Current and emerging air quality management challenges: Observations and Accountability

EPA/CDC Symposium on Air Pollution Exposure and Public Health

September 19-20, 2006

RTP, NC

Rich Scheffe, U.S. EPA, Office of Air Quality Planning and Standards

Acknowledge

- Tesh Rao
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- Norm Possiel
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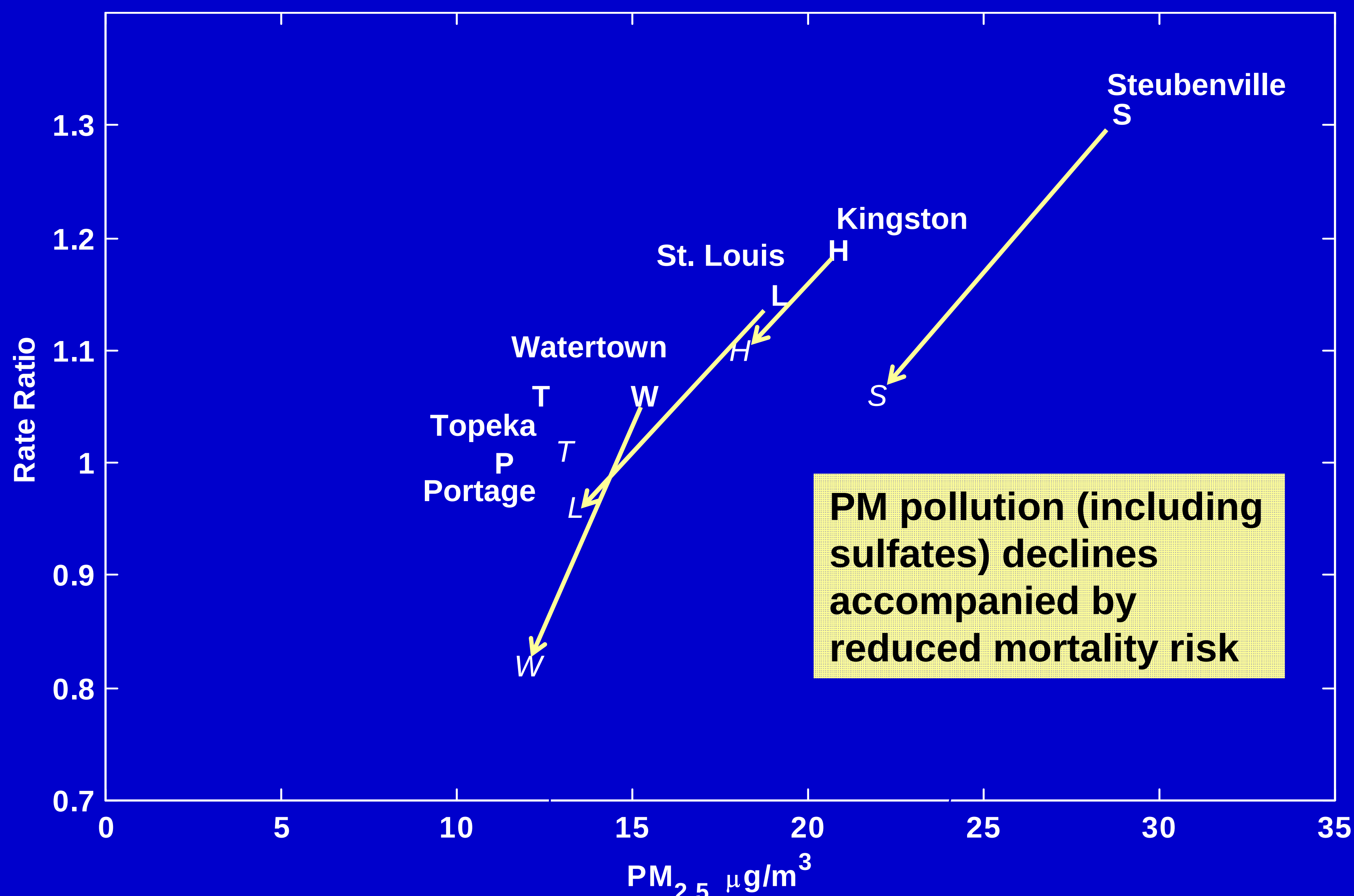
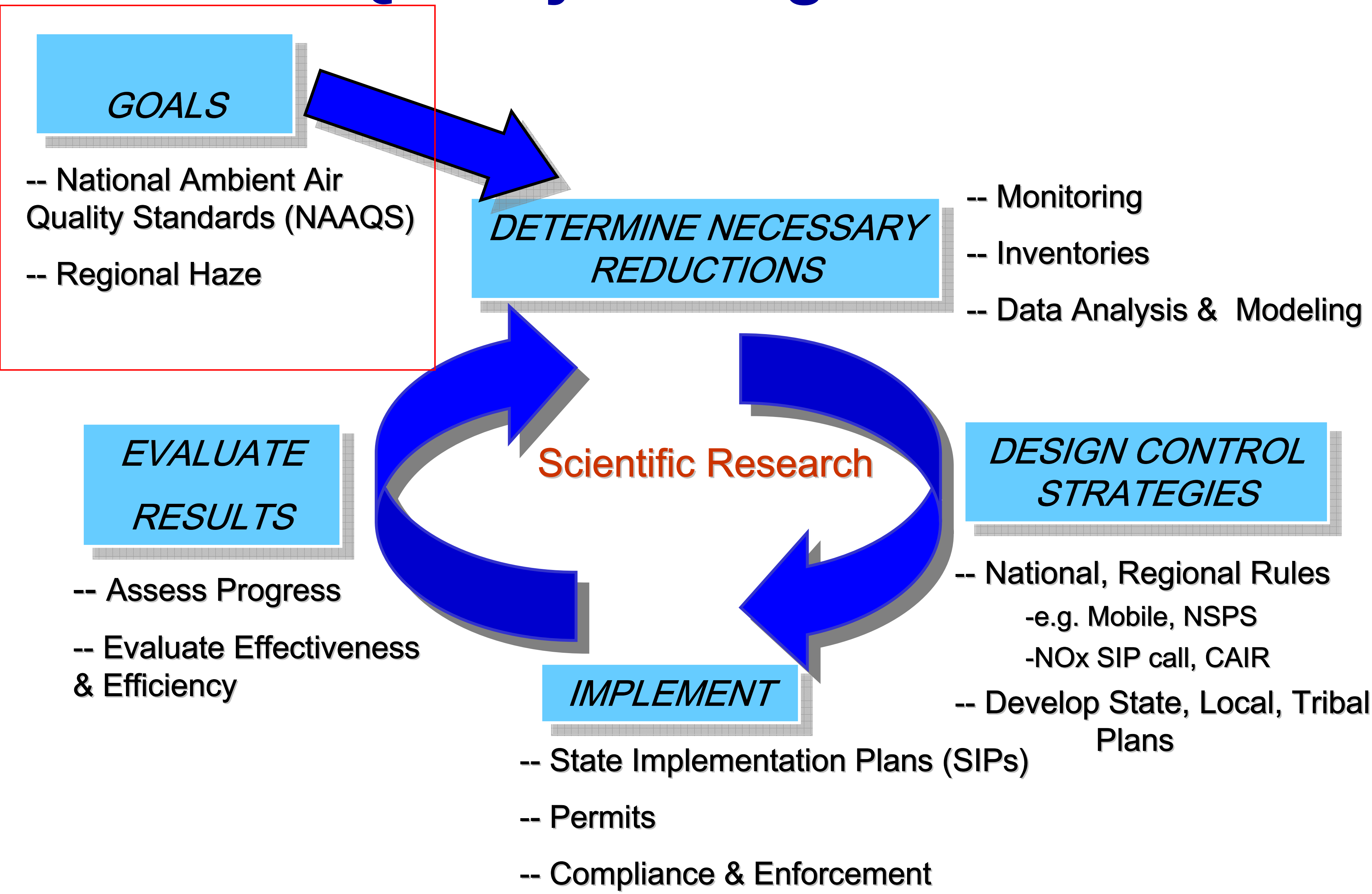
- John Bachmann
- Mary Ross
- Mark Schmidt

Fine Particle Reductions Work



Layden et al (2006). Effect of Reduction in Fine Particulate Air Pollution and on Mortality: A extended follow-up in of the Harvard Six Cities Adult Cohort

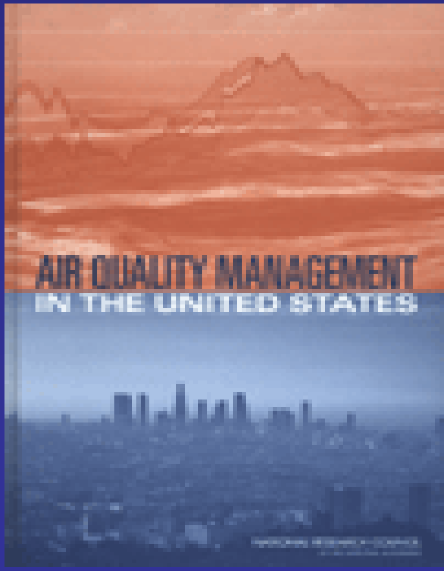
The Air Quality Management Process

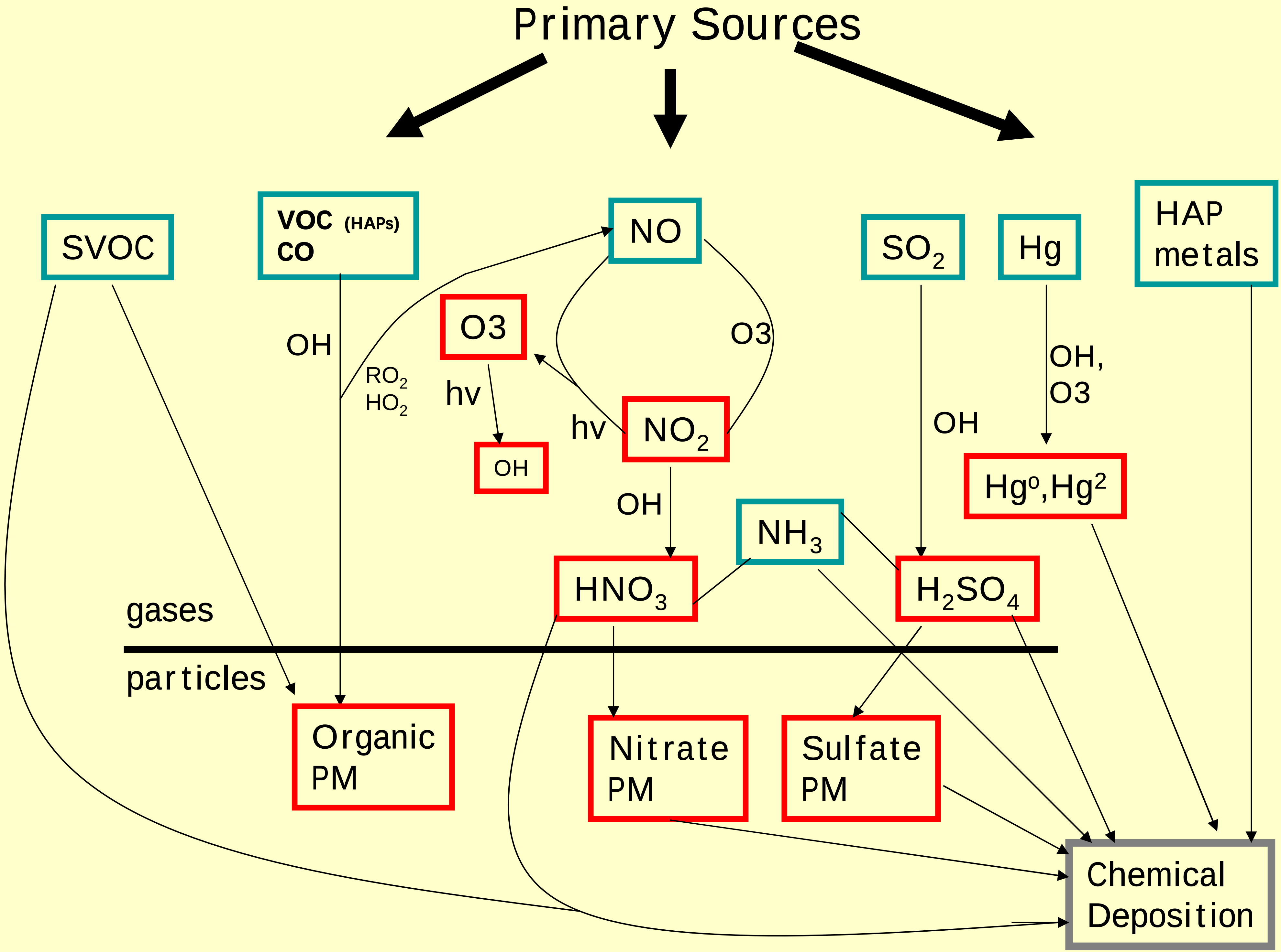


Air program drivers

- Pollutant category
  - Criteria: $PM_{2.5}$, ozone
  - Mercury
  - HAPs
- Pollutant sectors
  - Energy
  - Transportation (onroad, nonraod, marine)
  - Natural (biogenics, fires)
  - Industrial (chemical facilities, coatings, etc.)
  - Commercial/residential
- New Themes
  - Multiple pollutant
  - Accountability
  - Multiple media

