

**Annual Report
on the
California Air Resources Board's
Fine Particulate Matter Monitoring Program**



February 2019



State of California
California Environmental Protection Agency
California Air Resources Board

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California's PM2.5 monitoring network includes:

- Federally-approved monitors that measure PM2.5 mass over a 24-hour period are currently located at 59 sites throughout the state;



**Federal Reference Method
monitor**

Health and Safety Code, Section 39619.5(g) requires the California Air Resources Board (CARB) to provide an update each year on the status and results of the fine particulate matter (PM2.5) monitoring program. This report provides a summary of PM2.5 monitoring activities in 2018 and how the data are being used to support CARB programs.

California's PM2.5 air quality monitoring program provides information used for determining which areas violate PM2.5 standards, characterizing the sources that contribute to PM2.5 pollution, determining background concentrations, assessing pollution transport, and supporting health studies and other research. Monitoring data also provide information to develop and evaluate programs for improving air quality. Newly emerging technologies are evaluated and incorporated continuously in California's PM2.5 monitoring program to provide improved monitoring data.

California's PM2.5 monitoring network began collecting data in 1998. A number of different types of PM2.5 monitors are operated to provide information on PM2.5 mass and chemical composition which are summarized below. Types and numbers of the PM2.5 monitors vary each year. Figure 1 displays the locations of PM2.5 monitors throughout the State as of the end of 2018. Additional information on PM2.5 monitoring can be found at:

<https://www.arb.ca.gov/aaqm/partic.htm>

Federal Reference Method Monitors

The installation of federally-approved PM2.5 mass monitors throughout California began in 1998. As of the end of 2018, Federal Reference Method (FRM) monitors are operated at 59 sites. These monitors collect particulate samples on filters, which are later weighed and analyzed in a laboratory. Because of this two-step process, PM2.5 air quality data collected with these monitors are not immediately available. To provide "real-time" PM2.5 air quality information, continuous PM2.5 mass monitors were added to our network.

- Samplers that quantify PM2.5 mass continuously at 113 sites;



Beta Attenuation Monitor

and

- Monitors that collect PM2.5 samples for analysis of chemical components at 18 sites;



Speciation monitor

Continuous Mass Monitors

Continuous PM2.5 mass monitors provide valuable information for public reporting, temporal representation, health studies, transport studies, and background monitoring. PM2.5 mass can be measured continuously with several different commercially available technologies. We chose the Beta Attenuation Monitor (BAM) for use in California and several other types of continuous monitors (e.g., laser light scattering monitor) in limited use. There are 113 sites continuously measuring PM2.5 mass. The U.S. Environmental Protection Agency (U.S. EPA) designated certain models of the continuous monitors as Federal Equivalent Method (FEM) monitors. They are considered equivalent to the FRM monitors and therefore may be used to determine compliance with federal standards. Sixty-nine of California's continuous monitoring sites have FEM monitors.

Air Quality Sensors

PM2.5 mass can be continuously measured with air quality sensors. Air quality sensors for PM2.5 are newly emerging, low cost methods using optical sensors to count PM2.5 or measure PM2.5 concentrations. PM2.5 data can be accessed instantly via the Internet. As of January 2019, more than 2500 non-regulatory air quality sensors have been purchased and deployed across California by community groups, government agencies, private citizens, and others. Figure 2 displays the locations of PM2.5 sensors across the State as of January 2019. Real-time PM2.5 data from air quality sensors can be found at:

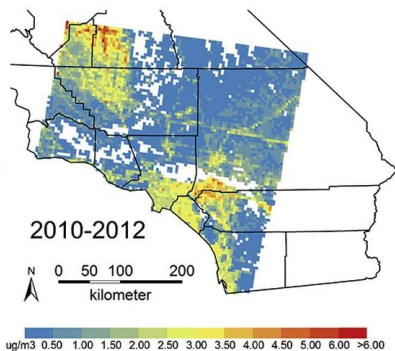
<https://ivan-imperial.org/air/list>

<https://www.purpleair.com/map>

Satellite Remote Sensing

Satellite remote sensing has been used to evaluate the spatial variabilities of PM2.5 concentrations. Technologies have improved such that certain Aerosol Optical Depth data can be used to estimate the concentrations of PM2.5 components, such as nitrate, sulfate, organic carbon, and elemental carbon. Satellite remote sensing can fill in

