The Next Air Monitoring Strategy: Linking Agencies, Disciplines, Media and Global Communities…and the National Academy of Sciences, accountability… and the meaning of satellite data to air program management

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Boulder, CO

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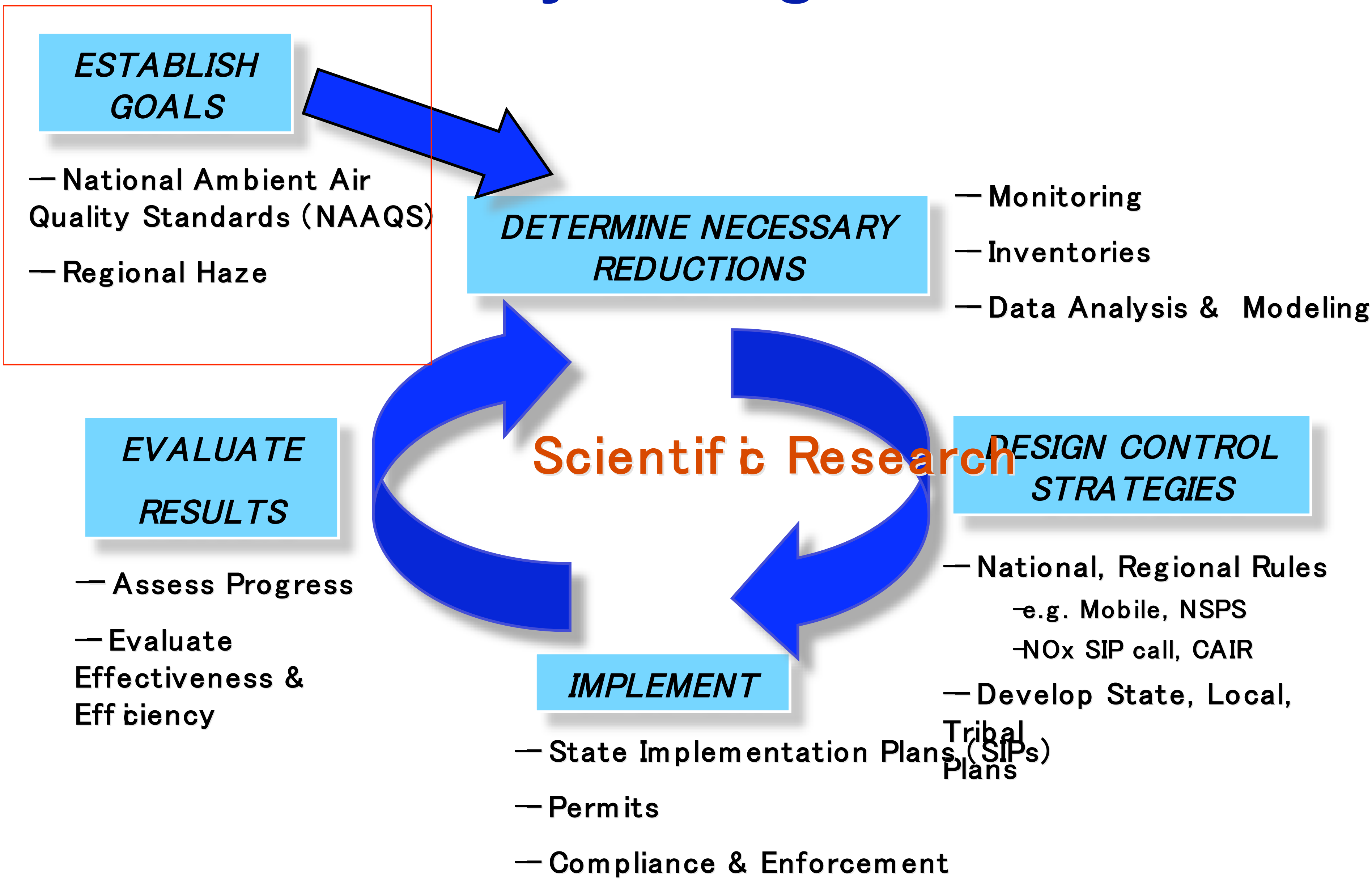
Steve Fine, NOAA, John Bachmann, EPA

Sequence

- Current air program priorities
- Subsequent air issues
- Air program perspective on linkage with satellites and advanced integrated systems

The Air Quality Management Process



Air program drivers

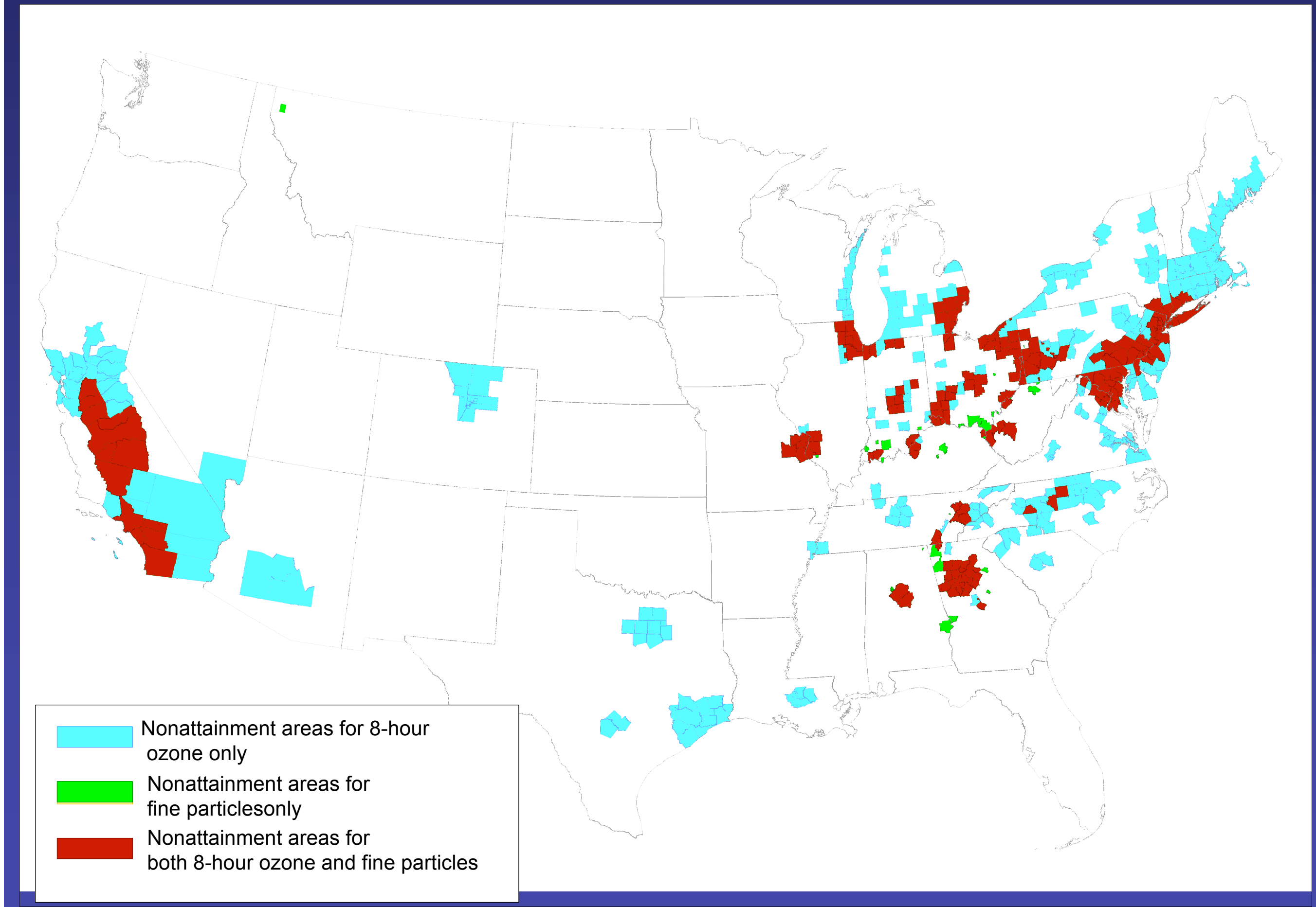
- Pollutant category
  - Criteria: $PM_{2.5}$, ozone
  - Mercury
  - HAPs
- Pollutant sectors
  - Energy
  - Transportation
  - Natural
  - Other (chemical facilities, minerals, coatings, etc.)
- New Themes
  - Multiple pollutant
  - Accountability
  - Multiple media

Response to 2004 NAS Report: AQM in U.S.

