CHAPTER 2

Air Quality

- **PM2.5 concentrations were measured at 22 sites throughout the South Coast Air Basin in 2022 and have decreased significantly over the past two decades.**

- **PM2.5 levels are strongly influenced by meteorology, emissions of primary PM2.5 as well as the emissions of secondary PM2.5 precursors.**

- **While the 2022 annual PM2.5 design value exceeded the 2012 PM2.5 federal standard, the South Coast Air Basin reported the lowest annual average PM2.5 concentration in 2022 since PM2.5 monitoring began.**

Introduction

In this chapter, ambient fine particulate matter (PM2.5) as monitored by South Coast AQMD is summarized for the year 2022 and prior year trends in the South Coast Air Basin (Basin). The factors influencing PM2.5 concentrations are also discussed. South Coast AQMD's recent air quality is compared to the NAAQS and to the California Ambient Air Quality Standards (CAAQS or State standards). Data presented indicate the current attainment or nonattainment status for the various NAAQS and CAAQS PM2.5 standards, showing the progress made to date and assisting the South Coast AQMD in planning for future attainment.

The South Coast AQMD began regular monitoring of PM2.5 in 1999 following the U.S. EPA's adoption of the national PM2.5 standards in 1997. In 2022, ambient PM2.5 concentrations were monitored at 22 locations throughout the South Coast Air Basin, including two near-road sites. Two types of PM2.5 sampling methods are used in the region. Federal Reference Method (FRM) samplers pull ambient air through a filter over a 24-hour period. The filter is then removed and weighed to determine ambient PM2.5 concentrations during the sampling period. The PM2.5 NAAQS are defined based on FRM measurements. The Federal Equivalent Method (FEM) samplers used by South Coast AQMD are Beta Attenuation monitors that report hourly PM2.5 concentrations continuously, which are averaged over a 24-hour period to determine daily averages. Because FRM data is the reference data for NAAQS purposes, FEM monitors undergo annual assessments by the U.S. EPA to determine their eligibility for NAAQS comparison.[1] While measurements from these two techniques produce similar concentrations, there still is some variation, with FEM samplers typically reading higher than collocated FRM samplers.

Of the 22 monitoring stations in our region, filter-based FRM PM2.5 sampling was employed at 14 of these stations. Seven of the FRM measurement stations, including the two near-road sites, were sampled daily to improve temporal coverage beyond the required 1-in-3-day sampling schedule. Eighteen stations, including two near-road sites, employed continuous PM2.5 monitors and ten of these were collocated with FRM measurements. Among the 18 stations with continuous PM2.5 monitors, seven stations utilize FEM monitors, while three stations use special purpose monitors (SPM) for continuous PM2.5 measurement. In 2021,[2] all FEM monitors, except for the one at the Los Angeles-North Main Street station, successfully passed the comparability assessment. Therefore, the daily averages from these monitors can be used to supplement FRM measurements on days with missing data. The SPM monitors are newly established FEM monitors that have not collected three years of data required for the NAAQS-comparability assessment. They are eligible for comparison to NAAQS after they have been operated for more than 24 months unless a waiver has been granted by U.S. EPA. The continuous data is used for

[1] The continuous PM2.5 monitors deployed by South Coast AQMD are FEM-designated Beta Attenuation Monitor (BAM) instruments. The U.S. EPA waiver from NAAQS compliance for the continuous samplers is re-evaluated annually as part of the South Coast AQMD Annual Air Quality Monitoring Network Plan [http://www.aqmd.gov/home/air-quality/clean-air-plans/monitoring-network-plan]

[2] At the time when this plan was drafted, the latest PM2.5 continuous monitor comparability assessment waiver approved by the U.S. EPA was for the design value period of 2019-2021

forecasting, real-time air quality alerts, predictive air quality advisories, and for evaluating hour-by-hour variations. Figure 2-1 provides the location of all regulatory PM2.5 monitors within the Basin.

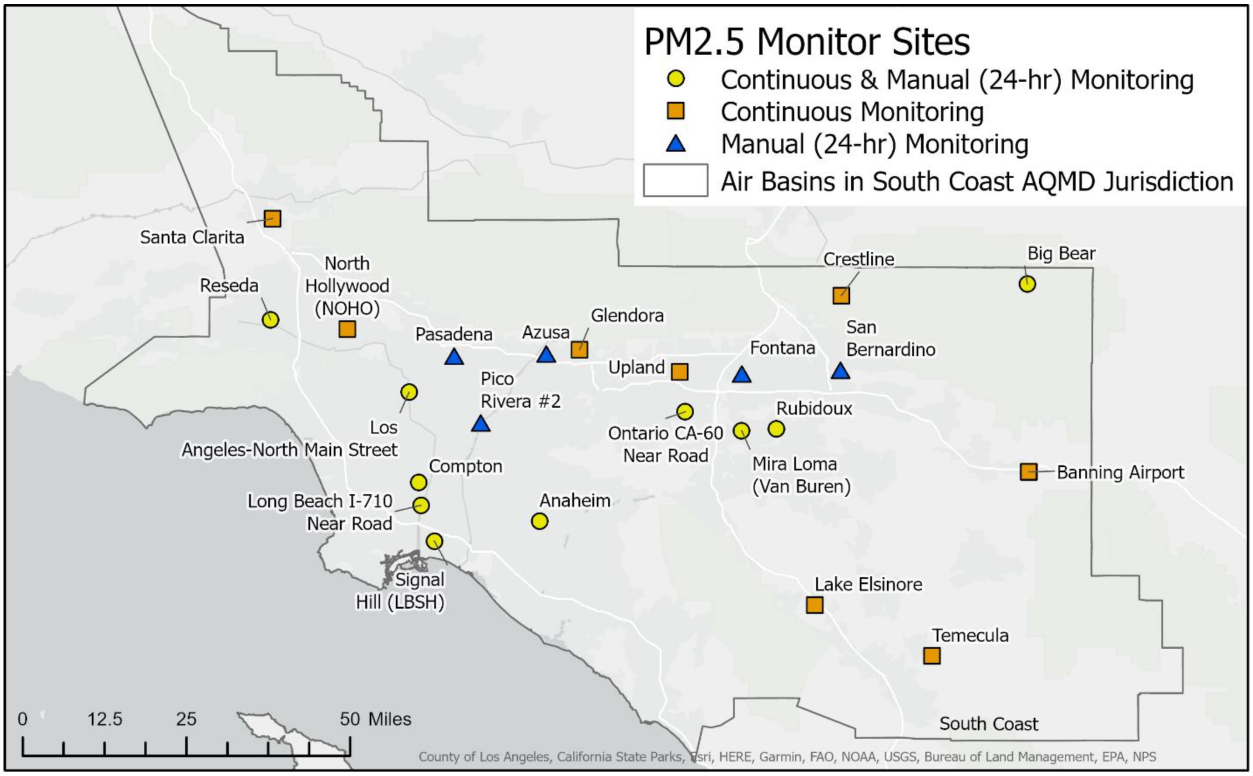


FIGURE 2-1

LOCATION OF ALL REGULATORY MONITORS IN THE SOUTH COAST AIR BASIN

Inhalation of fine particulate matter has been associated with a wide variety of health effects, including premature death. Other health impacts include exacerbation of symptoms in patients with respiratory or cardiovascular disease, decline in pulmonary function in children, increased risk of lung cancer, and potentially may be linked to adverse reproductive and cognitive effects. Some of the impacts of these health effects may be seen in increased asthma-related hospital admissions, increased school absences and lost workdays. Elevated PM2.5 concentrations also impair visibility. Detailed health effects information can be found in Appendix I: Health Effects in the 2022 AQMP[3] or in the U.S. EPA NAAQS documentation at https://www.epa.gov/naaqs.

[3] Available at www.aqmd.gov/2022aqmp

Factors that Influence PM2.5 Concentrations

The South Coast Air Basin's air pollution problems are a consequence of the combination of emissions from the nation's second largest urban area, meteorological conditions that limit the dispersion of those emissions, and mountainous terrain surrounding the Basin that traps pollutants as they are pushed inland with the sea breeze. PM2.5 is a suspension of solid or liquid particles that are less than 2.5 micron in diameter. There are two forms of PM2.5 - primary and secondary. Primary PM2.5 particles are directly emitted by combustion sources such as vehicles, industrial processes, cooking, or fires. Secondary PM2.5 is formed in the atmosphere through a series of complex chemical reactions of PM2.5 precursors such as volatile organic compounds (VOCs), oxides of nitrogen (NOx), and ammonia (NH_3) (Figure 2-2). The precursors that form PM2.5 are from mobile, point and area sources, with the largest portion resulting from fuel combustion. Both directly emitted PM2.5 and secondary PM2.5 that is formed in the atmosphere contribute to measured PM2.5 concentrations, but in the South Coast Air Basin, secondary PM2.5 formation is responsible for approximately two thirds of the total PM2.5 mass (Figure 2-3). Because secondary PM2.5 is a substantial portion of overall PM2.5 levels in the region, control strategies to reduce PM must address both sources of direct emissions as well as the PM2.5 precursors.

