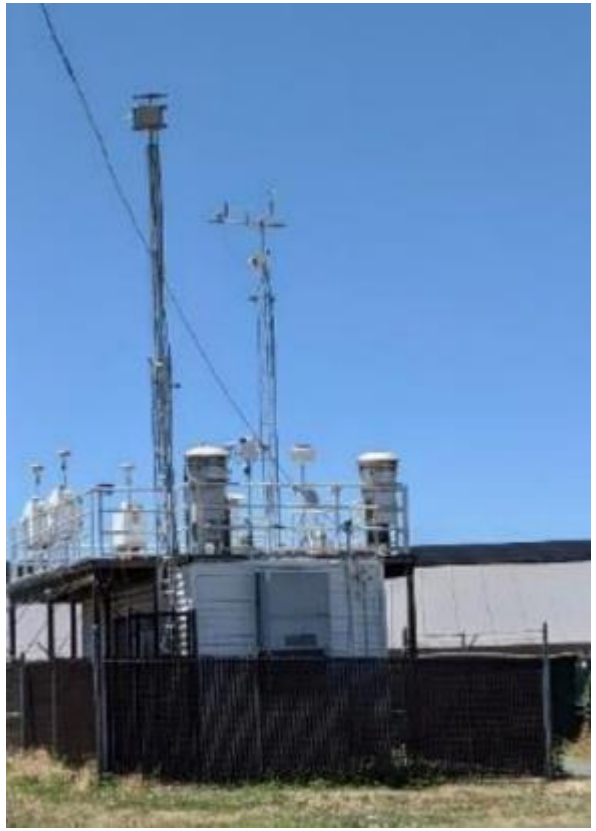
Clean Air Regions Initiative

Air Quality Planning Guidance Session II – AQM and best practices

November 23, 2021



Importance of Ambient Air Monitoring

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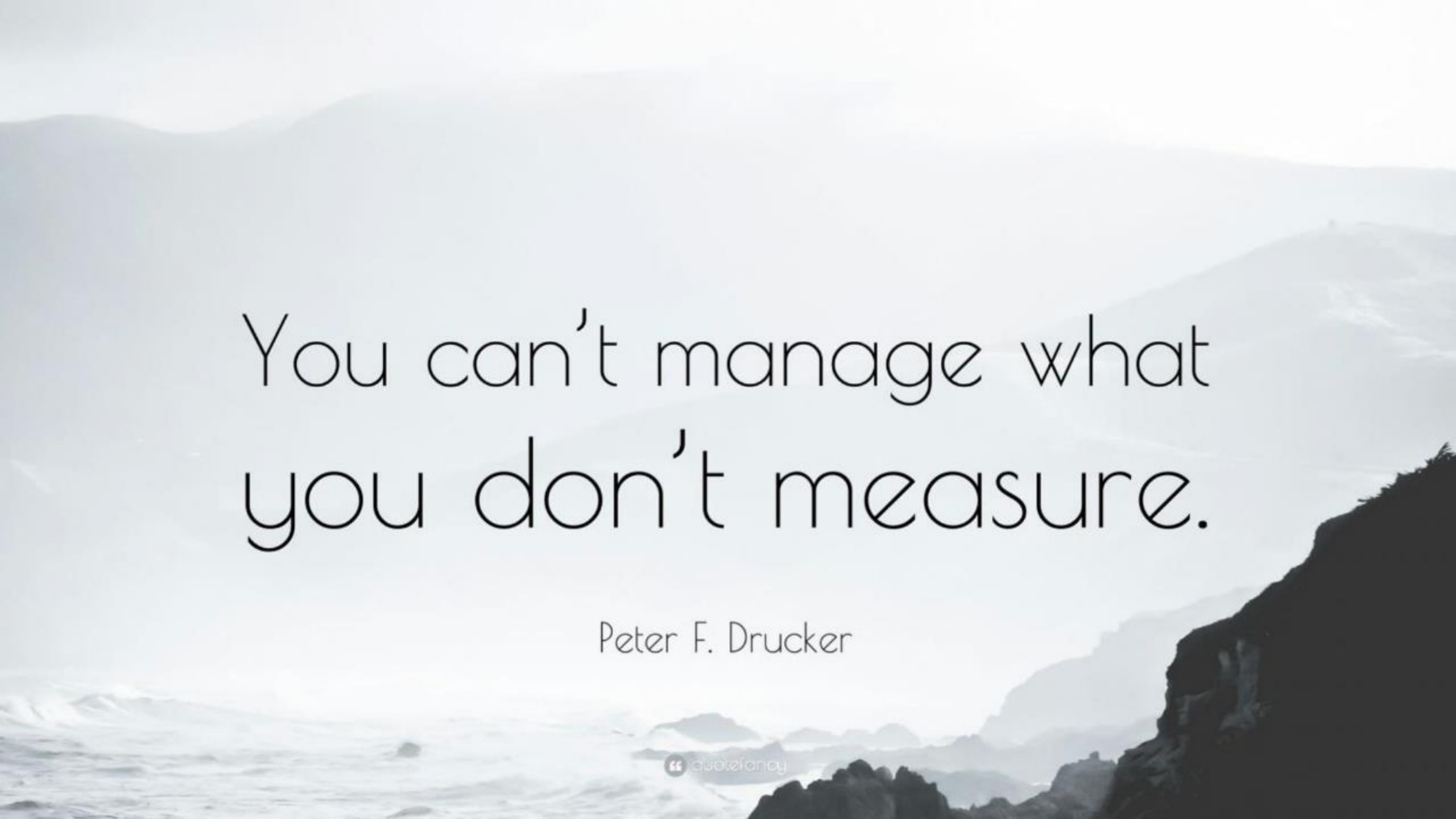
ACKNOWLEDGEMENTS

