Developing an Open, Coordinated and Collaborative Atmospheric Mercury Monitoring Network in North America

NADP Atmospheric Mercury Initiative
http://nadp.sws.uiuc.edu/mtn/

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Regulations + Monitoring = Accountability

The protection of the environment has often been deemed successful when there is a regulatory driver and complimentary monitoring component.

Comment: The next few slides illustrate both planned and unplanned success and yet to be realized success of the monitoring + regulations equation.
Prime example of high quality monitoring
Lacking a regulatory driver means success has yet to be realized for global CO₂
Success! - NADP SO$_4$ Deposition

Figures courtesy of Jim Lynch and Van Bowersox
Unanticipated success due to economic collapse in Eastern Europe

Total Gaseous Mercury at Swedish West Coast 1979 to 2002

Large influence from European emissions and regional transport

Mainly global background

Figure Courtesy of Dr. John Munthe, IVL, Sweden (john.munthe@ivl.se)
Largely missed opportunity to monitor success of regulation of medical and municipal waste incineration

No monitoring = No assessment of local scale impact reduction

Emissions dropped ~50% from 1990 to 1999

USA medical, municipal and hazardous waste incineration are biggest contributor to drop in emissions and local-scale source impacts.

EPA-HQ-OPPT-2005-0013
http://www.epa.gov/mercury/roadmap/htm
Maximum Hg emission period was missed in South Florida (MDN-FL11)

Comment: Emissions were overwhelmingly from medical and municipal waste incineration. What would we give now to have some air and deposition measurements in S. Florida from 1985-1993?
Example of unplanned local scale monitoring assessment

Interpretation is straightforward when Hg emissions decrease is large and abrupt

NADP-MDN Site
WA18, Seattle, USA
Abrupt decrease after 1997 due to closure of several medical waste incinerators (MWI) in Seattle (scale = 20km)

Pre-1997 Hg deposition in Seattle was not dominated by Asian and global sources!

Continuous monitoring has lagged behind emission source changes creating uncertainty in assessment of trends.

Regional, not global source emission reductions may better explain drop in signal at Rörvik in S. Sweden.

Alert, Nunavut
Steffan et al.
GEM 1.5 ng/m³

Mace Head, IR
Ebinghaus et al.
TGM 1.5 ng/m³

Anthropogenic Hg Emissions
Tons/year x 1000 (Pacyna et al. 2006)

Slemr et al., GRL 2003
CAIR, CAMR, CAVR Implementation Timeline

NOTE: More stringent State regulations will be in effect sooner!

**CAIR**

**Phase I: CAIR NOx Programs**
- (ozone-season and annual)
- (09)

CSP Early Emission Reduction Period
- (annual CAIR NOx program)
- (07 and 08)

FIP
- (June 06)

CAIR Rule signed

SPs Due
- (Sep 06)

SIPs due
- (Sep 06)

Regional Haze SIPs Due
- (Dec 07)

Phase I: Hg Program
- (10)

**Phase II: CAIR NOx and SO2 Programs Begin**
- (15)

Early reductions for CAIR NOx ozone-season program and CAIR SO2 program begin immediately because NOx SIP Call and title IV allowances can be banked into CAIR.

**CAMR and CAVR**

- States develop SPs
  - (18 months)

CAMR Rule signed

SPs Due
- (Nov 06)

CAVR

CAMR and CAVR

BART Controls Required
- (5 years after RH SIPs approved)

**Phase II: Hg Program**
- (18)

- We have an opportunity to monitor success
- Time is of the essence!

Source: USEPA
CAIR and State Regulations will result in co-benefit mercury reductions by 2010

AGAIN - More stringent State mercury regulations may make this drop larger

Nationwide Mercury Emissions under the Base Case, CAIR, and CAIR/CAMR/CAVR, 2010

Comment: Here is the predicted drop in mercury emissions over the next 3 years – we must begin now

Source: USEPA
CAIR will result in the installation of wet-scrubbers, which will remove SO2 and the water soluble Hg(II) present in flue gas.

