

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: 01-2003 to 12-2003
Date of Report: 03-16-2004
Meeting Dates: 10-20-03 to 10-24-03

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

Meeting Minutes: URL: <http://nadp.sws.uiuc.edu/meetings/fall03/Tech2003fall.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 2003, 256 NTN stations were collecting one-week precipitation samples in 49 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 9-site AIRMoN and the 82-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 2003, 43 states listed advisories warning people to limit game fish consumption due to high mercury levels. Advisories also were issued for coastal Maine, Massachusetts, Rhode Island, 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 2003 the site

received 53,823 unique visitors and nearly 1.4 million hits, up more than five-fold since 1998, when user statistics were first recorded. User sessions rose to 159,731 and users downloaded 18,398 data files. Certainly the most frequently viewed data products on the site continue to be the color-contour concentration and deposition maps, which appear in scientific journals, textbooks, and newspaper articles. In August, a “NetWatch” article in Science magazine featured the 2001 pH map and described the database and some of the on-line reports and products available from the NADP.

Educational/Extension Activities. In 2003, the NADP Program Office participated in the University of Illinois Extension Service program, Environmental Stewardship Week, designed to engage elementary school students in hands-on learning activities in the environmental sciences. Staff members led a learning activity entitled “pH and Precipitation” that focused on air pollution, acid rain, and water quality. Students measured the pH of selected household chemicals, water from a central Illinois lake, and rain samples from NTN sites across the country. Approximately 100 5th and 6th grade students participated in the activity.

Supporting informed decisions on air quality issues. In its most recent progress report, “Acid Rain Program, 2002 Progress Report,” the U.S. Environmental Protection Agency (USEPA) described the National Atmospheric Deposition Program as one of two long-term national monitoring networks with data that scientists and policy-makers routinely use to evaluate the impact of emissions reductions on the environment. In the report, the USEPA used NTN data to compare average 2000-2002 sulfate deposition with average 1989-1991 sulfate deposition. This comparison showed sulfate deposition decreases of about 35 percent to 55 percent in Midwestern and Northeastern states since 1990. In the Northeastern United States, a nearly one-for-one decrease in sulfate concentrations in precipitation and sulfur dioxide emissions was noted. These decreases were cited as evidence that sulfur dioxide emissions reductions under the 1990 Clean Air Act Amendments (CAAA-1990) have led to reductions in acidic deposition. A similar comparison with NTN nitrate data showed deposition decreases in the Northeast and Michigan, though nitrate concentrations remained virtually unchanged.

In a related report, “Response of Surface Water Chemistry to the Clean Air Act Amendments of 1990,” the USEPA examined the response of eastern U.S. lakes and streams to the sulfur dioxide and nitrogen oxide emissions reductions that occurred under the CAAA-1990. The authors used NTN data to quantify sulfate, nitrate, and base cation deposition trends. These trends were compared with changes in the acid-base chemistry of surface waters. Except for the Ridge and Blue Ridge Province in the central and southern Appalachian Mountains, sulfate deposition decreases were accompanied by sulfate concentration decreases in lakes and streams. Nitrate changes were small and generally insignificant in precipitation and in surface waters. In precipitation, base cation concentrations changed little, although in surface waters a 20-year base cation decline has continued. Concomitant decreases in sulfate and base cation concentrations has resulted in only small improvements in surface water acidity.

These 2003 reports point to the increasingly important role of NADP data in assessing the relationships among emissions, air quality, precipitation chemistry, and wet deposition effects on aquatic and terrestrial ecosystems. Long-term high-quality data from the network of

geographically representative NADP sites has become an invaluable resource for policy-relevant assessments. The current administration has introduced new clean air legislation, the Clear Skies Act, which would expand the cap-and-trade program to three pollutants, sulfur dioxide, nitrogen oxides, and mercury. Proponents of this legislation cite the cost-effectiveness of the current program and its demonstrated success in reducing acid deposition, as monitored by the NADP/NTN.

Publications

There were more than 220 publications, including 61 journal articles and a Master of Science thesis, using NADP data or resulting from NRSP-3 activities in 2003. An on-line database that lists citations using NADP data is now accessible at <http://nadp.sws.uiuc.edu/lib/bibsearch.asp>.