US State Department Air Quality Fellows Program

WESTERN BALKANS
GREEN CENTER

Energy Community


You can't manage what
you don't measure.
Peter F. Drucker
quotefancy

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 [2]		
		Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)[8]	1 Hour	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		
Respirable Particulate Matter (PM10)[9]	24 Hour	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	—		
Fine Particulate Matter (PM2.5)[9]	24 Hour	35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12.0 µg/m^3	15 µg/m^3	
Carbon Monoxide (CO)	1 Hour	35 ppm (40 mg/m^3)	—	Non-Dispersive Infrared Photometry (NDIR)
	8 Hour	9 ppm (10 mg/m^3)	—	
	8 Hour (Lake Tahoe)	—	—	
Nitrogen Dioxide (NO_2)[10]	1 Hour	100 ppb (188 µg/m^3)	—	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	Same as Primary Standard	
Sulfur Dioxide (SO_2)[11]	1 Hour	75 ppb (196 µg/m^3)	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)
	3 Hour	—	0.5 ppm (1300 µg/m^3)	
	24 Hour	0.14 ppm (for certain areas)[11]	—	
	Annual Arithmetic Mean	0.030 ppm (for certain areas)[11]	—	
Lead[12,13]	30 Day Average	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	1.5 µg/m^3 (for certain areas)[12]	Same as Primary Standard	
	Rolling 3-Month Average	0.15 µg/m^3		

Regional air pollution

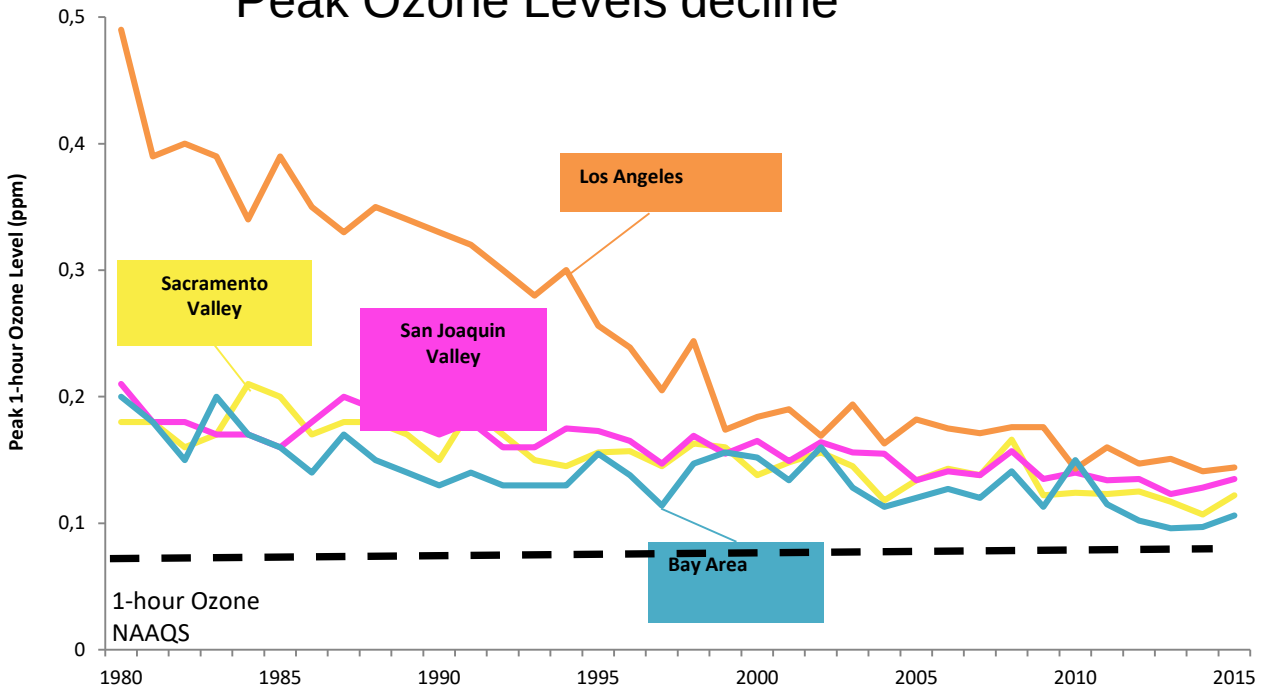
- Tremendous progress on pollution has been made
- But millions of Californians still breathing polluted air
- Air quality plans for attainment of ambient air quality standards dictate magnitude of pollution reductions needed
- All-or-nothing job. Standards must be met everywhere

