaged ozone, respectively. Comparing October 2 through 4 with preceding days September 30 and October 1, maximum temperatures decrease with relatively small decrease in wind speeds which would not be expected to lead to such high ozone concentrations.

The weather data, for both event periods, supports that ozone directly related to wildfire smoke from the wildfires in California affected the Simi Valley monitor and increased ozone concentrations. Unusual weather, other than the transport of ozone and related wildfire smoke, was not a factor contributing to the exceptional event.

IV. Clear Causal Relationship

A. Tier 1 Key Factor Analysis

This section provides the documentation requested for a Tier 1 analysis per the *Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*.[38] The Tier 1 analysis is for wildfires that clearly influence monitored ozone exceedances or violations when they occur in an area that typically experiences lower ozone concentrations. This includes establishing the seasonality and/or distinctive level of the monitored ozone concentration as well as providing evidence that the wildfire emissions were transported to the monitors. Analyses presented in this document include 2015-2020 8-hour maximums (Figure removed for brevity) to show seasonality and non-event related concentrations, proximity of wildfires (Section B of the Narrative Conceptual Model chapter), and transport of emissions from wildfires to the exceeding monitors (Section B of the Narrative Conceptual Model chapter and Section C of this chapter).

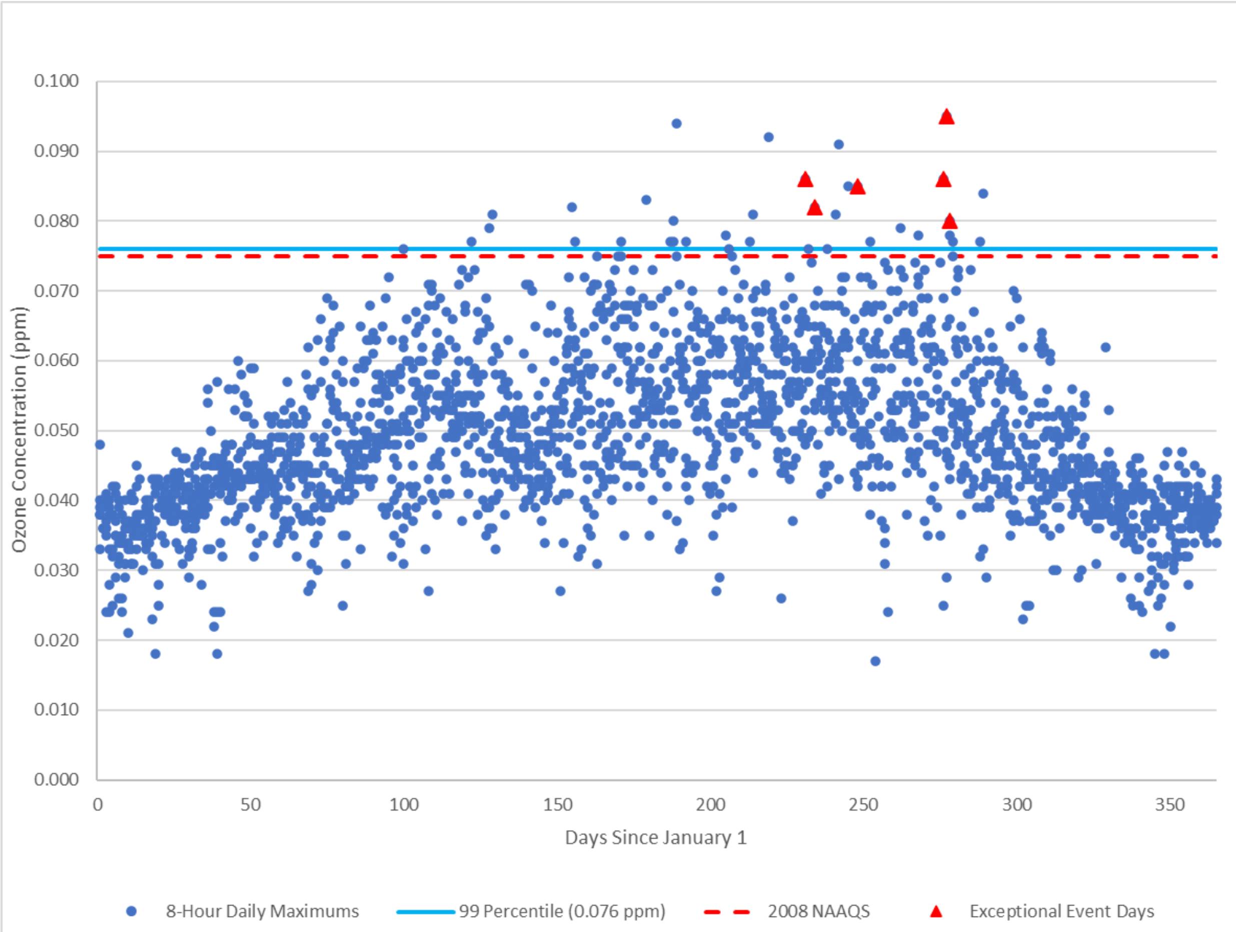
The key factor for Tier 1 requires establishing the seasonality and/or distinctive level of the monitored ozone concentration. The event-related exceedance occurs during a time of year that typically has no exceedances or is clearly distinguishable (at least 0.005 ppm higher) from non-event exceedances. Additionally, ozone impacts should be accompanied by clear evidence that the wildfire's emissions were transported to the location of the monitor.