Spatial Distribution of nitrate predicted by the satellite remote sensing;



(Source: Meng, X., Garay, M.J., Diner, D.J., Kalashnikova, O.V., Xu, J., Liu, Y., 2018. Estimating PM2.5 Speciation Concentrations using Prototype 4.4 km Resolution MISR Aerosol Properties over Southern California. *Atm. Env.* 181,70-81.)

PM2.5 data in areas without PM2.5 monitors. Satellite remote sensing refine our understanding of PM2.5 spatial distribution and track PM2.5 trends.

Speciation Monitors

Another major stage of network implementation is the deployment of PM2.5 speciation monitors. Speciation monitoring provides valuable information about the composition, and ultimately, the sources of PM2.5 pollution. In 2014, along with states, U.S. EPA conducted a nationwide assessment of the PM2.5 speciation network to determine whether the sites were meeting the objectives and still needed. The review determined that all of the sites in California were needed and should continue to operate. Recently, CARB is conducting evaluation of the PM2.5 monitoring sites to make appropriate size of network to meet the objectives.

Federally-Required Speciation Monitors

There are two components to the PM2.5 speciation network in California. The first component, mandated by the U.S. EPA, requires filter-based PM2.5 speciation monitoring at seven California sites that are now part of a national trends network for PM2.5 speciation. These monitors are the National Air Monitoring Stations (NAMS) monitors for the speciation network. The seven PM2.5 speciation monitors are located in Bakersfield, El Cajon, Fresno, Sacramento, San Jose, Los Angeles, and Riverside.

Additional Speciation Monitors

The second component of California's PM2.5 speciation network is the deployment of samplers at selected State and Local Air Monitoring Stations (SLAMS). Data from these sites provide additional information needed for developing effective air quality attainment plans. The focus of the SLAMS PM2.5 speciation network is to enhance the spatial coverage of the NAMS sites, particularly in areas with elevated PM levels.

CARB and local air districts operate filter-based speciation monitors at eleven sites - Anaheim, Calexico, Chico, Fontana, Modesto, Portola, Visalia, Sacramento, Vallejo, Livermore, and Oakland.

In 2007, CARB began monitoring for specific wood smoke tracers to determine the contribution of wood burning sources to PM2.5 ambient levels. Wood smoke tracers are being monitored at six of the speciation SLAMS sites - Calexico, Chico, Modesto, Portola, Sacramento, and Visalia during the winter season.

Accessing PM2.5 Data

State and National PM2.5 Ambient Air Quality Standards (micrograms per cubic meter)

	California	National
Annual	12	12.0
24-hour	---	35

Data collected as part of California’s PM2.5 monitoring program can be obtained in several ways. Daily PM2.5 values as well as summary statistics can be accessed through the interactive query program on CARB’s web page at:

<https://www.arb.ca.gov/adam>

Real-time hourly PM2.5 data from California’s continuous monitors can also be found at:

<https://www.arb.ca.gov/aqmis2/aqdselect.php>

PM2.5 Designations

The Clean Air Act requires the U.S. EPA to set national 24-hour and annual PM2.5 ambient air quality standards, and to designate nonattainment areas for the national standards. CARB established a more health protective State PM2.5 ambient air quality standard as required by California State law. California State law also requires CARB to designate each area as attainment, nonattainment, or unclassified for the State standard.