Los Angeles ~70 years ago

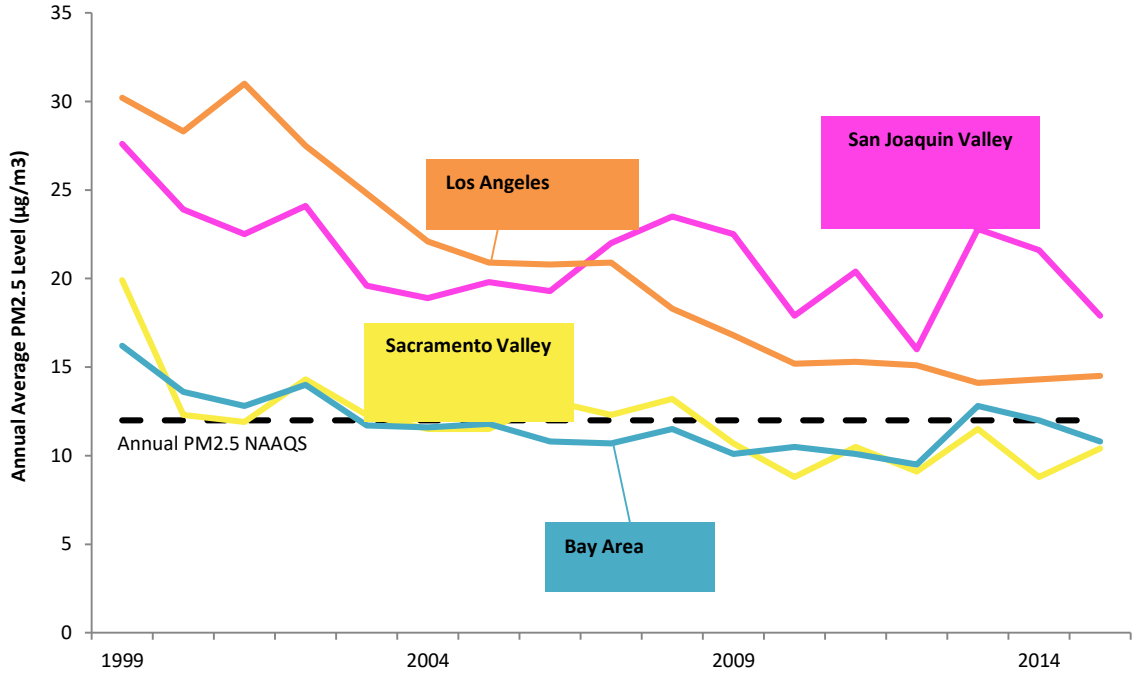
Courtesy of University of Southern California, on behalf of the USC Libraries Special Collections