(Figure removed for brevity) and Figure IV-1 shows that the exceedances occurred during the time of year where ozone concentrations tend to be higher for both monitoring sites, and that most of these exceedances are not clearly distinguishable from non-event exceedances as defined by guidance.

The Simi Valley (Ventura County) exceedance on October 3, 2020 of 0.095 ppm was the greatest concentration during 2015-2020 but was only 1 ppb higher than the second greatest concentration on July 8, 2017 of 0.094 ppm, which does not qualify for a Tier 1 analysis. The remainder of the exceedances were high for the season at Simi Valley; they do not qualify for a Tier 1 analysis.

[38] U.S. EPA, *Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*, p. 13, last accessed 7/26/21.

Figure IV-1: Simi Valley 8-Hour Daily Ozone Maximums by Day of the Year for 2015-2020



As most exceedances do not qualify for Tier 1, additional evidence that the wildfire emissions were transported to the monitors is needed for further Tier 2 analyses. Transport evidence is provided in Section B of the Narrative Conceptual Model chapter and Section C of this chapter as part of the Tier 3 – Weight of Evidence.

B. Tier 2 Key Factor Analysis

This section provides the documentation requested for a Tier 2 analysis, where ozone concentrations are not clearly higher than non-event related concentrations nor do they occur outside of the area’s normal ozone season, in effect not meeting Tier 1 requirements. Tier 2 requires a demonstration that the impacts of the wildfire event on ozone are higher than a non-event related concentration and that fire emissions compared to the fire’s distance from the monitor indicate a clear causal relationship. Analyses include those indicated in Section A of this chapter for Tier 1 as well as Q/D estimations, a more detailed comparison of the event-related ozone concentrations with non-event-related high ozone concentrations, and evidence that the emissions affected the monitor. The following sections provide the documentation requested for a Tier 2 analysis per U.S. EPA guidance.[39]

> Key Factor #1 - Fire emissions and distance of fire(s) to affected monitoring site location(s), and
>
> Key Factor #2 - Comparison of the event-related ozone concentrations with non-event related high ozone concentrations.

Evidence that the fire emissions impacted the exceeding monitor are also required. This evidence is provided with satellite evidence of smoke at the monitor (Narrative Conceptual Model chapter and Section C of this chapter), graphs of $PM_{2.5}$ concentrations nearby and in the same airshed (Section C of this chapter), and $PM_{2.5}$ speciation data near the wildfires impacting the monitor (Section C of this chapter), and differences in spatial and temporal patterns (Section C of this chapter).

1. Key Factor #1 (Q/D)

Key factor 1 requires determining the fire emissions (Q) and the distance (D) between the wildfires to the affected monitor. CARB staff worked with U.S. EPA staff, and provided shapefiles delineating perimeters, start dates, and end dates of all California wildfires in 2020 retrieved from the National Interagency Fire Center. U.S. EPA modeled the wildfires and emissions, produced emissions estimates for the fires for each date, and calculated the summed aggregate of emissions divided by the distance (Q/D) for each day for each monitoring site.

2. Key Factor #2 (Event vs Non-Event Ozone Concentrations)

Key factor #2 in a Tier 2 demonstration requires a comparison of the event related ozone concentration with non-event related high ozone concentrations. Statistical analyses of the exceedances must either demonstrate that exceedance concentrations are in the 99th percentile of the 5-year distribution of ozone monitoring data, or one of the 4 highest ozone concentrations within the year.

