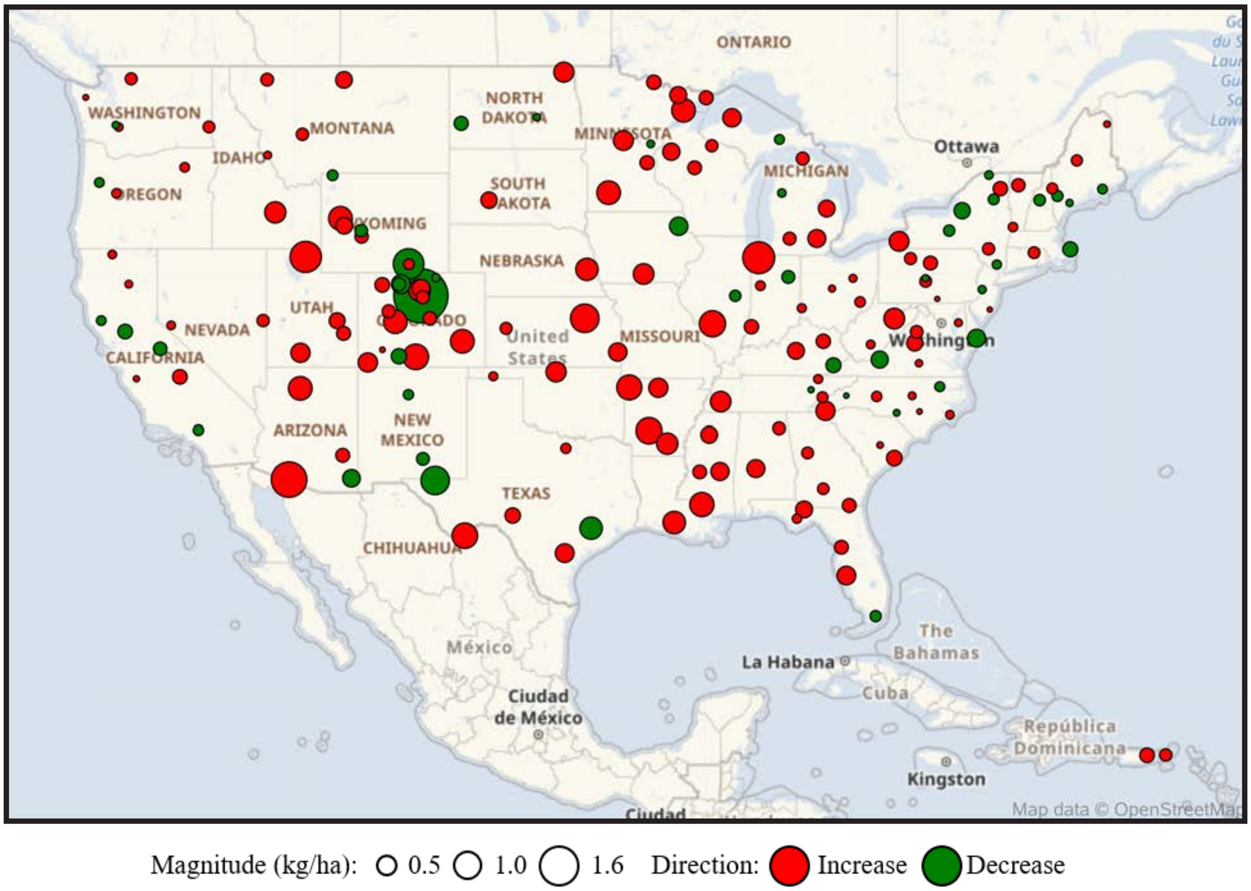
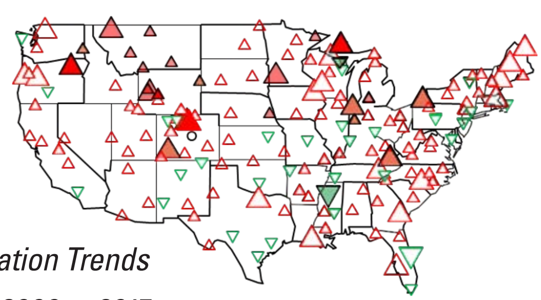
National Atmospheric Deposition Program

2022 Annual Summary

Change in Wet Deposition of Calcium, 2000 to 2022 (kg/ha)





Precipitation Trends

2000 to 2017

On the Cover: Several journal articles have recently noted increased deposition of calcium ion (at least through 2015), and have related it to drying in the West. This graphic is the change in calcium deposition between the Ca^{2+} deposition average for 2000-2002, and the Ca^{2+} deposition average for 2020-2022. The difference is the late average – early average, and the difference is mapped in kg/ha. Red dots are an increase in deposition between the periods, and the green dots are a decrease in deposition between the periods. Size of the dot represents the magnitude of change. The lower map show trends in precipitation (up triangles showing increases, and vise versa, and filled triangles are statistically significant at different levels) provided by M. McHale/USGS with further discussion on national trends in wet-deposition in a recent publication (McHale et al., 2021, *Atmospheric Environment* 247: 118219).

