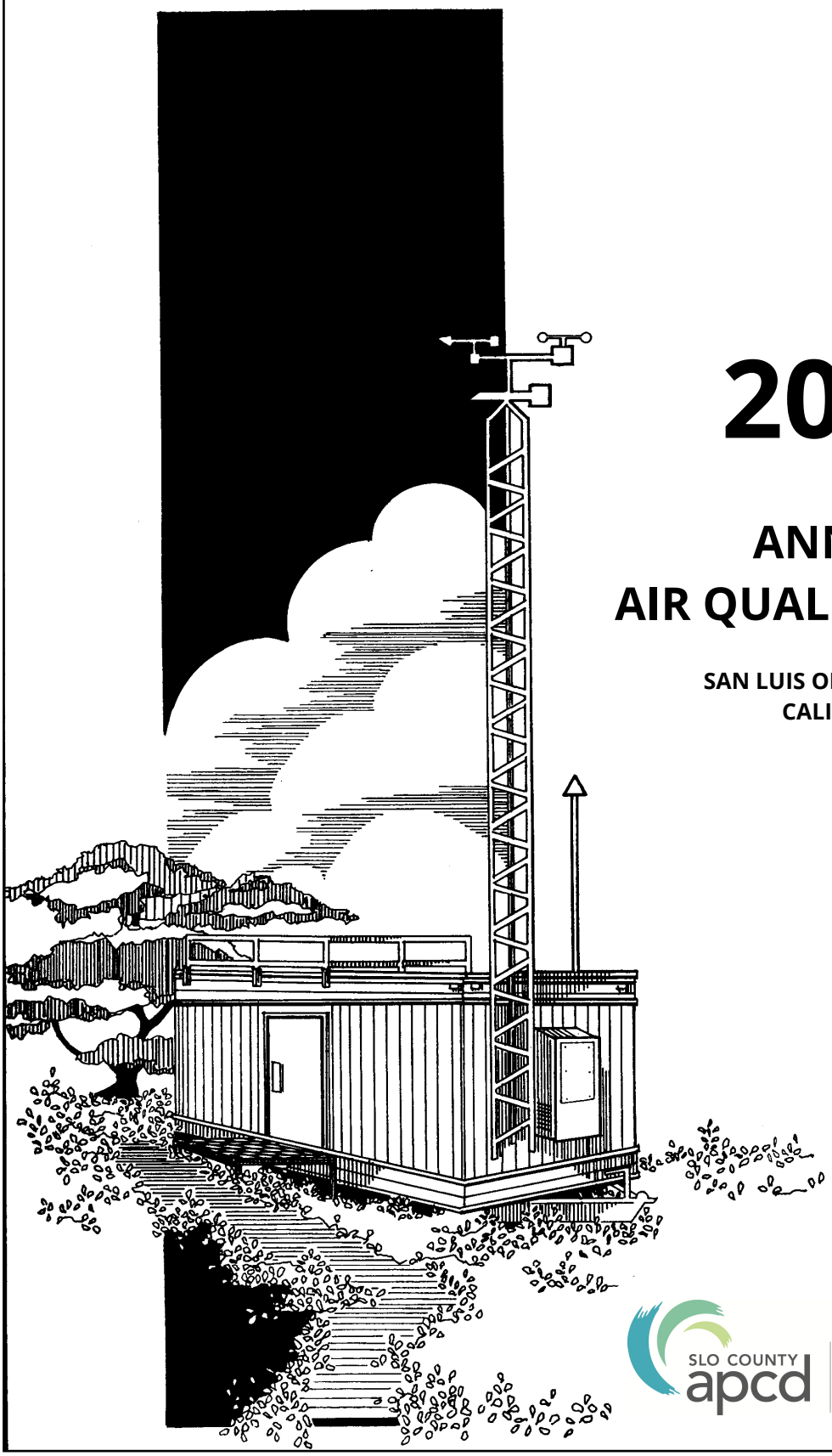

# 2014

# ANNUAL AIR QUALITY REPORT

**SAN LUIS OBISPO COUNTY**
**CALIFORNIA**

SLO COUNTY apcd

Air Pollution Control District
San Luis Obispo County

# AIR POLLUTION CONTROL DISTRICT
# SAN LUIS OBISPO COUNTY

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2014 Annual Air Quality Report
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## 2014 Air Quality Summary

While the majority of San Luis Obispo (SLO) County experienced relatively low levels of ozone pollution in 2014, ozone levels exceeding both state and federal standards were measured on a few 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), but air quality there continues to improve, with 2014 recording the fewest number of standard exceedences since monitoring began there (Figures 8 & 10). One exceedence of the federal standard was also recorded at NRP; this is the first South County exceedence since 2003. Morro Bay and San Luis Obispo also experienced somewhat higher ozone levels then typical this year, with San Luis Obispo even exceeding the state standard on one day. As discussed in the Appendix, the available evidence suggests that 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, and previous Annual Air Quality Reports have pointed out fires that could have contributed to high ozone levels. This year, no wildfires could be identified that might have contributed to poor air quality in the county.

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 2014 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 twice at CDF and once at Mesa2, and for the second year in a row CDF exceeded the federal and state standard for annual average $PM_{2.5}$.

Countywide particulate levels were higher than normal in January 2014, with several exceedences of the state $PM_{10}$ standard at CDF, Mesa2, Paso Robles and Atascadero and one exceedence of the 24-hour $PM_{2.5}$ standard at Atascadero. The remainder of the year experienced more typical levels: Compared to the previous year, the annual average $PM_{10}$ levels for 2014 were about the same or lower at all sites; $PM_{2.5}$ annual averages were slightly higher in South County but lower elsewhere in the County.

There were no exceedences of the standards for nitrogen dioxide or sulfur dioxide in 2014.

*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. 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.slocleanair.org***
APCD website
***www.arb.ca.gov***
ARB website
***www.epa.gov***
US EPA website
***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 2014; their 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 in 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 ($PM_{2.5}$ and $PM_{10}$) 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 2014 reviewed in this report was downloaded from the EPA's Air Quality System (AQS) database in October 2015. 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). The raw data and the R-code used to compile the statistics and generate the graphs in the report are available upon request.

**Figure 1: Map of San Luis Obispo County**

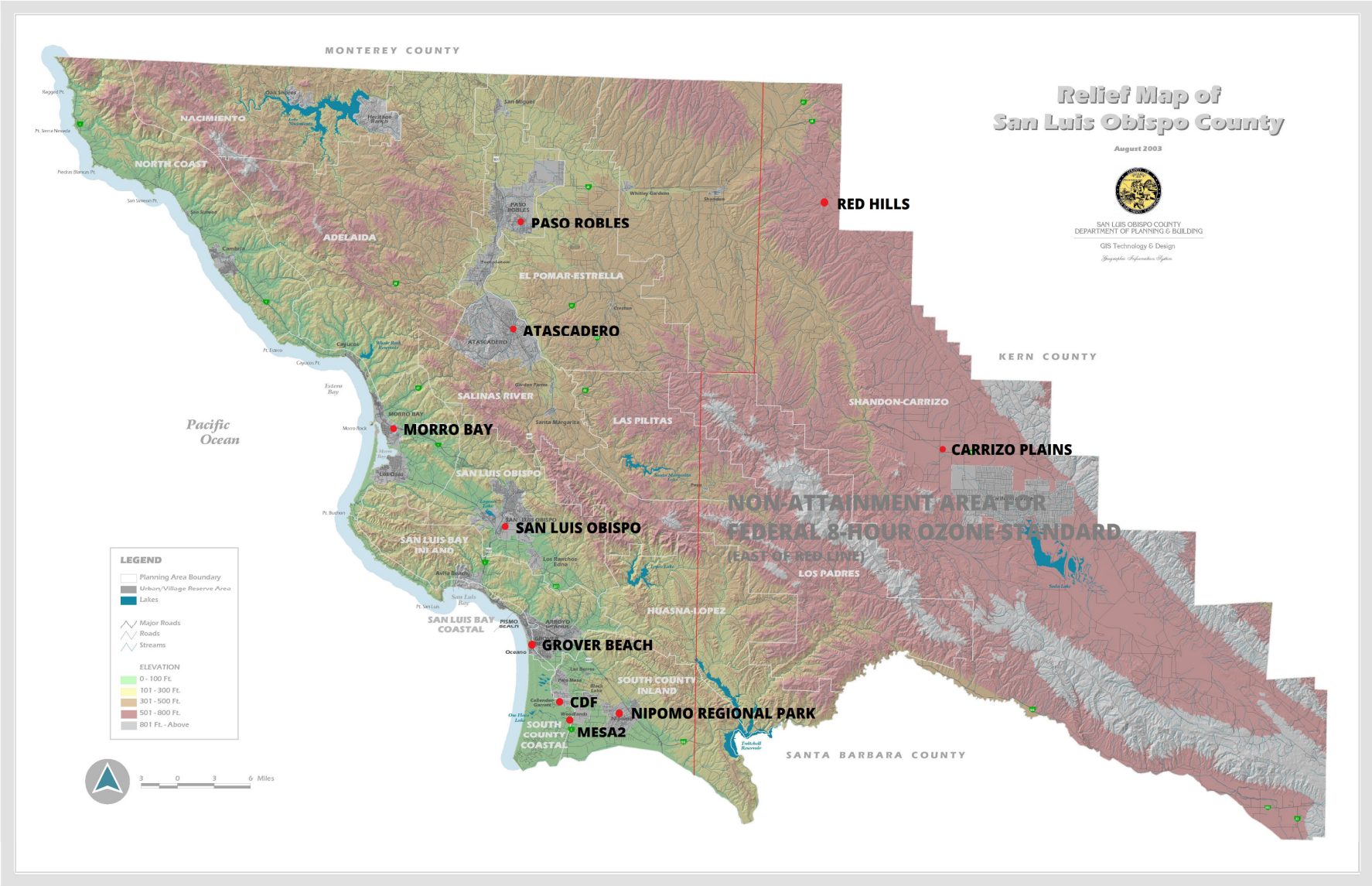

**Table 1: Ambient Air Quality Parameters Monitored in SLO County in 2014**

| | $O_3$ | NO | $NO_2$ | $NO_x$ | $SO_2$ | CO | $PM_{10}$ | $PM_{2.5}$ | WS | WD | ATM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 |

Acronyms:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $O_3$ | Ozone | $SO_2$ | Sulfur Dioxide | $PM_{10}$ | Particulates < 10 microns | WS | Wind Speed |
| NO | Nitric Oxide | CO | Carbon Monoxide | $PM_{2.5}$ | Particulates < 2.5 microns | WD | Wind Direction |
| $NO_2$ | Nitrogen Dioxide | | | | | ATM | Ambient Temp |
| $NO_x$ | 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 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.