Understanding Air Pollution Trends

Peak Ozone Levels decline



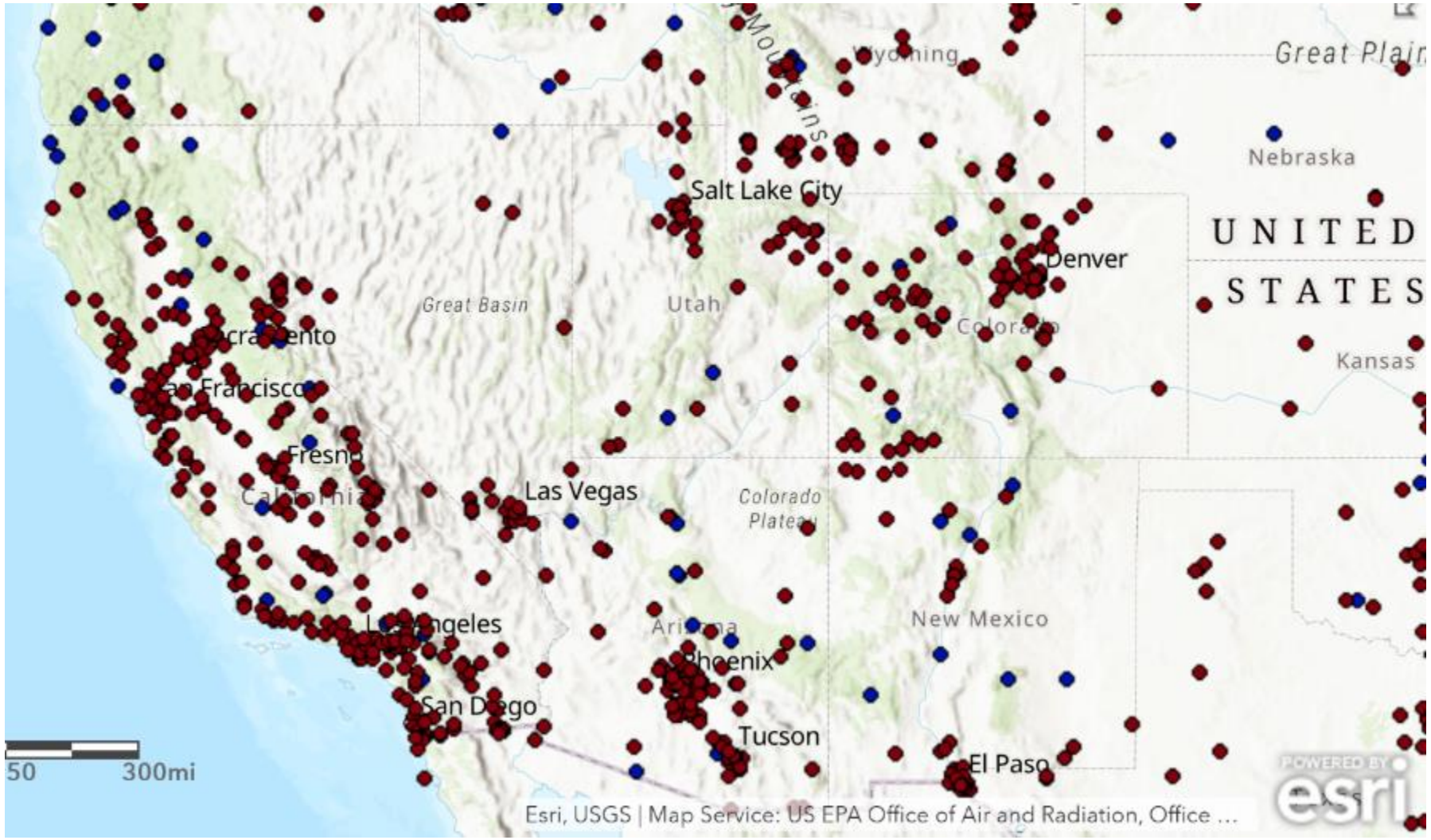
Annual average PM2.5 levels drop



NAAQS = National Ambient Air Quality Standards

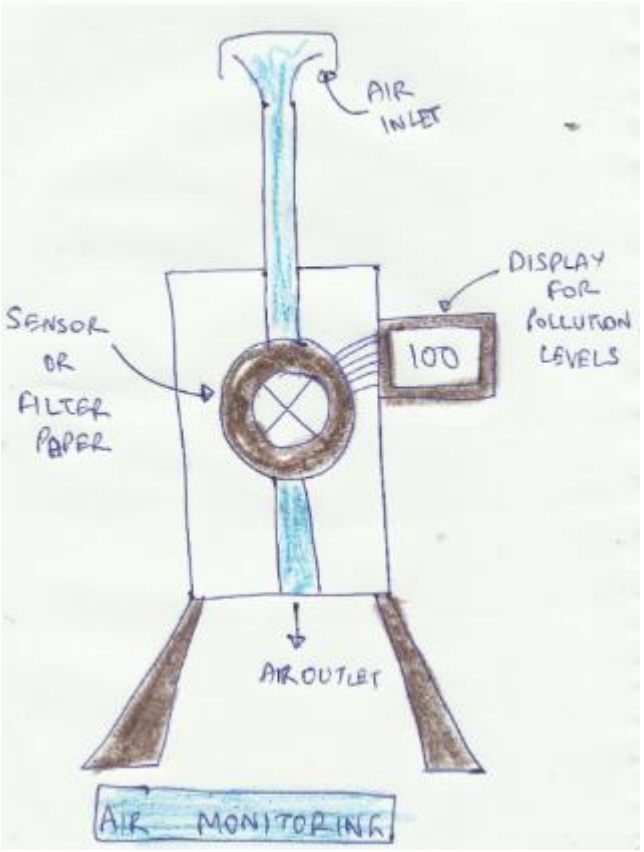
Regulatory Monitoring Network

~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_2, CH_4, and N_2O)
- Satellite-based observations of ground-level pollution



Source: urbanemissions.info

Types of Monitoring

- Regulatory (criteria pollutants)
  - Ground-level ozone (O3)
  - Carbon monoxide (CO)
  - Nitrogen dioxide (NO2)
  - Particulate matter (PM10, PM2.5, PM10-2.5)
  - Sulfur dioxide (SO2)
  - Lead (Pb)
- Toxic air contaminants and “hot spots”
- Greenhouse gas emissions
- Community-scale

