

# SAES-422 Multistate Research Activity Accomplishments Report

**Project Number:** NRSP-3

**Project/Activity Title:** The National Atmospheric Deposition Program (NADP)

**Period Covered:** 01-2001 to 12-2001

**Date of Report:** 02-22-2002

**Annual Meeting Dates:** 08-27-2001 to 08-30-2001

**Participants:** URL: [Copy of participants list](#)

**Brief summary of minutes of annual meeting:** URL: [Copy of Minutes](#)

## **Accomplishments:**

The National Atmospheric Deposition Program (NADP) 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. These data support informed decisions on air quality issues related to precipitation chemistry and are used by scientists, policy-makers, educators, and the public. Data are freely 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>).

**Atmospheric Chemical Deposition Measurements.** The NRSP-3 provides a framework for cooperation among governmental and nongovernmental organizations to support three NADP 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 2001, there were 232 NTN stations 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 63-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 2001, 42 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.

The NADP continued its extensive quality assurance program in 2001. Two NTN sites and one MDN site collected samples in side-by-side wet deposition collectors for the purpose of obtaining network precision measurements. Network precision data are now available for 2 MDN and 43 NTN sites. Ongoing comparisons between the two primary North American networks continued at co-located NTN and Canadian Acid Precipitation Monitoring Network sites in central Pennsylvania and southern Quebec Province. A site systems and performance review team checked equipment, operating procedures, and installations at 100 NTN and 18 MDN sites during the year. And, NADP Program Office staff began preparation of updated quality assurance documents.

**Technical Committee and Scientific Activities.** The Network Operations Subcommittee, Budget Advisory Committee, and Executive Committee met in Champaign, Illinois, on 27-30 August 2001. A total of 49 Technical Committee members attended one or more of these business meetings. Among the major topics addressed was the status of an initiative to identify a modern precipitation

gage and wet deposition collector to replace currently used equipment, a potential partnering arrangement with the National Climate Data Center's new long-term Climate Reference Network, and a new effort to measure hydrogen and oxygen isotopes in archival NADP samples as part of the U.S. Network for Isotopes in Precipitation (<http://www.nrel.colostate.edu/projects/usnip>). Unlike previous meetings, the 2001 Technical Committee meetings were not accompanied by a scientific symposium. Instead, NADP helped organize sessions on Atmospheric Deposition of Nitrogen and Effects of Atmospheric Deposition of Nitrogen at *N2001: The Second International Nitrogen Conference*, held in Potomac, MD, 14-18 October 2001. Nearly 400 scientists, policy-makers, and citizens, drawn from 30 nations, participated in this interdisciplinary conference, organized by Dr. James Galloway and Dr. Ellis Cowling, long-time NADP Technical Committee members. Sixty-three papers presented at this meeting, i.e., nearly one in five, either used NADP data or were presented by Technical Committee members or presenters in NADP-organized sessions.

**Support of Research and Education.** On-line Data and Information : The NADP database, with 23 years of NTN data, 9 years of AIRMoN data, and 5 years of MDN data, is an invaluable resource supporting research of atmospheric deposition and its effects on managed and unmanaged ecosystems, i.e., NRSP-3 objectives 1 and 2. In 2001, the NADP Internet site ([nadp.sws.uiuc.edu](http://nadp.sws.uiuc.edu)) received nearly 43,000 unique visitors, a 7 percent increase over 2000 usage. Site users logged more than 109,000 sessions, and the site received over one million hits for the first time in its history. Since tracking of Internet site usage began in 1998, usage has increased by 300 to 400 percent. Most frequently accessed data products continued to be color contour maps of pollutant concentrations and depositions. Site users viewed 88,367 maps in 2001 and retrieved 18,535 data files. User statistics show that researchers primarily use NADP data to study atmospheric deposition and watershed processes, as well as environmental phenomena such as the effects of deposition on aquatic and terrestrial ecosystems and on cultural resources. Universities account for 35 percent of NADP Internet site users, followed by federal agencies (21 percent) and public schools (18 percent). Research and educational usage have averaged 60 percent to 40 percent, respectively. College students and secondary and elementary school students use the popular on-line brochures, such as *Inside Rain* and *Nitrogen in the Nation's Rain*, as well as using NADP data for research and class assignments. NADP maps also appear in several new textbooks, such as *Ecosystem Change and Public Health* (Johns Hopkins University Press), *Chemistry in Context* (American Chemical Society), and *Meteorology* (McGraw-Hill).