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

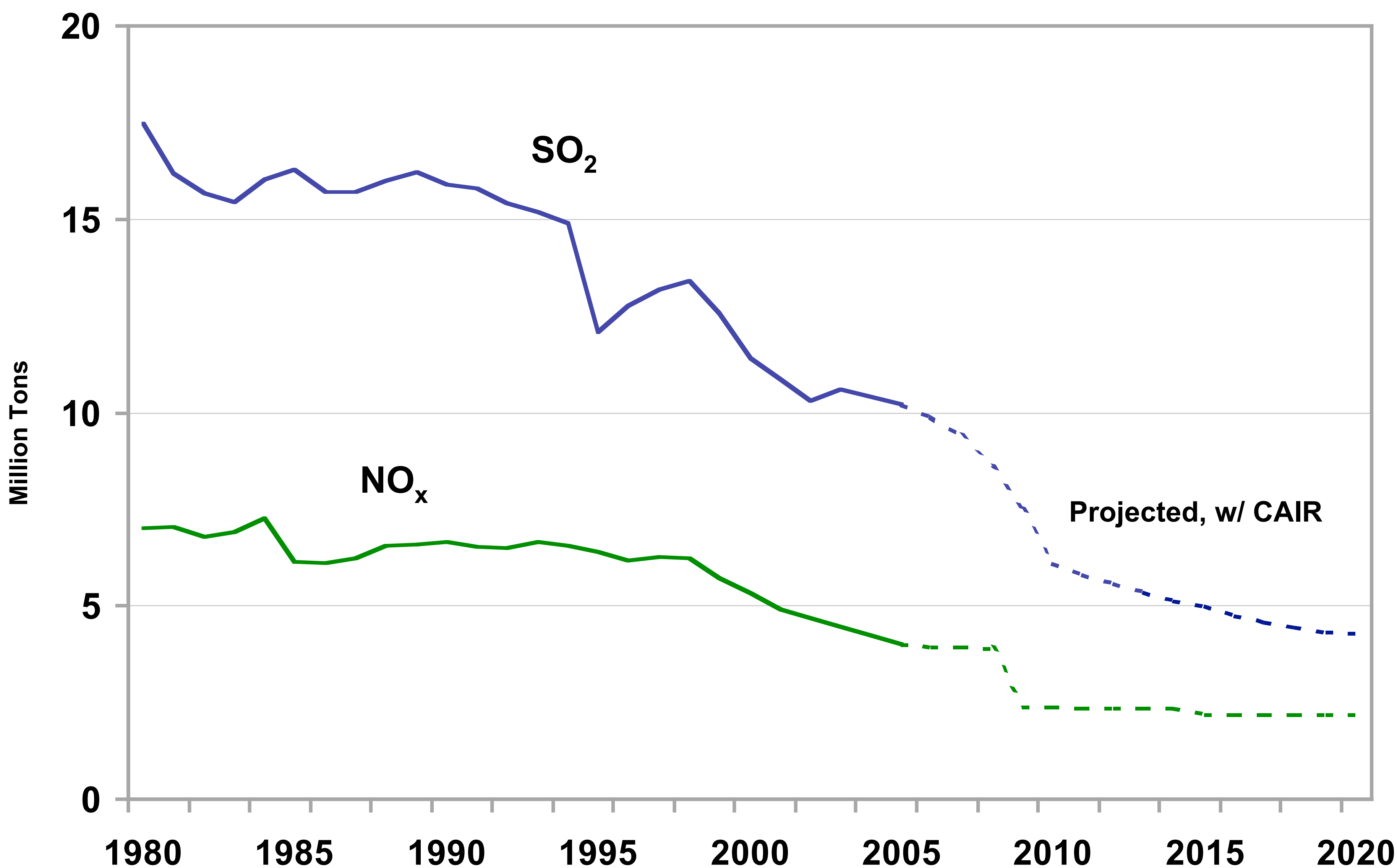


No. Counties with Monitors>NAAQS

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

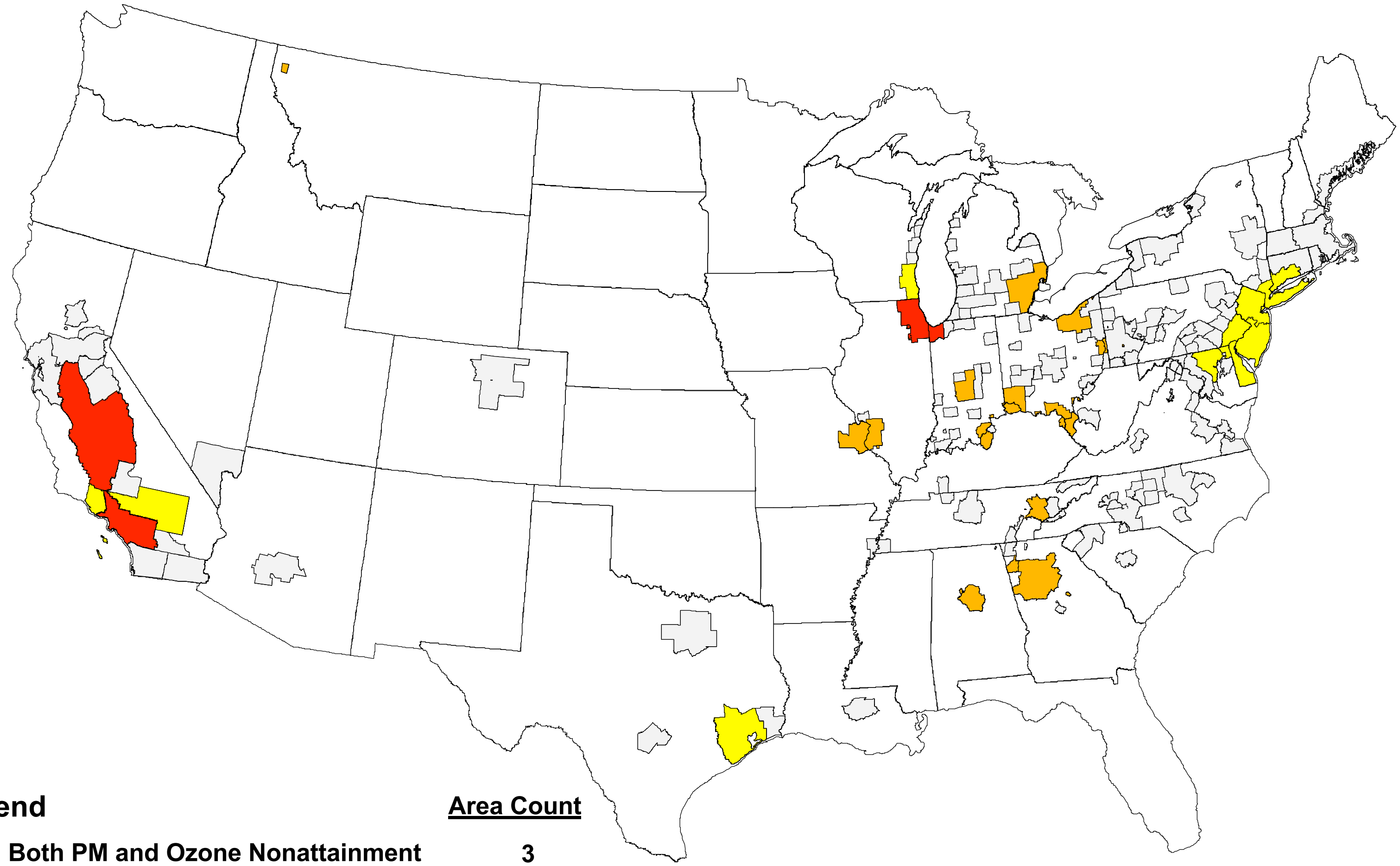
Ozone and PM are our highest priority

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.

