



# 2013

## ANNUAL AIR QUALITY REPORT

SAN LUIS OBISPO COUNTY  
CALIFORNIA



Air Pollution Control District  
San Luis Obispo County

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## 2013 Annual Air Quality Report

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## Table of Contents

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2013 Air Quality Summary.....	1
Air Quality Monitoring and Data.....	2
Ambient Air Pollutants Of Local Concern .....	5
Ozone .....	5
Particulate Matter .....	5
Nitrogen Dioxide, Sulfur Dioxide, and Carbon Monoxide.....	6
State and National Ambient Air Quality Standards.....	7
Exceptional Events .....	7
Ozone and Gaseous Pollutant Data Summary .....	9
First, Second and Third Highest Hourly Averages .....	9
Monthly Ozone Summary .....	10
Particulate Matter Data Summary.....	12
Maximum 24-hr Concentrations and Annual Averages .....	12
Monthly PM <sub>10</sub> Summary .....	14
Monthly PM <sub>2.5</sub> Summary .....	16
Trends .....	17
Countywide Ozone Trends, 2004 - 2013.....	17
Countywide Particulate Matter Trends, 2003 - 2013.....	19
Ambient Air Monitoring Network Plans.....	21
Appendix A: Ozone in Eastern San Luis Obispo County.....	22
Red Hills.....	22
Carrizo Plains .....	23
Appendix B: Particulate Matter Along the Southern Coast of San Luis Obispo County .....	31
Exceedences of the 24-hour PM <sub>10</sub> Standards on the Nipomo Mesa .....	31
Annual Average PM <sub>2.5</sub> Levels on the Nipomo Mesa .....	31

## 2013 Air Quality Summary

While urban and suburban areas of San Luis Obispo (SLO) County experienced relatively low levels of ozone pollution in 2013, ozone levels exceeding both state and federal standards were measured on several days in the rural eastern portion of the county. This area was designated as a nonattainment zone for the federal ozone standard in May 2012 (Figure 1). Nonetheless, air quality in this area shows continued improvement over the past several years, with 2013 recording the fewest number of standard exceedences since monitoring began there (Figure 8). As discussed in Appendix A, the available evidence suggests these exceedences, like those observed in earlier years, are primarily caused by the transport of ozone and ozone precursors from outside of the county, rather than by emissions originating within the county.

Smoke from wildfires can often adversely affect air quality. On October 15, 2013, a prescribed burn at Ford Ord in Monterey County got out of control and burned nearly 350 acres, according to media reports. The year's two highest hourly ozone measurements at Morro Bay for 2013 were recorded over the next two days (Table 3) following that event. In the first week of June, the Branch Fire burned about 500 acres in the Los Padres National Forest west of the Carrizo Plains, while several fires burned in Ventura County, sending smoke up the coastline. Several of the highest hourly and 8-hour ozone measurements from around the county were recorded during this period (Table 3).

The federal 1-hour sulfur dioxide standard, which was lowered to 75 ppb in 2011, was exceeded for the first time in 2013. The exceedence was measured on May 19 at the Mesa2 monitoring station, located immediately downwind of the Phillips 66 Santa Maria Refinery. The refinery was performing maintenance at the time, and process equipment that would normally control sulfur dioxide emissions was not operating. Releases of this type are unlikely to recur in the future as the refinery is no longer permitted to operate without these emission controls during scheduled maintenance procedures.

South County air quality continues to be impacted by dust blown from the Oceano Dunes State Vehicular Recreation Area (ODSVRA) along the coast. Two exceedences of the federal  $PM_{10}$  standard occurred in 2013 at our CDF site located directly downwind of the dunes, and numerous exceedences of the more stringent state  $PM_{10}$  standard were recorded at all 3 monitoring sites located on the Nipomo Mesa (Mesa2, CDF, and Nipomo Regional Park). In addition, the federal 24-hour  $PM_{2.5}$  standard was exceeded three times at CDF, and for the first time this site exceeded the federal and state standard for annual average  $PM_{2.5}$ . See Appendix B for additional details regarding these exceedences.

As shown in Table 4, the highest daily  $PM_{10}$  concentrations recorded at San Luis Obispo, Atascadero, Paso Robles and Nipomo Regional Park all occurred on October 4, and all exceeded the state 24-hour  $PM_{10}$  standard. Levels were also elevated that day at CDF and Mesa2, as well as at monitoring stations in Monterey County, Ventura County, and in the San Joaquin Valley. These high levels were caused by dust transported from the San Joaquin Valley, where the previous day gusty winds stirred up large amounts of dust and caused exceedences of the federal  $PM_{10}$  standard in Kings County.

*The air quality database for San Luis Obispo County is a public record and is available from the San Luis Obispo County Air Pollution Control District office in various forms, including comprehensive records of all hourly or other sample values acquired anywhere in the county. Data summaries are published in Annual Air Quality Reports like this one. Ozone summary data appear weekly in the Saturday edition of The Tribune, a local newspaper. Each month's data from ambient monitoring is added to separate archives maintained by the federal Environmental Protection Agency (EPA) and by the Air Resources Board (ARB). Summary data from San Luis Obispo County can be found in EPA and ARB publications and on the world wide web at the following websites:*

[www.slcleanair.org](http://www.slcleanair.org)

APCD website

[www.arb.ca.gov](http://www.arb.ca.gov)

ARB website

[www.epa.gov](http://www.epa.gov)

US EPA website

[www.airnow.gov](http://www.airnow.gov)

Air Quality Index site

## Air Quality Monitoring and Data

San Luis Obispo County air quality was measured by a network of ten ambient air monitoring stations in 2013; station locations are depicted in Figure 1. The San Luis Obispo County Air Pollution Control District (District or APCD) owns and operates seven permanent stations which are named for their locations: Nipomo Regional Park (NRP), Grover Beach, Morro Bay, Atascadero, Red Hills, Carrizo Plains, and the CDF fire station on the Nipomo Mesa. The California Air Resources Board (ARB) owns and operates stations at San Luis Obispo and Paso Robles. One station on the Nipomo Mesa, Mesa2, is owned by the Phillips 66 refinery but operated by the District. See Table 2 for a summary of the pollutants monitored at each station.

Air quality monitoring is rigorously controlled by federal and state quality assurance and quality control procedures and subject to annual equipment and data audits to ensure data validity. Gaseous pollutant levels are measured every few seconds and averaged to yield hourly values. Particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>) is sampled hourly using Beta Attenuation Monitors (BAMs). All monitoring instruments are Environmental Protection Agency (EPA)-approved Federal Equivalent Methods (FEMs) or Federal Reference Methods (FRMs).

The dataset for 2013 reviewed in this report was downloaded from the EPA's Air Quality System (AQS) database in June 2014. Prior to being uploaded to AQS, all data were thoroughly reviewed and validated by the collecting agency (i.e. ARB for data from Paso Robles and San Luis Obispo and APCD for all other sites). Some PM<sub>10</sub> data from Paso Robles were found to be in error and were removed from the dataset prior to analysis. No other modifications were made to the dataset extracted from AQS. The raw data and the R code used to compile the statistics and generate the graphs in the report are available upon request.

3



**Table 1: Ambient Air Quality Parameters Monitored in SLO County in 2013**

O <sub>3</sub>	NO	NO <sub>2</sub>	NO <sub>x</sub>	SO <sub>2</sub>	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	WS	WD	ATM
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**APCD Permanent Stations**

Atascadero	X	X	X	X			X	X	X	X	X
Morro Bay	X	X	X	X					X	X	
Nipomo Regional Park	X	X	X	X			X		X	X	X
Red Hills	X								X	X	X
Carrizo Plains	X								X	X	X
CDF							X	X	X	X	
Grover Beach									X	X	

**ARB Stations**

San Luis Obispo	X						X	X	X	X	X
Paso Robles	X						X		X	X	X

**Operated by APCD**

Mesa2, Nipomo					X		X	X	X	X	X
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Acronyms:

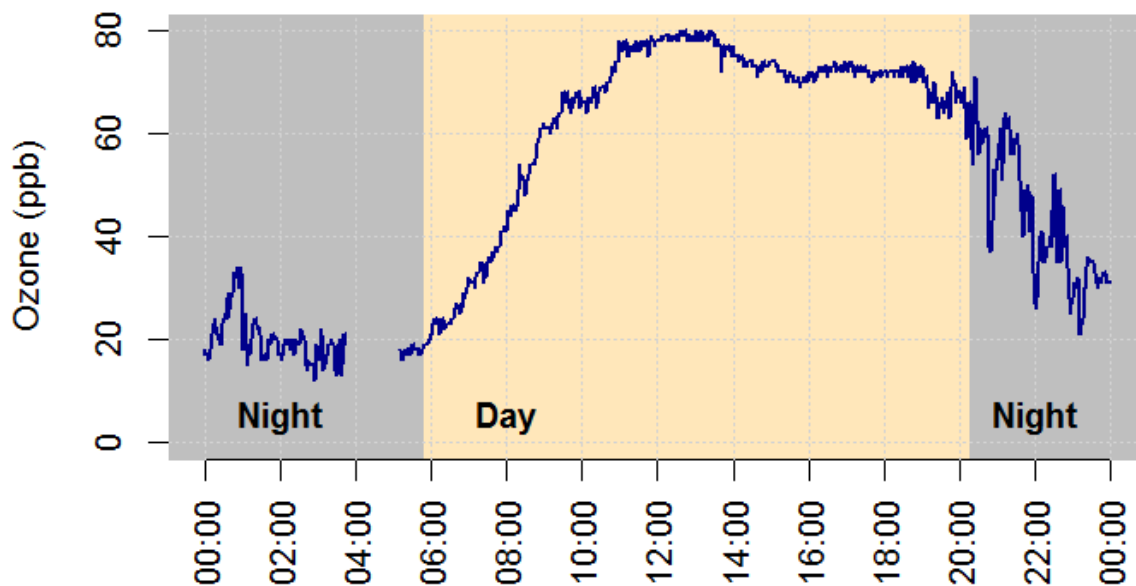
O <sub>3</sub>	Ozone	SO <sub>2</sub>	Sulfur Dioxide	PM <sub>10</sub>	Particulates < 10 microns	WS	Wind Speed
NO	Nitric Oxide	CO	Carbon Monoxide	PM <sub>2.5</sub>	Particulates < 2.5 microns	WD	Wind Direction
NO <sub>2</sub>	Nitrogen Dioxide					ATM	Ambient Temp
NO <sub>x</sub>	Oxides of Nitrogen						

## Ambient Air Pollutants Of Local Concern

### Ozone

Ozone is a gas that is naturally found near the earth's surface at low concentrations, typically 10 to 40 parts per billion (ppb). It is also a principle component of photochemical smog, produced when precursor pollutants such as volatile organic compounds and nitrogen oxides react under the influence of sunlight. Ozone precursors are emitted by many human activities, but industrial processes and the wide use of motor vehicles are the primary sources. The chemistry of atmospheric ozone is complex, and in the absence of sunlight ozone is destroyed by reaction with the same precursor molecules that fuel its formation during the day. As a result, ozone concentrations typically increase as sunlight intensity increases, peaking midday or in the afternoon and bottoming out in the early morning hours and just before sunrise, as shown in the example below.

### Hourly Ozone at Carrizo Plains, June 7, 2013



**Figure 2: Example of Diurnal Ozone Pattern**

As a pollutant, ozone is a strong oxidant gas that attacks plant and animal tissues. It can cause impaired breathing and reduced lung capacity, especially among children, athletes, and persons with compromised respiratory systems; it can also cause significant crop and forest damage. Ozone is a pollutant of particular concern in California where geography, climate, and emissions from industrial/commercial sources and millions of vehicles contribute to frequent violations of health-based air quality standards.

While ground level ozone is harmful to plants and animals and is considered a pollutant, upper level (stratospheric) ozone occurs naturally and protects the earth from harmful ultra-violet energy from the sun.

### Particulate Matter

Ambient air quality standards have been established for two classes of particulate matter: PM<sub>10</sub> (respirable particulate matter less than 10 microns in aerodynamic diameter), and PM<sub>2.5</sub> (fine particulate matter 2.5



microns or less in aerodynamic diameter). Both consist of many different types of particles that vary in their chemical activity and toxicity. PM<sub>2.5</sub> tends to be a greater health risk since these particles can get lodged deep in the lungs or enter the blood stream, causing both short and long-term damage. Sources of particulate pollution include diesel exhaust; mineral extraction and production; combustion products from industry and motor vehicles; smoke from open burning; paved and unpaved roads; condensation of gaseous pollutants into liquid or solid particles; and wind-blown dust from soils disturbed by demolition and construction, agricultural operations, off-road vehicle recreation, and other activities.

In addition to its harmful health effects, particulate matter can also greatly reduce visibility.

### **Nitrogen Dioxide, Sulfur Dioxide, and Carbon Monoxide**

Nitrogen dioxide (NO<sub>2</sub>) is the brownish-colored component of smog. NO<sub>2</sub> irritates the eyes, nose and throat, and can damage lung tissues. Sulfur dioxide (SO<sub>2</sub>) is a colorless gas with health effects similar to NO<sub>2</sub>. Both pollutants are generated by fossil fuel combustion from mobile sources such as vehicles, ships, and aircraft and at stationary sources such as industry, homes and businesses. SO<sub>2</sub> is also emitted by petroleum production and refining operations. These pollutants can create aerosols, which may fall as acid rain causing damage to crops, forests, and lakes. They can also exacerbate asthma and harm the human respiratory system.

Carbon monoxide (CO) is a colorless and odorless gas that can interfere with the ability of red blood cells to transport oxygen. Exposure to CO can cause headaches, fatigue, and even death. CO results from fuel combustion of all types, but motor vehicles are by far the chief contributor of CO in outdoor air.

## State and National Ambient Air Quality Standards

California ARB and the federal EPA have adopted ambient air quality standards for six common air pollutants of primary public health concern: ozone, particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), and lead. These are called “criteria pollutants” because the standards establish permissible airborne pollutant levels based on criteria developed after careful review of all medical and scientific studies of the effects of each pollutant on public health and welfare.