Plans for 2004/2005

-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. New on-line data presentations will be developed, including isopleth map animations that track annual concentration and deposition changes of cations and anions not now included in the map animation series. Site plan views that display the locations of NADP instruments and instruments of related measurement programs will be posted with other site information. An informational brochure on mercury, currently in draft form, will be completed and published.

- Supporting informed decisions on air quality issues. Scientists and policy-makers have a keen interest in the atmospheric deposition of nutrients and the role of nutrient deposition in affecting unmanaged forests, shrublands, and grasslands and in affecting surface water quality, especially in the estuarine waters of the Atlantic and Gulf Coasts. The NADP Central Analytical Laboratory is measuring total nitrogen and total phosphorus in precipitation samples to explore the feasibility of adding these analytes to the current measurement set. In addition, the NADP Environmental Effects Subcommittee is considering other measurements that would address policy-related issues. Among the measurements under consideration is gaseous ammonia and total mercury.

- Responding to emerging issues. The NADP Program Office is communicating with potential collaborators interested in evaluating the use of NADP samples for early detection of windborne plant pathogens. These pathogens can infect agricultural crops and forests. Atmospheric transport and deposition can be an important mechanism for the dispersal of plant pathogens and for the exposure of plants to pathogens from distant infected areas. Environmental monitoring networks, such as the three NADP networks, could play a potentially important role in a surveillance system for the detection and spread of pathogens, whether domestic and foreign in origin. The NADP is uniquely suited to address this issue with its 250 to 300 sites across the United States.

Impacts:

1. Syracuse University and Adirondack Lakes Survey scientists investigated the response of Adirondack lakes to the 20-year decline in sulfate deposition measured at northeastern NADP/NTN sites and found that sulfate has decreased in virtually all Adirondack lakes, while only a small number of lakes have become less acidic.
2. Using O₂ isotope measurements from NADP/NTN samples and from soil water, tree and leaf tissue, and airborne CO₂, researchers discovered that 80 percent of the respired CO₂ in a central Oregon forest comes from the soil and 20 percent from plants and that the isotopic composition of rain has an important influence on the isotopic composition of soil water.
3. According to a Tennessee Valley Authority report, peaks in the Great Smoky Mountains receive some of the highest nitrogen and sulfur deposition in the United States, based on NADP/NTN data; and these high-deposition levels may have long-term detrimental impacts on the health of these forests.
4. NOAA scientists used NADP/NTN ammonium concentration measurements as the basis for evaluating the current ammonia emissions inventory for the eastern United States and concluded that emissions estimates may be as much as 20 percent too high.
5. To assess the impact of human activities on nutrients in surface waters, USGS scientists used NADP/NTN nitrogen deposition data, watershed size and runoff, physiography, climate, and vegetative cover in an empirical model which estimates that current nitrogen concentrations in streams and rivers are about 6 times higher than background levels.
6. A team of scientists used NADP/NTN nitrogen deposition data in examining the biogeochemical cycling of nitrate in southwestern U.S. desert soils and discovered a large reservoir of previously overlooked nitrogen that raises global estimates of subsoil nitrogen in warm deserts and shrublands by 14 to 71 percent.
7. In a review of nitrogen emissions, deposition, and monitoring in the West, scientists used NADP/NTN data to describe the spatial distribution, deposition rates, and trends of ammonium and nitrate in precipitation at background locations in eleven western states.
8. Investigators tracked polluted air masses across the Pacific Ocean from Asia until they encountered the northwestern United States, where at the Hoh River NADP/NTN site they found nitrogen and sulfur deposition that was approximately twice the long-term mean, linking the dirty Asian air mass to dirty U.S. rain.
9. With support from the Electric Power Research Institute, a team of atmospheric modelers used NADP/MDN data to develop and evaluate a global- and nested continental-scale mercury transport model that simulates the sources and deposition rates of mercury deposited in the contiguous United States.
10. Penn State University scientists analyzed a 9-year precipitation chemistry record from the NADP/AIRMoN site in central Pennsylvania and found significant relationships between summertime weather patterns and acidity and sulfate in rain.
11. A University of Iowa statistician applied a Bayesian geostatistical model to evaluate NADP/NTN, NADP/AIRMoN, and Canadian network data and concluded that there was no difference between NTN and AIRMoN ammonium measurements, but that Canadian ammonium measurements were systematically higher than either of the NADP networks.

Publications:

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Authorization: