

Overview of Particulate Matter (PM) Air Quality in the United States

Updated: July 20, 2026

1. Introduction

The purpose of this document is to maintain an up-to-date graphical summary of air quality information that supports the review of the National Ambient Air Quality Standards (NAAQS) for particulate matter (PM). In previous reviews of the PM NAAQS, this type of information has generally been included in atmospheric sections of the Integrated Science Assessment (ISA) and Policy Assessment (PA) for PM. This document provides summaries of the air quality emissions and monitoring data to be included in future PM NAAQS review supporting documents and will be updated at regular intervals as new data becomes available.

This document follows an organizational structure similar to that of the atmospheric sections of past PM NAAQS review supporting documents. The subsequent sections are as follows: 2. Atmospheric Chemistry; 3. Sources and Emissions of PM in Ambient Air; 4. Ambient Air Monitoring Requirements and Monitoring Networks; 5. Data Handling Conventions and Computations for Determining Whether the Standards are Met; and 6. PM Concentrations Measured at Ambient Air Monitoring Sites Across the U.S.

2. Atmospheric Chemistry

In ambient air, PM is a mixture of substances suspended as small liquid and/or solid particles. Particle size is an important consideration for PM, as distinct health and welfare effects have been linked with exposures to particles of different sizes. Particles in the atmosphere range in size from less than 0.01 to more than 10 micrometers (μm) in diameter. When describing PM, subscripts are used to denote the aerodynamic diameter¹ of the particle size range in micrometers (μm) of 50% cut points of sampling devices. The EPA defines $\text{PM}_{2.5}$, also referred to as fine particles, as particles with aerodynamic diameters generally less than or equal to 2.5 μm . The size range for $\text{PM}_{10-2.5}$, also referred to as coarse particles, includes those particles with aerodynamic diameters generally greater than 2.5 μm and less than or equal to 10 μm . PM_{10} , which is comprised of both fine and coarse fractions, includes those particles with aerodynamic diameters generally less than or equal to 10 μm . Figure 1 provides perspective on these particle size fractions. In addition, ultrafine particles (UFP) are often defined as particles with a diameter of less than 0.1 μm .

Atmospheric distributions of particle size generally exhibit three distinct modes (“nucleation mode”, “accumulation mode”, and “coarse mode”) that roughly align with the PM size fractions defined above. Figure 2 below shows an example of the particle size distribution for each of these three modes. The nucleation mode is made up of freshly generated particles, formed either during combustion or by atmospheric reactions of precursor gases. The nucleation mode is especially prominent near sources like heavy traffic, industrial emissions, biomass burning, or cooking. While nucleation mode particles are only a minor contributor to overall ambient PM mass and surface area, they are the main contributors to ambient particle number. By number, most nucleation mode particles fall into the UFP size range, though some fraction of the nucleation mode number distribution can extend above 0.1 μm in diameter. Nucleation mode particles can grow rapidly through coagulation or uptake of gases by particle surfaces, giving rise to the accumulation mode. The accumulation mode is typically the predominant contributor to $\text{PM}_{2.5}$ mass and surface area, though only a minor contributor to particle number. $\text{PM}_{2.5}$ sampling methods measure most of the accumulation mode mass, although a small fraction of particles that make up the accumulation mode are greater than 2.5 μm in diameter. Coarse mode particles are formed by mechanical generation, and through processes like dust resuspension and sea spray formation. Most coarse mode mass is captured by $\text{PM}_{10-2.5}$ sampling, but small fractions of coarse mode mass can be smaller than 2.5 μm or greater than 10 μm in diameter.

¹Aerodynamic diameter is the size of a sphere of unit density (i.e., 1 g/cm^3) that has the same terminal settling velocity as the particle of interest.

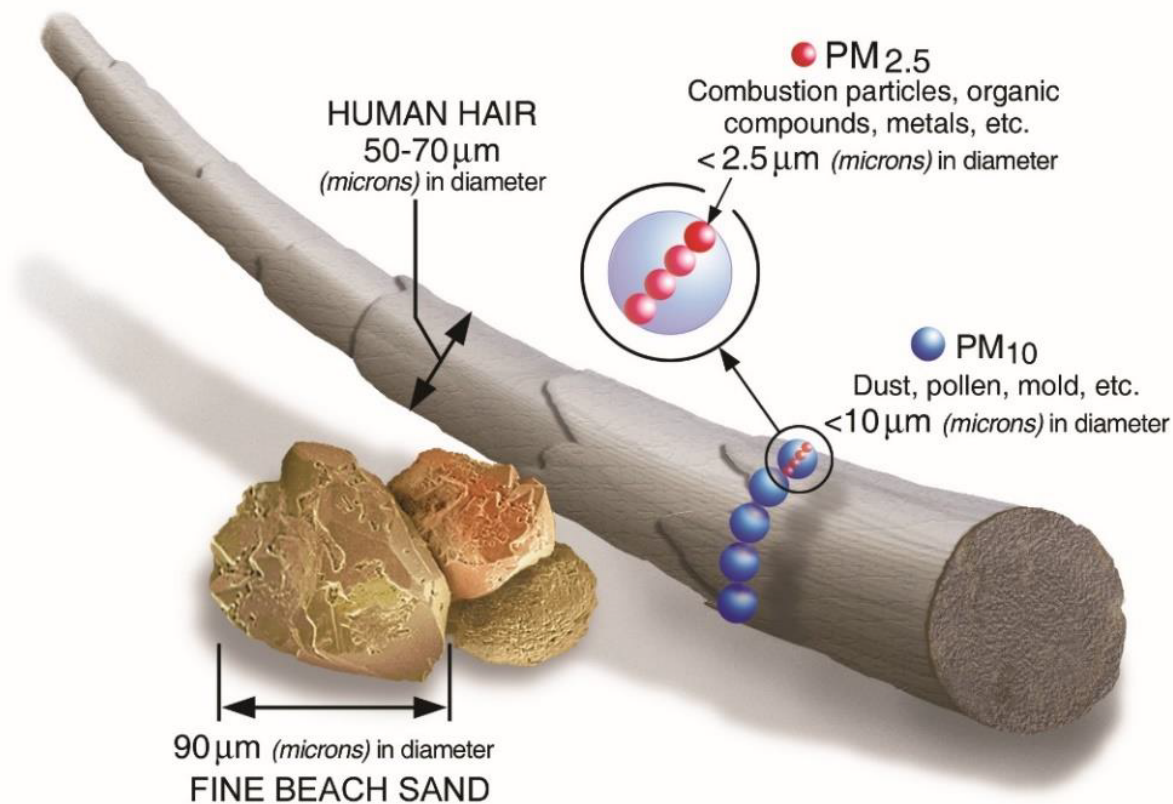


Figure 1. Comparisons of PM_{2.5} and PM₁₀ diameters to human hair and beach sand. Reproduced from Figure 2-1 of the [2020 PM PA](#).

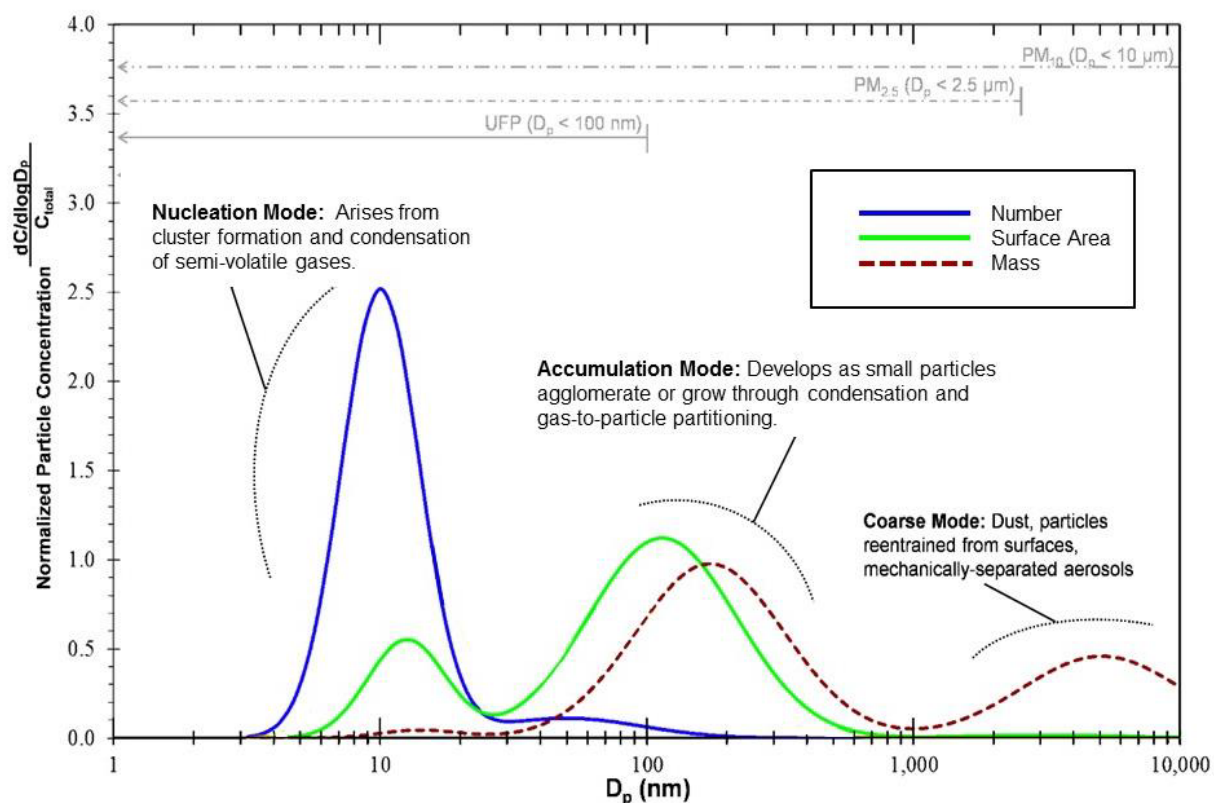


Figure 2. Comparison of particle size distribution by particle number, surface area, and mass. C_{total} = total particle concentration; D_p = particle diameter. Reproduced from Figure 2-1 of the [2019 PM ISA](#).

Most particles are found in the lower troposphere, where they can have residence times ranging from a few hours to weeks. Particles are removed from the atmosphere by wet deposition, such as when they are carried by rain or snow, or by dry deposition, such as gravitational settling or surface collision. Atmospheric lifetimes are generally longest for PM_{2.5}, which often remains in the atmosphere for days to weeks before being removed by wet or dry deposition. In contrast, atmospheric lifetimes for UFP and PM_{10-2.5} are shorter. Within hours, UFP can undergo coagulation and condensation that lead to formation of larger particles in the accumulation mode, or can be removed from the atmosphere by evaporation, deposition, or reactions with other atmospheric components. PM_{10-2.5} are also generally removed from the atmosphere within hours, through wet or dry deposition.

PM is composed of both primary and secondary components. Primary PM is derived from direct particle emissions from specific sources while secondary PM originates from gas-phase chemical compounds present in the atmosphere that have participated in new particle formation or condensed onto existing particles. Secondary PM, which accounts for a substantial fraction of PM_{2.5} mass, forms through atmospheric photochemical oxidation reactions of both inorganic and organic gas-phase precursors such as sulfur dioxide (SO₂), nitrogen oxides (NO_x), and ammonia (NH₃). Reactions leading to sulfate (SO₄²⁻) production from SO₂, nitrate (NO₃⁻) production from NO_x, and the gas-to-particle equilibrium between ammonia (NH₃) and ammonium (NH₄⁺) are relatively well understood, while formation of secondary organic PM, often referred to as secondary organic aerosols (SOA), is less well resolved.

3. Sources and Emissions of PM

Both primary PM and the gas-phase compounds contributing to secondary PM formation are emitted from both anthropogenic and natural sources. Anthropogenic sources of PM include both stationary and mobile sources. Stationary sources include fuel combustion for electricity production and other purposes, industrial processes, agricultural activities, and road and building construction and demolition. Mobile sources of PM include diesel- and gasoline-powered highway vehicles and other engine-driven sources (e.g., ships, aircraft, and construction and agricultural equipment). Both stationary and mobile sources directly emit primary PM to ambient air, along with secondary PM precursors (e.g., SO₂, NO_x) that contribute to the secondary formation of PM in the atmosphere.

Natural sources of PM include dust from the wind erosion of natural surfaces, sea salt, wildfires, primary biological aerosol particles (PBAP) such as bacteria and pollen, oxidation of biogenic hydrocarbons such as isoprene and terpenes to produce SOA, and geogenic sources such as sulfate formed from volcanic emissions of SO₂. Natural emissions sources contributing to PM_{2.5} concentrations can be interconnected with anthropogenic emissions through atmospheric chemistry, such as the modulation of biogenic SOA production by anthropogenic NO_x and SO₂ emissions.

Generally, the sources of PM for different size fractions vary. While PM_{2.5} in ambient air is largely emitted directly by sources such as those described above or through secondary PM formation in the atmosphere, PM_{10-2.5} is emitted almost entirely from primary sources (i.e., directly emitted) and is produced by surface abrasion or by suspension of sea spray or biological materials such as microorganisms, pollen, and plant and insect debris.

The major components of PM_{2.5} mass include sulfate, nitrate, elemental or black carbon (EC or BC), organic carbon (OC), crustal materials, and sea salt. Some of these PM components are emitted directly to the air (e.g., EC/BC) while others are formed secondarily through reactions by gaseous precursors (e.g., sulfate, nitrate). Anthropogenic SO₂ and NO_x are the predominant precursor gases in the formation of secondary PM_{2.5} sulfate and nitrate, and ammonia is the gas-phase precursor for PM_{2.5} ammonium. Atmospheric oxidation of volatile organic compounds (VOCs), both anthropogenic and biogenic, is an important source of SOA, particularly in summer.

The [National Emissions Inventory \(NEI\)](#) is a comprehensive and detailed estimate of air emissions of criteria pollutants, precursors to criteria pollutants, and hazardous air pollutants from air emissions sources. The NEI is released every three years based primarily upon data provided by State, Local, and Tribal air agencies for sources in their jurisdictions and supplemented by data developed by the EPA. The NEI is built using the EPA's Emissions Inventory System (EIS) first to collect the data from State, Local, and Tribal air agencies and then to blend that data with other data sources.

Accuracy in an emissions inventory reflects the extent to which the inventory represents the actual emissions that occurred. Anthropogenic emissions of air pollutants result from a variety of sources such as power plants, industrial sources, motor vehicles and agriculture. The emissions from any individual source typically vary in both time and space. For the thousands of sources that make up the NEI, there is uncertainty in one or both of these factors. For some sources, such as power plants, direct emission measurements enable the emission factors derived from them to be more certain than sources without such direct measurements. However, it is not practically possible to directly monitor each of the emission sources individually and, therefore, emission inventories necessarily contain assumptions, interpolation and extrapolation from a limited set of sample data.

Figure 3 shows the main sources contributing to primary PM_{2.5}, primary PM₁₀, SO₂, and NO_x emissions in the U.S. Fires, which include wildfires, prescribed fires, and agricultural fires, contributed about 43% of primary PM_{2.5} emissions

and 21% of primary PM₁₀ emissions in 2023. Dust particles from roads, agriculture, and construction contributed 26% of primary PM_{2.5} emissions and 62% of primary PM₁₀ emissions, while most of the remaining primary PM emissions came from stationary fuel combustion (e.g., coal combustion for electricity), industrial and mobile sources. Regarding precursors to secondary PM formation, the main sources of SO₂ and NO_x are stationary fuel combustion (54% of total SO₂ emissions; 7% of total NO_x emissions), industrial processes (32% of total SO₂ emissions; 24% of total NO_x emissions) and mobile sources (4% of total SO₂ emissions; 37% of total NO_x emissions).

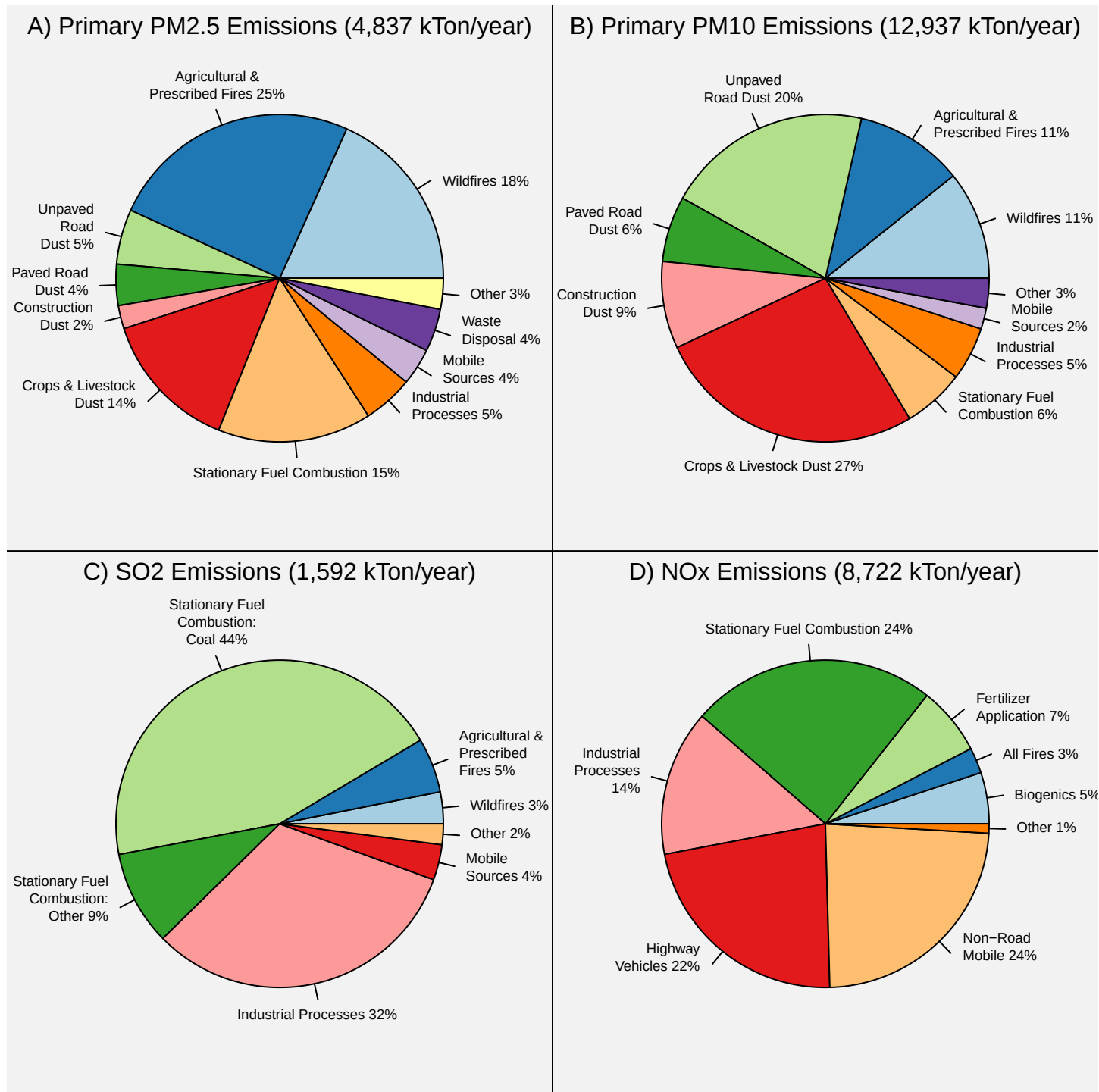


Figure 3: U.S. emissions for A) Primary PM_{2.5}; B) Primary PM₁₀; C) SO₂; and D) NO_x by sector. **Source:** 2023 NEI.

Figure 4 through Figure 7 show county-level estimates of U.S. emissions densities (in tons/year/mi²) for primary PM_{2.5}, primary PM₁₀, SO₂, and NO_x emissions, respectively based on the 2023 NEI. Primary PM emissions tended to be highest near urban areas due to the larger number of industrial sources and vehicles, and near the center of the country due to dust from roads and agricultural sources. Parts of the northwest U.S. and California also experienced higher primary PM emissions due to wildfires in 2023. The highest SO₂ emissions tend to be located near large point sources such as coal-fired power plants or large industrial facilities, while the highest NO_x emissions tend to be located near urban areas and large point sources.

