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I would like to briefly comment on three issues pertaining to effects of emissions of air pollutants associated with fossil fuel combustion (i.e., sulfur dioxide, nitrogen oxides and mercury) on sensitive watersheds in the northeastern U.S. These comments focus on: 1) effects of acidic deposition on soils, trees and surface waters, 2) effects of atmospheric mercury deposition on watersheds and lakes in remote regions and 3) monitoring programs to evaluate long-term trends of these pollutants.

Acidic Deposition

Acid rain, or acidic deposition, originates from emissions of sulfur dioxide and nitrogen oxides, largely derived from fossil fuel combustion and ammonia, largely released from agricultural activities. Effects of acidic deposition include: 1) accumulation of sulfur and nitrogen, depletion of exchangeable nutrient cations and mobilization of aluminum in soil, 2) stress to red spruce and sugar maple leading to death from climatic disturbance or insect defoliation, and 3) acidification of surface waters and decreases in species richness of aquatic biota. Since 1973 emissions of sulfur dioxide have declined about 35% due to controls on electric utilities in response to the 1970 and 1990 Amendments of the Clean Air Act. These reductions have decreased concentrations of sulfate in surface waters across the northeastern U.S., but with limited improvement in the acid-base status of surface waters. The computer model PnET-BGC has been used to project how an acid impacted forest ecosystem might respond to current proposed additional controls on emissions from electric utilities. Model calculations have indicated that additional controls in sulfur dioxide emissions beyond those required in the 1990 Amendments of the Clean Air Act will be necessary to accelerate chemical recovery of soils and surface waters.

Mercury

Many lakes in remote regions of eastern North America contain fish with elevated concentrations of mercury. This mercury is largely derived from atmospheric deposition and is predominantly in the form of ionic mercury. In wetlands and lakes, ionic mercury is converted to methyl mercury by bacteria. Methyl mercury is a powerful neurotoxin. Although concentrations of methyl mercury are very low in water, processes allow this substance to bioconcentrate through the aquatic food chain. Large older fish and piscivorus fish generally exhibit the highest concentrations of methyl mercury. Concentrations of methyl mercury are concentrated by a factor of a million to ten million from water to fish. Consumption of fish is the primary mechanism of human exposure to methyl mercury. Birds which consume fish as a large portion of their diet are also susceptible to mercury poisoning. Data from lake regions impacted by acidic deposition show that fish mercury concentrations increase with decreases in lake pH. Thus acidic deposition and acidification of surface waters exacerbates the problem of elevated mercury in fish tissue.

Data from sediment cores collected and dated in remote lakes in the Adirondack region of New York show a 3.5 fold increase in mercury deposition since 1850. Deposition of mercury increased markedly in the late 1800s and in most lake watersheds peaked approximately 20 years ago. There have been modest decreases in sediment mercury deposition in Adirondack lakes in recent years. Initially with the onset of increases in mercury deposition most of the mercury entered remote lakes from direct deposition to the lake surface. Mercury deposited on the land surface was largely retained in soil. Over time watershed retention of mercury has decreased. As a result, today much of the mercury entering many lakes is

derived from mercury previously deposited on the land surface. It is anticipated that if atmospheric inputs of mercury would decrease associated with emission controls, mercury that was previously deposited on the land would continue to be transported to lakes, thereby delaying recovery.

MONITORING

Environmental monitoring is critical to national environmental policy. Monitoring of atmospheric deposition and surface water chemistry provides the only quantitative means of assessing the efficacy of state and federal policy. There are several national monitoring networks that provide data to scientists and policymakers and need greater security and support. Five specific networks require increased federal funding to stabilize, expand and/or update the monitoring network.

1. National Atmospheric Deposition Program (NADP)

The NADP program is a successful inter-agency network that monitors wet deposition of sulfate and nitrate associated with fossil fuel emissions. The U.S. Geological Survey (USGS) is the lead federal agency and the Environmental Protection Agency (EPA) plays a strong supporting role. The coverage and baseline funding for this program are adequate to ensure a high-quality network. However, as the oldest network in the U.S., the system needs substantial modernization and a modest number of new sites. The NADP network currently relies on WWII vintage equipment.

Proposal:	Amount:	Agency:
Federal support for annual operating costs	$3.6 million	Inter-agency[1]
Modernization of existing 260+ sites and installation of 10 new sites	$6.0	EPA

[1] $2,000,000 to USGS; $600,000 to EPA; $600,000 to National Park Service; $400,000 to U.S. Forest Service.

2. Clean Air Status and Trends Network (CASTNet)

The CASTnet program, administered by the EPA, measures the component of atmospheric deposition that enters the environment in dry forms such as particles and gases. Monitoring dry deposition is critical to determining the total pollution load across the U.S. In some areas, dry deposition contributes as much as 59% of the total sulfur deposition. At present, CASTnet is a sparse network with only 70 sites nation-wide and none in the central U.S.