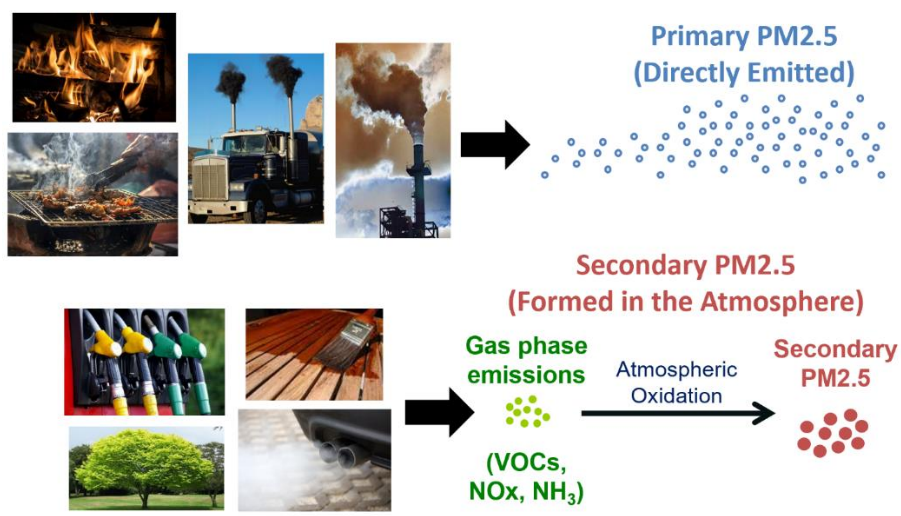


FIGURE 2-2
PM2.5 FORMATION MECHANISMS

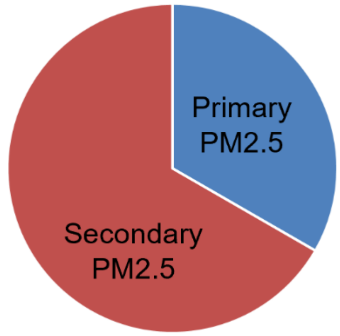


FIGURE 2-3
APPROXIMATE CONTRIBUTION OF SECONDARY AND PRIMARY PM2.5 IN THE SOUTH COAST AIR BASIN[4]

Most sources of PM2.5 and PM2.5 precursors have regular patterns of emissions that may vary by time of day, day of the week or by season. However, episodes of elevated PM2.5 can be caused by emission sources that occur infrequently such as wildfires, fireworks, or residential wood combustion. Wildfires are an important source of PM2.5 and PM2.5 precursors and can lead to multiple days of high PM2.5 levels, especially during the summer and fall months when fire activity is likely. Fireworks, either from commercial displays or personal use, are a significant source of PM2.5 on July 4th and 5th each year; concentrations recorded on these days are typically the highest measured in the entire year. Residential wood combustion is also an important source of PM2.5 and PM2.5 precursors, predominantly during the months of November through February. Residents are more likely to burn wood on cool nights, on the weekends, and during holiday periods. The spatial heterogeneity in PM2.5 emissions and micro meteorology lead to significant differences in PM2.5 measurements throughout the Basin.

While long term trends in PM2.5 concentrations are largely driven by changes in emissions, the observed day to day variations in PM2.5 concentrations are primarily the result of meteorological changes except on days with elevated atypical emissions such as fireworks, wildfires, or residential wood combustion. Elevated PM2.5 concentrations can occur in the Basin throughout the year but occur most frequently in fall and winter. This is mainly due to the unfavorable meteorological conditions that are more common in those months. Figure 2-4 summarizes the meteorological factors that influence PM2.5 concentrations.

---

[4] Fractions of primary and secondary PM were estimated using the PM2.5 speciation data measured at the Los Angeles-North Main street from June 2012 to July 2018. The total mass of the elemental carbon and metals was assigned as primary PM2.5. The total mass of inorganic ions was assigned as secondary PM2.5. For organic aerosols, we referred to Figure V-6-20 in the Appendix V of the South Coast AQMD's 2016 Air Quality Management Plan (AQMP) and assigned 30 percent of the organic aerosol as primary PM2.5 and 70% to the secondary PM2.5 fraction. Appendix V of the 2016 AQMP is available at https://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/appendix-v.pdf?sfvrsn=10

FIGURE 2-4
IMPORTANT FACTORS THAT INFLUENCE PM2.5 CONCENTRATIONS

The average wind speed for Los Angeles is the lowest of the nation's 10 largest urban areas, resulting in reduced dispersion throughout the region. In addition, the summertime daily maximum mixing heights[5] in Southern California are the lowest, on average, due to strong temperature inversions in the lower atmosphere that effectively trap pollutants–both primary PM2.5 and the PM2.5 precursors–near the surface. Southern California also has abundant sunshine, which drives the photochemical reactions that form secondary PM2.5. Periods of fog or high humidity can also lead to elevated PM2.5 concentrations as chemistry in fog droplets can increase fine particle mass.

Weather disturbances and rainstorms, which predominantly occur during the winter months, are effective in reducing ambient PM2.5 concentrations. Enhanced ventilation and the breakup of elevated inversion layers facilitate atmospheric mixing. Rainfall is extremely effective in reducing PM2.5 concentrations in the atmosphere. The frequency of these disturbances can strongly influence both the 98th percentile highest daily average concentrations and the annual average concentrations, which are the key parameters to determine attainment of the 24-hour PM2.5 standard and the annual PM2.5 standard, respectively.

[5] The maximum mixing height is an index of how well pollutants can be dispersed vertically in the atmosphere. The greater the mixing height, the greater the ventilation, and the more that pollutants are dispersed

Ambient Air Quality Standards

Federal and State Standards

Ambient air quality standards have been set by both the federal government and the State of California for fine particulate matter. In this chapter, statistics capturing the number of days exceeding federal standards are presented along with concentration trends and design values calculated from measurement data. Exceedance metrics are instructive regarding trends and control strategy effectiveness. However, it should be noted that an exceedance of the concentration level of a federal standard does not necessarily mean that the NAAQS was violated or that it would cause nonattainment. The form of the standard must also be considered. For example, for 24-hour PM2.5, the form of the standard is the annual 98th percentile measurement of all the 24-hour PM2.5 daily samples at each station. At a station with daily measurements, this corresponds to the 8th highest daily PM2.5 measurement.

For PM2.5 NAAQS attainment/nonattainment decisions, the most recent three years of data are considered along with the form of the standard, to calculate a *design value* for each station.[6] Design values are the statistical metrics used to compare with the NAAQS to determine attainment. The overall design value for an air basin is the highest design value of all the stations in that basin. The California State air quality standards are values not to be exceeded, typically evaluated over a three-year period, and the data is evaluated in terms of a *State Designation Value*, which allows for some statistical data outliers and exceptional events. Attainment deadlines for the State standards are 'as soon as practicable.'

[6] Note that for modeling attainment demonstrations, the U.S. EPA modeling guidance recommends a 5-year weighted average for the design value instead of the 3-year

TABLE 2-1

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) AND DESIGN VALUE REQUIREMENTS FOR FINE PARTICULATE MATTER

Averaging Time**	NAAQS Level	Design Value Form of NAAQS*
24-Hour (2006)	**35 $\mu g/m^3$**	**Three-year average of the annual 98th percentile of daily 24-hour concentration**
24-Hour (1997) ***	65 $\mu g/m^3$	
Annual (2012)	**12.0 $\mu g/m^3$**	**Annual average concentration, averaged over three years** *(annual averages based on average of 4 quarters)*
Annual (1997) ***	15.0 $\mu g/m^3$	
Annual (2024)****	9.0 $\mu g/m^3$	

Bold text denotes the current and most stringent NAAQS.

* The NAAQS is attained when the design value (form of concentration listed) is equal to or less than the level of the NAAQS.

** Year of U.S. EPA NAAQS update review shown in parenthesis and revoked or revised status in brackets; for revoked or revised NAAQS, areas may have continuing obligations until that standard is attained.

*** On July 25, 2016 U.S. EPA finalized a determination that the Basin attained the 1997 annual (15.0 $\mu g/m^3$) and 24-hour PM2.5 (65 $\mu g/m^3$) NAAQS, effective August 24, 2016.

**** On March 6, 2024, U.S. EPA strengthened the annual PM2.5 NAAQS, effective May 6, 2024.

TABLE 2-2

CALIFORNIA AMBIENT AIR QUALITY STANDARDS (CAAQS) AND DESIGNATION VALUE REQUIREMENTS FOR FINE PARTICULATE MATTER

Averaging Time**	CAAQS Level	Designation Value Form of CAAQS*
Annual (2012)	12.0 $\mu g/m^3$	Annual average of the daily 24-hour concentrations. Maximum value in a three-year

* The CAAQS is attained when the designation value (form of concentration listed) is equal to or less than the level of the CAAQS.