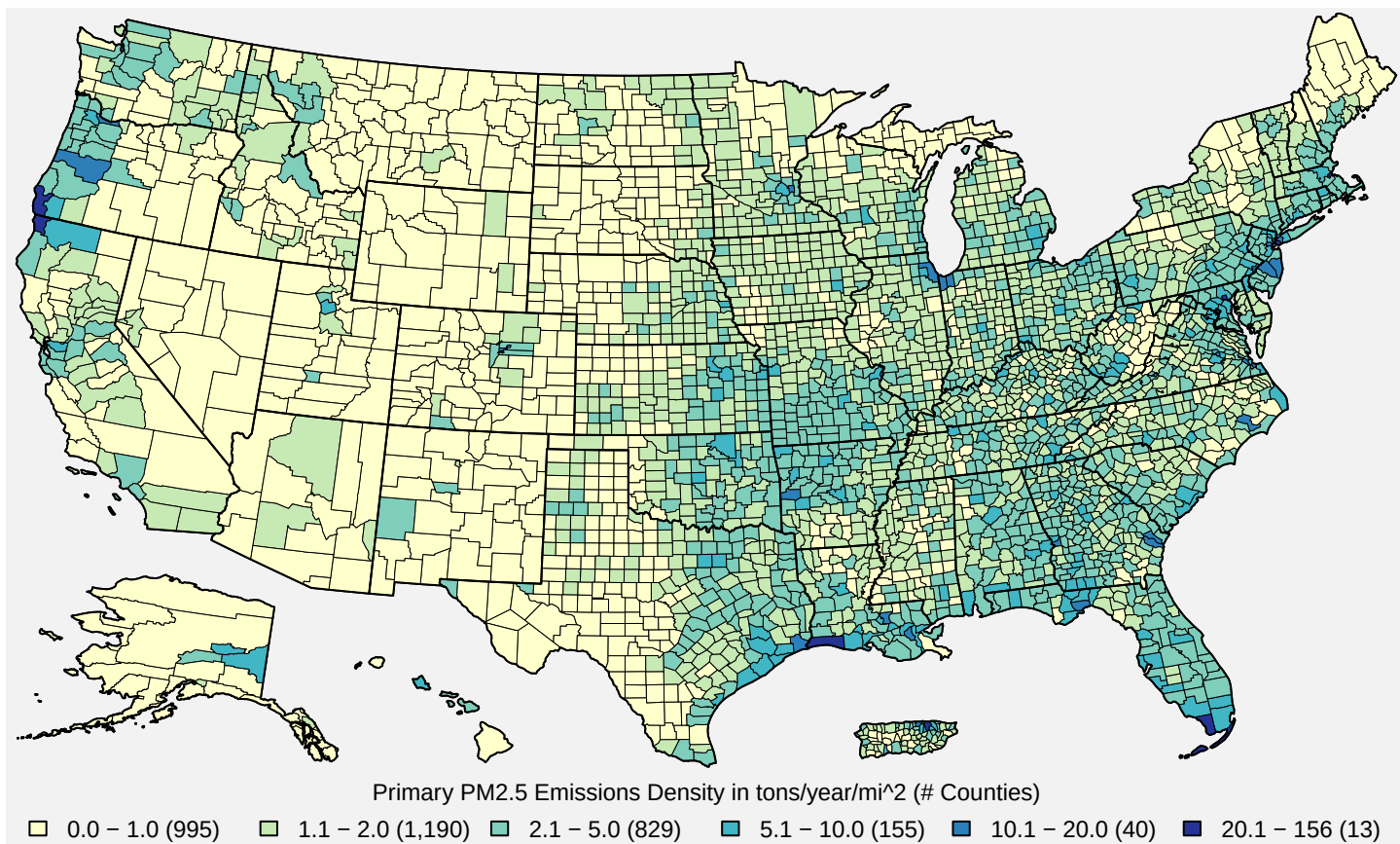


Figure 4. U.S. county-level primary PM_{2.5} emissions density estimates in tons/year/mi². **Source:** 2023 NEI

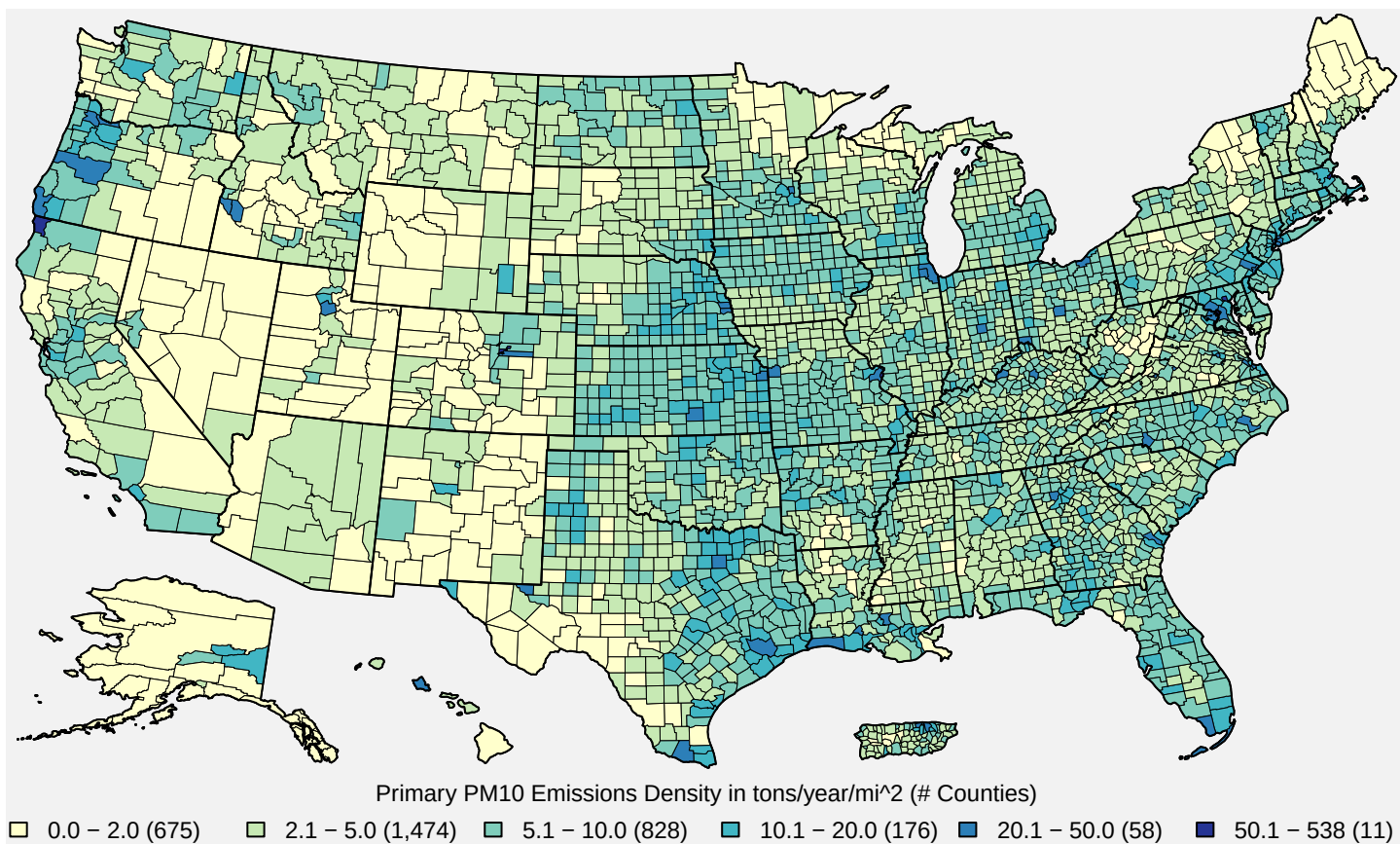


Figure 5. U.S. county-level primary PM₁₀ emissions density estimates in tons/year/mi². **Source:** 2023 NEI

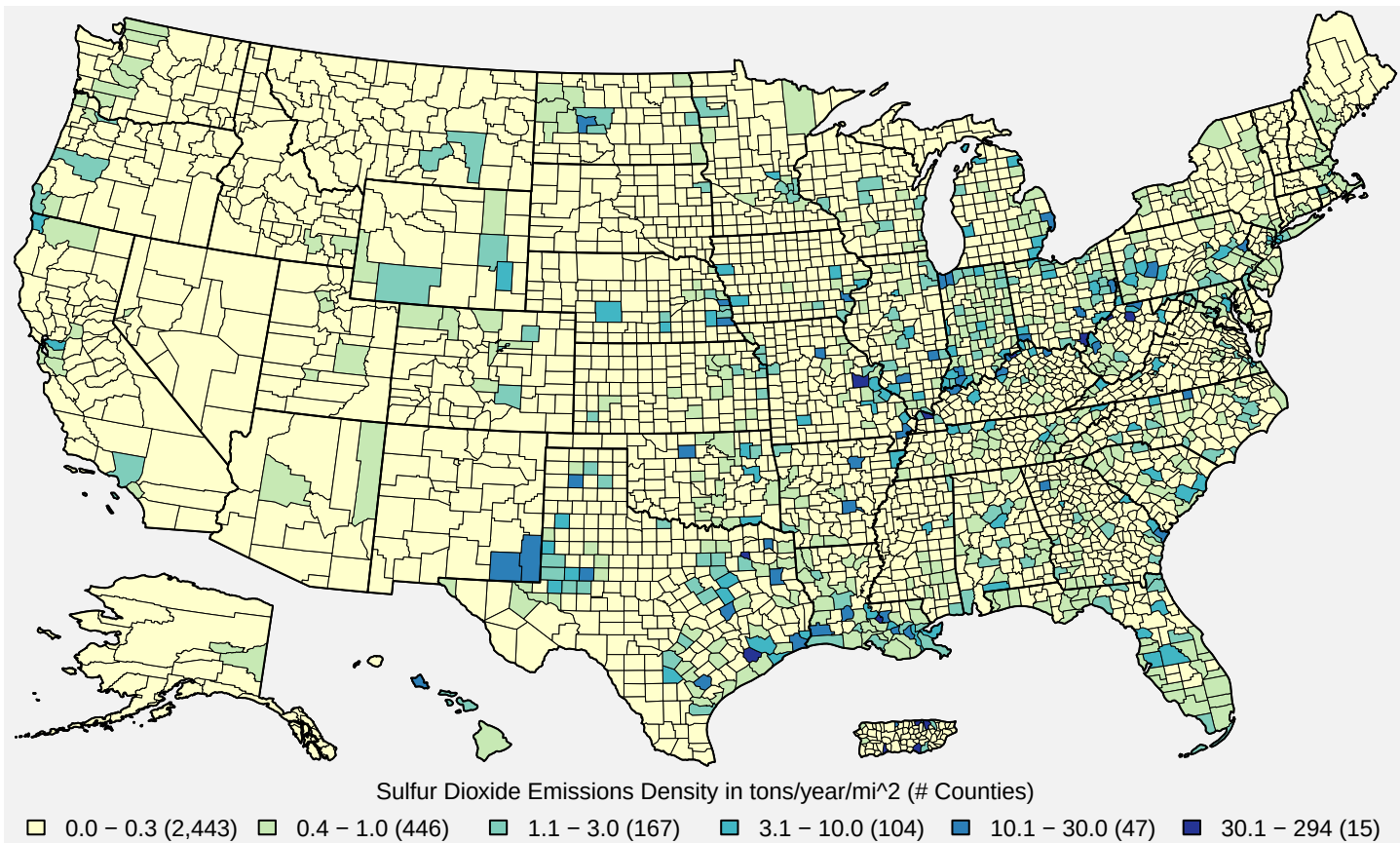


Figure 6. U.S. county-level SO₂ emissions density estimates in tons/year/mi². Source: 2023 NEI

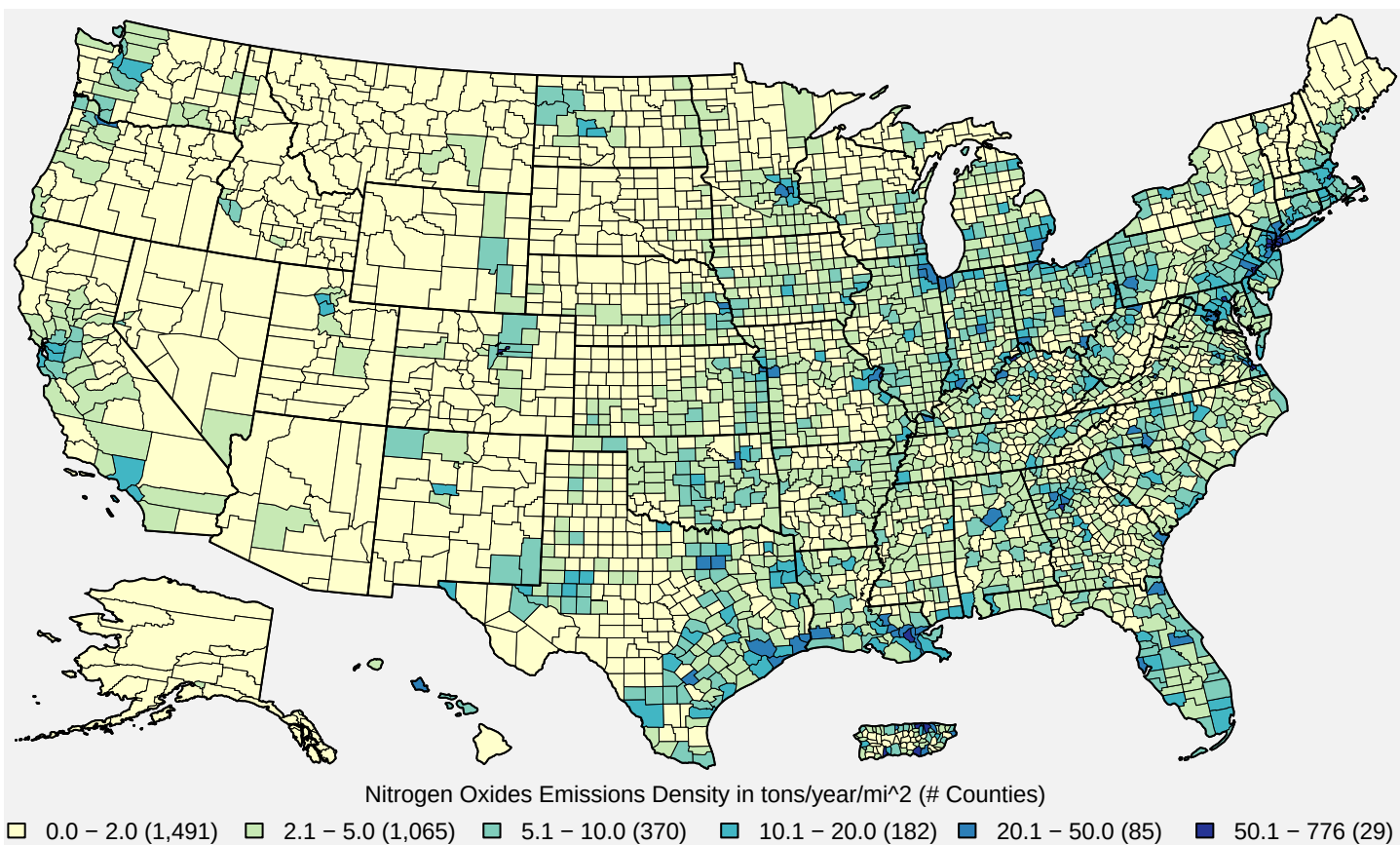


Figure 7. U.S. county-level NO_x emissions density estimates in tons/year/mi². Source: 2023 NEI

Figure 8 below shows the national trends in U.S. anthropogenic primary PM_{2.5}, primary PM₁₀, SO₂, and NO_x emissions from 2002 to 2025.² Primary PM_{2.5} emissions reached a maximum of 5 million tons per year in 2005 and have decreased by 15% to 4.2 million tons per year in 2025. Similarly, direct PM₁₀ emissions reached a maximum of 17 million tons per year in 2005 and have decreased by 30% to approximately 11.9 million tons per year in 2025. SO₂ emissions have decreased by 89% since 2002, while NO_x emissions have decreased by 69% since 2002. The large reductions in NO_x and SO₂ emissions are largely due to reductions in the electricity generation and transportation sectors resulting from EPA programs such as the Clean Air Interstate Rule and the Cross-State Air Pollution Rule for electric generating units, as well as the adoption of more stringent fuel economy standards and low sulfur diesel fuel standards for mobile sources.

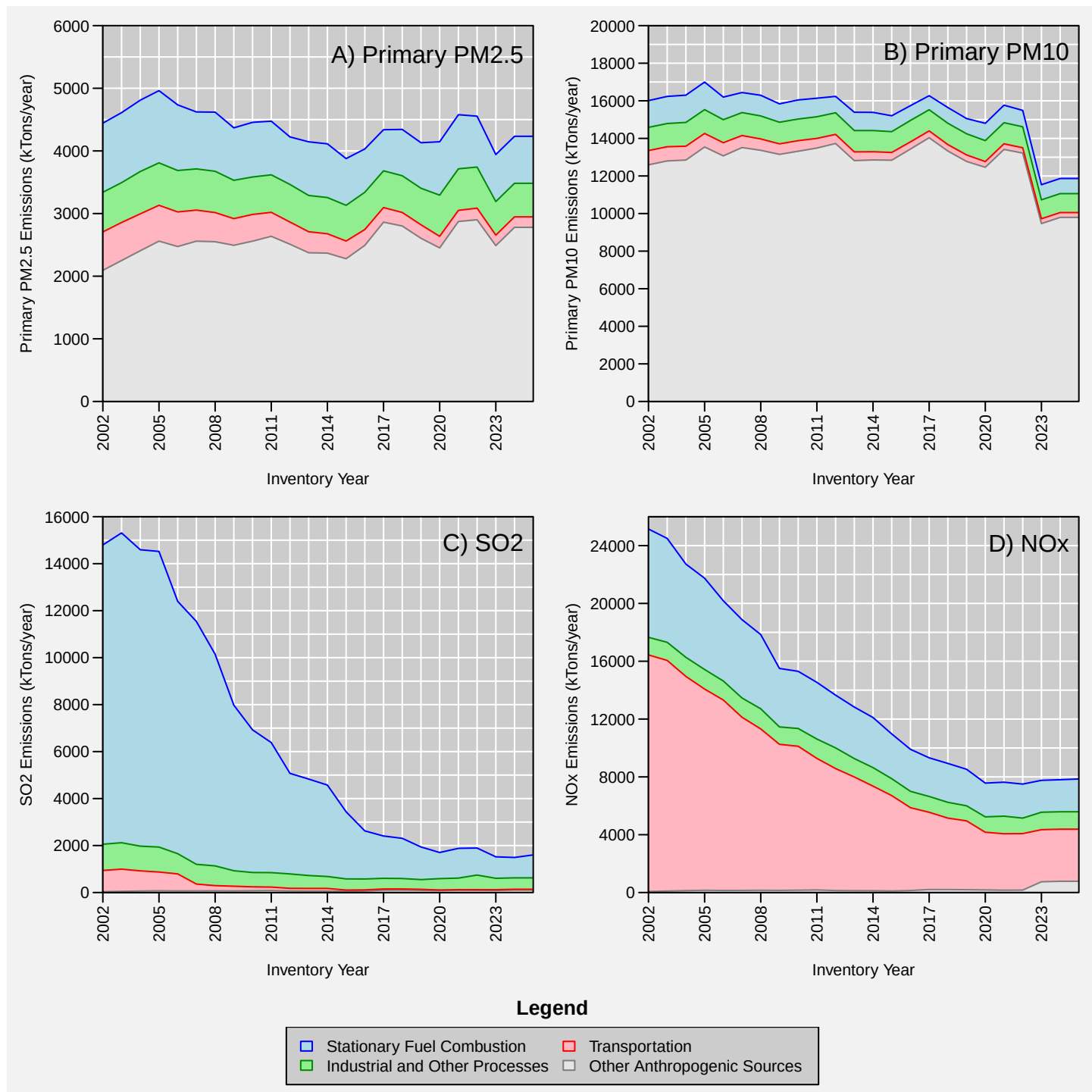


Figure 8. U.S. anthropogenic emissions trends for: A) Primary PM_{2.5}; B) Primary PM₁₀; C) SO₂; and D) NO_x. **Source:** EPA's Air Pollutant Emissions Trends Data

²Data for Figure 8 come from the EPA's [Air Pollutant Emissions Trends Data](#). Note that emissions for some sectors are interpolated between inventory years, and the emissions for some sectors are held constant beyond the most recent inventory year (for details, see the "Development of Data" table in the [national emissions trends data file](#). For the purposes of this document, wildfires are considered to be natural emissions and thus are not included in Figure 8.

4. Ambient Air Monitoring Requirements and Monitoring Networks

The EPA and its partners at State, Local, and Tribal monitoring agencies manage and operate the nation's ambient air monitoring networks. The EPA provides minimum monitoring requirements for PM and other pollutants in [40 CFR Part 58](#). Monitoring agencies carry out and perform ambient air monitoring in accordance with the EPA's requirements and guidance. Federal Reference Methods (FRMs) and Federal Equivalence Methods (FEMs) are monitoring methods that have been approved for use by States and other monitoring organizations to assess NAAQS compliance and implementation. The FRMs for measuring PM₁₀, PM_{2.5}, and PM_{10-2.5} are specified in [40 CFR Part 50](#), Appendices J, L, and O, respectively, while performance requirements for the approval of FRM and FEMs are in [40 CFR Part 53](#).

The EPA and monitoring agencies manage and operate robust national monitoring networks for both PM₁₀ and PM_{2.5}, as these are the two measurement programs directly supporting the PM NAAQS. PM₁₀ measurements are based on gravimetric mass, while PM_{2.5} measurements include gravimetric mass and chemical speciation. A smaller network of stations is operating and reporting data for PM_{10-2.5} gravimetric mass and a few monitors are operated to support special projects, including pilot studies, for continuous speciation and particle count data.

The EPA first established NAAQS for PM in 1971 based on total suspended particulates, or TSP. The size of the TSP monitoring network peaked in the mid-1970s when over 4,300 TSP samplers were in operation. The TSP NAAQS was replaced by the PM₁₀ NAAQS in 1987. TSP sampling remains in operation at a limited number of locations primarily to provide measurements for the Lead (Pb) NAAQS as well as for instances where a State may continue to have State standards for TSP. There were 118 monitoring sites reporting Pb TSP data to EPA during the 2023-2025 period.