The National Ambient Air Quality Standards (NAAQS; see Table 2) are used by EPA to designate a region as either “attainment” or “non-attainment” for each criteria pollutant. A non-attainment designation can trigger additional regulations for that region aimed at reducing pollution levels to bring the region into attainment. For most pollutants, the NAAQS allow a standard to be exceeded a certain number of times each calendar year without resulting in a non-attainment designation. Additionally, exceedences caused by exceptional events (see below) may be excluded from attainment/non-attainment determinations at the discretion of the EPA.

In May 2012, the EPA designated the eastern portion of San Luis Obispo County as marginally non-attainment for the 8-hour ozone standard based on enhanced monitoring over the last decade that revealed previously unrecognized elevated ozone levels in that region; the western portion of the county retained its federal ozone attainment status. (See Figure 1 for a map showing the boundary between the attainment and non-attainment areas.) The county is currently designated attainment for all of the other NAAQS; it does, however, exceed the federal 24-hour standard for PM<sub>10</sub> on the Nipomo Mesa and could be designated nonattainment for that pollutant if exceedences continue.

The California Ambient Air Quality Standards are generally more restrictive (i.e. lower) than the NAAQS, and typically are specified as not to be exceeded. Thus, a single exceedence is a violation of the applicable standard and triggers a non-attainment designation. As a result, San Luis Obispo County is designated as a non-attainment area for the state one-hour and 8-hour ozone standards, as well as the state 24-hour and annual PM<sub>10</sub> standards. The county is currently designated as attaining the state annual PM<sub>2.5</sub> standard, but we expect it to be designated as non-attainment when ARB finalizes area designations, which will likely occur in mid-2015.

The state and national standards for NO<sub>2</sub> have never been exceeded in this county. The state standard for SO<sub>2</sub> was exceeded periodically on the Nipomo Mesa up until 1993. Equipment and processes at the facilities responsible for the emissions were upgraded as a result, and the state SO<sub>2</sub> standard has not been exceeded since that time. Exceedences of the federal SO<sub>2</sub> standard had never been measured here until this year. State CO standards have not been exceeded in San Luis Obispo County since 1975.

### Exceptional Events

Exceptional Events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable or preventable and are unlikely to reoccur at a particular location. Thus, air quality monitoring data influenced by exceptional events can sometimes be excluded from regulatory determinations related to violations of the NAAQS, if recommended by the APCD and approved by the EPA. The APCD has not submitted any exceptional event documentation for 2013 and does not expect any data compiled in this report to be excluded from future attainment determinations.

**Table 2: Ambient Air Quality Standards for 2013 and Attainment Status\***

	Averaging Time	California Standard <sup>†</sup>	National Standard <sup>‡</sup>
<b>Ozone (O<sub>3</sub>)</b>	8 Hours	<b>70 ppb</b>	<b>75 ppb</b>
	1 Hour	<b>90 ppb</b>	
<b>Respirable Particulate Matter (PM<sub>10</sub>)</b>	24 Hours	<b>50 µg/m<sup>3</sup></b>	150 µg/m <sup>3</sup>
	1 Year <sup>‡</sup>	<b>20 µg/m<sup>3</sup></b>	
<b>Fine Particulate Matter (PM<sub>2.5</sub>)</b>	24 Hours		35 µg/m <sup>3</sup>
	1 Year <sup>‡</sup>	12 µg/m <sup>3</sup>	12 µg/m <sup>3</sup> <sup>§</sup>
<b>Carbon Monoxide (CO)</b>	8 Hours	9.0 ppm	9 ppm
	1 Hours	20 ppm	35 ppm
<b>Nitrogen Dioxide (NO<sub>2</sub>)</b>	1 Year <sup>‡</sup>	30 ppb	53 ppb
	1 Hour	180 ppb	100 ppb
<b>Sulfur Dioxide (SO<sub>2</sub>)</b>	3 Hours		500 ppb (secondary)
	1 Hour	250 ppb	75 ppb (primary)
<b>Hydrogen Sulfide (H<sub>2</sub>S)</b>	1 Hour	0.03 ppm	
<b>Visibility</b>	8 Hours	Sufficient amount to reduce the prevailing visibility to less than ten miles when the relative humidity is less than 70 %.	

**A standard exceedance** occurs when a measured pollutant concentration exceeds (or in some cases, equals) the applicable standard prescribed by state or federal agencies. It does not necessarily constitute a violation.

**A standard violation** may occur following a single or cumulative series of standard exceedances. Criteria constituting a violation are unique for each pollutant.

**A non-attainment designation** occurs when a state or federal agency formally declares an area in violation of a standard. Typically, ARB performs designations annually. Several years often pass between EPA designations.

\* Standards in **boldface print** are not attained in San Luis Obispo County as of September 2013.

<sup>†</sup> For clarity, the ozone, SO<sub>2</sub>, and NO<sub>2</sub> standards are expressed in parts per billion (ppb), however most of these standards were promulgated in parts per million (ppm).

<sup>‡</sup> This standard is calculated as the annual arithmetic mean.

<sup>§</sup> The national standard for PM<sub>2.5</sub> annual arithmetic mean was lowered in March 2013 from 15 to 12 µg/m<sup>3</sup>.

## Ozone and Gaseous Pollutant Data Summary

In 2013, the Red Hills station recorded three days exceeding the federal 8-hour ozone standard of 75 parts per billion (ppb); this was the only station to exceed the standard this year. Exceedences of the more stringent state 8-hour ozone standard (70 ppb) occurred on 11 days countywide, with 11 days at Red Hills, three at Carrizo Plains, and one at NRP. The state 1-hour standard (90 ppb) was not exceeded at any station in the county this year.

The Mesa2 station recorded one exceedence of the federal 1-hour sulfur dioxide standard (75 ppb). Standards for nitrogen dioxide were not exceeded anywhere in the county.

### First, Second and Third Highest Hourly Averages

Table 3 lists the highest hourly (and for ozone, 8-hour) values recorded in 2013 for ozone, sulfur dioxide and nitrogen dioxide at the stations where they are monitored. Concentrations are in parts per billion (ppb). Sampling date and hour appear under each pollutant value in the format "month/day: hour." All times are Pacific Standard Time; for 8-hour averages, the hour listed is the beginning hour. Values that exceed federal standards are shown in **bold**, and those exceeding state standards are underlined.

**Table 3: Highest Measurements for Gaseous Pollutants in 2013**

Station	O <sub>3</sub> 1-hour			O <sub>3</sub> 8-hour			SO <sub>2</sub> 1-hour			NO <sub>2</sub> 1-hour		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
<b>Paso Robles</b>	72 05/03:12	70 06/01:15	70 10/26:14	67 05/03:10	64 06/01:10	61 05/02:10						
<b>Atascadero</b>	73 05/03:12	71 06/01:14	68 05/02:12	70 05/03:10	65 06/01:10	64 05/31:12				42 11/12:18	42 12/16:17	40 12/30:17
<b>Morro Bay</b>	56 10/16:14	56 10/17:15	55 03/23:11	51 03/23:09	51 05/04:14	51 10/06:10				37 10/17:06	37 11/06:17	35 11/26:18
<b>San Luis Obispo</b>	67 05/03:14	54 03/23:11	54 10/17:15	61 05/03:09	51 03/23:09	51 05/04:13						
<b>Red Hills</b>	87 07/21:12	83 06/02:00	81 06/01:19	<b>81</b> 07/20:22	<b>80</b> 07/21:00	<b>77</b> 06/01:17						
<b>Carrizo Plains</b>	79 06/07:12	73 05/03:17	73 06/01:12	<u>74</u> 06/07:10	<u>71</u> 05/03:09	<u>71</u> 06/01:09						
<b>Nipomo Regional Park</b>	76 05/03:14	66 04/21:16	64 10/15:12	<u>72</u> 05/03:08	59 10/15:10	58 05/02:11				35 12/11:19	34 02/15:19	34 12/14:19
<b>Mesa2, Nipomo</b>							<b>146</b> 05/19:12	68 04/27:02	55 05/18:16			

### Monthly Ozone Summary

Figures 3 and 4 depict monthly ozone variation during 2013 at the seven monitoring stations in the county where this pollutant is monitored. In these “box and whisker” plots, the top and bottom of each box show the 75<sup>th</sup> and 25<sup>th</sup> percentile daily maximum 8-hour averages for each month, the heavy horizontal bar marks the median, and the dotted lines (the whiskers) extend to the maximum and minimum values. In other words, 50% of all measured values are captured in the red box for each month; 25% of values fall between the top of the box and the upper whisker line, and 25% of the values fall between the bottom of the box and the lower whisker line. The solid red line marks the federal 8-hour ozone standard of 75 ppb, and the dashed red line below it marks the state 8-hour standard of 70 ppb.

