



**Clean Air Regions Initiative**  
**Air Quality Planning Guidance Session II – AQM and best practices**  
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# Importance of Ambient Air Monitoring

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# ACKNOWLEDGEMENTS

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A grayscale landscape featuring a range of mountains in the background and a body of water in the foreground. The scene is misty or hazy, with the mountains appearing as soft, layered silhouettes. The water in the foreground shows some texture, possibly from waves or a rocky shore. The overall mood is serene and contemplative.

You can't manage what  
you don't measure.

Peter F. Drucker

# Setting the stage

- Federal Clean Air Act establishes legal framework for all actions, including ambient air monitoring
- National Ambient Air Quality Standards must be met
- Clean Air Act establishes NAAQS based solely on protection of public health and public welfare
- Legally binding commitments for all US regions
- Ambient air monitoring supports air quality management
- Federal government funds some activities
- Tribal, states, and local agencies carry out air monitoring duties
- Transportation conformity – federal transportation funding tied to air quality plans
- Ambient Air Monitoring Networks are used to assess progress towards meeting standards



# Ambient Air Monitoring for Air Quality Management

- Systemic, long-term assessment of pollution levels in the atmosphere by measuring the quantity and types of specific pollutants according to approved measurement principles and methods
- Assess extent of pollution
- Pollution level data for the public and research
- Implementation of air quality goals and standards
- Assess effectiveness of emission control strategies, including regulations
- Trend analysis

# Three Pillars of Environmental Protection in the US



Federal (US Environmental Protection Agency)



Regional and Local Air Agencies



State and Tribal Air Agencies



# US National Ambient Air Quality Standards (NAAQS) for Criteria Pollutants

Design of the standards specifies pollutant-specific measurement principle and sampling methods

Pollutant	Averaging Time	National Standards <sup>2</sup>		
		Primary <sup>3,5</sup>	Secondary <sup>3,6</sup>	Method <sup>7</sup>
Ozone (O <sub>3</sub> ) <sup>8</sup>	1 Hour	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m <sup>3</sup> )		
Respirable Particulate Matter (PM <sub>10</sub> ) <sup>9</sup>	24 Hour	150 µg/m <sup>3</sup>	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	—		
Fine Particulate Matter (PM <sub>2.5</sub> ) <sup>9</sup>	24 Hour	35 µg/m <sup>3</sup>	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12.0 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>	
Carbon Monoxide (CO)	1 Hour	35 ppm (40 mg/m <sup>3</sup> )	—	Non-Dispersive Infrared Photometry (NDIR)
	8 Hour	9 ppm (10 mg/m <sup>3</sup> )	—	
	8 Hour (Lake Tahoe)	—	—	
Nitrogen Dioxide (NO <sub>2</sub> ) <sup>10</sup>	1 Hour	100 ppb (188 µg/m <sup>3</sup> )	—	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.053 ppm (100 µg/m <sup>3</sup> )	Same as Primary Standard	
Sulfur Dioxide (SO <sub>2</sub> ) <sup>11</sup>	1 Hour	75 ppb (196 µg/m <sup>3</sup> )	—	Ultraviolet Fluorescence; Spectrophotometry (Pararosaniline Method)
	3 Hour	—	0.5 ppm (1300 µg/m <sup>3</sup> )	
	24 Hour	0.14 ppm (for certain areas) <sup>11</sup>	—	
	Annual Arithmetic Mean	0.030 ppm (for certain areas) <sup>11</sup>	—	
Lead <sup>12,13</sup>	30 Day Average	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	1.5 µg/m <sup>3</sup> (for certain areas) <sup>12</sup>	Same as Primary Standard	
	Rolling 3-Month Average	0.15 µg/m <sup>3</sup>		

# Regional air pollution

- Tremendous progress on pollution has been made
- But millions of Californians still breathing polluted air
- Air quality plans for attainment of ambient air quality standards dictate magnitude of pollution reductions needed
- All-or-nothing job. Standards must be met everywhere