2004 NAS Report: AQM in U.S.

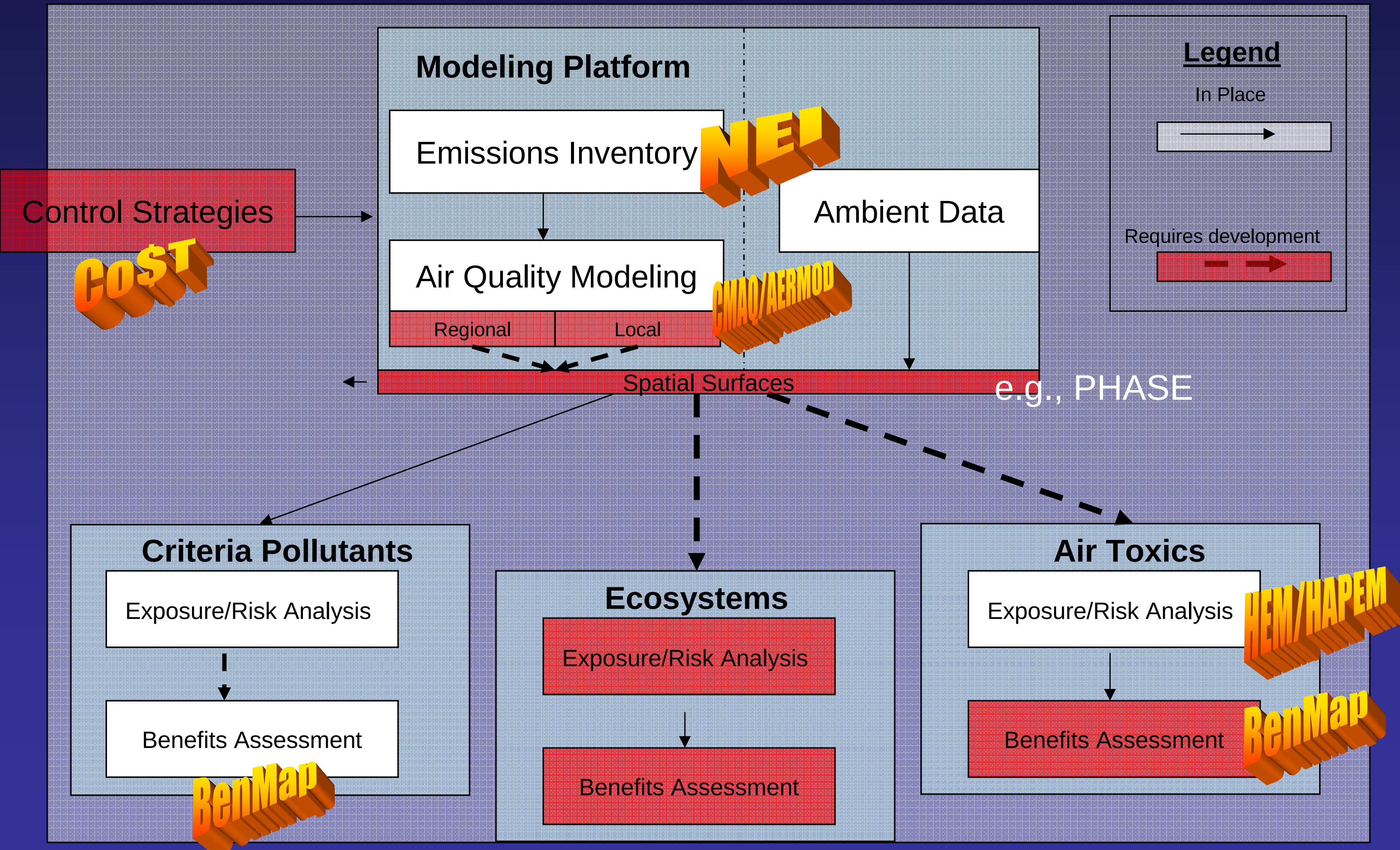




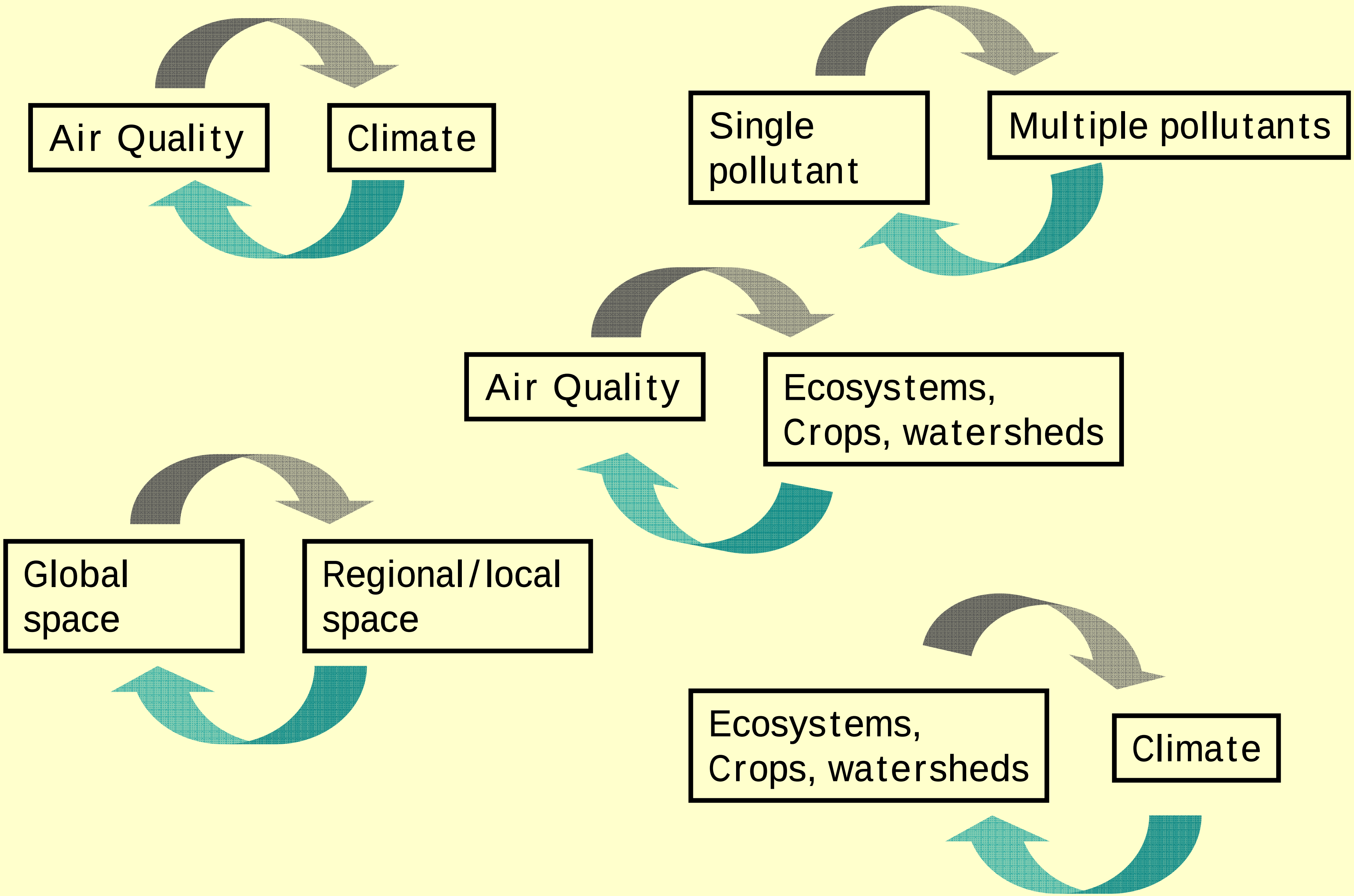
Primary Sources
SVOC
VOC (HAPs)
CO
NO
SO2
Hg
HAP
metals
OH
RO2
HO2
O3
hv
OH
hv
NO2
O3
OH
OH,
O3
Hgo,Hg2
OH
NH3
HNO3
H2SO4
gases
particles
Organic
PM
Nitrate
PM
Sulfate
PM
Chemical
Deposition

Multi-Pollutant Analytical Framework

Future = National Air Pollutant Assessment



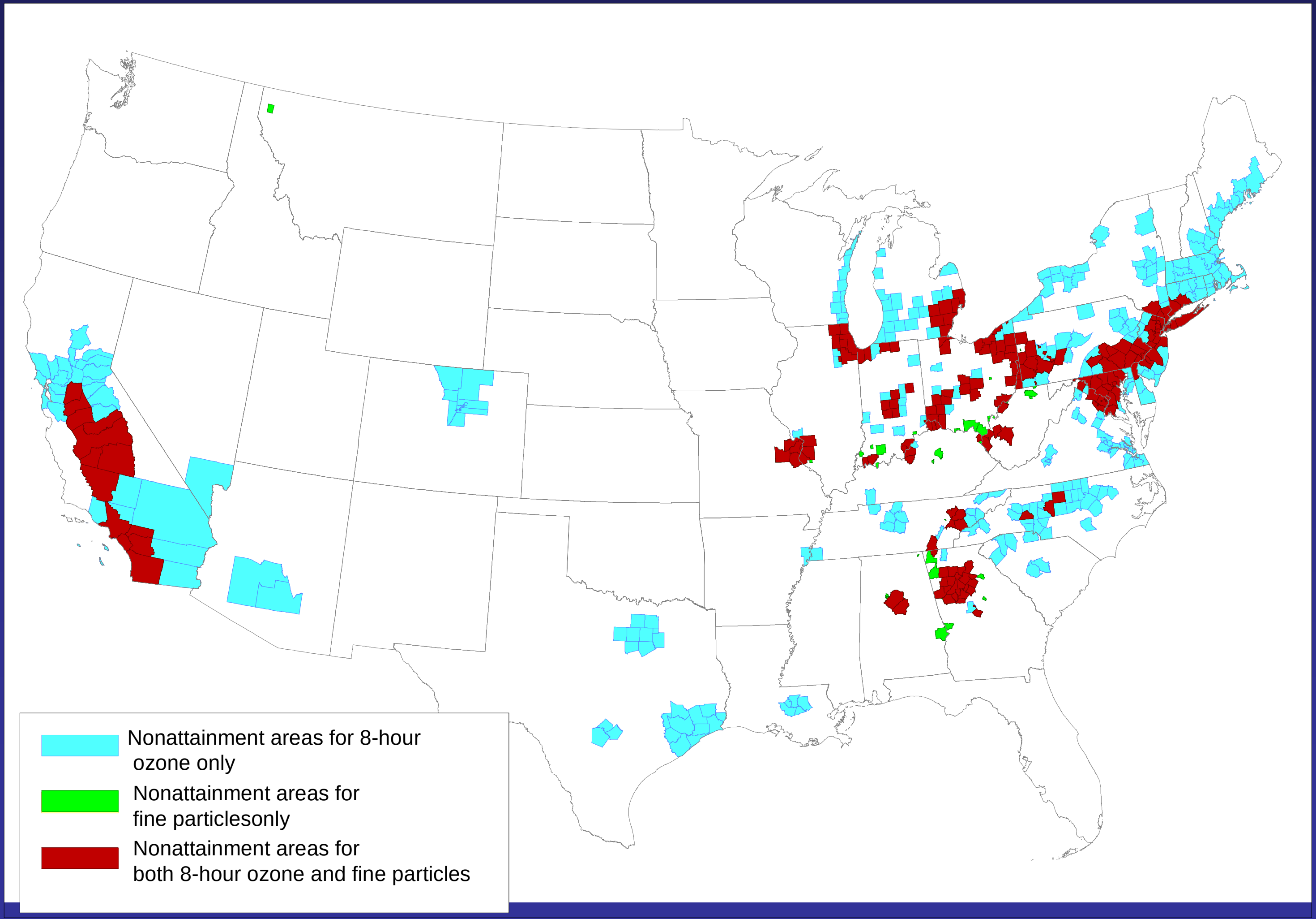
So many feedbacks with increasing impact over time



Setting Priorities in a Changing Policy Landscape - Air Quality Policy Context:

Which NAAQS are most important?

Areas Designated Nonattainment for Ozone and $PM_{2.5}$ 2004

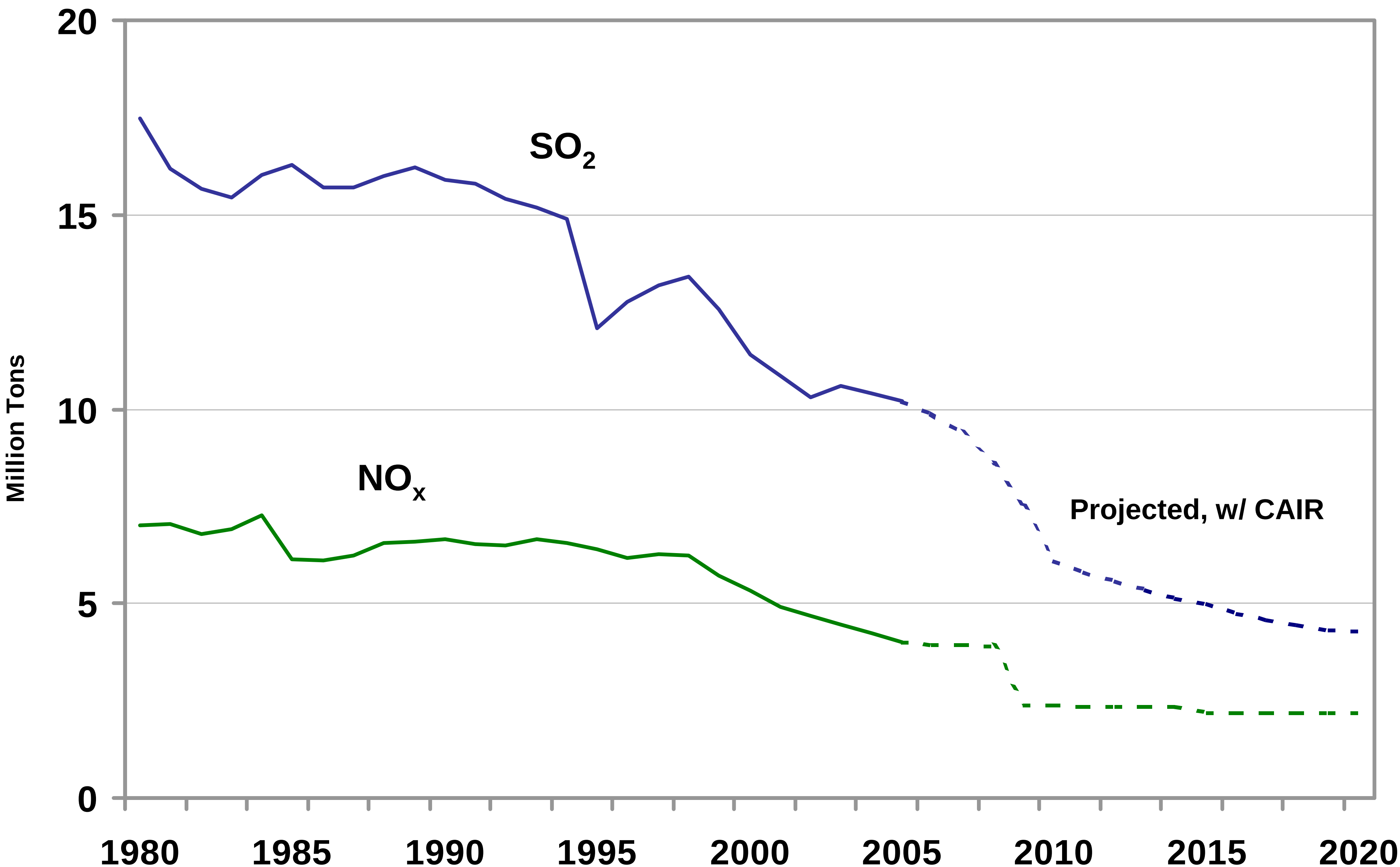


No. Counties with Monitors>NAAQS

CO	0
Lead	1
SO2	0
NO2	0
PM 10	46
PM 2.5	82
O_3	297

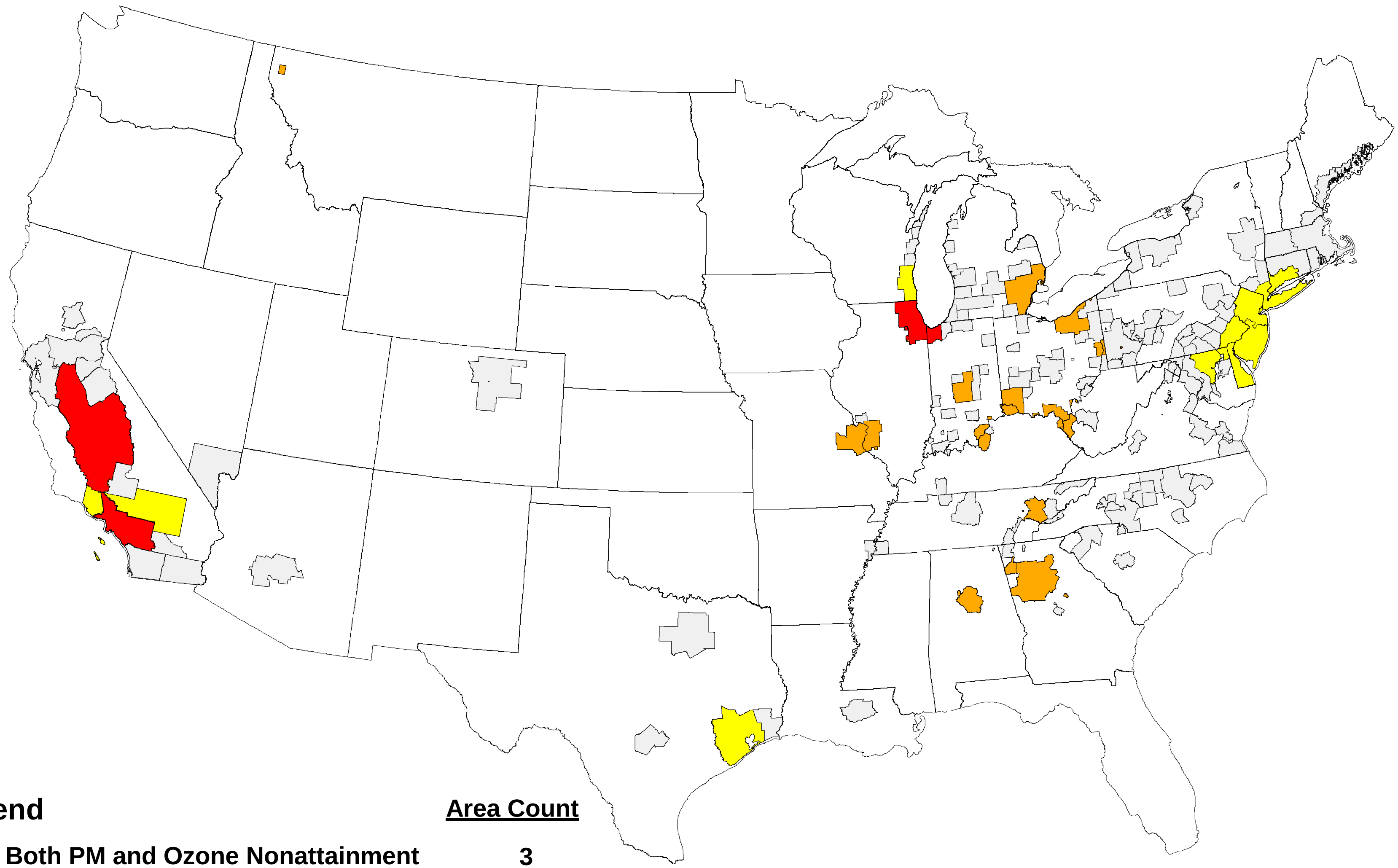
Ozone and PM are our highest priority

National NO_x and SO_2 Power Plant Emissions: Historic and Projected with CAIR



Source: EPA

Areas Projected to Exceed the $PM_{2.5}$ and 8-Hour Ozone Standards in 2015 with CAIR/CAMR/CAVR and Some Current Rules* Absent Additional Local Controls



Legend

	Area Count
Both PM and Ozone Nonattainment	**3**
PM Only Nonattainment	**14**
Ozone Only Nonattainment	**7**
Nonattainment areas projected to attain	**105**

**Areas forecast to remain in nonattainment may need to adopt additional local or regional controls to attain the standards by dates set pursuant to the Clean Air Act. These additional local or regional measures are not forecast here, and therefore this figure overstates the extent of expected nonattainment.

*Current rules include Title IV of CAA, NO_x SIP Call, and some existing State rules.