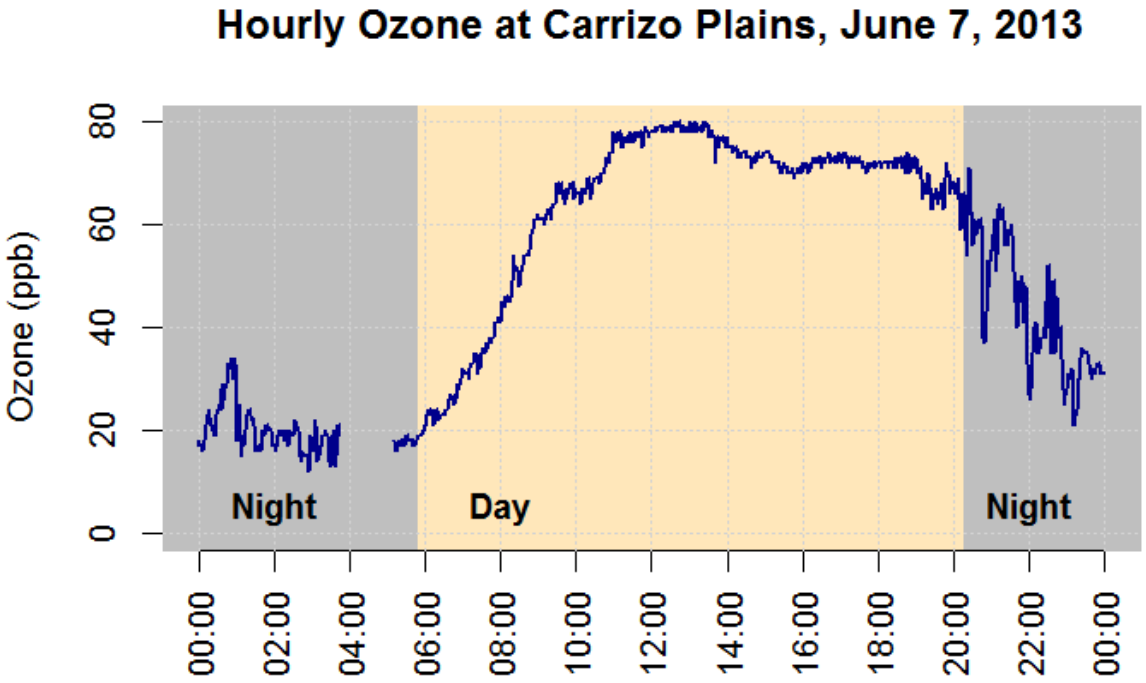


**Figure 2: Example of Diurnal Ozone Pattern**

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 and 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: $PM_{10}$ (respirable particulate matter less than 10 microns in aerodynamic diameter), and $PM_{2.5}$ (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. $PM_{2.5}$ 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 ($NO_2$) is the brownish-colored component of smog. $NO_2$ irritates the eyes, nose and throat, and can damage lung tissues. Sulfur dioxide ($SO_2$) is a colorless gas with health effects similar to $NO_2$. 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. $SO_2$ 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 ($PM_{10}$ and $PM_{2.5}$), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), 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 "nonattainment" for each criteria pollutant. A nonattainment designation can trigger additional regulations for that region aimed at reducing pollution levels and bringing 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 nonattainment designation. Additionally, exceedences caused by exceptional events (see below) may be excluded from attainment/nonattainment 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. This was based on data from 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 nonattainment areas). The county is currently designated attainment for all of the other NAAQS; it does, however, exceed the federal 24-hour standard for $PM_{10}$ 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 nonattainment area for the state one-hour and 8-hour ozone standards, as well as the state 24-hour and annual $PM_{10}$ standards. The county is currently designated as attaining the state annual $PM_{2.5}$ standard, but is expected to be designated as nonattainment the next time that ARB finalizes area designations.

The state and national standards for $NO_2$ have never been exceeded in this county. The state standard for $SO_2$ was exceeded periodically on the Nipomo Mesa until 1993. Equipment and processes at the facilities responsible for the emissions were upgraded as a result, and the state $SO_2$ standard has not been exceeded since that time. Exceedences of the federal $SO_2$ standard had never been recorded here until 2014, when maintenance activities at these facilities resulted in emissions exceeding the 1-hour standard of 75 ppb that was established in 2011. 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 2014 and does not expect any data compiled in this report to be excluded from future attainment determinations.

**Table 2: Ambient Air Quality Standards for 2014 and Attainment Status***

***A standard exceedence** 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 exceedences. Criteria constituting a violation are unique for each pollutant.*

***A nonattainment 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.*

| | Averaging Time | California Standard† | National Standard† |
|---|---|---|---|
| **Ozone ($O_3$)** | 8 Hours | **70 ppb** | **75 ppb** § |
| | 1 Hour | **90 ppb** | |
| **Respirable Particulate Matter ($PM_{10}$)** | 24 Hours | **50 µg/m$^3$** | 150 µg/m$^3$ |
| | 1 Year‡ | **20 µg/m$^3$** | |
| **Fine Particulate Matter ($PM_{2.5}$)** | 24 Hours | | 35 µg/m$^3$ |
| | 1 Year‡ | 12 µg/m$^3$ | 12 µg/m$^3$ |
| **Carbon Monoxide (CO)** | 8 Hours | 9.0 ppm | 9 ppm |
| | 1 Hours | 20 ppm | 35 ppm |
| **Nitrogen Dioxide ($NO_2$)** | 1 Year‡ | 30 ppb | 53 ppb |
| | 1 Hour | 180 ppb | 100 ppb |
| **Sulfur Dioxide ($SO_2$)** | 3 Hours | | 500 ppb (secondary) |
| | 1 Hour | 250 ppb | 75 ppb (primary) |
| **Hydrogen Sulfide ($H_2S$)** | 1 Hour | 0.03 ppm | |
| **Visibility** | 8 Hours | Sufficient amount to reduce the prevailing visibility to less than ten miles when the relative humidity is less than 70 %. | |

* San Luis Obispo County (in whole or in part) is designated as nonattainment for the standards in **boldface print** as of October 2015.

† For clarity, the ozone, $SO_2$, and $NO_2$ standards are expressed in parts per billion (ppb), however most of these standards were promulgated in parts per million (ppm).

‡This standard is calculated as the annual arithmetic mean.

§ For the period covered by this report, the national 8-hour ozone standard was 75 ppb, but on October 1, 2015, the EPA Administrator signed a final rule lowering the standard to 70 ppb.

# Ozone and Gaseous Pollutant Data Summary

In 2014, the federal 8-hour ozone standard of 75 parts per billion (ppb) was exceeded on three days: twice at Red Hills and once at NRP. Exceedences of the more stringent state 8-hour ozone standard (70 ppb) occurred on 10 days countywide, with 10 days at Red Hills and one day each at NRP and San Luis Obispo.[1] The state 1-hour standard for ozone (90 ppb) was not exceeded at any station in the county this year, nor were standards for nitrogen dioxide or sulfur dioxide.

**First, Second and Third Highest Hourly Averages**

Table 3 lists the highest hourly (and for ozone, 8-hour) values recorded in 2014 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 noted 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 2014**

| Station | $O_3$ 1-hour | | | $O_3$ 8-hour | | | $SO_2$ 1-hour | | | $NO_2$ 1-hour | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 1st | 2nd | 3rd | 1st | 2nd | 3rd | 1st | 2nd | 3rd |
| **Paso Robles** | 70 09/12:14 | 68 05/15:11 | 67 05/17:14 | 65 05/15:10 | 61 05/01:10 | 59 05/02:09 | | | | | | |
| **Atascadero** | 75 05/15:16 | 72 05/02:16 | 72 10/05:12 | 70 05/15:11 | 66 05/02:10 | 65 10/05:10 | | | | 60 04/14:16 | 47 01/02:17 | 47 04/14:13 |
| **Morro Bay** | 70 10/04:08 | 68 05/15:11 | 68 10/03:14 | 66 10/04:04 | 62 05/15:08 | 61 04/30:11 | | | | 42 10/03:06 | 39 11/25:17 | 36 01/15:07 |
| **San Luis Obispo** | 80 05/15:14 | 68 10/04:11 | 67 05/14:16 | 74 05/15:09 | 64 10/04:10 | 63 05/14:12 | | | | | | |
| **Red Hills** | 83 10/06:00 | 80 10/05:11 | 79 07/07:15 | **78** 10/05:21 | **76** 10/06:00 | 73 02/24:22 | | | | | | |
| **Carrizo Plains** | 73 09/12:14 | 72 05/15:10 | 72 06/09:10 | 70 09/12:10 | 69 08/29:10 | 68 05/15:08 | | | | | | |
| **Nipomo Regional Park** | 81 05/15:14 | 75 10/04:12 | 73 10/05:14 | **76** 05/15:09 | 69 10/04:09 | 66 05/02:08 | | | | 35 01/17:19 | 28 01/20:19 | 27 11/19:08 |
| **Mesa2, Nipomo** | | | | | | | 9 07/15:09 | 4 04/06:12 | 4 05/02:10 | | | |

[1] 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 13 exceedences of the state ozone standard at Red Hills.

**Monthly Ozone Summary**

Figures 3 and 4 depict monthly ozone variation during 2014 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$^{th}$ and 25$^{th}$ 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.