Due to the large number of dates impacted by the multiple large wildfires burning historically large amount of acreage producing massive amounts of emissions, CARB believes it reasonable to include all dates whereby wildfire emissions caused exceedances of the appropriate ozone NAAQS up to the adjusted 4th high, as noted in the tables below. Dates that are impacted by exceptional events should not count against the tally of “the 4 highest ozone concentrations within the year” as they were exceedances caused by contributions from wildfire emissions. This list also does not preclude the non-exceptional event requested dates from future consideration as wildfire related

[39] Ibid, p. 15

exceptional events, only that they are not being demonstrated as such as part of this exceptional events demonstration.

The 99th percentile value for the 5-year (2015-2019) distribution of ozone monitoring data at Simi Valley is 0.076 ppm. All dates being requested for exclusion due to wildfire exceptional events are in the top 8 concentrations in 2020 and in the 99th percentile or higher for concentrations during the prior 5-year distribution of data as shown below in (Table removed for brevity). After accounting for the exceptional event dates being requested the adjusted 4th high is 0.079 ppm, below all requested exceptional event dates. All requested dates qualify under the requirements for Tier 2 – Key factor #2.

C. Tier 3 – Weight of Evidence

The following sections provide additional evidence as required to support a Tier 3 analysis per U.S. EPA guidance[40] where the requested dates do not qualify for either a Tier 1 or a Tier 2 analysis. All dates requested for exclusion will be included in this Tier 3 analysis. The Tier 3 analysis utilizes a more complicated "weight of evidence" approach with additional complex analyses to show a clear causal relationship between wildfire emissions and the ozone concentrations at a site. Additional required elements in a Tier 3 analysis must provide:

1. Evidence that the emissions from the wildfire affected the exceeding monitor.

This requirement is met through evidence shown in Sections B and C of the Narrative Conceptual Model chapter and Section C of this chapter, and particularly in the evidence of an ozone/$PM_{2.5}$ correlation (Figure removed for brevity and Figure III-36), unusual ozone diurnal patterns seen in many of the (Figures removed for brevity), and unusual $PM_{2.5}$ patterns seen in many of the (Figures removed for brevity). Social media reports of smoke in the vicinity can also be found in Appendix F.

2. Evidence that the emissions were transported to the monitor.

This requirement is met through evidence given in the Narrative Conceptual Model chapter and this chapter using both backward trajectory analysis from the monitor as well as forward trajectory modeling from individual wildfires, satellite imagery and HMS satellite-derived smoke layers, NAAPS modeled aerosol optical depth, and meteorological analyses.

3. Additional evidence that the emissions caused the exceedance by reaching the ground and affecting the monitors.

[40] U.S. EPA, *Final Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*, p.25, last accessed 7/29/21

This requirement is met through the analysis of $PM_{2.5}$, black carbon, NAAPS modeled smoke surface concentration, and NWS Area Forecast Discussions in the following section as well as media reports of smoke at ground level.

1. 1-Hour Ozone (Diurnal Comparison)

The following figures (Figures removed for brevity) compare the daily diurnal pattern for each exceedance day with the hourly diurnal percentiles for ozone from 2015-2019. For the Simi Valley site, data is missing for the 0100 PST hour due to running daily quality check routines during the 0100-0200 PST hour and the seasonal ozone season is defined as April through October. Calculations of the 8-hour averages for the 2015 NAAQS are limited to the starting hours between 0700-2300 (hours 0000-0600 are excluded) while the 2008 NAAQS includes all starting hours of the day. These figures show that during many of the days for each site the pattern was unusual compared to the percentiles of each site's typical diurnal pattern with unusually timed peaks or spikes. Some days were extremely high throughout the day due to the ongoing presence of wildfire emissions with ozone precursors and ozone impacting these sites. These diurnal ozone figures support that the ozone exceedance days were unusual compared to historical patterns and act as supporting evidence that wildfire emissions directly impacted ozone concentrations at each site.

2. $PM_{2.5}$

Evidence of ground-level impacts of smoke on the monitor can also be indicated through analysis of particulate matter, as well as other speciated components.

The following figures show elevated $PM_{2.5}$ concentrations at multiple sites along California's central coast and on the western side of the San Joaquin Valley during the time of the exceptional event, which was a direct result of smoke and emissions from the wildfires in northern and central California. This supports that the wildfire smoke and emissions were widespread across the region and directly impacted monitors at the surface during the period.