To support the [1987 PM₁₀ NAAQS](#), the EPA and its State and Local partners implemented the first size-selective PM monitoring network in 1990 with the establishment of a PM₁₀ network consisting of mainly high-volume samplers. The PM₁₀ monitoring network peaked in size in 1995 with 1,665 stations reporting data. There were 676 monitoring sites reporting PM₁₀ data to EPA during the 2023-2025 period. Figure 9 shows the locations of these monitoring sites. Approximately 82% of these monitoring sites operate FEMs which report continuous PM₁₀ data while the remaining sites operate FRMs which typically collect samples every day, every 3rd day, or every 6th day.³

To support the [1997 PM NAAQS](#), the first PM NAAQS with PM_{2.5} as an indicator, the EPA and States implemented a PM_{2.5} monitoring network consisting of ambient air monitoring sites with PM_{2.5} mass and/or chemical speciation measurements. Network operation began in 1999 with nearly 1,000 monitoring stations operating FRMs to measure fine particle mass. The PM_{2.5} monitoring program remains one of the largest ambient air monitoring programs in the U.S. There were 1,100 monitoring sites reporting PM_{2.5} data to EPA during the 2023-2025 period. Figure 10 shows the locations of these monitoring sites. Approximately 91% of these monitoring sites operate FEMs which report continuous PM_{2.5} data while the remaining sites operate FRMs which typically collect samples every day, every 3rd day, or every 6th day.³

To provide an assessment of data quality, monitoring agencies must perform quality assurance (QA) checks, such as flow checks and leak tests, to ensure the monitors are operating within performance specifications and meeting measurement quality objectives. Estimates of precision and bias for continuous PM monitors are determined through independent audits and collocated sampling against the federal reference method.⁴ Ambient air quality data are reported to the EPA via the [Air Quality System \(AQS\)](#). Data are reported quarterly and must be submitted to AQS within 90 days after the end of each calendar quarter (i.e. Jan/Feb/Mar, Apr/May/Jun, Jul/Aug/Sep, Oct/Nov/Dec). Additionally, each monitoring agency is required to certify all FRM/FEM data that is submitted to AQS annually, taking into consideration any QA findings, and a data certification letter must be sent to the EPA Regional Administrator by May 1st of the following year.

The main network of monitors providing ambient data for use in implementation activities related to the NAAQS is the State and Local Air Monitoring Stations (SLAMS) network, which comprises about 86% of PM_{2.5} monitoring sites and 76% of PM₁₀ monitoring sites. Two important subsets of SLAMS sites are the [National Core \(NCore\) multipollutant monitoring network](#) and the [near-road monitoring network](#). The NCore network was designed to collect consistent measurements of criteria pollutants for trends and NAAQS compliance purposes. NCore was fully operational as of 2011 and consists of approximately 60 urban monitoring stations and 20 rural monitoring stations. NCore sites are required to measure PM_{2.5} using continuous and filter-based samplers, speciated PM_{2.5}, and PM_{10-2.5}. Each State is required to have at least one NCore station. PM_{2.5} monitoring was required for near-road network sites as part of the [2012 PM NAAQS review](#) and these sites monitors were phased into the network between 2015 and 2017. Near-road sites are required in each metropolitan statistical area (MSA) with a population of 1,000,000 or greater.

³Some PM₁₀ and PM_{2.5} monitoring sites operate both FEM and FRM instruments.

⁴Quality assurance requirements for monitors used in evaluations of the NAAQS are provided in [Appendix A to 40 CFR Part 58](#). Annual summary reports of precision and bias can be obtained for each monitoring site at the EPA's [Air Data website](#).

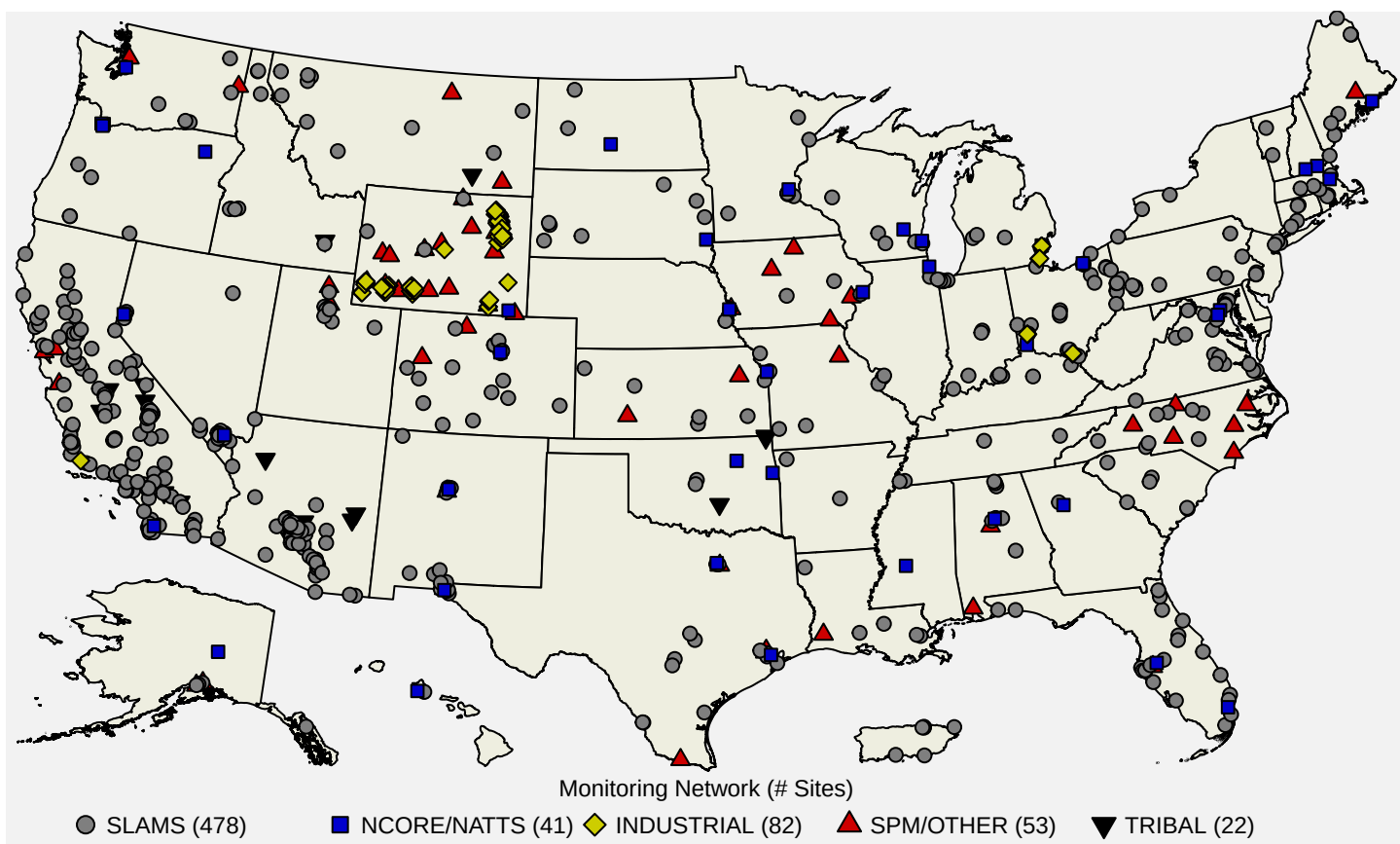


Figure 9: Map of U.S. PM₁₀ monitoring sites reporting data to the EPA during the 2023-2025 period. **Source:** [AQS](#).

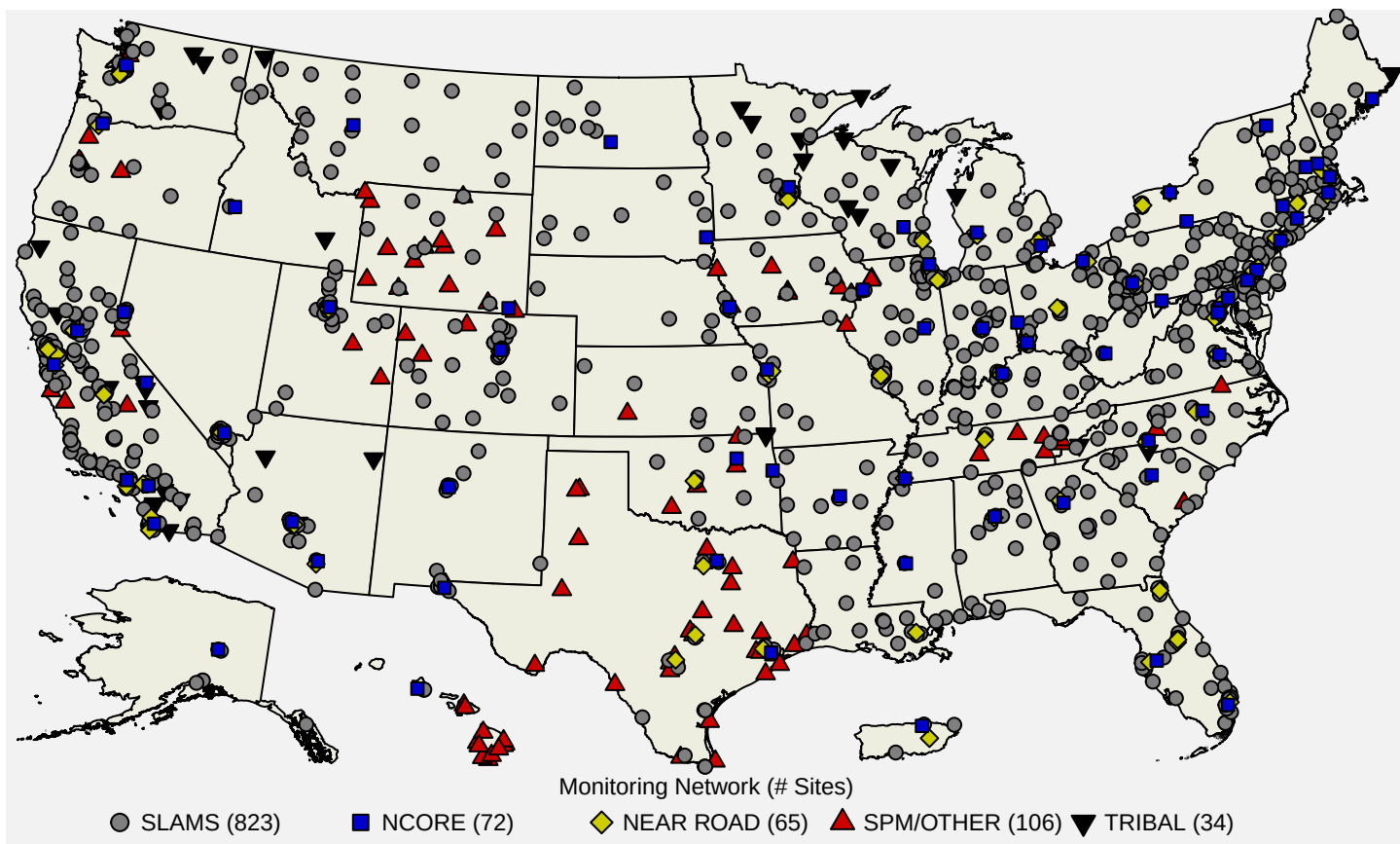


Figure 10: Map of U.S. PM_{2.5} monitoring sites reporting data to the EPA during the 2023-2025 period. **Source:** [AQS](#).

Due to the complex nature of fine particles, the EPA and States implemented the [Chemical Speciation Network \(CSN\)](#) to better understand the components of fine particle mass at selected locations across the country. The CSN was first piloted at 13 sites in 2000, and after the pilot phase, the program continued with deployment of the Speciation Trends Network (STN) later that year. The current CSN network consists of about 150 sites, of which about 50 are STN sites operating on a 1 in 3 day sampling schedule and about 100 are supplemental sites which typically operate on a 1 in 6 day sampling schedule. The locations of the CSN sites reporting data to the EPA during the 2023-2025 period are shown in Figure 11. CSN measurements are also collected at NCore stations, which are shown in Figure 10.

Specific components of fine particles are also measured through the [Interagency Monitoring of Protected Visual Environments \(IMPROVE\)](#) monitoring program, which supports the [Regional Haze Program](#) and tracks changes in visibility in Federal Class I areas as well as many other rural and some urban areas. CSN and IMPROVE data can also be used to better understand visibility through calculation of light extinction using the IMPROVE algorithm⁵ to support reviews of the secondary PM NAAQS. The locations of the IMPROVE sites reporting data to the EPA during the 2023-2025 period are shown in Figure 11.

As a result of the [2006 PM NAAQS review](#), the EPA promulgated a new FRM for the measurement of PM_{10-2.5} mass in ambient air. Although the standard for coarse particles uses a PM₁₀ indicator, a new FRM for PM_{10-2.5} mass was developed to provide a basis for approving FEMs and to promote the gathering of scientific data to support future reviews of the PM NAAQS. PM_{10-2.5} measurements are currently reported at NCore stations, IMPROVE monitoring stations, and at a few additional locations where State or Local agencies choose to operate a PM_{10-2.5} monitoring method. There were 287 monitoring sites reporting PM_{10-2.5} data to EPA during the 2023-2025 period. Figure 12 shows the locations of these monitoring sites. Additionally, some sites that operate both PM₁₀ and PM_{2.5} monitors also report PM_{10-2.5} concentrations by taking the difference of the two measurements.

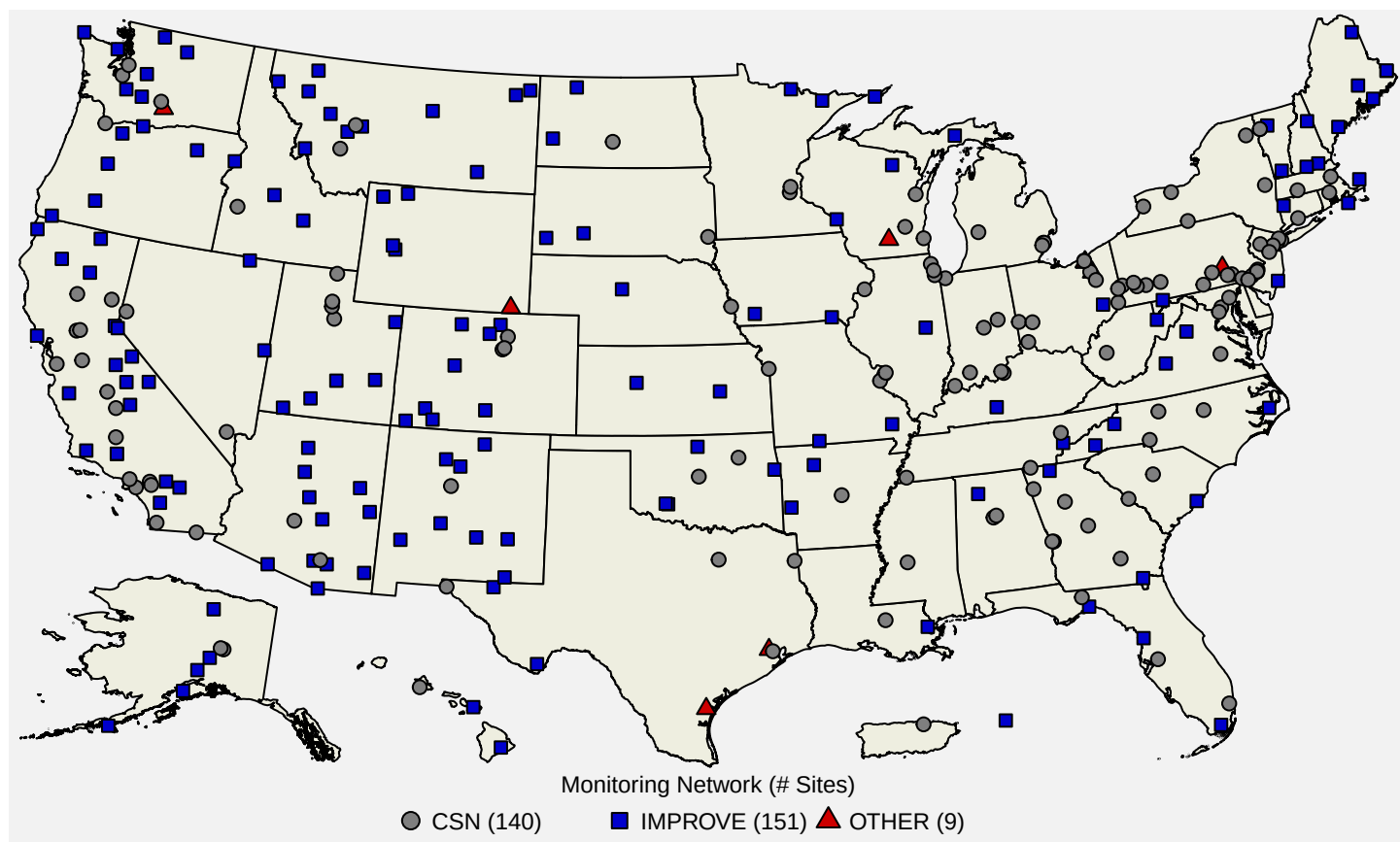


Figure 11: Map of U.S. PM_{2.5} speciation monitoring sites reporting data to the EPA during the 2023-2025 period. **Source:** [AQS](#).

⁵The IMPROVE algorithm is an equation to estimate light extinction based on the measured concentration of several PM components and is used to track visibility progress in the [Regional Haze Rule](#). More information about the IMPROVE algorithm is available at the [IMPROVE website](#).

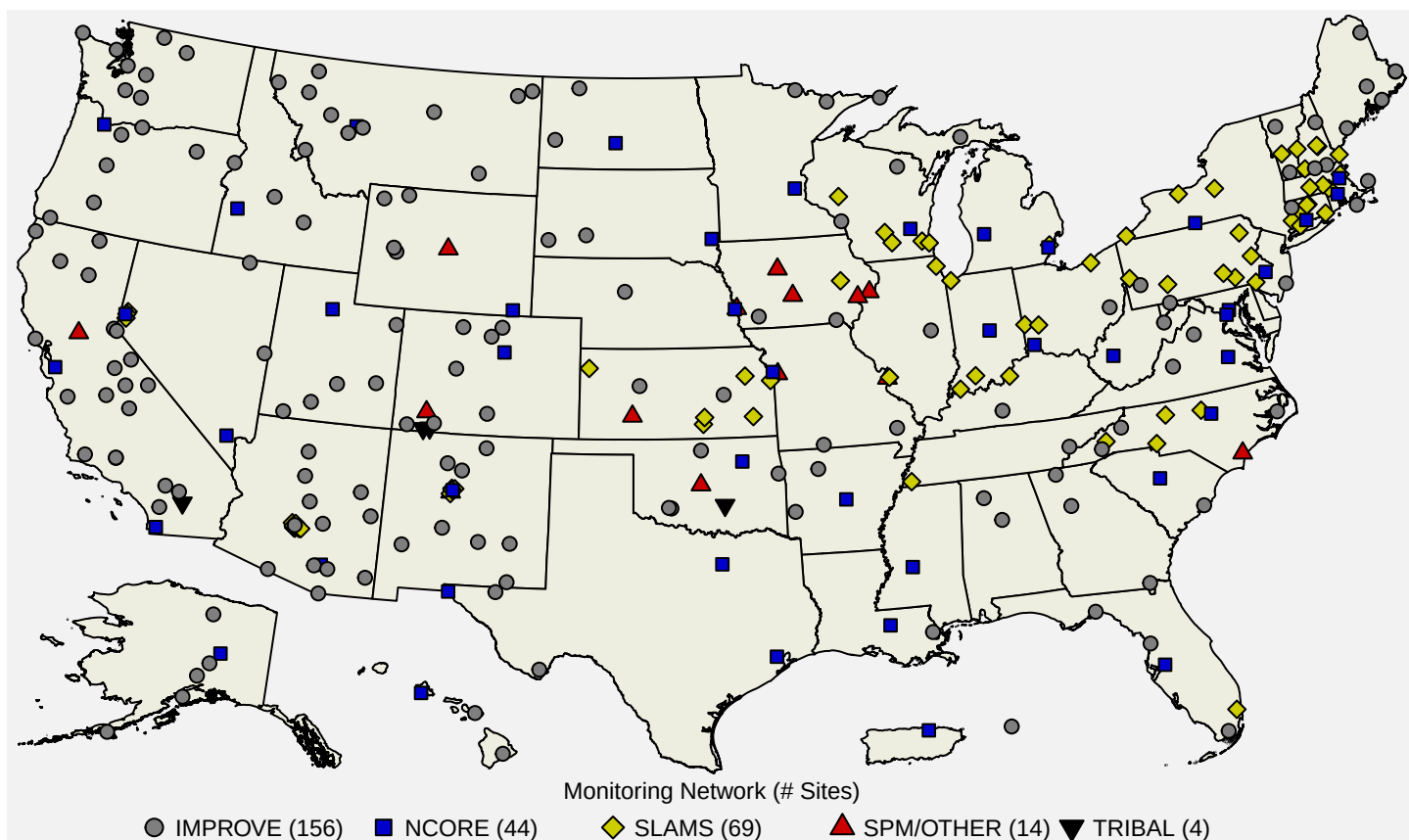


Figure 12: Map of U.S. PM_{10-2.5} monitoring sites reporting data to the EPA during the 2023-2025 period. **Source:** [AQS](#).

5. Data Handling Conventions and Computations for Determining Whether the Standards are Met

To assess whether a monitoring site or geographic area (usually a county or urban area) meets or exceeds a NAAQS, the monitoring data are analyzed consistent with the established regulatory requirements for the handling of monitoring data for the purposes of deriving a design value. A design value summarizes ambient air concentrations for an area in terms of the indicator, averaging time and form for a given standard such that its comparison to the level of the standard indicates whether the area meets or exceeds the standard. The procedures for calculating design values for the current PM NAAQS (established in 2024) are detailed in [Appendix K to 40 CFR Part 50](#) for PM₁₀ and in [Appendix N to 40 CFR Part 50](#) for PM_{2.5}.