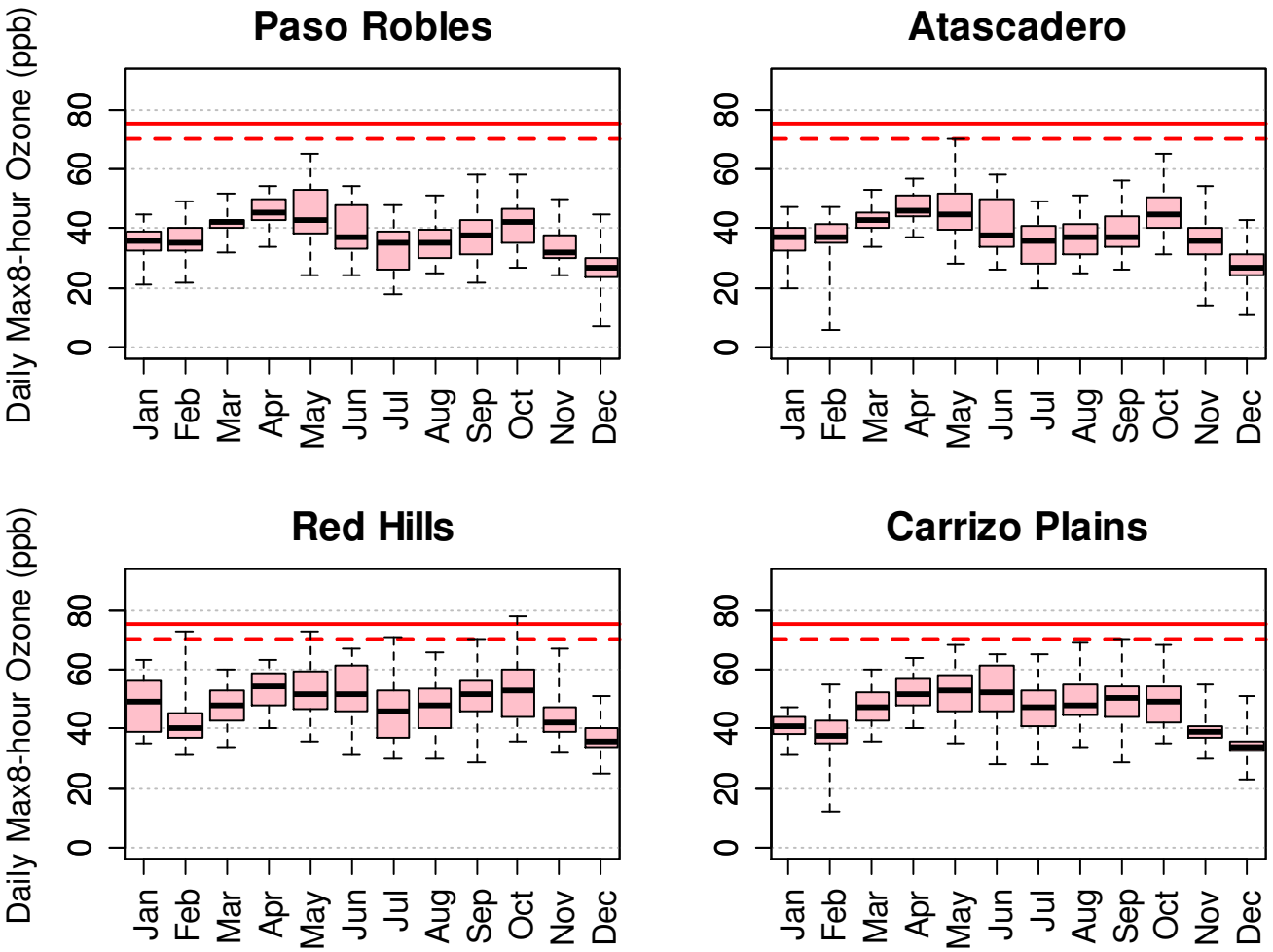


**Figure 3: Monthly Ozone Variation in 2014**

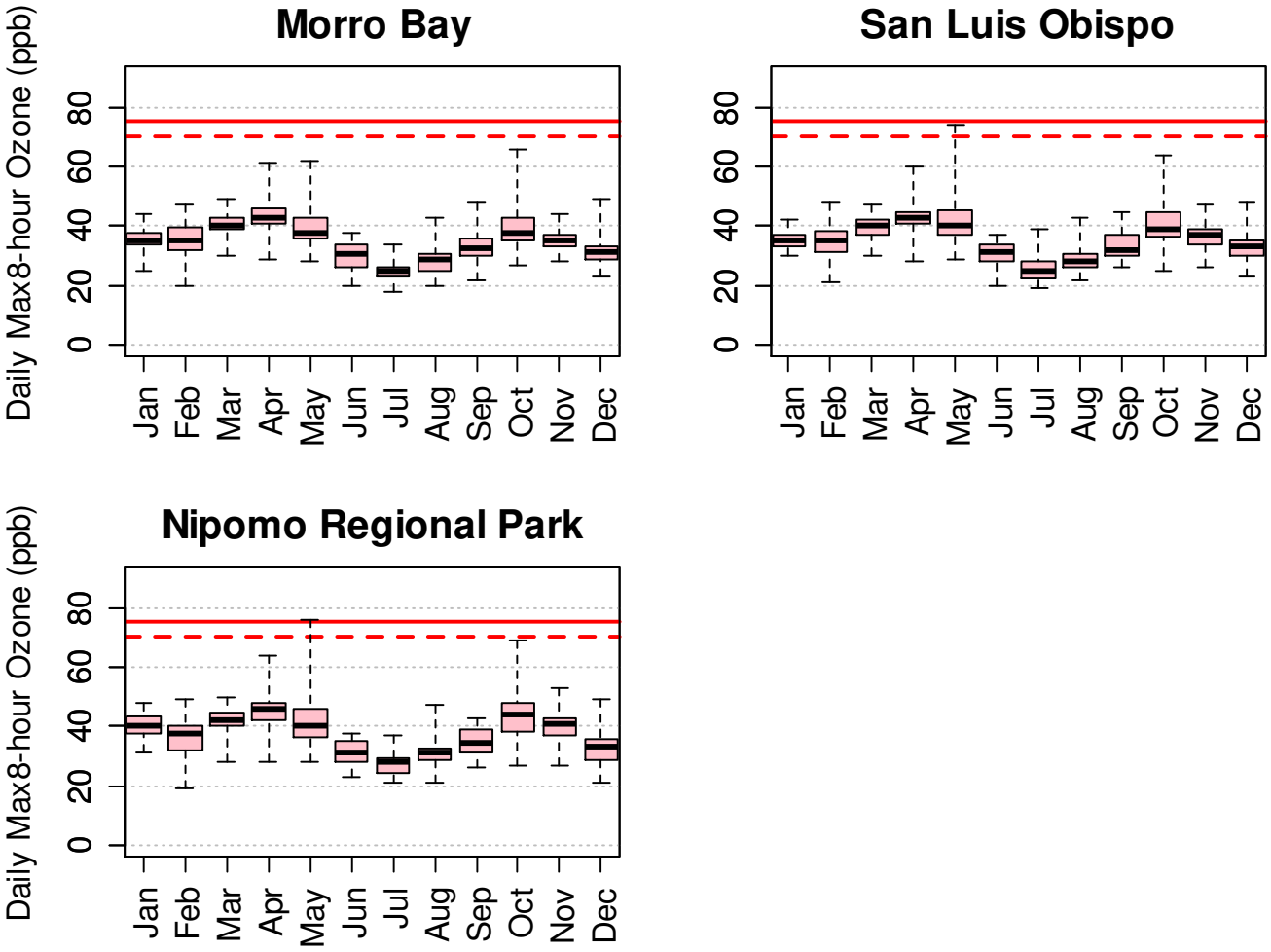


**Figure 4: Monthly Ozone Variation in 2014**

# Particulate Matter Data Summary

In 2014, the CDF station recorded two exceedences of the federal 24-hour $PM_{10}$ standard of 150 μg/m$^3$; no other stations exceeded this standard.[2] Exceedences of the state 24-hour $PM_{10}$ standard of 50 μg/m$^3$ were observed on 85 different days: 79 at CDF, 39 at Mesa2, 9 at NRP, 9 at Paso Robles, and two at Atascadero.[3] This year, NRP, CDF, and Mesa2 also exceeded the state annual average $PM_{10}$ standard of 20 μg/m$^3$, while San Luis Obispo, Atascadero, and Paso Robles remained below this level.

The federal 24-hour $PM_{2.5}$ standard of 35 μg/m$^3$ was exceeded on four days in 2014: twice each at CDF and Atascadero, and once at Mesa2.[4] For the second year in a row, CDF also exceeded the federal and state standards for annual average $PM_{2.5}$ (12 μg/m$^3$). As a result, the county is expected to be designated as nonattainment for the state standard the next time that ARB reviews area designations. Violation of the federal $PM_{2.5}$ annual standard (also12 μg/m$^3$) does not occur until the 3-year average of annual averages exceeds the standard.

**Maximum 24-hr Concentrations and Annual Averages**

Table 4 lists the highest 24-hour concentrations recorded in 2014 (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 <u>underlined</u>.

[2] While the federal $PM_{10}$ standard is nominally 150 μg/m$^3$, 40 CFR 50 Appendix K specifies that ambient $PM_{10}$ measurements are to be rounded to the nearest 10 μg/m$^3$ before being compared to the standard. Therefore, 24-hour $PM_{10}$ measurements between 150 and 154 μg/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 2014, a value of 150 μg/m$^3$ was also recorded at Mesa2 on May 28. This is not considered an exceedence of the standard.

[3] 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 87 exceedences of the state $PM_{10}$ standard at CDF, 43 at Mesa2, 13 at Paso Robles, 11 at Nipomo Regional Park, and 6 at Atascadero.

[4] The federal 24-hour $PM_{2.5}$ standard is nominally 35 μg/m$^3$, however 40 CFR 50 Appendix N specifies that a 24-hour average must exceed 35.5 μg/m$^3$ to be considered an exceedence. Therefore, 24-hour average $PM_{2.5}$ measurements between 35.0 and 35.5 are technically not exceedences of the standard. In addition to the two exceedences of the standard at Atascadero noted above, a value of 35.2 μg/m$^3$ was also recorded on January 21.

**Table 4: Summary of $PM_{10}$ and $PM_{2.5}$ Statistics for 2014**

| Station | $PM_{10}$ | | $PM_{2.5}$ | |
|---|---|---|---|---|
| | Highest 24-hour Concentration | Annual Arithmetic Mean | Highest 24-hour Concentration | Annual Arithmetic Mean |
| **Paso Robles** | 79 µg/m³ 01/21 | 19.3 µg/m³ | | |
| **Atascadero** | 69 µg/m³ 01/21 | 19.3 µg/m³ | **37.3 µg/m³** 01/05 | 5.8 µg/m³ |
| **San Luis Obispo** | 41 µg/m³ 10/02 | 15.4 µg/m³ | 15.6 µg/m³ 09/08 | 6.0 µg/m³ |
| **CDF, Arroyo Grande** | **165 µg/m³** 07/23 | 37.9 µg/m³ | **43.0 µg/m³** 05/28 | **12.8 µg/m³** |
| **Nipomo Regional Park** | 93 µg/m³ 08/31 | 23.5 µg/m³ | | |
| **Mesa2, Nipomo** | 150 µg/m³ 05/28 | 28.1 µg/m³ | **37.5 µg/m³** 05/28 | 10.2 µg/m³ |

**Monthly $PM_{10}$ Summary**

Figures 5 and 6, below, summarize the 24-hour $PM_{10}$ values from the six stations where this pollutant was measured in 2014. 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/$m^3$, respectively.