Sitting 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_{10} and $PM_{2.5}$	MSA Population, Design Value Concentration
NO_2	MSA Population
Near Road NO_2	MSA Population, Annual Average Daily Traffic
SO_2	MSA Population, SO_2 Emissions (tons/year)
Pb	Pb Emissions (NEI)

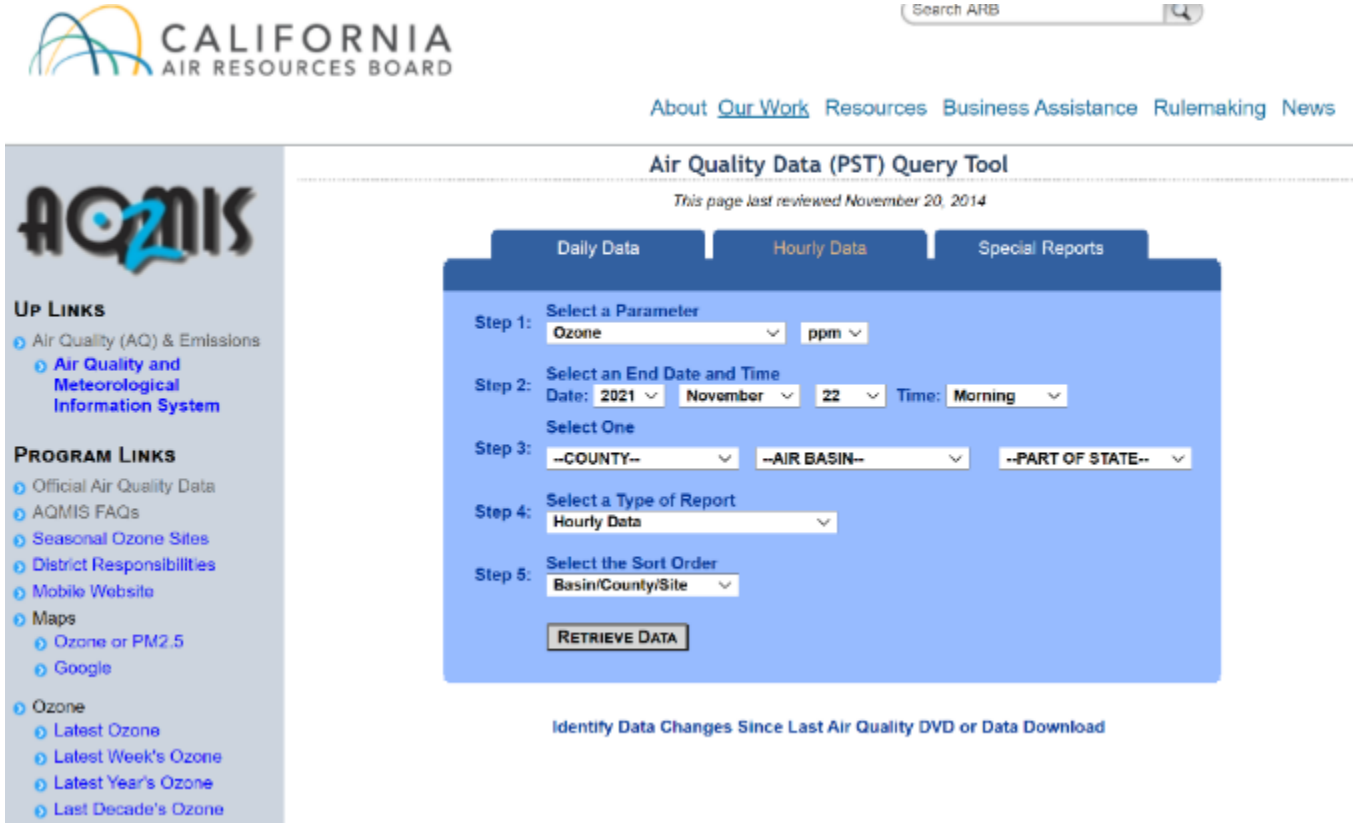
Note: Metropolitan statistical areas (MSA) are delineated by the US government as having at least one urbanized area with a minimum population of 50,000