This is especially true in the high density Ohio River Valley source region where the biggest change in signal is predicted by economic and air chemistry models.
CMAQ estimated fractional decrease in RGM from 2001 base to 2020 due to CAIR, CAMR and all other expected mercury source decreases (Figure courtesy of Russ Bullock, NOAA on assignment to EPA)

Comment: Thus first tier atmospheric Hg monitoring sites should be in locations where regulatory impact will be greatest and occur the soonest. Although sites that can evaluate a predicted deposition gradient or are regionally and globally representative are critical too.
Current Mercury Monitoring Status

NA-RUMP
(North American Random and Uncoordinated Monitoring Program)

NADP will provide coordination, QA and data products to turn this random mercury monitoring into a functional network?
Comment: The NADP Atmospheric Mercury Monitoring Advocates realize we are just one component. We are entirely dependent on high quality R&D and modeling advancements. It is critical that all three of the above functions are of equal importance.
NADP STRENGTHS

- standardized methods and operations
- internal and external quality assurance
- data management and data products.

Comment: These functions will be accomplished through an open process in collaboration with atmospheric mercury scientists, and federal and state agencies.
Atmospheric Mercury Initiative
Objectives

• Measure concentrations of wet deposition flux (MDN), Hg species, meteorology and land cover variables to provide data for provisional estimate of dry deposition flux.

• Immediate priority will be on areas with a strong impact from local and regional Hg sources expected to change due to regulations

• Longer term will include a mix of local, regional, remote continental and globally source influenced site locations.

Tekran Automated and URG manual mercury speciation methods. The methods use the exact same sample train and analytical method
Scientific Framework and Support

Two documents by scientists and policy makers that justifies development of an atmospheric mercury monitoring network

- SETAC “Monitoring the response to changing mercury deposition”
- EPA PBT Strategy for Mercury

and

- Environment Canada and the Canadian Atmospheric Mercury Network (CAMNet) is proving to be a strong collaboration
The NADP-Atmospheric Mercury Initiative aims to be inclusive and participatory

Attendees at Science Consensus Workshop, NADP Network Info Meeting, and NADP Site Sponsor Meetings May - October 2006
(Please contact us if you want to be involved)

Kevin Cavender, U.S. EPA-OAQPS
David Gay, NADP MDN
Rey Fortes, U.S. EPA-CAMD
Rick Haeuber, U.S. EPA CAMD
Chris Lehman, NADP QA
Eric Prestbo, Frontier Geosciences
Martin Risch, USGS-IN
David Schmeltz, U.S. EPA CAMD
Tim Sharac, U.S. EPA-CAMD

George Allen, NESCAUM
Praveen Amar, NESCAUM
Jack Butler, Cherokee Nation
Tom Butler, Cornell University
Ryan Callison, Cherokee Nation
Linda Candelaria, Santa Ana
Rusty D. Day, NIST
Cari Furniness, North Carolina State Univ
Stephen Hartfield, National Tribal Air Assoc
Maggie Kerchner, NOAA
Michael Koliak, US EPA
Preston Lewis, New York State DEC
Charles J Lippert, Mille Lacs Band of Ojibwe
Winston T. Luke, NOAA
Seth Lyman, Univ. of Nevada
Patrick Bart Malone, NYS DEC
Lisa McClain Vanderpool, US EPA Region 9
Paul Miller, NESCAUM
Kristi Morris, NPS
Todd Nettlesheim, EPA GLNPO
Pam Padgett, US Forest Service
Bruce Rodger, Wisconsin DNR
Eli Scott, US Forest Service
John Sherwell, Maryland DNR
Alan VanArsdale, EPA Region 1
Peter Weiss, Univ of Washington-Bothell
Greg Wetherbee, USGS-BQS
NADP Atmospheric Mercury Initiative
How did we get here?

- Fall 2004 NADP Mtg. – Prestbo and Risch propose Mercury Dry Deposition Advisory Workgroup formation based on realization of huge data gap and high MDN sponsor interest (Workgroup: Prestbo, Risch, Gay, Padget and Artz)

- 2005 NADP Spring Meeting – White paper presented and discussed by Advisory Working Group

- Summer 2005 NADP Exec. Comm. approved effort to proceed with a new initiative for mercury air and dry deposition monitoring

- Fall 2005 Workgroup developed detailed conceptual network design with critical review by EPA CAMD and EPA OAQPS

- Winter 2006 Advocates continue to develop work plan and budget – funded in Spring of 2006

ABOVE WERE UNFUNDED ACTIVITIES
NADP Atmospheric Mercury Initiative
What has been accomplished?

- 2006 - Organized and led two 1-day meetings with the purpose of providing information, input, and involvement.