When referencing maps or information in this report, please use the citation: National Atmospheric Deposition Program, 2023. National Atmospheric Deposition Program 2022 Annual Summary. Wisconsin State Laboratory of Hygiene, University of Wisconsin-Madison, WI.

Contents

2022 Highlights

The National Atmospheric Deposition Program (NADP) provides high-quality, robust measurements that support informed decisions about environmental and public health issues as they relate to atmospheric deposition chemistry, and advance our understanding of atmospheric processing through the measurement of gaseous ammonia and mercury. NADP data is relevant to scientists, educators, policymakers, and the public. All data is available without charge on the NADP website (http://nadp.slh.wisc.edu).

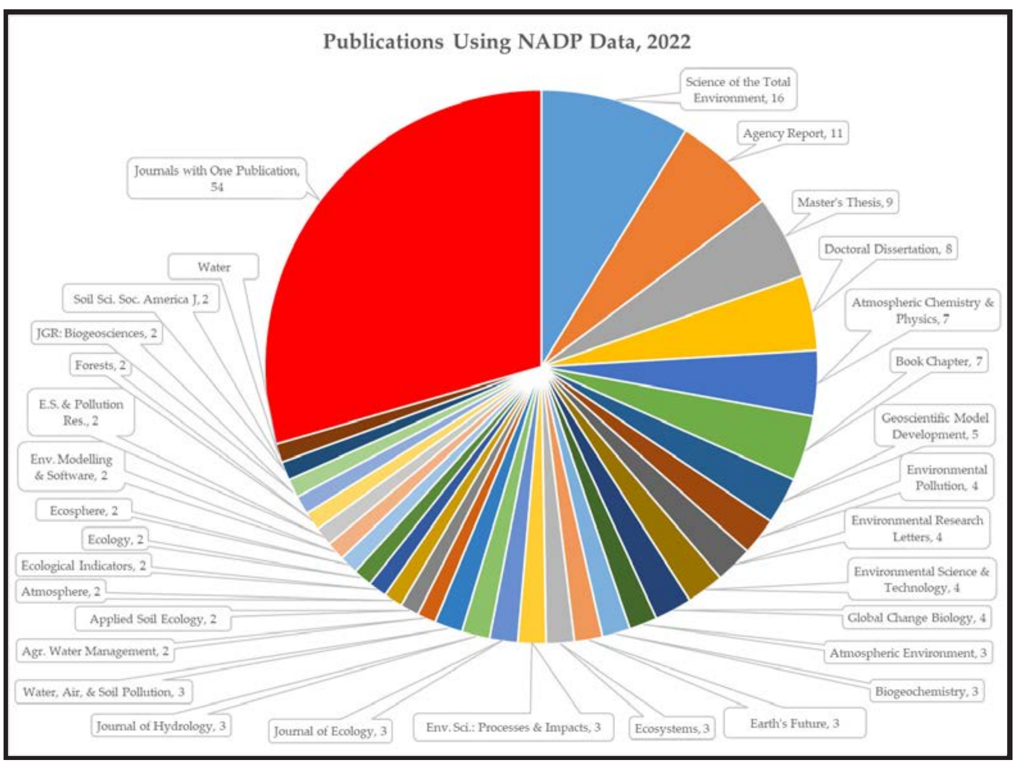
The NADP is composed of five networks, including the National Trends Network (NTN), the Mercury Deposition Network (MDN), the Atmospheric Mercury Network (AMNet), the Ammonia Monitoring Network (AMoN), and the Mercury Litterfall Network (MLN). The table nearby summarizes the number of measurements from each network in 2022.

Summary of 2022 Network Measurements

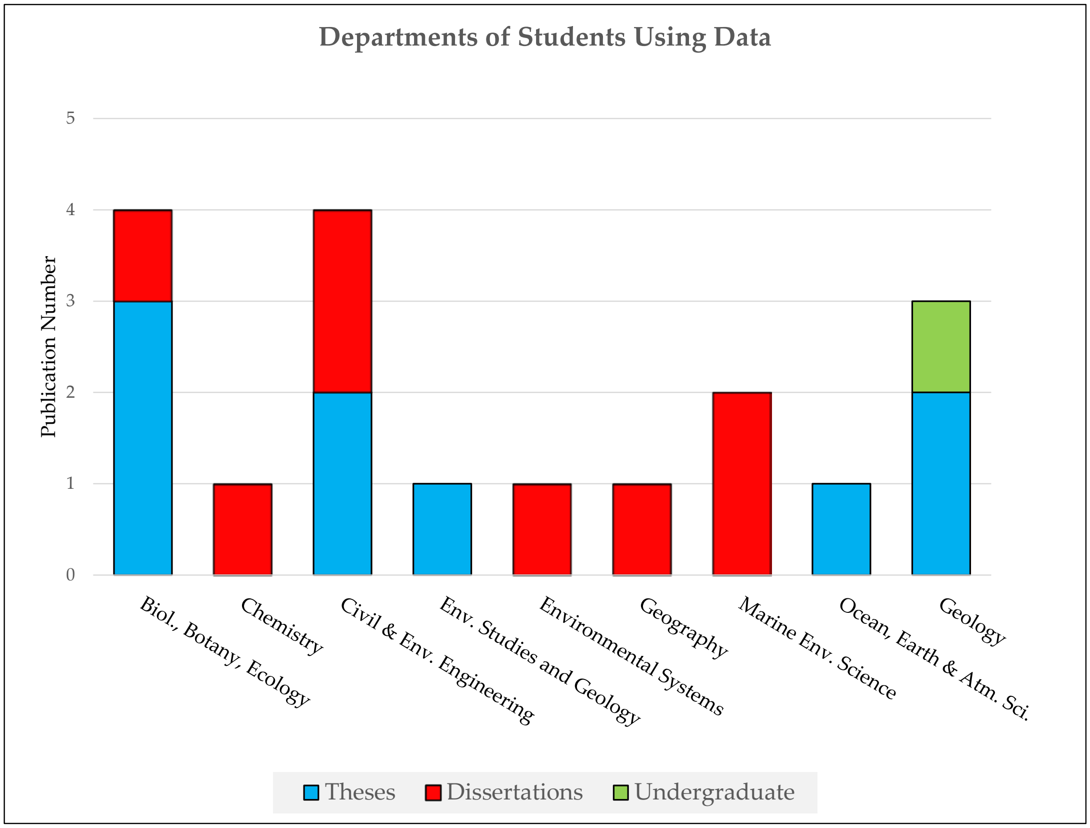
Network	Measurements	Period	No. of sites
NTN	13,052	weekly	261
MDN	4,084	weekly	85
AMNet	41,540	hourly/ 2-hourly	10
AMoN	3,422	two week	116
MLN	22	seasonal	23