Based on 2014-2016 air quality data collected as part of California’s PM2.5 monitoring network, CARB designates the attainment status of areas with respect to the State annual average PM2.5 ambient air quality standard of 12.0 µg/m³. Most urban areas of California exceed the State PM2.5 standard, as well as several more isolated

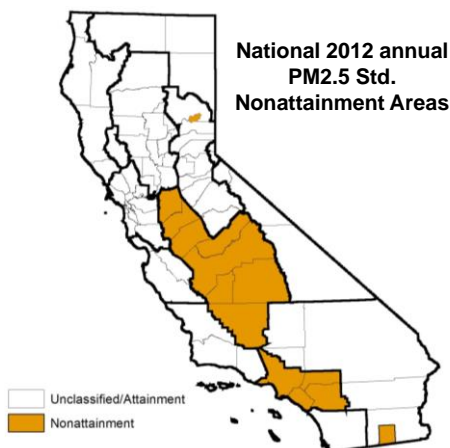


sub-areas. However, overall, as air quality has improved more areas now meet the State PM2.5 ambient air quality standard.



In 2006, U.S. EPA strengthened the national 24-hour PM2.5 standard from $65 \mu\text{g}/\text{m}^3$ to $35 \mu\text{g}/\text{m}^3$. The U.S. EPA issued final designations for this standard which became effective in December 2009. Seven areas in California were designated as not meeting the strengthened federal 24-hour PM2.5 standard – the South Coast Air Basin, San Joaquin Valley Air Basin, Bay Area Air Basin, Sacramento Metropolitan area, a portion of the Feather River Air Pollution Control District, a portion of Butte County, and a portion of Imperial County. Since 2009, U.S. EPA has determined that the Bay Area Air Basin, the Feather River Air Pollution Control District, Sacramento Metropolitan area, Imperial County, and Butte County have attained the standard. Information on the final designation may be found at:

<https://www3.epa.gov/region9/air/actions/ca.html>



In 2012, U.S. EPA lowered the annual PM2.5 standard from $15.0 \mu\text{g}/\text{m}^3$ to $12.0 \mu\text{g}/\text{m}^3$. The U.S. EPA issued final designations for this standard in December 2014 based on 2011-2013 air quality data. Four areas in California were designated as not meeting the lowered annual PM2.5 standard – South Coast Air Basin, San Joaquin Valley Air Basin, and portions of Imperial and Plumas Counties. Information on the State and federal designations may be found at:

<https://www.arb.ca.gov/degis/pm25desig/pm25desig.htm>

PM2.5 Attainment Plans

Progress in reducing PM2.5 levels has occurred throughout the State. As shown in the maps on the previous page, four areas now remain above the standards and are required to develop State Implementation Plans (SIPs). The South Coast 2016 Air Quality Management Plan (2016 AQMP) includes a comprehensive approach for attaining multiple PM2.5 air quality standards, including the $12.0 \mu\text{g}/\text{m}^3$ annual and the $35 \mu\text{g}/\text{m}^3$ 24-hour standards. The South Coast 2016

AQMP was approved by CARB and transmitted to U.S. EPA in 2017. The San Joaquin Valley prepared a comprehensive SIP in 2018 to address multiple PM2.5 standards: the 65 $\mu\text{g}/\text{m}^3$ 24-hour and the 15.0 $\mu\text{g}/\text{m}^3$ annual standards; the 35 $\mu\text{g}/\text{m}^3$ 24-hour and the 12.0 $\mu\text{g}/\text{m}^3$ annual standards. The SIP was adopted by the District in 2018 and approved by CARB in January 2019. Imperial County submitted the PM2.5 SIP for the annual standard in 2018 for the nonattainment area, which represents a portion of Imperial County. The SIP was approved by CARB and transmitted to U.S. EPA in 2018. The Plumas County SIP for the annual PM2.5 standard was submitted to U.S. EPA in 2017.