Under the Exceptional Events Rule,[7] U.S. EPA allows certain air quality data to not be considered for NAAQS attainment status when that data is influenced by exceptional events that meet strict evidence requirements, such as high winds, wildfires, volcanoes, or some cultural events (such as Independence Day or New Year's fireworks). An exceptional event meets the following criteria:

- The event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;
- The event was not reasonably controllable or preventable; and
- The event was caused by human activity that is unlikely to recur at a particular location or was a natural event.

For a few PM measurements in the Basin between 2016 and 2022, the South Coast AQMD applied the U.S. EPA Exceptional Events Rule to flag these PM2.5 data due to wildfires and fireworks on Independence Day. All of the PM exceptional event flags through 2022 have been submitted with the affected data to U.S. EPA's Air Quality System (AQS) database. PM2.5 attainment designation for the South Coast Air Basin will likely depend upon U.S. EPA's concurrence with the exceptional event flags and the analysis demonstrating that exceedances were caused by wildfire smoke and/or Independence Day fireworks.

Attainment Status of the Annual PM2.5 Standard

The 2022 PM2.5 annual federal design values are summarized in Table 2-3. Data likely to be approved as exceptional events by U.S. EPA are removed from this analysis. The highest 2022 PM2.5 federal annual design value of 13.7 µg/m^3 was measured in the Ontario CA-60 Near Road air monitoring station. The next highest 2022 PM2.5 federal annual design value was 13.4 µg/m^3, measured in the Metropolitan Riverside County area at the Mira Loma air monitoring station.

TABLE 2-3
2020–2022 ANNUAL FEDERAL DESIGN VALUES BY COUNTY*

County	2020–2022 PM2.5 Annual Design Value (µg/m^3)	Percent of Current (2012) PM2.5 NAAQS (12.0 µg/m^3)	Area of Design Value Max
Los Angeles	13.1	109	South San Gabriel Valley
Orange	10.9**	91	Central Orange County
Riverside	13.4	112	Metropolitan Riverside County
San Bernardino	13.7	114	Ontario CA-60 Near Road

* Data likely to be approved as exceptional events by U.S. EPA removed from analysis.
** Mission Viejo in the Saddleback Valley does not have a valid design value because measurements do not meet data completeness requirements.

[7] The Final 2016 U.S. EPA Exceptional Events Rule is available at https://www.epa.gov/air-quality-analysis/final-2016-exceptional-events-rule-supporting-guidance-documents-updated-faqs

The 2022 PM2.5 annual state designation values are summarized in Table 2-4. The 2022 PM2.5 annual state designation values measured in Los Angeles, Riverside, and San Bernardino Counties exceed the state standard of 12 μg/m^3. The highest 2022 PM2.5 state annual designation value of 18 μg/m^3 was measured at the Ontario CA-60 Near Road air monitoring station. State Designation Values are based on the maximum annual average recorded in the most recent three-year period, and therefore, they are less responsive to year-to-year changes in concentrations. Exceptional events were not removed when calculating these state designation values.

TABLE 2-4
2020–2022 ANNUAL STATE DESIGNATION VALUES BY COUNTY

County	2020–2022 PM2.5 Annual State Designation Value (μg/m^3)	Percent of Current PM2.5 CAAQS (12 μg/m^3)	Area of Designation Value Max
Los Angeles	16	142	East San Fernando Valley
Orange	12	100	Central Orange County
Riverside	16	142	Metropolitan Riverside County
San Bernardino	18	133	Ontario CA-60 Near Road

Figure 2-5 illustrates the spatial trend of the 2022 PM2.5 annual design values at all FRM PM2.5 stations in the South Coast Air Basin.[8] Data likely to be approved as exceptional events by U.S. EPA are removed from Figures 2-5 and 2-6. The highest PM2.5 annual averages are in the inland valley areas of Riverside and San Bernardino Counties and the southern portion of Los Angeles County.

[8] FEM PM2.5 data measured at Anaheim, Long Beach I-710 Near Road, Mira Loma, Ontario CA-60 Near Road, and Rubidoux stations were used to supplement missing FRM measurements

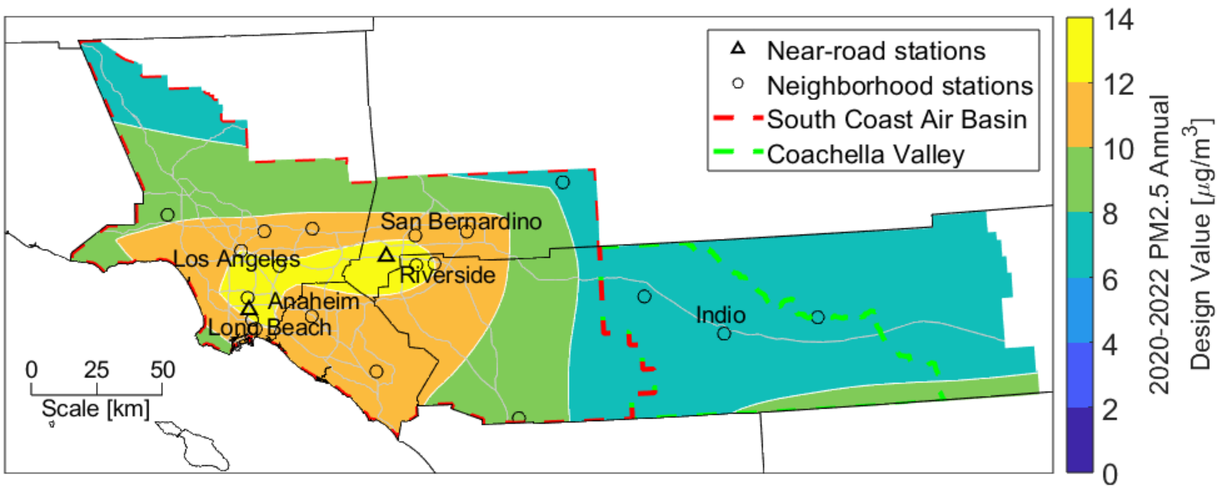


FIGURE 2-5
ALL FRM PM2.5 STATIONS IN THE SOUTH COAST AIR BASIN.
NEAR-ROAD STATIONS ARE SHOWN AS TRIANGLES, WHILE OTHER STATIONS ARE SHOWN AS CIRCLES. THE COLORS REPRESENT THE 2020-2022 ANNUAL PM2.5 DESIGN VALUE

2022 PM2.5 annual design values measured at all stations with regulatory PM2.5 data that meet U.S. EPA completeness criteria in the South Coast Air Basin are presented in Figure 2-6. As shown in the Figure, the 2022 PM2.5 annual design value exceeded the federal standard at six stations: Ontario CA-60 Near Road, Mira Loma, Compton, Long Beach I-710 Near Road, Pico Rivera, and Los Angeles-North Main St., with design values of 13.7 µg/m^3, 13.4 µg/m^3, 13.1 µg/m^3, 12.7 µg/m^3, 12.5 µg/m^3, and 12.1 µg/m^3, respectively. These correspond to 114, 112, 109, 106, 104, and 101 percent of the annual NAAQS, respectively.

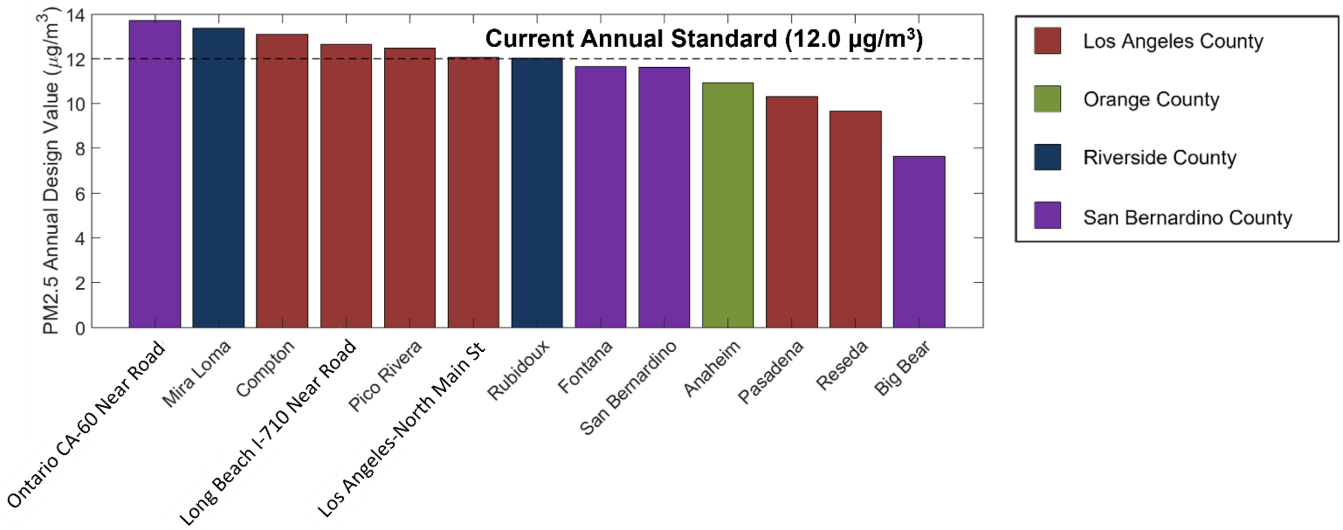


FIGURE 2-6
2020-2022 ANNUAL PM2.5 DESIGN VALUES MEASURED AT ALL STATIONS WITH COMPLETE DATA IN THE SOUTH COAST AIR BASIN. DATA LIKELY TO BE APPROVED AS EXCEPTIONAL EVENTS BY U.S. EPA REMOVED FROM ANALYSIS[9]

In summary, in 2022, the South Coast Air Basin failed to attain both the annual PM2.5 NAAQS and CAAQS. The highest PM2.5 annual design values for both NAAQS and CAAQS were measured at the Ontario CA-60 Near Road air monitoring station. In general, the PM2.5 annual averages measured in the inland valley areas of Riverside and San Bernardino Counties and the southern portion of Los Angeles County are higher than other parts of the South Coast Air Basin.