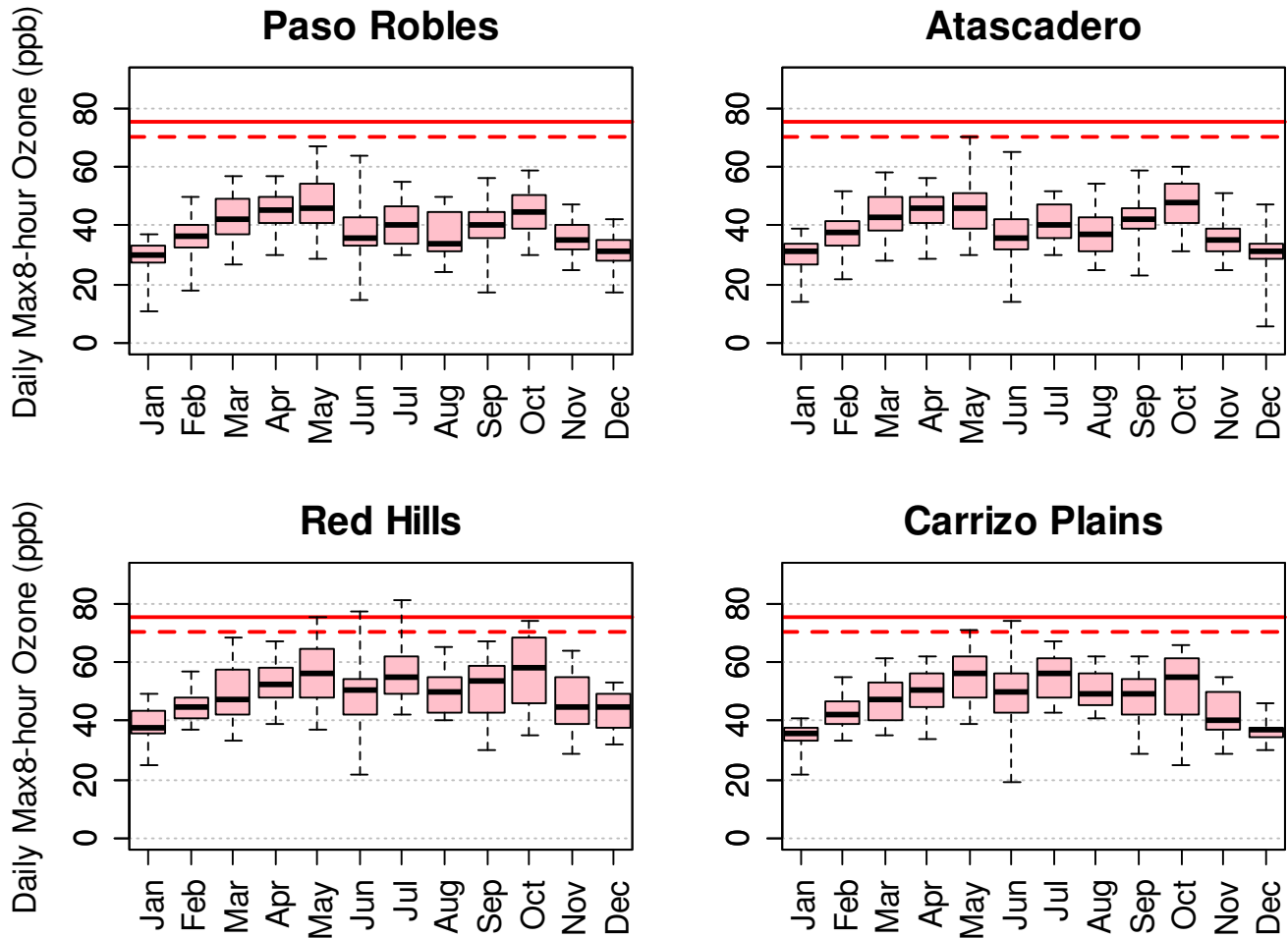


Figure 3: Monthly Ozone Variation in 2013

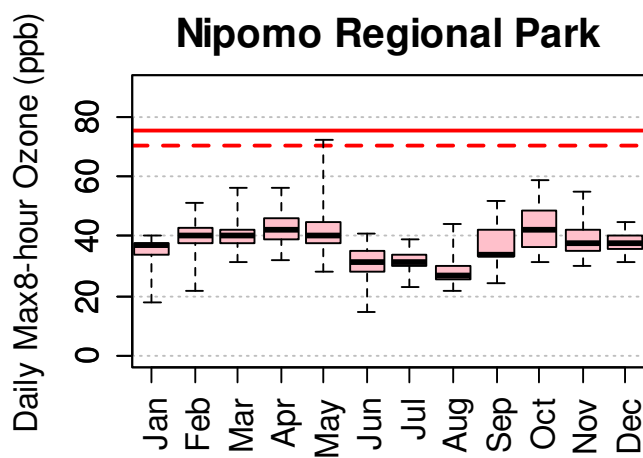
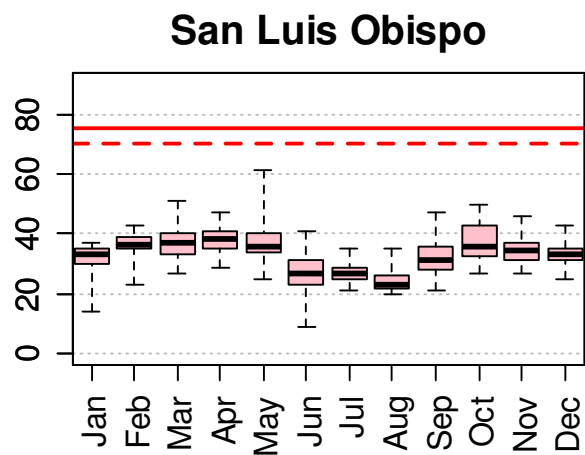
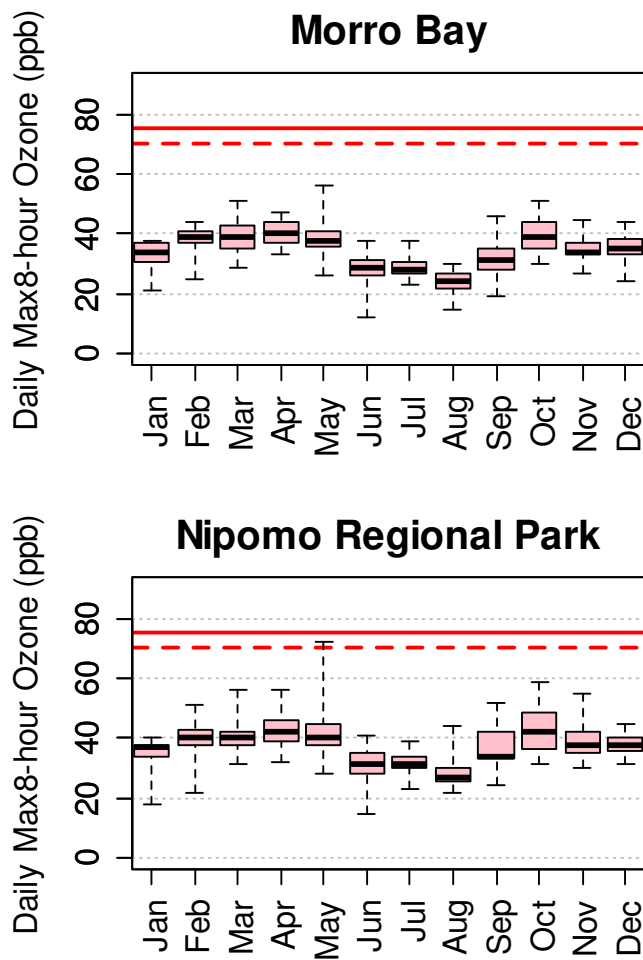


Figure 4: Monthly Ozone Variation in 2013

## Particulate Matter Data Summary

In 2013, the CDF station recorded two exceedences of the federal 24-hour  $PM_{10}$  standard of  $150 \mu\text{g}/\text{m}^3$ ;<sup>1</sup> no other stations exceeded this standard. Exceedences of the state 24-hour  $PM_{10}$  standard of  $50 \mu\text{g}/\text{m}^3$  were observed on 96 different days: 93 at CDF, 55 at Mesa2, 20 at NRP, two each at Atascadero and Paso Robles, and one at San Luis Obispo.<sup>2</sup> This year, NRP, CDF, Mesa2, and Paso Robles also exceeded the state annual average  $PM_{10}$  standard of  $20 \mu\text{g}/\text{m}^3$ , while the rest of the county remained below this level.<sup>3</sup>

The federal 24-hour  $PM_{2.5}$  standard of  $35 \mu\text{g}/\text{m}^3$  was exceeded three times at CDF in 2013; this site also exceeded the federal and state standards for annual average  $PM_{2.5}$  ( $12 \mu\text{g}/\text{m}^3$ ). As a result, the county will soon be designated by the ARB as nonattainment for that standard, since one year of exceeding the annual standard is a violation of the standard. Violation of the federal  $PM_{2.5}$  annual standard (also  $12 \mu\text{g}/\text{m}^3$ ) does not occur until the 3-year average of annual averages exceeds the standard. Unfortunately, data collected so far in 2014 indicates we may be in danger of violating the federal standard as well by year's end.

### Maximum 24-hr Concentrations and Annual Averages

Table 4 lists the highest 24-hour concentrations recorded in 2013 (and the dates on which they occurred) as well as the annual means for  $PM_{10}$  and  $PM_{2.5}$  for all stations where these pollutants were monitored. Values exceeding federal standards are shown in **bold**; those exceeding state standards are underlined.

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<sup>1</sup> While the federal  $PM_{10}$  standard is nominally  $150 \mu\text{g}/\text{m}^3$ , 40 CFR 50 Appendix K specifies that ambient  $PM_{10}$  measurements are to be rounded to the nearest  $10 \mu\text{g}/\text{m}^3$  before being compared to the standard. Therefore, 24-hour  $PM_{10}$  measurements between  $150$  and  $154 \mu\text{g}/\text{m}^3$  are technically not exceedences of the standard and are not counted as such by the EPA when determining attainment. In addition to the two  $PM_{10}$  exceedences recorded at CDF in 2013, a value of  $152 \mu\text{g}/\text{m}^3$  was also recorded at CDF on April 8. This is not considered an exceedence of the standard.

<sup>2</sup> ARB and EPA apply different conventions to the handling of significant digits. The ARB website (<http://www.arb.ca.gov/adam/topfour/topfour1.php>) thus counts 95 exceedences of the state  $PM_{10}$  standard at CDF, 59 at Mesa2, 20 at Nipomo Regional Park, and two at Atascadero. It also counts 19 at Paso and three at San Luis Obispo, but these differences are due to data points in the ARB database that should have been invalidate but were not.

<sup>3</sup> With the exception of data from San Luis Obispo and Paso Robles, the  $PM_{10}$  concentrations discussed in the text and shown in tables and graphs are corrected to standard temperature and pressure (STP). This is to facilitate comparison to the  $PM_{10}$  NAAQS, which is defined in STP units. For San Luis Obispo and Paso Robles, STP data is only available from June onward. Before June, only uncorrected  $PM_{10}$  data is available. Therefore, a mixture of STP and uncorrected  $PM_{10}$  data is used for these sites. Differences between data corrected to STP and data is generally very small, typically less than a few percent.

**Table 4: Summary of PM<sub>10</sub> and PM<sub>2.5</sub> Statistics for 2013**

Station	PM <sub>10</sub>		PM <sub>2.5</sub>	
	Highest 24-hour Concentration	Annual Arithmetic Mean	Highest 24-hour Concentration	Annual Arithmetic Mean
Paso Robles	<u>61 µg/m<sup>3</sup></u> 10/04	<u>21.5 µg/m<sup>3</sup></u>		
Atascadero	<u>59 µg/m<sup>3</sup></u> 10/04	19.2 µg/m <sup>3</sup>	33.0 µg/m <sup>3</sup> 12/14	7.5 µg/m <sup>3</sup>
San Luis Obispo	<u>70 µg/m<sup>3</sup></u> 10/04	17.0 µg/m <sup>3</sup>	19.5 µg/m <sup>3</sup> 12/18	6.8 µg/m <sup>3</sup>
CDF, Arroyo Grande	<b><u>163 µg/m<sup>3</sup></u></b> 05/22	<u>39.9 µg/m<sup>3</sup></u>	<b><u>39.6 µg/m<sup>3</sup></u></b> 09/25	<b><u>12.5 µg/m<sup>3</sup></u></b>
Nipomo Regional Park	<u>107 µg/m<sup>3</sup></u> 10/04	<u>25.1 µg/m<sup>3</sup></u>		
Mesa2, Nipomo	<u>132 µg/m<sup>3</sup></u> 05/22	<u>29.3 µg/m<sup>3</sup></u>	32.0 µg/m <sup>3</sup> 05/30	9.7 µg/m <sup>3</sup>



### Monthly PM<sub>10</sub> Summary

Figures 5 and 6, below, summarize the 24-hour PM<sub>10</sub> values from the six stations where this pollutant was measured in 2013. As with the ozone plots above, 50% of all measured values are captured in the red box for each month; 25% of values fall between the top of the box and the upper whisker line, and 25% of the values fall between the bottom of the box and the lower whisker line. The dashed and solid red lines mark the state and federal 24-hour standards of 50 and 150 µg/m<sup>3</sup>, respectively.

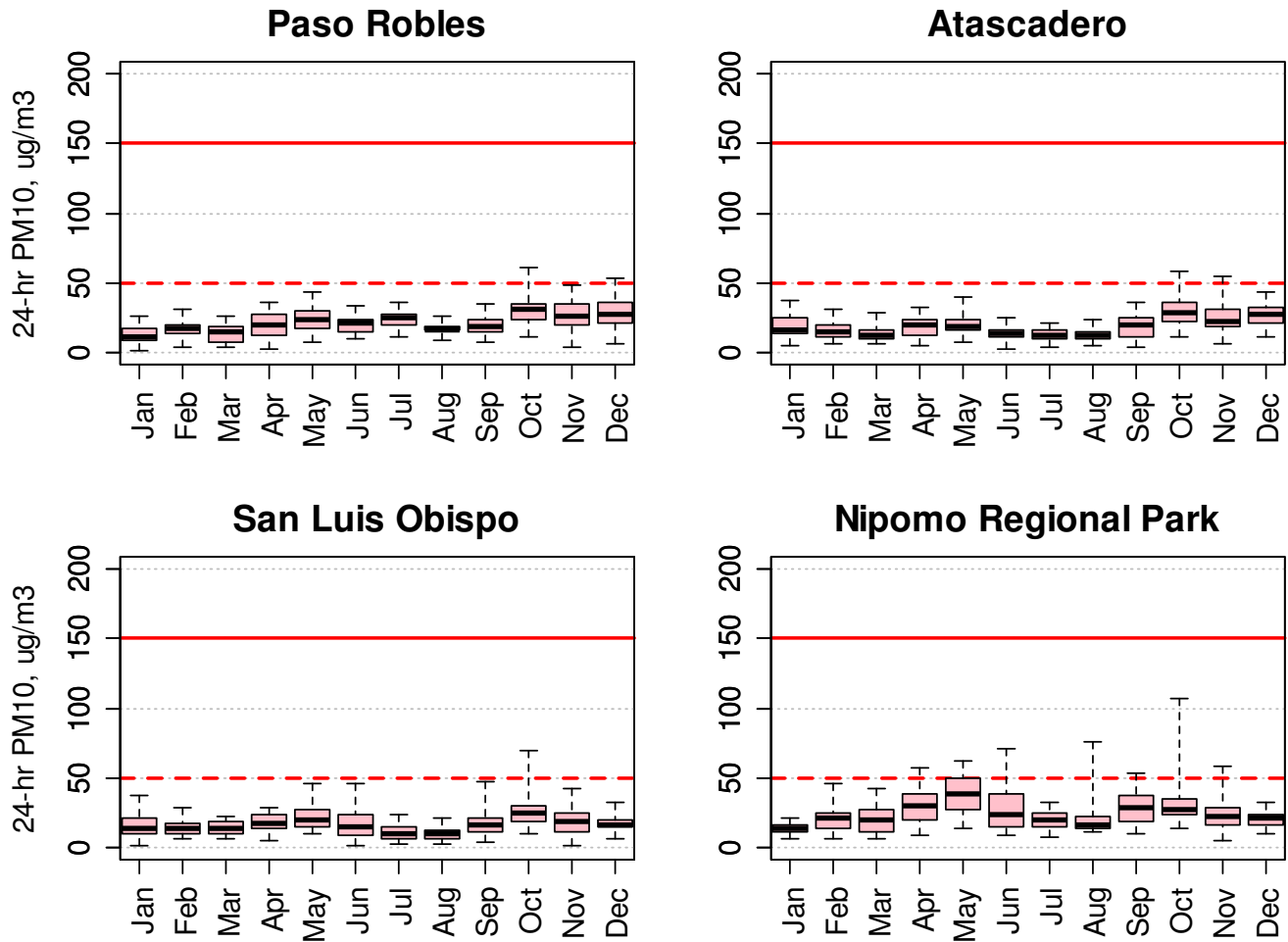


Figure 5: Monthly PM<sub>10</sub> Variation in 2013

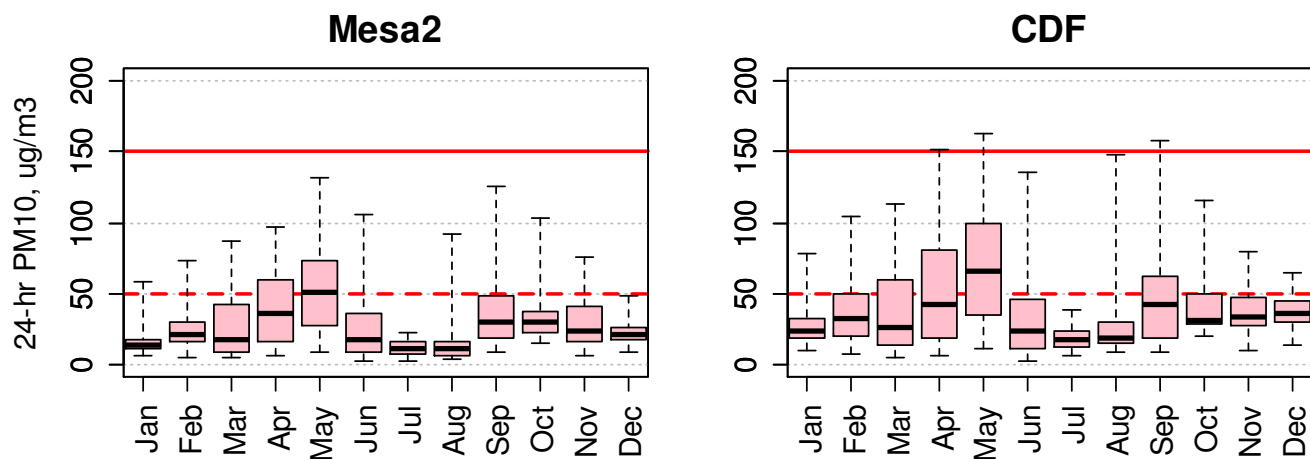


Figure 6: Monthly PM<sub>10</sub> Variation in 2013

### Monthly PM<sub>2.5</sub> Summary

Monitoring for fine particulate matter (PM<sub>2.5</sub>) was performed at four locations in 2013: San Luis Obispo, Atascadero, Mesa2, and CDF. The following graphs summarize 24-hr PM<sub>2.5</sub> values by site. The red line marks the federal 24-hour standard of 35 µg/m<sup>3</sup>; there is no state 24-hour standard for PM<sub>2.5</sub>.