Daily 24-hour PM₁₀ and PM_{2.5} samples collected at an ambient air monitoring site using FRMs or FEMs, meeting all applicable requirements in 40 CFR Part 58, and reported to AQS in micrograms per meter cubed ($\mu\text{g}/\text{m}^3$) are used in design value calculations. All decimal digits are truncated (i.e., removed) from reported PM₁₀ concentrations, and similarly, all digits after the first decimal place are truncated from reported PM_{2.5} measurements. Monitored 24-hour PM₁₀ and PM_{2.5} concentrations flagged by the States as having been affected by an exceptional event, having been the subject of a demonstration submitted by the State, and having received concurrence from the appropriate EPA Regional Office, are excluded from design value calculations consistent with [40 CFR 50.14](#).⁶

If hourly samples are reported from a continuous PM₁₀ or PM_{2.5} monitor, 24-hour average concentrations will be calculated from the hourly data. Calculated 24-hour average PM₁₀ and PM_{2.5} concentrations are considered valid if hourly concentrations are available for at least 18 of the 24 hours in a given calendar day, or, if after substituting zero for the missing hourly concentrations, the resulting average is greater than the level of the 24-hour PM₁₀ and PM_{2.5} NAAQS, respectively. If multiple PM₁₀ and/or PM_{2.5} monitors are operating at a site, one PM₁₀ monitor and one PM_{2.5} monitor are designated as the primary monitors. Daily values from collocated monitors of the same measurement type are substituted on days where data is missing for the primary monitor(s) to create a site-level data record.

The number of exceedances of the PM₁₀ NAAQS is determined for each calendar quarter over a 3-year period. The level of the PM₁₀ NAAQS is 150 $\mu\text{g}/\text{m}^3$, but monitored concentrations are rounded to the nearest 10 $\mu\text{g}/\text{m}^3$ when compared to

⁶A variety of resources and guidance documents related to identification and consideration of exceptional events in design value calculations are available at [<https://www.epa.gov/air-quality-analysis/final-2016-exceptional-events-rule-supporting-guidance-documents-updated-faqs>].

the NAAQS, so an exceedance occurs when measured concentrations are $155 \mu\text{g}/\text{m}^3$ or greater. To correct for missing data, the observed number of exceedances in each calendar quarter is adjusted by dividing it by the data completeness rate during that quarter and rounded to the nearest hundredth, which is the expected number of exceedances for that quarter. This adjustment is performed regardless of sampling schedule, for example, a monitoring site that has an every 3rd day sampling schedule will have a minimum of 3 expected exceedances for each observed exceedance even if the data completeness rate is 100%. The annual number of expected exceedances is the sum of the expected exceedances over the four calendar quarters, and the design value is the average of the annual expected exceedances over three consecutive years, rounded to the nearest tenth. The PM_{10} NAAQS is met when the design value is less or equal to 1.0.

A PM_{10} design value meeting the NAAQS must meet minimum data completeness requirements in order to be considered valid. Specifically, a site must have reported concentrations for a minimum of 75% of the scheduled sampled days in each calendar quarter of the 3-year period in order to be considered valid. A PM_{10} design value greater than the NAAQS is always considered valid. Appendix K to 40 CFR Part 50 has additional language describing situations where a valid design value may be derived for a site which does not meet these minimum data completeness criteria.

For the annual $\text{PM}_{2.5}$ NAAQS, the 24-hour concentrations from the site-level data record are averaged over each calendar quarter for a consecutive 3-year period. The four quarterly averages are then averaged over each year to calculate an annual average, and finally the annual $\text{PM}_{2.5}$ design value is the average of the three annual average values, rounded to the nearest tenth. The annual $\text{PM}_{2.5}$ NAAQS are met when the design value is less than or equal to $9.0 \mu\text{g}/\text{m}^3$. Annual $\text{PM}_{2.5}$ design values must have a minimum of 75% data completeness in each calendar quarter (according to the sampling schedule for the site) in order to be considered valid. In addition, for sites which fail to meet the 75% quarterly minimum data completeness, there are two data substitution tests in Appendix N to 40 CFR Part 50 by which an annual design value above or below the NAAQS, respectively, may be considered valid.

For the 24-hour $\text{PM}_{2.5}$ NAAQS, the 98th percentile of the 24-hour concentrations from the site-level data record is calculated for each of the three years. The 24-hour $\text{PM}_{2.5}$ design value is the average of the three 98th percentile values, rounded to the nearest integer. The 24-hour $\text{PM}_{2.5}$ NAAQS are met when the design value is less than or equal to $35 \mu\text{g}/\text{m}^3$. Similar to the annual $\text{PM}_{2.5}$ design values, 24-hour $\text{PM}_{2.5}$ design values must have a minimum of 75% data completeness in each calendar quarter to be considered valid. In addition, a site with a design value meeting the NAAQS may also be considered valid if it is able to pass the 24-hour $\text{PM}_{2.5}$ NAAQS data substitution test in Appendix N to 40 CFR Part 50.

6. PM Concentrations Measured at Ambient Air Monitoring Sites Across the U.S.

Table 1 below presents summary statistics based on daily PM_{10} , $\text{PM}_{2.5}$, and $\text{PM}_{10-2.5}$ monitoring data reported to AQS for 2023 to 2025 for the full year and for each calendar quarter. There are two daily metrics for PM_{10} and $\text{PM}_{2.5}$: the daily 24-hour average (DA24) metric, which is available for both filter-based and continuous monitoring instruments, and the maximum daily 1-hour average (MDA1) metric, which is available only for continuous monitoring instruments. For $\text{PM}_{10-2.5}$, most of the measurements are filter-based, thus only the DA24 metric is shown. Table 2 presents summary statistics for the DA24 metric based on 2023-2025 PM_{10} and $\text{PM}_{2.5}$ monitoring data by type of site, including urban (CSN) versus rural (IMPROVE) sites located in the eastern U.S. versus western U.S., as well as near-road sites for $\text{PM}_{2.5}$.⁷ Finally, Table 3 presents summary statistics for the same daily metrics based on 2023-2025 PM_{10} , $\text{PM}_{2.5}$, and $\text{PM}_{10-2.5}$ monitoring data for each [NOAA Climate Region](#).⁸

Table 1 shows that PM concentrations are typically highest in the 3rd quarter (July-September), which coincides with the period of highest wildfire frequency in the western U.S. $\text{PM}_{2.5}$ concentrations tend to be lowest in the 2nd quarter (April-June), while PM_{10} and $\text{PM}_{10-2.5}$ concentrations tend to be lowest in the 1st quarter (January-March). MDA1 concentrations are typically 2-3 times higher than DA24 concentrations. Table 2 shows evidence of a sharper gradient between urban and rural PM concentrations in the western U.S. than in the eastern U.S., and that $\text{PM}_{2.5}$ concentrations measured at near-road sites are comparable to concentrations measured at urban sites located away from roads. Table 3 shows that PM_{10} concentrations are generally highest in the Southwest and West regions. The Northwest and West North Central regions have the lowest median PM_{10} concentrations, while the two easternmost regions (Northeast and Southeast) have the lowest peak PM_{10} concentrations. For $\text{PM}_{2.5}$ the median concentrations are comparable across the nine climate regions, while there is greater disparity in the peak concentrations, with the western regions generally having higher peak $\text{PM}_{2.5}$ concentrations than the eastern regions.

⁷The MDA1 metric is not included in Table 2 because very few IMPROVE sites operate continuous PM_{10} and/or $\text{PM}_{2.5}$ instruments. $\text{PM}_{2.5}$ concentrations measured by the IMPROVE network are non-regulatory and thus may not meet all of the EPA's ambient air monitoring requirements in [40 CFR Part 58](#).

⁸For Table 3, monitoring sites in Alaska were assigned to the Northwest Region and monitoring sites in Hawaii were assigned to the West region.

Table 1. National distribution of PM concentrations in $\mu\text{g}/\text{m}^3$ by quarter based on monitoring data from 2023 to 2025.⁹ **Source:** AQS.

pollutant	metric	quarter	N.sites	N.obs	mean	SD	min	p1	p5	p10	p25	p50	p75	p90	p95	p98	p99	max	max.site
PM10	DA24	all	876	641,732	20	21	-9	1	4	5	9	15	24	37	49	67	86	2063	481410044
PM10	DA24	1st quarter	862	158,917	16	22	-4	1	2	4	7	12	20	31	41	60	81	2063	481410044
PM10	DA24	2nd quarter	855	160,531	20	21	-9	2	4	6	10	16	25	37	47	64	84	1799	060510011
PM10	DA24	3rd quarter	851	162,504	23	19	-8	3	6	8	12	18	28	41	53	70	88	792	040213011
PM10	DA24	4th quarter	850	159,780	19	19	-2	1	3	5	8	14	24	39	52	72	89	1402	060893003
PM10	MDA1	all	584	534,671	55	130	-1	6	10	13	20	32	56	100	150	255	385	17090	040213014
PM10	MDA1	1st quarter	570	130,953	49	141	-1	5	8	11	16	27	47	86	133	234	369	10982	060270028
PM10	MDA1	2nd quarter	568	132,672	55	127	0	7	11	14	21	33	56	99	148	261	396	16919	060510011
PM10	MDA1	3rd quarter	566	134,755	62	160	0	9	14	17	23	36	62	110	164	291	452	17090	040213014
PM10	MDA1	4th quarter	567	136,291	51	80	0	5	9	11	18	31	57	104	150	238	331	3538	060254003
PM2.5	DA24	all	1,390	1,185,475	7.4	6.8	-5.9	0.5	1.7	2.4	3.9	6.1	9.2	13.3	16.7	22.5	28.6	833.8	250092006
PM2.5	DA24	1st quarter	1,362	292,183	6.8	5.4	-5.9	0.2	1.3	2.0	3.5	5.7	8.7	12.6	15.6	20.0	24.1	322.5	040239000
PM2.5	DA24	2nd quarter	1,362	295,024	7.4	7.9	-4.3	0.6	1.7	2.4	3.8	5.9	8.9	13.1	16.9	24.1	31.7	288.5	481410044
PM2.5	DA24	3rd quarter	1,360	299,931	8.5	7.8	-3.7	1.0	2.5	3.2	4.7	7.0	10.2	14.5	18.4	26.1	34.9	512.0	410330036
PM2.5	DA24	4th quarter	1,367	298,337	7.0	5.5	-4.1	0.3	1.5	2.3	3.7	5.9	9.0	12.8	16.0	20.9	25.1	833.8	250092006
PM2.5	MDA1	all	1,187	1,109,299	15.1	17.7	-4.0	2.6	4.2	5.4	7.9	11.8	17.5	26.0	34.4	51.0	69.0	1525.6	120050006
PM2.5	MDA1	1st quarter	1,154	271,558	15.0	17.7	-4.0	2.3	4.0	5.1	7.7	11.9	18.0	26.1	34.0	48.0	62.3	1353.9	350130021
PM2.5	MDA1	2nd quarter	1,159	274,893	14.5	18.8	-0.4	2.5	4.0	5.0	7.4	11.0	16.4	24.2	32.6	50.4	73.0	1041.0	380650002
PM2.5	MDA1	3rd quarter	1,161	280,116	16.2	19.8	-1.0	3.4	5.0	6.0	8.5	12.2	18.0	26.3	36.5	58.4	83.5	1095.6	060510005
PM2.5	MDA1	4th quarter	1,169	282,732	14.8	13.8	-1.0	2.4	4.0	5.2	7.8	11.9	17.9	26.6	34.8	48.2	61.1	1525.6	120050006
PM10-2.5	DA24	all	285	164,445	9.3	13.4	-6.7	0.1	0.6	1.4	3.4	6.5	11.1	18.9	26.4	38.5	50.8	1845.9	481410044
PM10-2.5	DA24	1st quarter	279	40,504	7.8	15.9	-6.1	0.0	0.3	0.7	2.3	5.0	9.3	16.1	23.1	36.1	49.7	1845.9	481410044
PM10-2.5	DA24	2nd quarter	278	41,060	9.8	14.0	-4.4	0.3	1.2	2.0	4.2	7.3	12.0	18.9	25.1	35.5	47.3	1006.1	481410044
PM10-2.5	DA24	3rd quarter	276	41,893	10.2	11.6	-6.7	0.7	1.8	2.7	4.9	7.6	11.9	19.3	26.5	37.5	49.3	885.7	060650500
PM10-2.5	DA24	4th quarter	278	40,988	9.2	11.5	-4.4	0.0	0.4	1.0	2.7	5.7	11.0	21.3	30.8	43.3	54.1	331.2	481410044

N.sites = number of sites; N.obs = number of observations; SD = standard deviation; min = minimum; p1, p5, p10, p25, p50, p90, p95, p98, p99 = 1st, 5th, 10th, 25th, 50th, 90th, 95th, 98th, 99th percentiles; max = maximum; max.site = AQS ID number for the monitoring site corresponding to the observation in the max column. 1st quarter = January/February/March; 2nd quarter = April/May/June; 3rd quarter = July/August/September; 4th quarter = October/November/December.

Table 2. National distribution of PM concentrations in $\mu\text{g}/\text{m}^3$ by type of site based on monitoring data from 2023 to 2025.⁹ **Source:** AQS.

pollutant	metric	region	network	N.sites	N.obs	mean	SD	min	p1	p5	p10	p25	p50	p75	p90	p95	p98	p99	max	max.site
PM10	DA24	all	all	876	641,732	20	21	-9	1	4	5	9	15	24	37	49	67	86	2063	481410044
PM10	DA24	Eastern U.S.	CSN	67	58,013	18	13	0	4	6	8	11	16	22	31	38	49	60	611	401431127
PM10	DA24	Eastern U.S.	IMPROVE	56	25,261	12	11	-0	1	2	3	6	10	15	23	29	38	47	321	400019009
PM10	DA24	Western U.S.	CSN	33	30,900	26	28	-4	3	6	8	13	21	32	48	61	82	98	2063	481410044
PM10	DA24	Western U.S.	IMPROVE	100	35,156	10	15	-1	0	1	1	3	6	12	22	31	47	60	1402	060893003
PM2.5	DA24	all	all	1,390	1,185,475	7.4	6.8	-5.9	0.5	1.7	2.4	3.9	6.1	9.2	13.3	16.7	22.5	28.6	833.8	250092006
PM2.5	DA24	Eastern U.S.	CSN	101	99,166	8.8	7.0	-2.9	1.5	2.8	3.5	5.0	7.4	10.7	14.9	18.5	24.3	30.3	235.4	420710012
PM2.5	DA24	Eastern U.S.	IMPROVE	56	33,790	6.6	6.3	-0.8	0.6	1.3	2.0	3.2	5.3	8.2	12.0	15.2	20.7	27.3	244.8	400319000
PM2.5	DA24	Western U.S.	CSN	40	41,885	8.5	7.9	-5.9	0.8	2.0	2.7	4.2	6.5	10.4	15.9	20.8	28.7	35.4	288.5	481410044
PM2.5	DA24	Western U.S.	IMPROVE	100	37,338	4.3	7.8	-3.0	0.1	0.4	0.6	1.4	2.8	5.2	8.4	11.7	18.5	25.7	794.9	060893003
PM2.5	DA24	all	Near Road	65	61,595	8.8	6.3	-1.1	1.8	3.0	3.7	5.2	7.5	10.7	14.8	18.2	23.9	29.8	240.8	421010075

N.sites = number of sites; N.obs = number of observations; SD = standard deviation; min = minimum; p1, p5, p10, p25, p50, p90, p95, p98, p99 = 1st, 5th, 10th, 25th, 50th, 90th, 95th, 98th, 99th percentiles; max = maximum; max.site = AQS ID number for the monitoring site corresponding to the observation in the max column.

⁹Negative concentration values may appear in AQS datasets down to the negative of the lower detection limit (LDL) to allow for normal instrument variability at very low concentrations. Data that exceed the negative of the LDL is typically indicative of a malfunction or another issue that affects the data defensibility.

Table 3. National distribution of PM concentrations in $\mu\text{g}/\text{m}^3$ by climate region based on monitoring data from 2023 to 2025.⁹
Source: AQS.

pollutant	metric	region	N.sites	N.obs	mean	SD	min	p1	p5	p10	p25	p50	p75	p90	p95	p98	p99	max	max.site
PM10	DA24	all	876	641,732	20	21	-9	1	4	5	9	15	24	37	49	67	86	2063	481410044
PM10	DA24	Central	70	50,949	20	16	0	3	6	8	11	17	25	37	46	60	74	818	295100093
PM10	DA24	East North Central	47	25,046	18	15	-3	1	4	6	9	14	22	34	44	59	72	414	271377001
PM10	DA24	Northeast	89	67,362	13	10	0	2	4	5	8	11	17	23	29	38	46	688	250251004
PM10	DA24	Northwest	55	28,949	14	14	-1	0	1	2	5	10	17	28	37	52	65	378	160370002
PM10	DA24	South	69	44,771	25	31	-4	4	7	9	13	20	29	42	55	80	105	2063	481410044
PM10	DA24	Southeast	96	65,876	17	9	-8	3	6	8	11	15	20	27	32	42	50	262	120179000
PM10	DA24	Southwest	141	114,258	25	27	-1	1	4	6	11	19	31	47	62	89	117	1247	040213008
PM10	DA24	West	172	140,957	23	23	-9	1	4	6	10	18	29	43	55	73	92	1799	060510011
PM10	DA24	West North Central	137	103,564	16	17	-4	0	2	4	6	11	19	32	43	60	76	988	560310805
PM10	MDA1	all	584	534,671	55	130	-1	6	10	13	20	32	56	100	150	255	385	17090	040213014
PM10	MDA1	Central	49	46,423	49	78	0	8	12	15	21	32	54	92	130	204	280	7225	391450013
PM10	MDA1	East North Central	26	20,197	38	43	0	6	9	12	17	27	44	74	105	154	205	1108	260810020
PM10	MDA1	Northeast	67	61,862	27	37	0	5	7	9	14	20	30	47	65	97	131	2868	250251004
PM10	MDA1	Northwest	28	20,976	42	61	1	5	9	11	17	28	46	80	118	192	264	1985	160050015
PM10	MDA1	South	44	39,116	58	149	0	9	13	16	23	34	54	96	151	275	417	8142	481410044
PM10	MDA1	Southeast	71	59,355	34	32	2	8	12	14	19	26	38	59	81	121	156	1525	450190020
PM10	MDA1	Southwest	103	100,785	88	216	0	8	13	17	28	48	85	160	253	465	739	17090	040213014
PM10	MDA1	West	135	132,927	61	136	0	7	11	15	23	38	65	110	158	262	392	16919	060510011
PM10	MDA1	West North Central	61	53,030	44	76	-1	4	7	9	15	26	47	88	136	226	318	4069	560370851
PM2.5	DA24	all	1,390	1,185,475	7.4	6.8	-5.9	0.5	1.7	2.4	3.9	6.1	9.2	13.3	16.7	22.5	28.6	833.8	250092006
PM2.5	DA24	Central	170	147,437	8.6	6.5	-4.3	1.8	3.0	3.7	5.1	7.3	10.5	14.3	17.6	23.0	28.8	214.0	171132003
PM2.5	DA24	East North Central	100	86,488	8.4	8.3	-3.0	0.9	2.1	2.8	4.2	6.5	10.1	14.8	19.4	28.8	41.0	195.7	551110007
PM2.5	DA24	Northeast	202	182,960	7.2	7.0	-2.9	0.9	1.9	2.6	3.9	5.8	8.7	12.6	15.8	21.0	27.0	833.8	250092006
PM2.5	DA24	Northwest	166	140,357	6.3	8.2	-3.1	0.3	1.2	1.8	2.9	4.5	7.2	11.8	16.1	23.1	30.7	512.0	410330036
PM2.5	DA24	South	134	110,633	9.1	6.0	-3.3	1.5	3.0	3.9	5.5	8.0	11.1	15.1	18.4	23.5	28.7	288.5	481410044
PM2.5	DA24	Southeast	193	169,260	8.0	4.7	-2.3	1.5	3.0	3.7	5.2	7.1	9.7	13.0	15.7	20.0	24.1	197.0	120179000
PM2.5	DA24	Southwest	127	97,059	6.3	5.9	-4.3	0.3	1.3	2.0	3.3	5.1	7.6	11.2	14.7	20.4	25.6	322.5	040239000
PM2.5	DA24	West	209	182,830	7.0	6.4	-5.9	0.1	1.2	1.9	3.3	5.6	8.9	13.2	16.8	22.7	28.1	794.9	060893003
PM2.5	DA24	West North Central	89	68,451	5.9	7.7	-4.1	-0.6	0.5	1.1	2.3	4.1	7.0	11.4	15.9	24.8	34.6	236.6	380650002
PM2.5	MDA1	all	1,187	1,109,299	15.1	17.7	-4.0	2.6	4.2	5.4	7.9	11.8	17.5	26.0	34.4	51.0	69.0	1525.6	120050006
PM2.5	MDA1	Central	147	136,346	15.7	14.7	0.0	3.8	5.2	6.3	8.9	12.8	18.3	25.9	33.3	48.4	64.7	1106.1	391450013
PM2.5	MDA1	East North Central	87	81,175	15.2	17.2	0.0	2.4	3.8	4.8	7.3	11.7	17.5	26.2	36.0	57.6	83.3	498.0	191770006
PM2.5	MDA1	Northeast	184	176,618	13.1	14.8	-0.1	2.5	3.9	4.9	7.0	10.5	15.5	22.0	28.1	40.0	54.9	865.0	250092006
PM2.5	MDA1	Northwest	145	131,784	14.3	21.0	0.0	1.8	3.1	4.0	6.0	9.8	16.0	26.6	36.9	55.0	77.0	899.8	410170004
PM2.5	MDA1	South	110	101,836	18.1	20.8	-0.8	4.2	6.1	7.5	10.4	14.6	20.5	29.0	38.0	56.0	78.0	1033.0	481410055
PM2.5	MDA1	Southeast	169	158,305	15.0	13.3	0.0	4.0	5.7	6.8	9.0	12.5	17.3	24.0	31.0	44.6	58.5	1525.6	120050006
PM2.5	MDA1	Southwest	92	85,594	15.7	24.4	-1.0	2.0	4.0	5.1	7.4	11.1	17.2	27.6	38.1	58.8	84.5	1353.9	350130021
PM2.5	MDA1	West	180	173,949	15.7	16.5	-4.0	2.9	4.5	5.9	8.0	12.0	18.0	28.0	37.9	53.4	69.0	1095.6	060510005
PM2.5	MDA1	West North Central	73	63,692	14.3	19.3	-1.0	2.1	3.8	4.8	6.7	10.0	16.2	25.6	35.2	55.0	78.2	1041.0	380650002
PM10-2.5	DA24	all	285	164,445	9.3	13.4	-6.7	0.1	0.6	1.4	3.4	6.5	11.1	18.9	26.4	38.5	50.8	1845.9	481410044
PM10-2.5	DA24	Central	20	13,035	9.4	8.7	-5.0	0.6	1.9	2.8	4.7	7.4	11.2	17.2	23.3	33.8	42.8	354.2	295100085
PM10-2.5	DA24	East North Central	24	14,379	8.5	7.9	-1.1	0.3	1.1	2.0	3.9	6.6	10.7	17.0	22.1	30.4	38.3	191.3	260810020
PM10-2.5	DA24	Northeast	50	36,085	6.3	4.3	-4.0	0.4	1.3	2.0	3.5	5.5	8.0	11.0	13.4	17.4	20.7	99.8	250270023
PM10-2.5	DA24	Northwest	25	8,519	3.2	4.9	-6.7	0.0	0.1	0.2	0.6	1.8	3.9	7.3	11.2	18.1	24.0	97.2	160010010
PM10-2.5	DA24	South	28	18,901	15.1	24.9	-6.1	0.9	2.7	3.9	6.6	10.8	17.6	28.0	38.1	57.7	74.1	1845.9	481410044
PM10-2.5	DA24	Southeast	27	16,826	7.2	5.1	-2.2	0.4	1.4	2.3	4.0	6.5	9.0	12.2	15.2	20.4	25.3	109.9	120573002
PM10-2.5	DA24	Southwest	52	28,674	12.9	15.6	-1.9	0.1	0.7	1.4	3.7	8.7	16.9	28.3	38.1	54.1	70.5	454.7	350010029
PM10-2.5	DA24	West	34	16,317	10.9	17.5	-4.4	0.0	0.5	1.0	3.1	7.8	13.5	22.6	31.5	44.7	57.1	885.7	060650500
PM10-2.5	DA24	West North Central	25	11,709	6.0	7.9	-3.2	-0.9	0.1	0.3	1.2	3.5	7.9	14.8	21.0	29.6	35.9	227.5	460990009