Attainment Status of the 24-hour PM2.5 Standard

The 2022 PM2.5 24-hour design values are summarized in Table 2-2. Data likely to be approved as exceptional events by U.S. EPA are removed from this analysis. The highest 2022 PM2.5 24-hour design value of 35 µg/m^3 was measured in the South Central LA County area at the Compton air monitoring station and the Ontario CA-60 Near Road station. The next highest 2022 PM2.5 24-hour design value was 34 µg/m^3, measured in the Metropolitan Riverside County area at the Mira Loma air monitoring station. All 2022 PM2.5 24-hour design values were equal or below the 24-hour NAAQS (35 µg/m^3).

[9] Long Beach (North). Long Beach (South), Azusa, and Mission Viejo stations do not have complete data in 2022 due to site closure or modification

TABLE 2-5
2020–2022 24-HOUR PM2.5 DESIGN VALUES BY COUNTY*

County	2020–2022 PM2.5 24-Hour Design Value (µg/m³)	Percent of Current (2006) PM2.5 NAAQS (35 µg/m³)	Area of Design Value Max
Los Angeles	35**	100	South Central LA County
Orange	30***	86	Central Orange County
Riverside	34	97	Metropolitan Riverside County
San Bernardino	35	100	Ontario CA-60 Near Road

* Data likely to be approved as exceptional events by U.S. EPA removed from analysis.
** Subject to U.S. EPA approval of a waiver to only consider more accurate filter-based measurements at Compton by excluding measurements from a continuous instrument that does not meet performance goals. In the unlikely event that U.S EPA does not approve the waiver, the 2022 value at Compton is 37 µg/m³.
*** Mission Viejo in the Saddleback Valley area does not have a valid design value because measurements do not meet data completeness requirements.

2022 PM2.5 24-hour design values measured at all stations in the South Coast Air Basin are presented in Figure 2-7. After removing data likely to be approved as exceptional events by U.S. EPA, all stations in the South Coast Air Basin met the 24-hour federal standard by 2022. The design value at Compton is subject to U.S. EPA approval of a waiver to only consider more-accurate filter-based measurements at Compton by excluding measurements from a continuous instrument that does not meet performance goals. In the unlikely event that U.S. EPA does not approve the waiver, the 2022 design value at Compton is 37 µg/m³.

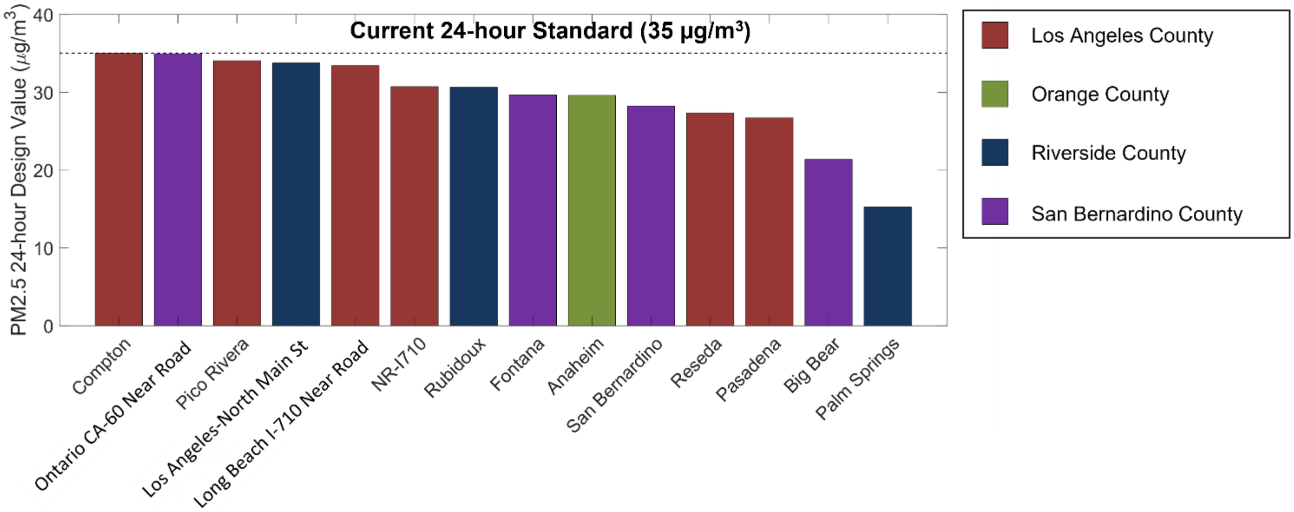


FIGURE 2-7

2020-2022 24-HOUR PM2.5 DESIGN VALUE MEASURED AT ALL STATIONS IN THE SOUTH COAST AIR BASIN. DATA LIKELY TO BE APPROVED AS EXCEPTIONAL EVENTS BY U.S. EPA REMOVED FROM ANALYSIS[10]

Figure 2-8 presents the number of days when the 24-hour PM2.5 exceed the 24-hour federal PM2.5 standard (35 μg/m^3)[11] in each month of 2022 at each FRM PM2.5 station in the South Coast Air Basin. As shown in the Figure, with the exception of exceedances recorded on the fourth and fifth of July due to Independence Day fireworks, all exceedances in 2022 occur in the months of October through January. Exceedances in the winter months are predominantly caused by cold and humid weather conditions that favor the formation of secondary PM2.5 and emissions of residential wood smoke. Limited ventilation in the atmosphere during winter months contributes to the elevated levels of PM2.5 as well. Year 2022 has less PM2.5 24-hour NAAQS exceedance days during the winter months (November-February) than past winter months.

[10] Long Beach (North). Long Beach (South), Azusa, and Mission Viejo stations do not have complete data in 2022 due to site closure or modification

[11] Due to rounding conventions, the threshold to meet the 24-hour PM2.5 NAAQS is 35.4 μg/m^3

Fairly clean period compared to past winter months. (Jan–Feb)

July 4th and 5th Fireworks (Jul)

Fairly clean period compared to past winter months. (Oct–Dec)

2022	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Compton	2	0	0	0	0	0	1	0	0	0	1	2
Pico Rivera #2	0	0	0	0	0	0	1	0	0	0	0	0
Ontario CA-60 Near Road	0	0	0	0	0	0	1	0	0	0	0	0
Rubidoux	0	0	0	0	0	0	1	0	0	0	0	0
San Bernardino	1	0	0	0	0	0	0	0	0	1	0	0
Long Beach I-710 Near Road	0	0	0	0	0	0	0	0	0	0	0	1
Fontana	0	0	0	0	0	0	0	0	0	1	0	0
Los Angeles-North Main Street	0	0	0	0	0	0	0	0	0	0	0	0
Reseda	0	0	0	0	0	0	0	0	0	0	0	0
Pasadena	0	0	0	0	0	0	0	0	0	0	0	0
Anaheim	0	0	0	0	0	0	0	0	0	0	0	0
Palm Springs	0	0	0	0	0	0	0	0	0	0	0	0
Mira Loma (Van Buren)	0	0	0	0	0	0	0	0	0	0	0	0
Big Bear	0	0	0	0	0	0	0	0	0	0	0	0