**New Uses of NADP Samples :** Research groups measuring the isotopic composition of water have found an important new application for archival NTN samples. Scientists are measuring the oxygen-18 and hydrogen-2 abundance in archival NTN samples and comparing the isotopic composition with standard mean ocean water. These data are used to evaluate the relative contributions of the Gulf of Mexico, North Pacific Ocean, and Atlantic Ocean as sources of the water vapor that led to precipitation. Spatial and seasonal changes in the oxygen-18 abundance also are used to assess the importance of continental recycling of ocean water and to investigate the effects of air and water temperatures on isotopic composition. An accessible database is being developed for the isotope research community using oxygen-18 and hydrogen-2 measurements from 80 NTN sites over 14 years. These sites comprise the U.S. contribution to the International Atomic Energy Agency's Global Network for Isotopes in Precipitation.

**Applications of NADP Data :** NADP data are being used in an integrated assessment of the effects of acidic deposition on streams, soils, and forests in the Southern Appalachian Mountains. The Southern Appalachian Mountains Initiative (SAMI), a partnership of state and federal environmental agencies, federal land managers, industries, environmental groups, academia, and interested citizens, is conducting the assessment. SAMI scientists use NTN data to track the spatial pattern of acidic deposition and its change over time. Using air quality models, they link present pollutant emissions to measured acidic deposition and apply these models to estimate acidic deposition under several future emissions scenarios. They also apply forest nutrient cycling and

watershed models to evaluate present and future acidic deposition effects on streams and forests in the 10-state SAMI region.

In its report, *Clean Coastal Waters, Understanding and Reducing the Effects of Nutrient Pollution*, a National Academy of Sciences Committee used NADP data to evaluate the role of atmospheric nitrogen deposition in causing excess nutrient levels in estuarine systems. Estimates range from 10 percent to 40 percent of total nitrogen input to estuaries comes from atmospheric deposition. Among the factors affecting these estimates are the water surface to watershed area and the degree of nitrogen saturation in tributary watersheds. NADP data were cited as crucial to the development of airshed and watershed models.

**Plans for 2002/2003.** Progress on the initiative to replace the current field equipment at NADP sites will continue to receive a high priority. NADP Committees will review results of field trials of candidate replacement precipitation gages and seek to reach a consensus on a replacement(s) that meets the pre-determined specifications. Field trials of newly-designed wet deposition collectors will continue, as needed. The Program Office will work with the Executive Committee to prepare a new five-year strategic plan. The Program Office also will complete preparation of an NADP Quality Management Plan for review by the Technical Committee and will update Quality Assurance Plans for the three deposition networks. The Network Operations and the Data Management and Analysis Subcommittees will complete the development of schemes to classify NADP sites according to population, pollutant emissions, and land use and cover information. The Environmental Effects Subcommittee will exam the feasibility of passive sampling of selected air pollutants at NADP sites.

The Program Office will continue applying Geographic Information System (GIS) data presentations that would link land-use, population, pollutant emissions, and other data to NADP wet deposition data. These presentations available on the Web site will enable users to download maps that could be used to examine relationships among wet chemical deposition and environmental effects, pollutant sources, etc. To support these research efforts, the Program Office database manager and technician are using GIS software and applications to prepare maps and overlays. Users will be able to submit on-line database queries by selecting a watershed and time (averaging) period for the data they need. Deposition rates (fluxes) and total watershed loads (masses) will be available. GIS overlays of land use/cover (which will enable flux estimates to forests, fields, and water bodies within a watershed), ecoregions, population, road miles, etc., are in preparation. This multi-year effort involves communications with users and guidance and input from the NADP Committees and Subcommittees.