- May 1, 2006—full day presentation and discussion of the NADP Atmospheric Mercury Initiative with invited NADP collaborators and potential stakeholders at the NADP Spring Meeting

- June 27, 2006—Full day presentation and discussion with invited group of expert atmospheric mercury measurement and modeling scientists to get critical review of “Guiding Principles and Best Practices for Monitoring Atmospheric Mercury”

- Also - July 8, 2006, NADP Executive Committee Update: Approval to continue Atmospheric Mercury Initiative was reinforced
NADP Atmospheric Mercury Initiative Supporting Documents available at http://nadp.sws.uiuc.edu/mtn/

- Network Summary
- NADP New Initiative Draft 12-Point Plan for Atmospheric Mercury Monitoring
- Summary of Comments from May 1, 2006 Meeting on Preliminary 12-Point Plan
- Guiding Scientific Principles for Atmospheric Mercury Monitoring in North America
- Summary of Comments from June 27, 2006 Scientific Expert Meeting
- Network location criteria from 2005
- Executive Committee Motion

FUNDED ACTIVITIES
A special meeting was held on May 1, 2006, prior to the NADP 2006 Spring Meeting in Riverside, CA, to consider a proposed new NADP initiative. The initiative would establish a new NADP network, with a goal of monitoring atmospheric mercury species and mercury wet deposition events to facilitate total and dry deposition of atmospheric mercury for predictive-model evaluation, source-receptor assessments, and spatial-temporal trend analysis.

The proposed network would establish a national network of monitoring stations to collect event-based concentrations of total mercury in precipitation samples; concentrations of atmospheric mercury species from continuous-automated and manually-operated measuring systems; and meteorological measurements for computing mercury wet deposition and estimating mercury dry deposition. Data would be collected with standardized methods developed through USEPA research, quality-assured, and archived in the NADP on-line database. The network would include locations that are regionally representative, rural, urban, and suburban, areas with high levels of mercury emissions and mercury deposition, and within sensitive ecosystems.

The initiative was presented by the Mercury Dry Deposition Working Group (specifically David Gay, NADP/MDN Coordinator; Eric Prestbo, MDN Science Advisor; David Schmeltz, U.S. EPA Office of Air and Radiation, and Martin Rusch, NADP Network Operations Subcommittee) and would complement the existing Mercury Deposition Network.

The NADP Quality Management Plan includes a guide (Appendix D) for the presentation of new initiatives. This guide requires a document that addresses 12 specific points covering purpose, operations, staffing needs and costs, funding, appropriateness to the NADP mission, etc. The NADP Executive Committee is charged with evaluating and approving or rejecting the “12-point plan” for an initiative. In support of this new initiative, a 12 point plan was developed to outline the specifics of the proposal for NADP. Any comments on the plan can be directed to the Working Group, or David Gay (dgay@tnc.edu or 217.244.0462).

On June 27, 2006, a second planning meeting was held where guiding principles for the proposed sampling procedures were discussed. Please see the minutes and notes from this meeting.
Specific Challenge for NADP-AMI Advocates and Stakeholders

A collaborative multi-agency and multi-scientist process is time intensive and thus requires more resources in comparison to an alternative single-agency “mercury czar” type of process.

Comment: The former is highly preferred over the later. However, we must be cognizant of the old adage – too many cooks in the kitchen may spoil the broth.
NADP-AMI Network Activities for 2007
Where are we going?

1. Survey of “best practices” and write SOP for atmospheric Hg speciation with colleagues
2. Data stream web-based products and management
3. NADP admin. and cost structure
4. Develop and internal and external quality assurance program
5. Site location criteria mapping
6. Planning, Communication and Advocacy
Monitoring schematic for CAMR and States regulatory assessment

Comment: The combination of emission and air concentration measurement and wet and dry deposition flux completes the atmospheric fate and transport assessment. The CEM bubble is as complex as the others but not detailed in this diagram.
Comment: Many other sites are currently operating and can be added once the NADP structure is in place. This is not final!

Expected Collaborators
USEPA, NOAA, USGS, Wisconsin DNR, Environment Canada, ARA + S. Company, Ohio U. and Ohio EPA

Maryland DNR, NESCAUM, UMAQL, Indiana DEQ, Florida DEP
Goals for Fall 2007 NADP Meeting

- 8-10 site atmospheric Hg network
- All sites operating on final draft SOP
- Atmospheric Hg webpage with QA’d data
- Draft quality assurance plan
- Start of external QA program
- Historical Hg speciation data on NADP website