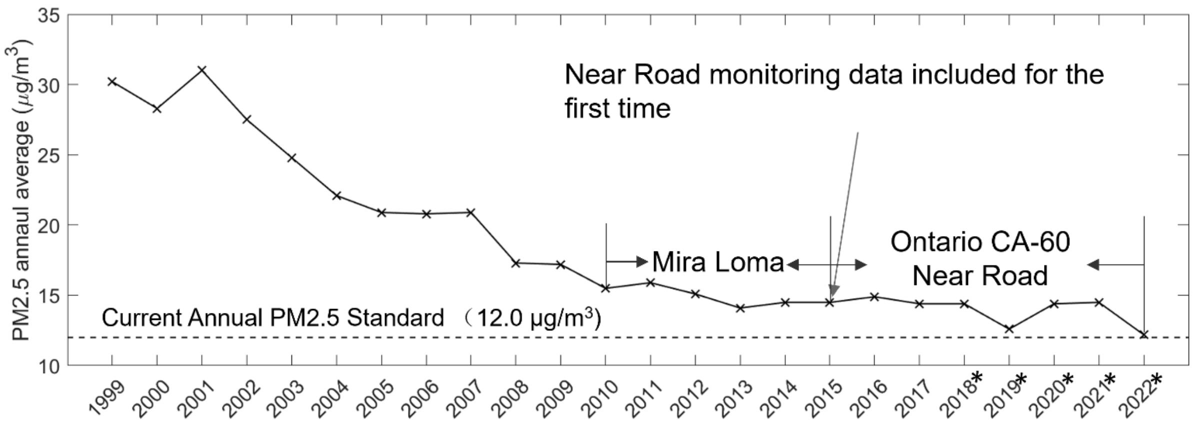
FIGURE 2-8

THE NUMBER OF DAYS WHEN THE 24-HOUR PM2.5 EXCEEDED THE 24-HOUR FEDERAL PM2.5 STANDARD (35 MG/M^3) IN EACH MONTH AT EACH FRM PM2.5 STATION IN THE SOUTH COAST AIR BASIN IN 2022. THE RED BOXES ARE EXCEPTIONAL EVENTS THAT ARE LIKELY TO BE APPROVED BY U.S. EPA

Historical Trends in Air Quality

Annual Standard

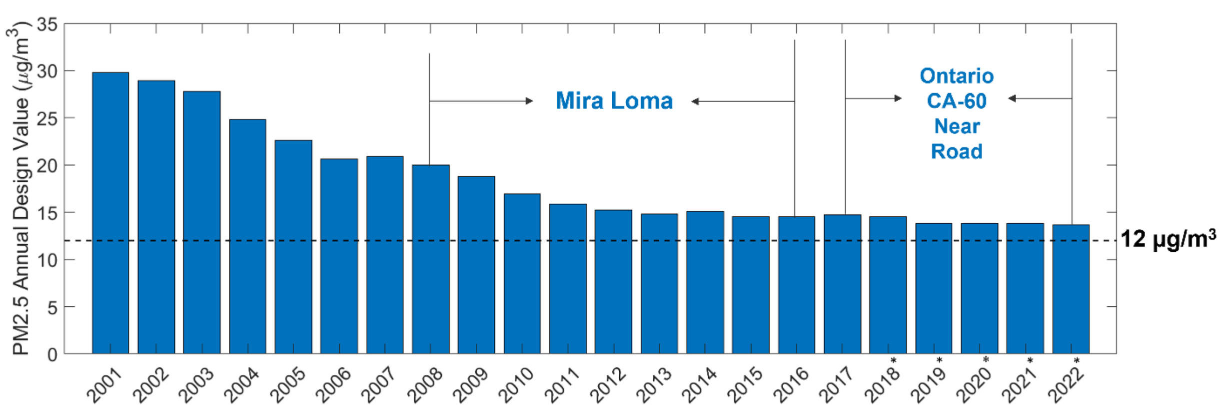
The historical trend of the annual average PM2.5 concentration measured in the South Coast Air Basin is presented in Figure 2-9. This parameter is an important metric for tracking progress towards clean air goals as the three-year average of the single year averages at each station represents the design value. As shown in the figure, the basin-maximum annual average PM2.5 has decreased significantly over the past two decades. The annual average recorded in 2022, which is the lowest on record, has decreased 60 percent compared with the value recorded in 2000, from 30.2 µg/m^3 to 12.2 µg/m^3. Between 2010 and 2015, the highest annual average PM2.5 concentration was recorded in Mira Loma. However, annual averages recorded at the Ontario CA-60 Near Road station exceed averages in Mira Loma since that monitor was established.



* Data likely to be approved as exceptional events by U.S. EPA removed from analysis.

FIGURE 2-9
BASIN-MAXIMUM ANNUAL AVERAGE PM2.5 CONCENTRATIONS MEASURED IN THE SOUTH COAST AIR BASIN FROM 1999-2022

Historical trends in the annual PM2.5 design values measured in the South Coast Air Basin are shown in Figure 2-10. The annual PM2.5 design value has decreased significantly over the past two decades. Compared with the design value in 2001, the annual PM2.5 design value in 2022 decreased by 54 percent, from 29.8 µg/m^3 to 13.7 µg/m^3. The Ontario CA-60 Near Road station currently has the highest annual design value. By the end of 2022, the annual PM2.5 design value in the South Coast Air Basin is 1.7 µg/m^3 higher than the 2012 annual PM2.5 federal standard. However, the 2022 design value is the lowest on record.



* Data likely to be approved as exceptional events by U.S. EPA removed from analysis.

FIGURE 2-10
ANNUAL AVERAGE PM2.5 DESIGN VALUE IN THE SOUTH COAST AIR BASIN FROM 2000-2022

24-hour Standard

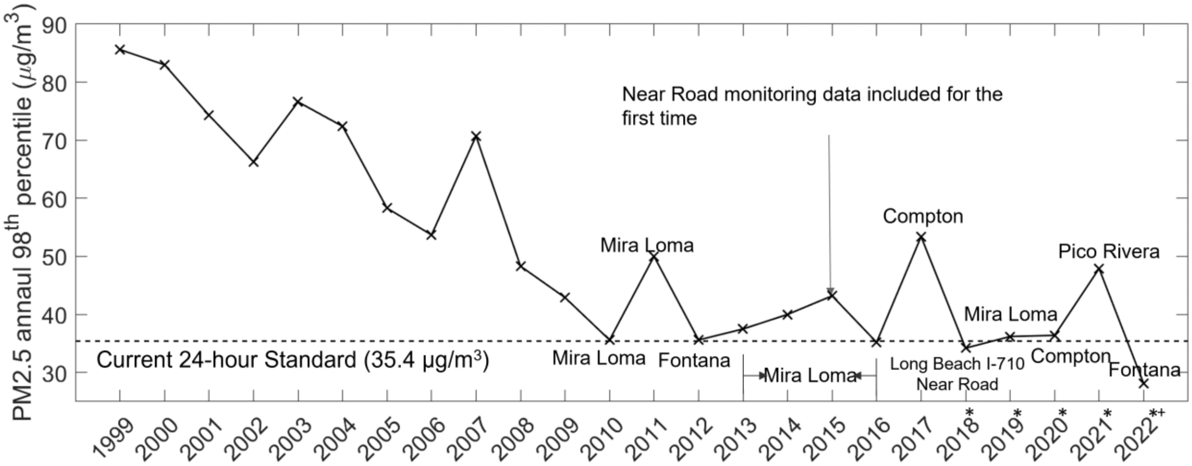
Over the past two decades, the number of 24-hour PM2.5 exceedance days have decreased significantly. The number of days when the basin-maximum 24-hour PM2.5 exceeded the 24-hour NAAQS in each month from 2000 to 2022 are shown in Figure 2-11. Among all past years on record, 2022 has the lowest number of 24-hour PM2.5 exceedance days. Compared with data collected in 2000, the number of days exceeding the standard in 2022 decreased by 92 percent, from 109 days to 9 days. In the early 2000s, exceedance days were recorded in every month. However, in recent years, the 24-hour standard is exceeded typically only in the colder months, from November to February, with the exception of exceedances resulting from Independence Day fireworks or wildfires.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2000	16	5	8	10	13	4	6	2	9	12	9	15	109
2001	12	1	15	8	21	7	7	7	12	19	18	11	138
2002	12	9	2	8	6	6	7	10	7	22	11	13	113
2003	13	2	7	0	12	12	4	0	14	18	4	8	94
2004	14	3	14	4	0	11	2	1	4	10	6	4	73
2005	4	0	5	1	2	2	3	1	3	8	8	13	50
2006	4	9	0	2	11	2	2	0	0	5	8	3	46
2007	1	4	5	5	6	1	2	0	0	5	16	2	47
2008	4	1	2	0	1	0	2	0	2	2	8	4	26
2009	4	2	3	0	4	0	1	4	1	0	6	5	30
2010	1	4	0	1	0	0	1	0	0	2	1	2	12
2011	0	1	0	0	0	0	1	0	0	5	3	5	15
2012	2	0	0	0	0	0	1	0	0	1	7	6	17
2013	1	3	1	0	0	0	0	0	0	4	2	1	12
2014	8	0	0	0	1	0	0	0	0	0	0	2	11
2015	13	10	3	3	0	0	1	0	0	0	0	0	30
2016	3	1	1	0	0	0	1	0	0	1	0	3	10
2017	1	0	1	0	1	0	2	0	0	1	5	8	19
2018	6	0	0	0	0	0	2	0	0	2	5	4	19
2019	2	0	0	0	0	0	2	0	0	0	7	1	12
2020	4	1	0	0	0	0	2	1	6	7	3	4	28
2021	2	1	0	0	0	0	2	0	1	0	9	8	23
2022	3	0	0	0	0	0	2	0	0	1	1	2	9

FIGURE 2-11

THE NUMBER OF DAYS WHEN THE BASIN-MAXIMUM 24-HOUR PM2.5 CONCENTRATIONS EXCEEDED THE 24-HOUR PM2.5 STANDARD (35 MG/M^3) IN EACH MONTH FROM 2000 TO JUNE 2022 IN THE SOUTH COAST AIR BASIN

The historical trend of the basin-maximum 98th percentile 24-hour PM2.5 measured in the South Coast Air Basin is presented in Figure 2-12. This parameter is an important metric for tracking progress towards clean air goals as the three-year average of the 98th percentile concentration at each station represents the design value. In addition, the annual 98th percentile concentrations better capture year-to-year variations in PM2.5 levels. As shown in the figure, the basin maximum 98th percentile 24-hour PM2.5 values have declined significantly over the past two decades. The value recorded in 2019 has decreased by 67 percent compared with the value recorded in 2000, from 85.6 µg/m^3 to 28.1 µg/m^3. With the exception of 2012, Mira Loma has had the highest 98th percentile value at all years pre-2017. Compton had the highest 98th percentile value in 2017 due to three anomalous measurements. The highest 98th percentile in the Basin in 2021 and 2022 was recorded at Pico Rivera and Fontana, respectively. However, the basin-maximum 98th percentile 24-hour PM2.5 measured in 2022 is the lowest on record.