Los Angeles ~70 years ago

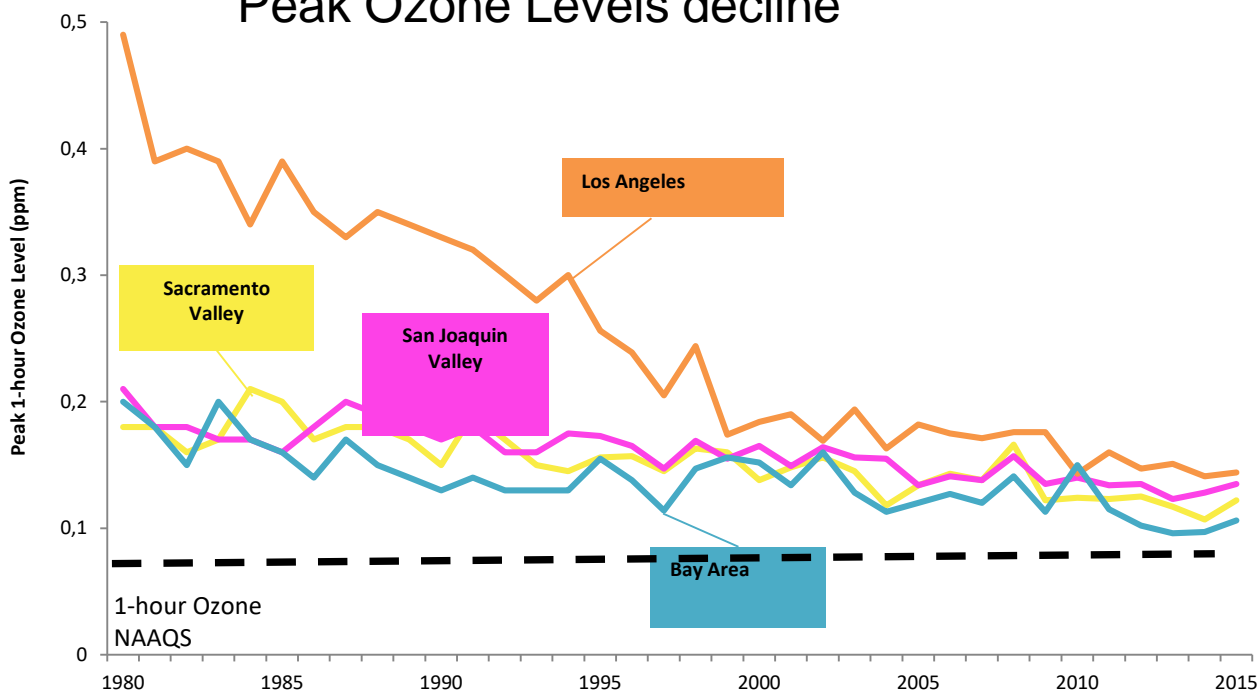


Courtesy of University of Southern California, on behalf of the USC Libraries Special Collections