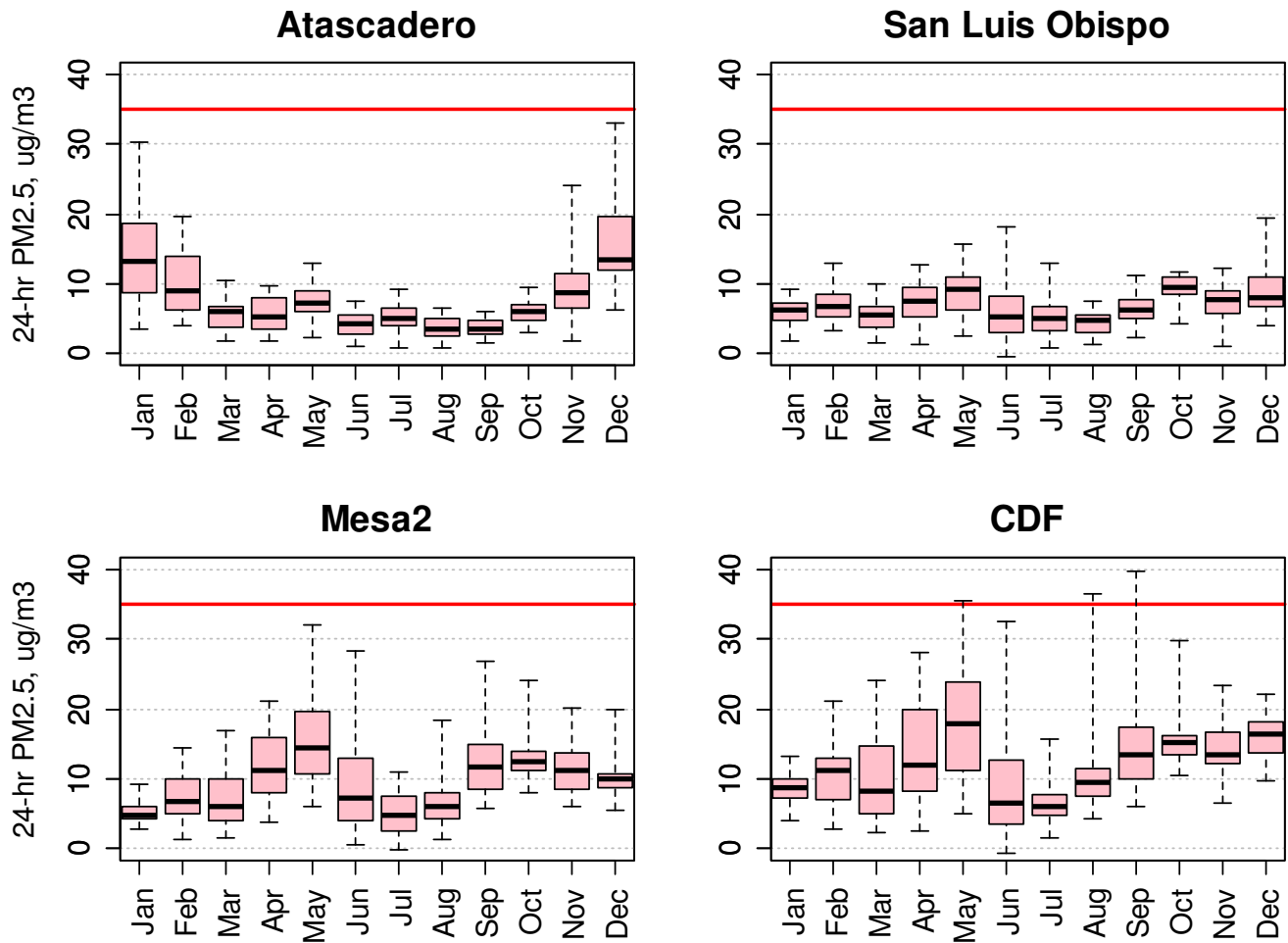


Figure 7: Monthly PM<sub>2.5</sub> Variation in 2013

## Trends

### Countywide Ozone Trends, 2004 - 2013

The following graphs (Figures 8 and 9) depict ozone trends at seven locations within the county for the past 10 years, except Carrizo Plains, where monitoring began in 2006. Each data bar represents the total number of hours in a given year during which the ozone concentration was at or above 65 ppb. This is a useful indicator for trend purposes even though there are no health standards for single-hour exposures to this level of ozone.

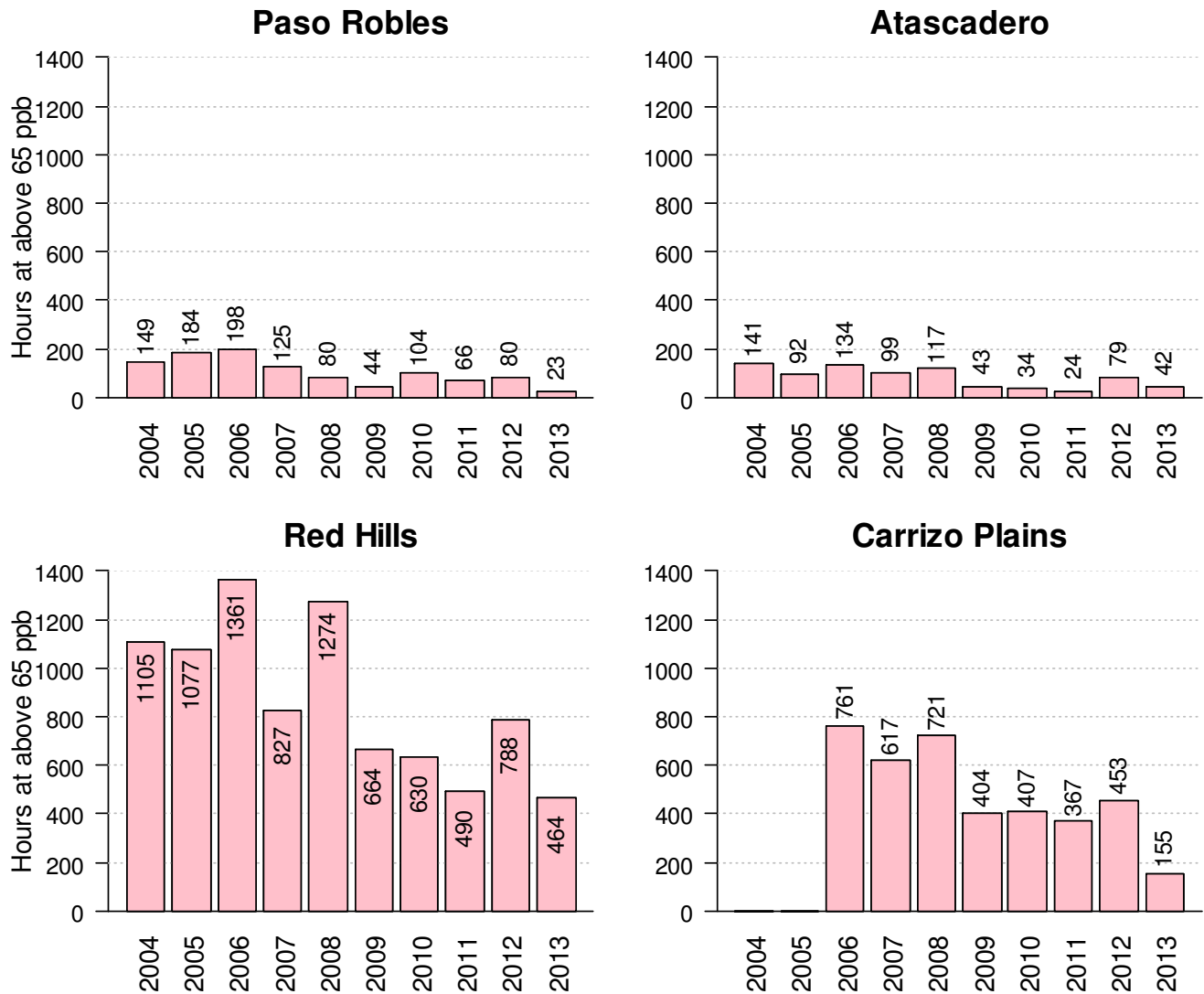
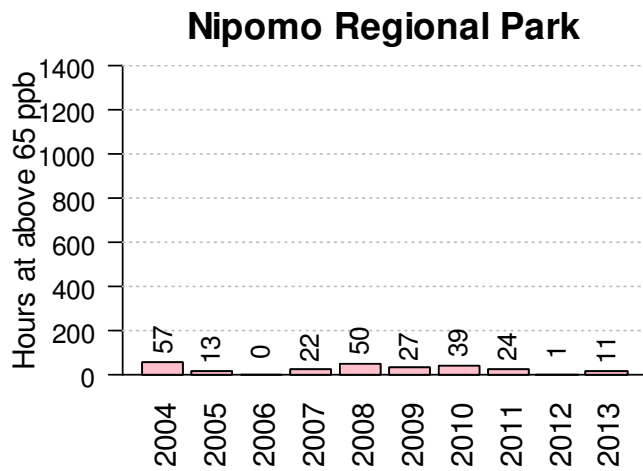
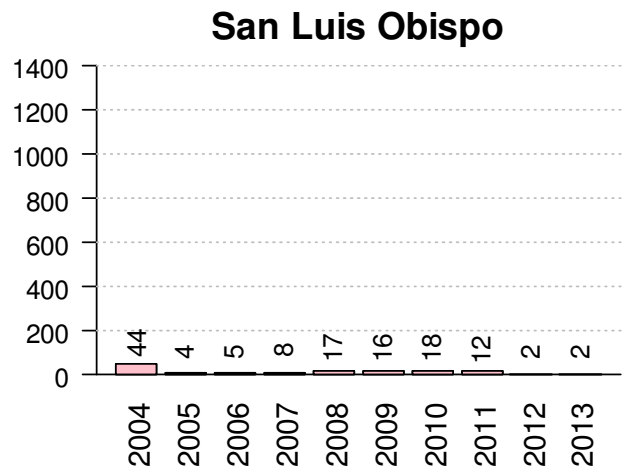
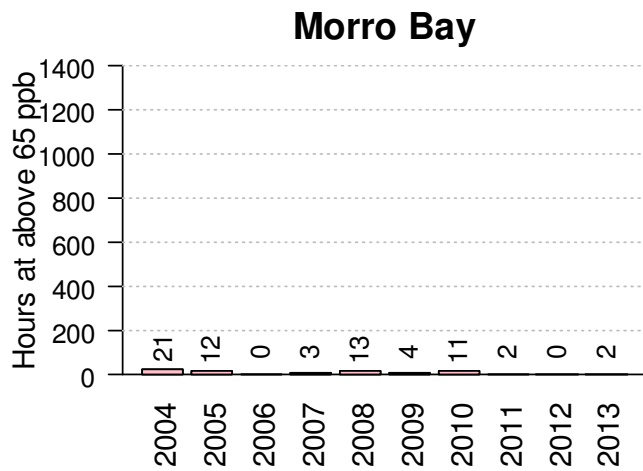


Figure 8: Hours At or Above 65 ppb Ozone, 2004-2013



**Figure 9: Hours At or Above 65 ppb Ozone, 2004-2013**

### Countywide Particulate Matter Trends, 2003 - 2013

Figure 10, below, depicts the annual average PM<sub>10</sub> concentrations at six locations in SLO County over the past 11 years; the SLO station moved in 2005 so data is not shown for that year. The red dashed line marks the state PM<sub>10</sub> standard for the annual arithmetic mean, 20 µg/m<sup>3</sup>. While occasional exceedences of the standard occur at most sites, the monitors on the Nipomo Mesa at Nipomo Regional Park, Mesa2, and CDF are consistently higher than elsewhere in the county.

Trends in the annual average PM<sub>2.5</sub> levels are depicted in Figure 11 for the four sites in the county where it is measured. Data for the past 11 years are shown, and years with partial data are omitted. The red dashed line marks the 12 µg/m<sup>3</sup> state and federal PM<sub>2.5</sub> standard for the annual mean. As with PM<sub>10</sub>, the stations on the Nipomo Mesa record higher levels than those elsewhere in the county.