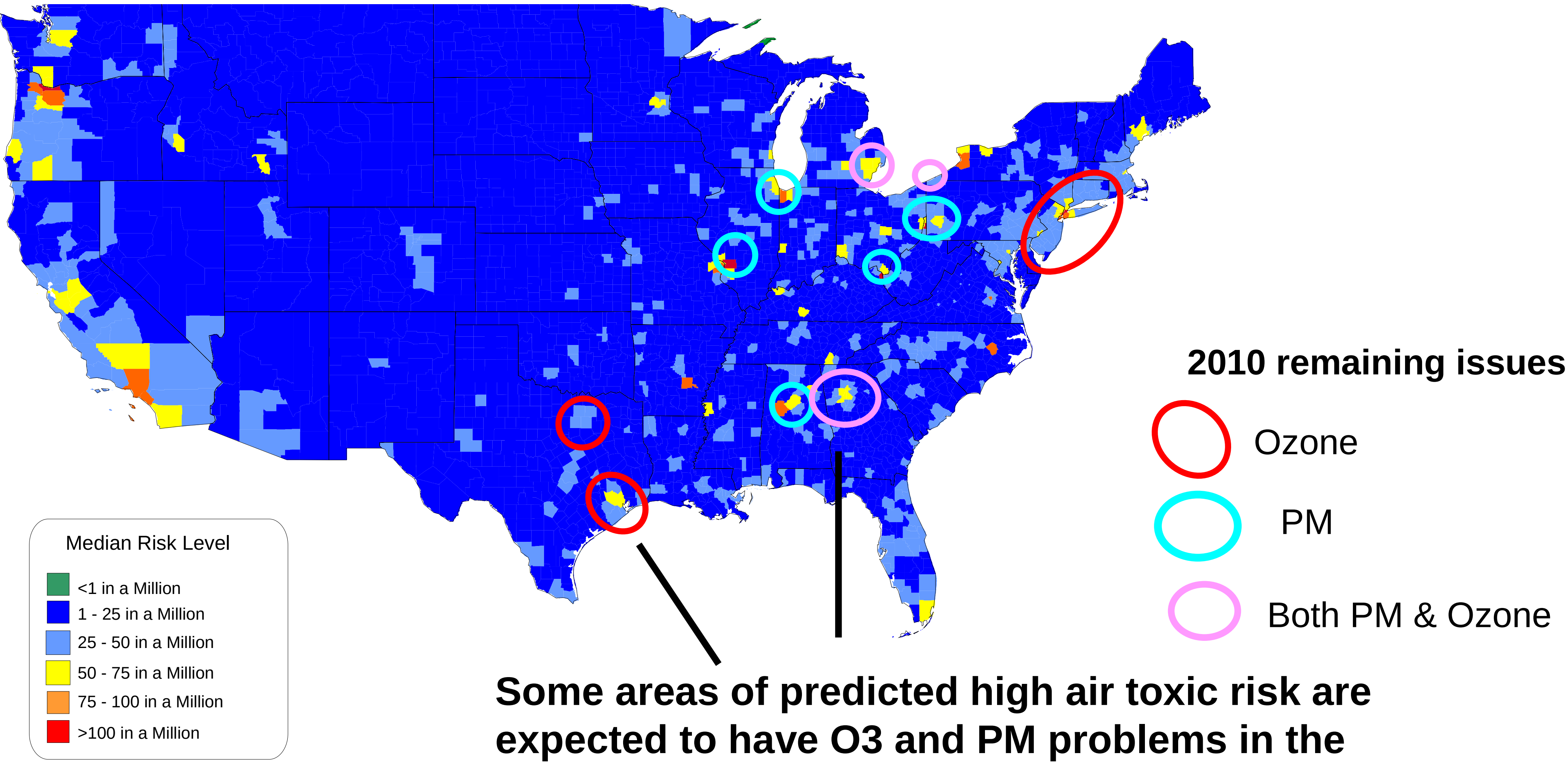
Revised PM NAAQS

- Annual NAAQS remains 15 ug/m3
- 24 hour NAAQS changed from 65 to 35 ug/m3
  - Implications
    - Scaling (importance of urban/local scale and sector specific phenomena)
    - Previous “anomalous” events rise in importance
      - E.g., forest fire impacts, wind blown dust
- Monitoring for $PM_{(10\text{-}2.5)}$
  - In combination with new multiple pollutant NCORE sites

High Risk Counties often Coincide with Locations where Criteria Pollutant Issues are Significant -

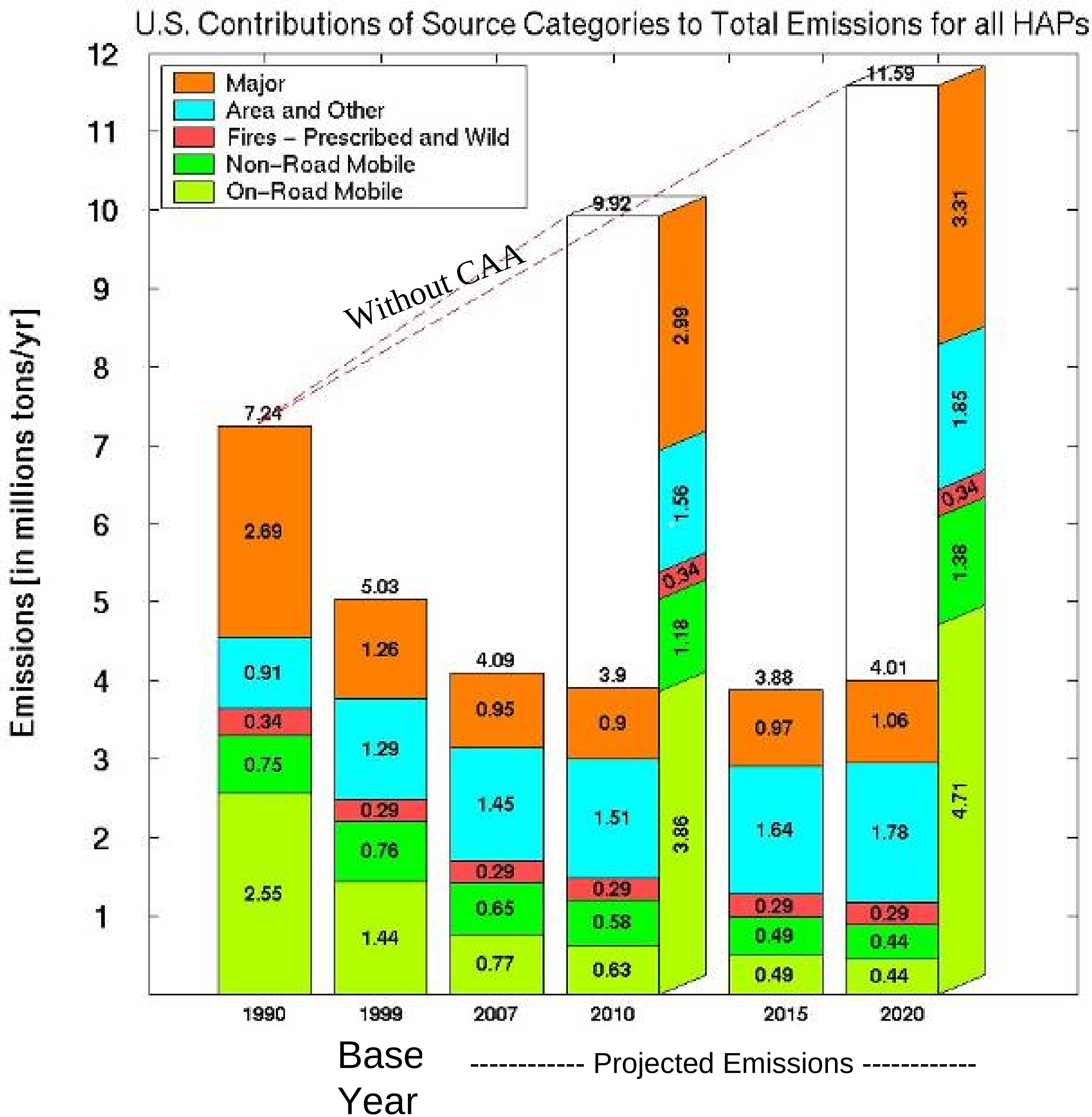
Impetus for multi-pollutant strategies

1999 NATA - National Scale Assessment



Some areas of predicted high air toxic risk are expected to have O3 and PM problems in the future (2010)

US (All 50 States) Emissions of HAPs by Source

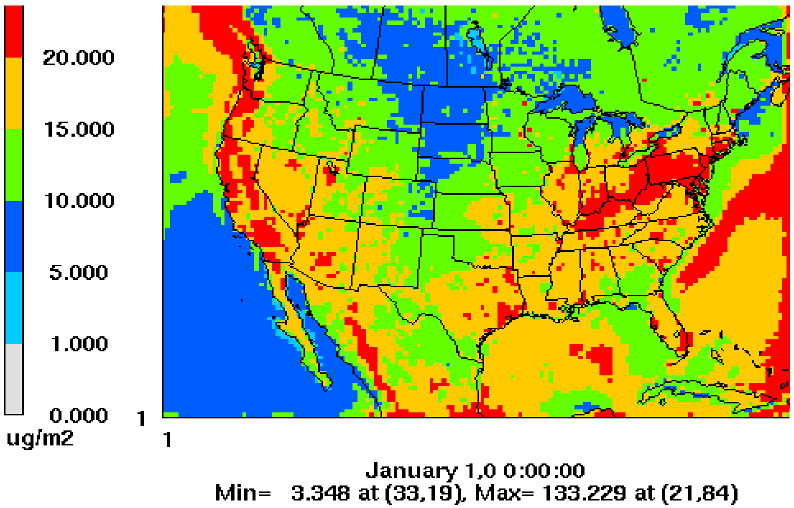


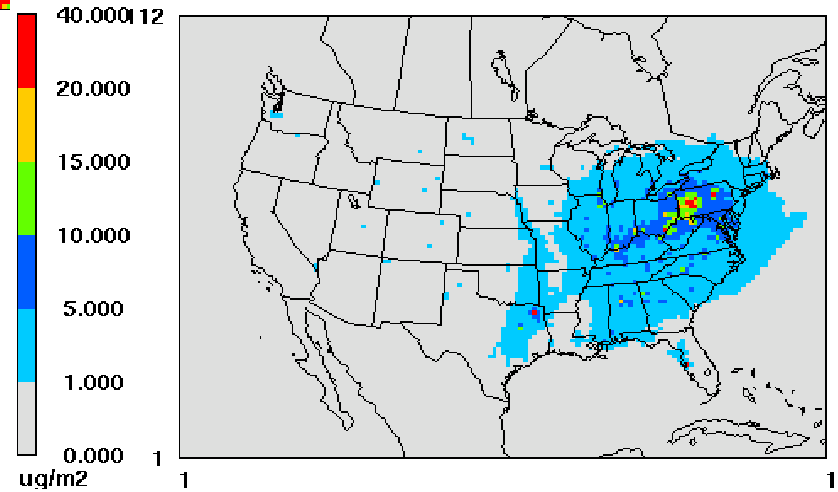
* After 2010, stationary source emissions are based only on economic growth. They do not account for reductions from ongoing toxics programs such as the urban air toxics program, residual risk standards and area source program, which are expected to further reduce toxics. In addition, mobile source reductions are based on programs currently in place. Programs currently under development will result in even further reductions.

Key Findings

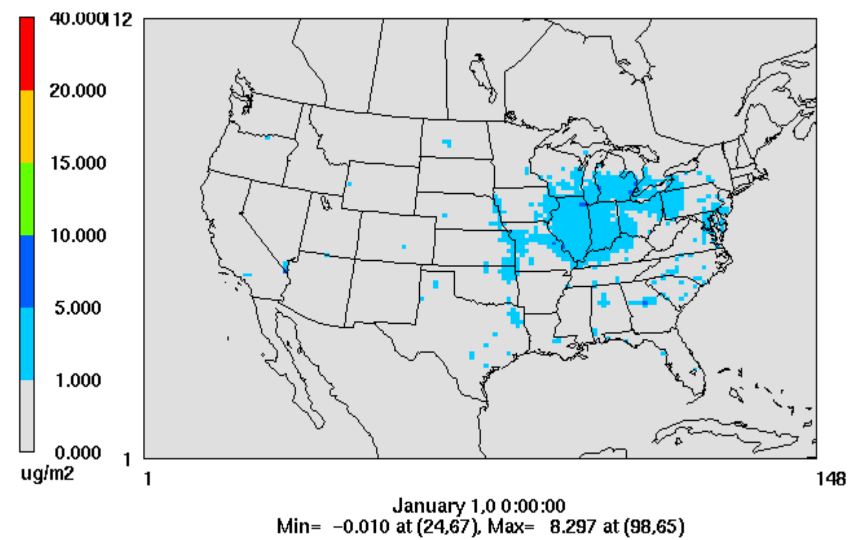
- CAA has been very effective in reducing overall tonnage of air toxics
- In absence of CAA, total emissions would be more than twice those projected in 2020

Mercury, current and future AQ challenge requiring multiple – scale approach





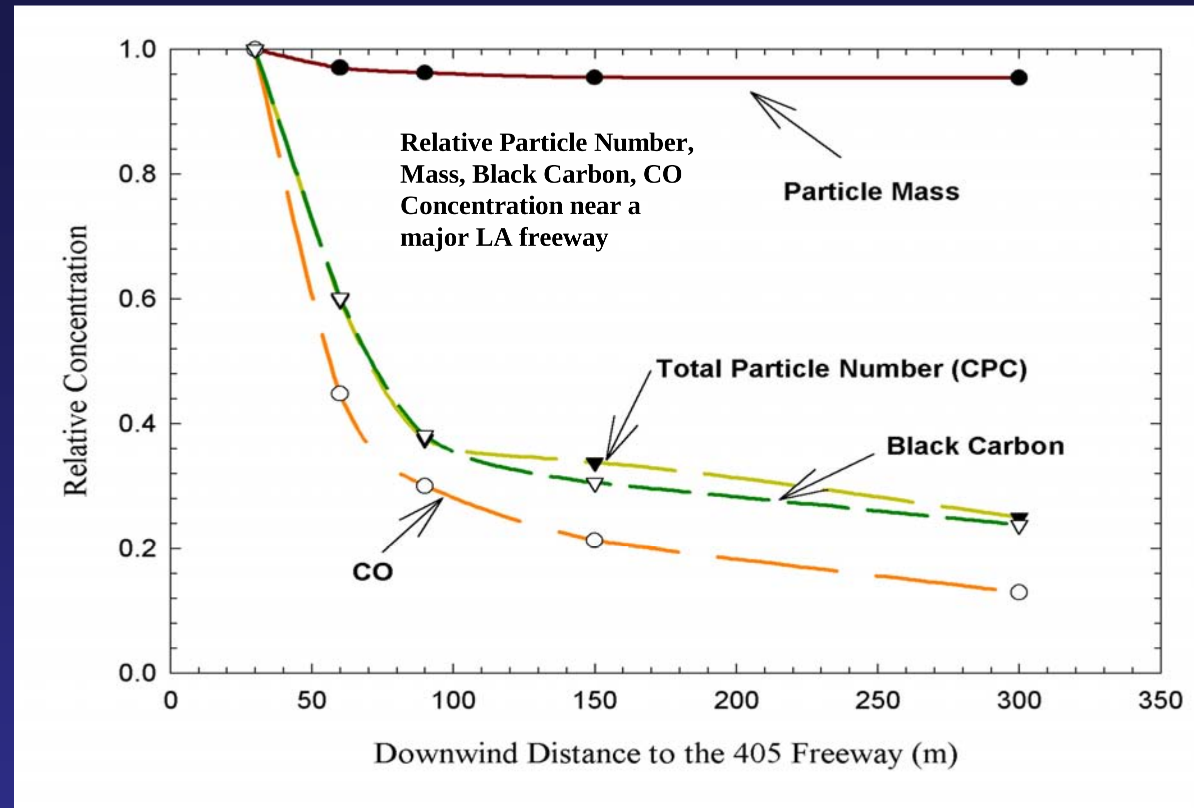
Mercury Deposition from US Power Plants: 2020 with CAIR & CAMR



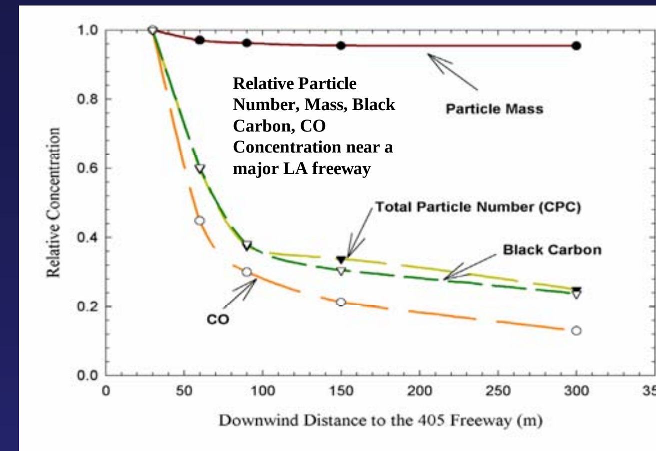
New findings on roadway pollution

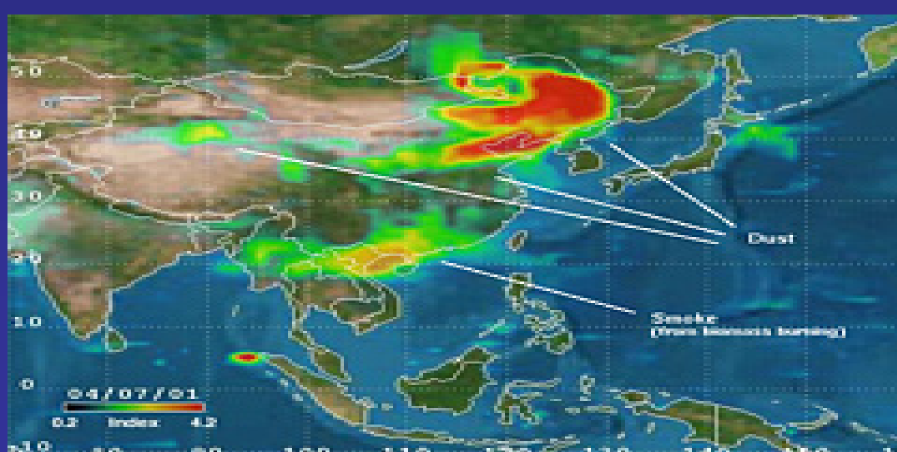
High exposure to ultrafine particles, CO, other pollution near roadway