PM NAAQS Proposal

- Annual NAAQS 15 ug/m3
  - 24 hour 98th percentile NAAQS 35 ug/m3
  - Replace PM10 with ‘qualified’ coarse standard
    - focus on urban coarse PM resuspended by heavy traffic, industrial sources, and construction
    - excludes rural dust uncontaminated by urban, industrial sources (excludes agriculture, mining, wind blown dust

Counties Exceeding the Proposed PM2.5 NAAQS- 2015 Base Case Annual 15 ug/m3 and 24-Hour 35 ug/m3

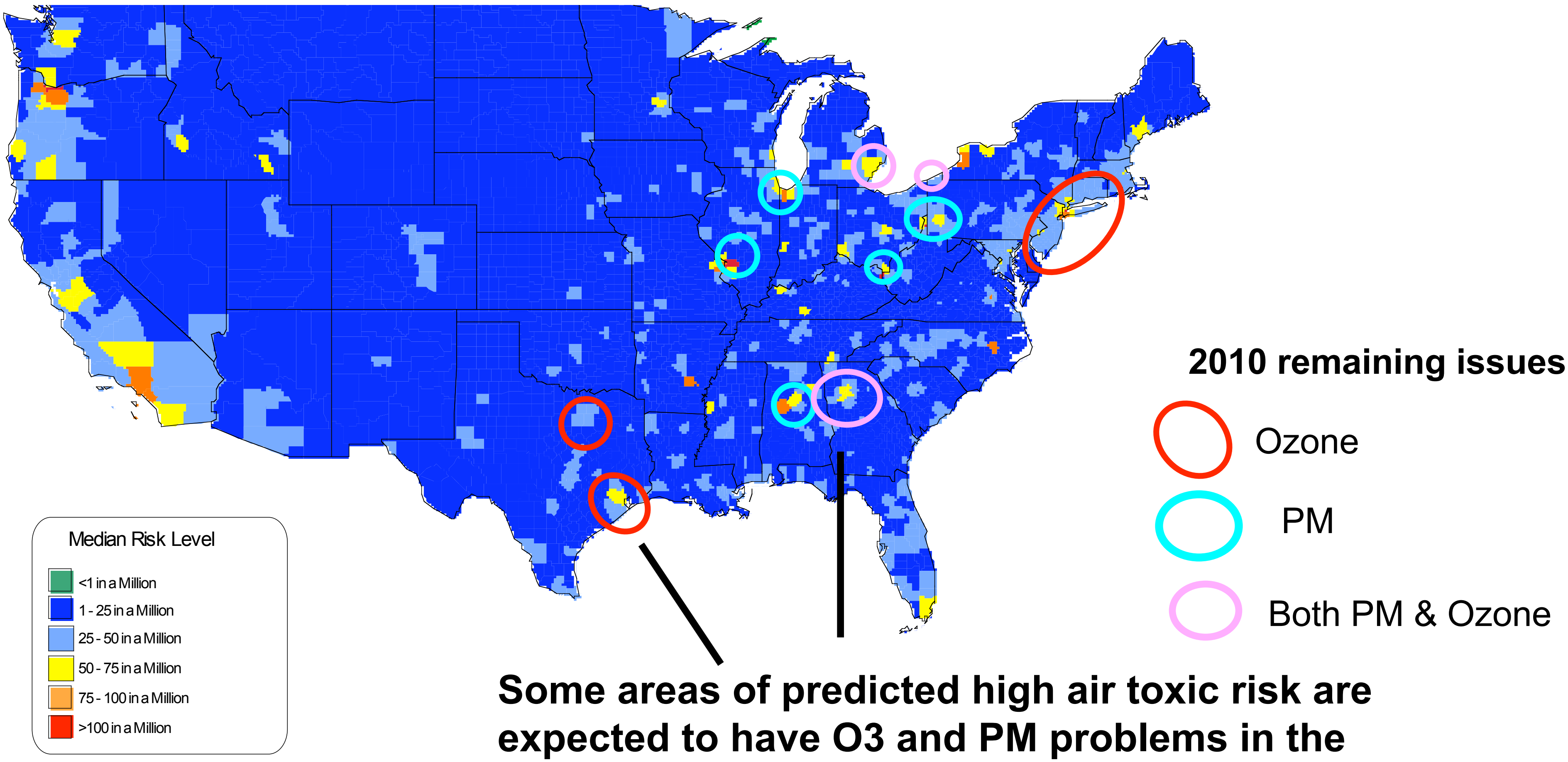
New (proposed) standards increase relevancy
of satellite data and comprehensive observational systems

**EPA models assume implementation of CAIR/CAMR/CAVR, mobile source and other federal rules and existing state programs. Air quality is expected to be better than shown. This approach does not forecast actions states will take to meet current PM standards. Also note that modeled air quality forecasts are subject to a number of uncertainties.*