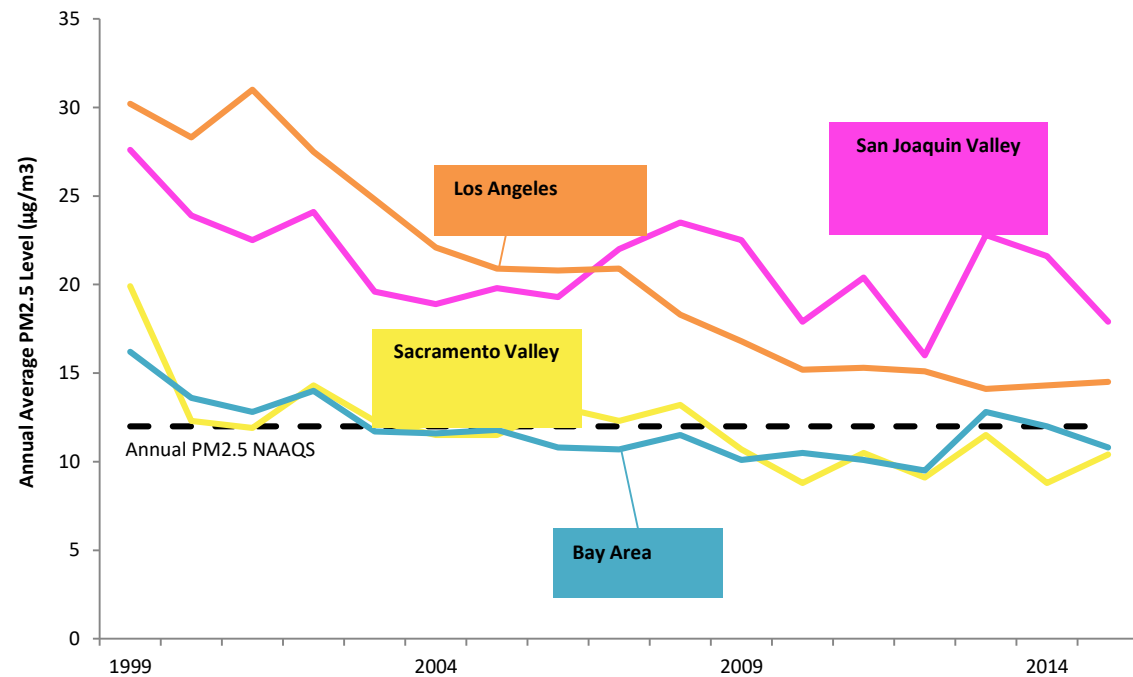


# Understanding Air Pollution Trends

## Peak Ozone Levels decline



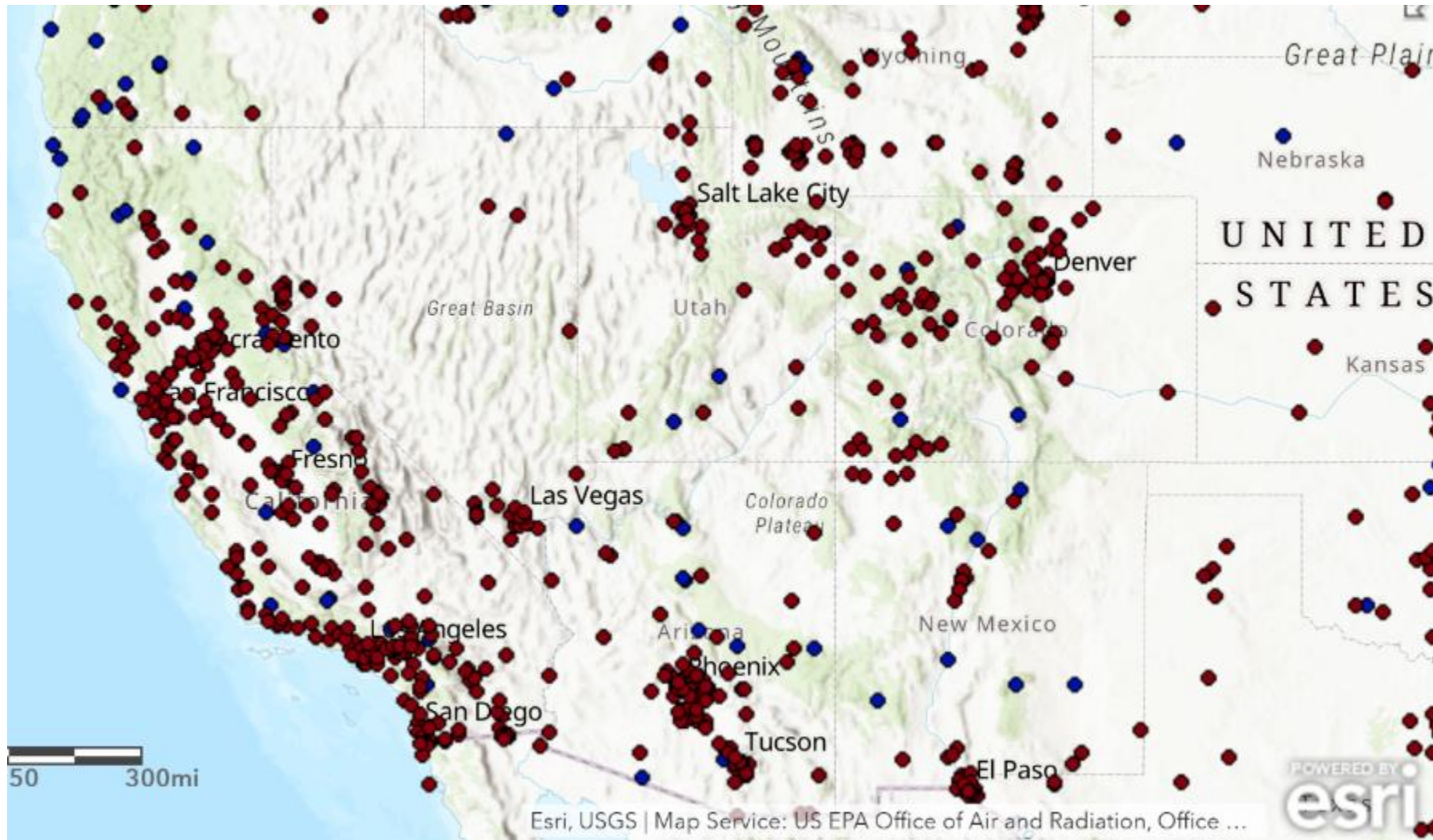
## Annual average PM2.5 levels drop



NAAQS = National Ambient Air Quality Standards

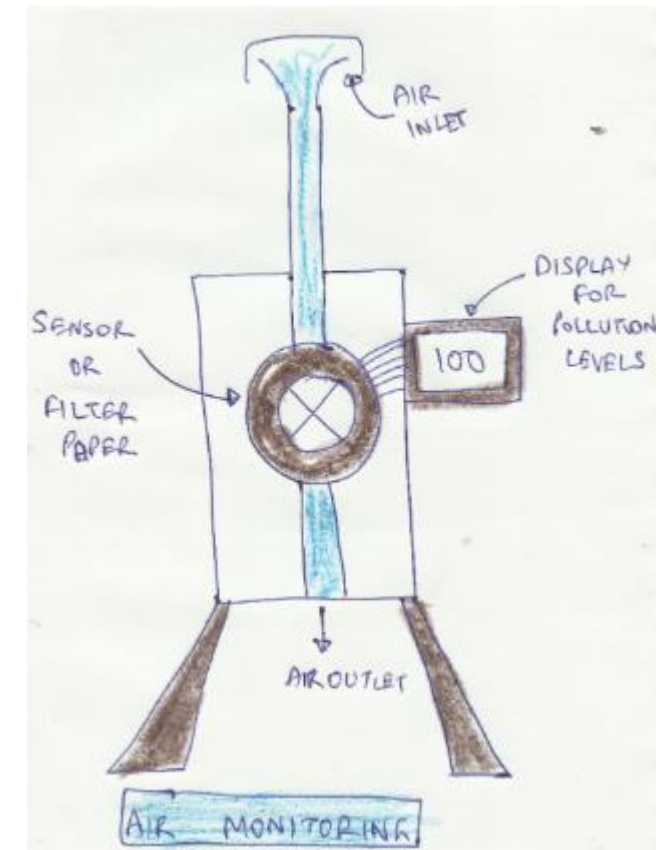
# Regulatory Monitoring Network

*~250 active monitoring stations in California*



# Various Air Monitoring Networks

- Various types of conventional ambient air monitoring networks
- Near-road monitoring network
- Photochemical Assessment Monitoring Stations (PAMS)
- National Core Multi-pollutant Monitoring Network (NCORE)
- PM Chemical Speciation Network (CSN)
- State and Local Air Monitoring Stations (SLAMS)
- Special Purpose Monitoring (SPM)
- Interagency Monitoring of Protected Visual Environments (IMPROVE)
- Clean Air Status and Trends Network (CASTNET)
- Community scale Monitoring (e.g., portable sensors like Purple Air)
- California Greenhouse Gas Monitoring Network (CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O)
- Satellite-based observations of ground-level pollution



Source: [urbanemissions.info](http://urbanemissions.info)

# Types of Monitoring

- Regulatory (criteria pollutants)
  - Ground-level ozone (O<sub>3</sub>)
  - Carbon monoxide (CO)
  - Nitrogen dioxide (NO<sub>2</sub>)
  - Particulate matter (PM<sub>10</sub>, PM<sub>2.5</sub>, PM<sub>10-2.5</sub>)
  - Sulfur dioxide (SO<sub>2</sub>)
  - Lead (Pb)
- Toxic air contaminants and “hot spots”
- Greenhouse gas emissions
- Community-scale

# Siting criteria for monitoring stations

- Spatial scale: micro, neighborhood, urban, regional
- Source oriented
- Highest concentration/maximums
- Upwind/Background
- General/Background
- Population exposure