Highlights:

- During the 2022 calendar year, 183 articles and reports were identified as having used NADP data. See the figure below for where these data appeared. Within the publications, there were several non-journal publications, including:
  - 8 doctoral dissertations
  - 9 master's theses
  - 7 agency/institute reports



These theses and dissertations came from a variety of department types as shown below.



- Officers for the Federal Year 2022/2023
  - Chair: Linda Geiser, USDA–FS
  - Vice Chair: Mike Bell, NPS
  - Secretary: Melissa Puchalski, US EPA
  - Past Chair: John Walker, US EPA

- We started a new AMNet site that is currently operating in Mexico City supported by the National Autonomous University of Mexico (MC03, Mexico City SEDEMA); and an NTN site in Bermuda (BM01, Tudor Hill), supported by a NSF research project.

- **UPDATE:** The long lifespan of the Belfort mechanical precipitation gages is finally over. The final 2 belfort rain-gages (MI99 and MS19) were retired during the year. The Belfort gages served us well during the earlier years, but it was time to move on.

- Additionally, fewer personal digital assistants (PDAs) are being used by sites, with only 20 or so PDAs still in use.

- The annual Fall Meeting and Scientific Symposium was held in Knoxville, TN from November 14 to 18, 2022. It was a hybrid meeting, and we had 176 total attendees, with 59 virtual attendees (https://nadp.slh.wisc.edu/nadp2022/).

- During 2022, COVID had little impact on the operations of the networks.
- At the end of 2022, we discovered that there was random, low-level mercury contamination in one lot of MDN bottles used, even after following our normal quality assurance testing of all bottle lots. The normal procedures did detect the contamination before most bottles were used, however. Many of the bottle lot were uncontaminated, but a significant number of samples were ultimately invalidated (see table below). This bottle lot has been removed from the MDN processing, and QA procedures have been updated. About 5 additional bottles were used in 2023.

Sample Types	Total Bottles from Lot Used	Total Samples Invalidated
Wet Samples	473	136
System Blanks (DF/DK Samples)	30	14
Dry Samples	114	0

Operator Recognition Award - Jim Renfro

2023

Nominated by Kristi Morris in 2023

Congratulations to Jim Renfro for being the recipient of the National Atmospheric Deposition Program's Operator Recognition Award.

Jim has operated several NADP sites at Great Smoky Mountains National Park including National Trends Network (NTN) site TN11, Mercury Deposition Network (MDN) sites TN11 and TN12, Mercury Litterfall Network (MLN) site TN11 and TN97, and Ammonia Monitoring Network (AMoN) site TN01, starting in 1987.

The National Park Service has been a long-term supporter of the NADP as a means of tracking trends in atmospheric deposition, quantifying inputs to sensitive ecosystems, and understanding the effects of these inputs on park resources. Jim is both a dedicated site operator with amazing attention to detail and a strong advocate for clean air in parks.

In the course of his work, he has promoted scientific investigation of air quality at the park and given tours of the monitoring station to visitors ranging from elementary school-aged scientists to senators and congresspeople.

Jim often highlights NADP as a tangible illustration of nature's interconnectedness and points to the data record as evidence that air quality is improving.

He recently hosted the 2022 NADP Fall Scientific Symposium Field Trip at Great Smoky Mountains National Park, inspiring all who attended with his enthusiasm for science and education.

Jim's message of stewardship and love of science will help ensure the protection and enjoyment of the park for future generations to come.

For exemplary service to NADP, sustaining and amplifying the value of the network.