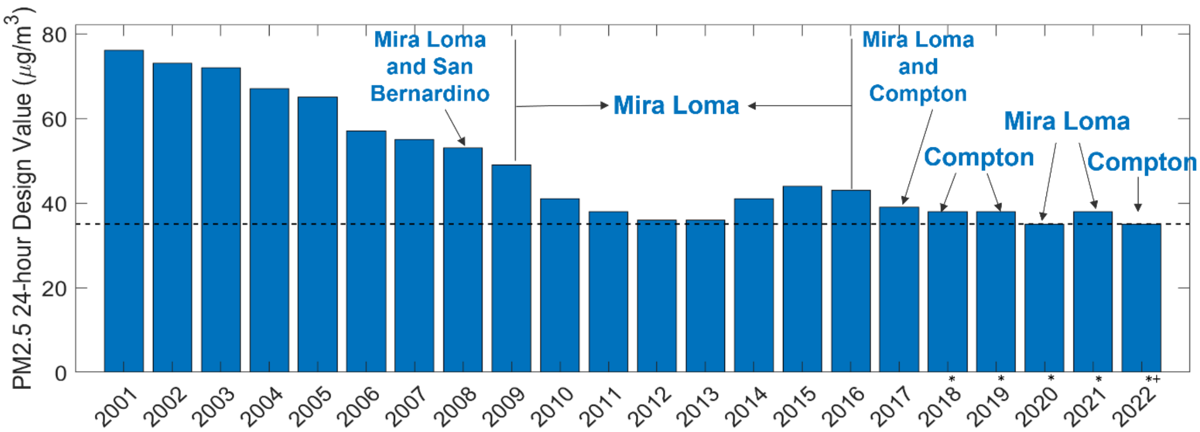
* Data likely to be approved as exceptional events by U.S. EPA removed from analysis.

\+ Subject to U.S. EPA approval of a waiver to only consider more accurate filter-based measurements at Compton by excluding measurements from a continuous instrument that does not meet performance goals. In the unlikely event that U.S. EPA does not approve the waiver, the 2022 value is 37 µg/m^3 measured at Compton.

FIGURE 2-12

BASIN-MAXIMUM 98TH PERCENTILE 24-HOUR PM2.5 CONCENTRATIONS MEASURED IN THE SOUTH COAST AIR BASIN FROM 1999-2022

The historical trend of the 24-hour basin-maximum PM2.5 design value measured in the South Coast Air Basin is shown in Figure 2-13. After removing exceptional events occurring in 2020, the 24-hour PM2.5 design meets the 24-hour PM2.5 federal standard (35 µg/m^3) subject to U.S. EPA approval of a waiver to only consider more accurate filter-based measurements at Compton by excluding measurements from a continuous instrument that does not meet performance goals. Compared with the design value in 2001, the 24-hour PM2.5 design value has declined by 54 percent, from 76 µg/m^3 in 2001 to 35 µg/m^3 in 2022. From 2009 to 2016, the highest design value was recorded in Mira Loma. However, since 2018, except 2020 and 2021, Compton has replaced Mira Loma as the station with highest 24-hour PM2.5 design value. The elevated 24-hour PM2.5 design values in 2014 are due in large part to extreme drought conditions experienced in Southern California and the associated lack of periodic storm events in the winter months that facilitate dispersion and washout of pollutants.[12]



* Data likely to be approved as exceptional events by U.S. EPA removed from analysis.
+ Subject to U.S. EPA approval of a waiver to only consider more accurate filter-based measurements at Compton by excluding measurements from a continuous instrument that does not meet performance goals. In the unlikely event that U.S. EPA does not approve the waiver, the 2022 value is 37 µg/m^3 measured at Compton.

FIGURE 2-13
24-HOUR PM2.5 DESIGN VALUE IN THE SOUTH COAST AIR BASIN FROM 2001-2022

PM2.5 Speciation

Analysis of major chemical components of PM2.5 provides insight into the composition and sources of fine particulate matter in the Basin. These chemical components are measured through PM2.5 speciation samplers. Currently, PM2.5 speciation samplers are deployed at four representative locations in each of the Basin's counties. They are Anaheim, Fontana, Los Angeles, and Rubidoux stations. Integrated 24-hour filter samples are collected every six days and analyzed at the South Coast AQMD Laboratory. The speciation analysis presented in this chapter uses a different approach than the speciation analysis for the modeling attainment demonstration and therefore, should not be used for future projection of PM2.5 design values. FRM measurements that the NAAQS are based upon do not retain all the PM2.5 that is measured by chemical speciation samplers. Therefore, for the modeling attainment demonstration, an adjustment technique is used to estimate the species composition as measured on FRM filters to allow for

[12] 2016 South Coast AQMD Air Quality Management Plan. Available at https://www.aqmd.gov/home/air-quality/clean-air-plans/final-2016-aqmp

the projection of base year measurements into the future.[13] However, the speciation analysis in this chapter uses established techniques for analyzing measured PM2.5 speciation data and provides valuable insight on current and past PM2.5 species fractions.

Figure 2-14 shows trends in average annual concentrations of six PM2.5 component species: elemental carbon (EC), organic matter, sulfate, nitrate, ammonium ion, and crustal material from 2010-2022. Note that data from 2020 were not included due to a 3-month hiatus in PM2.5 speciation sampling at the beginning of the COVID-19 pandemic. EC, sulfate, nitrate, and ammonium ion were measured directly, while organic and crustal components were calculated from measurements of organic carbon (OC) and metal concentrations, respectively, according to guidance for the U.S. EPA Chemical Speciation Network (CSN).[14]

Organic Matter = 1.4 × Organic Carbon

Crustal Material = 2.2 × Aluminum + 2.49 × Silicon + 1.63 × Calcium + 2.42 × Iron + 1.94 × Titanium

Annual median field blank organic carbon concentrations across the four sites were subtracted from OC measurement data to account for the well-documented positive sampling artifact caused by absorption of gas-phase OC onto filters. This correction method is similar to the current OC artifact correction method used by the Interagency Monitoring of Protected Visual Environments (IMPROVE) network and CSN, except annual field blank median concentrations were used instead of monthly medians to increase the pool of available field blank data. Furthermore, it is important to note that there is considerable uncertainty in the conversion factor between measured organic carbon and organic matter, which can range from just above 1 for organic matter with a composition close to pure carbon to greater than 2 for highly oxidized organic matter. Thus, the trend shown in Figure 2-14 is an approximation assuming the average composition of organic matter in the Basin is relatively constant.

Reported concentrations below analytical detection limits also add some uncertainty to annual average concentrations, as the true concentration for a measurement below the detection limit may range from zero to the detection limit. To account for uncertainty in non-detect concentrations, annual means for each component were calculated by substituting zero and minimum detection limit concentrations for non-detects to calculate lower and upper limit means, respectively. As shown in Figure 2-14, crustal material was the only component that was significantly affected by non-detect concentration uncertainty.

Annual mean concentrations of most components show a generally decreasing trend over the ten-year period from 2010-2022 with more muted changes from 2015-2022. The largest decrease is observed for the EC component, with average concentrations dropping by more than 50 percent at all sites from 2010 to 2022. This reduction in EC concentrations reflects the continued success of regulatory efforts to control

[13] See https://www.epa.gov/sites/default/files/2020-10/documents/draft-o3-pm-rh-modeling_guidance-2014.pdf for details

[14] https://www.epa.gov/amtic/chemical-speciation-network-csn

diesel emissions and other sources of EC in the Basin. In contrast to other components, average crustal concentrations remained largely similar at all sites throughout this period. Crustal material is primarily derived from windblown soil and anthropogenic sources of dust (fugitive dust, road dust, construction, etc.). These sources are generally more difficult to control and may be exacerbated by drought and other meteorological conditions. The increase of the crustal materials, EC, and organic matter in 2020 was due to the increase of wildfire activities in 2020.