Information on SIPs for the South Coast, the San Joaquin Valley, Imperial County, and Plumas County are available, respectively, at:

<https://www.arb.ca.gov/planning/sip/planarea/scabsip/scabsip.htm>

<https://www.arb.ca.gov/planning/sip/planarea/sanjqnvllysip.htm>

<https://www.arb.ca.gov/planning/sip/planarea/imperial/imperialsip.htm>

<https://www.arb.ca.gov/planning/sip/planarea/nsierra/nsierr.htm>

Figure 1: PM2.5 Monitoring Stations in California

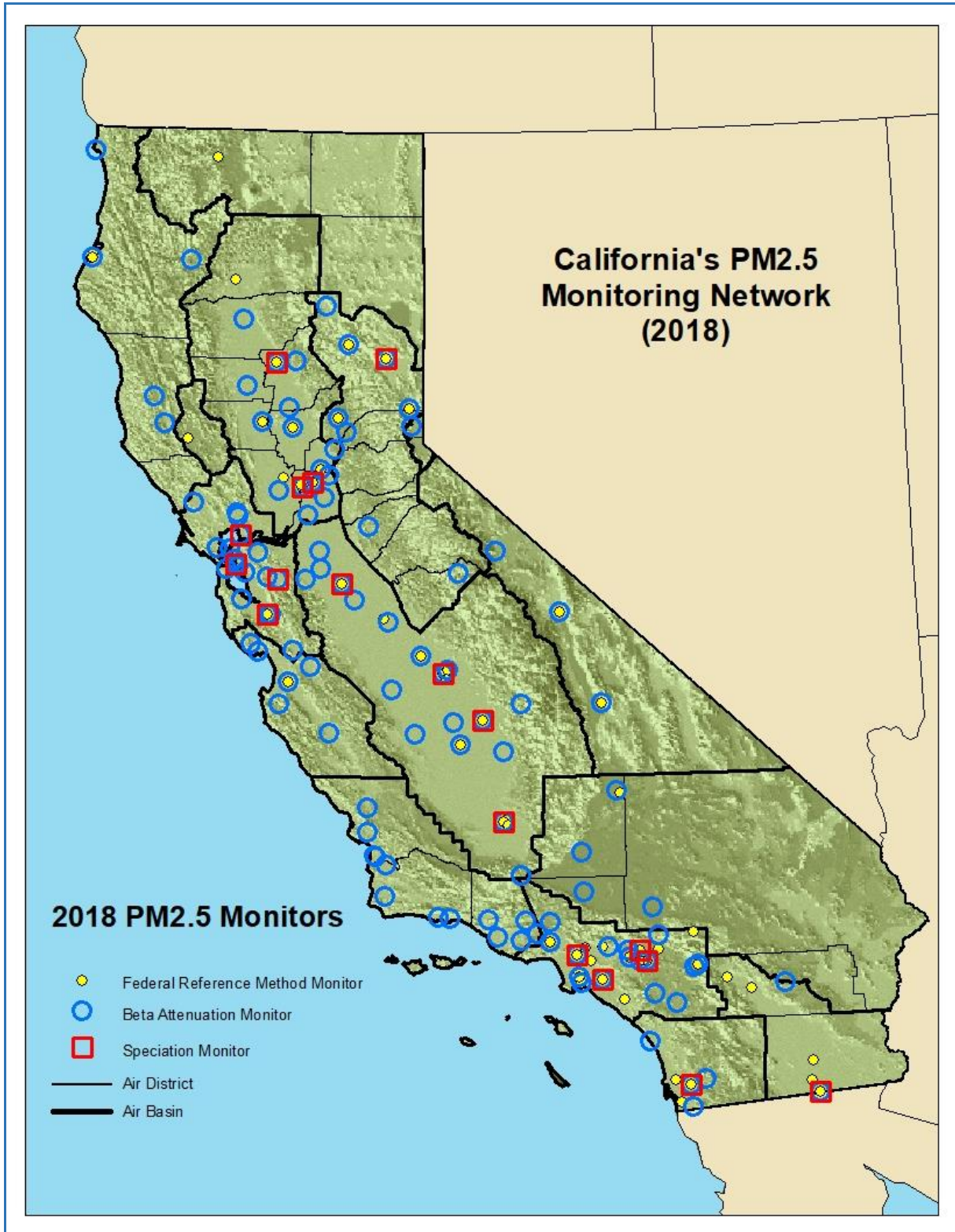


Figure 2: PM2.5 sensor locations in California