# Minimum Monitoring Requirements

Pollutant	Minimum Monitor Criteria
Ozone, PM <sub>10</sub> and PM <sub>2.5</sub>	MSA Population, Design Value Concentration
NO <sub>2</sub>	MSA Population
Near Road NO <sub>2</sub>	MSA Population, Annual Average Daily Traffic
SO <sub>2</sub>	MSA Population, SO <sub>2</sub> Emissions (tons/year)
Pb	Pb Emissions (NEI)

Note: Metropolitan statistical areas (MSA) are delineated by the US government as having at least one urbanized area with a minimum population of 50,000

# Operational Parameters and Quality Assurance Checks

- Ambient Air Quality Standards establish measurement principles and methods
  - Federal Reference Method (FRM)
  - Federal Equivalent Method (FEM)
  - Annual Monitoring Network Plan
  - Monitoring Network Assessment every 5 years
  - Dedicated technical staff
  - Supervisory levels of data review
  - Quality assurance audit
  - Primary Quality Assurance Organization
- Temporal Scales for Pollution Sampling
    - Episodic
    - 1 in 6 days (eg., PM10)
    - 1 in 3 days (eg., PM2.5)
    - Daily
    - Hourly
    - Real-time



# Readily Accessible State and Federal Air Monitoring Data Repositories



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## Air Quality Data (PST) Query Tool

*This page last reviewed November 20, 2014*

**Daily Data** | **Hourly Data** | **Special Reports**

**Step 1: Select a Parameter**  
Ozone  ppm

**Step 2: Select an End Date and Time**  
Date: 2021  November  22  Time: Morning

**Step 3: Select One**  
--COUNTY--  --AIR BASIN--  --PART OF STATE--

**Step 4: Select a Type of Report**  
Hourly Data

**Step 5: Select the Sort Order**  
Basin/County/Site

[Identify Data Changes Since Last Air Quality DVD or Data Download](#)



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## Air Data: Air Quality Data Collected at Outdoor Monitors Across the US