NADP Background

The NADP was established in 1977 under State Agricultural Experiment Station (SAES) leadership to address the problem of atmospheric deposition, and its effects on agricultural crops, forests, rangelands, surface waters, and other natural and cultural resources. The NADP's primary charge was to provide data on the temporal trends and geographic distribution of the atmospheric deposition of acids, nutrients, and base cations by precipitation. In 1978, sites in the NADP precipitation chemistry network first began collecting weekly, wet-only deposition samples. Chemical analysis was performed at the Illinois State Water Survey's Central Analytical Laboratory (CAL), located at the University of Illinois Urbana-Champaign and the Program Coordinator was housed at Colorado State University.

Initially, the NADP was organized as SAES North Central Regional Project NC-141, which all four SAES regions further endorsed in 1982 as Interregional Project IR-7. A decade later, IR-7 was reclassified as the National Research Support Project No. 3 (NRSP-3), which it remains to this day. NRSP projects are multistate activities that support research on topics of concern to more than one state or region of the country. Multistate projects involve the SAES in partnership with the USDA National Institute of Food and Agriculture (NIFA) and other universities, institutions, and agencies.

In October 1981, the federally-supported National Acid Precipitation Assessment Program (NAPAP) was established to increase our understanding of the causes and effects of acidic precipitation. This program sought to establish a long-term precipitation chemistry network of sampling sites away from point source influences. Building on its experience in organizing and operating a national-scale network, the NADP agreed to coordinate operation of NAPAP's National Trends Network. Later, to benefit from identical siting criteria, operating procedures, and a shared analytical laboratory, NADP and NTN merged with the designation NADP/NTN. This merger brought substantial new federal agency participation into the program. Many NADP/NTN sites were supported by the USGS, NAPAP's lead federal agency for deposition monitoring.

In October 1992, the AIRMoN was formed from the Multistate Atmospheric Power Production Pollution Study (MAP3S), which was operated by the Department of Energy and NOAA. MAP3S measured wet deposition and estimated dry deposition (later discontinued) for the same analytes. AIRMoN sites collect samples daily when precipitation occured, and were analyzed for the same analytes as NTN samples.

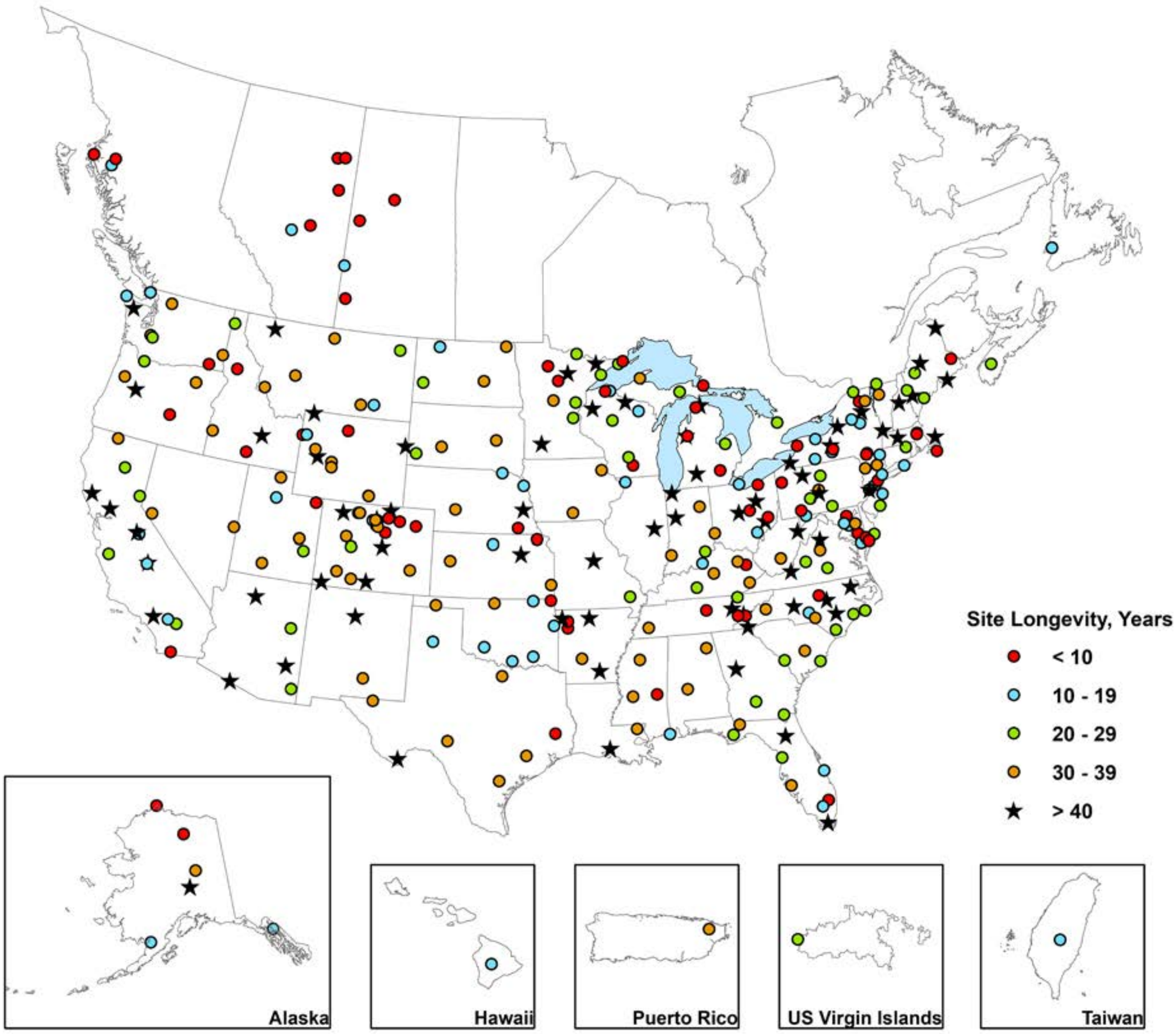
In January 1996, the NADP established the MDN, the third network in the organization. The MDN was formed to provide data on the wet deposition of mercury to surface waters, forested watersheds, and other receptors. MDN samples, like NTN samples, are weekly collections.

