

SAES-422 Multistate Research Activity Accomplishments Report

Project Number: NRSP-3
Project Title: The National Atmospheric Deposition Program (NADP) – A Long-term Monitoring Program in Support of Research on the Effects of Atmospheric Chemical Deposition
Period Covered: 01-2002 to 12-2002
Date of Report: 02-20-2003
Meeting Dates: 09-10-02 to 09-13-02

Participants: URL: <http://nadp.sws.uiuc.edu/meetings/fall02/TCmin2002Fall.pdf>

Meeting Minutes: URL: <http://nadp.sws.uiuc.edu/meetings/fall02/TCmin2002Fall.pdf>

Accomplishments:

The NRSP-3 provides a framework for cooperation among State Agricultural Experiment Stations (SAES) and governmental and nongovernmental organizations to support the National Atmospheric Deposition Program (NADP), which provides quality assured data and information on the exposure of managed and natural ecosystems and cultural resources to acidic compounds, nutrients, base cations, and mercury in precipitation. NADP data support informed decisions on air quality issues related to precipitation chemistry and are used by scientists, policy-makers, educators, and the public. NRSP-3 activities address the “environment, natural resources, and landscape stewardship,” which is a national research priority of the state-federal (SAES-USDA) partnership.

The NADP operates three precipitation chemistry networks: the National Trends Network (NTN), the Atmospheric Integrated Research Monitoring Network (AIRMoN), and the Mercury Deposition Network (MDN). At the end of December 2002, 248 NTN stations were collecting one-week precipitation samples in 48 states, Puerto Rico, the Virgin Islands, and Quebec Province, Canada. The NTN provides the only long-term nationwide record of wet deposition in the United States. Complementing the NTN are the 10-site AIRMoN and the 73-site MDN. Data from daily precipitation samples collected at AIRMoN sites support continued research of atmospheric transport and removal of air pollutants and development of computer simulations of these processes. The MDN offers the only regional measurements of mercury in North American precipitation, and MDN data are used to quantify mercury deposition to water bodies that have fish and wildlife consumption advisories due to this toxic chemical. In 2002, 43 states listed advisories warning people to limit game fish consumption due to high mercury levels. Advisories also were issued for coastal Maine, the Atlantic Coast from the Virginia-North Carolina border to the southern tip of Florida, and the entire U.S. Gulf Coast.

NADP Internet Site. NADP data are available via the Internet, which enables on-line retrieval of individual data points, seasonal and annual averages, trend plots, concentration and deposition maps, reports, manuals, and other data and information (<http://nadp.sws.uiuc.edu>). The number of Internet site users, data files accessed, and maps viewed continued to increase in 2002. The

site had 52,843 unique visitors, an increase of 23.3 percent over 2001, and user sessions rose by nearly 43 percent to 156,182. This site now regularly receives more than a million hits annually, and the number of data files downloaded now exceeds 18,000 files per year. Users viewed 91,328 color-contour concentration and deposition maps, an increase of 3 percent over 2001. These maps continue to be the most frequently accessed data products on the site. Color-contour pH maps from the NTN also appear in chapters on air pollution in newly published McGraw-Hill textbooks, *Meteorology and Environmental Geology*.

Extension Activities. In 2002, the NADP Program Office contributed to the University of Illinois Extension Service program, Environmental Stewardship Week. This ongoing program engages elementary school students in hands-on learning activities in the environmental sciences. The learning activity run by NADP staff members compared the pH of household chemicals with the pH of water from a nearby lake and that of an acid rain sample from the NADP network. Nearly 1,200 children participated.

Supporting informed decisions on air quality issues. In July, President George Bush sent the U.S. Congress legislation that would set new limits on electric power plant emissions of sulfur dioxide, nitrogen oxide, and mercury. These limits would require emissions reductions in a cap-and-trade program modeled after the acid rain portion of the 1990 Clean Air Act Amendments (CAAA). Documentation supporting this legislation from the U.S. Environmental Protection Agency used NTN maps to describe current conditions and demonstrate the efficacy of the current sulfur dioxide emissions reduction program under the 1990 CAAA. Federal agencies continue to rely on NADP data to monitor changes in the nation's air quality, and this new legislation would broaden the focus from sulfur compounds to nitrogen compounds and mercury.

In its report, *State of the Waters 2002 - Region 5*, the EPA summarized its joint efforts with environmental agencies in the six upper Midwestern states of EPA Region 5 to meet the goals of the Clean Water Act. Among long-term Region 5 goals is that "all waters support healthy aquatic biological communities." Based on information from state agencies, the report cited atmospheric deposition as the primary source of impairment of rivers, streams, lakes, and reservoirs. Mercury deposition, the principal cause for concern, has a reported link to high levels of mercury in fish tissue, resulting in fish consumption advisories. The NADP/MDN now has 16 Region 5 sites measuring weekly concentrations and depositions of total mercury. These data support ongoing efforts to quantify atmospheric mercury deposition and its role in causing high mercury levels in fish.

Homeland security. The authors of a feature article on "Environmental Monitoring and National Security: Is There a Connection?" suggest several ways in which environmental monitoring networks, such as the NADP, could assist in a national surveillance system for biological, chemical, or radiological agents spread by terrorists. The NADP has previous experience in special efforts to monitor disasters. For example, after the explosive release and spread of radionuclides during the Chernobyl nuclear accident in April 1986, the NADP sent precipitation samples to a federal laboratory in New York City, where government scientists could measure radionuclides and use the data to map the distribution and estimated amounts of radioactive fallout across the United States. With more than 20 years of experience, geographically dispersed

monitoring stations, a communications network, and a management infrastructure, the NADP stands ready to help if called on to assist in the national homeland security efforts.