N.sites = number of sites; N.obs = number of observations; SD = standard deviation; min = minimum; p1, p5, p10, p25, p50, p90, p95, p98, p99 = 1st, 5th, 10th, 25th, 50th, 90th, 95th, 98th, 99th percentiles; max = maximum; max.site = AQS ID number for the monitoring site corresponding to the observation in the max column. Central = Illinois, Indiana, Kentucky, Missouri, Ohio, Tennessee, West Virginia; East North Central = Iowa, Minnesota, Michigan, Wisconsin; Northeast = Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; Northwest = Alaska, Idaho, Oregon, Washington; South = Arkansas, Kansas, Louisiana, Mississippi, Oklahoma, Texas; Southeast = Alabama, Florida, Georgia, North Carolina, South Carolina, Virginia; Southwest = Arizona, Colorado, New Mexico, Utah; West = California, Hawaii, Nevada; West North Central = Montana, Nebraska, North Dakota, South Dakota, Wyoming.

Figure 13 and Figure 14 show maps of the annual and 24-hour $\text{PM}_{2.5}$ design values, respectively, at U.S. ambient air monitoring sites based on monitoring data from the 2023-2025 period. Approximately one-sixth of the current $\text{PM}_{2.5}$ sites had valid design values exceeding the annual $\text{PM}_{2.5}$ NAAQS, which was recently revised in 2024 to a level of $9.0 \mu\text{g}/\text{m}^3$. Additionally, there were 33 sites with design values exceeding the 24-hour $\text{PM}_{2.5}$ NAAQS of $35 \mu\text{g}/\text{m}^3$ in 2023-2025. The highest annual $\text{PM}_{2.5}$ design value was located at a site in Brownsville, Texas, while the highest 24-hour $\text{PM}_{2.5}$ design value occurred at a site in El Paso, Texas.

The PM_{10} NAAQS is unique in that the form of the standard is expressed in terms of expected exceedances rather than a concentration-based value. Alternatively, a “design concentration” can be used to show PM_{10} concentrations that would be expected at each site based on the averaging time and form of the NAAQS. The design concentration for PM_{10} is determined using a table lookup procedure.¹⁰ For example, for a PM_{10} monitor with 3 years of complete daily sampling data, the design concentration is the 4th highest 24-hour average concentration measured during the 3-year period. Figure 15 shows a map of the PM_{10} design concentrations based on monitoring data from the 2023-2025 period. The overall pattern appears similar to the 24-hour $\text{PM}_{2.5}$ design values in Figure 14, with generally lower design concentrations in the eastern U.S. and higher concentrations in parts of the western U.S. One notable difference is the presence of several sites with high PM_{10} design concentrations in the central U.S., which is likely due to higher emissions of coarse particles in those regions. This is corroborated by Figure 16, which shows the average annual $\text{PM}_{10-2.5}$ concentrations measured at U.S. monitoring sites during the 2023-2025 period.

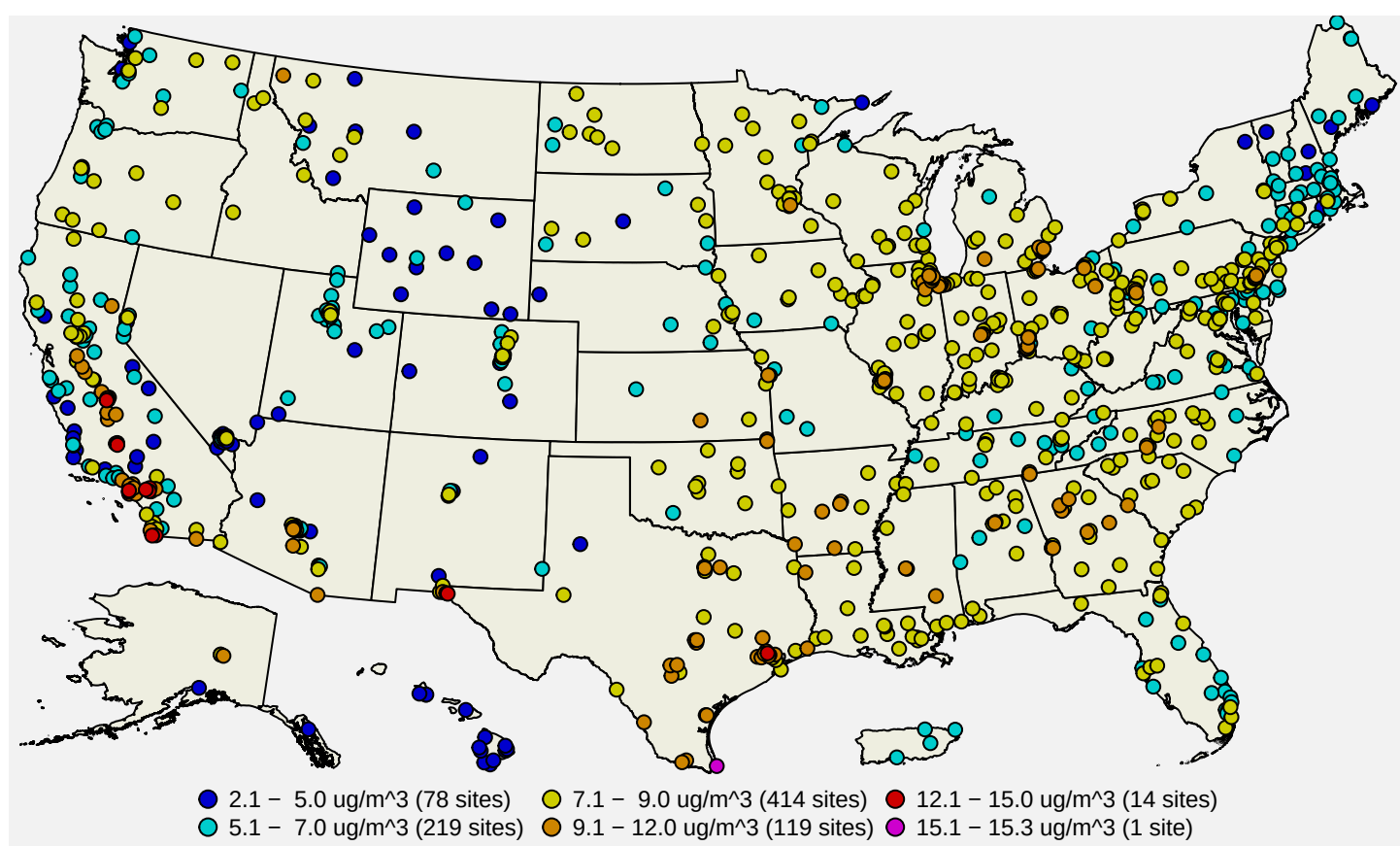


Figure 13: Annual $\text{PM}_{2.5}$ design values in $\mu\text{g}/\text{m}^3$ for the 2023-2025 period. **Source:** AQS.

¹⁰The table lookup procedure is documented in Section 6.3 of the 1987 EPA guidance document *PM₁₀ SIP Development Guideline*.

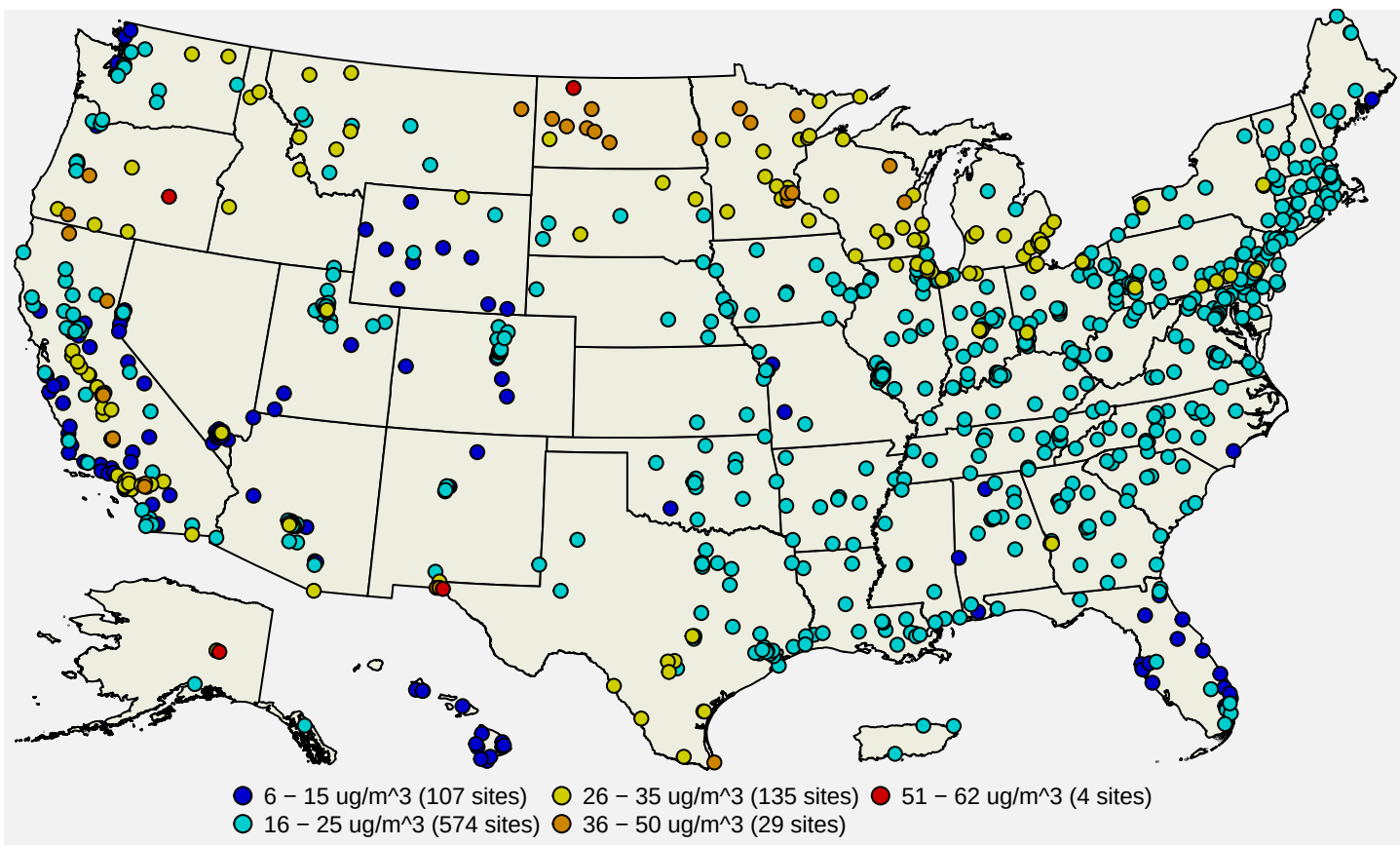


Figure 14: 24-hour PM_{2.5} design values in $\mu\text{g}/\text{m}^3$ for the 2023-2025 period. Source: [AQS](#).

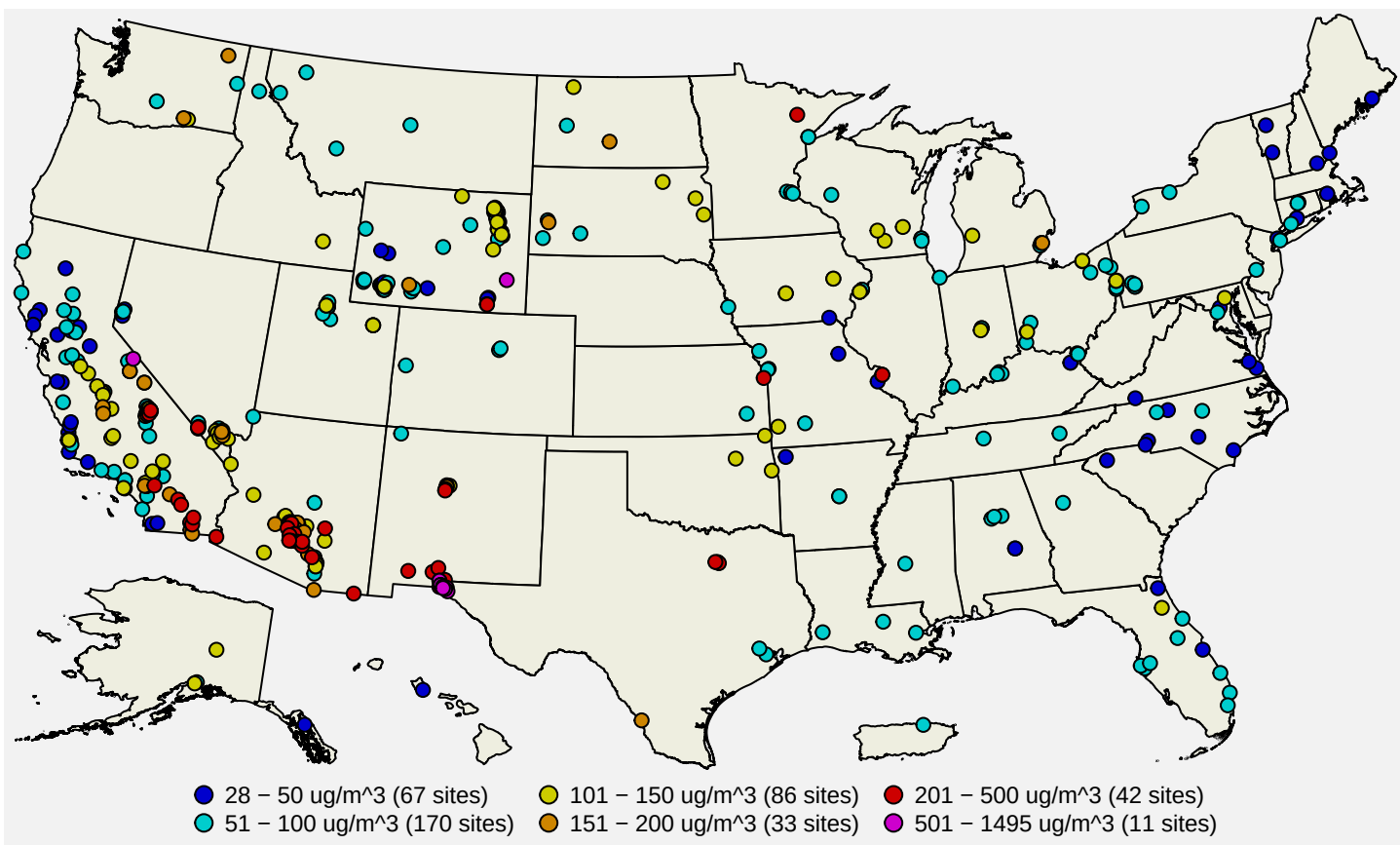


Figure 15: 24-hour PM₁₀ design concentrations in $\mu\text{g}/\text{m}^3$ for the 2023-2025 period. Source: [AQS](#).

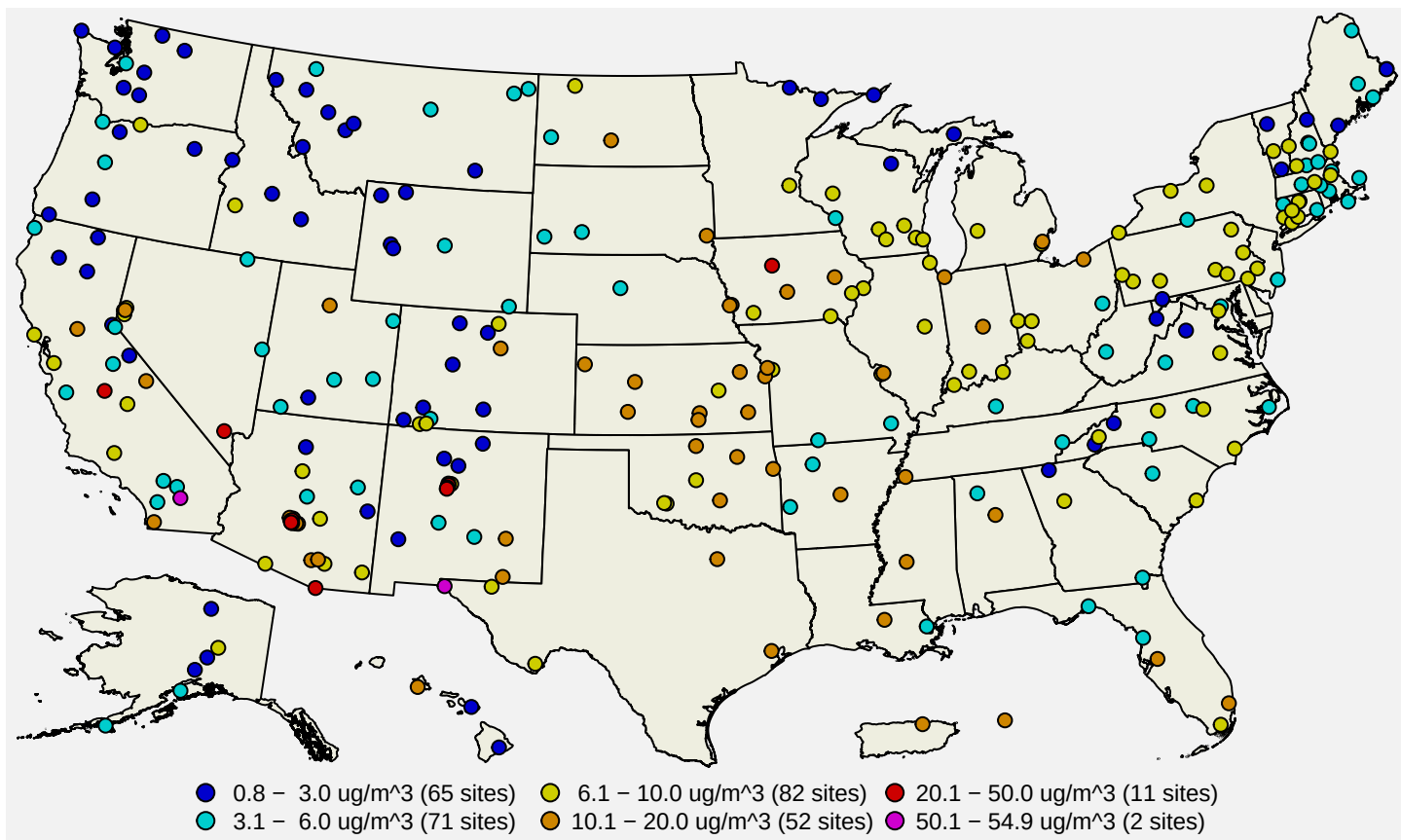


Figure 16: Average annual $\text{PM}_{10-2.5}$ concentrations in $\mu\text{g}/\text{m}^3$ for the 2023-2025 period. **Source:** AQS.