In October 2009, AMNet joined the NADP as its fourth network. AMNet measures the concentration of atmospheric mercury at high-time resolution using on-site, real-time analyzers.

In October 2010, AMoN joined the NADP. Atmospheric ammonia concentrations are measured every two weeks using passive samplers. The AMoN furthers the understanding of wet and dry deposition and ammonia partitioning in the atmosphere, allowing better assessment of ecosystem impacts and secondary air pollution formation.

Beginning in late 2017 and completed in mid-2018, the NADP PO and CAL moved from the University of Illinois at Urbana-Champaign to the University of Wisconsin–Madison. In June 2019 the HAL moved to the University of Wisconsin–Madison. Also in 2019, AIRMoN collected its last sample and the network was closed.

In the fall of 2021, the MLN joined the NADP. MLN measures concentrations of total mercury found in plant biomass litterfall. This measurement occurs in monthly samples over the autumn using passive collectors. The MLN provides information of additional mercury deposition in forested canopies.



Global distribution and longevity of NADP sites (years).

About the Maps

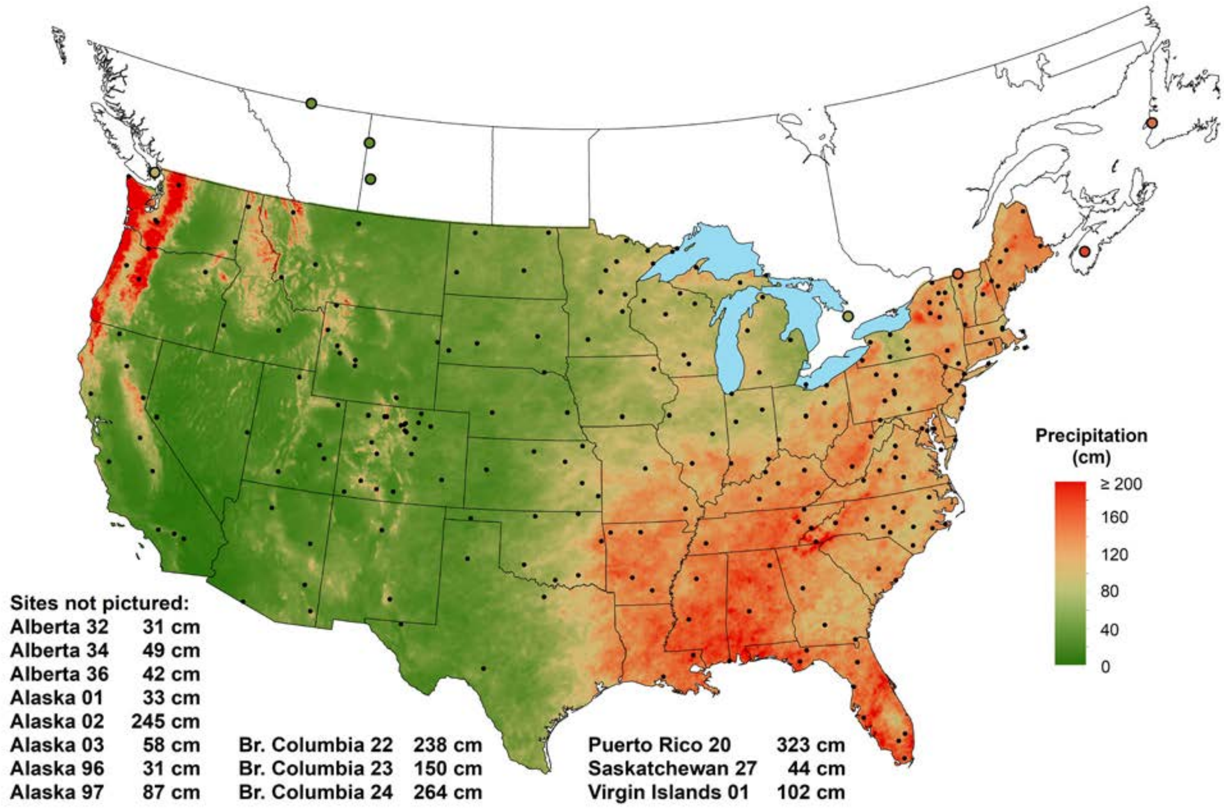
This map series is a principal product of the NADP. It summarizes the results of network operation for the most recent complete calendar year in graphical form. Additional maps, related geographic information, and reviewed analytical results are available on the NADP website.