### Download Data

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# GHG Monitoring Network

CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O

Black Carbon  
(fraction of PM)  
from other networks

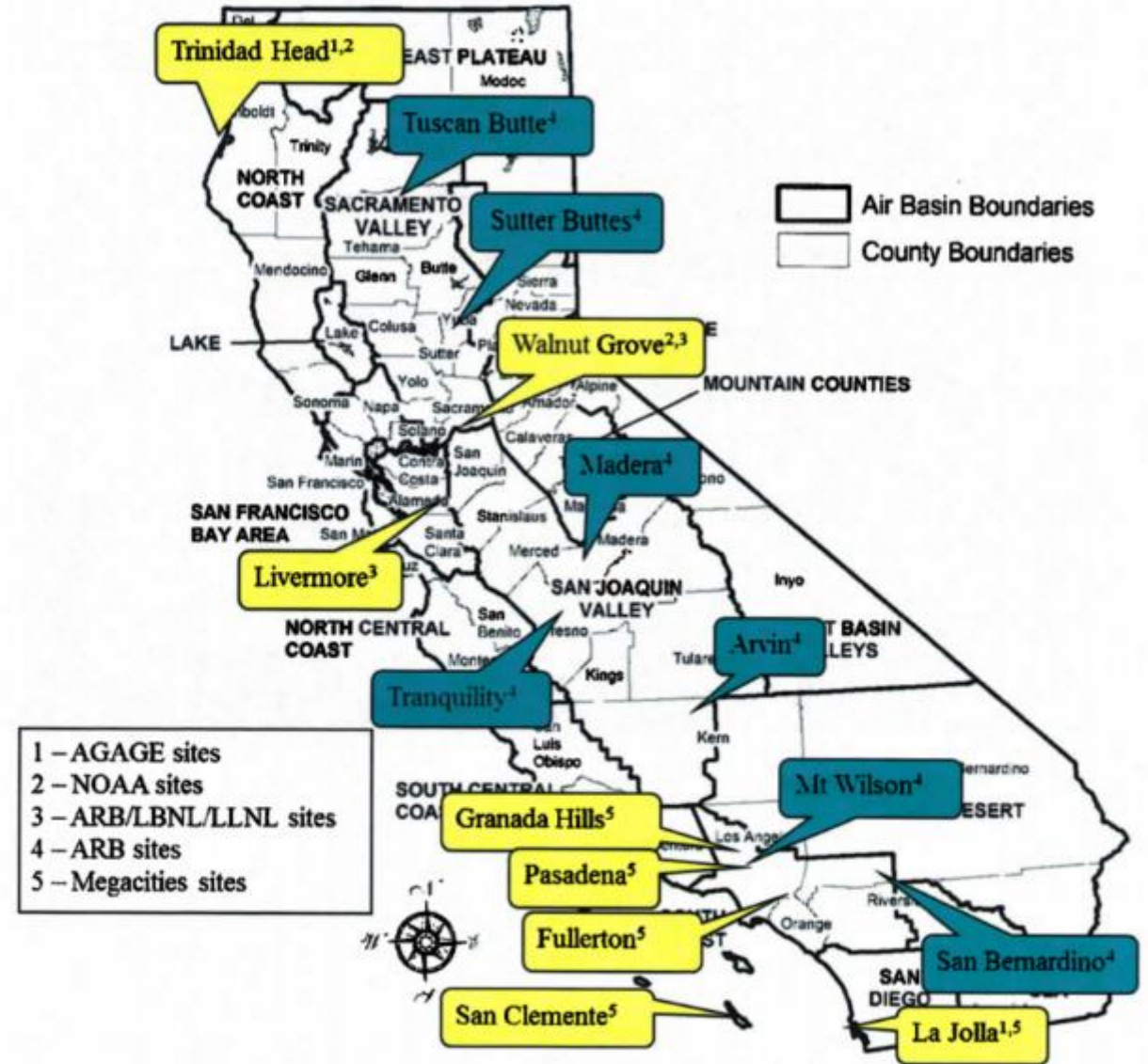
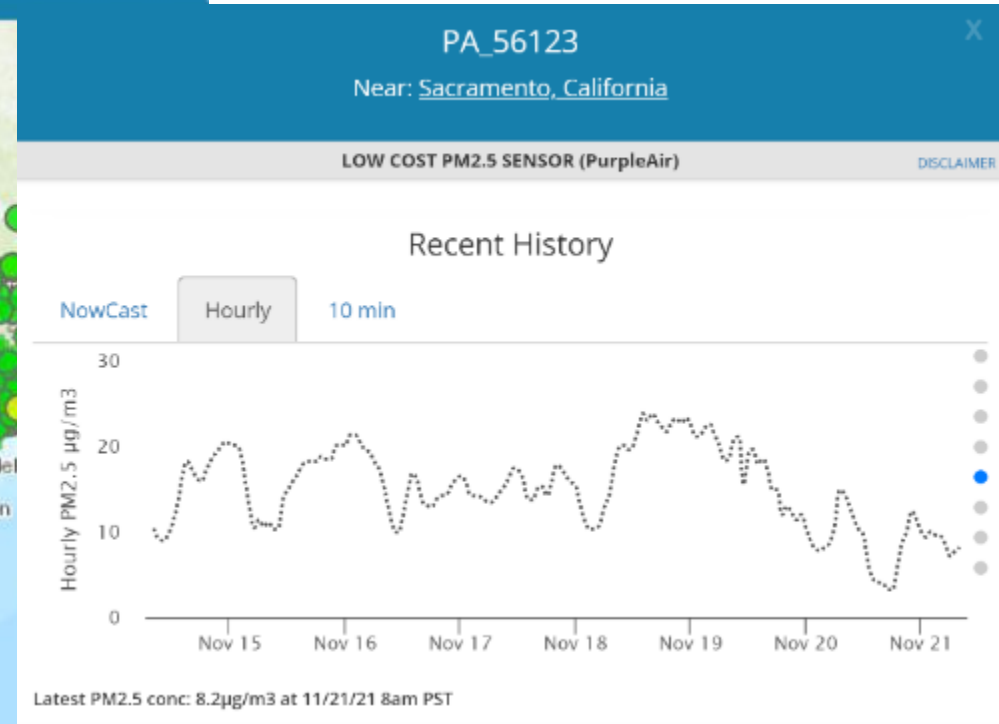
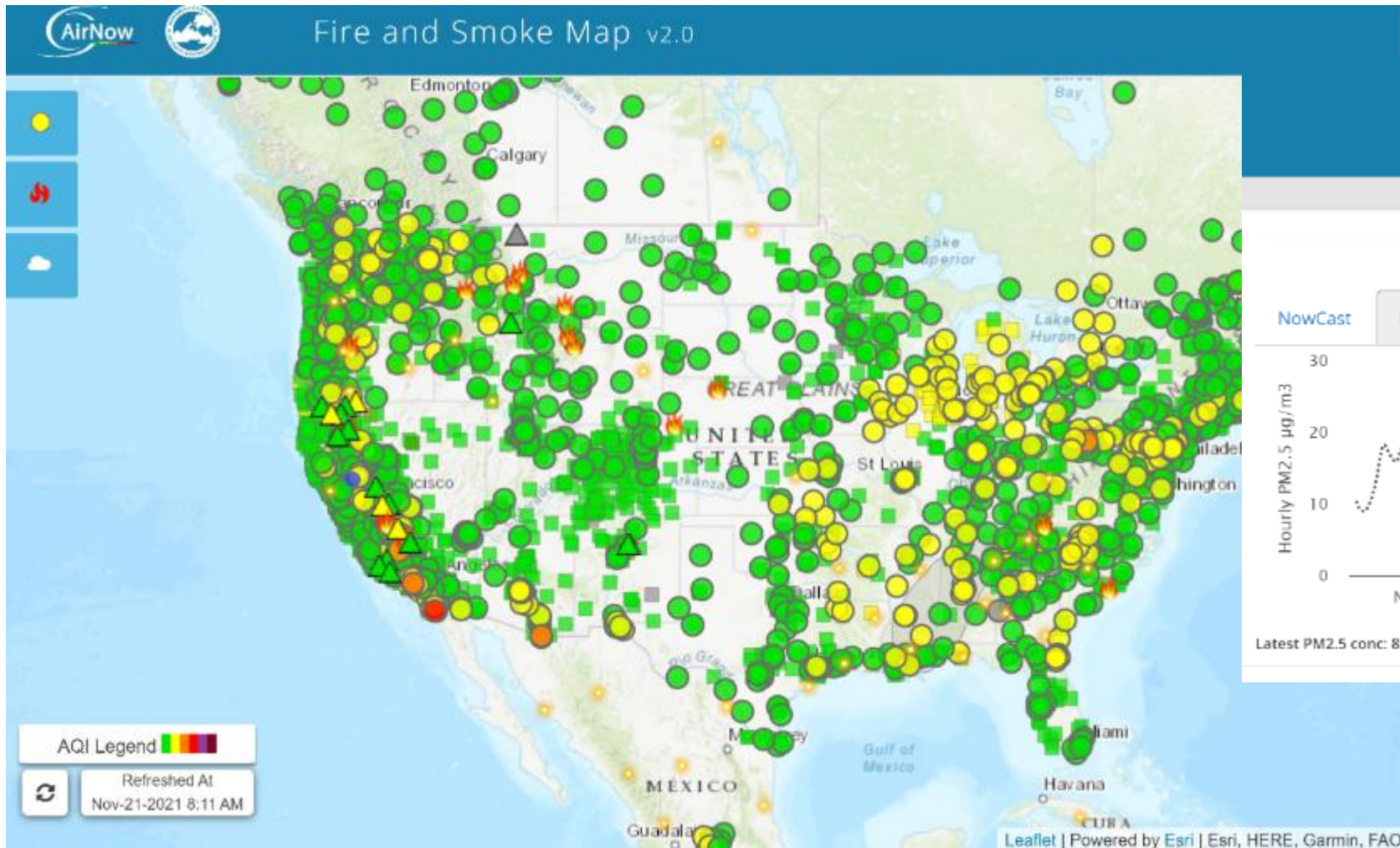