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

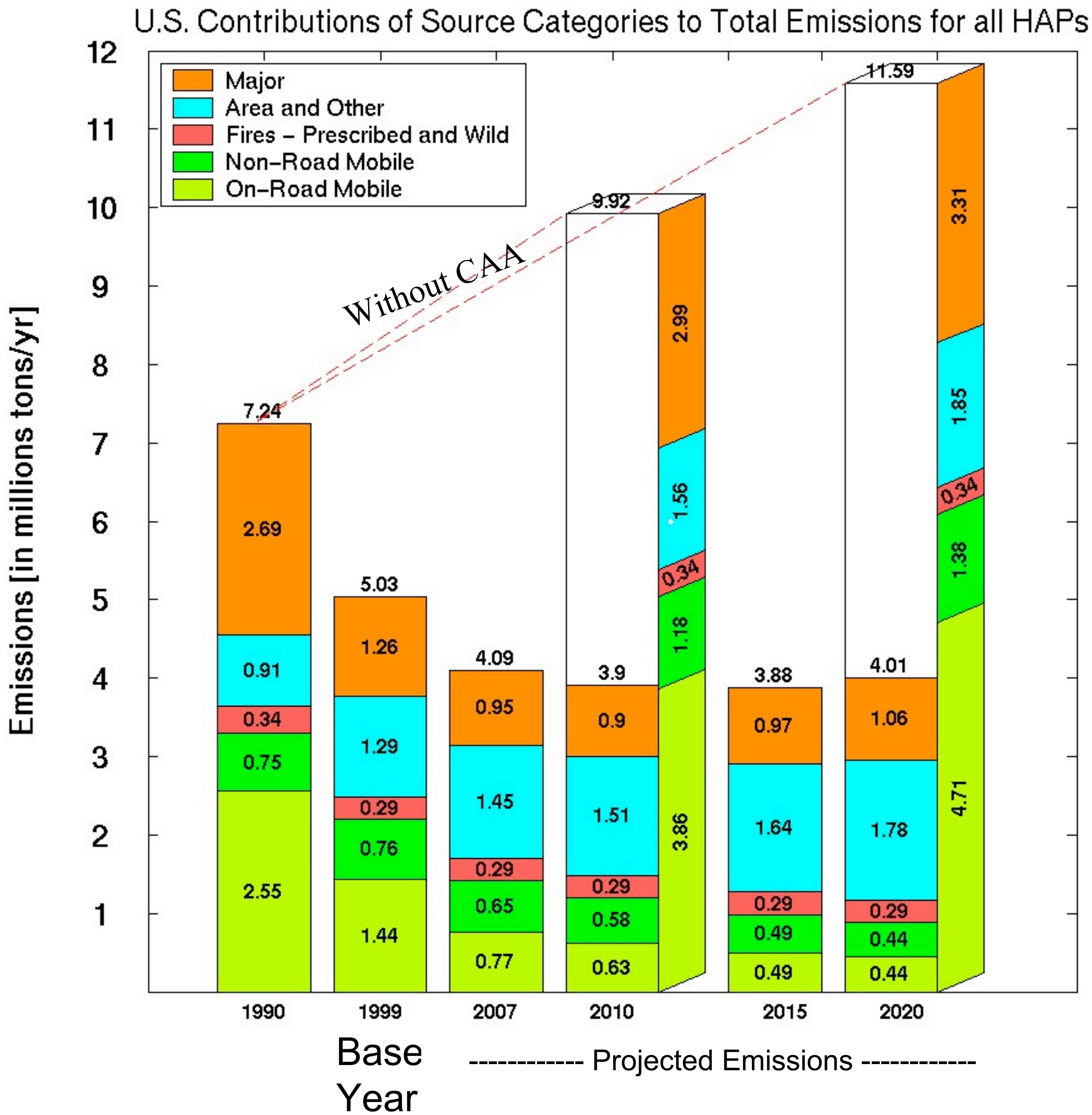
Impetus for multi-pollutant strategies

1999 NATA - National Scale Assessment
Predicted County Level Carcinogenic Risk



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



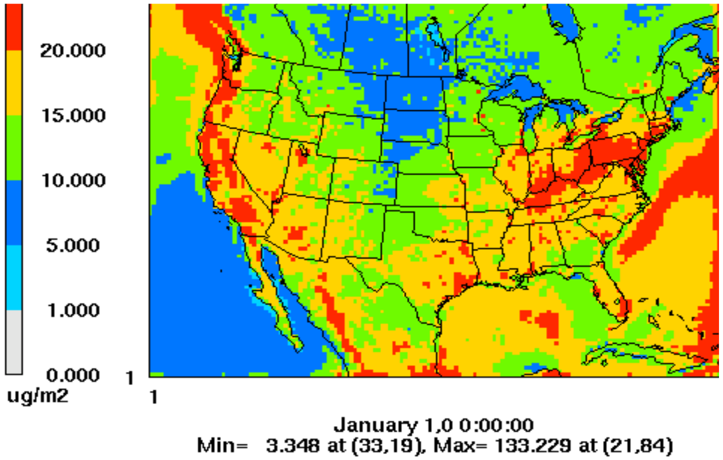
* After 2010, stationary source emissions are based only on economic growth. They do not account for reductions from ongoing toxics programs such as the urban air toxics program, residual risk standards and area source program, which are expected to further reduce toxics. In addition, mobile source reductions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

Key Findings

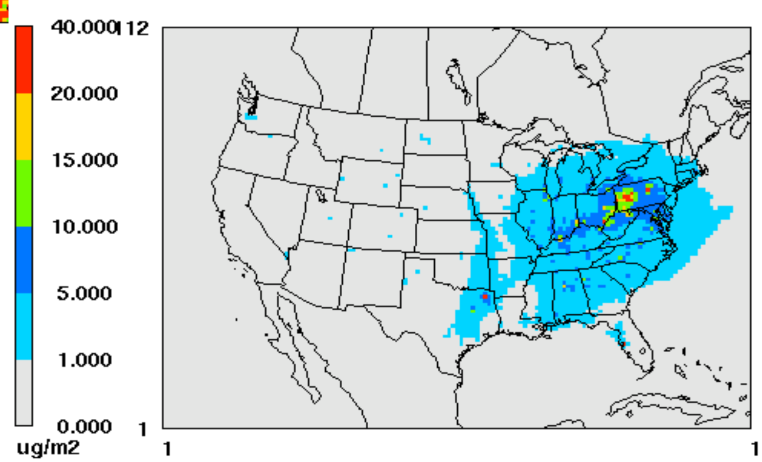
- CAA has been very effective in reducing overall tonnage of air toxics
- In absence of CAA, total emissions would be more than twice those projected in 2020

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

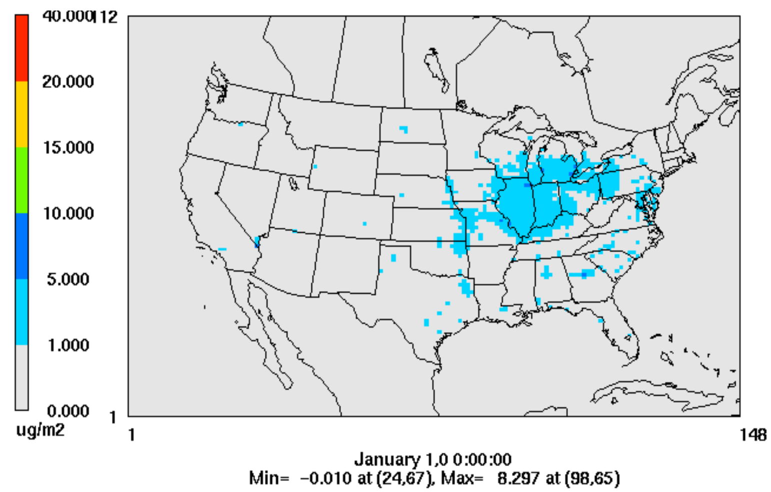
Mercury Deposition From All Sources: 2001



Mercury Deposition from US Power Plants: 2001



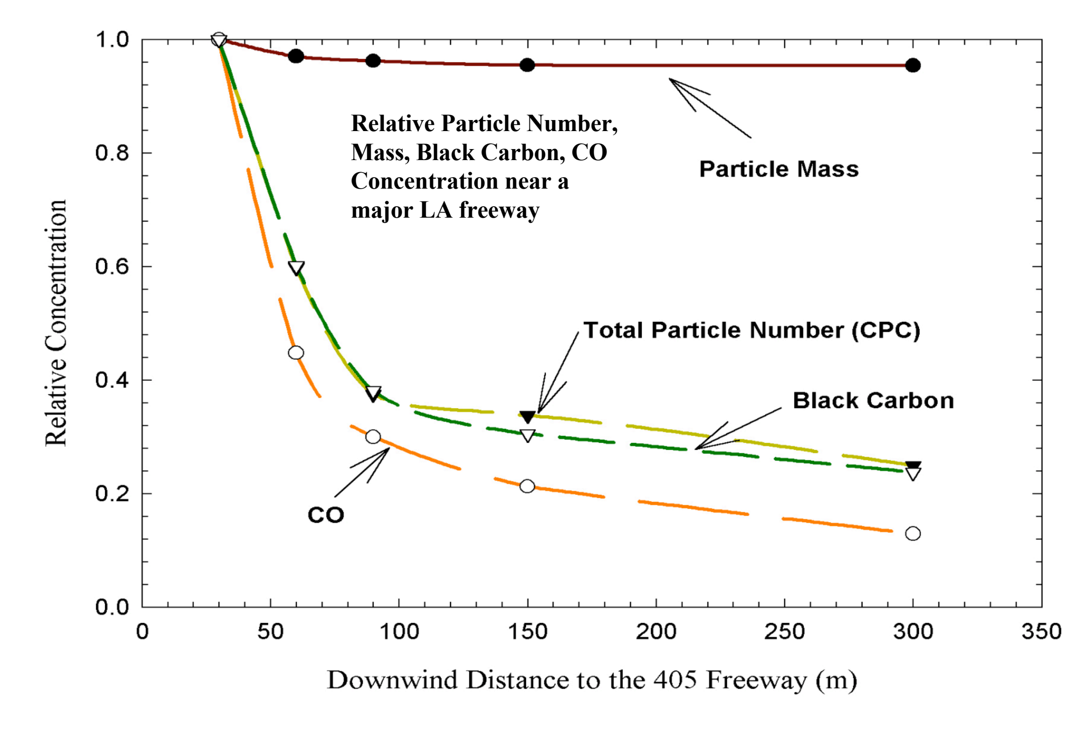
Mercury Deposition from US Power Plants: 2020 with CAIR & CAMR



