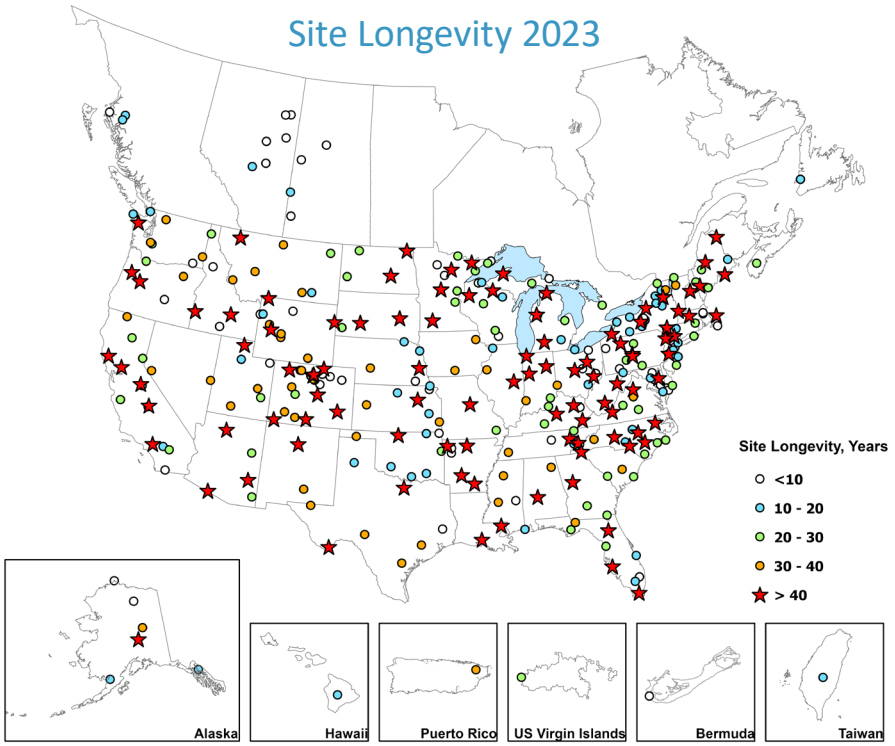
National Atmospheric Deposition Program

National Atmospheric Deposition Program's (NADP) Long-Term Monitoring Networks

NADP manages the world's largest wet deposition monitoring network. With over 40 years of experience operating a successful monitoring platform, NADP is the premier organization for collecting, analyzing, and reporting high-quality environmental data. Since 1978, NADP has adapted to meet the needs of the scientific, ecological, and regulatory communities. The program is comprised of five networks that examine trends in concentrations of sulfur, nitrogen, mercury, and ammonia and atmospheric deposition of these parameters.



OK06 - Wichita Mountains NWR, Photo credit: G. Crider

Data from more than 250 National Trends Network (NTN) sites are used to assess long-term trends of sulfur and nitrogen pollutants in precipitation. Typically, NTN sites are located in rural areas away from stationary emissions sources, providing NADP a unique opportunity to report data in locations where air quality information is sparse.

The Mercury Deposition Network (MDN) provides NADP with information about mercury fluxes and concentrations in precipitation, and the Mercury Litterfall Network (MLN) provides estimates of mercury dry deposition to forested landscapes. The Atmospheric Mercury Network (AMNet) measures ambient concentrations of mercury and is used for estimates of dry deposition.

The Ammonia Monitoring Network (AMoN) is the only routine ambient air monitoring network in the United States measuring gaseous ammonia. AMoN is a cost-effective solution for capturing spatial gradients and long-term trends and has grown to over 90 sites.

Together, these five networks provide consistent, high-quality deposition data at more than 350 sites across North America plus locations in Bermuda, Hawaii, and Asia. NADP delivers maps from these sites describing spatial and temporal trends of acidic compounds, nutrients, base cations, and mercury concentrations and deposition. Federal, tribal, state, and local agencies frequently utilize NADP data to evaluate, implement, or assess environmental policies. NADP data products are used by policymakers to reduce impacts from pollution that cause negative human and ecological health conditions (e.g., reductions in fish populations). Scientific literature frequently cites NADP data and products due to their high quality and availability. Over 3,000 published journal articles have used data collected by the NADP.