Publications

More than 180 citations, including 67 journal articles, of 2002 publications used NADP data or were published by NRSP-3 scientists. In April, the journal Atmospheric Environment featured a special section "NADP 2000 - Ten Years After the Clean Air Act Amendments" that contained nine articles presented at the 2000 NADP Technical Committee meeting.

Plans for 2003/2004 -Serving science and education. The NRSP-3 seeks to continue to support the needs of researchers and educators by providing up-to-date quality-assured data and information on nutrients, acidic compounds, base cations, and mercury in precipitation. Experience has demonstrated the value of the Internet in making NADP data available to scientists, educators, students, and policy-makers. Several new Internet products are under development, including time-series and site classification maps and related geographic coverages, such as orography and land coverage. A new informational brochure on mercury in rain, similar to the popular nitrogen brochure, will be developed.

- Supporting informed decisions on air quality issues. Scientists and policy-makers have a keen interest in the atmospheric deposition of ammonia and other nitrogen compounds, especially in East and Gulf coast estuaries experiencing eutrophication, hypoxia, or anoxia. NTN data show that ammonium concentrations are on the rise in several areas of the country. A recent National Academy of Sciences report calls for improved measurements of atmospheric ammonia. In recognition of this interest in ammonia, a one-and-a-half-day workshop on ammonia measurements is being planned in conjunction with the 2003 NADP Technical Committee meeting.

- Responding to emerging issues. Researchers now receive archival NADP precipitation samples for measuring stable isotopes of hydrogen and oxygen. In the coming year, archival samples will be delivered to two researchers who plan to measure N-15 and O-18 in nitrate, as a potential means of tracing sources of nitrate in precipitation.

Environmental monitoring networks, such as the NADP, could assist in a national surveillance system. The NADP is cooperating with the University of Illinois Veterinary Diagnostic Clinic to look for anthrax spores in selected precipitation samples. These spores occur naturally in some soils. If found in rain, the effort will turn to identifying their genetic signature, which will make it possible to map the distribution and genetic fingerprint of naturally occurring anthrax, providing a reference against which to detect unnatural releases.

Impacts:

1. Data from NTN sites at the Georgia Agricultural Experiment Station and elsewhere in the state were used in a new book, "The Greening of Georgia," to characterize air quality in Georgia and describe how sulfur dioxide and acid rain have changed over the last 20-25 years.

2. Syracuse University scientists used NTN data to develop regression models describing the spatial distribution and elevational dependence of sulfate and nitrate deposition in the Adirondack region of New York, where soils and surface waters are highly sensitive to acidic inputs.
3. Comparing snowpack and NTN sample chemistry at NTN sites in the Rocky Mountains, U.S. Geological Survey scientists found good agreement for sulfate and nitrate concentrations, and concluded that combining snowpack and NTN data could improve sulfate and nitrate deposition estimates for high-elevation alpine environments.
4. A National Oceanic and Atmospheric Administration modeler has led the effort to adapt the Community Multi-scale Air Quality Model to simulate transport, transformation, and deposition of atmospheric mercury, using MDN measurements to compare modeled and measured wet deposition fluxes of mercury and to guide model improvements.
5. Investigators at the University of Maryland and Syracuse University studied nitrogen sources for 10 Atlantic Coast estuaries from Maine to North Carolina and, using NTN and other data, determined that atmospheric nitrogen deposition was (a) the second or third largest source, (b) 28 - 74 percent higher in 1997 than in 1987, and (c) 15 - 42 percent of the total nitrogen entering these systems.
6. By coupling an analysis of NTN data, breeding bird surveys, and soil pH and forest vegetation data, researchers at Cornell University's Laboratory of Ornithology discovered a strong, highly significant, negative effect of acid rain on eastern U.S. wood thrush populations and suggested that calcium depletion in forest soils may be the cause.
7. Participants in the Bay Region Atmospheric Chemistry Experiment reported that the highest average daily wet deposition fluxes of nitrogen in samples at the Tampa Bay AIRMoN site occurred for air masses classified as terrestrial in origin and influenced by combustion sources within 100 miles of the collection site
8. In SAES research at Purdue University, scientists applied a two-layer model that tracks water and nitrogen movements in soils and, using the 10-year NTN nitrogen deposition record, found evidence that climate conditions may strongly influence retention of nitrogen deposited on unmanaged eastern U.S. soils.
9. Describing increases in ammonium deposition at a North Carolina NTN site since the late 1980s, a University of North Carolina professor cited concerns that increases in ammonium in coastal watersheds may cause changes in estuarine microbial communities and outlined an interdisciplinary research agenda to learn more about connections between atmospheric nitrogen deposition and coastal eutrophication.
10. By measuring oxygen and nitrogen isotopes in the nitrate in snowpack and melt water, surface water, groundwater, and NTN precipitation samples at the Loch Vale watershed in the Colorado Rockies, U.S. Geological Survey and National Park Service scientists learned that more than half of the nitrate in atmospheric deposition enters and is stored in alpine soils before nitrification and export to streams.

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