Figure 1. Map of GHG Monitoring Network  
Cyan labels indicate CARB sites, while yellow labels indicate sites operated by other organizations (universities, national laboratories, federal agencies, and consortia of organizations).

# Community-level PM Monitoring Empowers Citizen Science





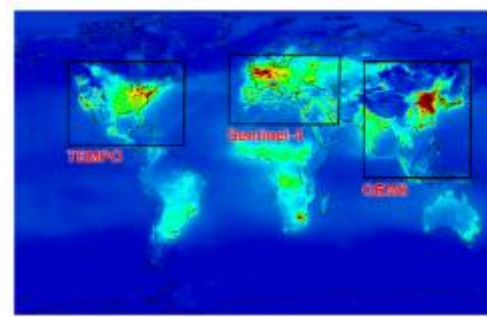
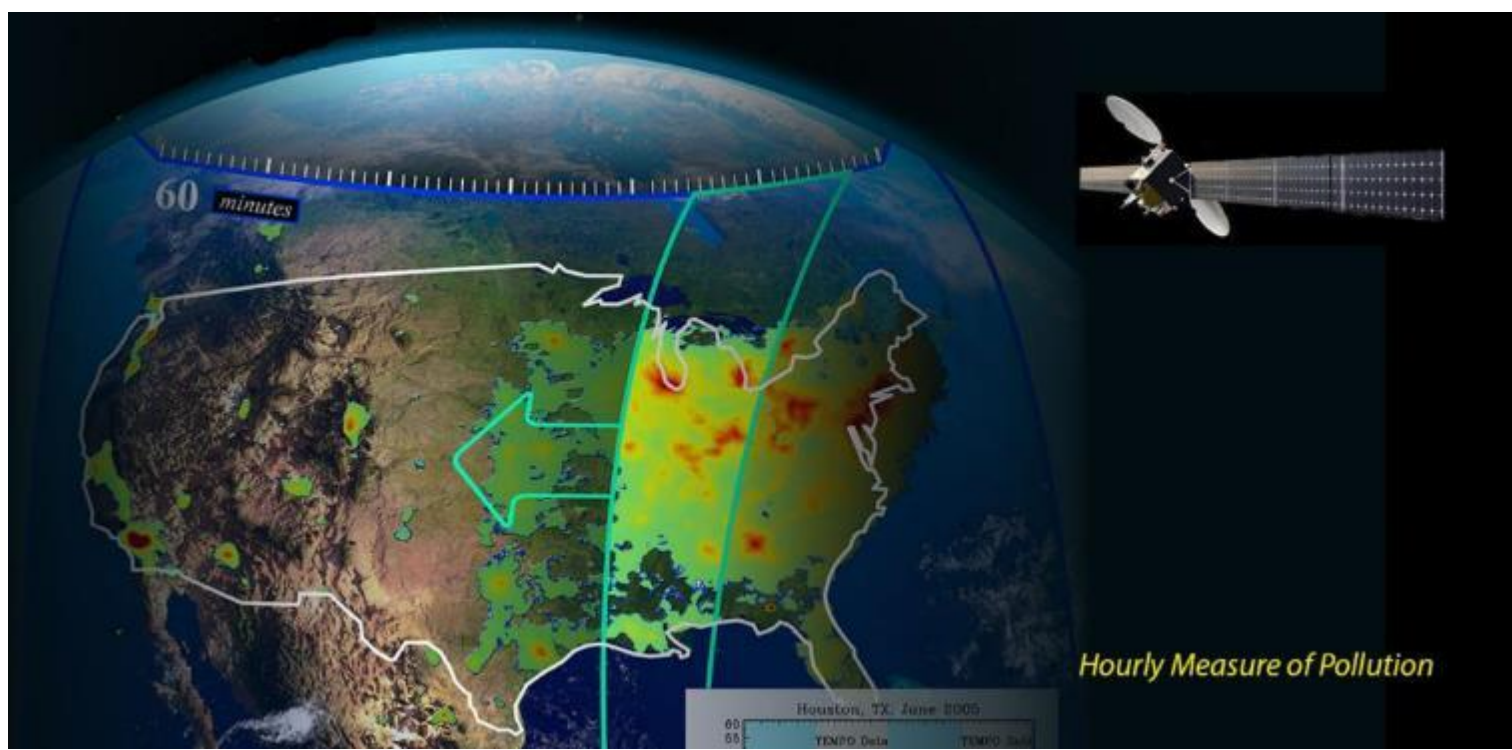


# Tropospheric Emissions: Monitoring of Pollution

*Hourly Measurement of Pollution*



Smithsonian Astrophysical  
Observatory



TEMPO will be the North American component of a global group of satellites tracking air pollution from geosynchronous orbit

Thank you



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