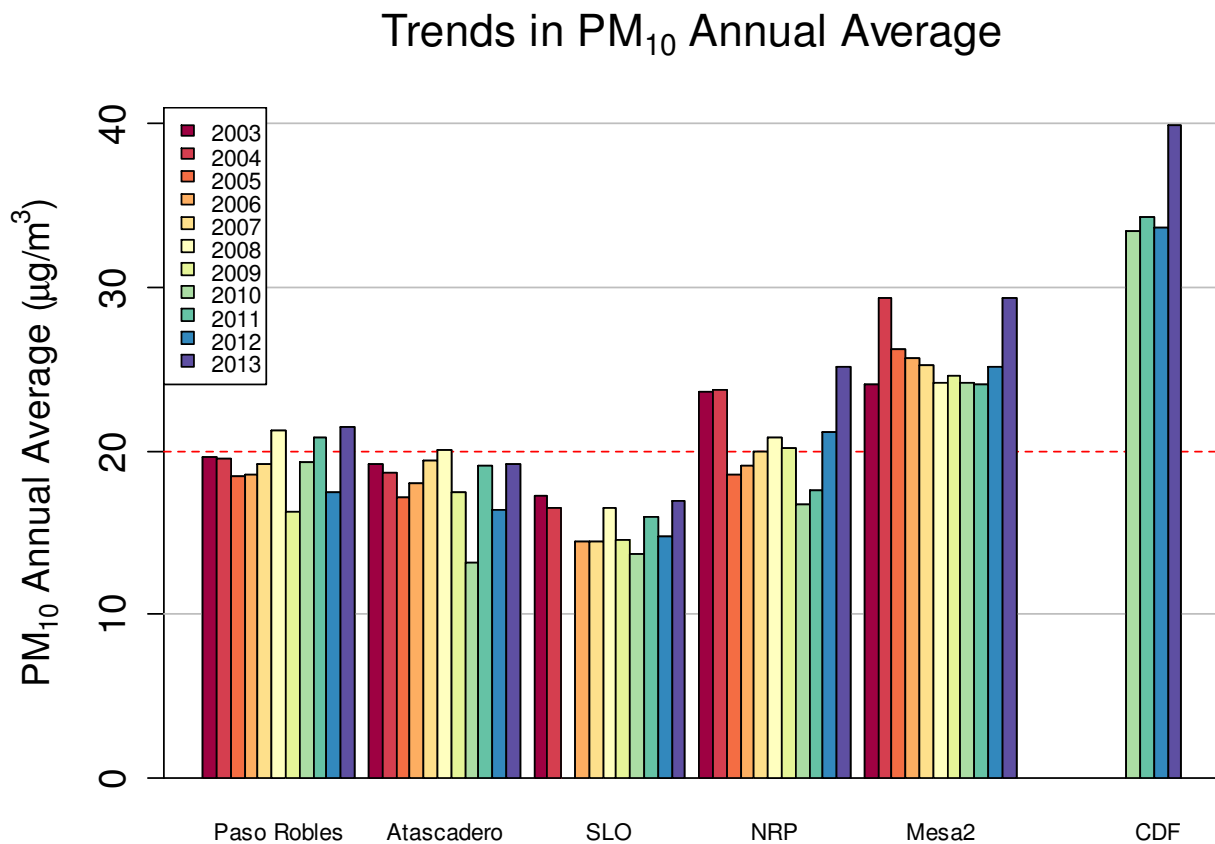


Figure 10: PM<sub>10</sub> Annual Average, 2003-2013

## Trends in PM<sub>2.5</sub> Annual Average

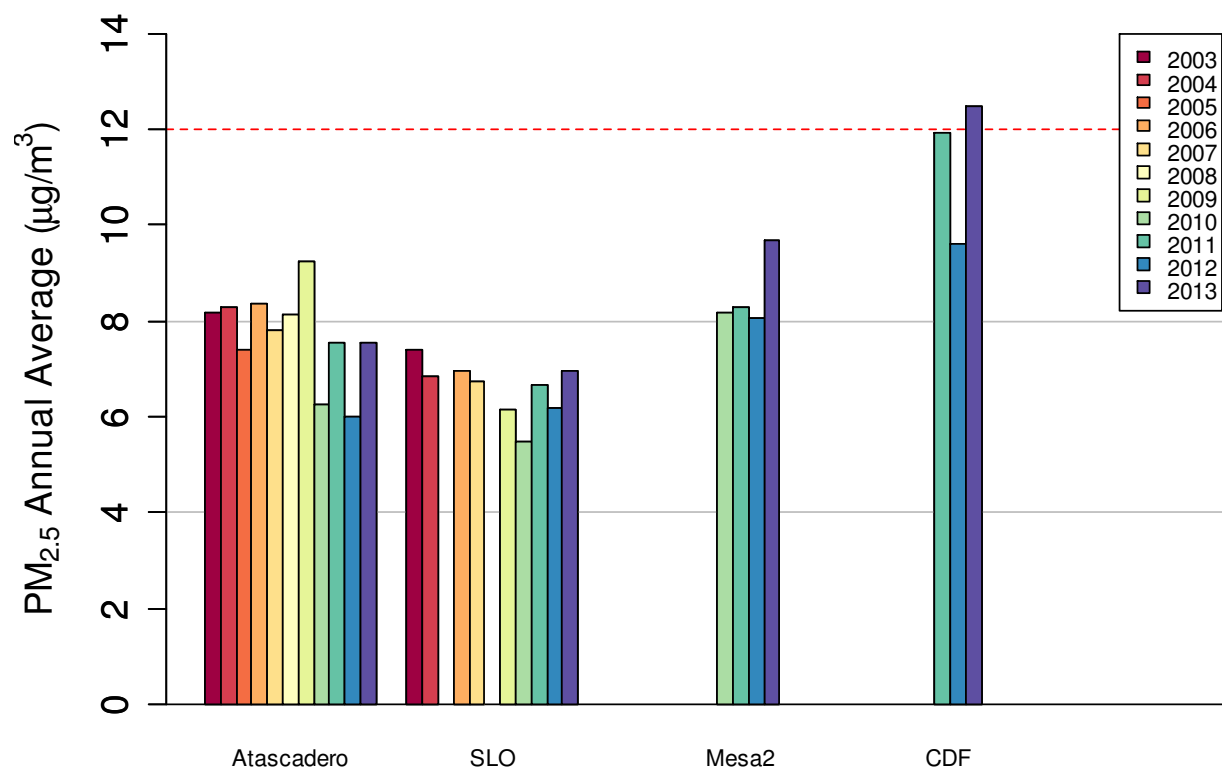


Figure 11: PM<sub>2.5</sub> Annual Averages, 2003-2013

## Ambient Air Monitoring Network Plans

Each year APCD prepares an Ambient Air Monitoring Network Plan. This document is an annual examination and evaluation of the APCD network of air pollution monitoring stations. The annual review of the network is required by 40 CFR 58.10. The review process helps ensure continued consistency with the monitoring objectives defined in federal regulations, and it confirms that the information in state and federal monitoring records accurately describes each station.

Each report is a directory of existing and proposed monitors in the APCD network and serves as a progress report on the recommendations and issues raised in earlier network reviews. Reports also address ongoing network design issues. The most recent Ambient Air Monitoring Network Plan is available online at <http://www.slocleanair.org/air/stations.php>.

In 2013, no major changes were made to the monitoring network. No stations were closed, no new stations opened, and no monitors were added or removed from existing stations. Only minor equipment and structural upgrades were made; see the 2014 Plan for details.



## Appendix A: Ozone in Eastern San Luis Obispo County

The Red Hills and Carrizo Plains monitoring stations have routinely recorded exceedences of the federal 8-hour ozone standard (75 ppb), and in 2012 the EPA officially designated the eastern portion of the County as a nonattainment area for that standard;<sup>4</sup> see Figure 1 for the boundary of the nonattainment area. The purpose of this appendix is to take a closer look at ozone levels in this area and explore the cause(s) of the continued exceedences.

In its recommendation to EPA for area designations, the APCD and ARB argued that these exceedences are caused by the transport of ozone and ozone precursors from the San Joaquin Valley and the San Francisco Bay Area.<sup>5</sup> The EPA concurred, citing an analysis of local meteorological conditions and back trajectory calculations performed by APCD staff.<sup>6</sup> An analysis of 2012 data was presented in the 2012 Annual Air Quality Report. That analysis suggested that, while emissions from within the county contribute to the ozone levels observed at Red Hills and Carrizo Plains, the highest concentrations at those sites that year were caused by transport of ozone and/or its precursors from outside of the county. A similar analysis using 2013 data is presented below, and the same conclusions are reached.

This analysis employs polar plots to depict the relationship between ozone levels and wind speed and direction. In these plots, wind direction is shown as on a compass, and wind speed is plotted radially outward from the center. Ozone intensity is displayed with the color scale. In these plots, various measures of pollutant intensity can be used; average hourly ozone and maximum hourly ozone are the measures used here.<sup>7</sup> For example, Figure A1, below, presents polar plots of average hourly ozone at Red Hills. The upper left panel of the figure is the plot for springtime levels.<sup>8</sup> This panel shows that in the spring when winds blew directly from the east at 20 mph, the *average* ozone concentration at the site was about 50 to 55 ppb. Figure A2 is analogous, except maximum ozone levels are depicted. The upper left panel of this figure shows that out of all the occasions in the spring when 20 mph winds blew directly from the east, the *maximum* observed level was about 60 ppb.

### Red Hills

Figures A1 and A2, below, present polar plots showing the dependence of hourly ozone concentrations on the local wind speed and direction in 2013. As shown in the figures, average and maximum ozone levels are highest in the spring and summer and when winds blow from the east. Since the Red Hills site is located just 2 miles west of the county line, this suggests the elevated ozone levels measured at that station come from across the county line. That high ozone levels are associated with high winds (rather than with stagnant conditions) also supports transport as the cause.

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<sup>4</sup> 77 FR 30087, May 21, 2012.

<sup>5</sup> Letter from Mary D Nichols, Chairman, Air Resources Board, to Laura Yoshi, Acting Regional Administrator, U.S. Environmental Protection Agency, Region 9, dated March 11, 2009. [http://www.epa.gov/glo/designations/2008standards/rec/letters/09\\_CA\\_rec.pdf](http://www.epa.gov/glo/designations/2008standards/rec/letters/09_CA_rec.pdf)

<sup>6</sup> Letter from Jared Blumenfeld, Acting Regional Administrator, U.S. Environmental Protection Agency, Region 9, to Edmund G. Brown, Jr., Governor of California, dated December 9, 2009. <http://www.epa.gov/glo/designations/2008standards/rec/region9R.htm>

<sup>7</sup> These plots were produced using openair (Carslaw, D.C. and K. Ropkins, (2012) openair — an R package for air quality data analysis. Environmental Modelling & Software. Volume 27-28, 52-61,) which employs an algorithm that first populates wind speed/wind direction bins with pollutant concentrations, then finds the average or maximum concentration in each bin, and finally fits a smooth surface to these values. This surface is what is plotted in the color scale shown in the figure. There tend to be few observations along the edge of surface (i.e., at the highest wind speeds), so uncertainty is highest along the edge.

<sup>8</sup> In all figures with separate panels for each season, spring is taken to be March, April, and May; summer to be June, July, and August; fall to be September, October, and November; and winter to be December (2013), January, and February.

While Figures A1 and A2 clearly show that strong winds from the east are associated with high ozone levels, these conditions occur infrequently—especially in the summer months when ozone levels tend to be the highest. This is depicted in the wind roses presented in Figure A3. This underscores that the exceedences of the ozone standard at this station are driven by relatively rare events when ozone is transported to the station from the east.

These polar plots demonstrate that the highest ozone levels observed at Red Hills enter the immediate area of the station from just outside of the county, but they do not provide insight into the ultimate source of the high levels observed at the station. It is possible, for example, that ozone precursors could originate within the county, are then blown eastward into Kern County, and then finally are blown back into San Luis Obispo County where the resulting ozone is measured at Red Hills. To investigate this issue, back trajectories were calculated for Red Hills for the three days that exceeded the federal ozone standard in 2013. In its analysis, EPA used the National Oceanic and Atmospheric Administration's (NOAA) Hybrid Single-Particle Lagrangian Integrated Trajectory ("HYSPLIT") tool to calculate back trajectories.<sup>9</sup> EPA calculated trajectories ending at 500 meters above ground level (m AGL) and used EDAS 40 km meteorological data. The back trajectories presented below were calculated analogously. For each HYSPLIT run, 24-hr back trajectories were calculated to bracket each hour included in the day's highest 8-hour ozone concentration.

The results of the HYSPLIT back trajectory calculations for 2013 are shown in Figures A4-A6. In all cases, the trajectories originate in the Bay Area or near Monterey Bay and spend little time over San Luis Obispo County before arriving at the Red Hills station. The trajectories all arrive at the station from out of the north or northwest, which is different from the pattern suggested by Figure A1 and different from the pattern observed in 2012. Nonetheless, taken together, Figures A1-A6 suggest ozone transport from outside of the county is the primary cause of the highest levels observed at the station in 2013. The fact that two of the three exceedences occurred overnight (contrary to the typical diurnal pattern of photochemistry [see Figure 2]) also supports this conclusion.

### **Carrizo Plains**

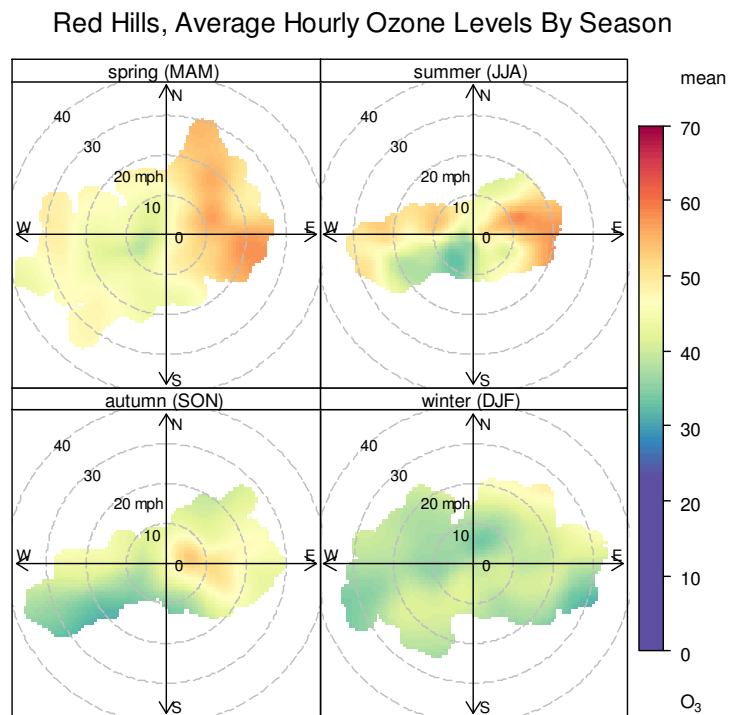
While the Red Hills station is located just two miles from the county line, the Carrizo Plains station is located more in the interior of the county, so no matter what its trajectory, an air mass must traverse the county for some time before reaching the station. Furthermore, the Carrizo Plains basin is bounded on one side by the Temblor Range which runs northwest to southeast, on the other by the La Panza Range—also running northwest to southeast—and to the south by the Caliente Range which separates it from Santa Barbara County. In most years, these terrain features tend to channel the winds along the northwest—southeast axis; see the 2012 Annual Air Quality Report for an example. In 2013, a somewhat different pattern emerged, with high frequencies of northeasterly winds in addition to the usual northwesterly and southeasterly winds, as shown in Figure A9.