Figure 17 and Figure 18 show site-level trends in the annual and 24-hour $\text{PM}_{2.5}$ design values, respectively, for sites having valid design values in at least 18 of the 24 3-year periods from 2000-2002 through 2023-2025. The trends were computed using the Thiel-Sen estimator, and tests for significance ($p\text{-value} < 0.05$) were computed using the Mann-Kendall test. From this figure it is apparent that most of the U.S. has experienced significant decreasing trends in both the annual and 24-hour $\text{PM}_{2.5}$ design values over the past two decades, especially in the eastern U.S., where regional control programs such as the Clean Air Interstate Rule (CAIR) and the Cross-State Air Pollution Rule (CSAPR) have enabled large reductions in NO_x and SO_2 emissions, which led to long-term reductions in secondary $\text{PM}_{2.5}$ components. There has been less progress in the western U.S., where most controls to-date have focused on local reductions, and emissions from wildfires in recent years have caused increases in $\text{PM}_{2.5}$ concentrations in some areas.

Figure 19 shows site-level trends in the 24-hour PM_{10} design concentrations for sites having valid design values in at least 20 of the 26 3-year periods from 1998-2000 through 2023-2025, while Figure 20 shows site-level trends in annual average $\text{PM}_{10-2.5}$ concentrations for sites having data for at least 16 of the 21 years from 2005 to 2025. The trends in the 24-hour PM_{10} design concentrations are much more variable than those for $\text{PM}_{2.5}$. While trends in the eastern U.S. are decreasing in most locations, there is no clear pattern in the western U.S., with sites even in close proximity sometimes having trends in opposite directions. Nationally, over half of the sites had no significant trend. The reason for this is apparent from Figure 20, which shows no clear trend the annual average $\text{PM}_{10-2.5}$ concentrations at the vast majority of U.S. monitoring sites.

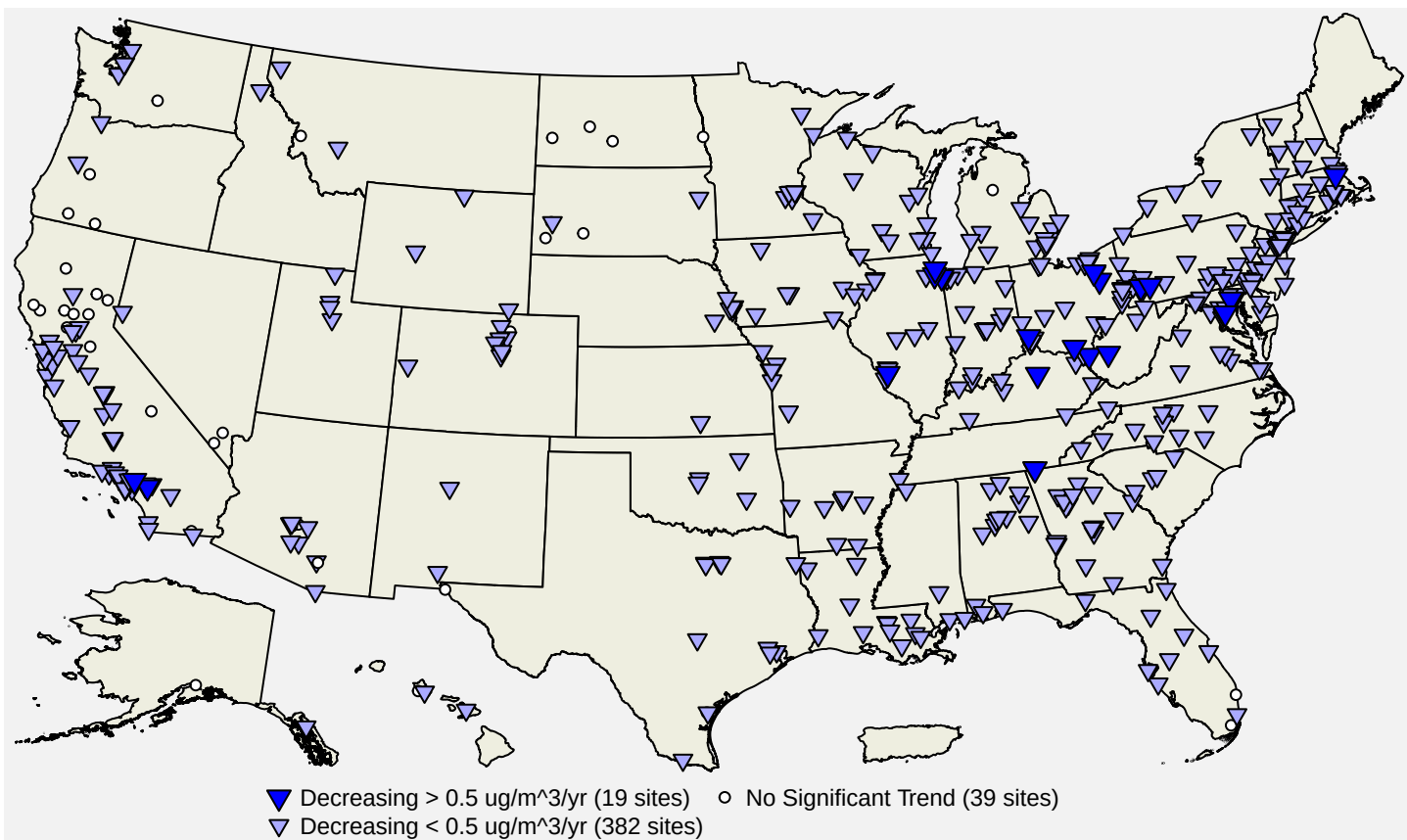


Figure 17: Site-level trends in annual PM_{2.5} design values based on data from 2002 through 2025. **Source:** AQS, trends computed using R statistical software.

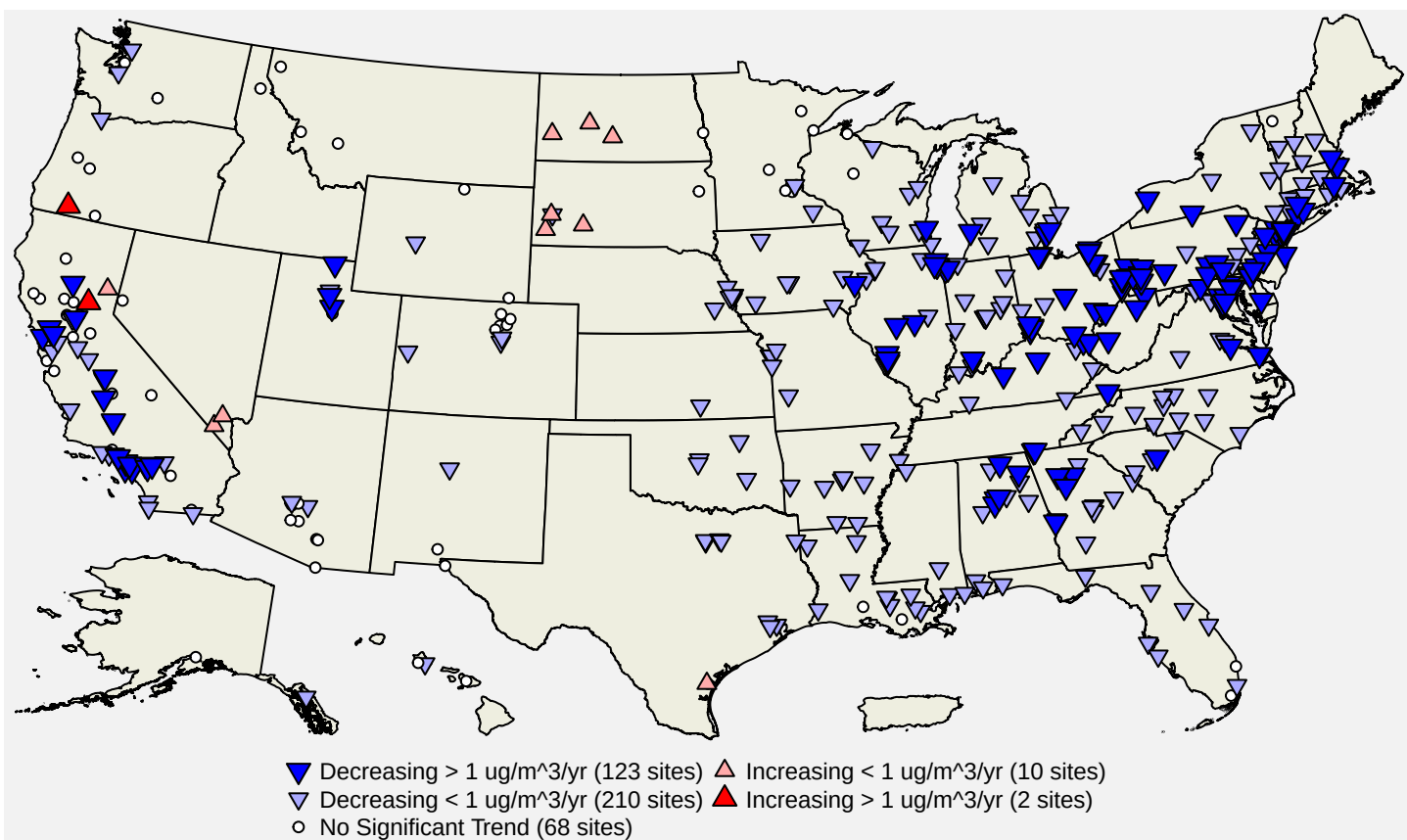


Figure 18: Site-level trends in 24-hour PM_{2.5} design values based on data from 2002 through 2025. **Source:** AQS, trends computed using R statistical software.

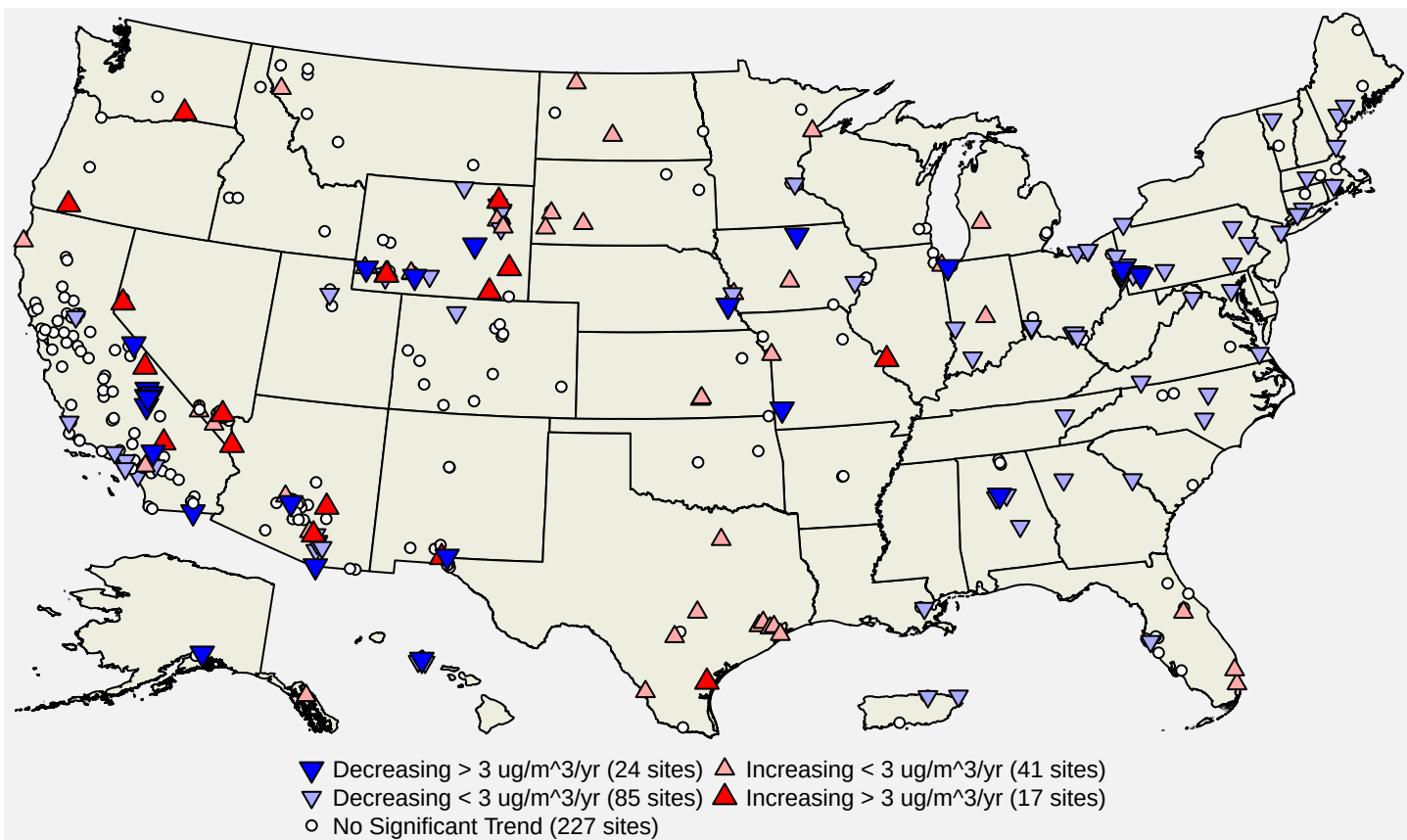


Figure 19: Site-level trends in 24-hour PM₁₀ design concentrations based on data from 2000 through 2025. **Source:** AQS, trends computed using R statistical software.

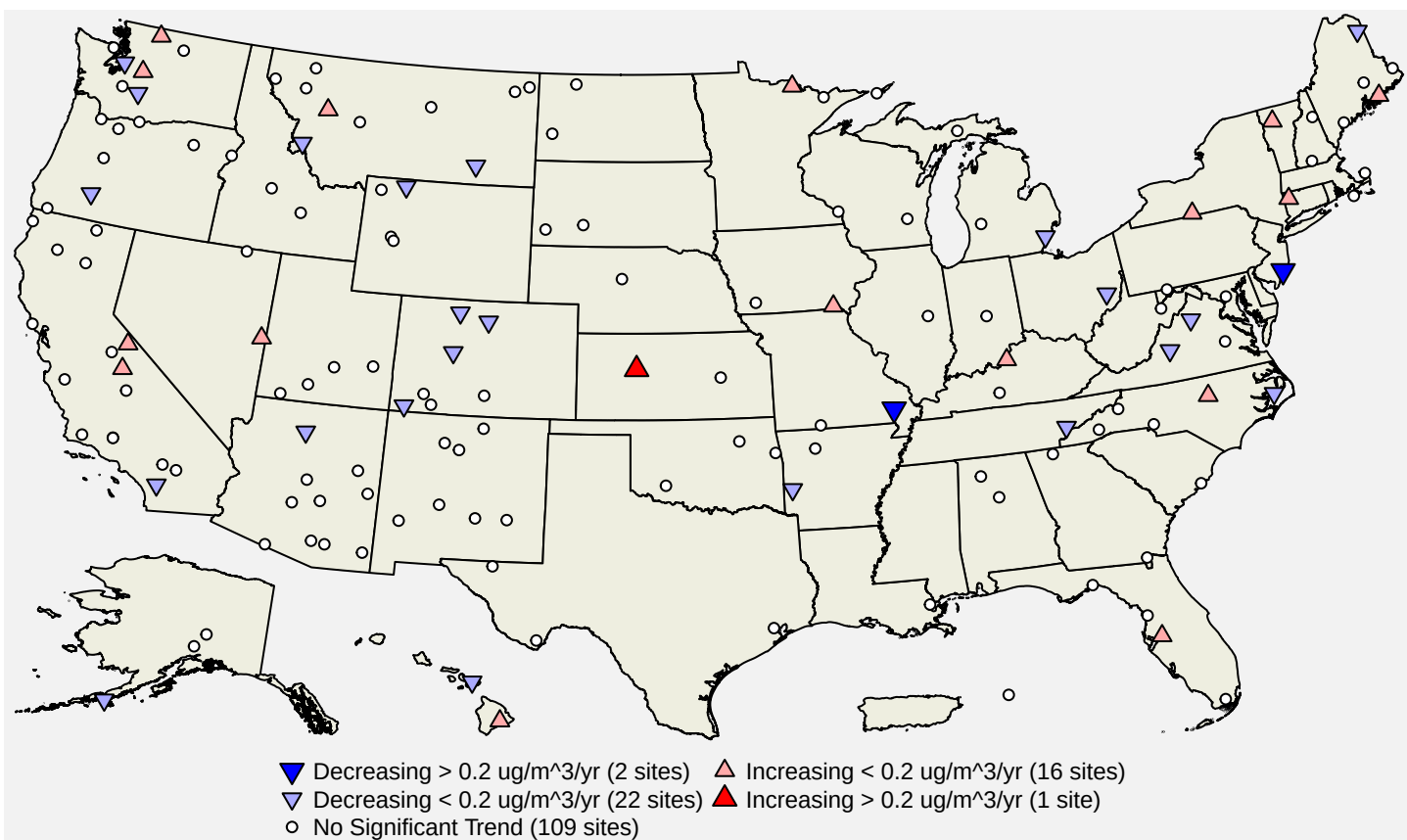


Figure 20: Site-level trends in annual average PM_{10-2.5} concentrations based on data from 2005 through 2025. **Source:** AQS, trends computed using R statistical software.

Figure 21 shows the national trends in the annual and 24-hour $\text{PM}_{2.5}$ design values based on the 440 sites in Figure 17 and the 413 sites in Figure 18, respectively. The U.S. median annual $\text{PM}_{2.5}$ design value decreased by 42% from $13.6 \mu\text{g}/\text{m}^3$ in 2002 to $7.9 \mu\text{g}/\text{m}^3$ in 2025, while the U.S. median 24-hour $\text{PM}_{2.5}$ design value decreased by 42% from $36 \mu\text{g}/\text{m}^3$ in 2002 to $21 \mu\text{g}/\text{m}^3$ in 2025.

Both the annual and 24-hour $\text{PM}_{2.5}$ design values exhibited steady decreases from 2002 to 2016. In recent years, the median annual $\text{PM}_{2.5}$ design value has remained relatively constant at about $8 \mu\text{g}/\text{m}^3$ while the 10th and 90th percentile trends have also remained relatively flat at about $6 \mu\text{g}/\text{m}^3$ and $10 \mu\text{g}/\text{m}^3$, respectively. The 10th percentile and median of the 24-hour $\text{PM}_{2.5}$ design values, which are based on the annual 98th percentile, have also remained relatively constant at about $15 \mu\text{g}/\text{m}^3$ and $20 \mu\text{g}/\text{m}^3$, respectively, since 2016. However, the 90th percentile of the 24-hour $\text{PM}_{2.5}$ design values has fluctuated substantially in the past 9 years largely as a result of increased wildfire activity.

Figure 22 shows the national trend in the 24-hour PM_{10} design concentrations based on the 394 sites in Figure 19. The national median of the 24-hour PM_{10} design concentrations has remained relatively constant over the past 25 years. The 90th percentile 24-hour PM_{10} design concentration has been highly variable, most likely as a result of year-to-year fluctuations in weather conditions and wildfire emissions.