### **Impacts:**

1. In its report, [Clean Coastal Waters, Understanding and Reducing the Effects of Nutrient Pollution](#), a National Academy of Sciences Committee used NADP data to evaluate the role of atmospheric nitrogen deposition in causing excess nutrient levels in estuarine systems. Estimates range from 10 percent to 40 percent of total nitrogen input to estuaries comes from atmospheric deposition. NADP data were cited as crucial to the development of airshed and watershed models.

### **Publications:**

#### **NADP PROGRAM OFFICE PUBLICATIONS**

National Atmospheric Deposition Program. 2001. NADP 2001 - NADP Committee Meeting Proceedings. (prepared by Douglas, K.E. and P.S. Bedient) NADP Proceedings 2001-01, August 27-30, 2001, Champaign, IL, and October 14-18, 2001, N2001 - The Second Annual International Nitrogen Conference, Potomac, MD. NADP Program Office, Champaign, IL. 120 pp.

National Atmospheric Deposition Program. 2001. National Atmospheric Deposition Program 2000 Annual Summary. NADP Data Report 2001-01. NADP Program Office, Champaign, IL. 16 pp.

National Atmospheric Deposition Program. 2001. Quality Assurance Report, National Atmospheric Deposition Program, 1999, Laboratory Operations, Central Analytical Laboratory. (prepared by J.E. Rothert) NADP QA Report 2001-01, NADP Program Office, Champaign, IL. 127 pp.

National Atmospheric Deposition Program. 2001. 2002 CALENDAR. NADP Program Office, Champaign, IL. 30 pp.

## **JOURNAL ARTICLES**

Bischoff, J.M., P. Bukaveckas, K. Ohrui, and M.J. Mitchell. 2001. Nitrogen Storage and Cycling in Vegetation of a Forested Wetland: Implications for Watershed N Processing. *Water, Air, and Soil Pollution*. 128:97-114.

Bytnerowicz, A., P.E. Padgett, S.D. Parry, M.E. Fenn, and M.J. Arbaugh. 2001. Concentrations, Deposition, and Effects of Nitrogenous Pollutants in Selected California Ecosystems. *The Scientific World* 1(S2):304-311.

Butler, T.J., G.E. Likens, and B.J.B. Stunder. 2001. Regional-scale Impacts of Phase I of the Clean Air Act Amendments in the USA: the Relation Between Emissions and Concentrations, Both Wet and Dry. *Atmospheric Environment*. 35:1015-1028.

Civerolo, K.L., E. Brankov, S. T. Rao, and I. Zurbenko. 2001. Assessing the Impact of the Acid Deposition Control Program. *Atmospheric Environment*. 35: 4135-4148.

Civerolo, K. L., and S. T. Rao. 2001. Space-time Analysis of Precipitation-Weighted Sulfate Concentrations Over the Eastern United States. *Atmospheric Environment*, 35: 5657-5661.

David, M.B., G.F. McIsaac, T.V. Royer, R.G. Darmody, and L.E. Gentry. 2001. Estimated Historical and Current Nitrogen Balances for Illinois. *The Scientific World*. 1(S2):597-604.

Driscoll, C.T., G.B. Lawrence, A.J. Bulger, T.J. Butler, C.S. Cronan, C. Eagar, K.F. Lambert, G.E. Likens, J.L. Stoddard, and K.C. Weathers. 2001. Acidic Deposition in the Northeastern United States: Sources and Inputs, Ecosystem Effects, and Management Strategies. *BioScience*. 51(3): 180-198.