Membership

NADP is looking for additional cooperating partners to operate or sponsor monitoring sites and increase its spatial coverage of pollutant measurements. Supporting a monitoring site automatically provides membership in NADP. The NADP community offers members a voice in making decisions about site operations, data reporting, and quality assurance procedures. Membership includes the option to participate in science committees where discussions focus on new priorities, data products, and research needs to improve air quality and deposition estimates. Many federal, state, local, international, and tribal agencies, as well as, universities, non-governmental organizations, and private organizations participate as NADP members. Site sponsors manage their individual sites following NADP Standard Operating Procedures. The collaboration between partners and operators benefits NADP by providing network stability, advancing the science and methods that build on wide-ranging expertise, and expanding the networks to include new pollutants and new products to meet stakeholder needs. Two such examples of meeting stakeholder needs are:

1. The Federal Land Managers use NADP data to assess critical loads in terrestrial and aquatic ecosystems and use this information to make conservation management and regulatory decisions.
2. The Environmental Protection Agency uses NADP data to determine progress in meeting public welfare and environmental air quality standards.

Asian-Pacific Mercury Monitoring Network

To build global partnership capacity, NADP provides guidance to international organizations on how to design and implement new monitoring networks following the NADP model such as the Asia-Pacific Mercury Monitoring Network (APMMN).

Addressing Data Gaps and Building Capacity in Monitoring Networks

With over 350 monitoring network locations, NADP data provide long-term, consistent measurements for reporting trends over time. Model-based data provide deposition estimates for areas where no network measurement sites exist. Improvements to chemical transport models and validation of satellite measurements frequently rely on NADP network data.

NADP works with internal and external researchers to measure emerging pollutants of interest and evaluate new cost-effective monitoring methods. For example, in 2007, the NADP approved AMoN, which utilizes passive ammonia samplers to address a gap in the total nitrogen budget. To build scientific capacity and explore new research areas, several pilot studies are underway to evaluate how well the existing NADP samples and monitoring equipment can be used for other measurements such as:

- Targeted and non-targeted PFAS compounds
- Pollen amounts and seasonal changes
- Total nitrogen and total phosphorous
- Black carbon
- Dry deposition of phosphorous
- Microplastics
- Presence of biological material
- Wildfire smoke chemical markers

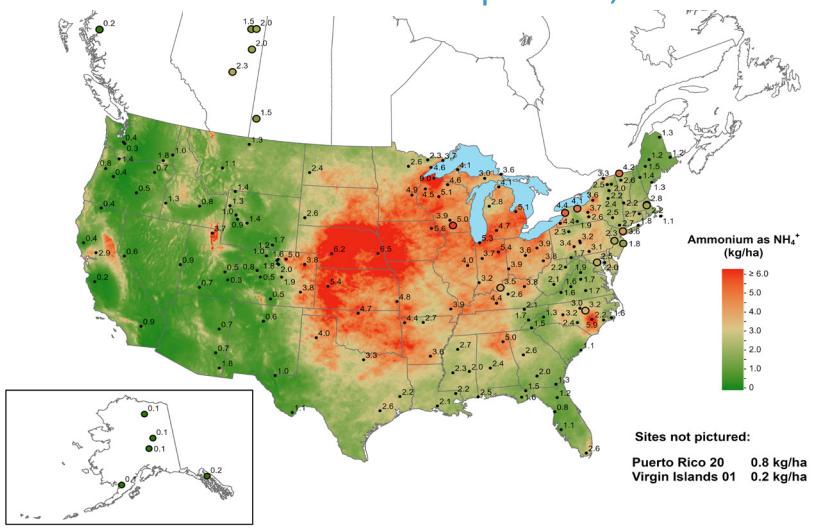
Data Quality and Availability

NADP field samples are sent to the Wisconsin State Laboratory of Hygiene (WSLH) for analysis. WSLH implements a rigorous quality assurance program that includes internal and external audits, participation in inter-laboratory comparisons, and formal accreditation. An independent auditor routinely compares the NADP field equipment with traceable standards from the National Institute of Standards and Technology (NIST) to verify that equipment is working properly. All available data are publicly accessible on the NADP website. https://nadp.slh.wisc.edu/