Proposal:	Amount:	Agency:
Federal contribution to annual operating costs	$5.0 million	EPA
Installation of 30 new sites	$1.5	EPA
Modernization of existing 79 sites	$3.1	EPA

3. Mercury Deposition Network (MDN)

The mercury deposition network is a patchwork of sites, occurring mostly in the Northeast, that is funded through contributions by state agencies. Some of the highest mercury emitting states, such as Ohio, Kentucky and West Virginia, have no deposition monitoring. Given the tremendous public importance of mercury pollution, it is essential that monitoring be established to develop a mercury deposition baseline and to t rack changes over time.

Proposal:	Amount:	Agency:
Federal contribution to annual operating costs	$1.0 million	EPA
Installation of 60 new sites and upgrade existing sites	$2.0	EPA

4. Temporally Integrated Monitoring of Ecosystems (TIME) and Long-Term Monitoring

The TIME/L TM program monitors lake and stream chemistry and documents changes in response to changing emissions and acid deposition. This program is administered through the

EPA. TIME/LTM is the only national network that directly measures the impact of atmospheric deposition and quantifies the affect of emissions controls. Funding for the TIME/LTM program is both inadequate and unstable. Funding has been cut 50% over the past two years and the program appears to be slated for discontinuation. Funding needs to be reestablished.

Proposal:	Amount:	Agency:
Federal contribution to annual operating costs	$2.5 million	EPA

5. Atmospheric Integrated Research Monitoring Network (AIRMon)

The AIRMon program provides high resolution precipitation and dry deposition chemistry using daily sampling methods operated by the National Oceanic and Atmospheric Administration (NOAA). Funding for this program has been flat for ten years resulting in the unfortunate closure of 3 AIRMon dry deposition sites (Sequoia. CA; Panola, GA; and Burlington, VT). Without an increase in annual operating funds, more site closures are inevitable. Moreover, AIRMon equipment dates to 1984 and has exceeded its life expectancy.

Proposal:	Amount:	Agency:
Federal contribution to annual operating costs	$1.5 million	NOAA
Modernization of existing 20 sites	$1.0	NOAA

In addition to the resources required to stabilize and improve these networks, there are other monitoring needs. For example programs are needed to assess the recovery of soils, trees and aquatic biota in response to decreases in acidic deposition. There are few sites at which mercury in studied in soil, surface waters and fish. None of these have been established as long term monitoring sites to determine baseline conditions and to monitor ecosystem response to changes in atmospheric mercury deposition following emission controls. Finally there is a need for comprehensive ecosystem study sites, such as the National Science Foundation, Long-Term Ecological Research (LTER) program. Comprehensive ecosystem study sites should be viewed as a national resource. At these sites, many environmental measurements are made and ecosystem processes are studied in detail. Through research at comprehensive study sites, cause and effect relationships between air pollution and ecosystem health can be determined, and environmental models used to predict ecosystem response to policy and management strategies can be tested.

Current Air Quality Monitoring Networks and the Pollutants Monitored

The following two tables (Tables 1 and 2) summarize key aspects of the monitoring networks. These tables as well as other more detailed air monitoring information are available from a 1999 report, "The Role of Monitoring Networks in the Management of the Nation's Air Quality" (http:bqs.usgs.gov/acidrain/).

Table 1.

Network	Visibility	Nitrogen species	Sulfur species	Lead	Particulate matter	Carbon monoxide	Ozone or precursors	Stream chemistry	Atmospheric deposition
NADP/NTN*									*wet
AIRMon		*	*						*dry and wet
CASTNet	*	*	*		*		*		*dry and wet
MDN									*wet mercury
TIME/LTM								*	

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Table 2.

Network	Lead Federal Agency	Website	Estimated FY99 Federal funding (millions $)	Proposal (millions $)		Non federal participation?	Number of sites	Year initiated
				Annual	Upgrade			
NADP/NTN	USGS	http:llnadp.sws.uiuc.edu/	$3.50	$3.6 Inter-Agency	$6.0 EPA	Yes	220	1978
AIRMoN	NOAA	http://www.arl.noaa.gov/research/programs/airmon.html	$0.60	$1.5 NOAA	$1.0 NOAA	Yes	23	1984
CASJNET	EPA	http://www.epa.gov/acidrain/castnet/	$4.50	$5.0 EPA	$4.6 EPA	No	80	1988
MDN	None	http://nadp.sws.uiuc.edu/	*	$1.0 EPA	$2.0 EPA	Yes	36	1996
TIME/LTM			$1.6	$2.5 EPA			80 lakes 125 streams	1982
TOTAL			$10.2	$13.6	$13.6			

* Total funding approximately $0.6M, nearly all from State and local sources.