NARSTO and the Multi-Pollutant Accountability Assessment
What Is NARSTO?

• A multi-stakeholder, public-private partnership among government, the private sector, and academia throughout Canada, Mexico, and the United States that collaborates to improve air quality management science in North America.

• NARSTO’s charter enables it to take on a wide variety of activities, but its principal role has been in the production of policy-relevant scientific assessments.
Some History

- RETHINKING THE OZONE PROBLEM IN URBAN AND REGIONAL AIR POLLUTION
- NRC
- 1991
- NARSTO
- 1995
- 2000
- 2003
- 2005

NRC Reports On PM Research (1999-2004)

- An Assessment of Tropospheric Ozone Pollution — A North American Perspective
- Particulate Matter Science for Policy Makers
- Improving Emission Inventories for Effective Air Quality Management Across North America

A NARSTO Assessment
Prepared by:
The NARSTO Emission Inventory Assessment Team
The Current Assessment

• Motivated by the 2004 NRC report: *Air Quality Management in the United States; themes:*
  – *Multiple pollutants*
  – *Multiple media – ecosystems*
  – *accountability*

• Scope: Conduct an assessment of the technical challenges of implementing “accountability” within a risk-based, multi-pollutant air quality management framework

• Accountability: The process of evaluating the effectiveness of air quality management actions in terms of their success in achieving air quality management goals.
The Air Quality Management Process

**ESTABLISH GOALS**
- National Ambient Air Quality Standards (NAAQS)
- Regional Haze
- Critical loads?

**DETERMINE NECESSARY REDUCTIONS**

**EVALUATE RESULTS**
- Assess Progress
- Evaluate Effectiveness & Efficiency

**IMPLEMENT**
- State Implementation Plans (SIPs)
- Permits
- Compliance & Enforcement

**DESIGN CONTROL STRATEGIES**
- National, Regional Rules
  - e.g. Mobile, NSPS
  - NOx SIP call, CAIR
- Develop State, Local, Tribal Plans

**MONITORING**
- Monitoring

**INVENTORIES**
- Inventories

**DATA ANALYSIS & MODELING**
- Data Analysis & Modeling

**SCIENTIFIC RESEARCH**
Multi-Pollutant Analytical Framework

Future = National Air Pollutant Assessment

- Control Strategies
- Criteria Pollutants
- Ecosystems
- Air Toxics

Modeling Platform
- Emissions Inventory
- Air Quality Modeling
  - Regional
  - Local
- Ambient Data
- Spatial Surfaces

Legend
- In Place
- Requires development

Cost

Benefits Assessment

Exposure/Risk Analysis

Benefits Assessment

PHASE

NEI

EMAP/AERMUD

BenMap

BenMap
Source emissions
Direct NO, SO2, VOC, CO, metals,

Ambient precursors and intermediates
NO, NOy, CO, VOC, SO2, metals, radicals, peroxides

Ambient target species
O3, PM, HAPs

Secondary and deposition loads
Visibility, acidification, eutrophication, metals

Exposures
Inhalation, digestion

Health effects
Asthma, cardio-pulmonary ↓, Cancer, death

Ecosystem + effects
Defoliation, Visibility ↓ biodiversity, Metals concentration

Perceived (measured?)
Life quality

Increasing influence in confounding factors and perceived value to public policy

Increasing confidence
In characterization

Feedback/correction
Primary Sources

SVOC

VOC (HAPs)

CO

NO

O3

OH

RO₂, HO₂

hv

NO₂

O3

OH

NH₃

HNO₃

SO₂

H₂SO₄

Hg

Hg⁰, Hg²

SVOC

Organic PM

Nitrate PM

Sulfate PM

Chemical Deposition

Traditional NARSTO Atmospheric science perspective
So many feedbacks with increasing impact over time
Scope of Pollutants and Effects?