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



GHG Monitoring Network

CO_2, CH_4, and N_2O

Black Carbon
(fraction of PM)
from other networks

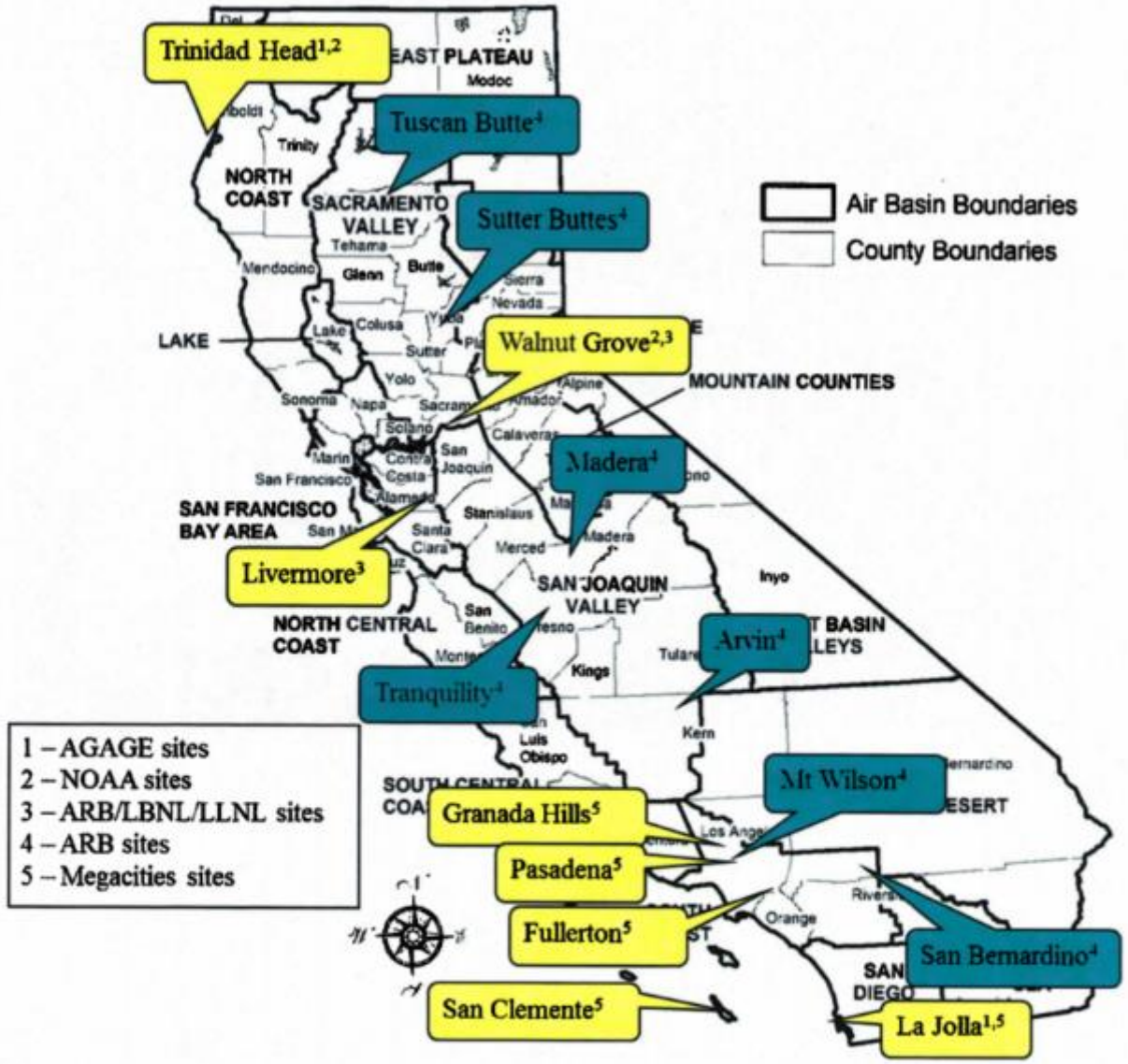
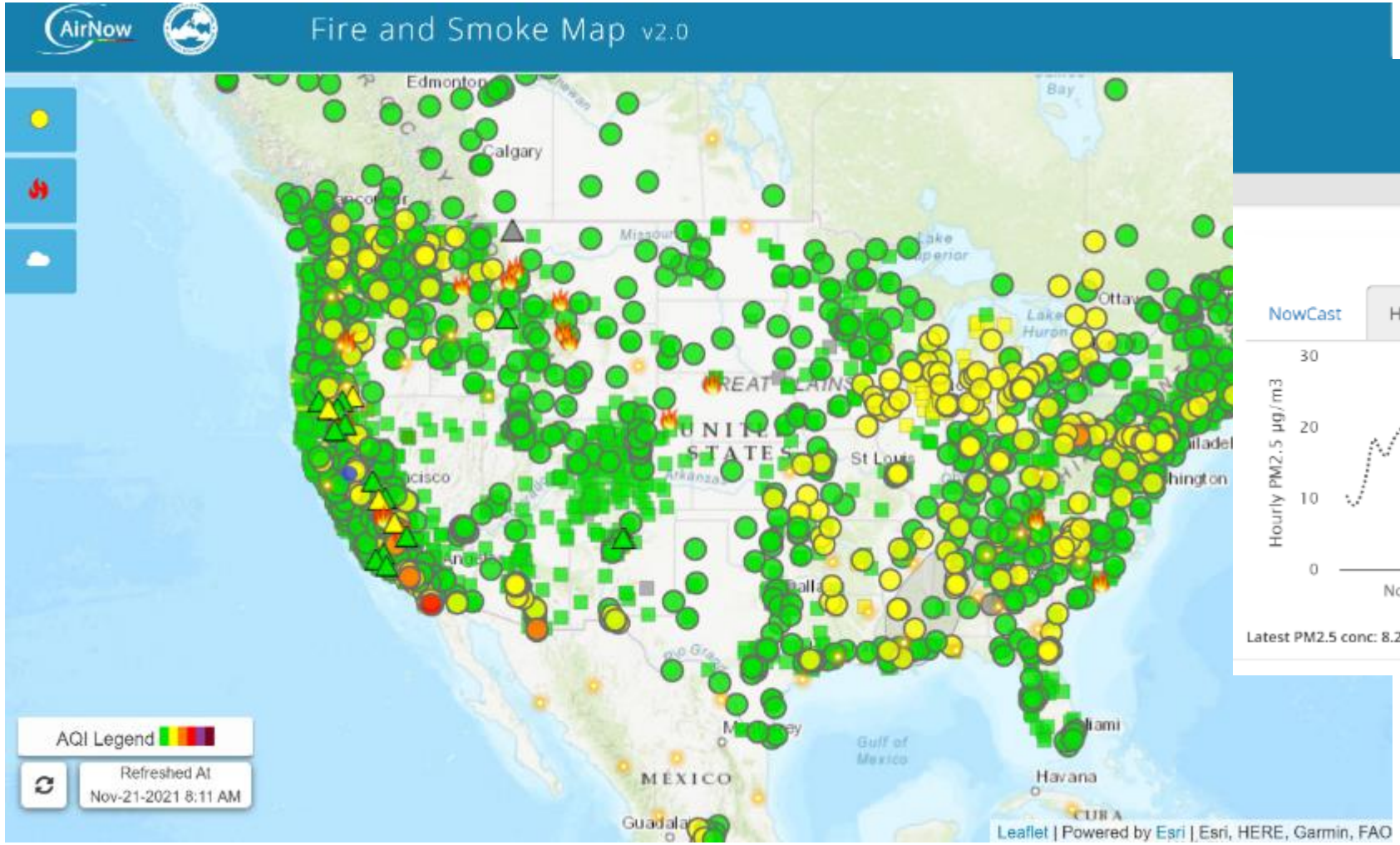
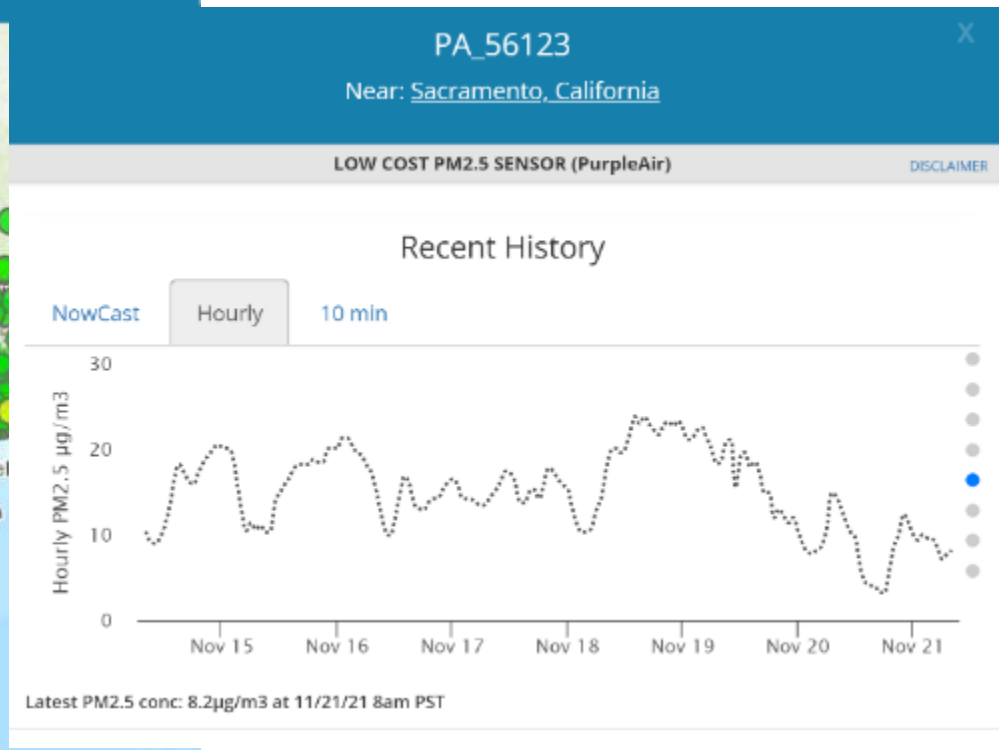