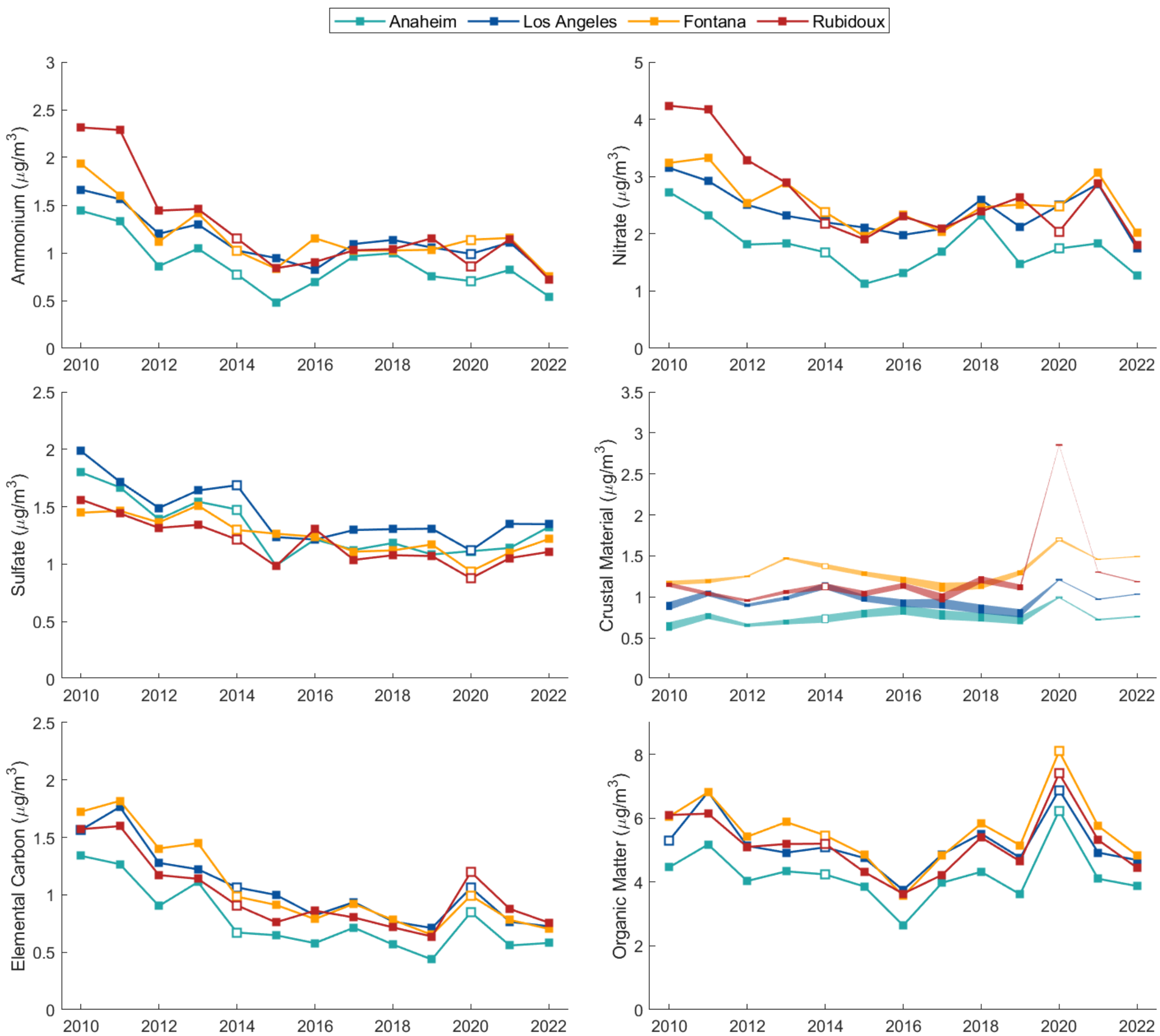


FIGURE 2-14

SOUTH COAST AIR BASIN PM2.5 SPECIATION NETWORK ANNUAL AVERAGE CONCENTRATION TRENDS, 2010–2022[15]

[15] Open symbols represent years with <75 percent data completeness (67-74 percent). The uncertainty associated with concentrations below analytical detection limits is represented with shading and different sized markers for the crustal component. For all other components, this uncertainty is negligible

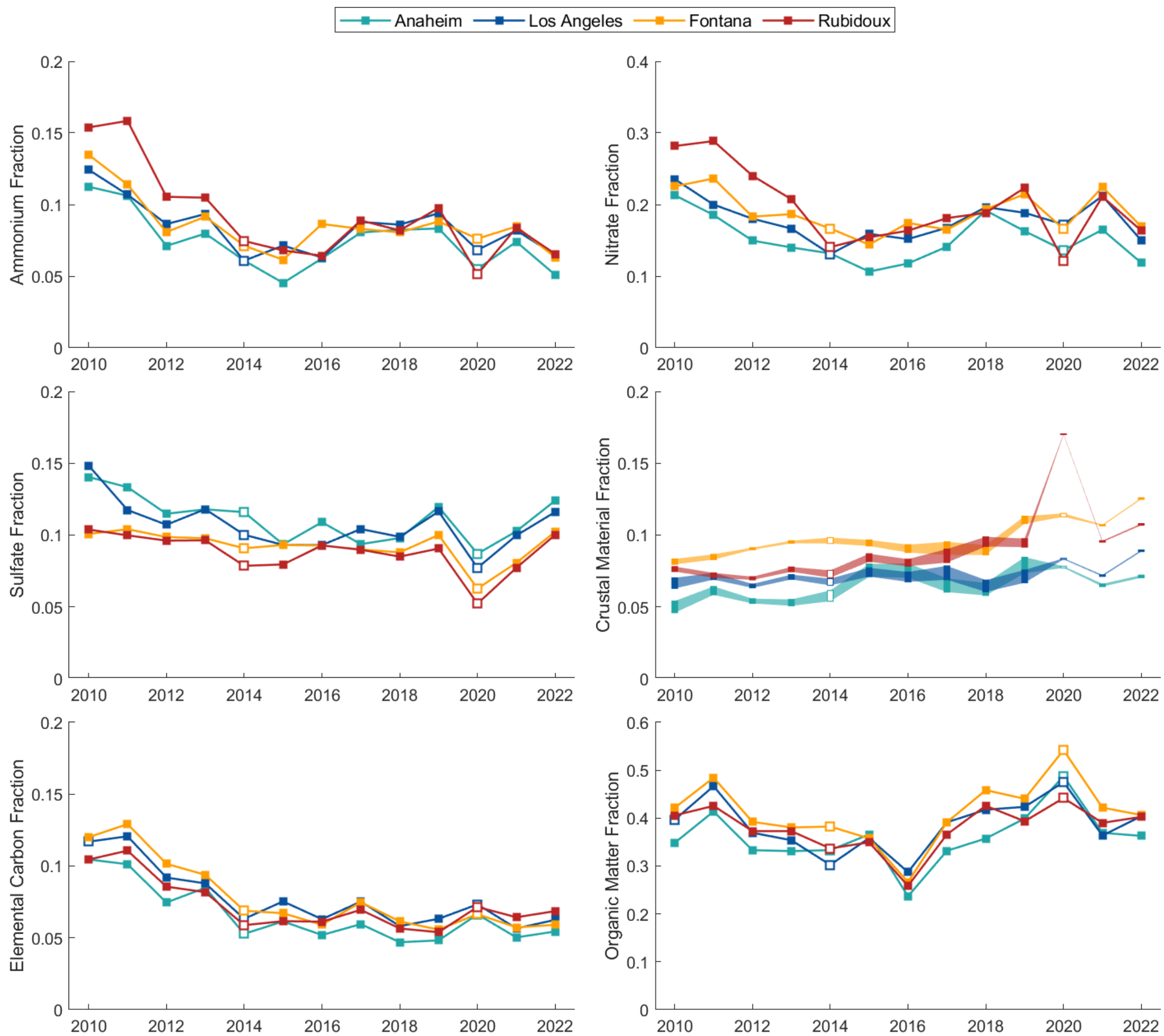


FIGURE 2-15

SOUTH COAST AIR BASIN PM2.5 SPECIATION NETWORK WEIGHTED ANNUAL AVERAGE RELATIVE CONTRIBUTION TRENDS OF RELATIVE CONTRIBUTION TO MASS, 2010–2022[16]

[16] Open symbols represent years with <75 percent data completeness (67-74 percent). The uncertainty associated with concentrations below analytical detection limits is represented with shading and marker size for the crustal component. For all other components, this uncertainty is negligible.