To be included in a map product, site data must meet strict data completeness criteria (see the NADP website for details). Black dots mark site locations that met NADP completeness criteria in 2022. Open circles designate urban sites, defined as having at least 400 people per square kilometer (km^2) within a 15-km radius of the site. Sites (e.g., Canadian sites) that are too far removed from other observations to extend the contour surface also are represented as color- filled circles.

The map contour surface represents a gridded interpolation. Grid points within 500 km of each site are used in computations. Urban sites do not contribute to the contour surface. Colors represent interpolated values of concentration, deposition, or precipitation.

The precipitation surface is a modified version of the U.S. precipitation grid developed by the PRISM Climate Group ("Parameter-elevation Regressions on Independent Slopes Model," http:// prism. oregonstate.edu, data downloaded September 2023). These annual precipitation estimates incorporate point data, a digital elevation model, and expert knowledge of complex climatic extremes to produce continuous grid estimates. NADP precipitation observations are used to supplement the PRISM precipitation grids through an inverse distance weighting within a 20 km radius of each NADP site (see the NADP website for specific information). The resulting precipitation map is used to generate the deposition maps.

The precipitation figure on the next page has a continuous gradient of color from dark green (0 cm of precipitation) to yellow to dark red (greater than 200 cm of precipitation). Concentration and deposition maps follow this same format, with specified units on each map. All maps back to 1985 follow this schema and are available in multiple formats from the NADP website (https://nadp.slh.wisc.edu).



Total annual precipitation for 2022, using precipitation measurements from the NADP and PRISM (in cm).

National Trends Network (NTN)

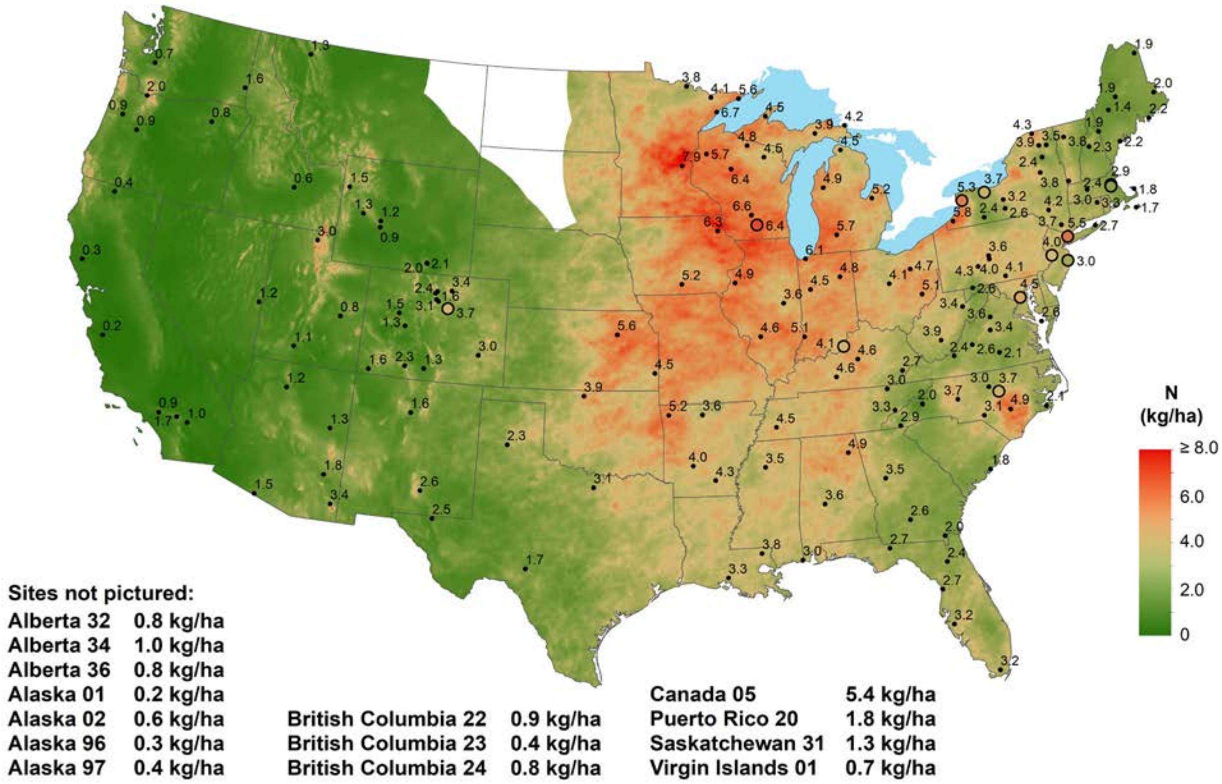
The NTN is the largest North American network that provides a long-term record of precipitation chemistry. Most sites are located away from urban areas and point sources of pollution, although urban sites do participate. Each site has a precipitation collector and precipitation gage. The automated collector ensures that sampling only occurs during precipitation events. Site operators follow standard operating procedures to help ensure NTN data comparability and representativeness across the network. Weekly samples are collected each Tuesday morning, using containers provided by the NADP.