Figure 1. Map of GHG Monitoring Network
Cyan labels indicate CARB sites, while yellow labels indicate sites operated by other organizations (universities, national laboratories, federal agencies, and consortia of organizations).

Community-level PM Monitoring Empowers Citizen Science





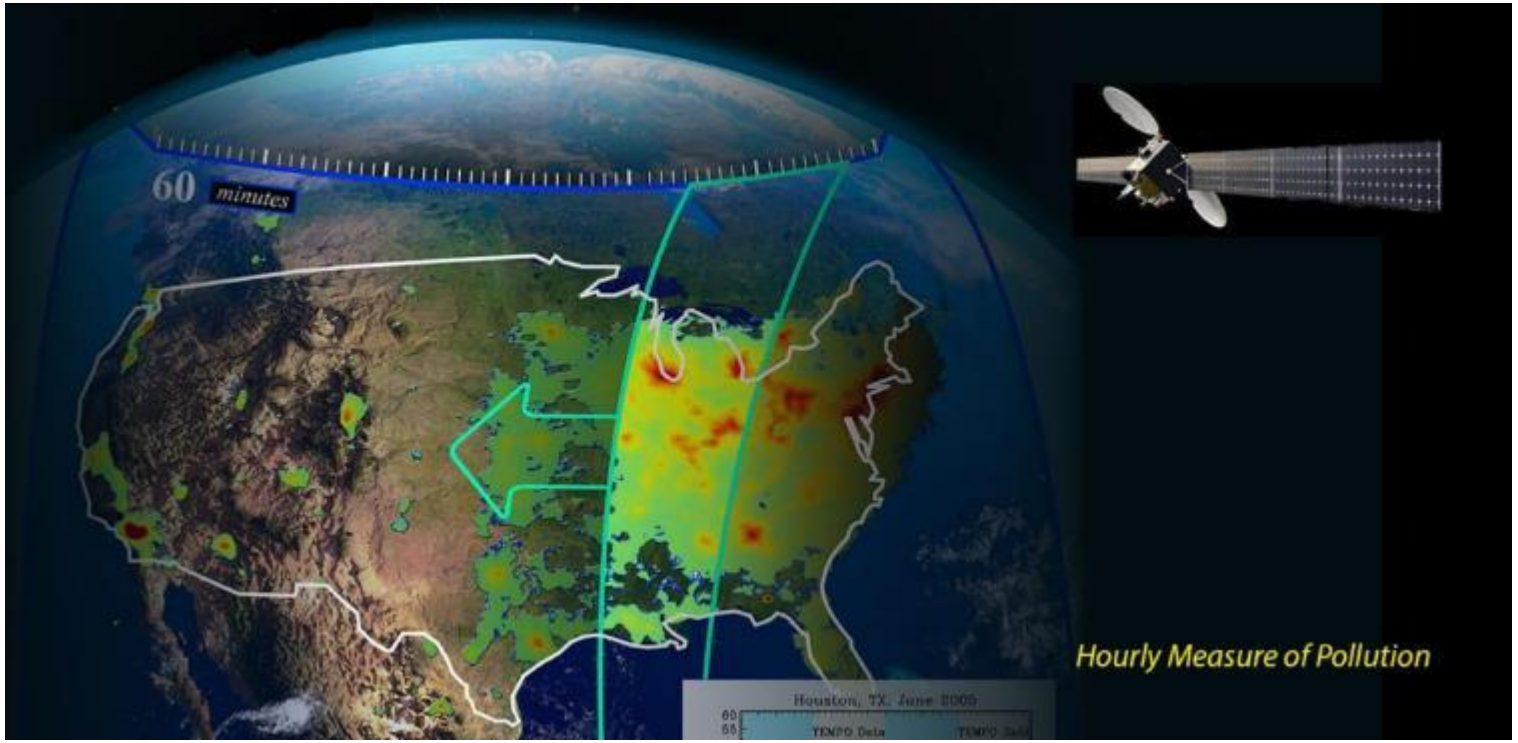
Tropospheric Emissions: Monitoring of Pollution

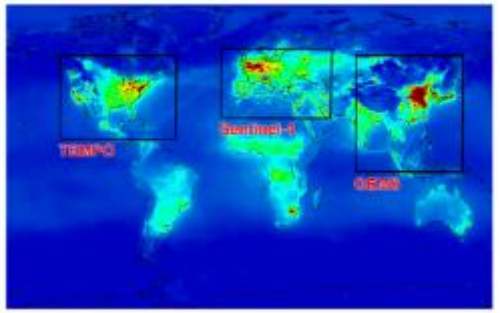
Hourly Measurement of Pollution

TEMPO

NASA

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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