Eshleman, K.N., D.A. Fiscus, N.M. Castro, J.R. Webb, and F.A. Deviney, Jr. 2001. Computation and Visualization of Regional-Scale Forest Disturbance and Associated Dissolved Nitrogen Export from Shenandoah National Park, Virginia. *The Scientific World*. 1(S2): 539-547.

Fenn, M.E. and M.A. Poth. 2001. A Case Study of Nitrogen Saturation in Western U.S. Forests. *The Scientific World*. 1(S2): 433-439.

Johnson, C.A., M.A. Mast, and C.L. Kester. 2001. Use of <sup>17</sup>O/<sup>16</sup>O to Trace Atmospherically-Deposited Sulfate in Surface Waters: A Case Study in Alpine Watersheds in the Rocky Mountains. *Geophysical Research Letters*. 28: 4483-4486.

Harvey, F.E. 2001. Use of NADP Archive Samples to Determine the Isotope Composition of Precipitation: Characterizing the Meteoric Input Function for Use in Ground Water Studies. *Ground Water*. 49(3): 380-390.

Krajick, K. 2001. Long-term Data Show Lingering Effects from Acid Rain. *Science*. 292:195-196.

Likens, G.E., T.J. Butler, and D.C. Buso. 2001. Long- and Short-term Changes in Sulfate Deposition: Effects of the 1990 Clean Air Act Amendments. *Biogeochemistry*. 52: 1-11.

Miegroet, H.V., I.F. Creed, N.S. Nicholas, D.G. Tarboton, K.L. Webster, J. Shubzda, B. Robinson, J. Smoot, D.W. Johnson, S.E. Lindberg, G. Lovett, S. Nodvin, and S. Moore. 2001. Is There Synchronicity in Nitrogen Input and Output Fluxes at the Noland Divide Watershed, a Small N-Saturated Forested Catchment in the Great Smoky Mountains National Park. *The Scientific World*. 1(S2): 480-492.

Mitchell, M.J., P.J. McHale, S. Inamdar, and D.J. Raynal. 2001. Role of Within Lake Processes and Hydrobiogeochemical Changes over 16 Years in a Watershed in the Adirondack Mountains of New York State, U.S.A. *Hydrological Processes*. 15: 1951-1965.

Napier, T.L. and M. Tucker. 2001. Factors Affecting Nutrient Application Rates within Three Midwestern Watersheds. *Journal of Soil and Water Conservation*. 56(3): 220-228.

Nilles, M.A. and B.E. Conley. 2001. Changes in the Chemistry of Precipitation in the United States, 1981-1998. *Water, Air, and Soil Pollution*. 130: 409-414.

Norton, S.A., B.J. Cosby, I.J. Fernandez, J.S. Kahl, and M.R. Church. 2001. Long-term and Seasonal Variations in CO<sub>2</sub>: Linkages to Catchment Alkalinity Generation. *Hydrology and Earth System Sciences*. 5: 83-91.

Parker, J.L., I.J. Fernandez, L.E. Rustad, and S.A. Norton. 2001. Effects of Nitrogen Enrichment, Wildfire, and Harvesting on Forest Soil Carbon and Nitrogen. *Soil Science Society of America Journal*. 65: 1248-1255.

Pryor, S.C., R.J. Barthelmie, M. Carreiro, M.L. Davis, A. Hartley, B. Jensen, A. Oliphant, J.C. Randolph, and J.T. Schoof. 2001. Nitrogen Deposition to and Cycling in a Deciduous Forest. *The Scientific World*. 1(S2): 245-254.

Rabaud, N.E., T.A. James, L.I. Ashbaugh, and R.G. Flocchini. 2001. A Passive Sampler for the Determination of Airborne Ammonia Concentrations near Large-Scale Animal Facilities. *Environmental Science and Technology*. 35(6): 1190-1196.

Showstack., R. 2001. Further Emissions Cuts Needed for Speedier Acid Rain Recovery. *EOS, Transactions, American Geophysical Union*. 82:161-162.