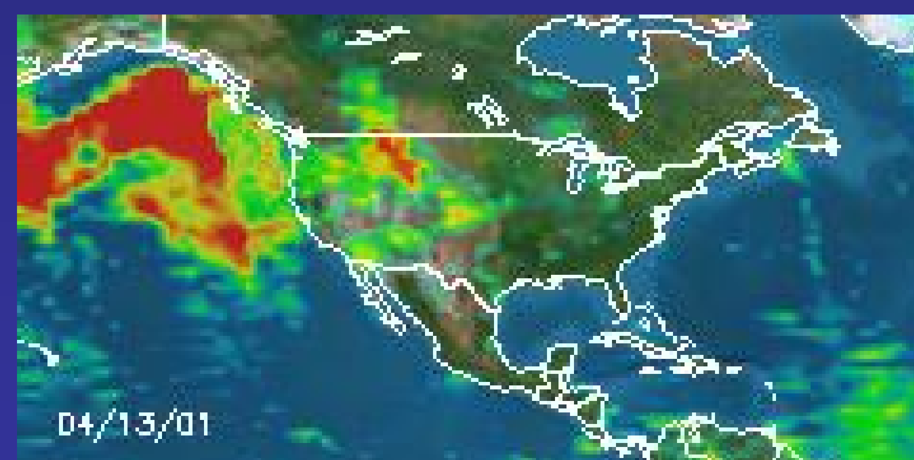
Increased risk near and on roadways



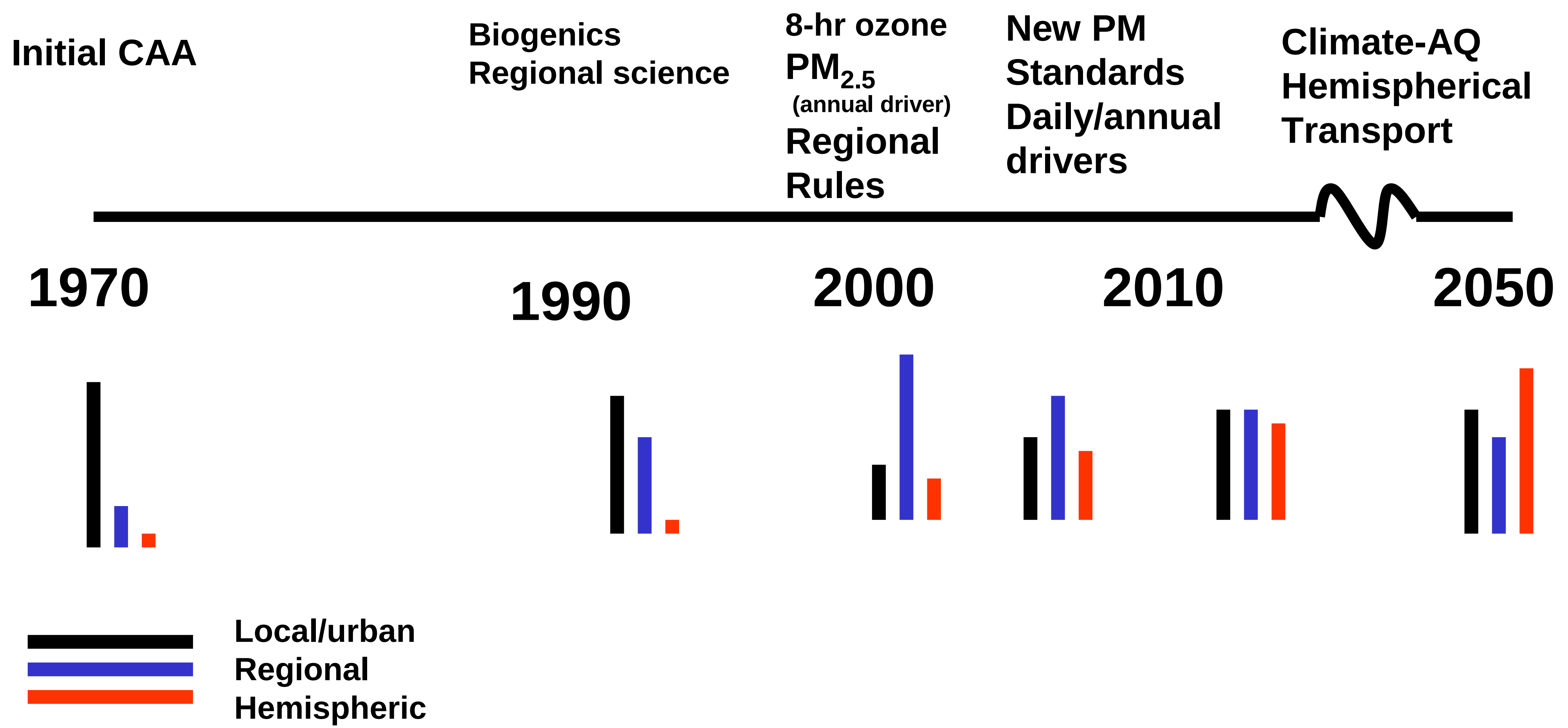
Challenge of multiple scales



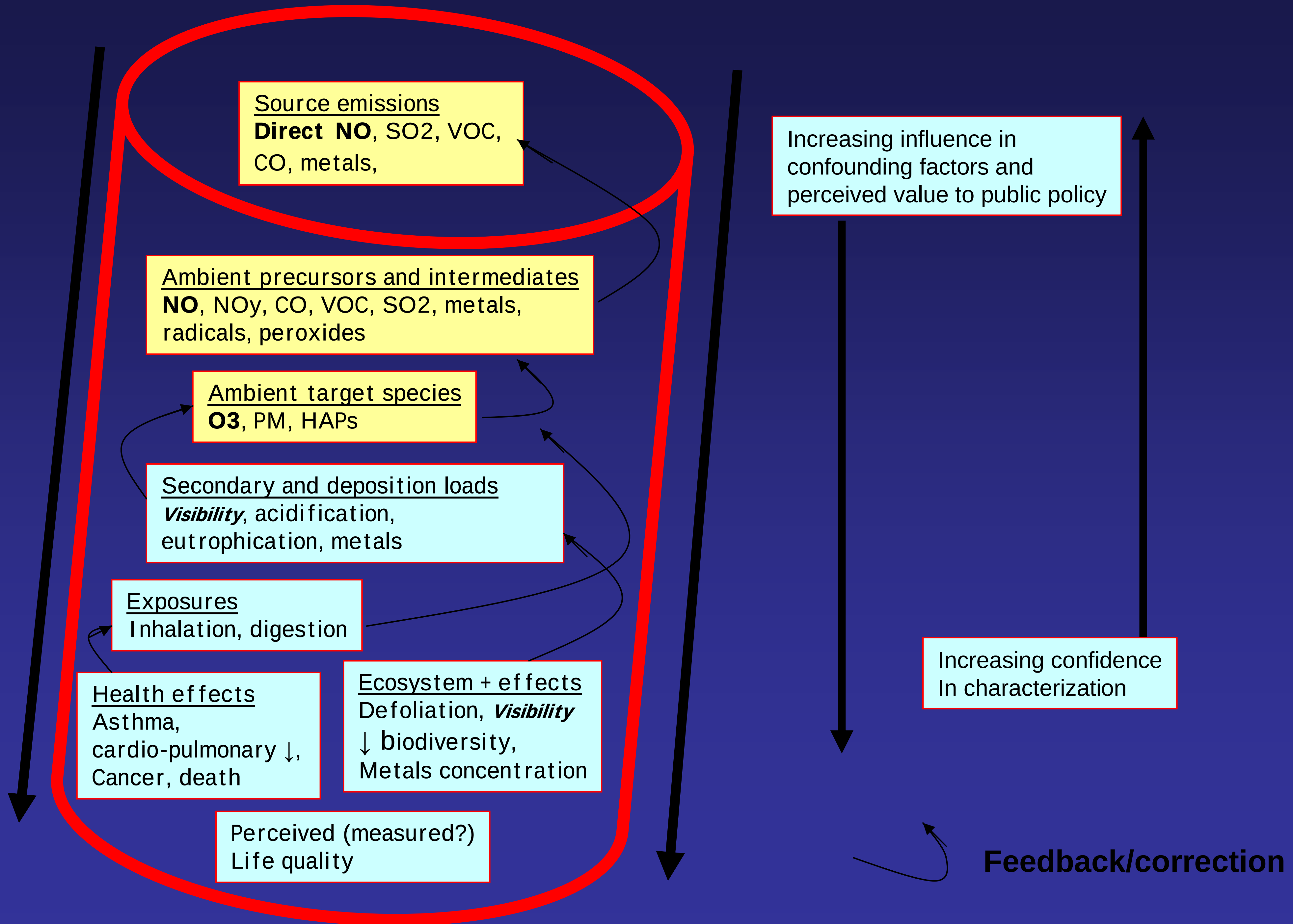




Evolutional change in National Air Pollution Management



Accountability and Indicators Pipeline



Traditional Air Accountability Examples

- Emissions to ambient air/deposition

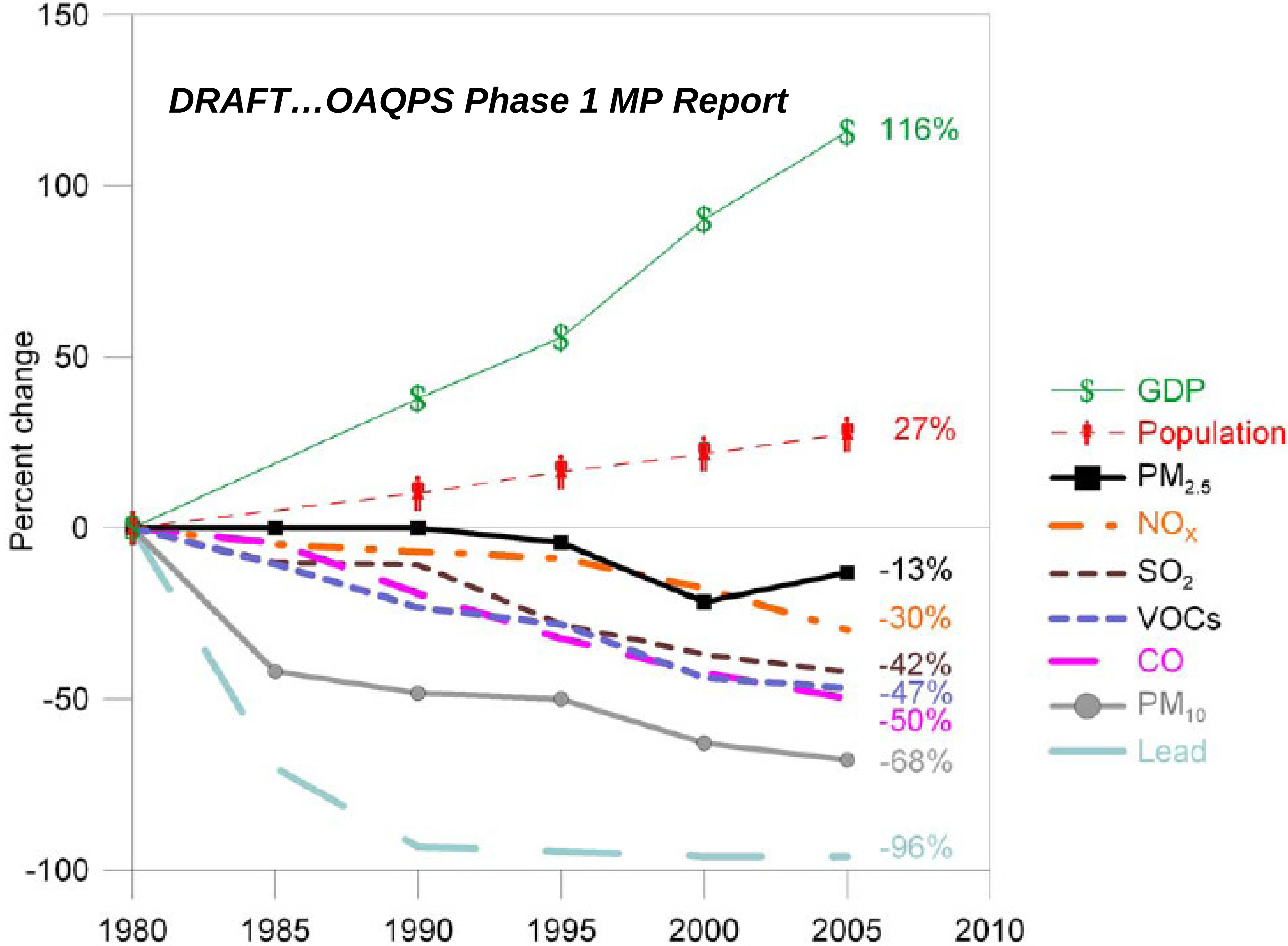
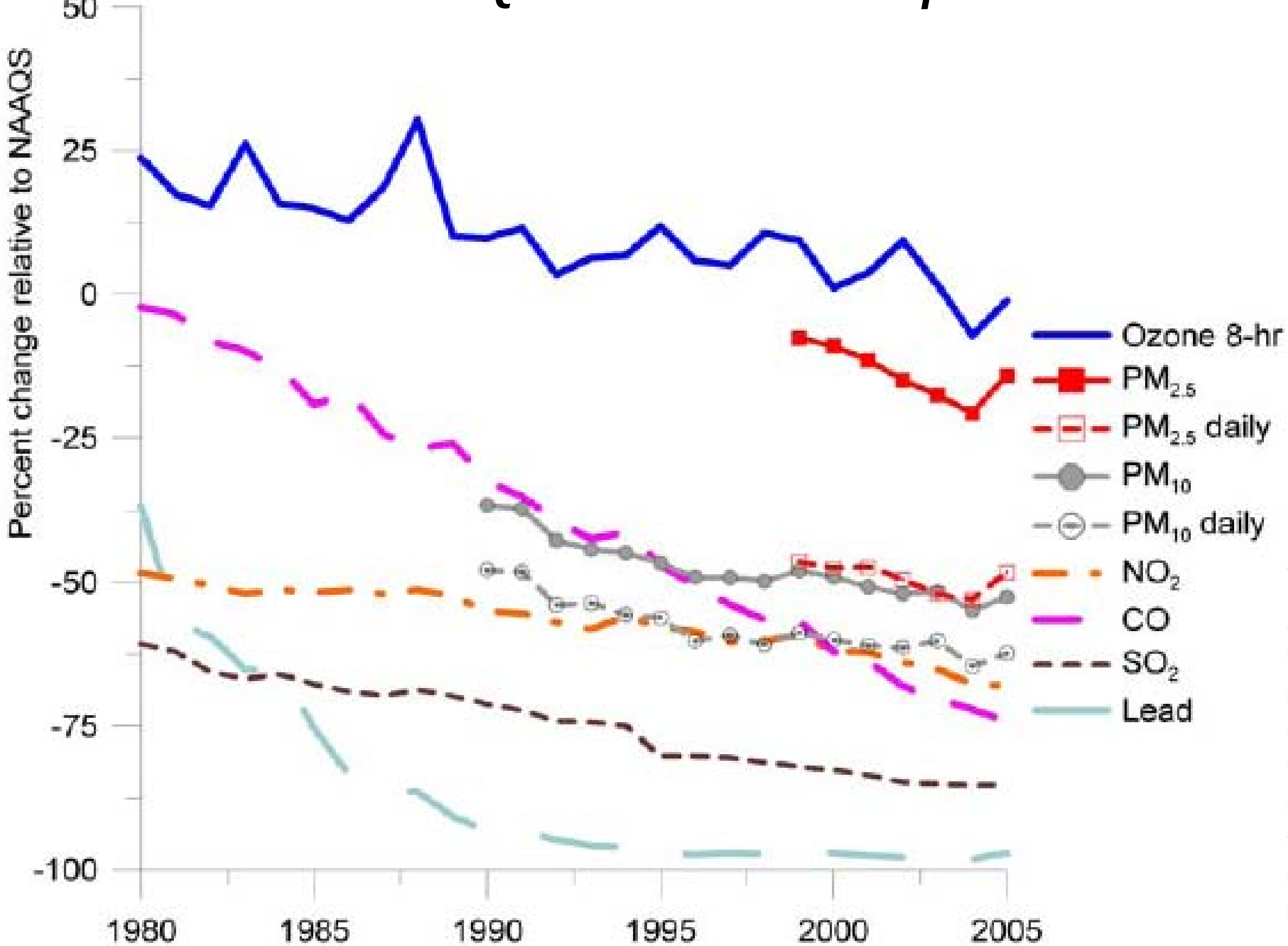


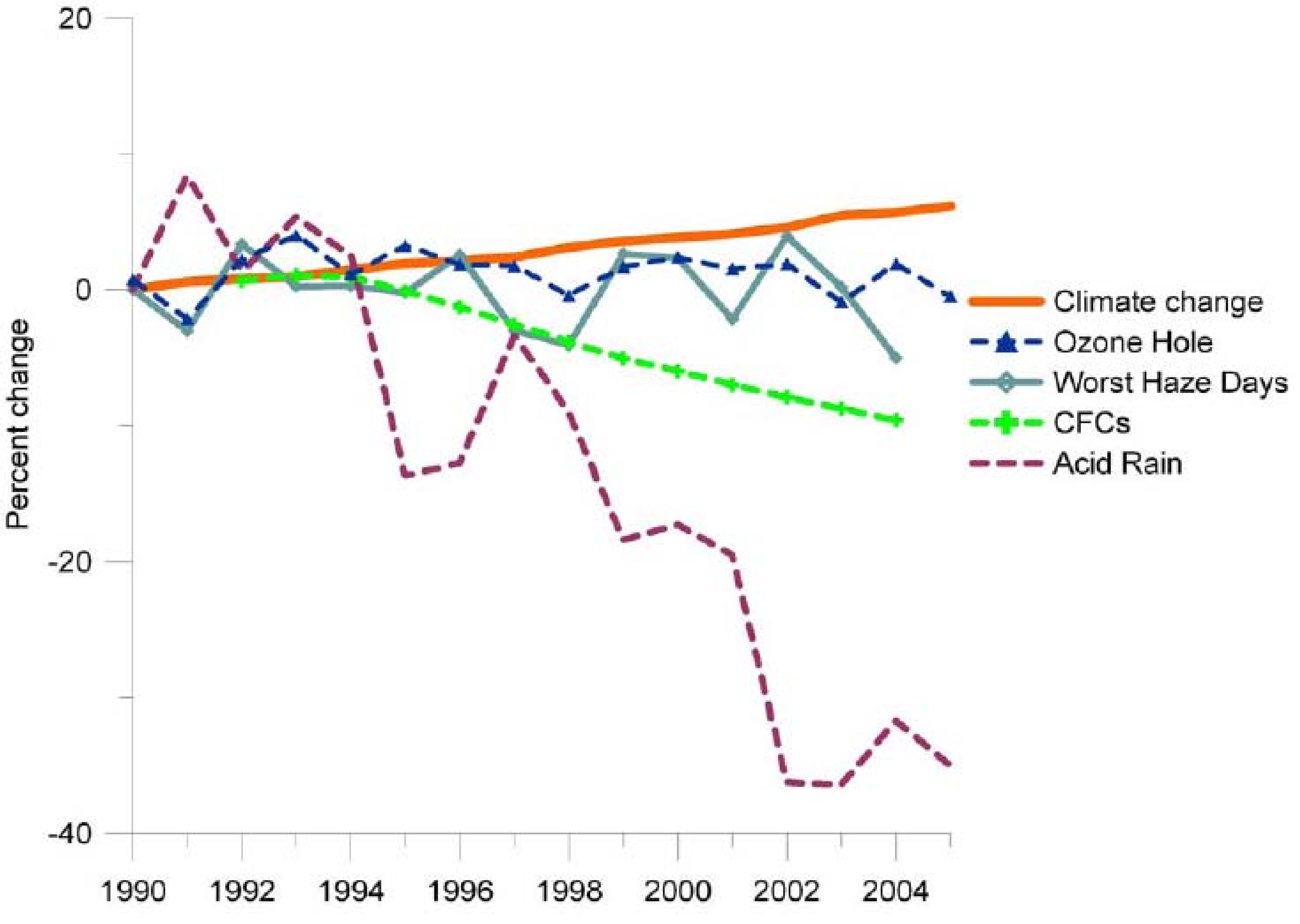
Figure 3-2. Changes in emissions, population, and GDP since 1980.



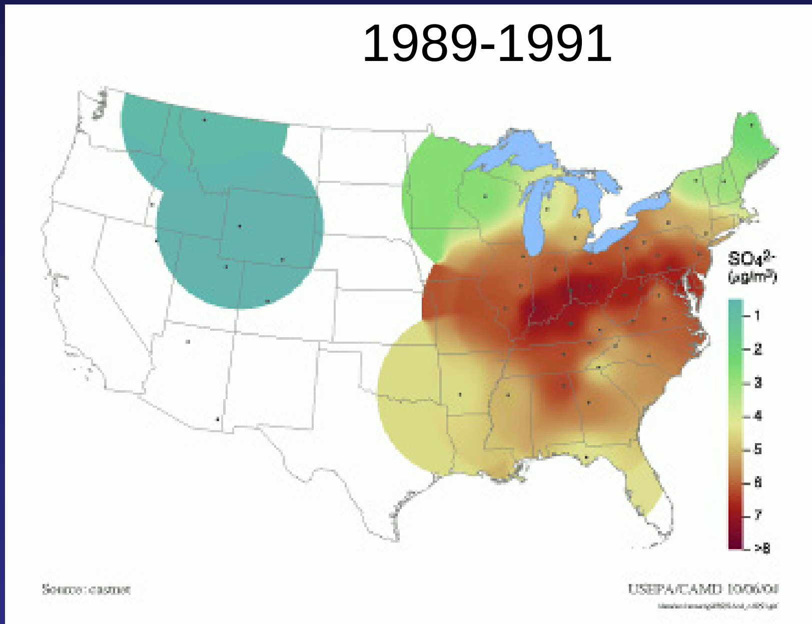
Percent Change in Air Quality		
	1980-2005	1990-2005
NO2	-37	-25
O3 (1-hr)	-28	-12
(8-hr)	-20	-8
SO2	-63	-48
PM10	---	-25
PM2.5	---	-7
CO	-74	-60
Pb	-96	-38

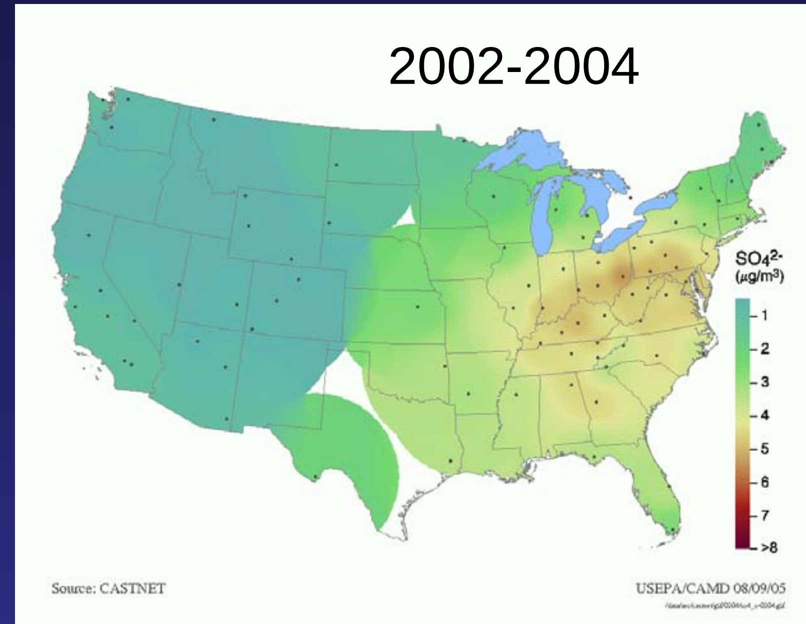
Figure 3-1. Changes in annual average concentrations of the criteria pollutants since 1980 relative to the NAAQS.

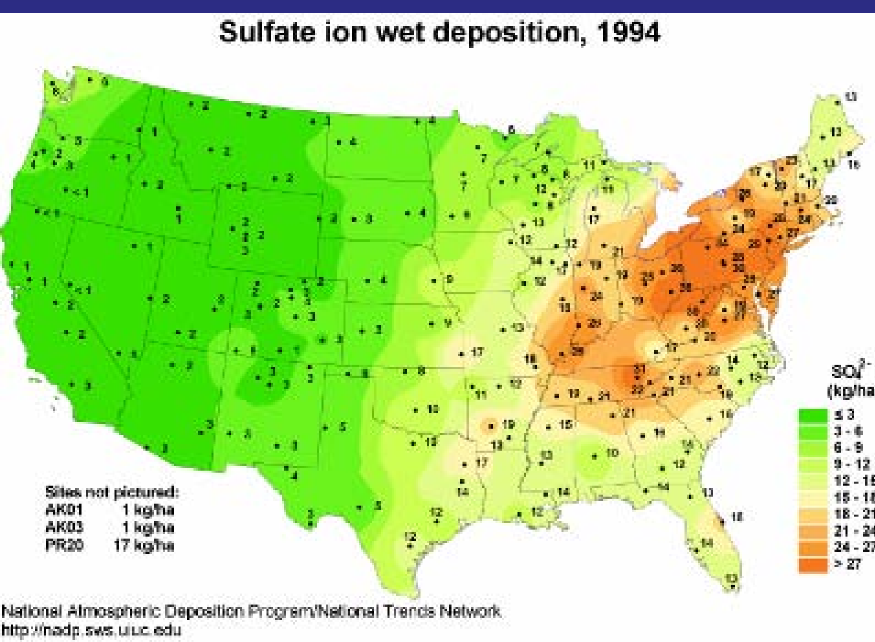
Trends in related air quality issues

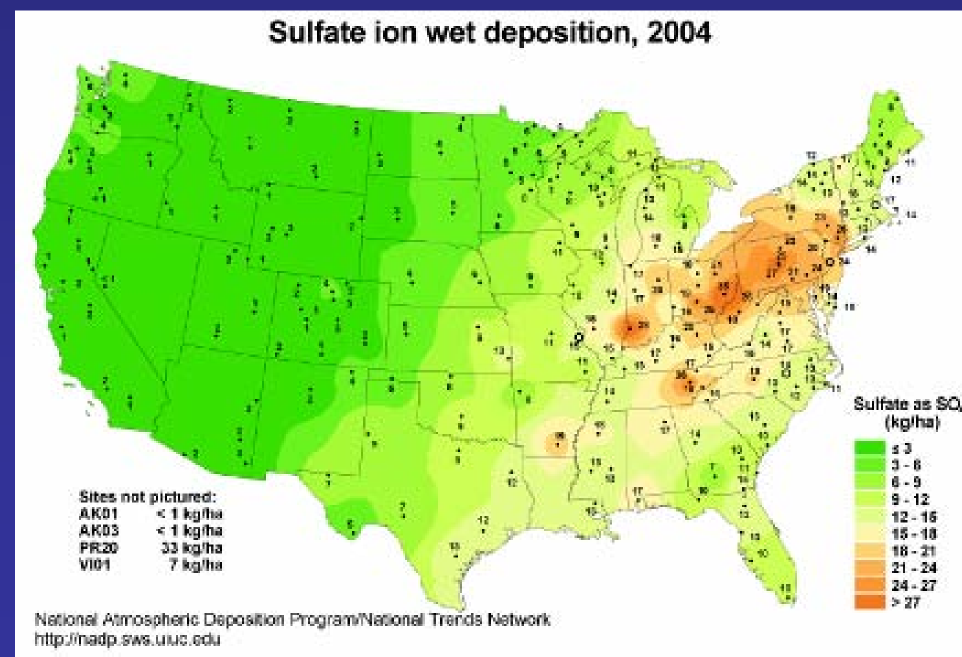


Changes in sulfate (dry ambient and wet deposition) CASTNET/NADP

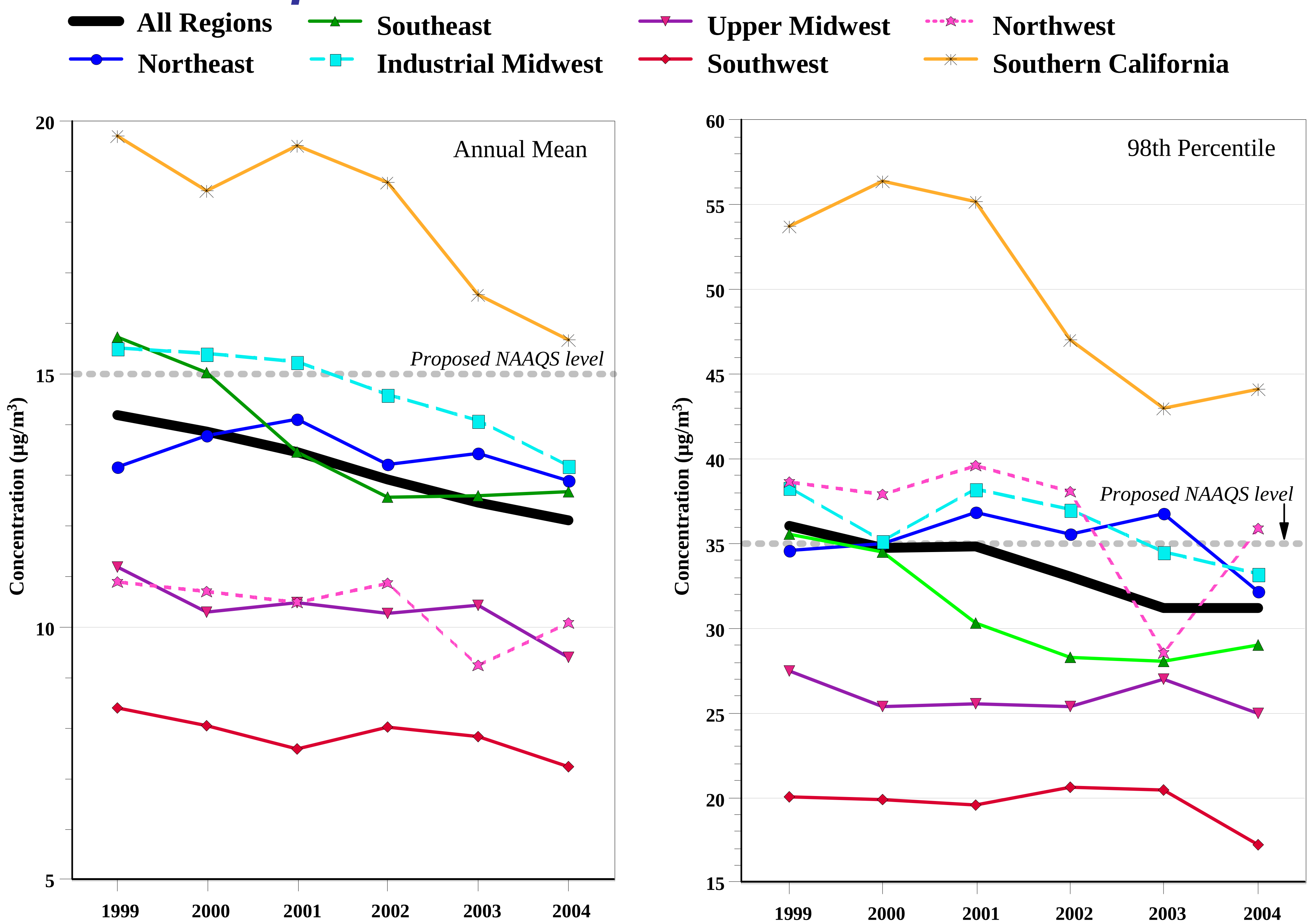






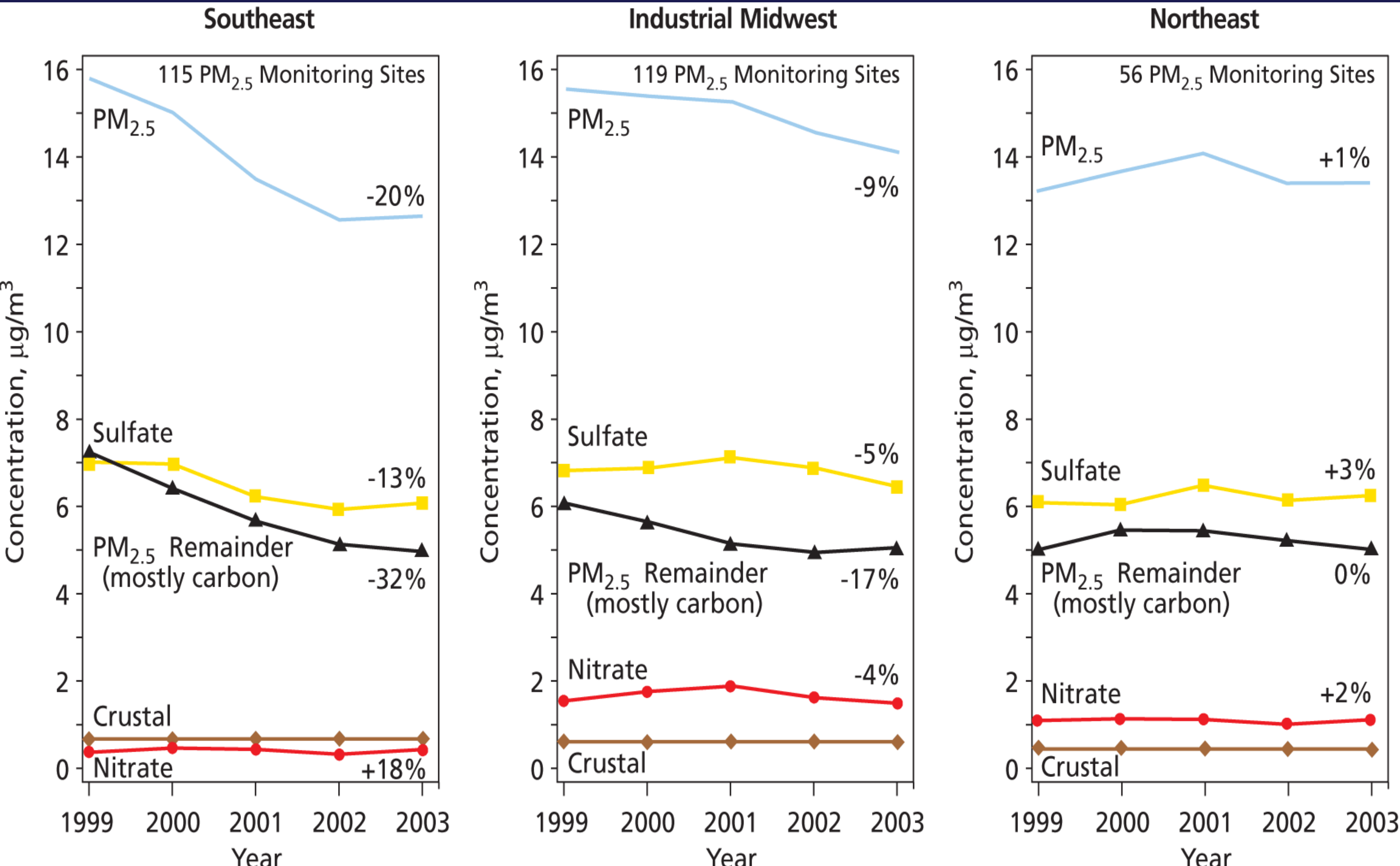


Fine particle concentrations decline….



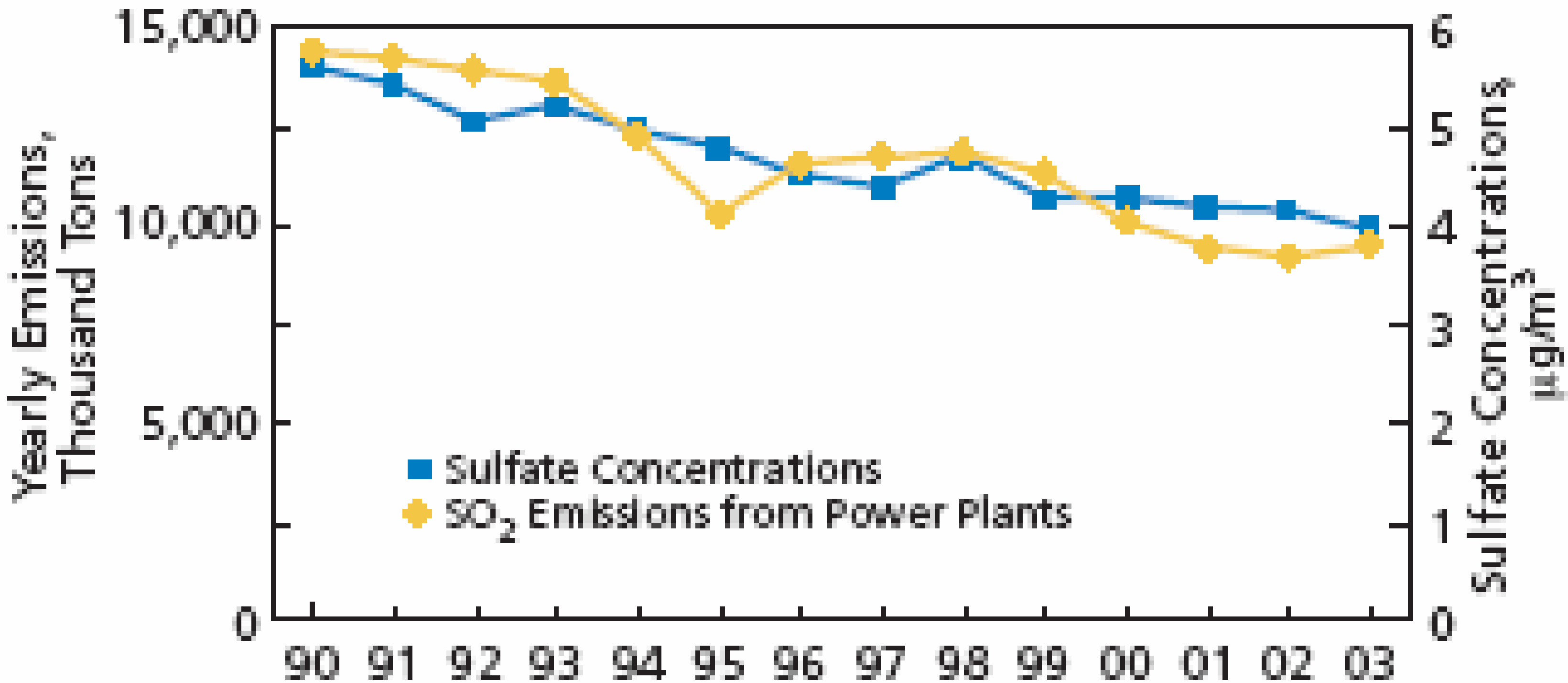
$PM_{2.5}$ Annual Mean and 98th Percentile Concentration Trends by Region, 1999-2004

What parts went down….?



….and why?

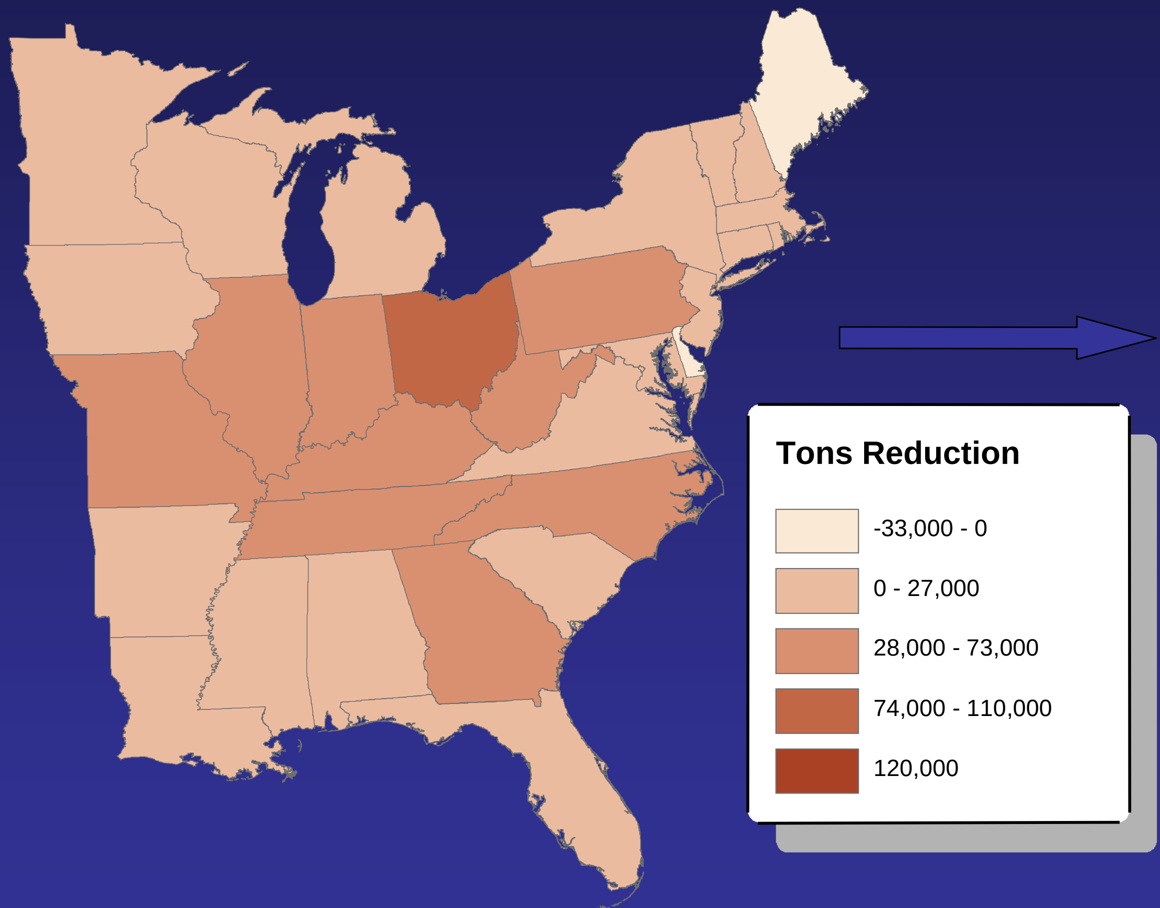
Figure 15. Eastern annual trends of sulfur dioxide emissions from power plants and sulfate concentrations.



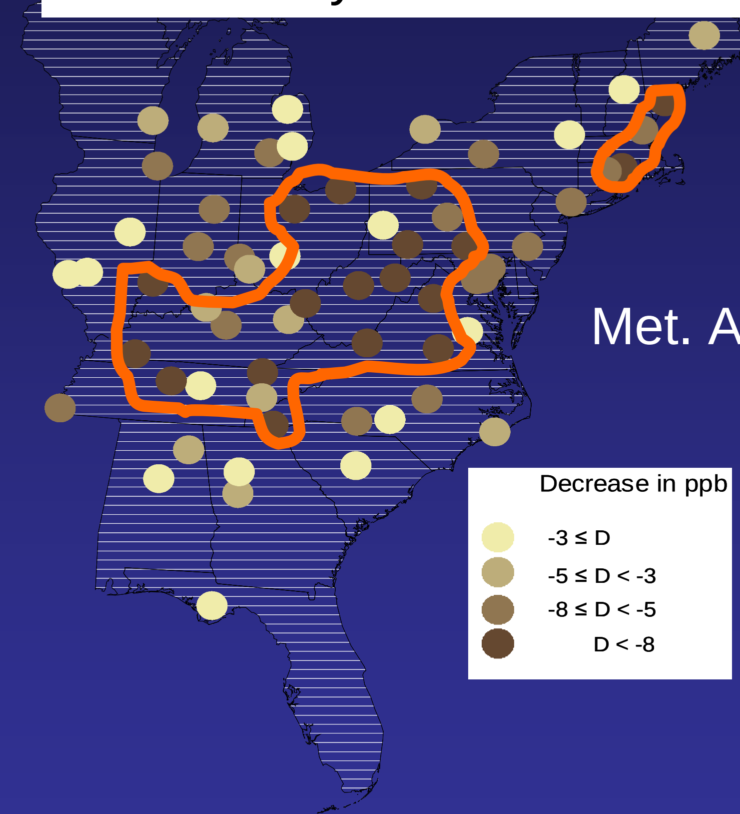
Note: Sulfate concentrations are from EPA's CASTNET monitoring network, www.epa.gov/castnet

Largest decline in ozone occurs in and downwind of EGU NOx emissions reductions (2002-2004)

EGU NOx Tons Reduced



Decline in “Seasonal Average” 8-Hour Daily Maximum Ozone

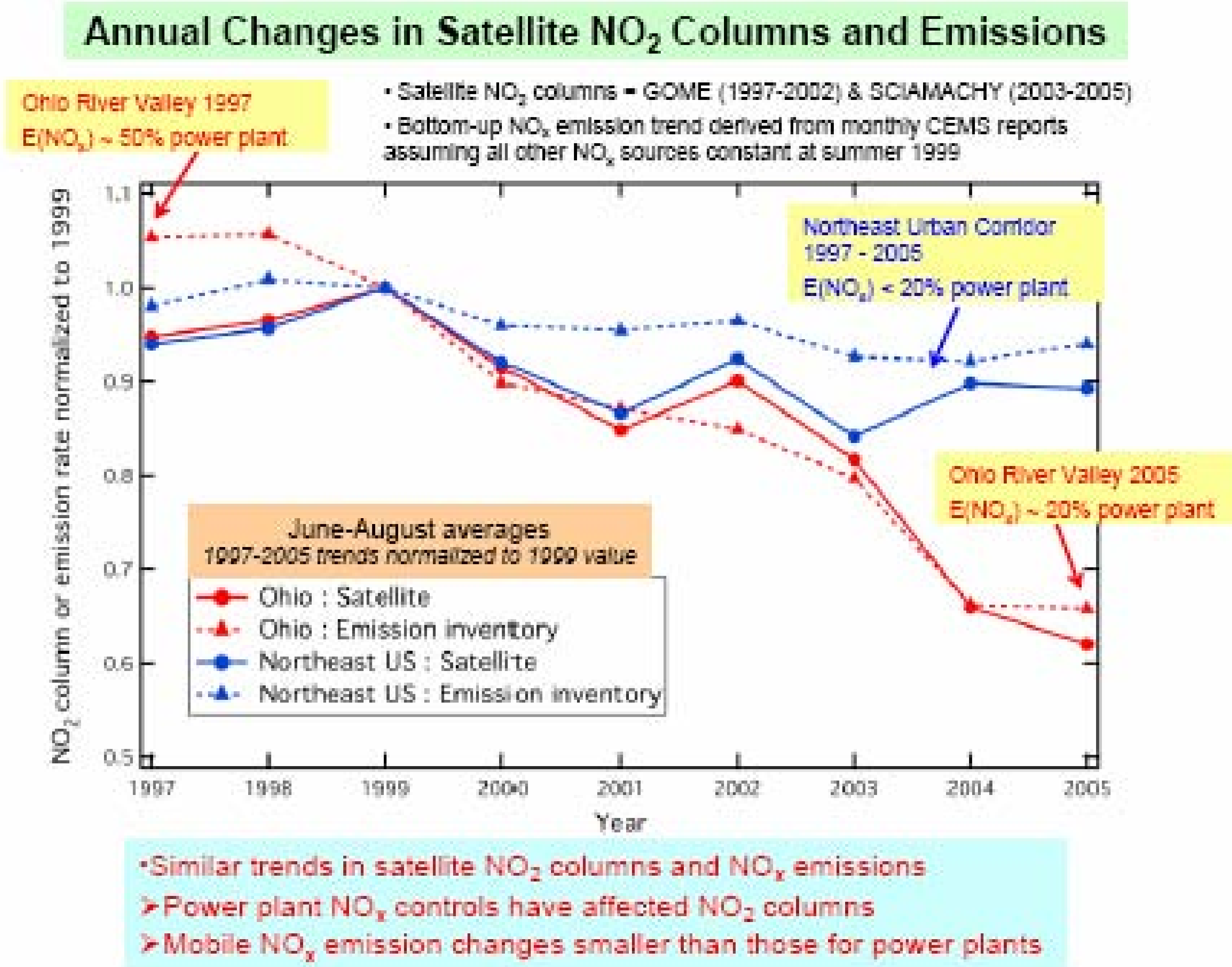


Met. Adj.

The major EGU NOx emissions reductions occurs after 2002 (mostly NOx SIP Call)

Average rate of decline in ozone between 1997 and 2002 is 1.1%/year.

Average rate of decline in ozone between 2002 and 2004 is 3.1%/year.



Courtesy NOAA, Kim et al.

Controlled local examples of air quality progress linked to specific facility

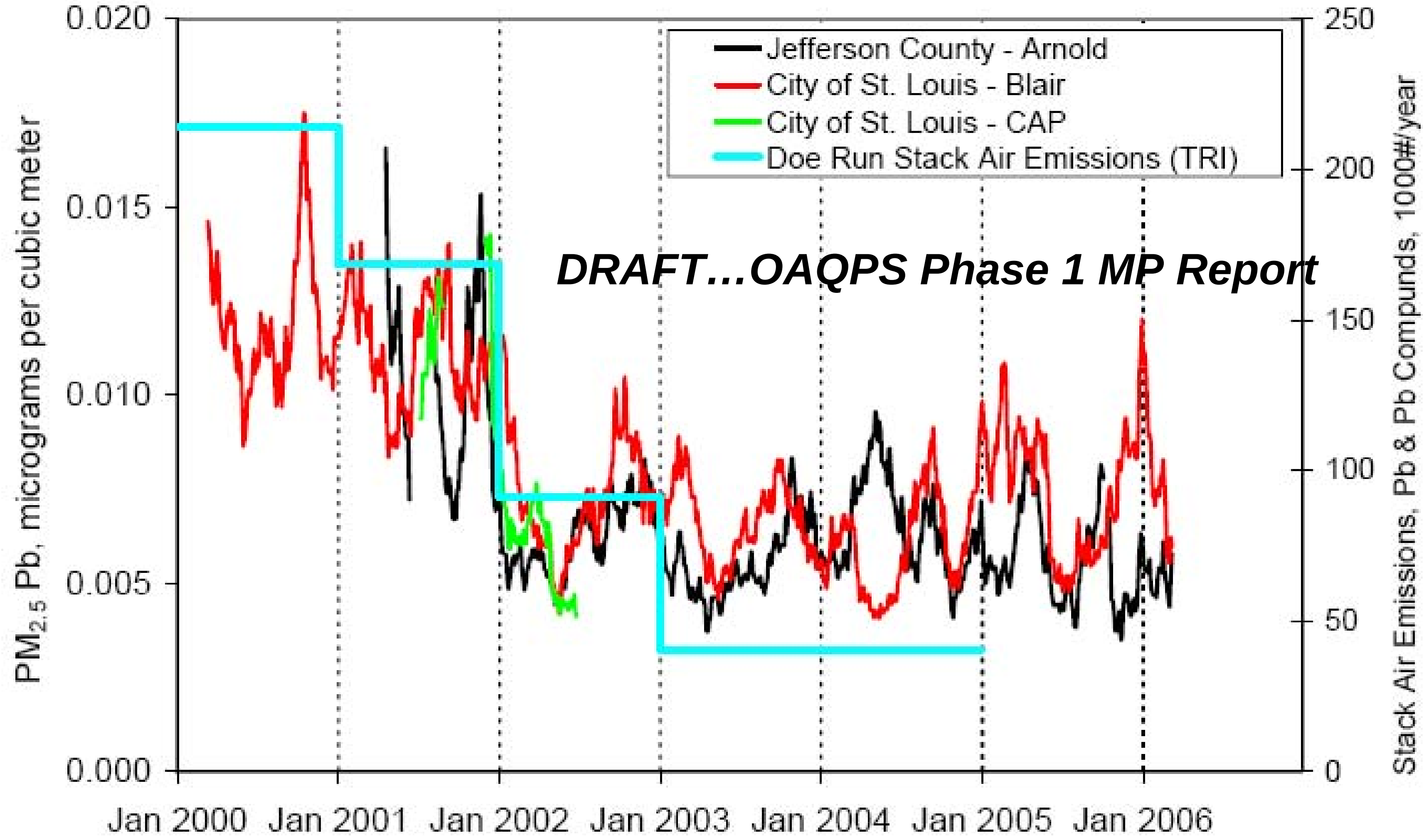
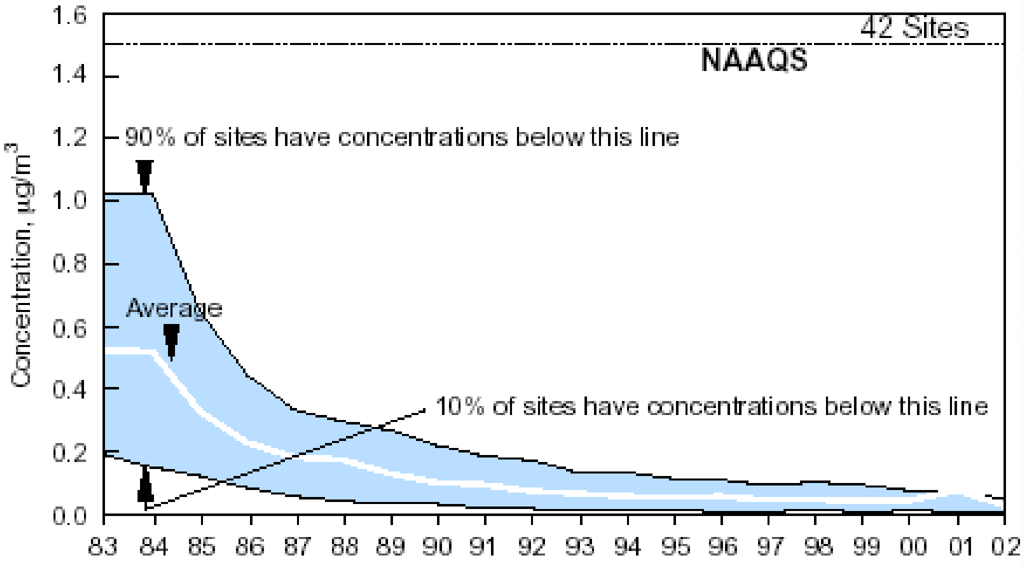


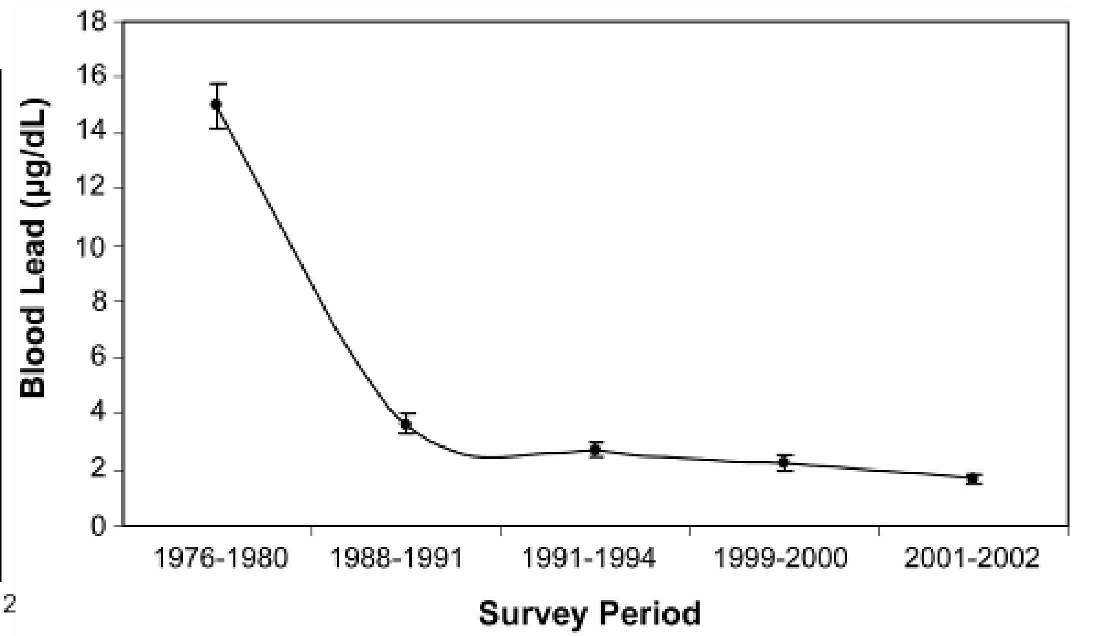
Figure 4-3. Concentrations of lead monitored in St. Louis near the Doe Run lead smelter during a period of major lead reduction.

Accountability: If only it was as easy as Lead…..

Lead Air Quality, 1983–2002
Based on Annual Maximum Quarterly Average



1983–02: 94% decrease
1993–02: 57% decrease

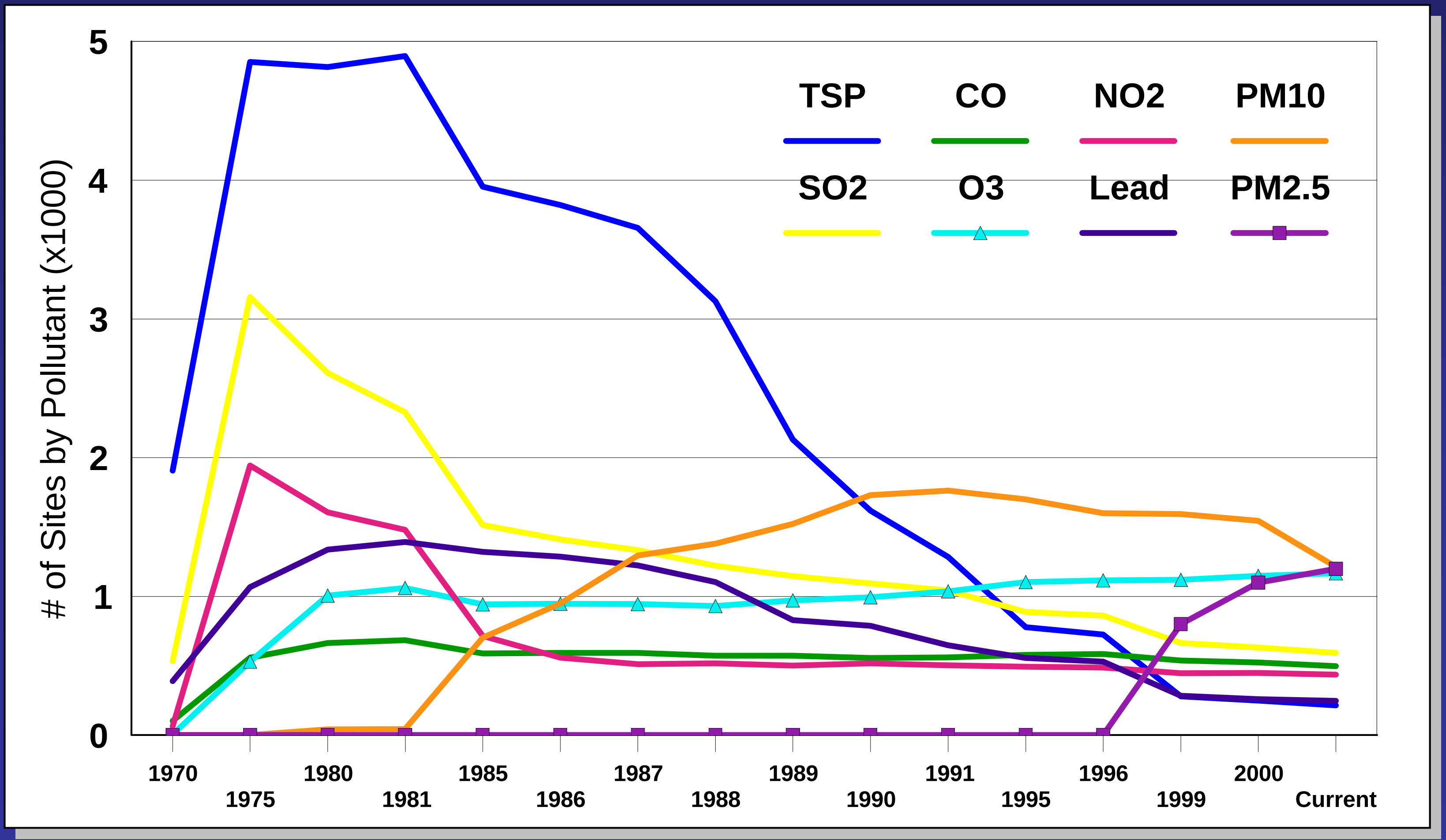


Accountabilty and Observations

- National Ambient Air Perspective…

Evolution of National Ambient Air Monitoring Networks

Is regulatory design adequate for accountability?
Are the right parameters measured at the right locations?



Accountabilty and Observations, considerations…

- National Ambient Air Perspective…
  - Transition from a compliance “highest” concentration, regulatory “indicator” to
  - System accommodating
    - Broad/robust population exposures
    - Conserving “precursor” mass from emissions through transformation to receptor locations
      - Reducing “noise” from confounding reduction progras
  - Adequate connections to exposure, ecosystems and MP considerations

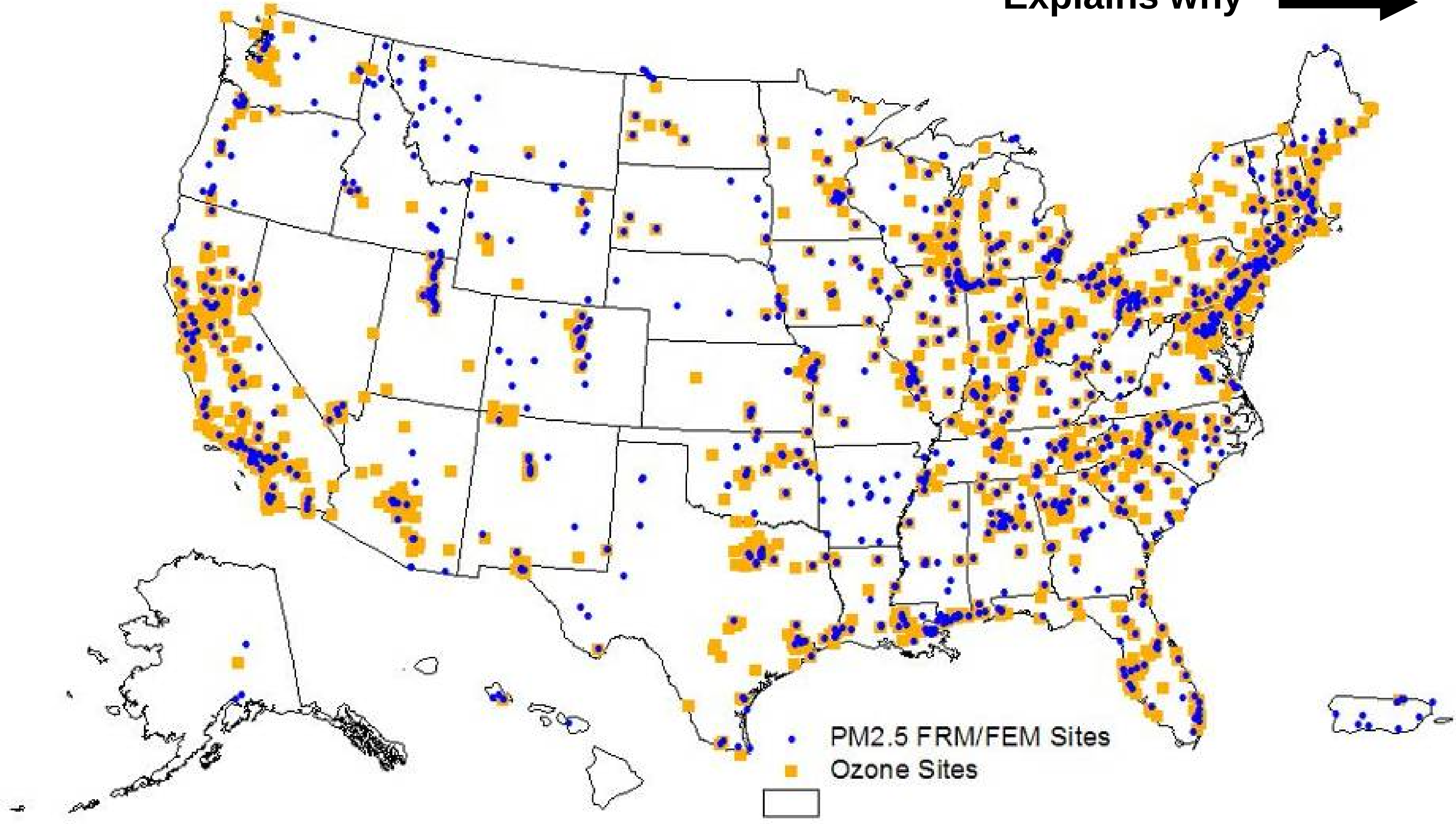
National Core (NCore) Multi-pollutant Sites

- NCore Multi-Pollutant Network
  - Network plans due July 1, 2009
  - Full network operational by January 1, 2011
    - ~75 Sites Nationally
    - ~55 Urban Sites at Neighborhood to Urban Scale
    - ~20 Rural Sites at Regional Scale
    - 1-3 sites per State
    - 50 States, plus, DC, VI, and PR
    - States with 2-3 sites – CA, FL, IL, MI, NY, NC, OH PA, TX.
    - Additional rural sites negotiated with States, NPS, Tribes, CASTNET
- Pollutants
  - Particles
    - $PM_{2.5}$ filter-based and continuous, speciated $PM_{2.5}$ PM10-2.5 FRM/FEM at 1:3 or continuous $PM_{10-2.5}$ FEM
  - Gases
    - O_3; high-sensitivity - CO, SO_2, NO/NO_y
      - Waivers for NOy in urban areas until NO2 method improves so that NOy and NOy differences are meaningful
  - Meteorology
    - Amb. Temp, WS, WD, RH

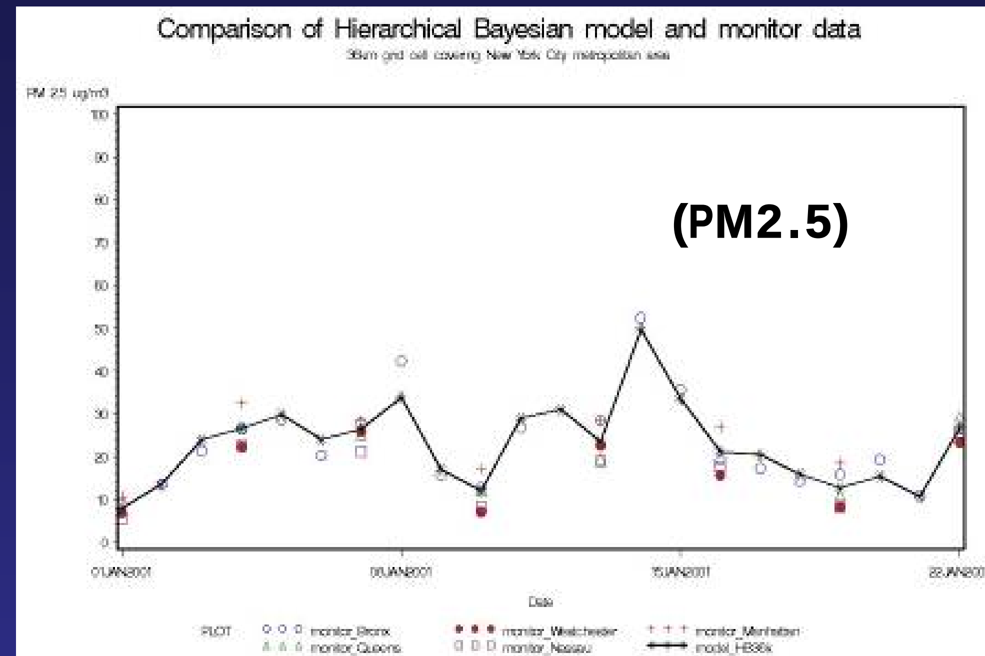
Working Draft of NCore Multi-pollutant Sites

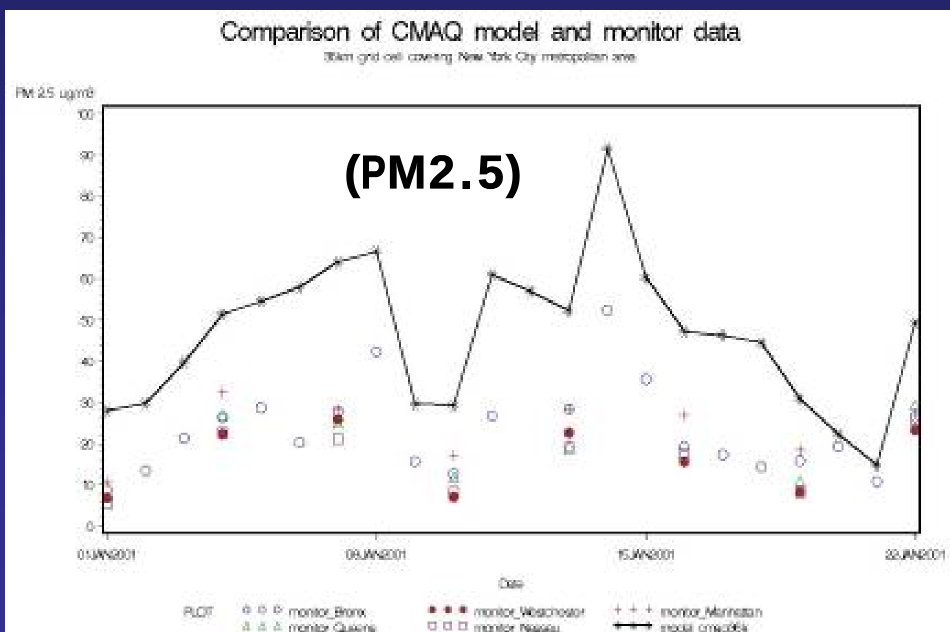
$PM_{2.5}$ FRM / FEM and Ozone Monitoring Sites

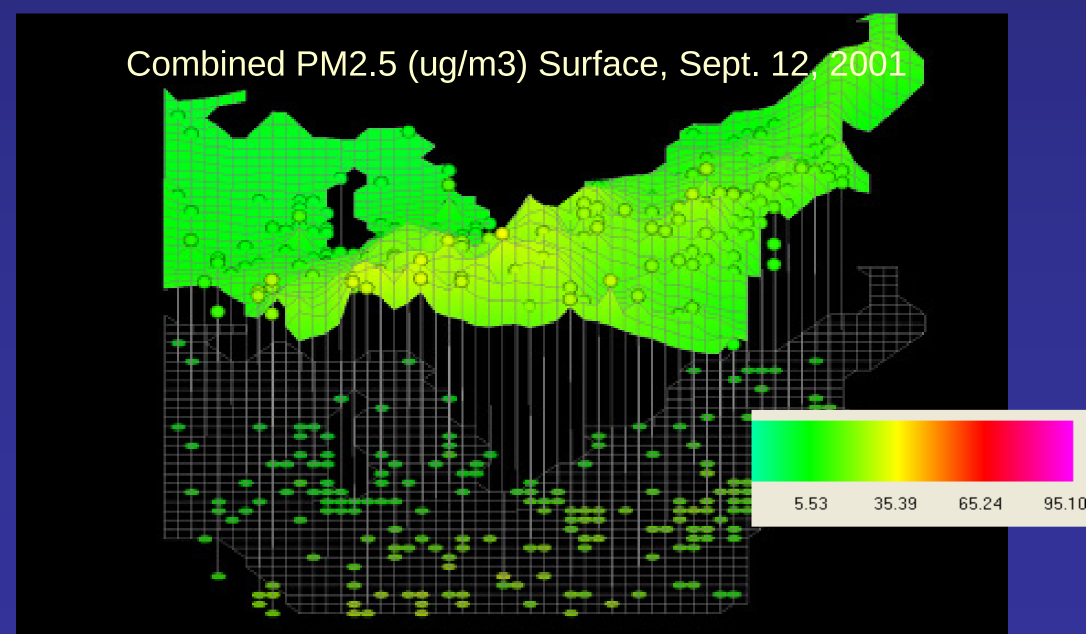
Explains why →



Model-observation fusion (e.g., PHASE) is successful





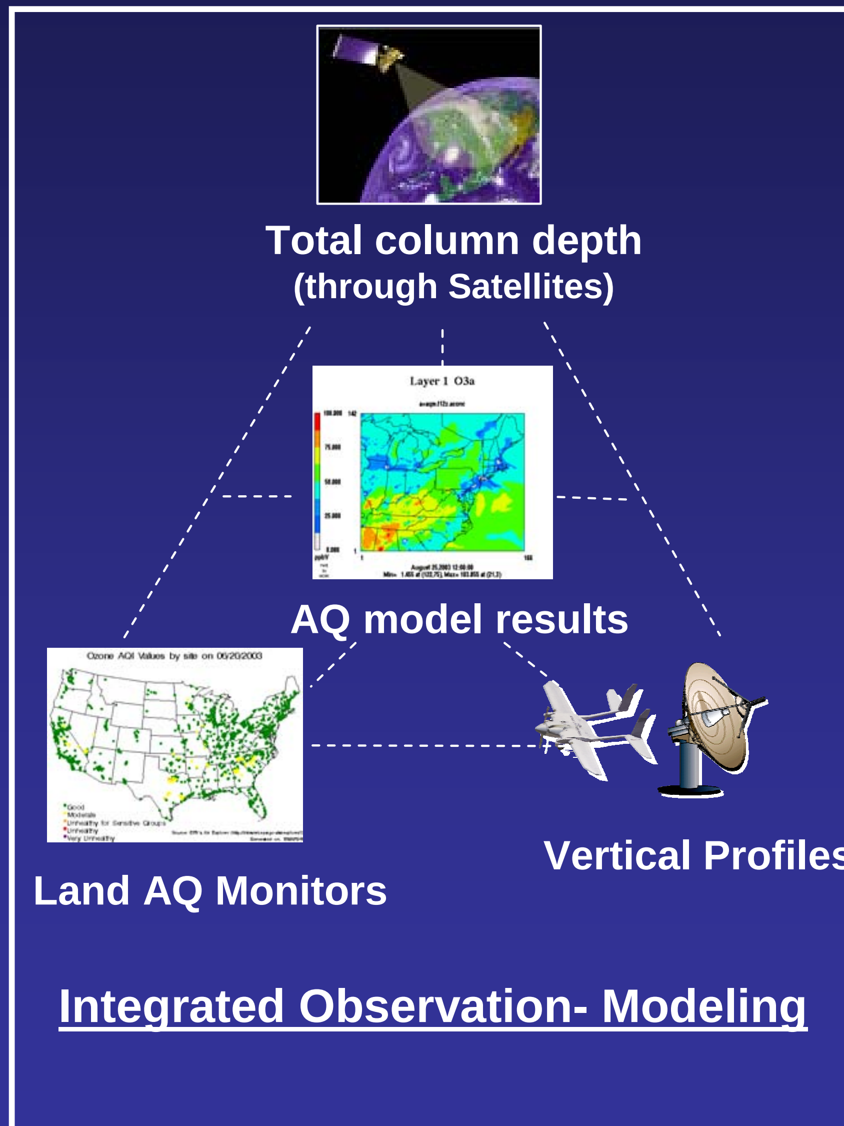


Next steps

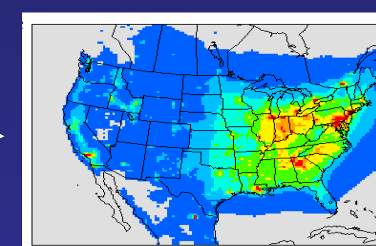
- Accommodating multiple scales
- Multiple technologies
- Multiple agencies
- Multiple issues