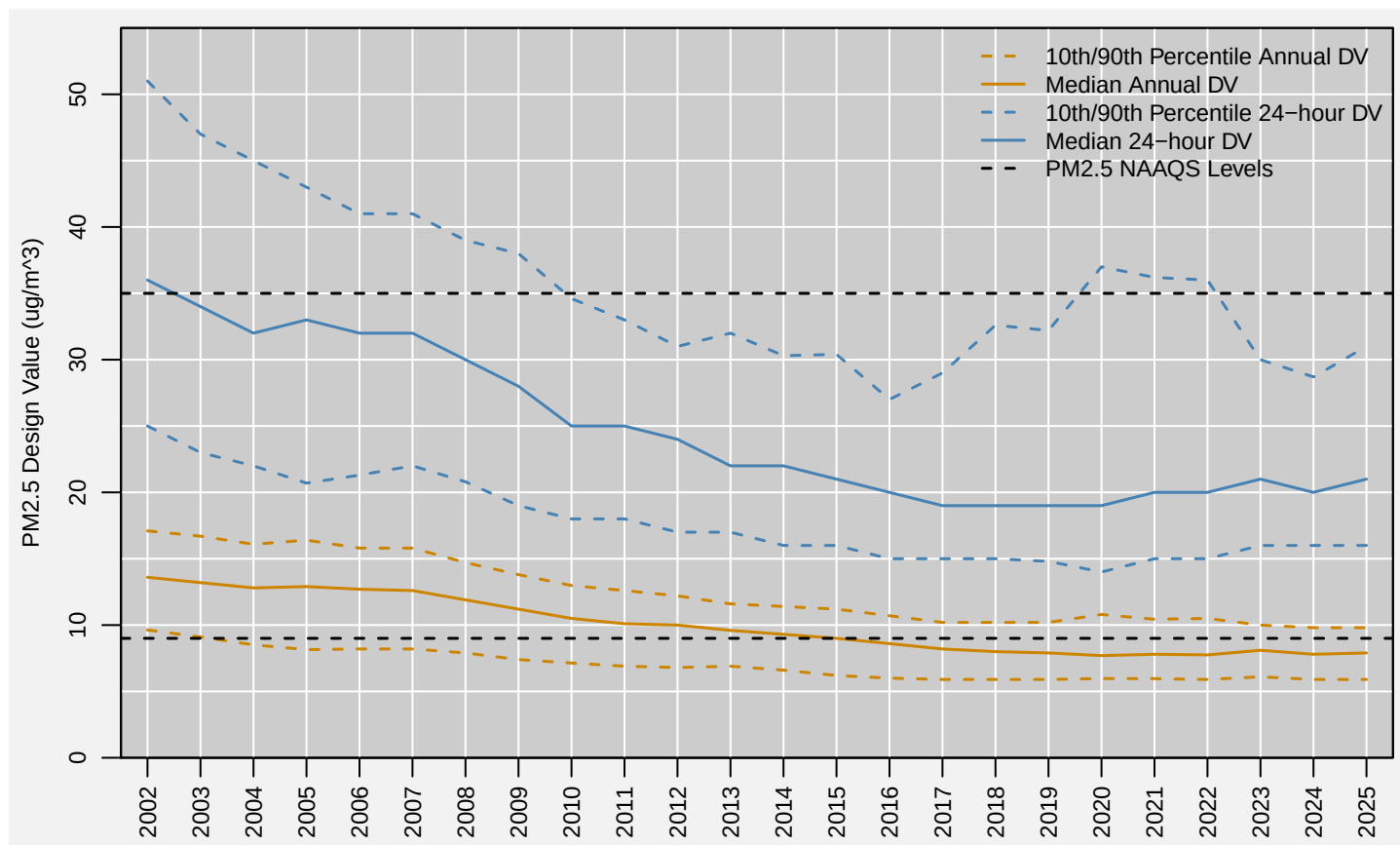


Figure 21: National trend in $\text{PM}_{2.5}$ design values in $\mu\text{g}/\text{m}^3$, 2002 to 2025. **Source:** AQS.

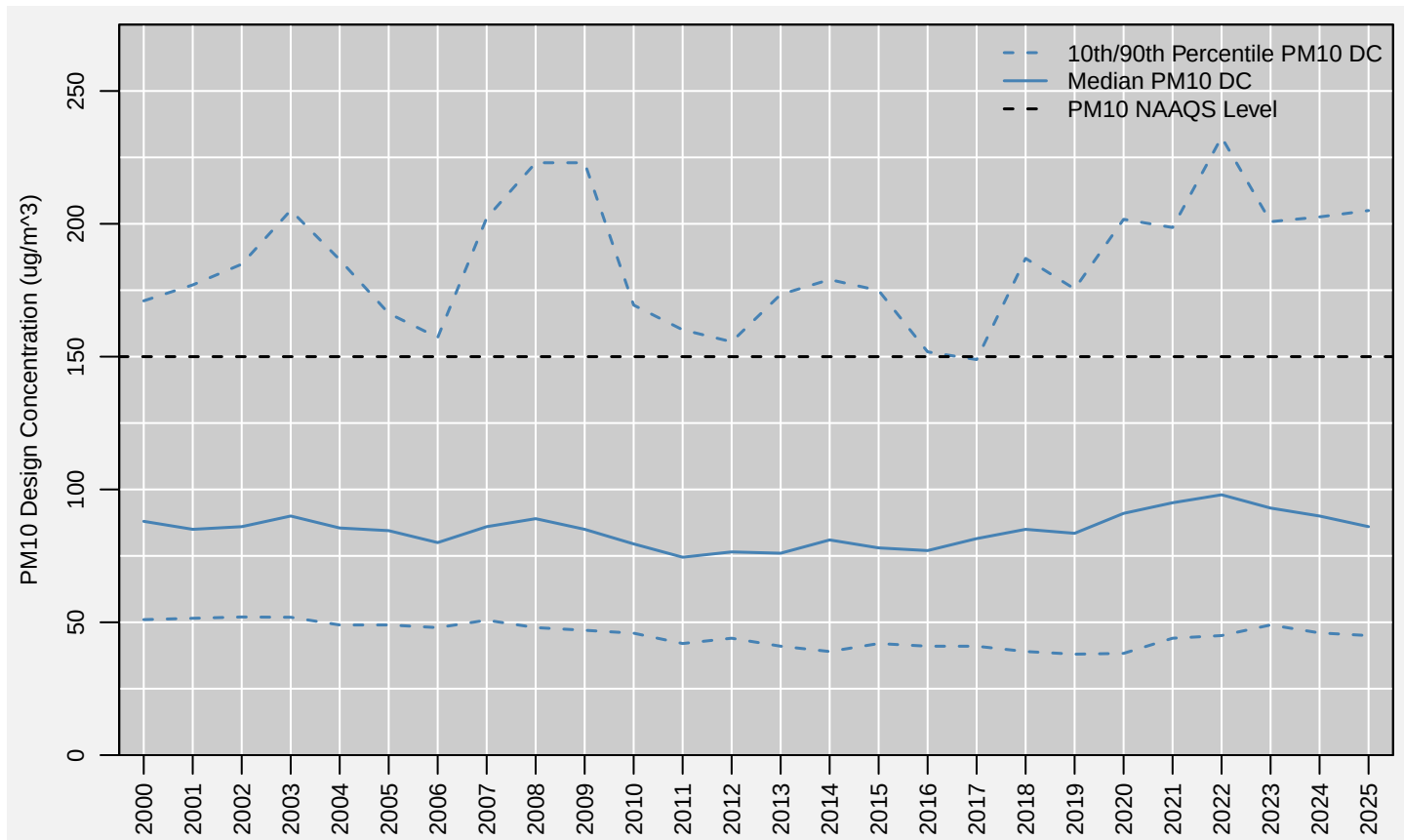


Figure 22: National trend in 24-hour PM₁₀ design concentrations in µg/m³, 2000 to 2025. **Source:** AQS.

Figure 23 shows the national distribution of the annual average PM_{2.5} concentrations along with the number of PM_{2.5} monitoring sites reporting data in each year, while Figure 24 shows the national distribution of the annual 98th percentile 24-hour PM_{2.5} concentrations reported in each year from 2000 to 2025 along with the number of PM_{2.5} monitoring sites reporting data in each year.¹¹ The median of the annual average PM_{2.5} concentrations decreased by 45%, from 13.1 µg/m³ in 2000 to 7.2 µg/m³ in 2025. Similarly, the median of the annual 98th percentile 24-hour PM_{2.5} concentrations decreased by 42%, from 32.2 µg/m³ in 2000 to 18.7 µg/m³ in 2025. Both the annual average and 98th percentile 24-hour PM_{2.5} concentrations decreased steadily from the early 2000s until 2016, and have fluctuated in recent years, especially in the upper tail of the distribution. These fluctuations are largely due to large-scale wildfire events that have occurred in recent years. The size of the PM_{2.5} monitoring network increased rapidly following the establishment of a PM_{2.5} NAAQS in 1997, and has been relatively stable at around 1,000 sites since 2000.¹²

Figure 25 shows the national distribution of the annual 2nd highest 24-hour PM₁₀ concentrations reported in each year from 1990 to 2025 along with the number of PM₁₀ monitoring sites reporting data in each year.¹³ The median of the annual 2nd highest 24-hour PM₁₀ concentration increased by 3%, from 61 µg/m³ in 1990 to 63 µg/m³ in 2025. Note, however, that many sites in the western U.S. were influenced by smoke from wildfires in 2020 and 2021, many sites in the eastern U.S. were impacted by Canadian wildfire smoke in 2023, and the median concentration in 2019 was only 49 µg/m³. The PM₁₀ monitoring network grew in size from its inception in the mid-1980's to a maximum size of around 1,600 sites in the mid-1990's. Following the establishment of a PM_{2.5} NAAQS in 1997 along with new requirements for PM_{2.5} monitoring, many PM₁₀ sites were discontinued in 1998 and 1999. Over the past two decades, the PM₁₀ monitoring network has slowly decreased in size over time as priorities have shifted toward PM_{2.5} monitoring, and the geographic distribution of the PM₁₀ network has shifted toward the western U.S., where higher concentrations are often measured due to the prevalence of wildfires and dust storms.

¹¹For this analysis, the annual average and 98th percentile 24-hour PM_{2.5} concentrations were retrieved from AQS for all U.S. sites for years that had at least 75% annual data completeness.

¹²Some agencies are late in reporting and certifying their data in AQS, resulting in an apparent decrease in the number of sites in 2025 in Figures 23 through 25. It is expected that the number of sites with complete data in 2025 will increase in future versions of this document.

¹³For this analysis, the annual 2nd highest 24-hour PM₁₀ concentrations were retrieved from AQS for all U.S. sites for years that had at least 50% annual data completeness.

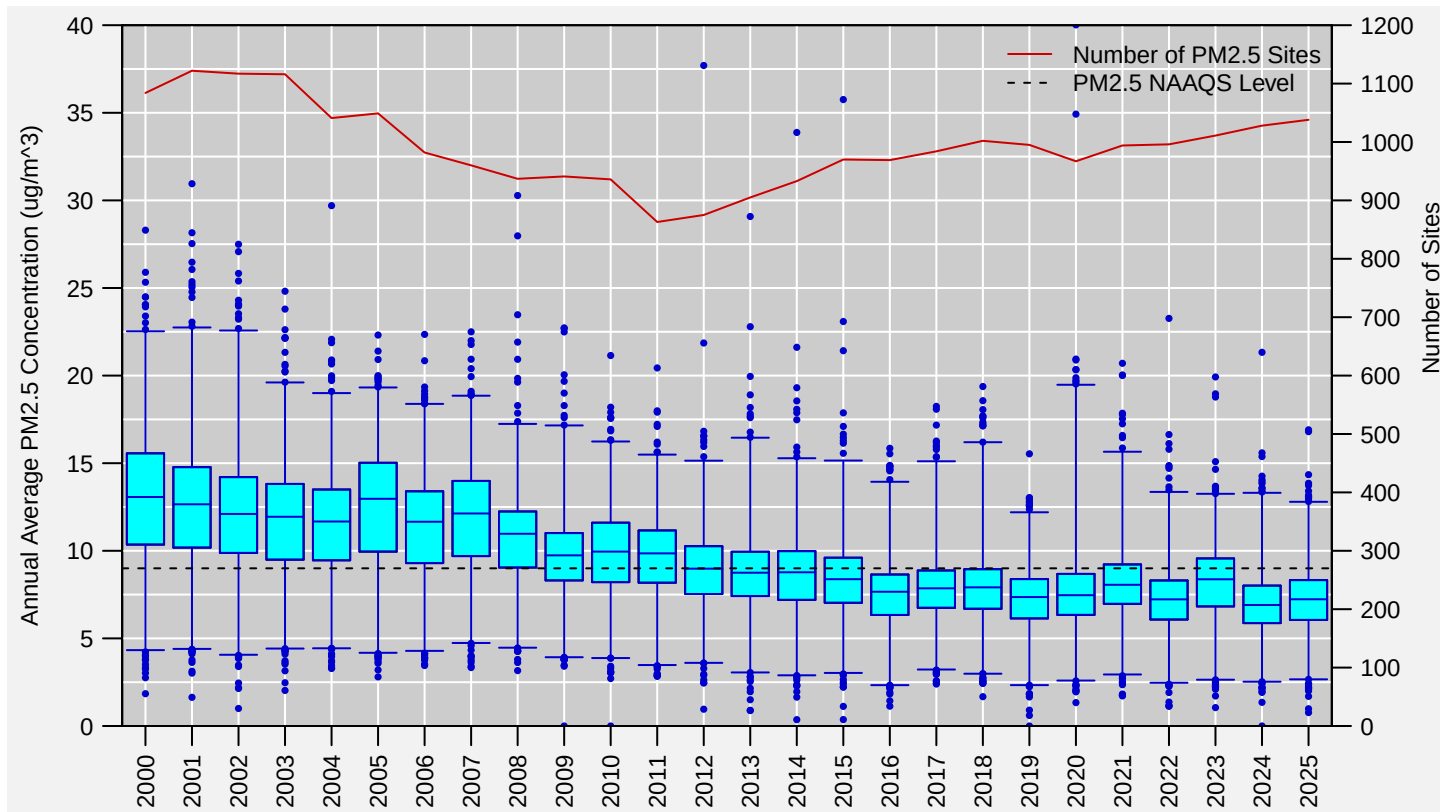


Figure 23: Distribution of annual average PM_{2.5} concentrations measured at U.S. monitoring sites, 2000 to 2025. Boxes represent the median and interquartile range, whiskers extend to the 1st and 99th percentiles, and values outside this range are shown as circles. The red line shows the number of PM_{2.5} monitoring sites reporting data to EPA in each year. **Source:** AQS.

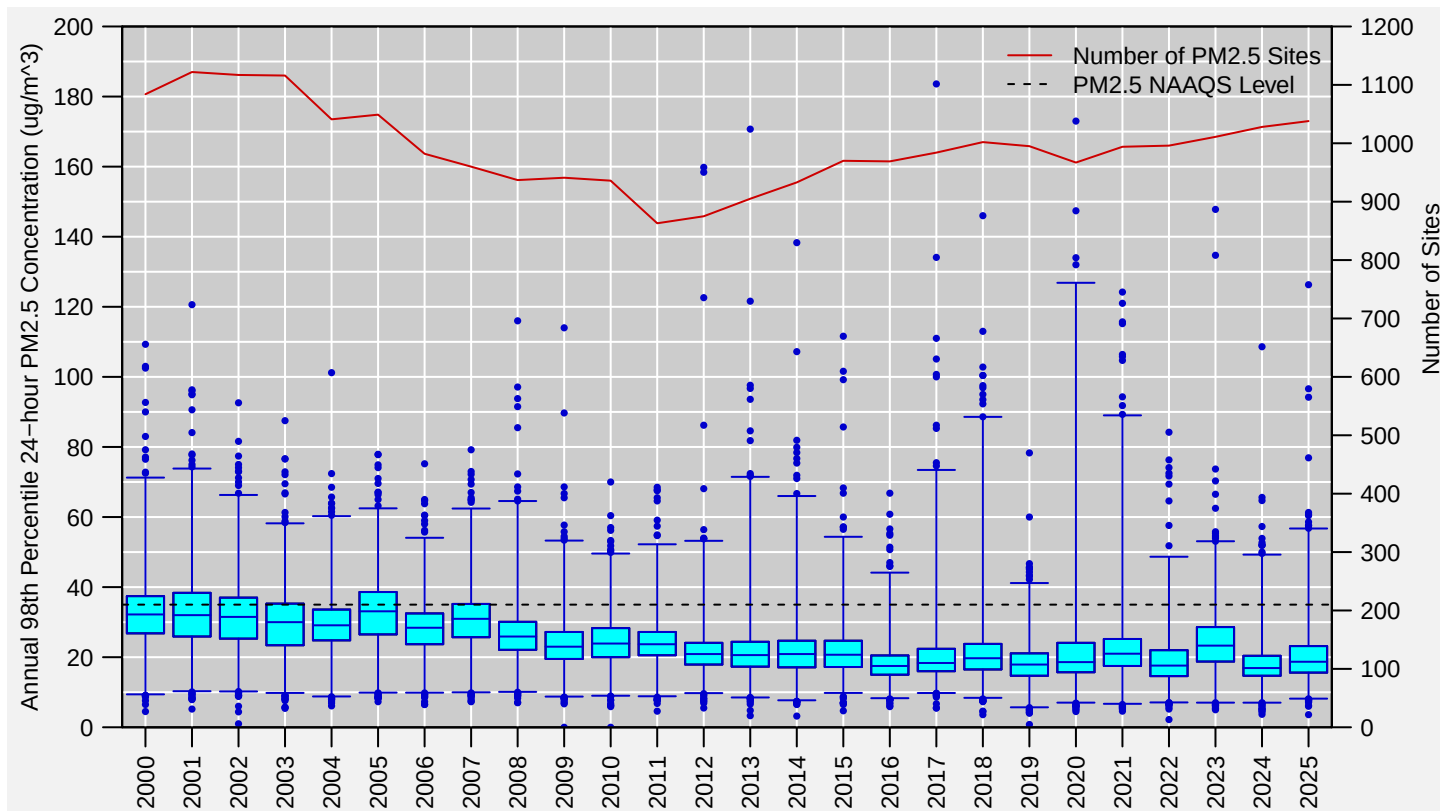


Figure 24: Distribution of annual 98th percentile 24-hour PM_{2.5} concentrations measured at U.S. monitoring sites, 2000 to 2025. Boxes represent the median and interquartile range, whiskers extend to the 1st and 99th percentiles, and values outside this range are shown as circles. The red line shows the number of PM_{2.5} monitoring sites reporting data to EPA in each year. **Source:** AQS.

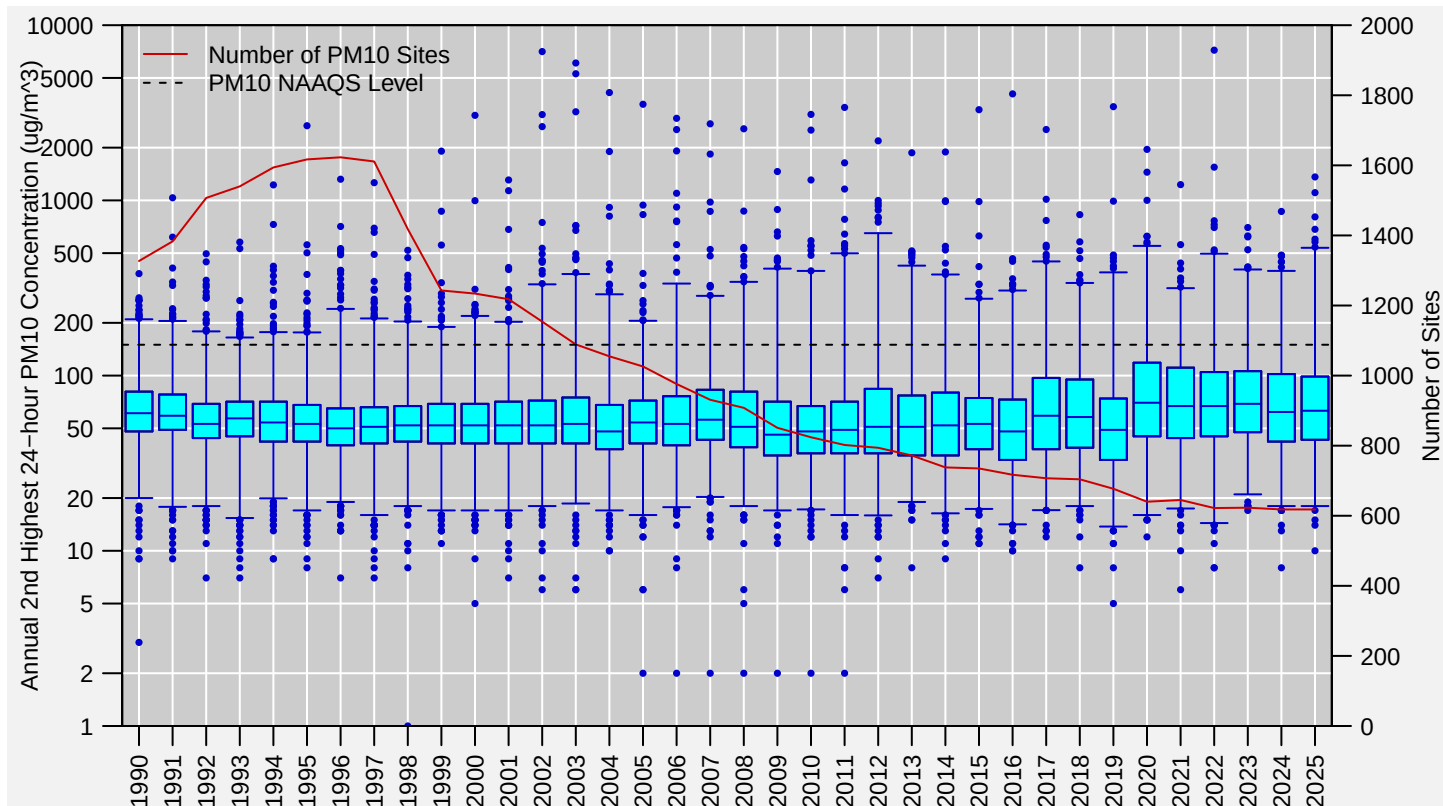


Figure 25: Distribution of annual 2nd highest 24-hour PM_{10} concentrations measured at U.S. monitoring sites, 1990 to 2025. Boxes represent the median and interquartile range, whiskers extend to the 1st and 99th percentiles, and values outside this range are shown as circles. The red line shows the number of PM_{10} monitoring sites reporting data to EPA in each year. **Source:** AQS.

Table 4 presents summary statistics based on daily measurements of $\text{PM}_{2.5}$ species reported to AQS from 2023 to 2025. Sulfate and nitrate have opposite seasonal patterns, with sulfate typically having the highest concentrations during the summer months and nitrate typically having the highest concentrations during the winter months. EC has a relatively small contribution to total $\text{PM}_{2.5}$ mass and little seasonal pattern, while OC is the largest contributor to total $\text{PM}_{2.5}$ mass and has the highest concentrations during the summer, which is also peak wildfire season in the western U.S. On average, crustal material has roughly the same contribution to total $\text{PM}_{2.5}$ mass as sulfate and nitrate, with the highest concentrations occurring in the spring and summer months. Finally, sea salt is the smallest contributor to total $\text{PM}_{2.5}$ mass with very low concentrations typically measured away from coastal areas.