- Largely determined by authors
- Discussion points
  - Emphasis on pollutants related to major air program implementation efforts
    - Nitrogen, sulfur, ozone, mercury
  - Emphasis on pollutants linked through source, atmospheric chemistry, and/or common scaling characteristics
Assessment Outline

TECHNICAL CHALLENGES OF APPLYING ACCOUNTABILITY-BASED
AIR QUALITY MANAGEMENT WITH A MULTI-POLLUTANT FRAMEWORK
OUTLINE

1. Introduction
2. Decision framework for air quality management
4. Case Studies of multi-pollutant issues and interactions
5. Conventional atmospheric science—current directions, practice and prospective changes
6. Measuring progress in mitigating specific air quality related health outcomes
7. Measuring progress in reducing ecological effects
8. Building a comprehensive accountability system
9. Effects of climate change relevant to air pollution exposure
10. Current constraints on multipollutant management approaches
11. Conclusions and Recommendations
Disciplines Feeding Assessment Report

**Assessment Report**

**TECHNICAL CHALLENGES OF APPLYING ACCOUNTABILITY-BASED AIR QUALITY MANAGEMENT WITH A MULTI-POLLUTANT FRAMEWORK OUTLINE**

- Health Effects
- Networks/Measurements
- Ecosystem effects (aquatic/terrestrial)
- Integrated Systems Modeling
- Multi-dimension Risk and decision models

Diagram showing relationships between the disciplines.
What We Need From You

- From a practical point of view, how (or can) we measure or evaluate the effects of air quality management actions on ecosystem health?
- What is possible now and what might be possible in the future?
- What specific research is needed to achieve what is possible?
- What information is missing?
- What specific observations and model products are needed from the atmospheric science; terrestrial and aquatic (physical/chemical and biological) effects communities?
Schedule

- Health and ecosystem workshops - April 2007
- Guidance to lead authors - May 2007
- Detailed outlines - June 2007
- Prepare draft reports - June - Oct. 2007
- Co-chairs synthesis meeting - Nov. 2007
- Prepare draft synthesis report - Nov. - Feb. 2008
- Final synthesis draft for internal review - March - June 2008
- External peer review - July - Aug. 2008
- Completion of final report - Sept. - Nov. 2008
New findings on roadway pollution

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

Increased risk near and on roadways

Relative Particle Number, Mass, Black Carbon, CO Concentration near a major LA freeway

Downwind Distance to the 405 Freeway (m)
Relative Particle Number, Mass, Black Carbon, CO Concentration near a major LA freeway

Challenge of multiple scales
Evolutional change in National Air Pollution Management

- Initial CAA
- Biogenics
- Regional science
- 8-hr ozone PM$_{2.5}$ (annual driver)
- Regional Rules
- New PM Standards
- Daily/annual drivers
- Climate-AQ Hemispherical Transport


Legend:
- Local/urban
- Regional
- Hemispheric
Largest decline in ozone occurs in and downwind of EGU NOx emissions reductions (2002-2004)

Decrease from 2002 to 2004 (Adjusted Data)

-3 ≤ D
-5 ≤ D < -3
-8 ≤ D < -5
D < -8

Decrease in ppb

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.
What does accountability mean now?

• Added focus on effects (human health and ecosystems)
  – Linking back to program implementation

• Major programs to be evaluated
  – Continuation of NOx SIP CALL
  – CAIR: major SOx, NOX and Hg reductions over next 2 decades
  – CAMR: continued Hg reductions after CAIR
  – Mobile source rules
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.
Annual Changes in Satellite NO\textsubscript{2} Columns and Emissions

- Bottom-up NO\textsubscript{x} emission trend derived from monthly CEMS reports assuming all other NO\textsubscript{x} sources constant at summer 1999

Ohio River Valley 1997
E(NO\textsubscript{x}) \approx 50\% power plant

Northeast Urban Corridor 1997 - 2005
E(NO\textsubscript{x}) \approx 20\% power plant

Ohio River Valley 2005
E(NO\textsubscript{x}) \approx 20\% power plant

June-August averages 1997-2005 trends normalized to 1999 value

- Ohio: Satellite
- Ohio: Emission inventory
- Northeast US: Satellite
- Northeast US: Emission inventory

Similar trends in satellite NO\textsubscript{2} columns and NO\textsubscript{x} emissions
- Power plant NO\textsubscript{x} controls have affected NO\textsubscript{2} columns
- Mobile NO\textsubscript{x} emission changes smaller than those for power plants

Courtesy NOAA, Kim et al.