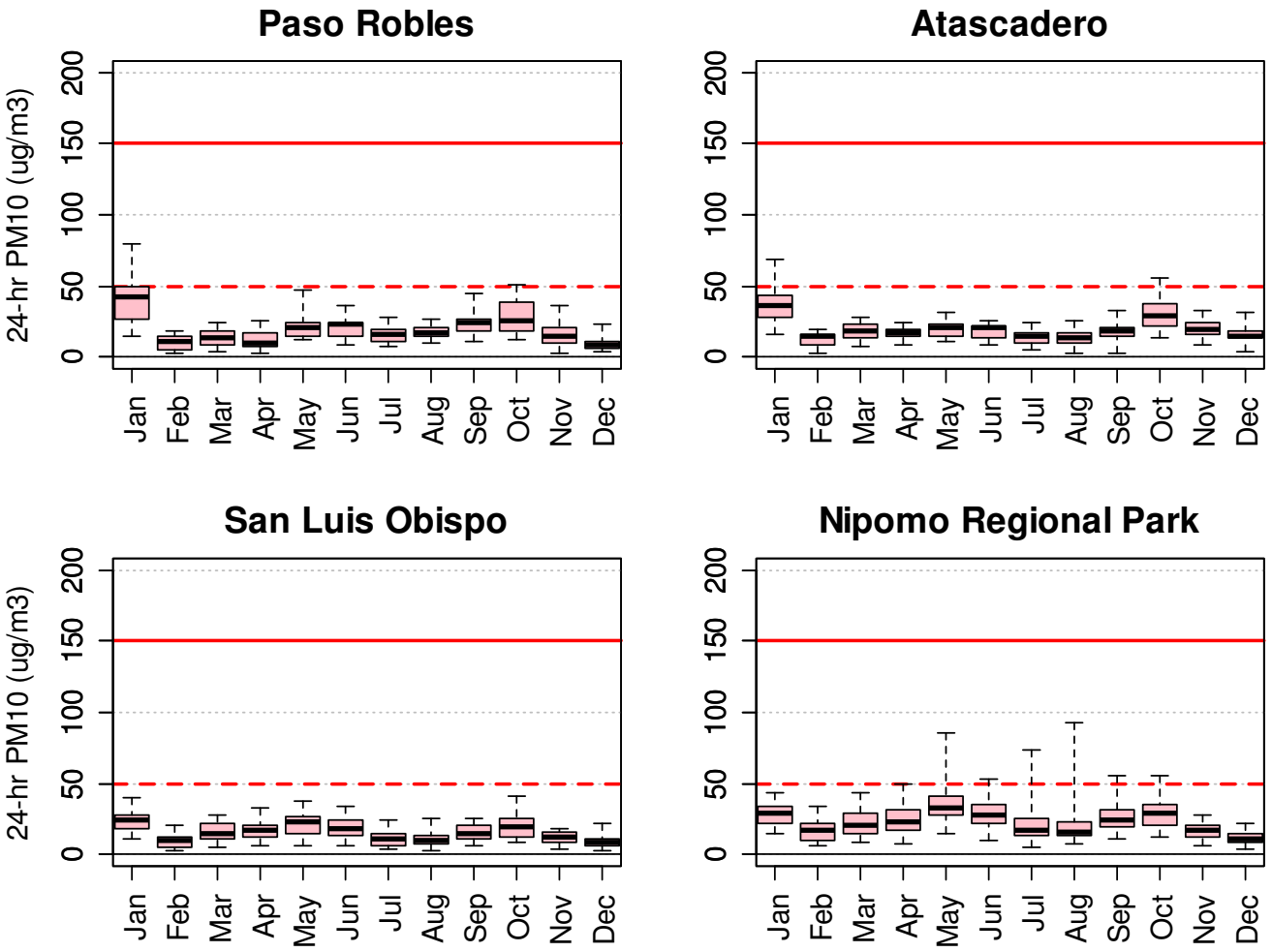


**Figure 5: Monthly $PM_{10}$ Variation in 2014**

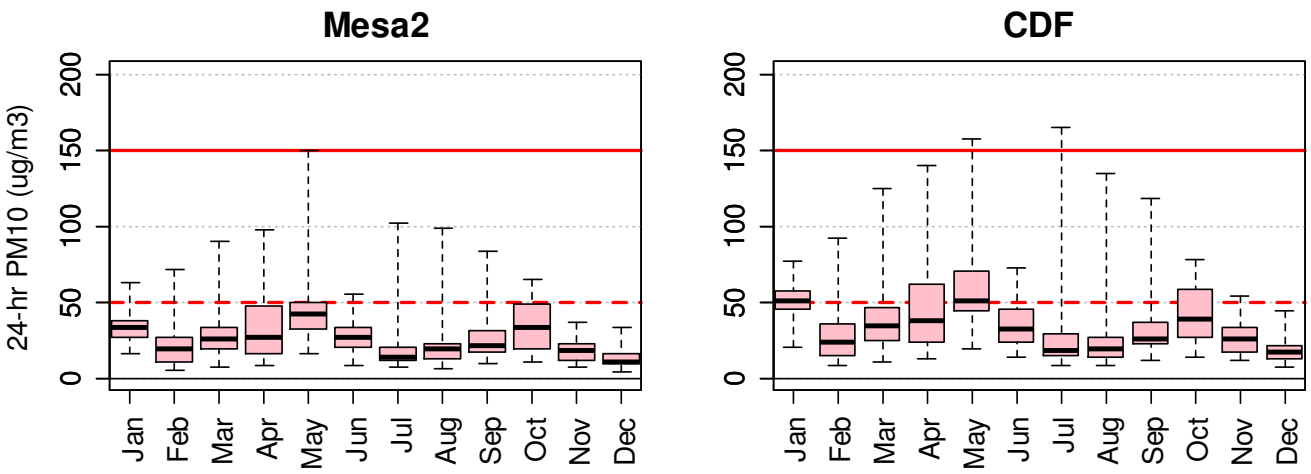


**Figure 6: Monthly $PM_{10}$ Variation in 2014**

**Monthly $PM_{2.5}$ Summary**

Monitoring for fine particulate matter ($PM_{2.5}$) was performed at four locations in 2014: San Luis Obispo, Atascadero, Mesa2, and CDF. The following graphs summarize 24-hr $PM_{2.5}$ values by site. The dashed red line marks the federal 24-hour standard of 35 $\mu g/m^3$; there is no state 24-hour standard for $PM_{2.5}$.

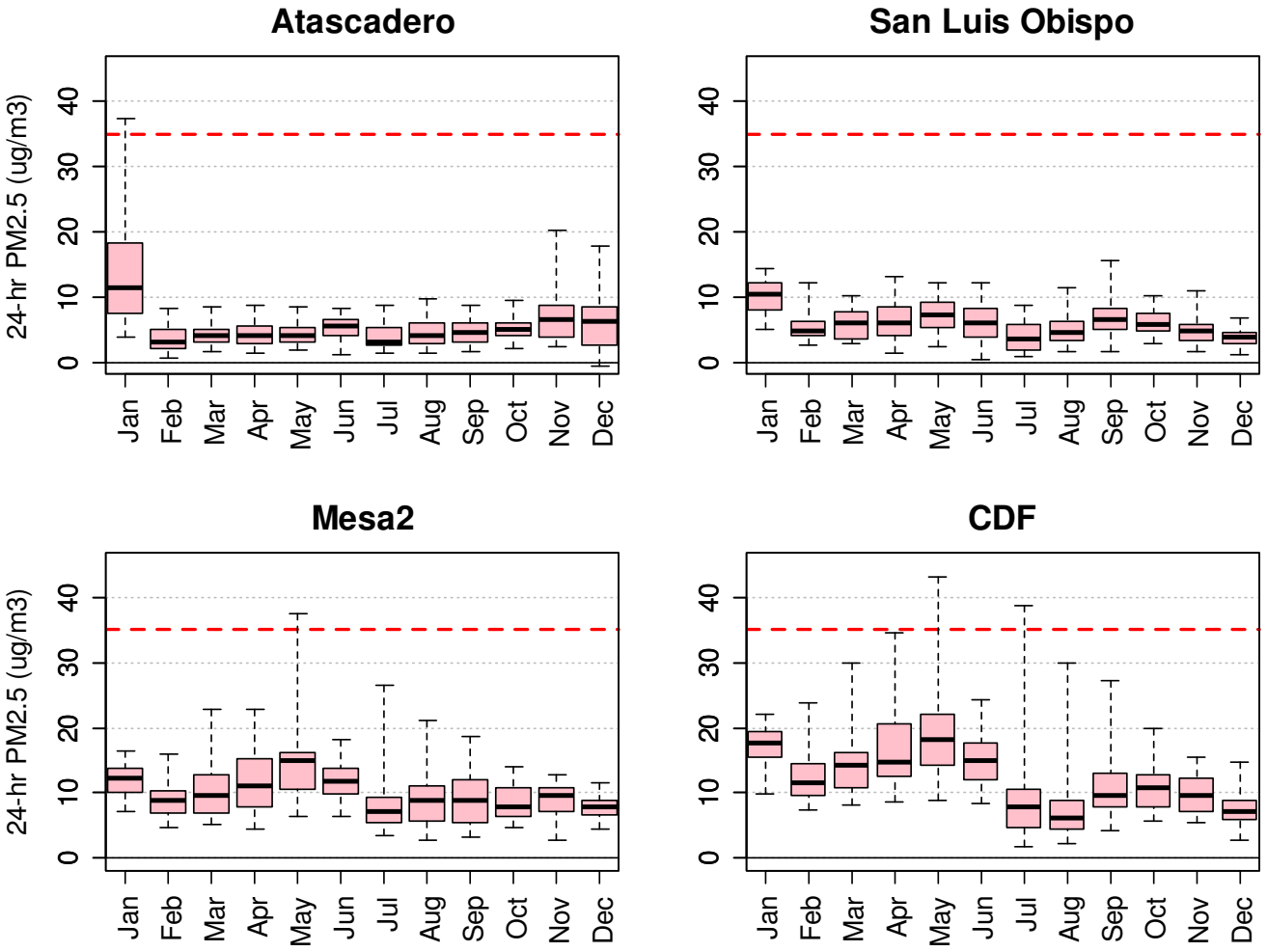


**Figure 7: Monthly $PM_{2.5}$ Variation in 2014**

# Trends

**Countywide Ozone Trends, 2004 - 2014**

Figures 8 and 9, below, depict the total number of hours in a given year at each site 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 10 shows ozone design values over the same period. Design values are used by EPA to determine whether an area attains a federal standard. For ozone, the design value is calculated by averaging the 4$^{th}$ highest annual 8-hour average over three consecutive years. For example, a 2014 design value is the average of the 4$^{th}$ highest 8-hour averages from each year for 2012, 2013, and 2014. Only design values meeting data completeness requirements are included in Figure 10; the red dashed line is the federal 8-hour standard, 75 ppb.