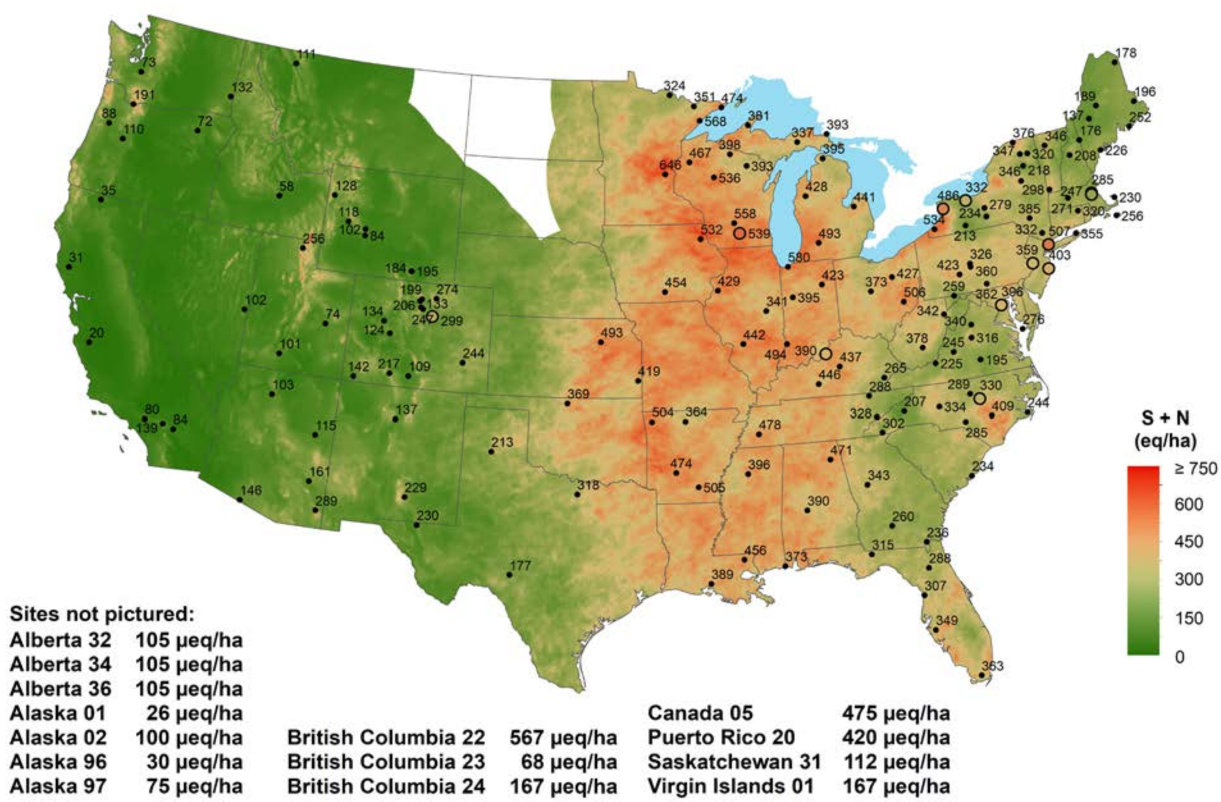
All samples are sent to the NADP laboratory for analysis of free acidity (H^+ as pH), specific conductance, calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), sulfate (SO_4^{2-}), nitrate (NO_3^-), chloride (Cl^-), and ammonium (NH_4^+) ions. The NADP quantifies orthophosphate for quality assurance purposes, as an indicator of potential field contamination. The CAL reviews field and laboratory data for accuracy and completeness and flags samples that were mishandled, compromised by equipment failure, or grossly contaminated. Data from the NTN are available on the NADP website (https://nadp.slh.wisc.edu/).