Stottlemeyer, R. 2001. Ecosystem Processes and Nitrogen Export in Northern U.S. Watersheds. *The Scientific World*. 1(S2): 581-588.

## **OTHER PUBLICATIONS**

Center for Environmental Information. 2001. Acid Rain: Are the Problems Solved? Conference Executive Summary, May 2-3, 2001, Washington, D.C. 34 pp.

Daley, B. 2001. Acid Rain Resists '90s Fix, Study Says. In *The Boston Globe*. March 26, 2001.

Dripps, W.R., C.J. Kucharik, J.D. Lenters, M.P. Anderson, and J.A. Foley. 2001. Modeling the Spatial and Temporal Distribution of Groundwater Recharge Across a Forested Watershed in Northern Wisconsin. In *Proceedings, 2001 Spring Meeting, American Geophysical Union*. May 29-June 2, 2001, Boston, MA.

Driscoll, C.T., G.B. Lawrence, A.J. Bulger, T.J. Butler, C.S. Cronan, C. Eagar, K.F. Lambert, G.E. Likens, J.L. Stoddard, and K.C. Weathers. 2001. Acid Rain Revisited: Advances in Scientific

Understanding Since the Passage of the 1970 and 1990 Clean Air Act Amendments. Hubbard Brook Research Foundation. Science Links™ Publication. Vol. 1, No. 1. 20 pp.

Driscoll, C.T., G.B. Lawrence, A.J. Bulger, T.J. Butler, C.S. Cronan, C. Eagar, K.F. Lambert, G.E. Likens, J.L. Stoddard, and K.C. Weathers. 2001. Acid Rain Revisited: Advances in Scientific Understanding Since the Passage of the 1970 and 1990 Clean Air Act Amendments. In Hubbard Brook Research Foundation Acid Rain Update II. 2 pp.

Ecological Society of America. 2001. N2001: The Second International Nitrogen Conference, Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection. Program and Abstracts. October 14-18, 2001, Potomac, MD. Ecological Society of America, Washington, DC. 119 pp.

Environmental Science and Engineering, Inc. 2001. Clean Air Status and Trends Network (CASTNet) 1999 Annual Report. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. 176 pp.

Evans, J., I.J. Fernandez, L.E. Rustad, and S.A. Norton. 2001. Methods for Evaluating Carbon Fractions in Forest Soils. A Review (Technical Bulletin 178). University of Maine Agricultural Experiment Station, Orono, ME. 39pp.

Kentucky Environmental Quality Commission. 2001. Air Quality Sulfur Dioxide. In 2000-2001 State of Kentucky's Environment: A Report on Environmental Trends and Conditions. Kentucky Environmental Quality Commission, Frankfort, KY. pp 51-52.

Larson, R.S. and V.C. Bowersox. 2001. The National Atmospheric Deposition Program's Databases. In Proceedings 94th Annual Air & Waste Management Association Meeting (paper #669). Air and Waste Management Association, Sewickley, PA. 13 pp.

Lloyd, S.A. 2001. Acid Deposition. In Ecosystem Change and Public Health. Eds. J.L. Aron and J.A. Patz. Johns Hopkins University Press, Baltimore, MD. p. 209-213.

North Carolina Department of Environment and Natural Resources. 2001. Acid Rain and Statewide Trends. In 1999 Ambient Air Quality Report (Air Monitoring Section Report #2001.01). North Carolina Division of Air Quality, Department of Environment and Natural Resources, Raleigh, NC. pp 58-73.

Risch, M. 2001. Monitoring Program for Mercury in Precipitation in Indiana. U.S. Geological Survey, Indianapolis, IN. 4 pp.

Southern Appalachian Mountains Initiative. 2001. Acid Deposition Assessment. In 2001 Interim Report. Southern Appalachian Mountains Initiative, Asheville, NC. p. 16-17.

U.S. Environmental Protection Agency. 2001. Clean Air Status and Trends Network (CASTNet): Monitoring the Results of Emission Reductions. U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, D.C. 2 pp.