New findings on roadway pollution

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

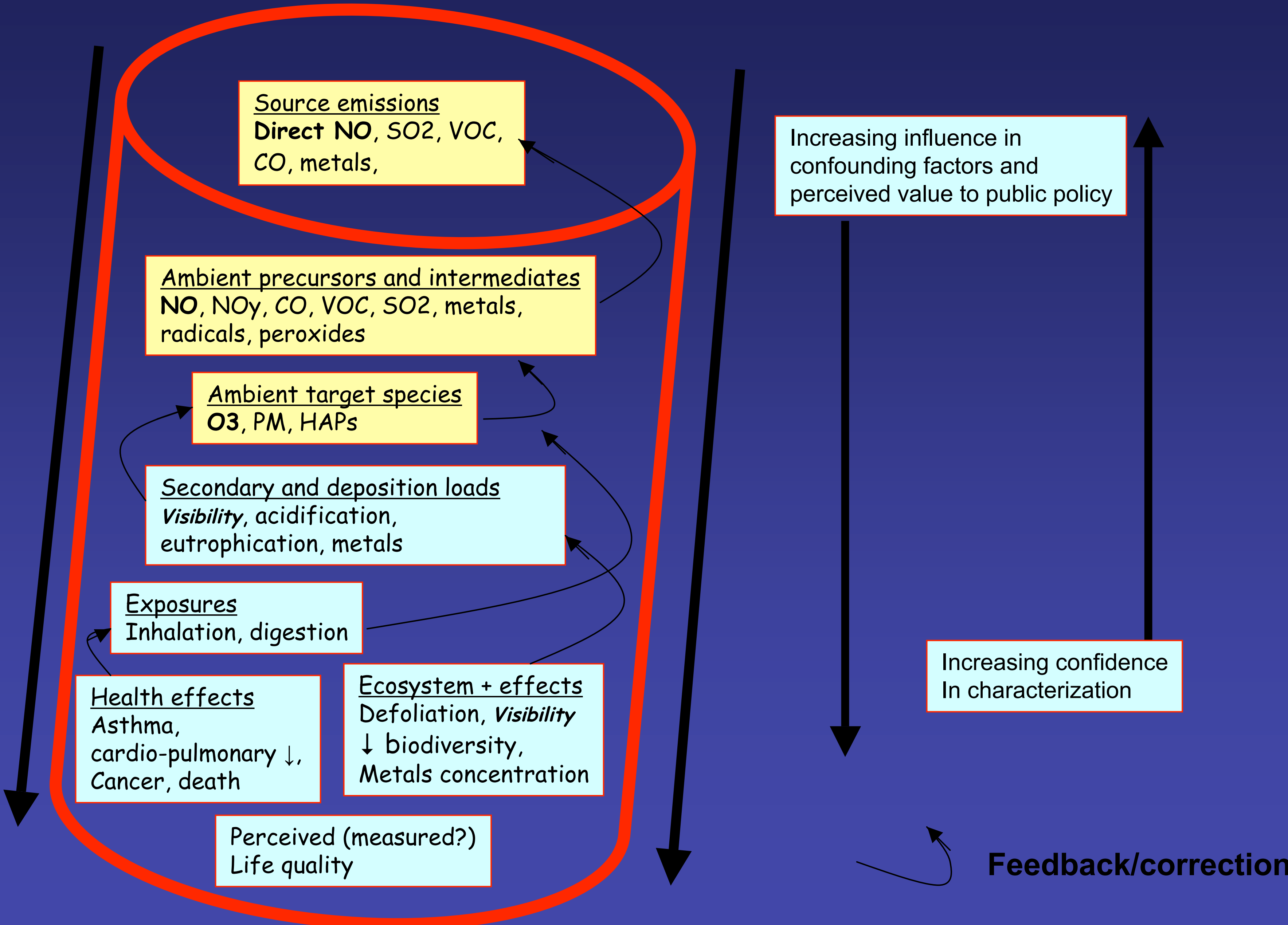
Increased risk near and on roadways



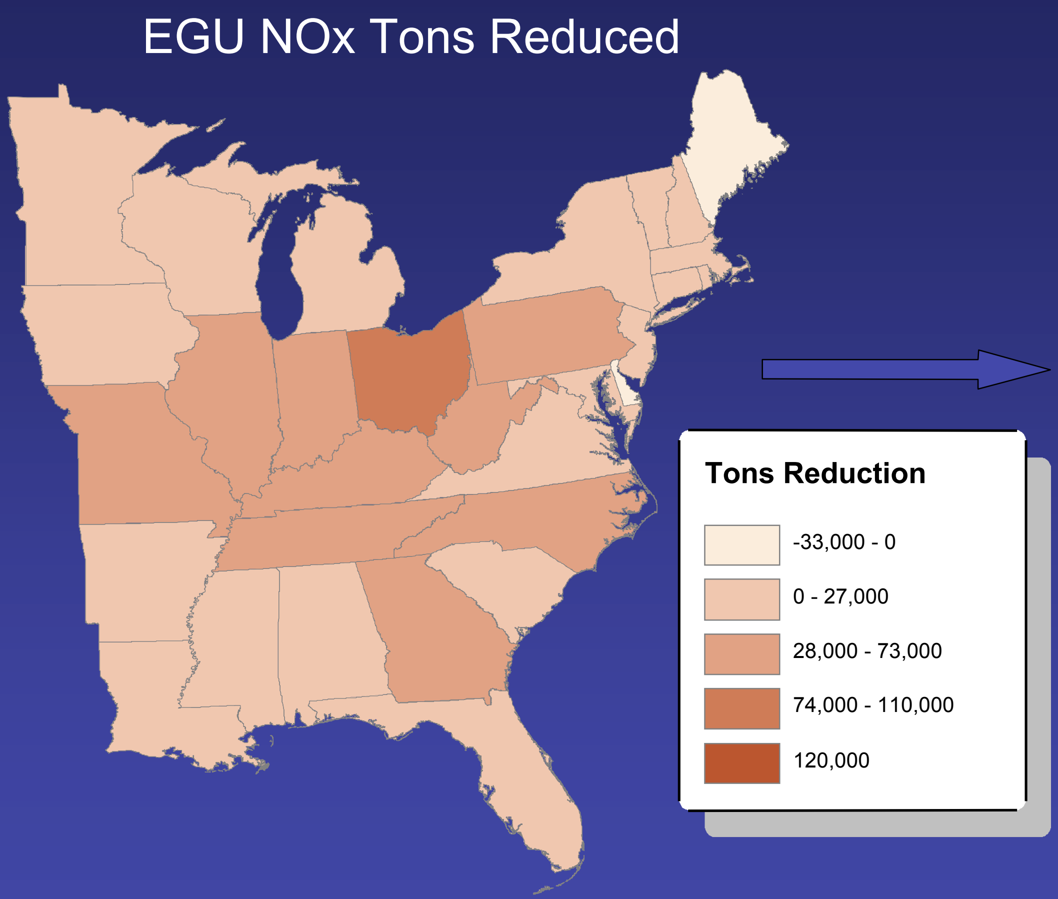
Emerging Challenges for Air Policy

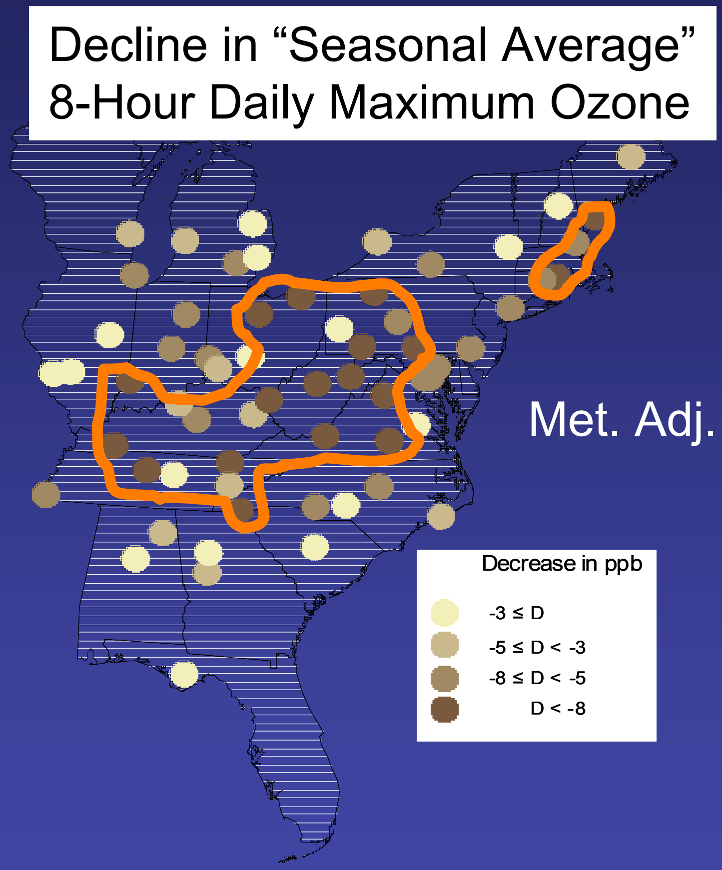
- Meeting NAAQS for O3 and PM2.5 and Reducing Regional Haze
- Designing and Implementing Controls for Hazardous Air Pollutants
- Protecting Human Health and Welfare in the Absence of a Threshold
- Ensuring Environmental Justice
- Assessing and Protecting Ecosystem Health
- Intercontinental and Cross-Border Transport
- Maintaining AQM System Efficiency in the face of Changing Climate

Accountability and Indicators Pipeline



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





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.

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

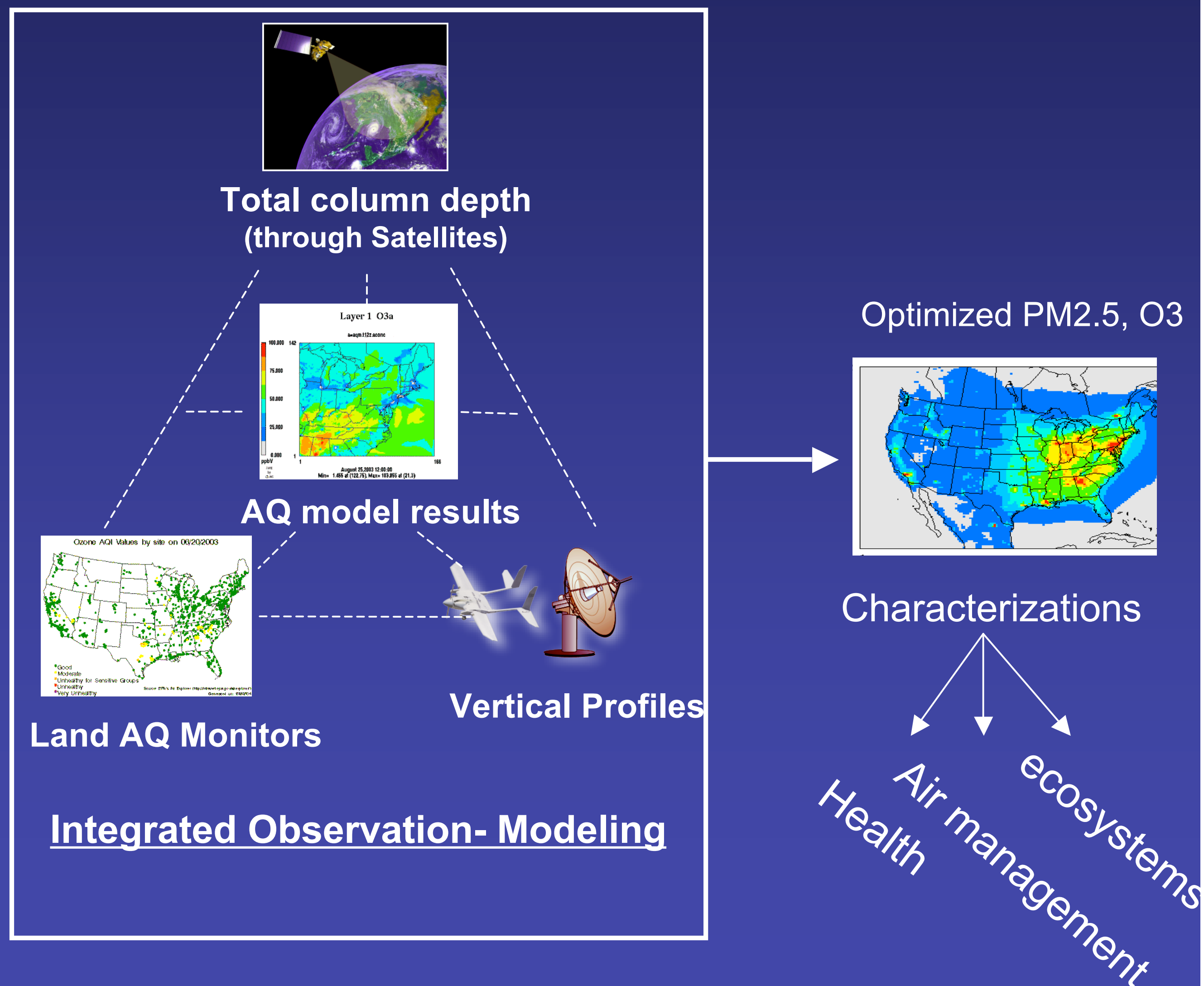
Note: IGACO; AQ, ox eff., strat-O3, climate

Consequently

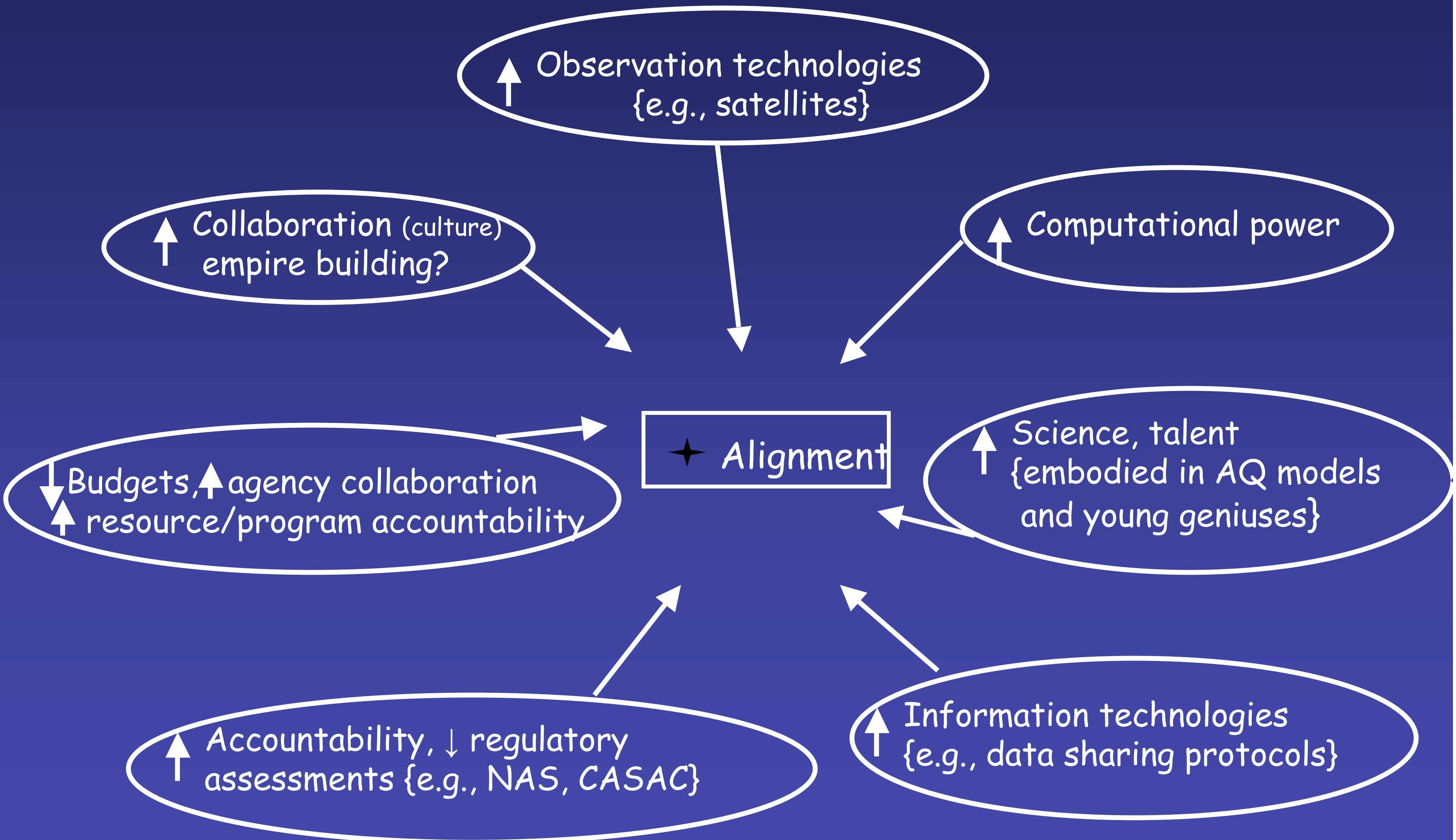
- A simple overarching goal or vision,
  - Strive for maximum and efficient AQ characterization in time, space and compositional terms
- the intersecting or common link between air programs and satellite data and integrated advanced systems

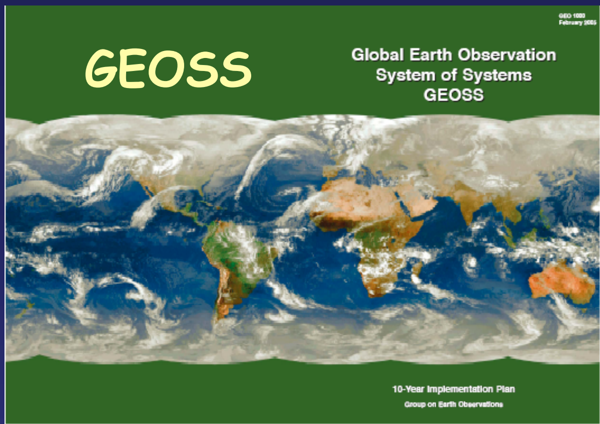
TGAS/Aerosol Satellite Measurements and Numerical Predictive Models

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



Stars aligned?



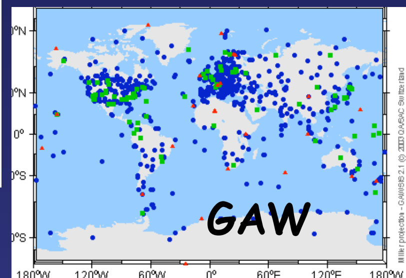


http://earthobservations.org/

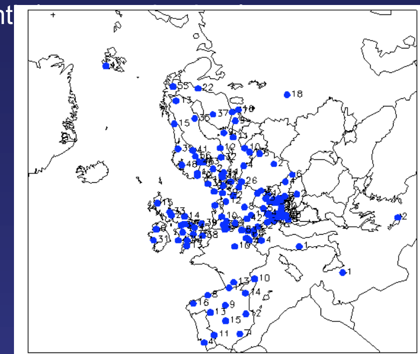
National Ambient Air Monitoring Strategy

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

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

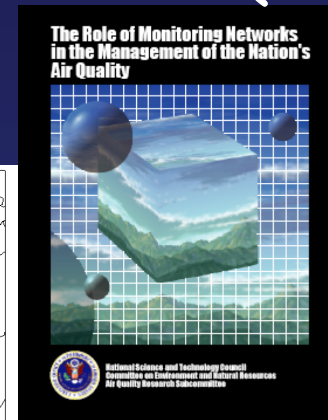


http://www.empa.ch/gaw/gawsis/

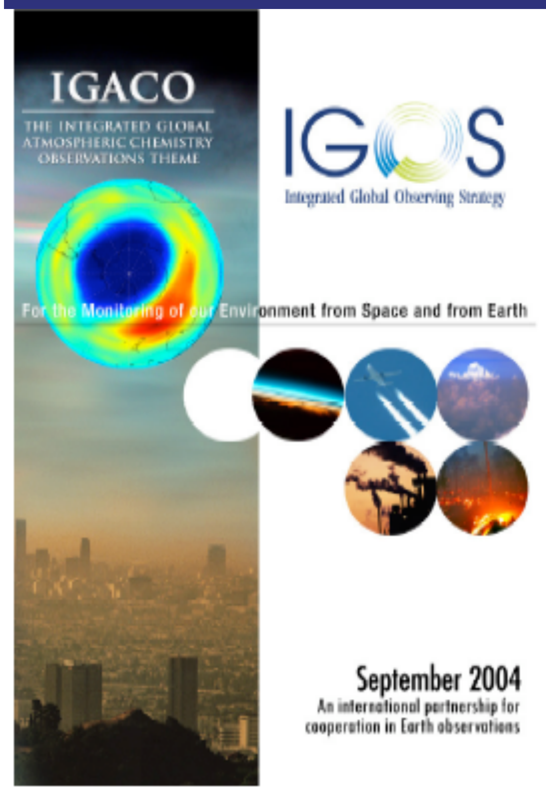


http://www.emep.int/

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/

Common parameters linking column totals and surface measurements

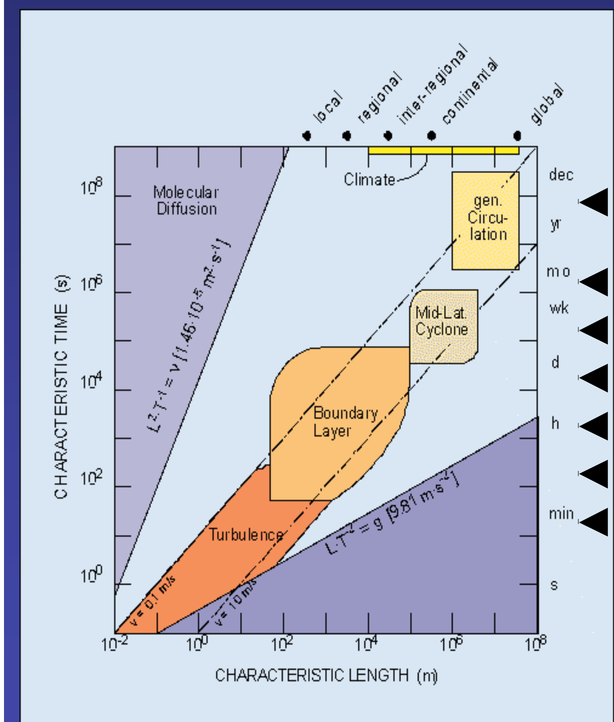
Key species defined by IGACO

Chemical species	*air quality*	*oxidation capacity*	*climate*	*stratospheric ozone*	NCORE Level 2 trace species
O_3	+	+	+	+	+
CO	+	+			+
UV-A $j(NO_2)$	+	+			
UV-B $j(O_3)$	+	+			
H_2O	+	+	+	+	
HCHO	+	+			
C_2H_6	+	+			
$NO_x = NO+NO_2$	+	+		+	+
HNO_3	+	+		+	+
SO_2	+		+		+
BrO, ClO, OClO				+	
HCl, $ClONO_2$				+	
CH_3Br, CFC-12, HCFC-22				+	
aerosol optical properties	+		+	+	
CO_2			+		
CH_4		+	+	+	