Figure 2-15 shows the annual mean contribution of each component to measured PM2.5 mass, weighted by total mass (i.e., days with higher PM2.5 have more influence on annual average). Organic matter was the dominant fraction at all sites from 2010-2022, with estimated contributions ranging from 24-54 percent of total mass. Ammonium ion and nitrate contributions to PM2.5 mass have generally increased from 2015-2019 after reaching their lowest levels around 2014-2015. This increasing trend is driven by both slight increases in absolute nitrate and ammonium ion concentrations as well as decreasing contributions from other species such as EC. Sulfate and crustal material contributions to total mass generally show muted changes from 2010-2022, with slight increases in crustal contributions and slight decreases in sulfate contributions observed at some sites. Due to the influence of increased wildfire activities, the fractions of crustal material, EC, and organic matter increased in 2020, while the fraction of ammonia, nitrate, and sulfate decreased compared to previous years. In 2021 and 2022, fractions of all PM2.5 species were similar to what was measured between 2016 and 2019.

Average seasonal concentrations of PM2.5 components across all sites from 2015-2022 are shown in Figure 2-16. Organic matter was the dominant component in all seasons. Both nitrate and EC concentrations and relative mass contributions peaked in the winter, while sulfate concentration and mass contribution peaked in the summer. These seasonal trends are consistent with meteorological impacts on secondary ion formation and particulate accumulation, as well as changes in seasonal PM2.5 emissions (i.e., residential wood burning). Other components showed more complex seasonal patterns, reflecting the competing influences of meteorology, atmospheric chemical processes, and emission patterns.

The ratio of organic carbon to elemental carbon (OC/EC) can provide further insight into the sources of organic matter in the Basin, with lower OC/EC ratios associated with primary combustion sources (e.g., diesel and gasoline combustion) and higher ratios with secondary organic formation and other OC sources. As shown in Figure 2-17, annual median OC/EC ratios show a generally increasing trend from 2010-2022, which is consistent with the steady decline in EC concentrations during this period. This trend suggests that contributions of secondary and other sources of organic matter are becoming increasingly important as diesel emissions decrease.

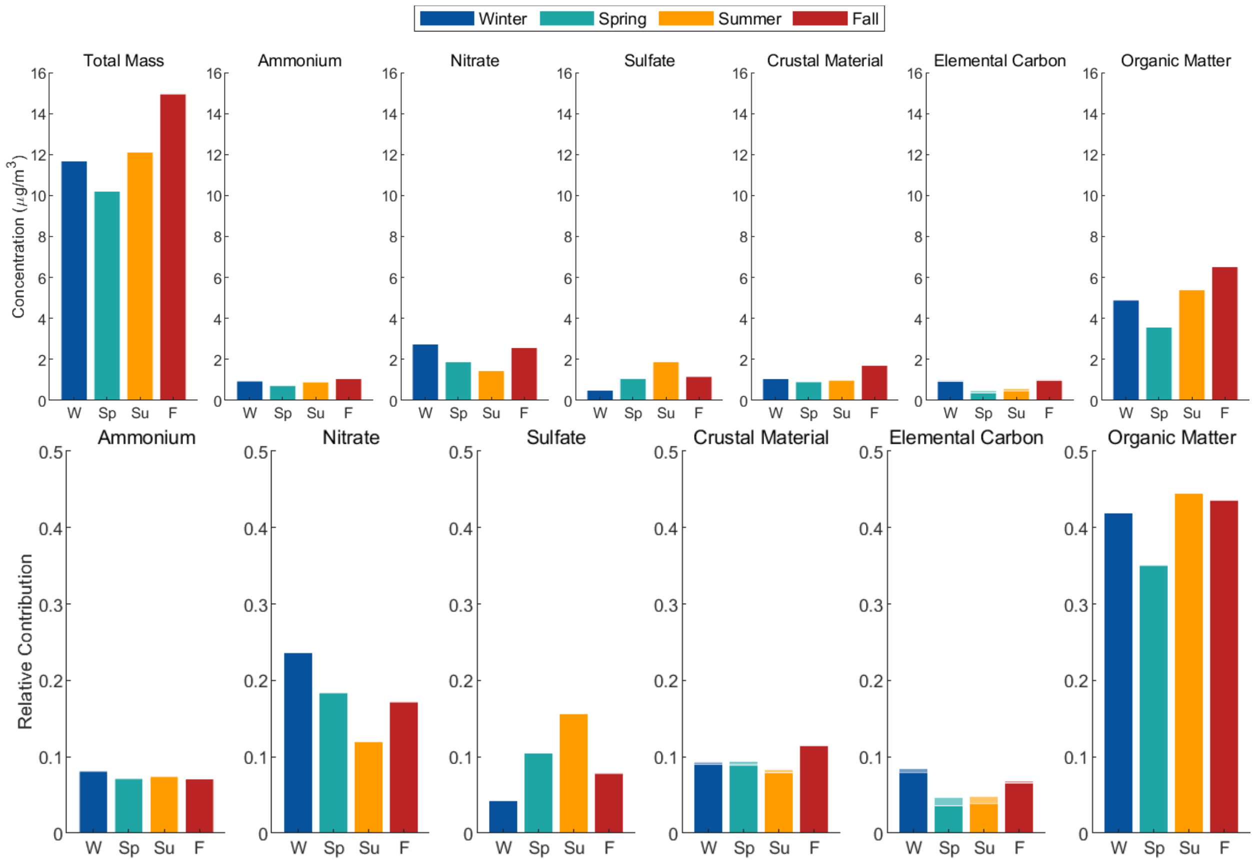


FIGURE 2-16

SEASONAL VARIATION IN CONCENTRATIONS OF PM2.5 COMPONENTS (TOP) AND RELATIVE CONTRIBUTION OF PM2.5 COMPONENTS TO TOTAL MASS (BOTTOM), 2015-2022[17]

[17]Winter, spring, summer, and fall are defined as DEC-FEB, MAR-MAY, JUN-AUG, SEP-NOV, respectively. The uncertainty associated with concentrations below analytical detection limits is represented with hatched shading at the top of each bar

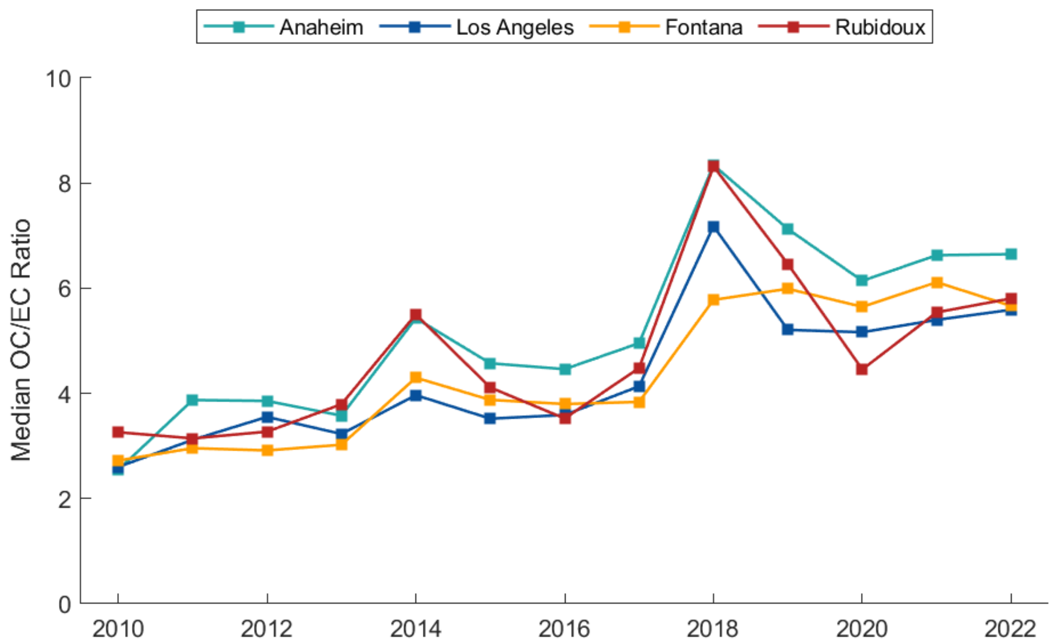


FIGURE 2-17
TRENDS OF SOUTH COAST AIR BASIN PM2.5 ORGANIC CARBON (OC) TO ELEMENTAL CARBON (EC) RATIO, 2010–2022[18]

Summary

PM2.5 concentrations have declined considerably since monitoring began in the early 2000s. PM2.5 levels are a strong function of meteorology, emissions of primary PM2.5 and emissions of PM2.5 precursors. The 2022 24-hour PM2.5 design value meets the federal standard subject to removal of likely exceptional events and U.S. EPA approval of a waiver to only consider more accurate filter-based measurements at Compton by excluding measurements from a continuous instrument that does not meet performance goals. In addition, the 98th percentile PM2.5 values measured in 2022 were the lowest on record. While the annual PM2.5 design values are still above the annual standard, 2022 saw the cleanest maximum annual average PM2.5 level ever recorded in the South Coast Air Basin.

[18] Annual median blank-corrected organic carbon to elemental carbon ratio at each site. Note that median ratios were calculated to limit effect of outliers associated with very low EC concentrations

References

South Coast Air Quality Management District. (2016). *2016 Air Quality Management Plan (AQMP).*

South Coast Air Quality Management District. (2022). *2022 Air Quality Management Plan (AQMP).*