3. Additional Supporting Ground-Level Evidence

a) Area Forecast Discussions

In the days prior to the smoke impacts in southern California, Area Forecast Discussions issued by the National Weather Service (NWS) Los Angeles/Oxnard (LOX) office focused on high temperatures and the potential for thunderstorms. On August 17, the AFD only mentioned the pyrocumulous plumes from the Lake and Ranch2 Fires. Smoke impacts were not noted until August 18 with an initial mention of impacts for flight regulations at the San Luis Obispo Airport (KSBP). Later, LOX noted the presence of a thick layer of smoke from the fires over Monterey

County covering San Luis Obispo and Santa Barbara Counties.[41] AFDs from that point, though October, frequently noted the presence of smoke and the impacts on air quality, temperature forecasting, and aviation. Air Quality Alerts were issued by LOX for Ventura County (Appendix C).

A sampling of Area Forecast Discussions from the NWS Los Angeles/Oxnard forecast office are included in Appendix C.

b) Satellite Smoke Indications

The smoke that enhanced the ozone reaching the exceeding monitors from mid-August through early November 2020 was primarily from the wildfires in the northern and central portions of the State, along with the River and Dolan Fires in Monterey County, just to the north, the Creek Fire and the SQF Complex on the eastern side of the San Joaquin Valley, and the Apple and Bobcat Fires in the South Coast Air Basin. A smaller fire just 12 miles north of Simi Valley, the Holser Fire, contributed to smoke impacts in mid-August. The combined smoke from these fires increasingly impacted sites throughout California, including monitors in the South Central Coast Air Basin. Several tools are available to look at smoke in the areas that impacted the monitors.

The NOAA Hazard and Mapping System (HMS) Fire and Smoke Product is an analysis of various satellite imagery to map out the scope and even to some extent thickness of smoke layers. These products were extensively utilized in the Narrative Conceptual Model and Clear Causal Relationship chapters of this document.

NOAA Smoke Text Product[42] is a text-based analysis of satellite imagery. These products are used to give an overall view of smoke origins, current locations, and potential transport. Unfortunately, Smoke Text Products were unavailable for the August 2020 events. Relevant Smoke Text Products issued from September 30 through October 4 are in Appendix E, with an example shown here.

4. NAAPS Global Aerosol Model

The NAAPS (Navy Aerosol Analysis and Prediction System) Global Aerosol Model is used to predict the distribution of tropospheric aerosols using global meteorological fields.[43] The model can provide smoke simulations in near-real-time with up to 120-hour forecasts. Of particular interest are the total optical depth and smoke surface concentration outputs. Aerosol optical depth (AOD) can indicate how much aerosol is in the atmosphere, with higher AOD values corresponding with increasing levels of particulate matter. The model can also give a simulation

[41] Iowa State University, Mesonet, *Area Forecast Discussions, AFDLOX 2020-08-19 05:25 UTC*, last accessed 11/5/21

[42] NOAA Hazard and Mapping System (HMS), *Fire and Smoke Text Product*, last accessed 11/8/21

[43] Naval Research Laboratory, *Navy Aerosol Analysis and Prediction System (NAAPS) Global Aerosol Model*, last accessed 11/16/21

of AOD further broken down into sulfates, dust, and smoke. In addition, the model can also simulate concentrations of smoke at the surface, with darker colors indicating thicker smoke. (Figure removed for brevity) shows the high smoke AOD levels and smoke surface concentrations at the Simi Valley monitors during August 21. Additional AOD and smoke surface concentration model outputs covering the requested event dates are shown in Appendix E and show the presence of smoke in the Ventura County area.

5. Conclusion

Beginning in mid-August 2020, smoke from several large wildfires throughout California generated emissions that directly resulted in elevated concentrations at the Simi Valley ozone monitor in the Ventura County ozone nonattainment area. Inspection of $PM_{2.5}$ concentrations, satellite-derived smoke layers, and modeled trajectories indicate pathways for the transport of smoke and associated precursors from the wildfires in California to move downrange and into the surface boundary layer. This supports the transport of smoke, ozone precursors, and generated ozone that mixed down to the surface at the exceeding monitoring sites.

All requested dates for exceptional events were in the 99th percentile of the prior 5-year distribution of 8-hour ozone data and fall in the adjusted top 4 rank for 2020 when excluding the requested exceptional events days. Area forecast discussions, satellite smoke products, black carbon analyses, and NAAPS Global Aerosol Model all indicated periods of wildfire smoke aloft and at the surface during the requested event dates. Daily diurnal comparison graphs show many days with abnormal patterns and unusually timed peaks due to the impacts of wildfire emissions.