Contributions of Space Observations for Air Quality

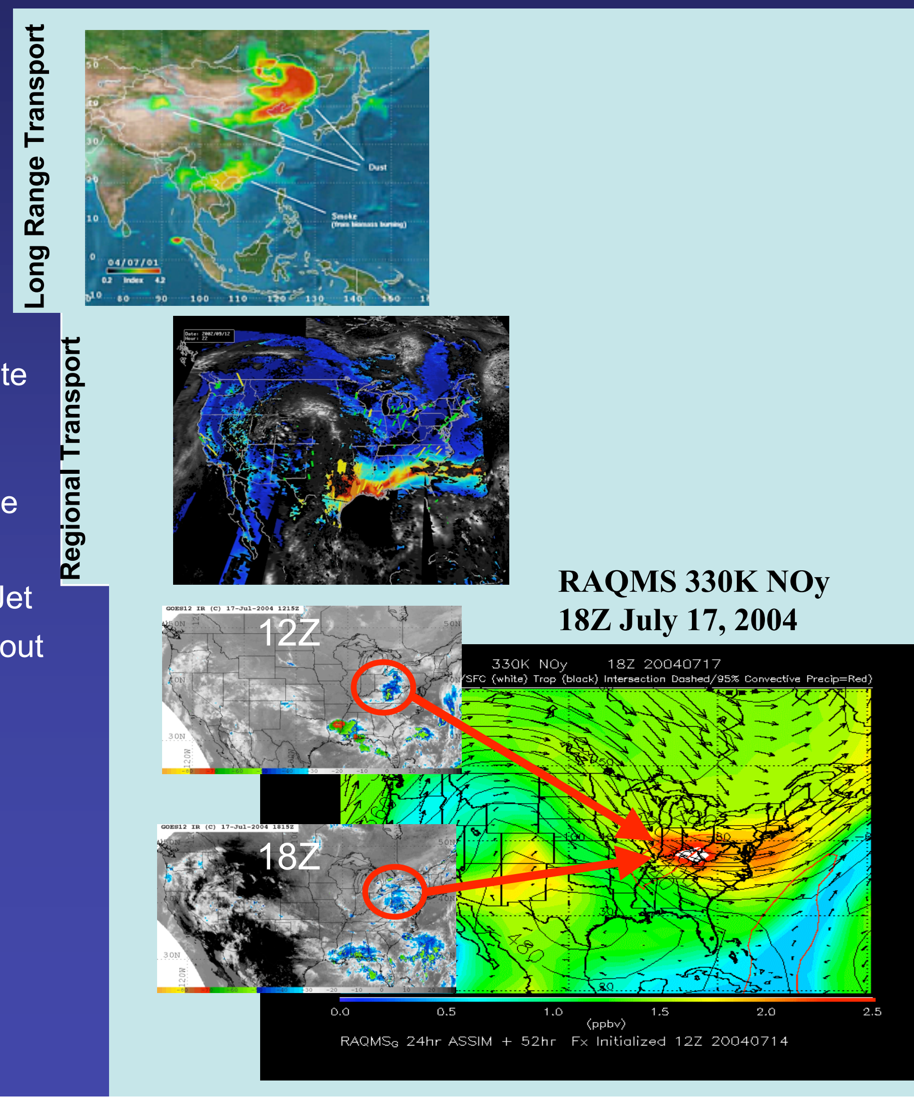
- Gap filling Inherent spatial averaging usable for air quality models vs. point in-situ observations (***vertical profiles needed for linkage***).
  - Fills in gaps over large water bodies and remote land areas
  - Critical support for inverse modeling and improved emission inventories
- Uniformity overcomes inter-calibration issues for ground-based instruments.
- Scale connection Synoptic views can inform inter-relations of processes of different scales (likely requires complementary geostationary and polar orbiting satellites), relevant for study of global-to-regional connections.
- Process connection Observe and monitor the connections between emissions and weather phenomena.
  - Monitor the onset, progress, and decay of severe-episodic air quality events.
  - Identify and locate interactions between pollution and synoptic systems like troughs/ridges, jet streams, regions of intense convection, and convergence zones on a continuous basis.
- Media connection Movement toward bi-directional multimedia assessments
  - Adding in carbon exchange, surface characterization, climate and other strategies that impact emissions and AQ
  - Require whole Earth..space based chracterizations

Process Scales relevant to Air Quality vs. Space Observations



Pollution Dynamics

- Global Composition/Climate
- Intercontinental Transport
- Regional Haze/Subsidence
- Strat/Trop Exchange
- Residual layer/Nocturnal Jet
- Convective exchange/rainout
- Urban Canyon



simply, Arithmetic injustice

- Greater than 95% of air pollutant mass is located above 100m,
  yet we (air program community) focus 95 % of our characterization on the bottom 10 meters

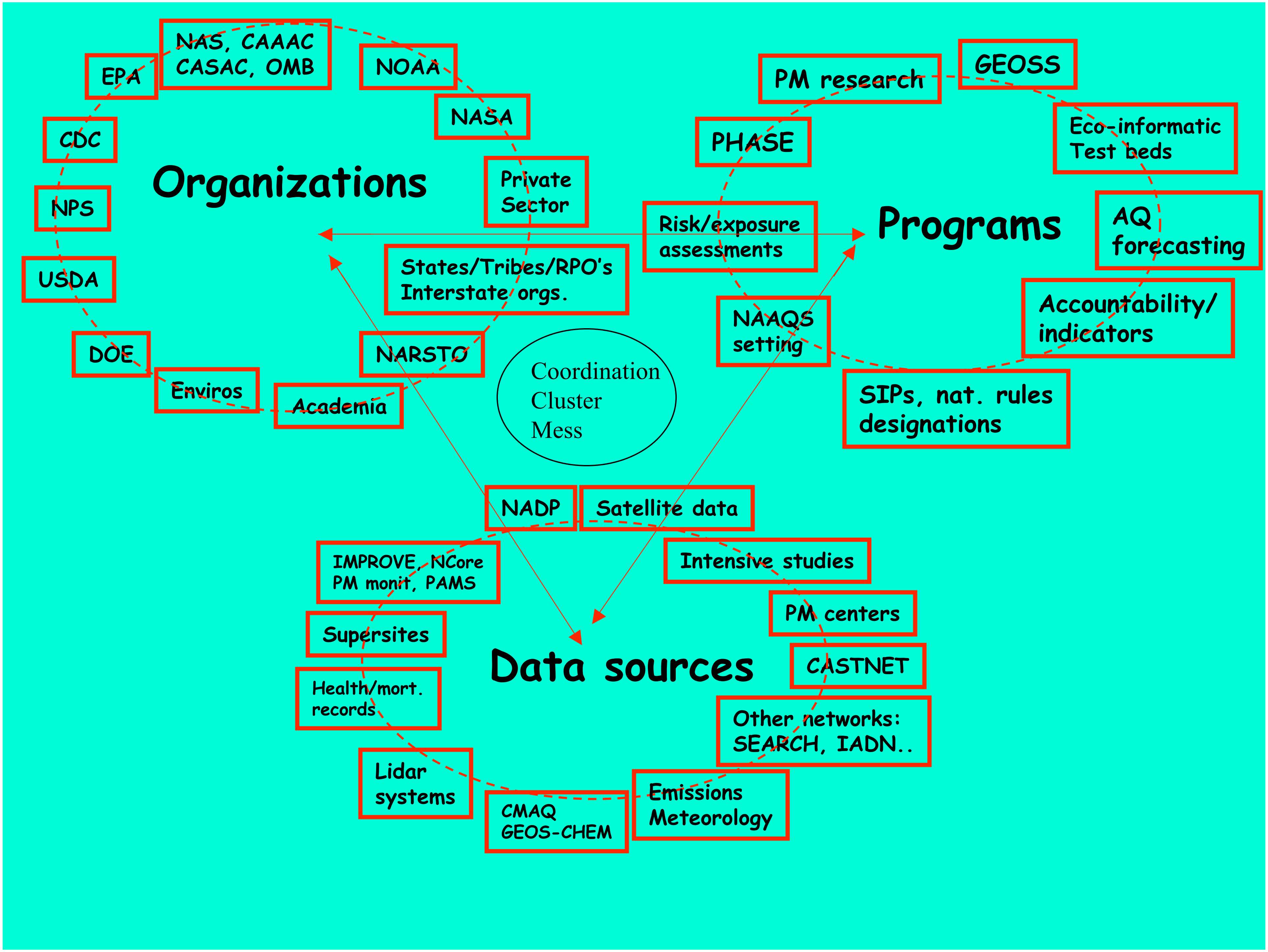
  {compromises both predictive and current characterization phenomena}

Concerns, practical considerations, communications, steps

- What is the most practical role for satellite data in surface applications?

  (Beyond conceptual model development)

  - Key in constraining and diagnosing model behavior
  - Real strength will be in chemical data assimilation in a modeling framework
    - Subsequent role in any air program related assessment
- Increasing relative contribution of Hemispherical Transport
  - Adds increased reliance on satellite products for both conceptual model formulation and improved global-regional model linkage
  - Further enhanced with tighter daily aerosol standards
- Identifying and building known integration steps
  - Vertical profiles (ground, aircraft (MOZAIC/IAGOS), space (TES, Calipso)\
  - Chemical data assimilation-model fusion
  - Data storage, harmonization, interpretation and delivery


Organizations
EPA
NAS, CAAAC CASAC, OMB
NOAA
NASA
CDC
NPS
USDA
Private Sector
States/Tribes/RPO's Interstate orgs.
DOE
Enviros
Academia
NARSTO
Coordination Cluster Mess
Programs
PM research
GEOSS
PHASE
Eco-informatic Test beds
Risk/exposure assessments
AQ forecasting
NAAQS setting
Accountability/ indicators
SIPs, nat. rules designations
Data sources
NADP
Satellite data
IMPROVE, NCore PM monit, PAMS
Intensive studies
Supersites
PM centers
CASTNET
Health/mort. records
Other networks: SEARCH, IADN..
Lidar systems
CMAQ GEOS-CHEM
Emissions Meteorology