Merging Measurement Systems and Numerical Predictive Models

- Assimilation of data to improve
  - air quality models for forecast
  - Current and
  - Retrospective assessments
- Global-Regional Air Quality Connections
- Climate-AQ connections



Optimized PM2.5, O3

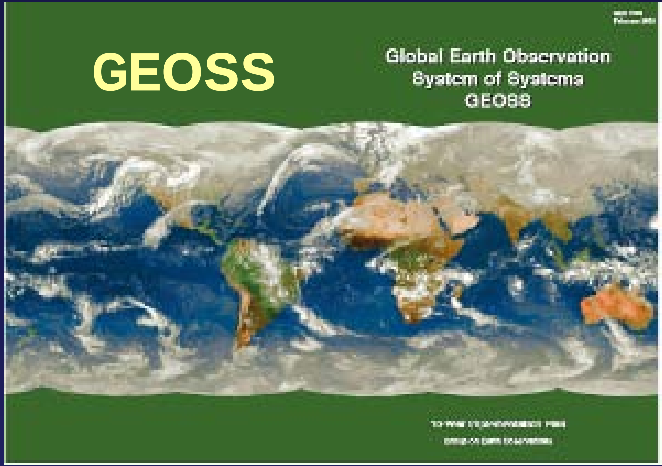


Characterizations

Health

Air management

ecosystems

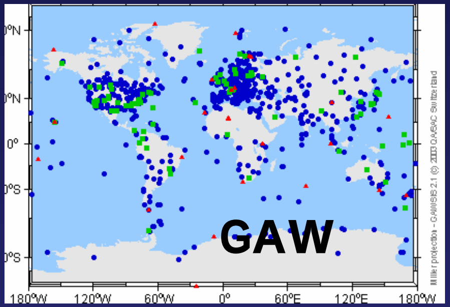


http://earthobservations.org/

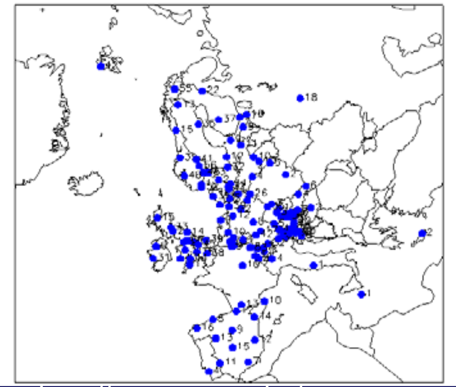
National Ambient Air Monitoring Strategy

Office of Air Quality Planning and Standards
Research Triangle Park, NC
December 2005

http://www.epa.gov/ttn/amtic

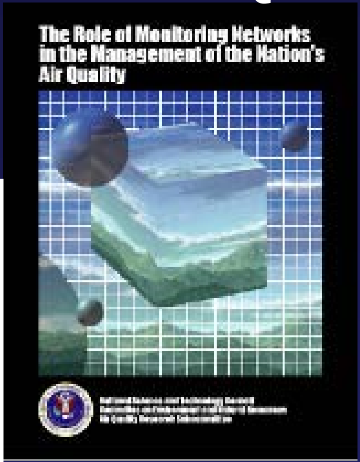


http://www.empa.ch/gaw/gawsis/

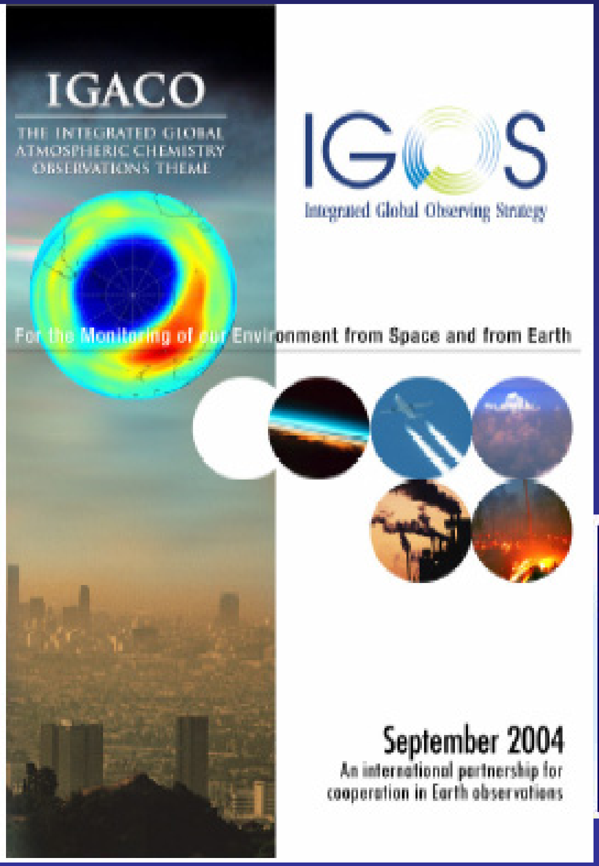


http://www.emep.int/

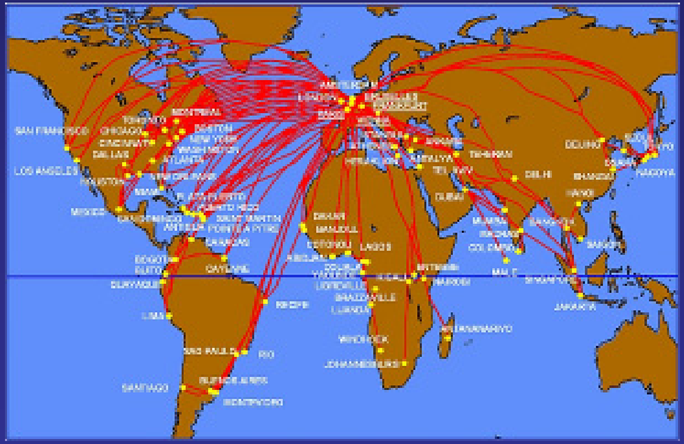
CENR/AQRS



http://www.al.noaa.gov/AQRS/reports/monitoring.html



http://www.igospartners.org/



http://www.fz-juelich.de/icg/icg-ii/mozaic/home
http://www.fz-juelich.de/icg/icg-ii/iagos/

NOAA NESDIS

http://www.nesdis.noaa.gov/

NOAA CMDL

Barrow

Trinidad Head

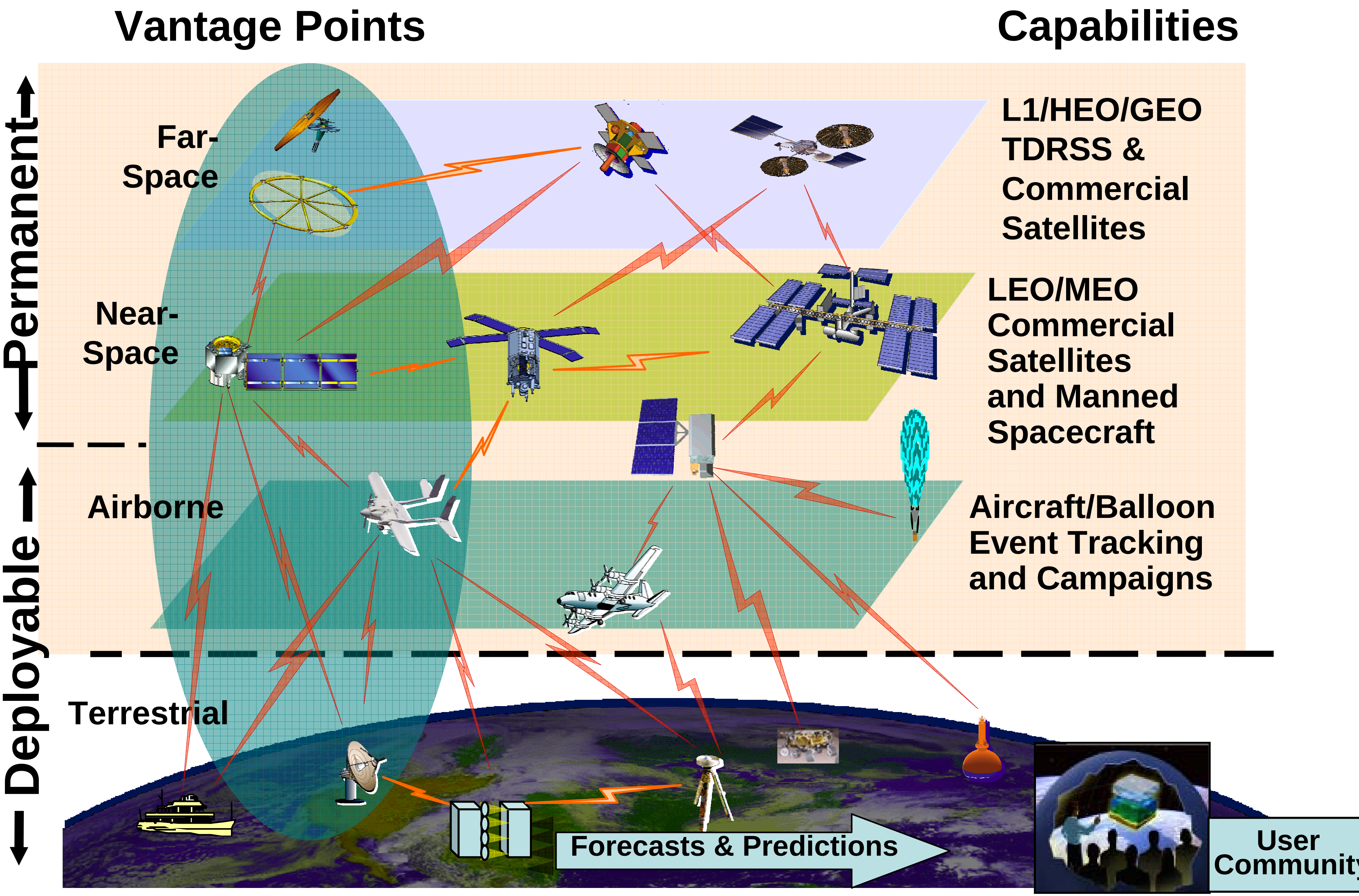
Mauna Loa

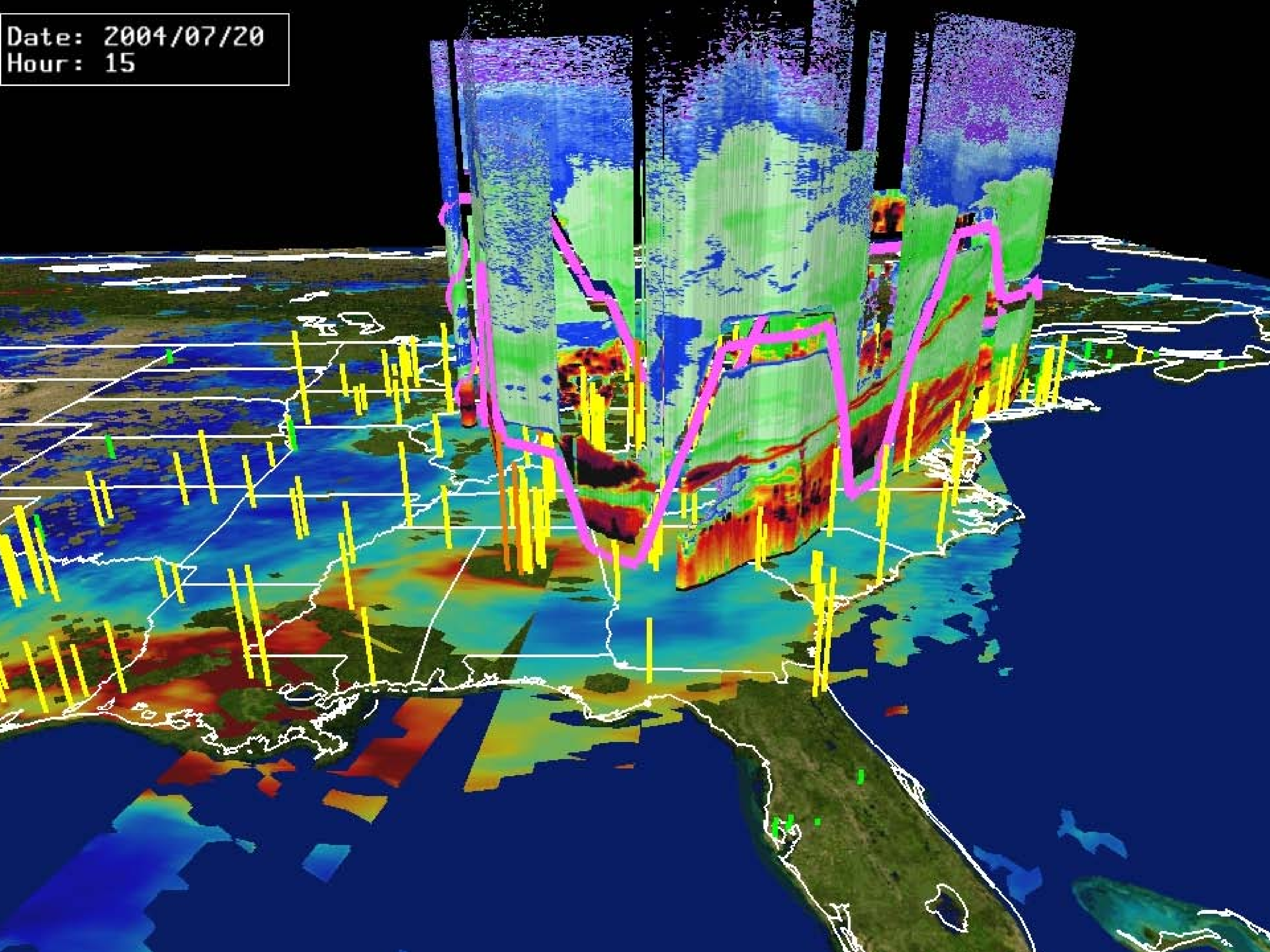
A. Samoa

S. Pole

http://www.cmdl.noaa.gov/

Coordinating Earth Observing Systems




Date: 2004/07/20
Hour: 15

Building an integrated observation-modeling complex: an air program perspective

- Health
  - effects/outcomes associations (PHASE)
  - Public health warnings/forecasting
- Air program support
  - defining attainment/nonattainment areas (and projection, *current practice*)
  - developing emission strategies
  - accountability
- Environmental
  - Ecosystem deposition assessments/support
  - AQ trends in National Parks
  - Regional haze assessments
- Atmospheric science
  - Diagnosing emissions and models

Benefit from Air quality characterizations

And benefit even more from rich (t,s,c) AQ characterizations

Note: IGACO; AQ, ox eff., strat-O3, climate

Why we need to support air quality-public health partnerships

Life expectancy by States,

To illustrate the conundrum of confounding factors…

Rank	State	Life Expectancy
1	Hawaii	80.0
2	Minnesota	78.8
3	Utah	78.7
4	Connecticut	78.7
5	Massachusetts	78.4
6	New Hampshire	78.3
7	Iowa	78.3
8	North Dakota	78.3
9	Rhode Island	78.3
10	California	78.2
11	Vermont	78.2
12	Colorado	78.2
13	Washington	78.2
14	Wisconsin	77.9
15	Idaho	77.9
16	Nebraska	77.8
17	Oregon	77.8
18	South Dakota	77.7
19	New York	77.7
20	Maine	77.6
21	Florida	77.5
22	Arizona	77.5
23	New Jersey	77.5
24	Kansas	77.3
25	Montana	77.2
26	Alaska	77.1
27	New Mexico	77.0
28	Virginia	76.8
29	Delaware	76.8
30	Texas	76.7
31	Pennsylvania	76.7
32	Wyoming	76.7
33	Illinois	76.4
34	Michigan	76.3
35	Maryland	76.3
36	Ohio	76.2
37	Indiana	76.1
38	Missouri	75.9
39	Nevada	75.8
40	North Carolina	75.8
41	Georgia	75.3
42	Kentucky	75.2
43	Arkansas	75.2
44	Oklahoma	75.2
45	Tennessee	75.1
46	West Virginia	75.1
47	South Carolina	74.8
48	Alabama	74.4
49	Louisiana	74.2
50	Mississippi	73.6
51	District of Columbia	72.0

Data: Harvard University Initiative for Global Health and the Harvard School of Public Health