Network	Sites	Observations made in 2023			Measurements
		Sample Parameter	Sample Frequency	Sample Count	
NTN	240	Precipitation	Weekly	12,638	Free acidity (H^+ as pH), specific conductance, calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), sulfate (SO_4^{2-}), nitrate (NO_3^-), chloride (Cl^-), and ammonium (NH_4^+)
AMoN	91	Gaseous	Biweekly	2,580	Ammonia (NH_3)
MDN	75	Precipitation	Weekly	4,006	Total Hg, methyl Hg
AMNet	8	Gaseous	Eight or four daily (depending on parameter)	43,151	Elemental Hg, reactive gaseous Hg, particulate bound Hg
MLN	26	Leaf litter	Seasonal	26	Total Hg

The over 40-year data record shows large reductions in oxidized sulfur and nitrogen species throughout the U.S. reflecting parallel reductions in emissions from the industrial sector and mobile sources. These data provide accountability to federal, state, local, and tribal agencies that regulate emissions or develop plans to reduce air pollution.

Ammonium ion wet deposition, 2023



NADP Science Committees

The NADP program has four specialized science committees focused on key areas of atmospheric deposition, scientific interest, and applications. These committees meet throughout the year and present their work through scientific presentations at NADP meetings and symposiums.

The Total Deposition (TDep) Science Committee enhances the utility of the NTN data by combining the wet deposition measurements and ambient concentrations with modeled deposition to provide interpolated maps of total deposition. The unique total deposition data products are applied to estimate pollution impacts on ecosystems, determine critical loads, estimate reductions of crop yield losses across agricultural regions, and inform policies protecting sensitive areas, such as Clean Air Act Class I areas located in national parks and wildness areas. Currently, TDep participates in the World Meteorological Organization-Global Atmosphere Watch project that evaluates measurement-model fusion techniques and provides global mapping of total deposition using the best available information from models and observations.

Total deposition (TDep) is calculated as wet deposition plus dry deposition. Total deposition is the amount of pollutant being deposited to the Earth's surface in precipitation (wet) or through settling, impaction, or adsorption (dry).

The Critical Loads of Atmospheric Deposition (CLAD) Science Committee brings together scientists, natural resource managers, and regulatory agencies to understand deposition impacts and thresholds relevant to terrestrial and aquatic ecosystems. CLAD has been instrumental in developing maps showing trends in ecosystem recovery as a result of emissions reductions and changes in air pollution.

The Aeroallergen Monitoring Science Committee (AMSC) advances the science of aeroallergen monitoring by identifying emerging technologies, evaluating methods to ensure data quality, coordination of monitoring stations, and serving as a repository of long-term aeroallergen monitoring data. AMSC supports the development of models for the forecast, emission, transport, and removal of aeroallergens from the atmosphere. AMSC furthers the NADP vision to remain one of the nation's premier cooperative research support programs serving science and education, supporting communication, and providing information for air quality decisions that affect ecosystems and human health.

The Mercury in the Environment and Links to Deposition (MELD) Science Committee addresses measurement and data gaps for understanding mercury pathways and bioaccumulation impacts. MELD builds connections between NADP and national and international organizations to advance global mercury science and evaluates the effectiveness of global mercury reductions. MELD activities are essential for linking atmospheric deposition of mercury to public health risks and bioaccumulation of methylmercury in fish.

If you are interested in participating in NADP, becoming a site sponsor or have questions about the program, contact nadp@slh.wisc.edu.

National Atmospheric Deposition Program

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Connect with us

Disclaimer: The NADP is the National Research Support Project-3: A Long-Term Monitoring Program in Support of Research on the Effects of Atmospheric Chemical Deposition. More than 250 sponsors support the NADP, including private companies and other non-governmental organizations, universities, local and state government agencies, State Agricultural Experiment Stations, national laboratories, Native American organizations, Canadian government agencies, the U.S. Geological Survey, the U.S. Environmental Protection Agency, the National Park Service, National Oceanic and Atmospheric Administration, the U.S. Fish & Wildlife Service, the Bureau of Land Management, the U.S. Department of Agriculture - Forest Service, and the U.S. Department of Agriculture - National Institute of Food and Agriculture under agreement no. 2022-39133-38451. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the program sponsors or the University of Wisconsin-Madison.