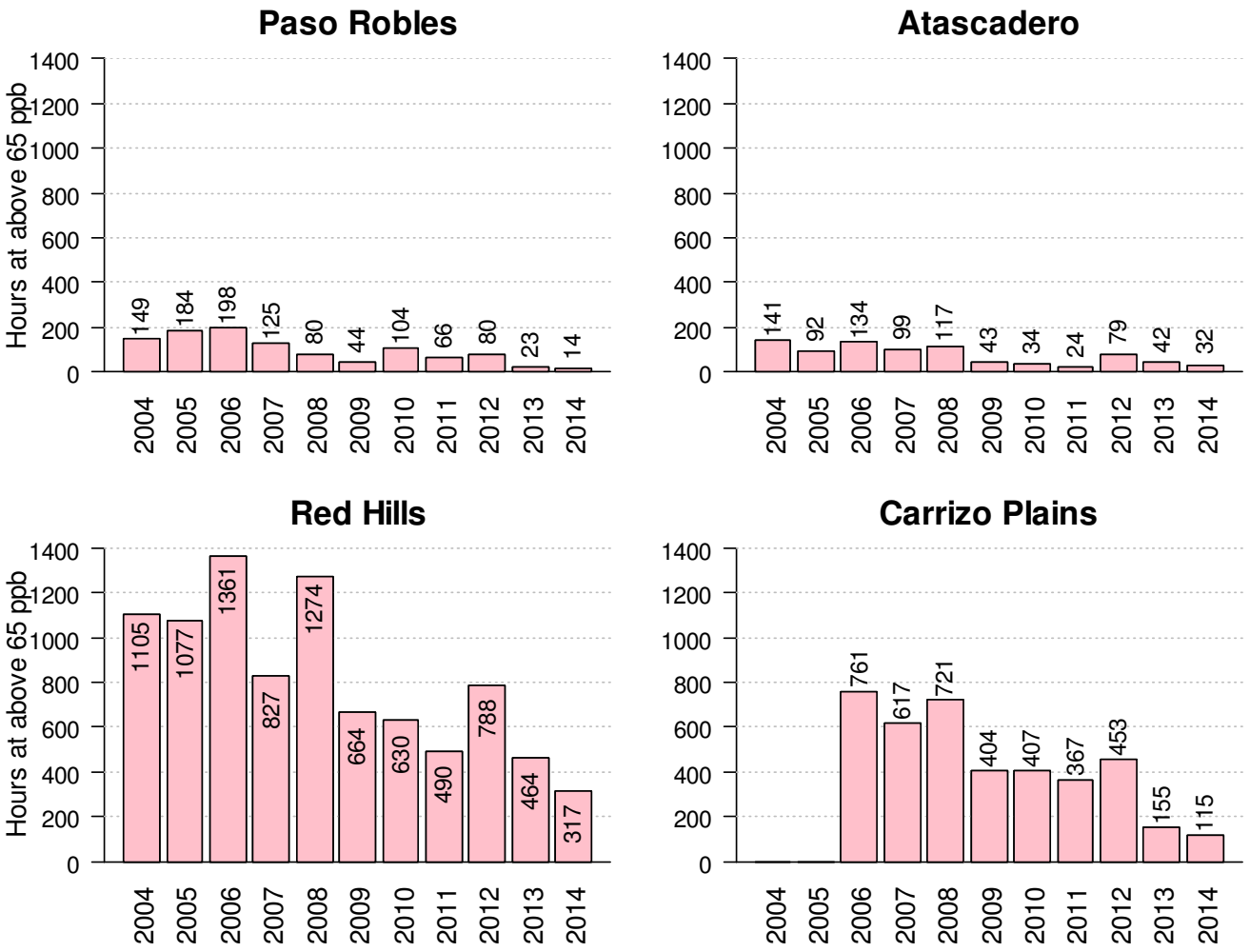


**Figure 8: Hours At or Above 65 ppb Ozone, 2004-2014**

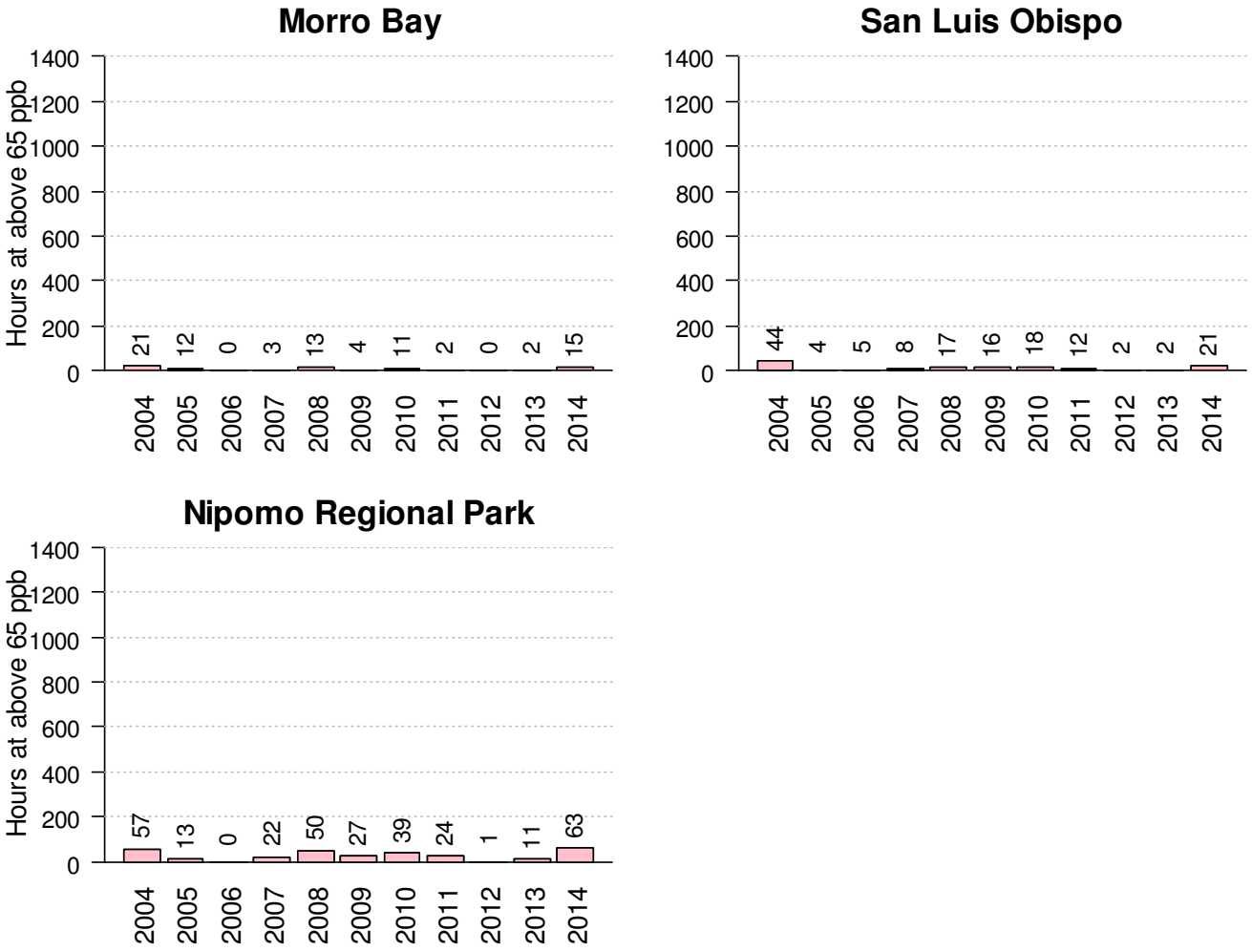


**Figure 9: Hours At or Above 65 ppb Ozone, 2004-2014**

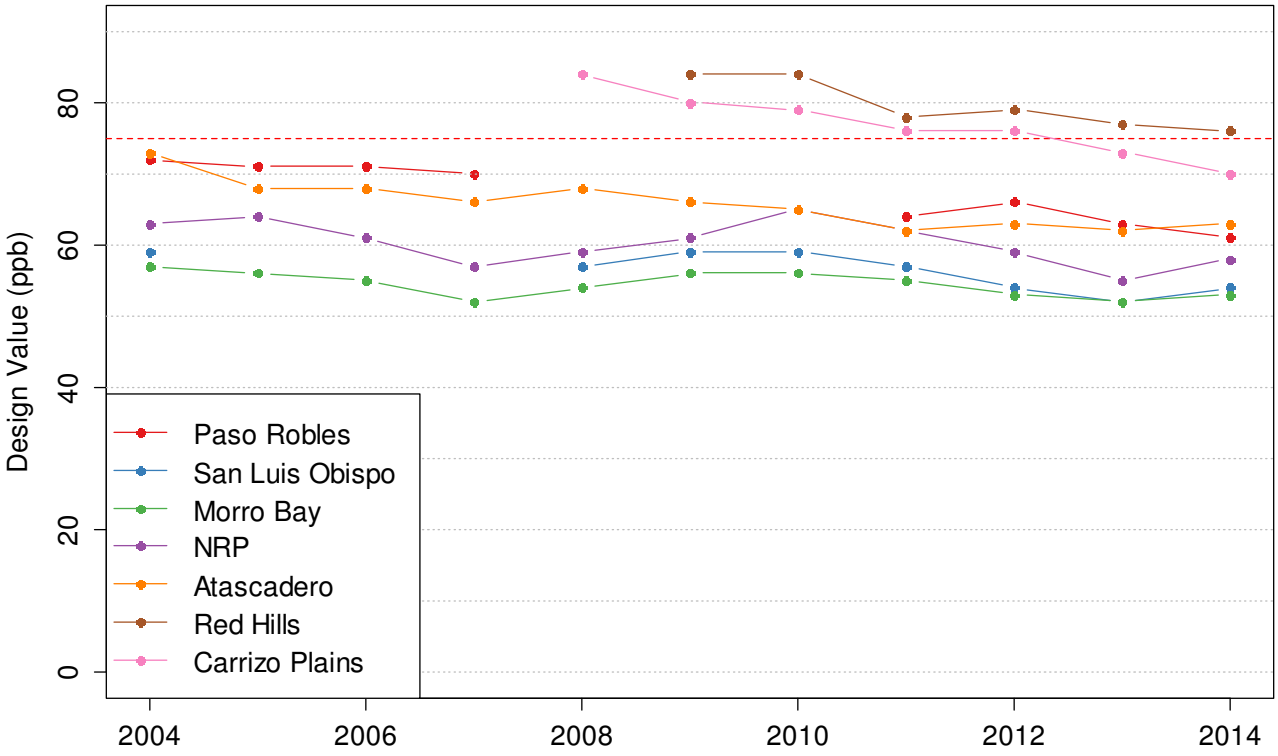


**Figure 10: Ozone Design Value Trends, 2004-2014**

**Countywide Particulate Matter Trends, 2004 - 2014**

Figure 11, below, depicts the annual average $PM_{10}$ concentrations at six locations in SLO County over the past 11 years;[5] the SLO station moved in 2005 so data is not shown for that year. The red dashed line marks the state $PM_{10}$ standard for the annual arithmetic mean, 20 μg/m$^3$. 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 $PM_{2.5}$ levels are depicted in Figure 12 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$^3$ state and federal $PM_{2.5}$ standard for the annual mean. As with $PM_{10}$, the stations on the Nipomo Mesa record higher levels than those elsewhere in the county.

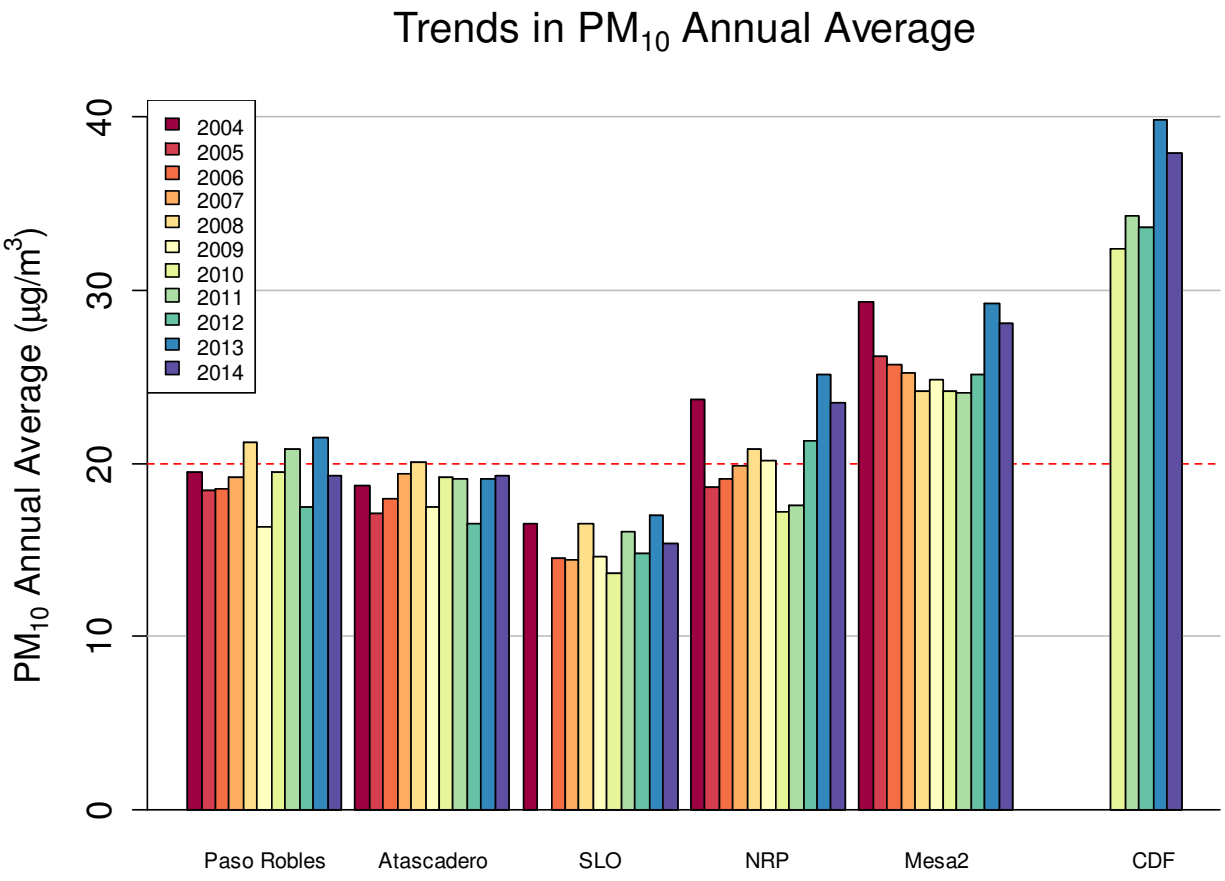


**Figure 11: $PM_{10}$ Annual Average, 2004-2014**

[5] In general, these are seasonally weighted averages as calculated by AQS. For years when sampling methodology changed, the average depicted is the time-weighted average of the methodologies.

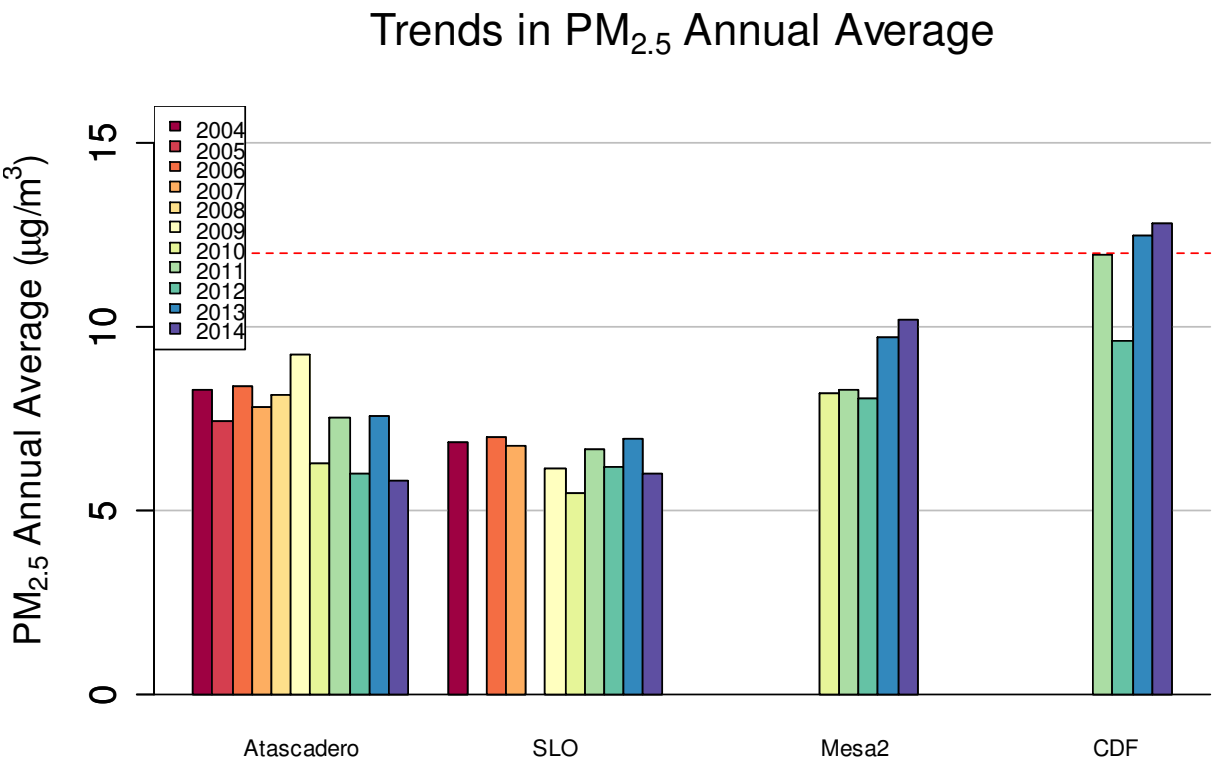


**Figure 12: $PM_{2.5}$ Annual Averages, 2004-2014**

## Ambient Air Monitoring Network Plans

Each year, the 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 2014, 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 2015 Plan for details.

# Appendix: Ozone Exceedences San Luis Obispo County

The Red Hills and Carrizo Plains monitoring stations routinely record 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;[6] see Figure 1 for the boundary of the nonattainment area. In 2014, the county saw the fewest number of exceedences at these sites since monitoring began there. At the same time, NRP exceeded the federal standard for the first time in a decade, and annual maximum values at Morro Bay and San Luis Obispo were higher than usual (though still less than federal standards). Therefore, rather than focusing solely on the eastern nonattainment region—as was done in the 2012 and 2013 Annual Air Quality Reports—this year this appendix examines ozone at all sites in the county.

As in earlier Annual Air Quality Reports, this analysis employs polar plots to depict the relationship between ozone levels and wind speed and direction. In these plots (Figures A1 to A7), 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, maximum hourly ozone is used as the measure of ozone intensity.[7] For example, Figure A1 presents polar plots of hourly ozone at Paso Robles. The upper left panel of the figure is the plot for springtime levels.[8] This panel shows that in the spring, for those hours when winds blew from the west southwest at 10 mph, the *maximum* ozone concentration at the site was about 50 to 55 ppb.

Figures A1 and A2 depict the results for the North County sites of Paso Robles and Atascadero, respectively. Both indicate that ozone is highest in the spring and when winds blow from the southwest.

Figures A3 and A4, respectively, show the 2014 results for Red Hills and Carrizo Plains. These look very similar to the analogous plots of 2013 data presented in the 2013 Annual Air Quality Report (Figures A2 and A8 in that report, respectively) and suggest the same conclusion, namely that transport is the predominant cause of the highest ozone levels observed at these sites.

At Red Hills, ozone levels are highest in the spring, summer, and fall 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. The fact that high ozone levels are associated with high winds (rather than with stagnant conditions) also supports transport as the cause. Further support for this conclusion is the timing of ozone events: As shown in Table 3, the highest ozone levels at Red Hills tend to occur overnight or in the morning.

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, geographic features (i.e. the La Panza and Caliente Ranges) tend to channel the winds along the northwest—southeast axis; see the 2012 Annual Air Quality Report for an example. Polar plots show that high ozone levels tend to arrive at the Carrizo Plains

[6] 77 FR 30087, May 21, 2012.

[7] 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 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.

[8] 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, January, and February.

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.

The results for the coastal sites of Morro Bay, San Luis Obispo, and NRP are shown in Figures A5-A7. The figures show that at these sites, ozone is highest in the spring and fall. (See also Figure 4, above.) In the spring, moderate winds from the west or northwest are associated with high ozone. This is also true for the fall at NRP and San Luis Obispo, but at Morro Bay, northeasterly winds carry the highest ozone levels.

The polar plots in Figure A1 to A7 summarize a full year's ozone and wind data for each site; the details of individual ozone events are thus obscured. Back trajectory analysis is a more appropriate tool for exploring the details of specific ozone events. Therefore, in order to investigate the source(s) of ozone on the highest days in 2014, Hybrid Single-Particle Lagrangian Integrated Trajectory ("HYSPLIT") back trajectories were calculated for all three federal exceedence days in 2014 (May 15 and October 5 and 6), as well as for October 4, which was the day of the highest hourly average for Morro Bay.

All HYSPLIT back trajectories in the following figures are 48-hour trajectories, and all were calculated and displayed using AirNowTech's Navigator tool.[9] A height of 500m above ground level was used in order to be consistent with previous Annual Air Quality Reports. All times are Pacific Standard. The HYSPLIT trajectories are depicted in green, and the stations they end on are red squares. The colored dots in these figures are other ozone monitors, and the blue numbers next to them are their ozone values for the hour. Wildfires, when present, are noted with red triangles, and HMS smoke plumes are shown as gray areas.

Figure A8 shows HYSPLIT trajectories for May 15, 2014, the day that the federal 8-hour ozone standard was exceeded at NRP. Also, on that day, the highest hourly ozone values for the year were recorded at Atascadero (75 ppb, 4 pm), San Luis Obispo (80 ppb, 2 pm), and NRP (81 ppb, 2 pm); the second highest hourly values were recorded at Paso Robles (68 ppb, 11 am), Morro Bay (68 ppb, 11 am), and Carrizo Plains (72 ppb, 10 am); and top three 8-hour averages were recorded at Paso Robles (first highest, 65 ppb, 10 am to 5 pm), Atascadero (first, 70 ppb, 11 am to 6 pm), Morro Bay (second, 62 ppb, 8 am to 3 pm), San Luis Obispo (first, 74 ppb, 9 am to 4 pm), Carrizo Plains (third, 68 ppb, 8 am to 3 pm), and NRP (first, 76 ppb, 9 am to 4 pm). The figure shows trajectories for all of these sites; an ending time of noon was used since it is near the middle of the times when the high values noted above were recorded. These trajectories all show air masses spending significant time over the Bakersfield and Visalia areas before entering the county and arriving at monitoring stations. The image also indicates a large smoke plume from fires burning in San Diego County and Baja, Mexico, but the trajectories do not enter it.

The highest annual hourly value for Morro Bay (70 ppb) was recorded October 4, at 8 am. This is the highest ozone level recorded by the station since October 2010. The second highest hourly values for the year were also recorded this day at San Luis Obispo (68 ppb, 11 am) and NRP (75 ppb, noon), and the third highest at Red Hills (79 ppb, 3 pm). In addition, highest 8-hour ozone averages were recorded at Morro Bay (first, 66 ppb, 4 am to 11 am), San Luis Obispo (second, 64ppb, 10 am to 5 pm), and NRP (second, 69 ppb, 9 am to 4 pm). Figure A9 shows HYSPLIT trajectories for these sites ending at noon, October 4, since this is about the middle of the times of these maxima. It indicates that these stations were influenced by air originating over the San Joaquin Valley.

Figure A10 shows HYSPLIT trajectories for Atascadero, Red Hills, and NRP that end at noon on October 5, 2014. Around this time, the following highest annual values were recorded by the District ozone network:

[9] Sonoma Technology, Inc. https://www.airnowtech.org.

the third highest hourly values at Atascadero (72 ppb, noon) and NRP (73 ppb, 2 pm), the second highest hourly value at Red Hills (80 ppb, 11 am), the third highest 8-hour value at Atascadero (65 ppb, 10 am to 5 pm). As shown in the figure, air masses arrive at these stations from the east after traversing most of the San Joaquin Valley.

The highest 8-hour ozone value measured by the District Network in 2014 (78 ppb) was at Red Hills and began at 9pm on October 5; the second highest 8-hour value (76 ppb, also at Red Hills) began a few hours later at midnight on October 6. The single highest hourly ozone value for the county (83 ppb) was also at Red Hills on midnight, October 6. Figure A11, therefore, shows the trajectory for Red Hills that ends at midnight, October 6. It shows an air mass entering the county from the north after traversing the San Joaquin Valley.

Figures A8 – A11 suggest that all exceedences of the federal 8-hour ozone standard in 2014, as well as many of the year's maximum values, were the result of transport of ozone and/or ozone precursors from the San Joaquin Valley into San Luis Obispo County. A similar pattern was noted in the 2012 and 2013 Annual Air Quality Reports.

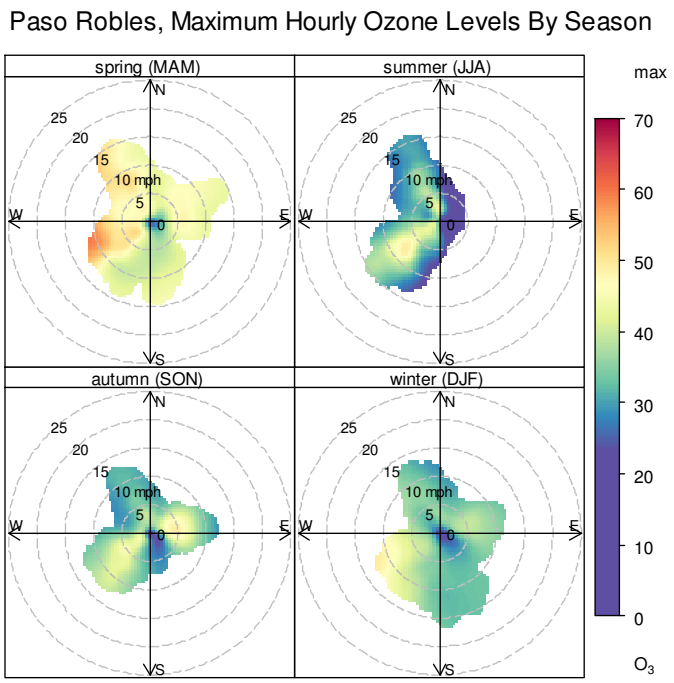


**Figure A1: Polar plots showing average hourly ozone levels at Paso Robles by wind speed, wind direction, and season for 2014.**

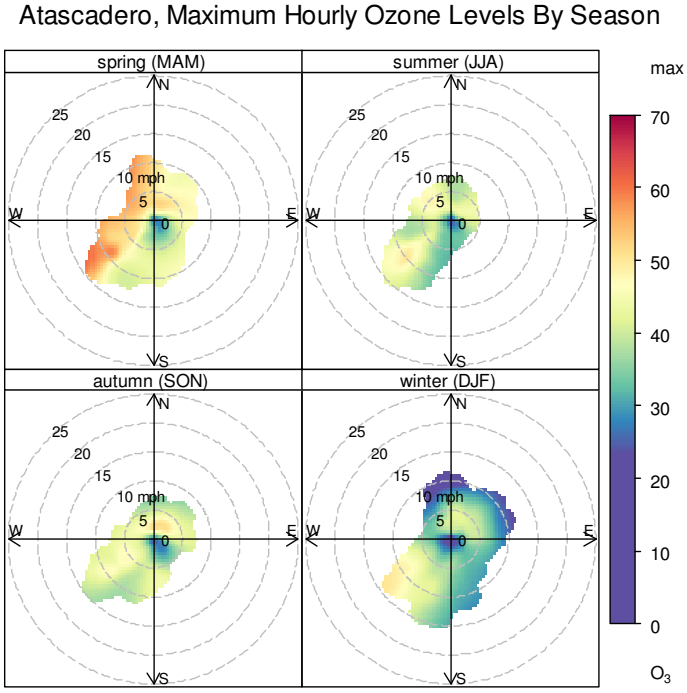


**Figure A2: Polar plots showing average hourly ozone levels at Atascadero by wind speed, wind direction, and season for 2014.**

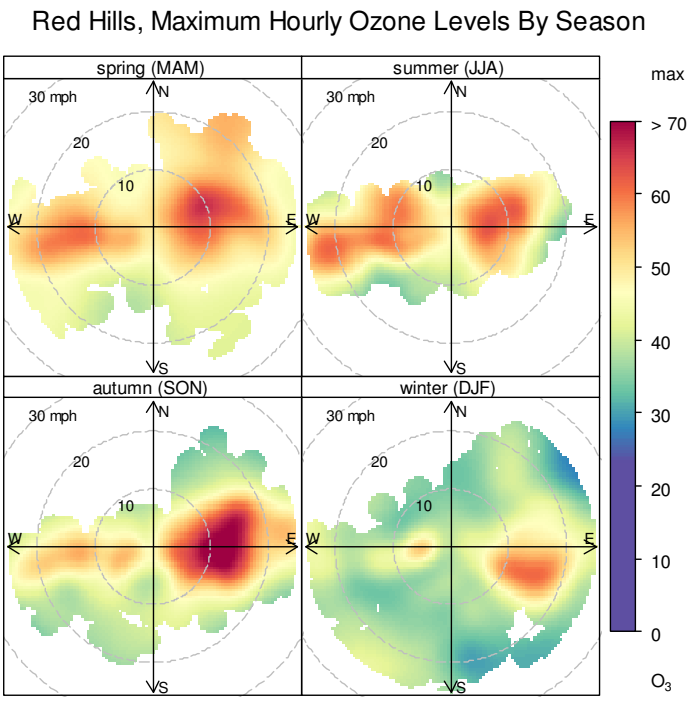


**Figure A3: Polar plots showing average hourly ozone levels at Red Hills by wind speed, wind direction, and season for 2014.**

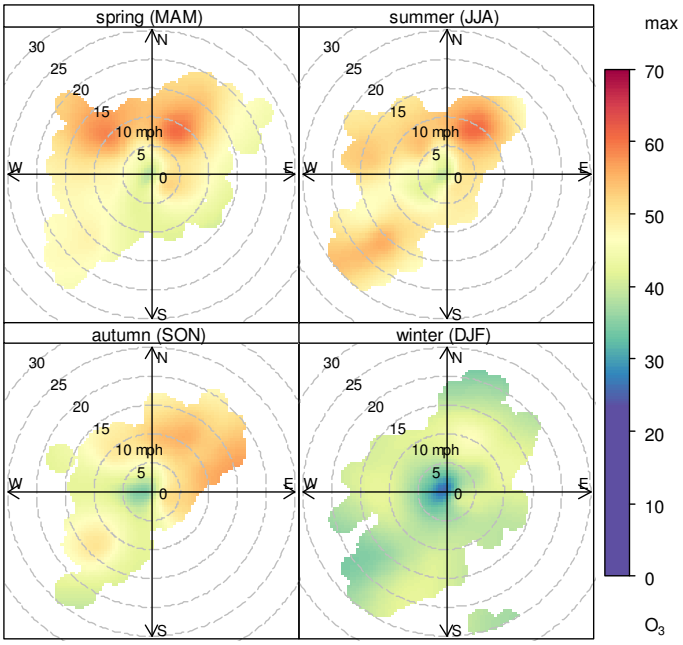


**Figure A4: Polar plots showing average hourly ozone levels at Carrizo Plains by wind speed, wind direction, and season for 2014.**

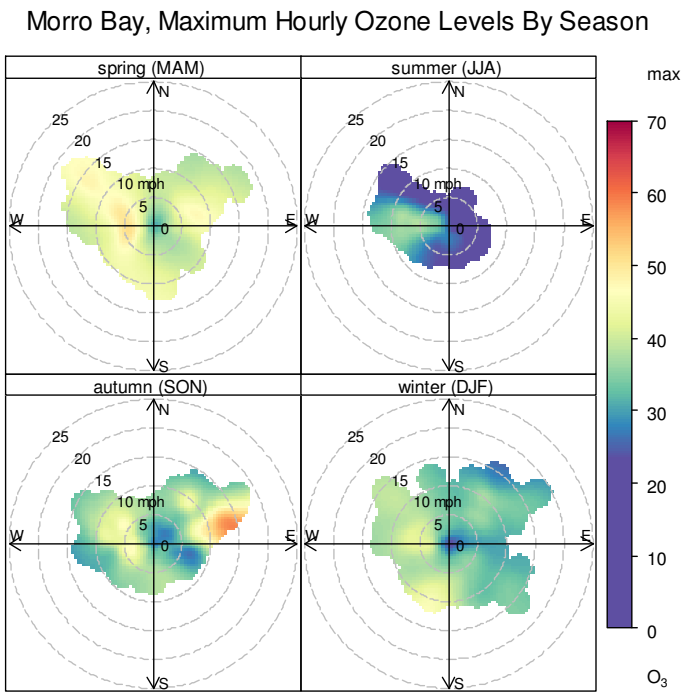


**Figure A5: Polar plots showing average hourly ozone levels at Morro Bay by wind speed, wind direction, and season for 2014.**

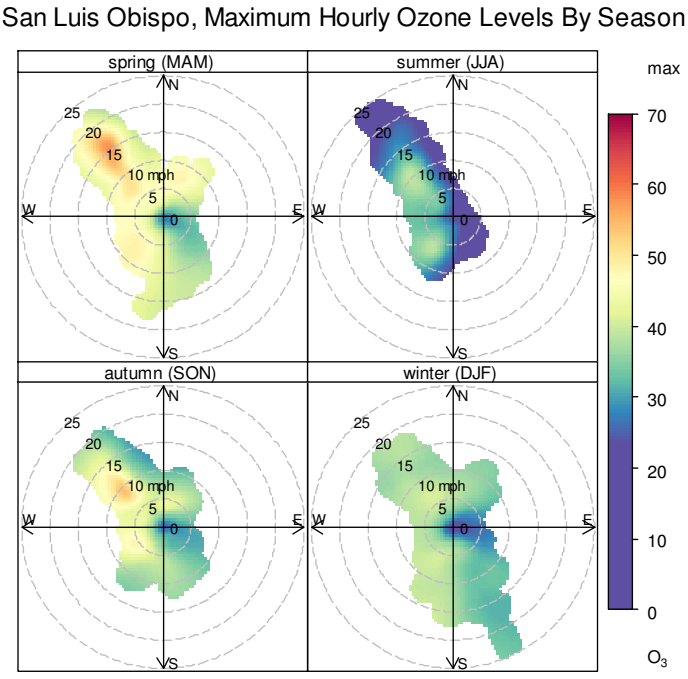


**Figure A6: Polar plots showing average hourly ozone levels at San Luis Obispo by wind speed, wind direction, and season for 2014.**