Polar plots showing the dependence of hourly ozone concentrations on the local wind speed and direction are provided in Figures A7 and A8. Like those in the 2012 Report, these plots show that high ozone levels tend to arrive at the Carrizo Plains station from the northeast to northwest. Calm winds are associated with low ozone levels even during the summer months, suggesting that transport is the main cause of the higher ozone levels seen here.

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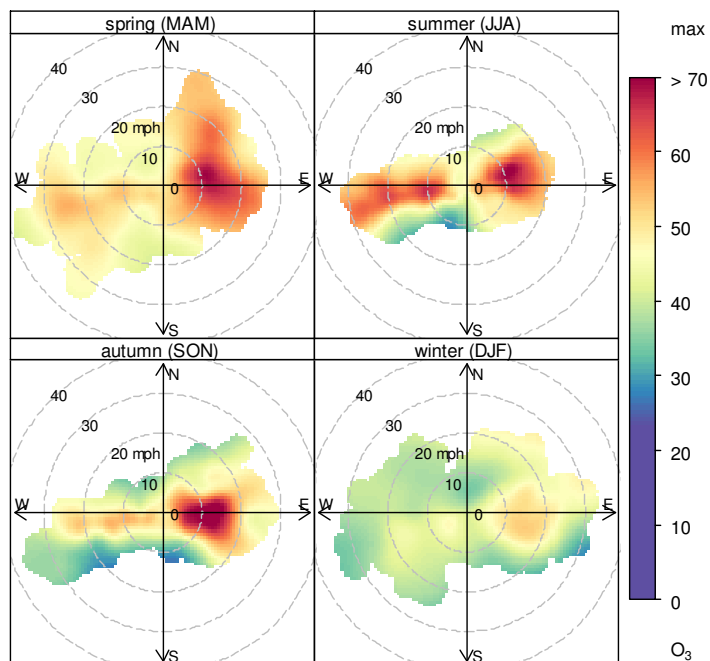
<sup>9</sup> Draxler, R.R. and Rolph, G.D., 2013. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (<http://www.arl.noaa.gov/HYSPLIT.php>). NOAA Air Resources Laboratory, College Park, MD.

There were no exceedences of the federal 8-hour ozone standard at this site in 2013, so no back trajectories are calculated.



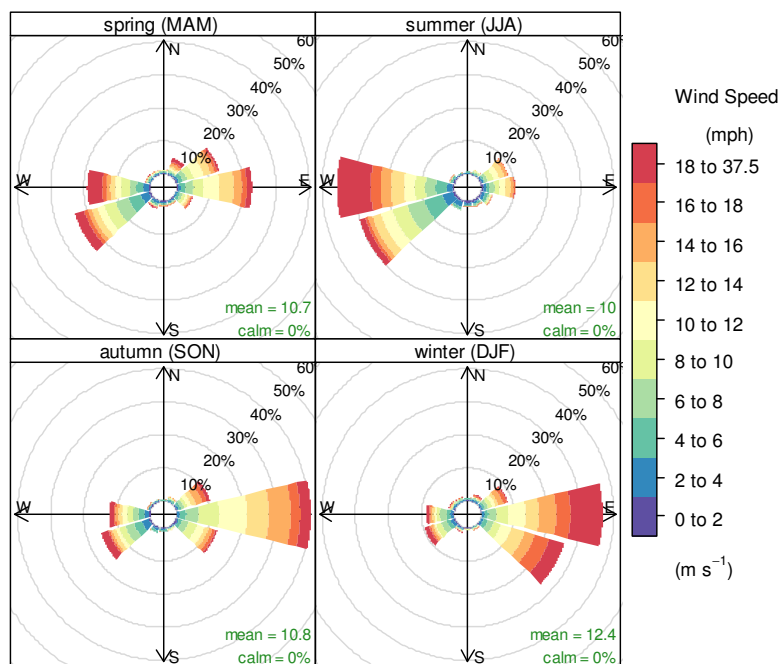
**Figure A1.** Polar plots showing average hourly ozone levels at Red Hills by wind speed, wind direction, and season for 2013.

### Red Hills, Maximum Hourly Ozone Levels By Season



**Figure A2.** Polar plots showing maximum hourly ozone levels at Red Hills by wind speed, wind direction, and season for 2013.

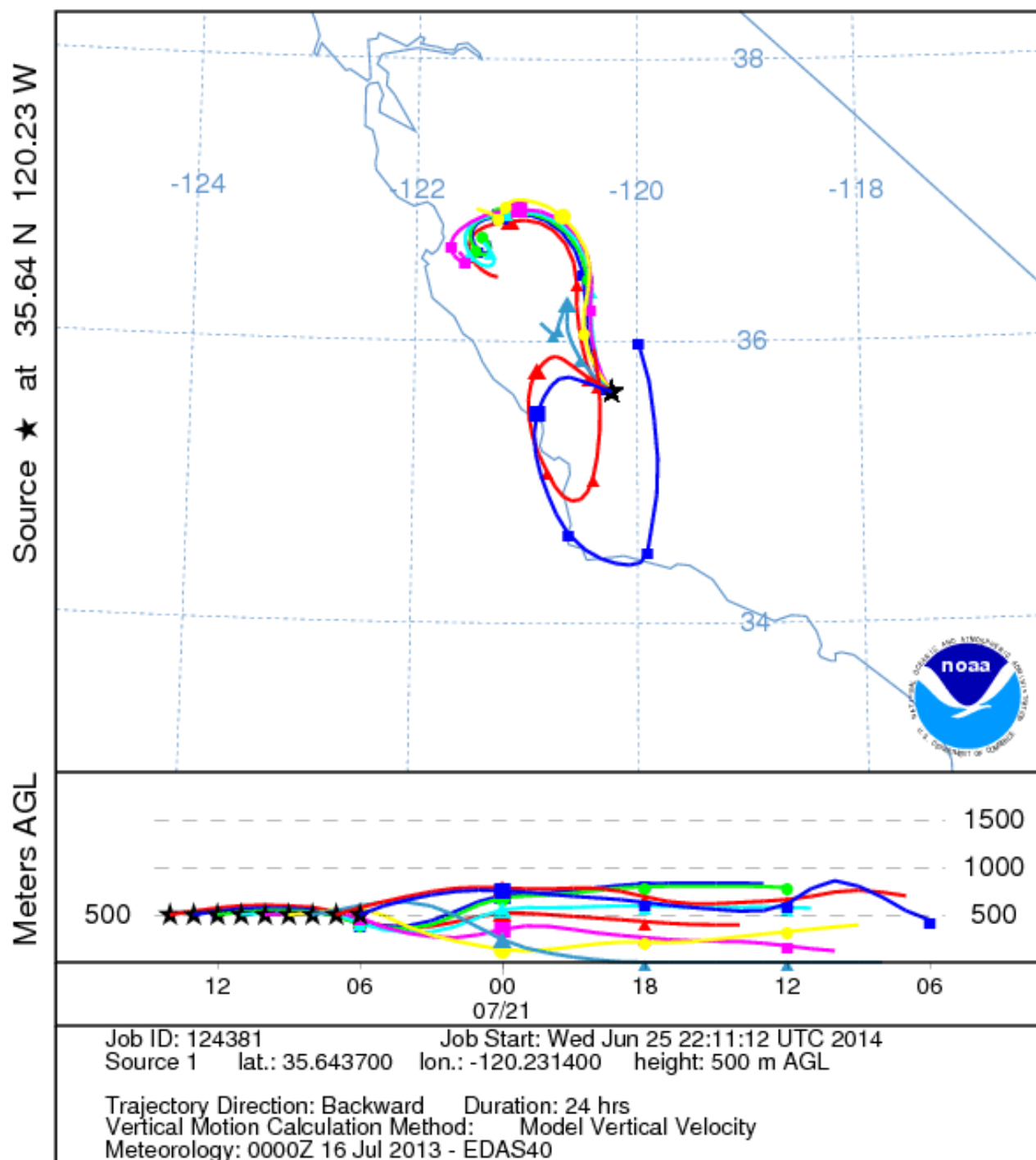
### Red Hills, Wind Roses By Season



Frequency of counts by wind direction (%)

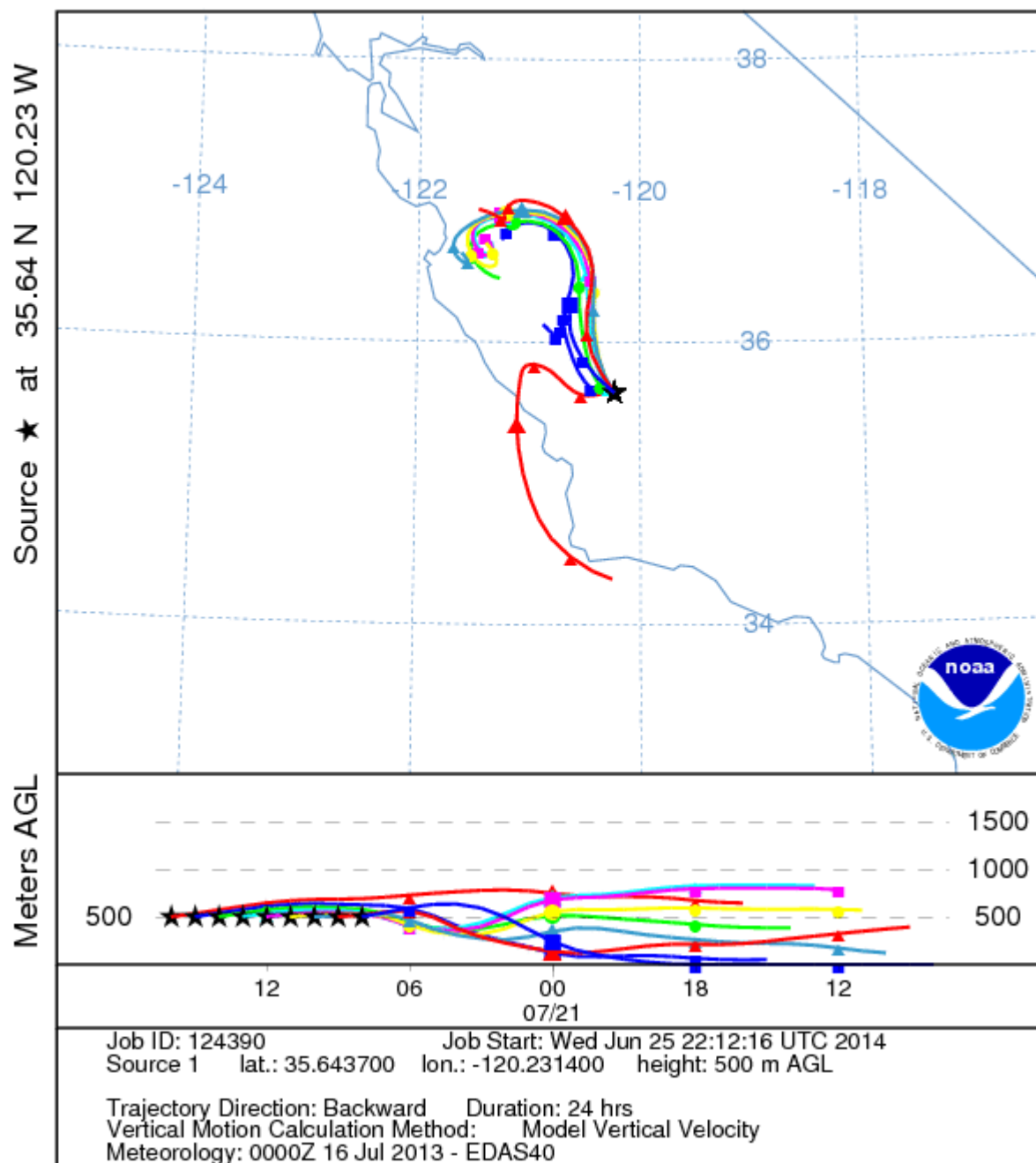
**Figure A3.** Wind roses showing the frequency distribution of wind speeds by direction and season at Red Hills in 2013.