The comparisons and analyses provided in the Narrative Conceptual Model and Clear Causal Relationship chapters of this demonstration support our conclusion that the numerous wildfire events affected air quality in such a way that there exists a clear causal relationship between the monitoring exceedances or violations as listed in Table I-4 and thus satisfies the clear causal relationship criteria.

V. Natural Event/Human Activity Unlikely to Recur

The Background and Narrative Conceptual Model chapters of this document provide evidence that the event qualifies as a “Natural Event” as defined in 40 CFR 50.1(k). The fires that impacted the exceeding ozone monitors occurred on wildlands that meet the definition in 40 CFR 50.1(n) and (o). When considering fire cause, "wildfires on wildland initiated by accident or arson are considered natural events, and on a case-by-case basis this treatment for wildfires may bear on the appropriate treatment of accidental and arson-set structural fires.[44]”

[44] 81 FR 68233, Footnote 35

U.S. 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), and accordingly, CARB has shown that this event is a natural event and may be considered for treatment as an exceptional event.

VI. Not Reasonably Controllable and/or Not Reasonably Preventable

The Background and Narrative Conceptual Model chapters of this document provide evidence the wildfires impacting the ozone monitors at Simi Valley in Ventura County were natural events predominantly occurring on wildland in California. CARB is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable. Therefore, emissions from the wildfires were not reasonably controllable or preventable.

VII. Public Notification

As presented in Sections E and F of the Narrative Conceptual Model chapter, all affected districts maintain public alert systems as well as publicly available information via their websites to keep residents informed of potential wildfire smoke impacts. Examples of the information released to the public is included in Appendix B and Appendix F.

The CARB will hold a 30-day public comment period to solicit public input regarding this demonstration. Notification of the public comment period will be posted on the CARB website and emailed to interested stakeholders. Any comments received, and CARB's responses, will be submitted to U.S. EPA at the end of the 30-day public comment period.

VIII. Summary/Conclusion

Seven major wildfire complexes (including the August, SCU Lightning, LNU Lightning, and North Complex fires which each exceeded 300,000 acres burned) and ten individual fires (including the Creek, Dolan, and Bobcat wildfires which each exceeded 100,000 acres burned) were the primary focus of these retroactive analyses and discussions but is likely not inclusive of all wildfires that were active and contributed emissions during these events. These massive fires were all active producers of vast amounts of wildfire smoke and emissions, which ultimately consumed over four million acres of wildlands in California during 2020.

During the event timeframe of August 18 to October 4, wildfires were particularly active, producing enormous amounts of wildfire smoke and emissions, including ozone precursors, which blew downwind blanketing vast portions of northern California and often settling into valleys and foothills when conditions allowed. Air quality monitors showed elevated $PM_{2.5}$ throughout the South Central Coast Air Basin and in surrounding regions, indicating smoke impacts at the surface.

Black carbon and NAAPS Global Aerosol Model products further identified the wildfires as sources of the emissions impacting surface sites. Elevated ozone concentrations correlated well with the elevated $PM_{2.5}$ concentrations at collocated or nearby monitors (as available) during the event at each of the impacted sites.

This 2020 Southern California Ozone Exceptional Events Demonstration supports the criteria for an exceptional event as detailed in the 2016 Exceptional Events Rule[45] and Wildfire Ozone Guidance.[46] This documentation used the following evidence to demonstrate the exceptional event:

- Ambient air monitoring data
- HYSPLIT forward and backward trajectory analyses
- Satellite imagery and narratives
- Wildfire smoke emissions estimates
- Statistical historical concentration comparisons
- Meteorological conditions
- Air Quality District alerts and advisories
- NOAA and HMS smoke products
- Aerosol modeling

This Exceptional Events Demonstration clearly demonstrates justification for exclusion of data as listed in Table I-4 due to an exceptional event under 40 CFR 50.14(c)(3)(iv). The 2020 Southern California Ozone Exceptional Events Demonstration has provided evidence that:

- Describes the events causing the exceedance and a discussion of how emissions from the event led to the exceedance at each monitor;
- Demonstrates a clear causal relationship between the wildfire emissions and the ozone exceedances at each monitor for their respective requested dates;
- Shows that event-influenced concentrations were unusual and above normal historical concentrations;
- Demonstrates the event was neither reasonably controllable nor reasonably preventable; and
- Verifies the event was multiple wildfires, all-natural events or human activity that is unlikely to recur at a particular location, all occurring predominantly on wildlands.

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[45] 81 FR 68216

[46] U.S. EPA, *Final Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*, p.25, last accessed 7/29/21