Ambient Air Monitoring and NAAQS Overview

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What is encompassed in the U.S. Ambient Air Monitoring Networks? (as reported to AQS)

185 Reporting Agencies
4,857 Sites
49,336 Monitors¹
~121 M measurements a year

¹ Each measurement is reported as its own monitor.
What types of Reporting Agencies are represented in our ambient air monitoring network databases? – AQS and AIRNow reporting

**Reporting to AQS**
- EPA, 1
- Tribal, 37
- State, 52
- Industrial, 46
- Local - County, 19
- Local - City, 7
- Local - Air District, 13
- Other Federal, 2
- Institution or Contractor, 8

AQS is EPA’s long-term repository of data

**Reporting PM₂.₅ to AIRNow**
- State, 51
- Local, 51
- Department of State, 56
- Tribal, 13
- Other Federal, 2
- EPA, 2
- Countries outside North America, 3
- Mexico, 3
- Canada, 13

AirNow is EPA’s real-time database for reporting and forecasting of the AQI
Number of NAAQS Sites Reporting by Pollutant since 1999

- Large robust networks for:
  - Ozone
  - PM$_{2.5}$

- Stable networks for:
  - Nitrogen dioxide
  - Sulfur dioxide

- Networks with a decreasing number of sites in recent years:
  - PM$_{10}$
  - Carbon monoxide
  - Lead
Reporting of PM$_{2.5}$ Federal Reference Methods (FRMs) and continuous Federal Equivalent Methods (FEMs) to AQS by daily days loaded

<table>
<thead>
<tr>
<th>Year</th>
<th>FRM max daily count</th>
<th>Collocation max daily count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>168K</td>
<td>38k</td>
</tr>
<tr>
<td>2000</td>
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<td>2001</td>
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<td>2020</td>
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<tr>
<td>2021</td>
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</tbody>
</table>

**Required sample frequency**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>Typically</td>
<td>1:3</td>
</tr>
<tr>
<td>Daily</td>
<td></td>
</tr>
</tbody>
</table>

**Total sample days reported**

<table>
<thead>
<tr>
<th>Year</th>
<th>FRM (and any filter-based FEM, i.e., dichot) Daily Count</th>
<th>Continuous FEM Daily Count</th>
<th>Number of FRM:FEM collocated pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>72,055</td>
<td>257,414</td>
<td>33,654</td>
</tr>
</tbody>
</table>

- FRM max daily count = 168K
- Collocation max daily count = 38k
- First PM2.5 continuous FEM designated (3/2008)
Monitoring Objectives for NAAQS data

- Comparison with air quality standards (i.e., NAAQS) and supporting technical uses of the data.
  - Development and assessment of emission control strategies (Accountability) including long-term trends.
- Public awareness (Air Quality Index).
- Support for air pollution research studies.
  - Atmospheric processes
  - Health effects/exposure

Monitor-based PM2.5 concentrations in key U.S. epidemiologic studies (Figure 3-8 in 2022 PM Policy Assessment)

CO Air Quality, 1980 – 2021
(Annual 2nd Maximum 8-hour Average)
National Trend based on 33 Sites

1980 to 2021: 87% decrease in National Average
NAAQS Background and Statutory Requirements

- EPA sets National Ambient Air Quality Standards (NAAQS) for six criteria pollutants; the Clean Air Act requires EPA to review the standards every 5 years.
  - Carbon monoxide
  - Ground-level ozone
  - Particulate matter
  - Oxides of Nitrogen
  - Oxides of Sulfur
  - Lead

- **Primary (health-based) standards**: in the “judgment of the Administrator” must be “requisite” to protect public health with an “adequate margin of safety”.
  - The term requisite means “sufficient, but not more than necessary” [a zero-risk standard is neither possible nor required]
  - By requiring an “adequate margin of safety”, Congress was directing EPA to build a buffer to protect against uncertain and unknown dangers to human health

- **Secondary (welfare-based) standards**: “…specify a level of air quality the attainment and maintenance of which” in the “judgment of the Administrator” are “requisite to protect the public welfare from any known or anticipated adverse effects”.
  - Welfare effects include “effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility and climate . . .”

- In setting NAAQS, EPA is barred from considering the cost of implementing the standards or adjusting a protective standard solely on the basis of attainability in light of background concentrations of the pollutant.
Ambient Air Monitoring data are used throughout the National Ambient Air Quality Standards (NAAQS) process.

**NAAQS** are set by the EPA Administrator with four key elements:
- Indicator
- Averaging Period
- Level
- Form

**Networks and Data**
SLT’s operate their networks and data are compared to the NAAQS.

**Health and Atmospheric Studies**
Ambient air monitoring data are used in a variety of studies.

**Integrated Science Assessment (ISA)**
EPA reviews the peer reviewed literature and issues an ISA. CASAC provides independent review of this process.