NOAA HYSPLIT MODEL  
Backward trajectories ending at 1400 UTC 21 Jul 13  
EDAS Meteorological Data



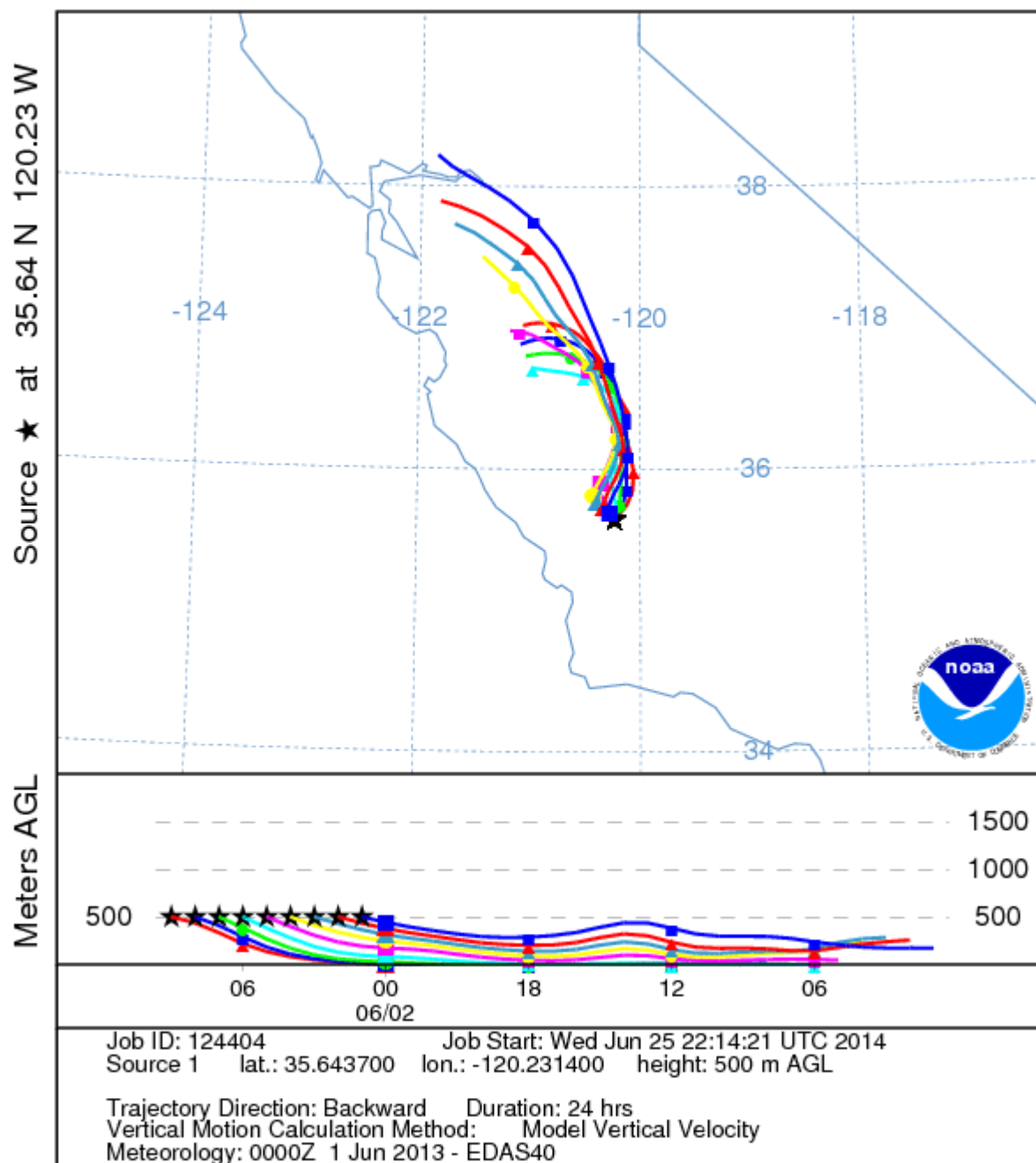
**Figure A4.** HYSPLIT back trajectories for the highest 8-hour ozone concentration (84 ppb) measured at Red Hills in 2013: July 20<sup>th</sup>, 22:00 through July 21<sup>st</sup>, 5:59 PST (UTC-8).

NOAA HYSPLIT MODEL  
Backward trajectories ending at 1600 UTC 21 Jul 13  
EDAS Meteorological Data



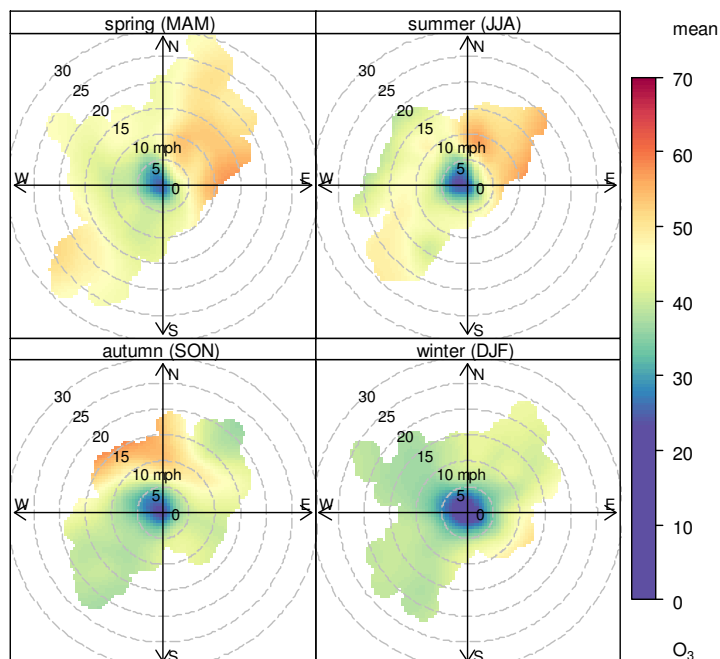
**Figure A5.** HYSPLIT back trajectories for the second highest 8-hour ozone concentration (80 ppb) measured at Red Hills in 2013: July 21<sup>st</sup>, 00:00 through 7:59 PST.

NOAA HYSPLIT MODEL  
Backward trajectories ending at 0900 UTC 02 Jun 13  
EDAS Meteorological Data



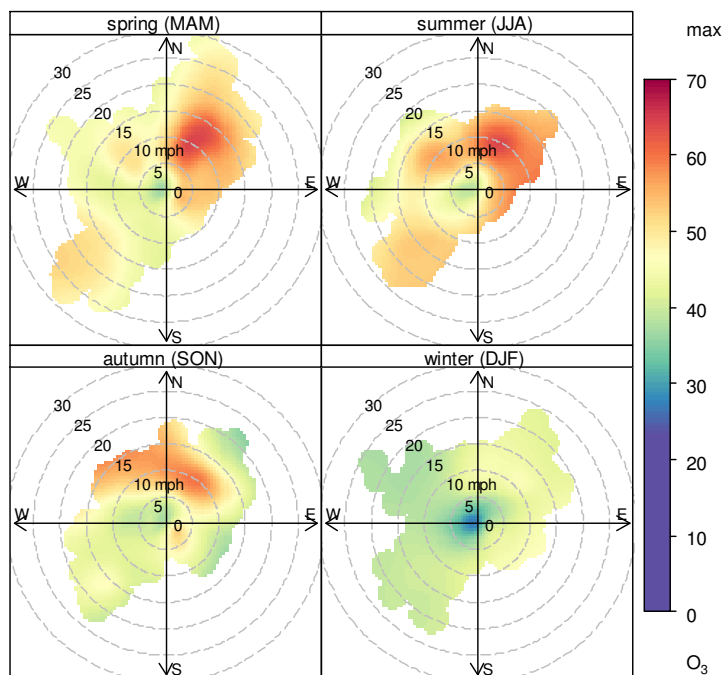
**Figure A6.** HYSPLIT back trajectories for the third highest 8-hour ozone concentration (77 ppb) measured at Red Hills in 2013, June 1<sup>st</sup>, 17:00 through June 2<sup>nd</sup>, 00:59 PST.

### Carrizo Plains, Average Hourly Ozone Levels By Season



**Figure A7.** Polar plots showing average hourly ozone levels at Carrizo Plains by wind speed, wind direction, and season for 2013.

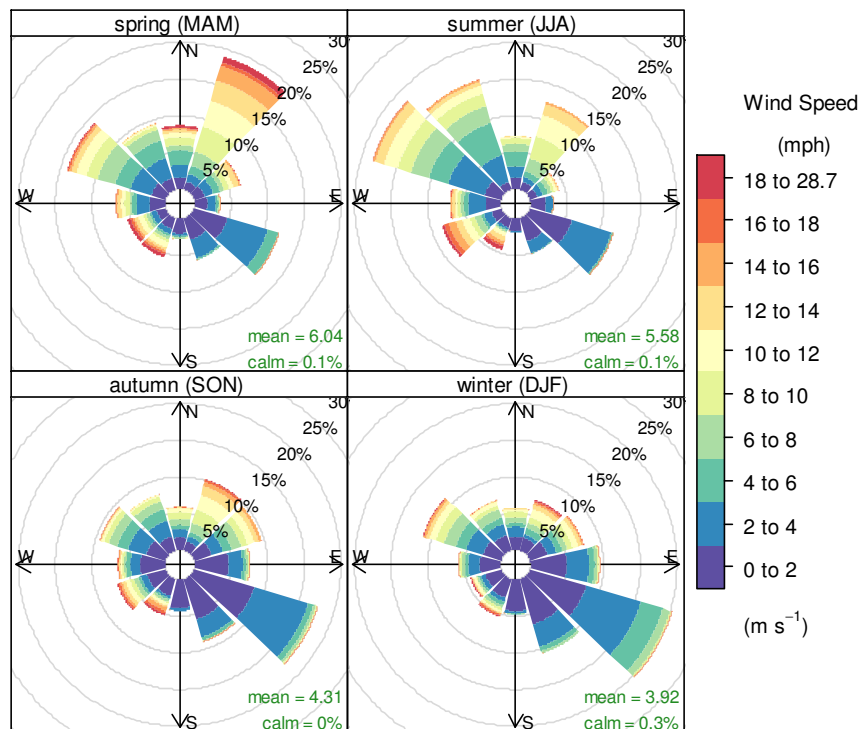
### Carrizo Plains, Maximum Hourly Ozone Levels By Season



**Figure A8.** Polar plots showing maximum hourly ozone levels at Carrizo Plains by wind speed, wind direction, and season for 2013.



## Carrizo Plains, Wind Roses By Season



### Frequency of counts by wind direction (%)

**Figure A9.** Wind roses showing the frequency distribution of wind speeds by direction and season at Carrizo Plains in 2013.

## Appendix B: Particulate Matter Along the Southern Coast of San Luis Obispo County

In contrast to the rest of the county where PM<sub>10</sub> and PM<sub>2.5</sub> levels have trended downward over the last 20 years, the Nipomo Mesa continues to see high levels of particulate matter pollution. A recent analysis of data from 1991 through 2011 found no evidence of improvement at CDF or Mesa2, and only slight improvement at Nipomo Regional Park.<sup>10</sup> Figure 10, above, suggests that whatever improvement Nipomo Regional Park saw through 2011 may have been erased in 2012 and 2013. Studies by the APCD have determined that the dune complex along the coast of the Five Cities area is the source of the high particulate matter levels measured at these stations.<sup>11,12</sup>

### Exceedences of the 24-hour PM<sub>10</sub> Standards on the Nipomo Mesa

Polar plots depicting hourly PM<sub>10</sub> levels as a function of wind speed and direction—analogueous to the ozone plots presented in Appendix A—show that coastal dunes continue to be the dominant influence on Nipomo Mesa PM<sub>10</sub> levels in 2013. For CDF, hourly PM<sub>10</sub> concentrations are shown by wind speed and direction in Figures B1 and B2. As in previous years, the highest levels are observed when winds are from the northwest, and increasing wind speeds correspond to higher PM<sub>10</sub> levels. These conditions occurred most frequently in the spring and fall, as shown in the wind roses (Figure B3, middle panel). The same picture emerges for Mesa2 (Figures B5 through B7.) These observations of 2013 data corroborate APCD's previous conclusions and show the Oceano Dunes State Vehicular Recreation Area is the primary source of the high particulate levels measured at this station.

For Nipomo Regional Park (Figures B9 through B11), a somewhat different pattern is evident. High PM<sub>10</sub> levels still correspond with high winds from the west, as would be expected with the ODSVRA as the dominant regional source. However, compared to CDF and Mesa2—which are close to the shore—PM<sub>10</sub> levels are significantly lower at NRP, which is further from the coast and centrally located in the community. As was the case in 2012, in 2013 some higher PM<sub>10</sub> levels also occur under other wind conditions, reflecting the influence of sources other than the dunes at this site.

### Annual Average PM<sub>2.5</sub> Levels on the Nipomo Mesa

As noted earlier, there are two federal PM<sub>2.5</sub> standards: the 24-hour standard (35 µg/m<sup>3</sup>) and the annual average standard (12 µg/m<sup>3</sup>). In 2013, both were exceeded at CDF, but assuming current trends continue the station is only at risk violating the annual average standard. The station is not currently in danger of violating the 24-hour standard because it must be exceeded multiple times each year for a violation to occur, and the three exceedences observed there this year and last year are not enough. (Specifically, for standard to be violated, the 98<sup>th</sup> percentile of the observed 24-hour values must exceed the standard. Since PM<sub>2.5</sub> is sampled daily, this means that the standard can be exceeded six or seven times each year without the standard being violated.)

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<sup>10</sup> Tupper, K.A., March 2013. Air Quality Trends, 1991-2011. San Luis Obispo County Air Pollution Control District, San Luis Obispo, Calif.

<http://www.slocleanair.org/images/cms/upload/files/Final%20AQ%20Trends%282%29.pdf>

<sup>11</sup> San Luis Obispo County Air Pollution Control District, 2007. Nipomo Mesa Particulate Study. San Luis Obispo, Calif. [http://www.slocleanair.org/images/cms/upload/files/air/pdf/pm\\_report2006\\_rev1.pdf](http://www.slocleanair.org/images/cms/upload/files/air/pdf/pm_report2006_rev1.pdf)

<sup>12</sup> Craig, J., Cahill, T., and Ono D., February 2010. South County Phase 2 Particulate Study. San Luis Obispo County Air Pollution Control District, San Luis Obispo, Calif.

[http://www.slocleanair.org/images/cms/upload/files/pdf/PM2-final\\_report.pdf](http://www.slocleanair.org/images/cms/upload/files/pdf/PM2-final_report.pdf)

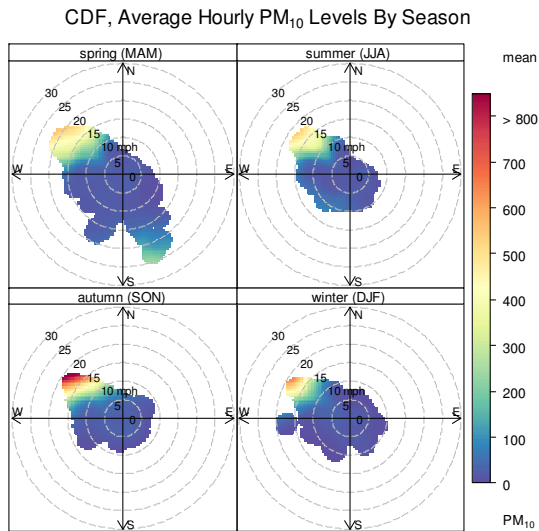
In contrast, the annual average standard is violated when the 3-year average exceeds the standard. As shown in Figure 11, annual average at CDF exceeded the standard in 2013 and approached it in 2011; 2012 was significantly lower. If subsequent years look like 2011 and 2013, then the station could violate the standard and the county could be designated as non-attainment for the annual average standard.