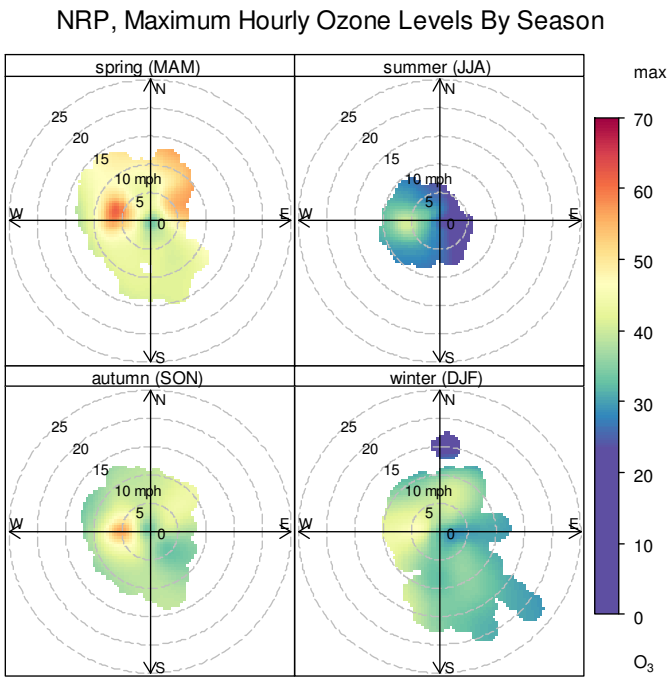


**Figure A7: Polar plots showing average hourly ozone levels at NRP by wind speed, wind direction, and season for 2014.**

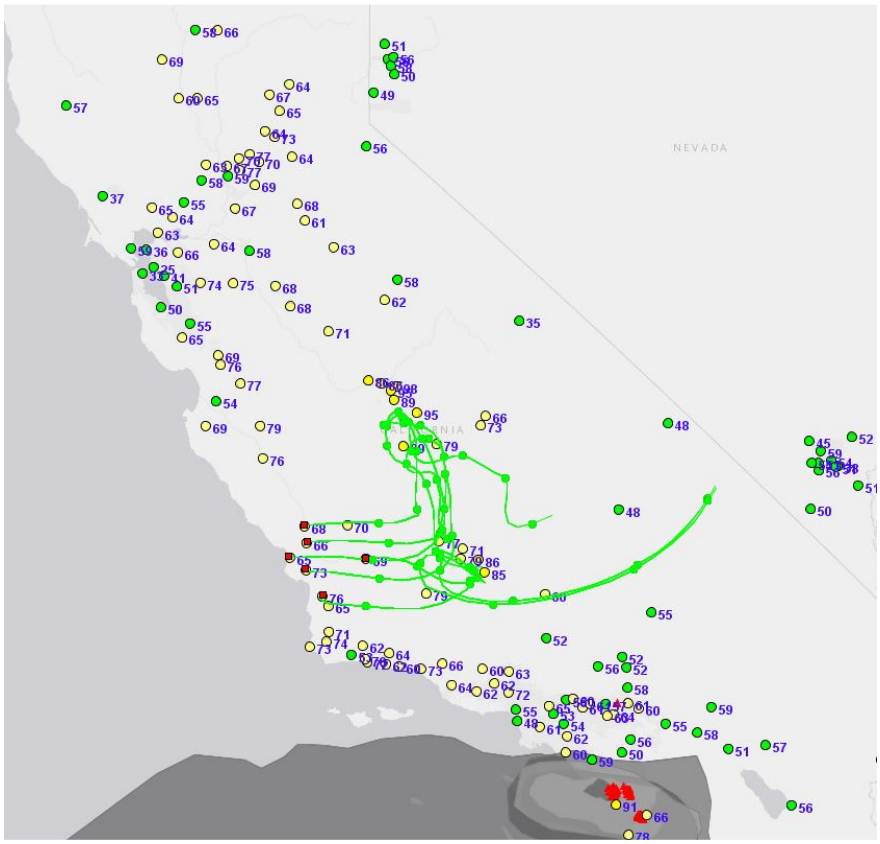


**Figure A8: HYSPLIT back trajectories for Paso Robles, Atascadero, Morro Bay, San Luis Obispo, Carrizo Plains, and NRP ending at noon, May 15, 2014.**

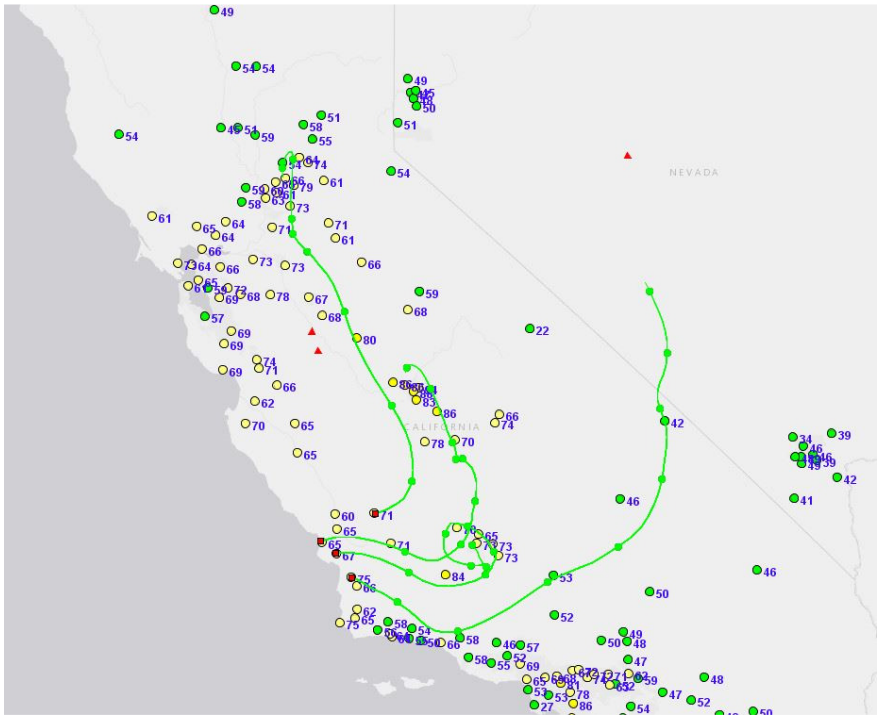


**Figure A9: HYSPLIT back trajectories for Morro Bay, San Luis Obispo, Red Hills, and NRP ending at noon, October 4, 2014.**

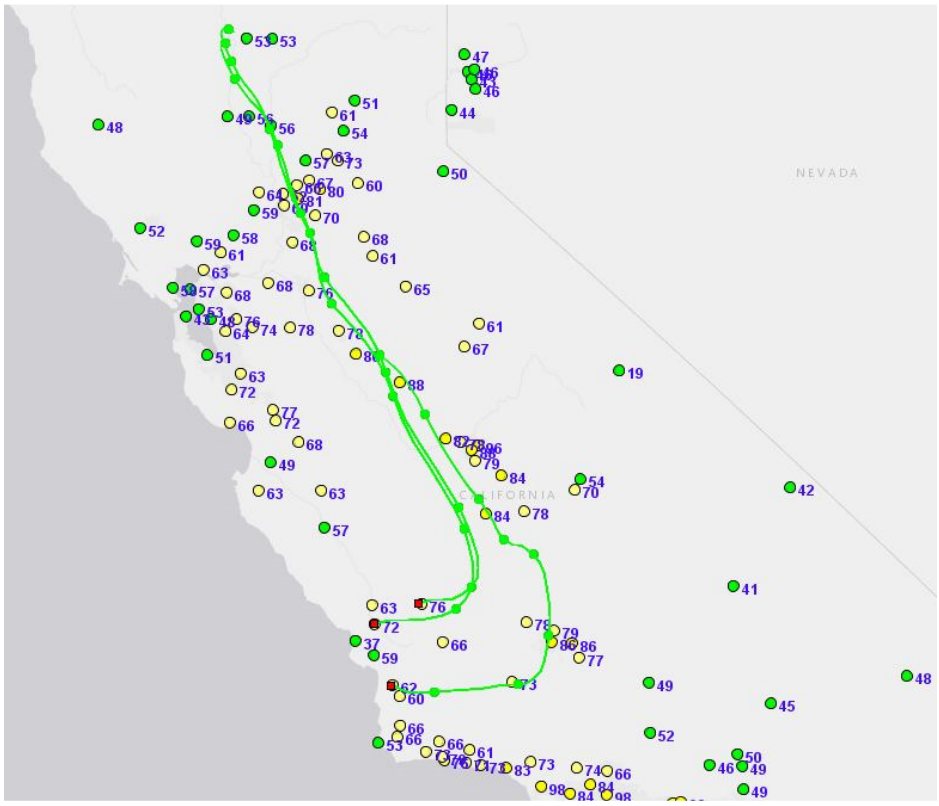


**Figure A10: HYSPLIT back trajectories for Atascadero, Red Hills, and NRP ending at noon, October 5, 2014.**

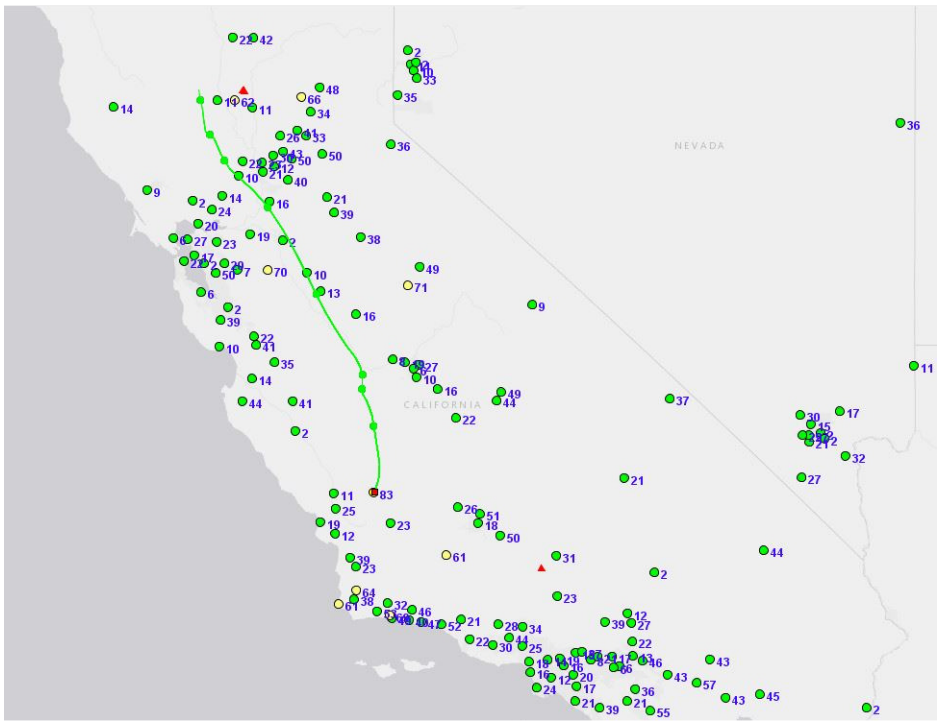


**Figure A11: HYSPLIT back trajectory for Red Hills ending at midnight, October 6, 2014.**