FACT SHEET

IMPROVING TOTAL NITROGEN DEPOSITION BUDGETS

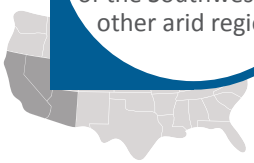
Research is needed to protect ecosystem health in the U.S.

Accurate and complete deposition budgets of nutrients and acidity are fundamental requirements for the assessment of ecological impacts and protection of human welfare. While much progress has been made in developing total deposition budgets for the U.S. over the past several years, improvement in the completeness, accuracy, and spatial representativeness of total reactive nitrogen deposition budgets remains limited by key data and knowledge gaps.

Total reactive nitrogen (Nr) deposition refers to the transfer of Nr-containing pollutants from the atmosphere to the Earth's surface via wet and dry processes.

55%
of total Nr deposition is dry across the U.S.

90%
or more
of total Nr deposition is dry over broad areas of the Southwest and other arid regions



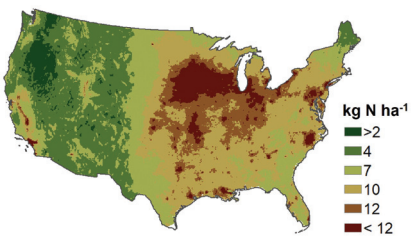
50%
of total Nr deposition across the U.S. is reduced N (NH_x)

89%
of Class I (protected) areas exceed at least one critical load for ecosystem harm

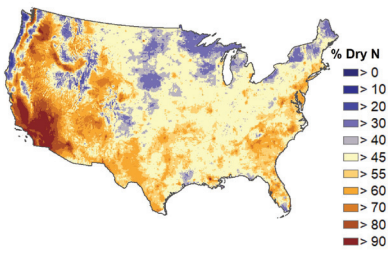
Air pollutants containing Nr are emitted from a variety of sources. In general, those coming from cars, power plants, and other industries are oxidized (NO_x), while those coming from agriculture, including animal production and crop fertilization, are reduced (NH_x). The deposition of these pollutants in excess of ecosystem thresholds (critical loads) causes a variety of harmful effects including reduced terrestrial biodiversity, soil and lake acidification, drinking water contamination, and reduced resilience to climate variability and other stressors.

Atmospheric concentrations and deposition of Nr are monitored by several different networks including the National Atmospheric Deposition Program (NADP)/National Trends Network (NTN), which measures nitrate and ammonium in wet deposition; the NADP/Ammonia Monitoring Network (AMoN), which measures ambient ammonia; and the Clean Air Status and Trends Network (CASTNET), which measures ambient nitric acid, particulate nitrate, and particulate ammonium. The NADP Total Deposition (TDep) Science Committee uses these measurements along with atmospheric models to estimate and map total Nr deposition. These estimates are then compared to critical loads to inform resource management and policy decisions.

A critical load is the amount of deposition below which no harmful ecosystem effect is expected to occur.



The total Nr deposition map on the left shows that levels are highest in large agricultural areas (the Midwest, eastern PA, NC, and the San Joaquin Valley in CA) and urban areas (NYC-Philadelphia-DC and Los Angeles). The map on the right shows that more than half of Nr deposition is dry in many areas of the U.S. and the vast majority of deposition is dry over broad areas of the West, especially the Southwest. Maps are 3-year averages from 2016 to 2018.



TOTAL DEPOSITION ESTIMATES ALLOW US TO:

Addressing Key Knowledge Gaps & Research Needs

Key knowledge gaps in Nr deposition are of interest to a broad group of stakeholders including many federal[1], state, and Tribal agencies, academia, industry, and non-profit groups. These stakeholders share a wide variety of interconnected scientific and policy interests and have prioritized the three following research needs:

Better characterize patterns and trends in Nr deposition. It is important to accurately account for all Nr inputs across the U.S. Some important geographical areas lack monitoring and there are existing data sets that could be used in the TDep mapping process. Additionally, some types of Nr measurements are not being made routinely.

To address this need:

- Expand existing monitoring networks (NTN, AMoN, and CASTNET) in urban and agricultural areas
- Measure dry deposition fluxes in different regions and land-use types to help characterize parameters and improve performance of dry deposition models
- Utilize existing data sets (urban nitrogen dioxide - NO_2) and incorporate satellite data into measurement-model mapping process
- Add monitoring to include other compounds (organic Nr) that contribute to Nr deposition

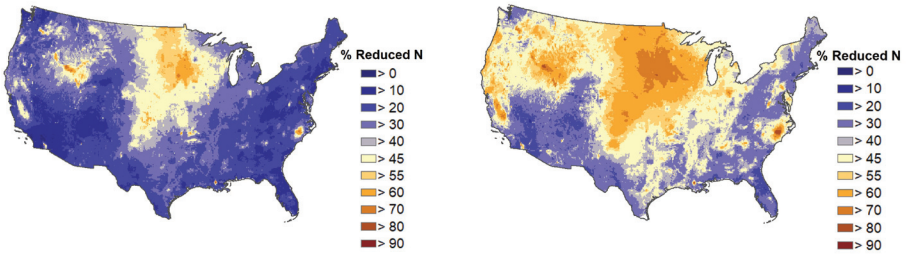

NADP Site at Grand Teton National Park


Dry Deposition Monitoring System

Quantify and reduce uncertainty in deposition estimates used for critical loads applications so that exceedances can be determined reliably.

To address this need:

- Conduct a comprehensive comparison of commonly used air quality models[2] to assess differences in deposition estimates.
- Develop methods for quantifying total uncertainty in deposition budgets derived from measurement-model fusion



A comparison of percent reduced Nr deposition in 2000-2002 (left) to 2016-2018 (right) shows that the prevalence of reduced Nr has grown over large portions of the U.S. due to reductions of oxidized Nr emissions.

Improve understanding of the linkages between agricultural emissions and Nr deposition. As NO_x emissions decline and the importance of NH_x emissions increases, a better understanding of NH_x emissions and ways to reduce them are needed.

To address this need:

- Improve inventories for agricultural NH_x emissions (animal production and crop fertilization)
- Identify cost-effective best management practices that reduce NH_x emissions

[1] Environmental Protection Agency, U.S. Geological Survey, National Park Service, U.S. Forest Service, Fish and Wildlife Service, Bureau of Land Management, National Oceanic and Atmospheric Administration, and National Aeronautics and Space Association.
[2] Community Multiscale Air Quality Model (CMAQ), Comprehensive Air Quality Model with Extensions (CAMx), Global Environmental Multiscale – Modelling Air quality and Chemistry (GEM-MACH).

National Atmospheric Deposition Program

This Fact Sheet is based on "Science needs for continued development of total nitrogen deposition budgets in the United States," a deposition research white paper that resulted in 9 peer-reviewed journal articles and 4 magazine articles, all available at http://nadp.slh.wisc.edu/committees/tdep/reports/

The mission of the National Atmospheric Deposition Program's Total Deposition Science Committee is to improve estimates of atmospheric deposition by advancing the science of measuring and modeling atmospheric wet, dry, and total deposition of species such as sulfur, nitrogen, and mercury by providing a forum for the exchange of information on current and emerging issues within a broad multi-organization context including atmospheric scientists, ecosystem scientists, resource managers, and policy makers.

March 2021