To investigate the sources that contribute to the PM<sub>2.5</sub> annual averages at CDF and Mesa2, polar plots of this pollutant vs wind speed and direction are shown in Figures B4 (CDF) and B8 (Mesa2). Instead of plotting maximum or average values (as was done for ozone and PM<sub>10</sub>), frequency weighted means are plotted, since this statistic better shows which wind speed/direction regions contribute the most to the annual average. To understand why, it is helpful to compare the federal PM<sub>10</sub> and PM<sub>2.5</sub> standards. The federal PM<sub>10</sub> standard is based on a 24-hour averaging time; there is no annual average standard for this pollutant. For the federal PM<sub>10</sub> standard to be violated, one or more exceedences per year are needed.<sup>13</sup> Polar plots of average and maximum PM<sub>10</sub> levels are therefore insightful because they show the conditions under which the maximum values occur. It matters less how frequently those conditions occur because even if they occur only once per year this is still often enough to cause a violation if the maximum exceeds the standard. In contrast, when considering an annual average, the maximum values and their frequency of occurrence are both important. For example, a single day that is much greater than the 24-hour standard will not likely cause the annual average to exceed the standard, if the other 364 days are well below the standard. On the other hand, if many of the individual days frequently exceed the level of the annual average standard even by a small amount, this could result in an annual average that exceeds the standard.

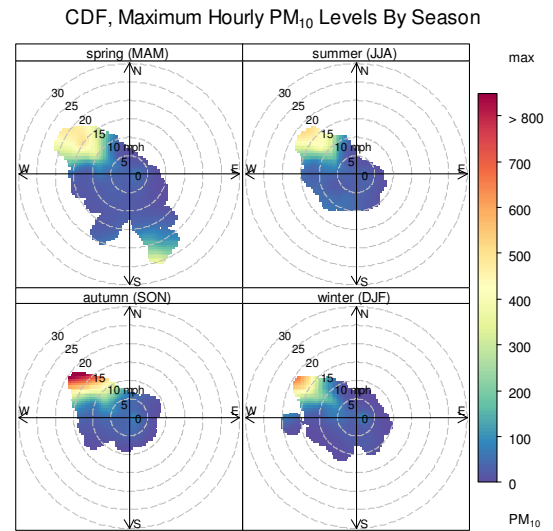
The frequency weighted means plotted in Figures B4 and B8 capture this interplay and show which wind speed/direction combination contribute the most to the PM<sub>2.5</sub> annual average. At CDF in the summer, fall, and especially spring, 10 to 15 mph-winds from the northwest are the biggest contributor to average PM<sub>2.5</sub> levels. This indicates the dunes are the dominant source of fine particulates that impact the site during those months; in the fall and especially in the winter, stagnation also appears to contribute. At Mesa2 the pattern is similar. This site measures stronger northwesterly winds than CDF, especially in the spring (compare Figures B3 and B7). This explains why the area contributing most to the average PM<sub>2.5</sub> levels is shifted to higher wind speed values in the spring. In the summer and fall, this area splits into high and medium wind speed regions, and in the fall and winter, contributions from stagnation become apparent.

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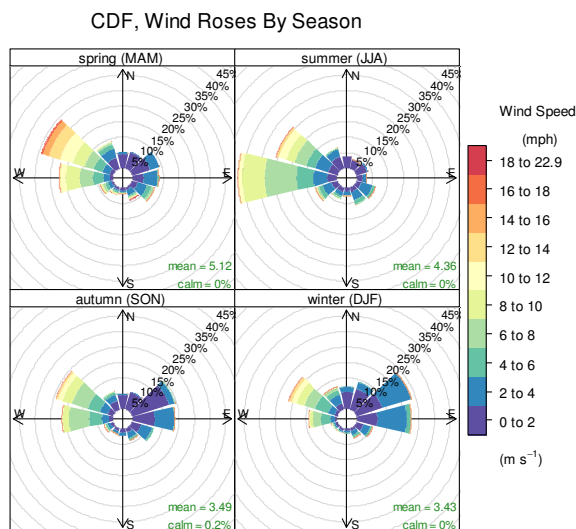
<sup>13</sup> Technically, for the federal 24-hr PM<sub>10</sub> standard to be violated, the average number of expected exceedences over a 3-year period needs to be 1 or more exceedences per year.



**Figure B1.** Polar plots showing average hourly PM<sub>10</sub> levels at CDF by wind speed, wind direction, and season for 2013.

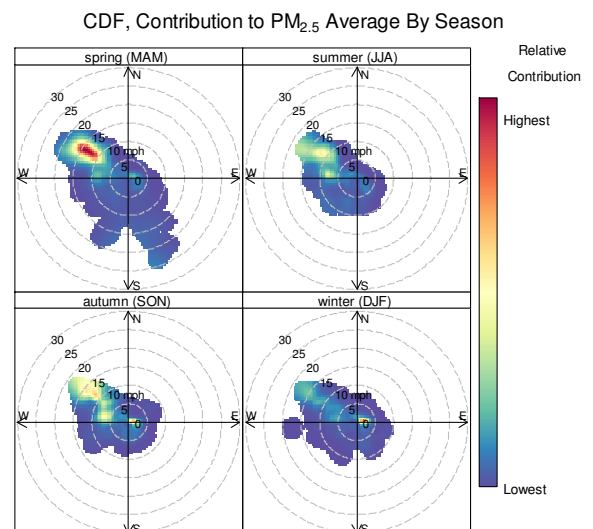


**Figure B2.** Polar plots showing maximum hourly PM<sub>10</sub> levels at CDF by wind speed, wind direction, and season for 2013.

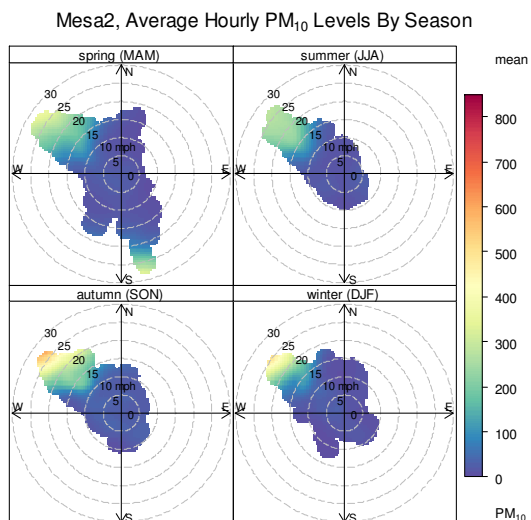


Frequency of counts by wind direction (%)

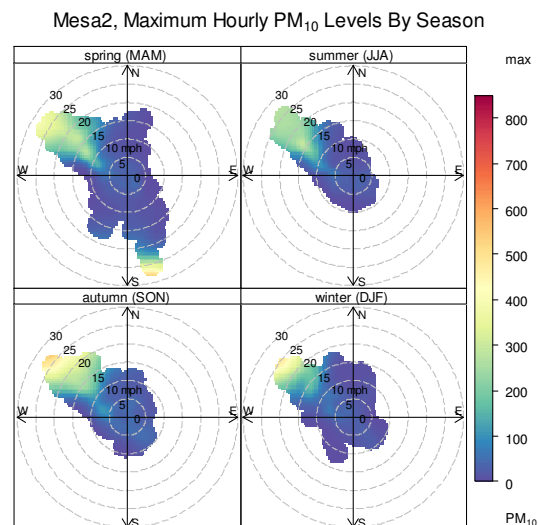
**Figure B3.** Wind roses showing the frequency distribution of wind speeds by direction and season at CDF in 2013.



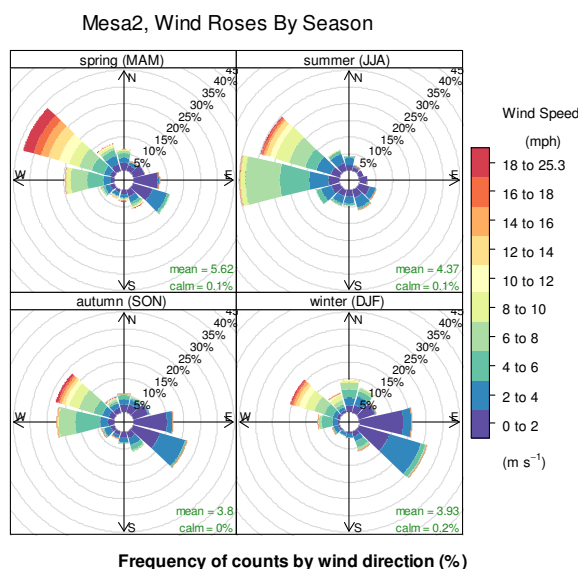
**Figure B4.** Polar plots showing contributions to the average PM<sub>2.5</sub> levels at CDF by wind speed, wind direction, and season for 2013.



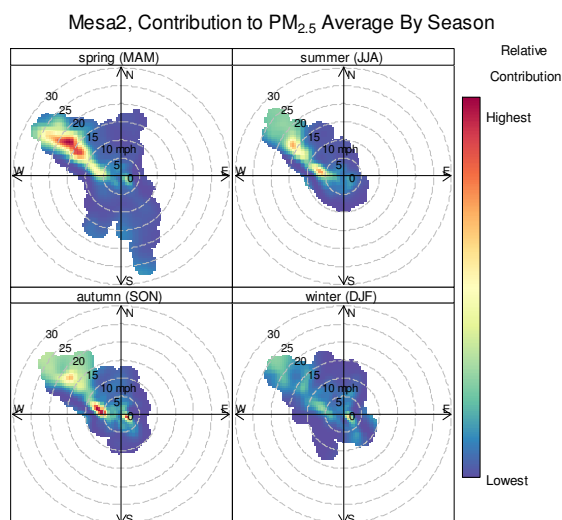
**Figure B5.** Polar plots showing average hourly PM<sub>10</sub> levels at Mesa2 by wind speed, wind direction, and season for 2013.



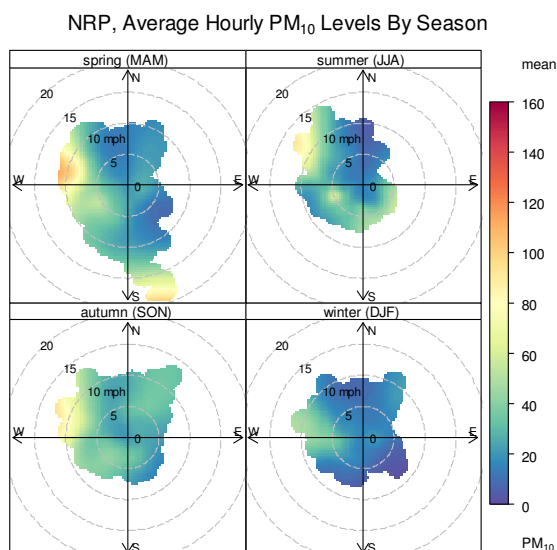
**Figure B6.** Polar plots showing maximum hourly PM<sub>10</sub> levels at Mesa2 by wind speed, wind direction, and season for 2013.



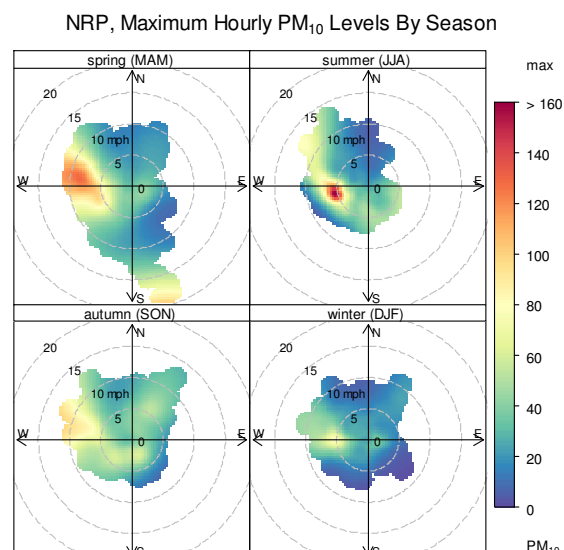
**Figure B7.** Wind roses showing the frequency distribution of wind speeds by direction and season at Mesa2 in 2013.



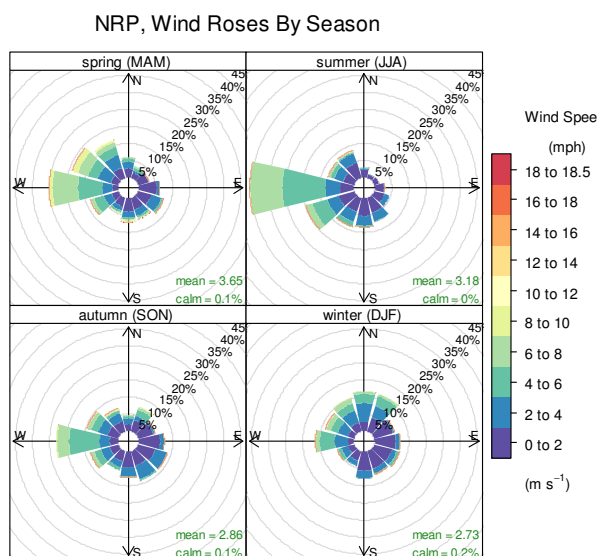
**Figure B8.** Polar plots showing contributions to the average PM<sub>2.5</sub> levels at Mesa2 by wind speed, wind direction, and season for 2013.



**Figure B9.** Polar plots showing average hourly PM<sub>10</sub> levels at Nipomo Regional Park by wind speed, wind direction, and season for 2013. Note that the color scale has a different range than that in Figures B1, B2, B5, and B6.



**Figure B10.** Polar plots showing maximum hourly PM<sub>10</sub> levels at Nipomo Regional Park by wind speed, wind direction, and season for 2013. Note that the color scale has a different range than that in Figures B1, B2, B5, and B6.



Frequency of counts by wind direction (%)

**Figure B11.** Wind roses showing the frequency distribution of wind speeds by direction and season at Nipomo Regional Park in 2013.