**Policy Assessment**
EPA staff present conclusions regarding the policy options supported by the current scientific evidence and quantitative assessments. CASAC provides independent review of this process.
## Summary of Current U.S. Standards

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Type</th>
<th>Averaging Time</th>
<th>Level</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>primary</td>
<td>8 hours</td>
<td>9 ppm</td>
<td>Not to be exceeded more than once per year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour</td>
<td>35 ppm</td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>primary &amp; secondary</td>
<td>Rolling 3-month average</td>
<td>0.15 µg/m³</td>
<td>Not to be exceeded</td>
</tr>
<tr>
<td>Nitrogen Dioxide (NO₂)</td>
<td>primary</td>
<td>1 hour</td>
<td>100 ppb</td>
<td>98th percentile of 1-hour daily maximum concentrations, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>primary &amp; secondary</td>
<td>1 year</td>
<td>53 ppb</td>
<td>Annual mean</td>
</tr>
<tr>
<td>Ozone (O₃)</td>
<td>primary &amp; secondary</td>
<td>8 hours</td>
<td>0.070 ppm</td>
<td>Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years</td>
</tr>
<tr>
<td>Particle Pollution (PM)</td>
<td>PM₂·₅</td>
<td>primary</td>
<td>1 year</td>
<td>12.0 µg/m³ annual mean averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>secondary</td>
<td>1 year</td>
<td>15.0 µg/m³</td>
</tr>
<tr>
<td></td>
<td>primary &amp; secondary</td>
<td>24 hours</td>
<td>35 µg/m³</td>
<td>98th percentile, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>PM₁₀</td>
<td>primary &amp; secondary</td>
<td>24 hours</td>
<td>150 µg/m³ Not to be exceeded more than once per year on average over 3 years</td>
</tr>
<tr>
<td>Sulfur Dioxide (SO₂)</td>
<td>primary</td>
<td>1 hour</td>
<td>75 ppb</td>
<td>99th percentile of 1-hour daily maximum concentration, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>secondary</td>
<td>3 hours</td>
<td>0.5 ppm</td>
<td>Not to be exceeded more than once per year</td>
</tr>
</tbody>
</table>
Connecting the Criteria Pollutant PM to the measurements (FRMs and FEMs) for PM

**Criteria pollutant** in Clean Air Act
- PM (Particulate Matter)

**Indicators** in final agency rulemakings
- Coarse particles as PM$_{10}$ mass
- Fine particles as PM$_{2.5}$ mass

**Federal Reference Methods (FRMs)** in Final Agency rulemakings:
- Appendix J to Part 50. Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere
- Appendix L to Part 50. Reference Method for the Determination of Fine Particulate Matter as PM2.5 in the Atmosphere

**Federal Equivalent Methods (FEMs)** Designated in accordance with 40 CFR Part 53
- Continuous methods are performance based

Includes design (e.g., inlet and separator) and performance specifications (e.g., flow rate, temperature control)
Integrated Science Assessment

- Comprehensive evaluation and synthesis of the policy-relevant scientific information that is the foundation for the review
  - Characterization of the strengths and uncertainties of the evidence
  - Conclusions on causality for health and welfare effects
  - Characterization of evidence for at-risk populations
  - Assessment of evidence for dose/concentration-response relationships

http://www.epa.gov/isa

PM ISA includes detailed chapter on: Sources, Atmospheric Chemistry, and Ambient Concentrations. This includes subsection on Measurement and Monitoring.
Risk and Exposure Analyses

The nature and strength of evidence influences selection of appropriate quantitative risk characterization model.

Air Quality Monitoring/Modeling (Estimates of ambient air concentrations)

Exposure Modeling (Estimates of inhalation exposure concentrations)

Dosimetry Modeling (Estimates of internal biomarker concentration)

Ambient concentration-response (e.g., PM, O₃)

Exposure-response and/or health effect-based benchmarks (e.g., O₃, NO₂, SO₂)

Internal concentration-response (e.g., CO, Pb)

Risk Assessment/Characterization
Policy Assessment for the Reconsideration of the NAAQS for PM

- Presents conclusions regarding the policy options supported by the current scientific evidence and quantitative assessments
- Considers all elements of the standard: indicator, averaging time, form, level

Does the evidence call into question the adequacy of existing standard(s)?
- Scientific evidence assessed in ISA
- Quantitative exposure/risk assessments
- CASAC advice
- Public input

Yes
Consider revising existing standard(s)

No
Consider retaining existing standard(s)

Identify array of potential alternative standards appropriate for consideration, based on the evidence, quantitative assessments, CASAC advice, public input

PM PA includes sections detailing PM emissions, monitoring, and air quality

Publication No. EPA-452/R-22-004, May 2022
Available on the web at: https://www.epa.gov/naaqs/particulate-matter-pm-standards-policy-assessments-current-review-0
NAAQS Process: Regulatory Steps

• The Agency decision-making process for the proposed and final rulemaking decisions includes internal EPA deliberation of key issues and decisions, development of proposed and final decision notices and review of draft notices by other federal agencies
  • Interagency review is coordinated through the Office of Management and Budget

• Final decisions are informed by scientific evidence, any quantitative analyses conducted, staff conclusions in the PA, CASAC advice, and public comments on the proposal

Rulemaking diagram:
- EPA proposed decisions on standards
- Interagency review
- Agency decision making and draft proposal notice
- Public hearings and comments on proposal
- Agency decision making and draft final notice
- Interagency review
- EPA final decisions on standards
NAAQS Designations & Implementation

- EPA revises National Ambient Air Quality Standards, Monitoring Requirements
- EPA Designates Nonattainment Areas

Scientific Research

- Ongoing Evaluation by EPA and Air Agency: Air Quality Monitoring, Tracking Emissions and Implementation of Control Programs
- Air Agency Submits Plan to EPA and Implements Control Strategies Through Regulatory and Non-regulatory Approaches
- Air Agency Assesses Expected Improvement From Federal Measures, and Develops Additional Control Strategies to Attain Standards
Thank You!