Figure 26 shows a map with pie charts showing the major $\text{PM}_{2.5}$ species as a fraction of total $\text{PM}_{2.5}$ mass as measured at selected NCore, CSN, and IMPROVE sites during the 2023 to 2025 period. The six species shown are sulfate (SO_4), nitrate (NO_3), elemental carbon (EC), organic carbon (OC), crustal material, and sea salt. The pie charts are located at each monitoring site on the map. This figure portrays several aspects of regional variability in $\text{PM}_{2.5}$, for example, large portions of total $\text{PM}_{2.5}$ mass can be attributed to sulfate in the Appalachian region, nitrate in the upper Midwest, OC in the Pacific Northwest, crustal material in the southwest, and sea salt in coastal areas.

Figure 27 shows the average concentrations for four $\text{PM}_{2.5}$ components (sulfate, nitrate, EC, and OC) based on data collected during the 2023 to 2025 period. From this figure it is apparent that sulfate concentrations are highest in the Ohio River valley and along the Gulf of Mexico, while nitrate concentrations are highest in the upper Midwest, along the northeast urban corridor, and in parts of California. EC concentrations tend to be higher near urban areas, especially those with large industrial sources, while OC tends to be more concentrated in rural areas, with impacts from prescribed burns, wildfires, and residential wood smoke.

Figure 28 shows trends in annual average concentrations for sulfate, nitrate, EC, and OC based on sites that collected data for at least 15 out of 20 years from 2006 to 2025.¹⁴ Broad national reductions in SO_2 emissions have resulted in significant reductions in sulfate concentrations nationally and especially in the eastern U.S. Similarly, reductions in NO_x emissions have resulted in significant decreasing trends in nitrate concentrations in most of the U.S., especially in areas where nitrate concentrations were historically highest. EC and OC concentrations were more variable, with most sites showing no clear trend.

¹⁴Although $\text{PM}_{2.5}$ speciation monitoring has been conducted since 2000, the trends in Figure 28 begin in 2006 to avoid excluding CSN sites, which experienced a change in EC and OC sampling methods between 2007 and 2010.

Table 4. National distribution of PM_{2.5} species concentrations in $\mu\text{g}/\text{m}^3$ by quarter based on monitoring data from 2023 to 2025.⁹ **Source:** [AQS](#).

	species	quarter	N.sites	N.obs	mean	SD	min	p1	p5	p10	p25	p50	p75	p90	p95	p98	p99	max	max.site
24	SO4	all	297	84,700	0.65	0.60	-0.03	0.03	0.09	0.14	0.27	0.50	0.85	1.30	1.65	2.17	2.66	26.39	530530029
	SO4	1st quarter	295	21,313	0.56	0.61	-0.01	0.02	0.06	0.09	0.19	0.41	0.74	1.15	1.50	2.10	2.73	22.24	020900035
	SO4	2nd quarter	294	21,374	0.72	0.60	-0.03	0.06	0.15	0.21	0.33	0.57	0.95	1.41	1.77	2.34	2.89	10.31	051190007
	SO4	3rd quarter	293	21,381	0.77	0.65	-0.01	0.08	0.18	0.24	0.38	0.63	1.01	1.47	1.78	2.24	2.66	26.39	530530029
	SO4	4th quarter	291	20,632	0.52	0.48	-0.02	0.02	0.07	0.10	0.19	0.39	0.69	1.09	1.40	1.86	2.27	10.97	150010005
	NO3	all	295	84,474	0.56	1.07	-0.02	0.01	0.02	0.04	0.09	0.22	0.55	1.38	2.27	3.70	4.98	35.93	490050007
	NO3	1st quarter	293	21,254	0.88	1.36	-0.02	0.01	0.02	0.04	0.12	0.39	1.09	2.33	3.42	4.93	6.27	35.93	490050007
	NO3	2nd quarter	292	21,316	0.40	0.60	-0.01	0.01	0.04	0.06	0.11	0.22	0.44	0.85	1.29	2.08	2.94	12.84	060371103
	NO3	3rd quarter	291	21,327	0.26	0.41	-0.02	0.01	0.03	0.04	0.08	0.15	0.29	0.52	0.78	1.33	1.91	11.12	060712002
	NO3	4th quarter	289	20,577	0.71	1.40	-0.02	0.00	0.02	0.03	0.08	0.25	0.72	1.83	2.90	4.65	6.36	29.32	060658001
	EC	all	285	81,076	0.34	0.51	-0.01	0.00	0.01	0.03	0.07	0.19	0.42	0.79	1.12	1.64	2.13	43.76	040059000
	EC	1st quarter	283	20,315	0.32	0.48	0.00	0.00	0.01	0.02	0.06	0.15	0.41	0.81	1.17	1.74	2.25	10.12	180890022
	EC	2nd quarter	282	20,450	0.29	0.48	-0.01	0.00	0.02	0.03	0.07	0.17	0.36	0.67	0.94	1.37	1.87	22.07	460710001
	EC	3rd quarter	283	20,582	0.35	0.45	-0.01	0.00	0.02	0.05	0.10	0.23	0.45	0.75	1.03	1.44	1.79	28.55	060893003
	EC	4th quarter	279	19,732	0.38	0.61	-0.01	0.00	0.01	0.03	0.07	0.19	0.48	0.94	1.35	1.94	2.49	43.76	040059000
	OC	all	287	81,608	1.48	2.87	-0.14	0.02	0.11	0.18	0.43	0.95	1.80	3.03	4.13	6.24	8.79	428.15	060893003
	OC	1st quarter	284	20,455	1.00	1.51	-0.09	0.00	0.06	0.11	0.24	0.60	1.29	2.28	3.13	4.55	5.80	50.74	040239000
	OC	2nd quarter	283	20,558	1.51	2.52	-0.14	0.04	0.15	0.24	0.47	0.94	1.73	2.93	4.15	6.83	9.89	52.39	110010043
	OC	3rd quarter	283	20,683	2.06	3.20	-0.10	0.08	0.29	0.46	0.82	1.45	2.43	3.76	5.21	8.74	12.61	224.97	060893003
	OC	4th quarter	281	19,872	1.32	3.70	-0.06	0.02	0.09	0.16	0.36	0.83	1.68	2.86	3.88	5.34	6.81	428.15	060893003
	Crustal	all	298	83,207	0.63	1.15	-0.12	0.00	0.03	0.05	0.14	0.33	0.71	1.39	2.14	3.48	4.82	67.13	421255001
	Crustal	1st quarter	295	20,909	0.45	1.09	-0.12	-0.00	0.02	0.03	0.09	0.21	0.45	0.92	1.47	2.56	3.78	32.21	400319000
	Crustal	2nd quarter	294	20,954	0.82	1.33	-0.09	0.02	0.06	0.12	0.24	0.49	0.96	1.72	2.57	3.95	5.18	67.13	421255001
	Crustal	3rd quarter	294	21,028	0.78	1.25	-0.11	0.01	0.05	0.09	0.21	0.43	0.86	1.68	2.56	4.25	5.98	40.47	060290014
	Crustal	4th quarter	291	20,287	0.48	0.79	-0.11	0.00	0.02	0.03	0.09	0.23	0.53	1.12	1.76	2.90	3.88	16.94	780200001
	Sea_Salt	all	298	85,212	0.18	0.52	-0.02	0.00	0.00	0.01	0.01	0.04	0.15	0.43	0.81	1.54	2.19	38.97	040239000
	Sea_Salt	1st quarter	296	21,423	0.22	0.59	-0.01	0.00	0.00	0.01	0.02	0.06	0.20	0.52	0.90	1.64	2.31	38.97	040239000
	Sea_Salt	2nd quarter	295	21,498	0.20	0.54	-0.01	0.00	0.00	0.01	0.02	0.05	0.14	0.47	0.93	1.71	2.41	12.22	550790010
	Sea_Salt	3rd quarter	294	21,545	0.15	0.47	-0.02	0.00	0.00	0.01	0.01	0.04	0.10	0.31	0.61	1.26	1.96	21.78	120573002
	Sea_Salt	4th quarter	292	20,746	0.17	0.45	-0.02	0.00	0.00	0.00	0.01	0.04	0.15	0.41	0.77	1.42	2.04	19.90	550270001

N.sites = number of sites; N.obs = number of observations; SD = standard deviation; min = minimum; p1, p5, p10, p25, p50, p90, p95, p98, p99 = 1st, 5th, 10th, 25th, 50th, 90th, 95th, 98th, 99th percentiles; max = maximum; max.site = AQS ID number for the monitoring site corresponding to the observation in the max column. 1st quarter = January/February/March; 2nd quarter = April/May/June; 3rd quarter = July/August/September; 4th quarter = October/November/December.

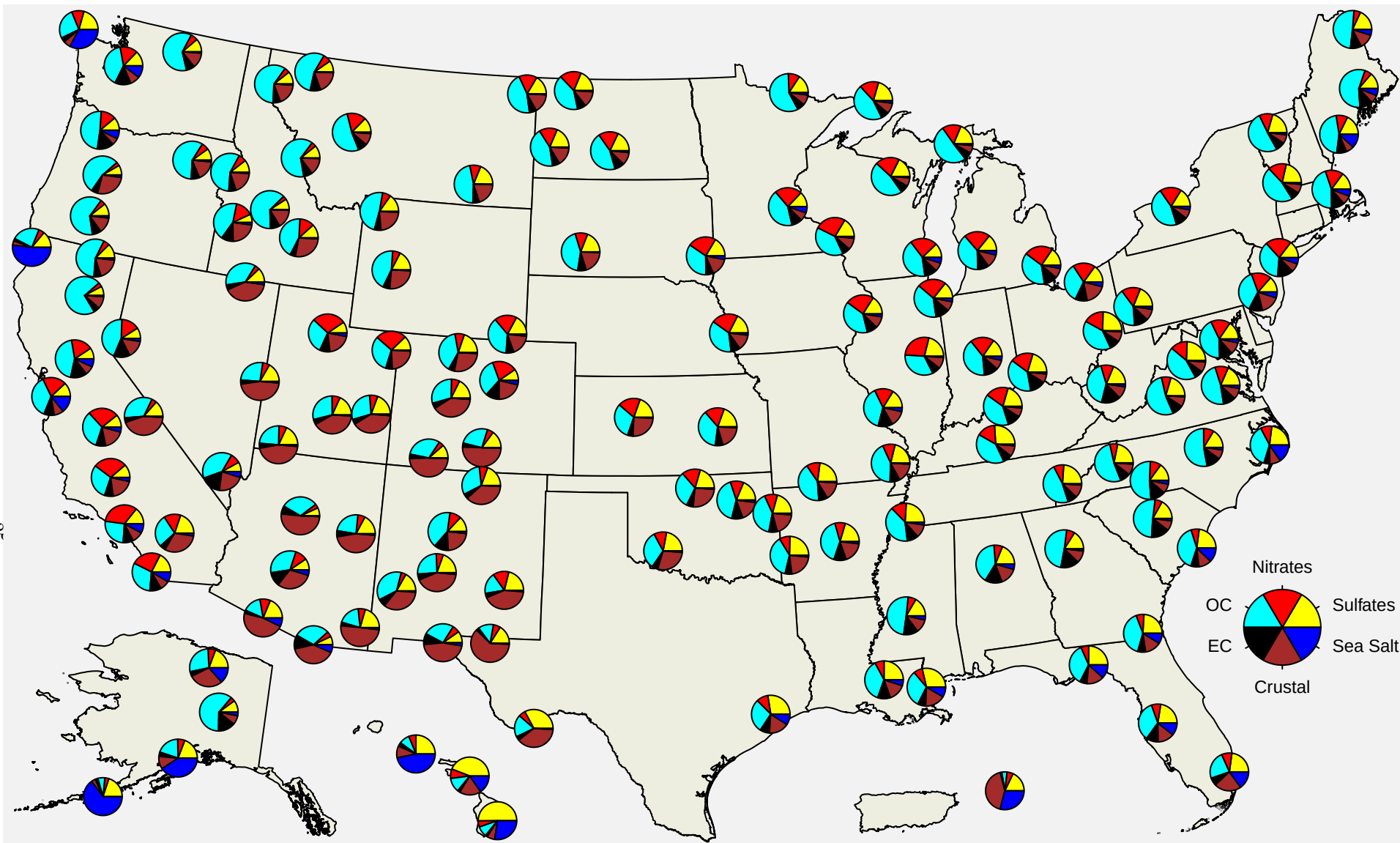


Figure 26: Map showing pie charts of PM_{2.5} component species at selected U.S. monitoring sites based on 2023-2025 data. **Source:** [AQS](#).

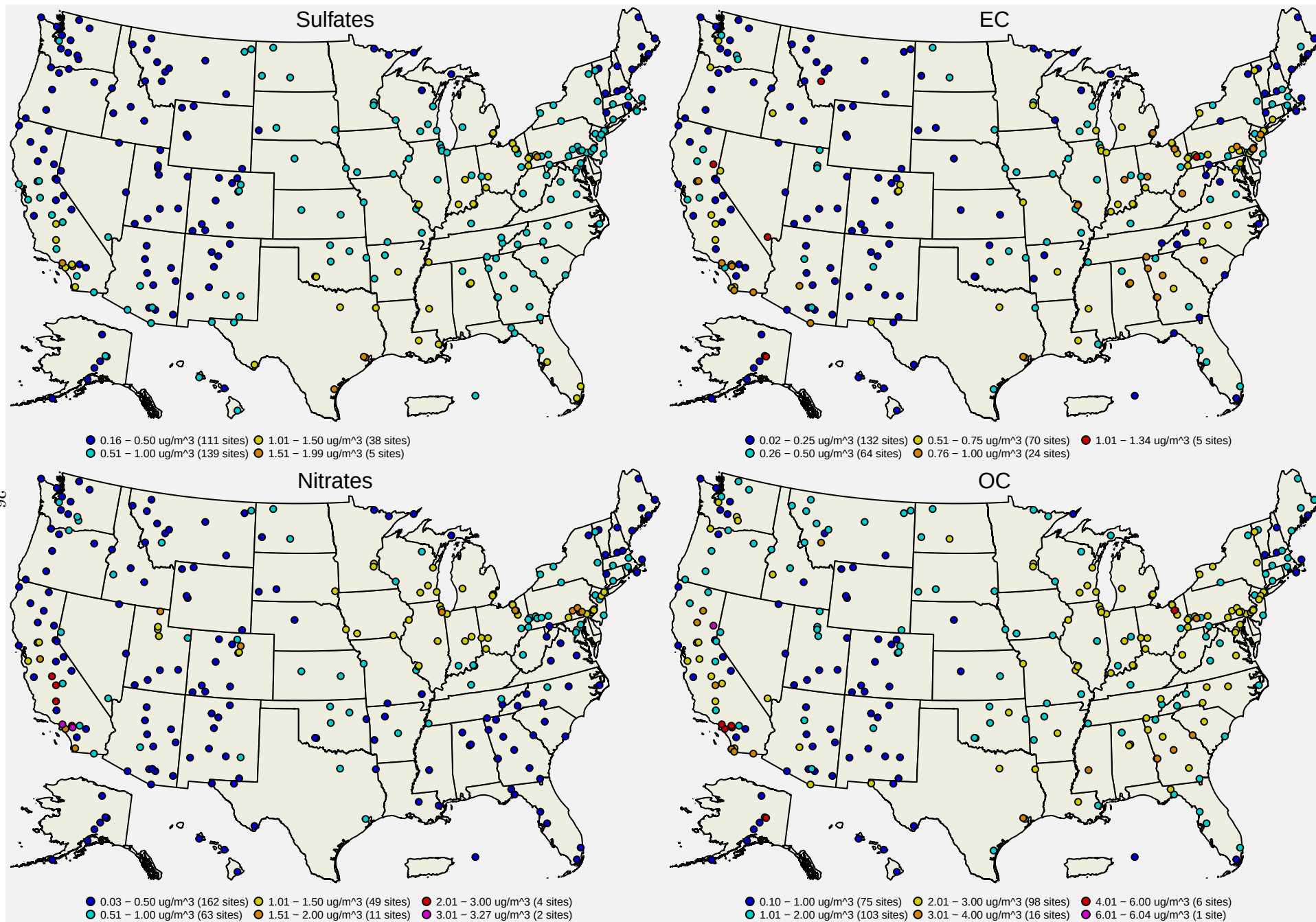


Figure 27: Average concentrations for sulfate (top left), nitrate (bottom left), elemental carbon (top right), and organic carbon (bottom right) at U.S. monitoring sites based on 2023-2025 data. **Source:** AQS.

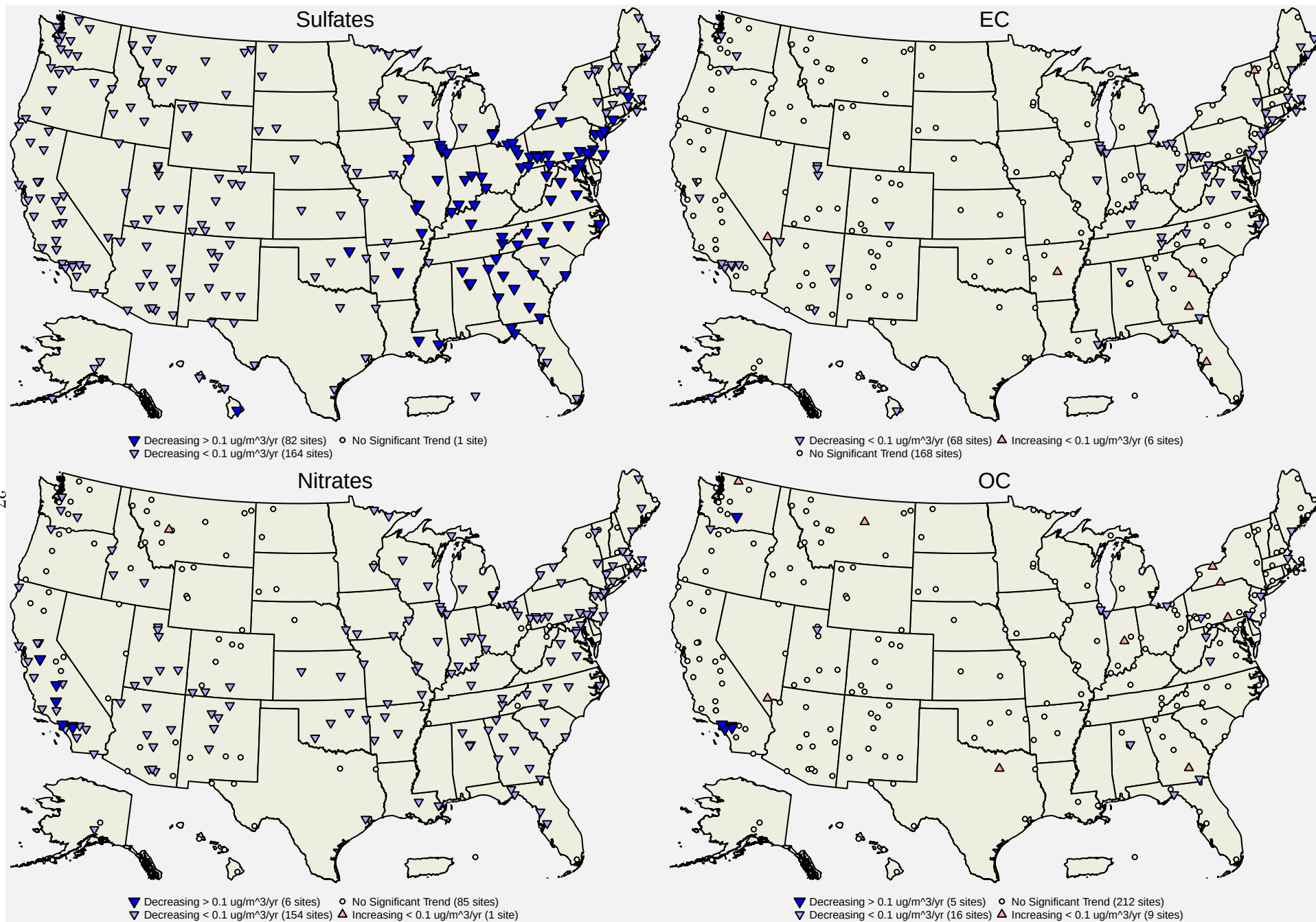


Figure 28: Site-level trends in annual average concentrations for sulfate (top left), nitrate (bottom left), elemental carbon (top right), and organic carbon (bottom right) based on data from 2006 through 2025. **Source:** AQS, trends computed using R statistical software.

References

U.S. EPA. [Integrated Science Assessment for Particulate Matter \(Final Report, December 2019\)](#). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-19/188, 2019.

U.S. EPA. [Policy Assessment for the Review of the PM NAAQS \(Final Report, January 2020\)](#). U.S. Environmental Protection Agency, Research Triangle Park, NC, EPA-452/R-20-002, 2020.

Additional Resources

- [Particulate Matter \(PM\) Pollution](#)
- [Particulate Matter \(PM\) Air Quality Standards](#)
- [National Emissions Inventory \(NEI\)](#)
- [Ambient Monitoring Technology Information Center \(AMTIC\)](#)
- [Air Quality Design Values](#)
- [National Air Quality: Status and Trends of Key Air Pollutants](#)
- [Air Data: Air Quality Data Collected at Outdoor Monitors Across the U.S.](#)