NTN Maps

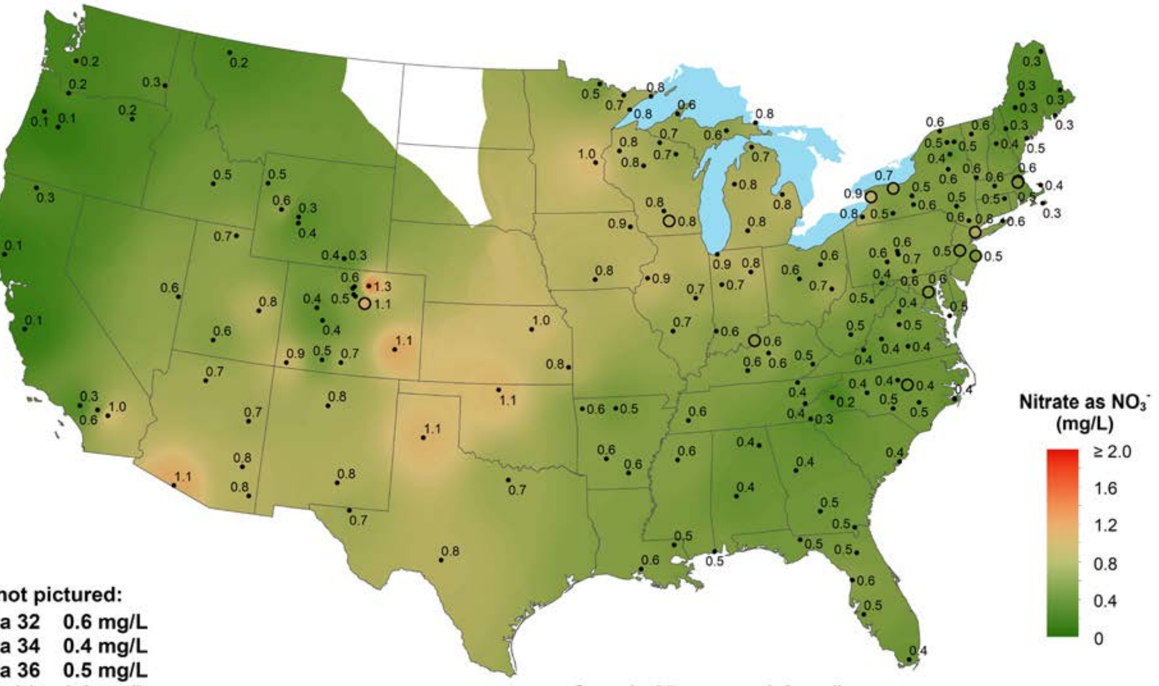
The maps on pages 13 through 22 show precipitation-weighted mean concentration and annual wet deposition for select acid anions, nutrients, and base cations. Substantial spatial heterogeneity across the nation is apparent for all measured species. In 2022, 175 of the 261 active sites met NADP completeness criteria. Concentration and deposition maps are included for SO_4^{2-}, NO_3^-, NH_4^+, pH, Ca^{2+}, Mg^{2+}, Cl^-, Na^+ and K^+

Annual maps for wet deposition of inorganic nitrogen (i.e., NO_3^- + NH_4^+) and sulfur + nitrogen (S + N) are also included. S + N (i.e., SO_4^{2-} + NO_3^- + NH_4^+) deposition is mapped as hydrogen ion equivalents per hectare (eq/ha).





Inorganic nitrogen wet deposition from nitrate and ammonium (top) and sulfur plus nitrogen wet deposition from sulfate, nitrate and ammonium (bottom), 2022.



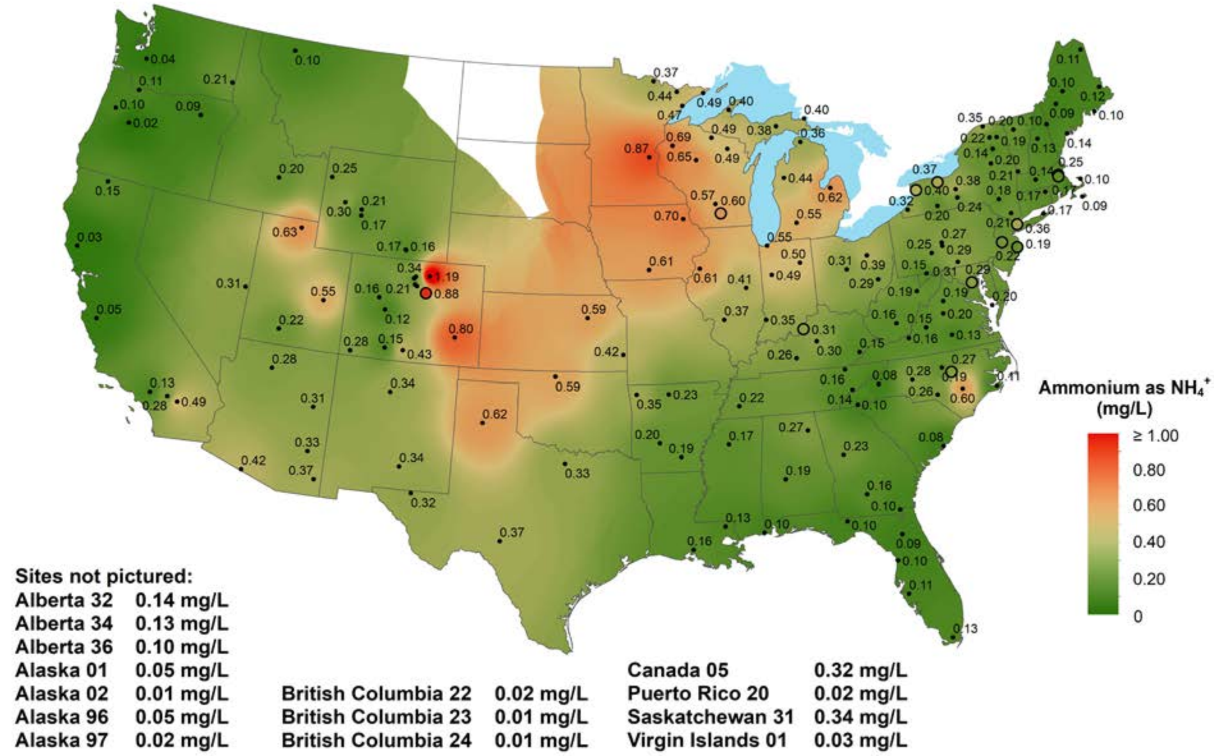
Sites not pictured:

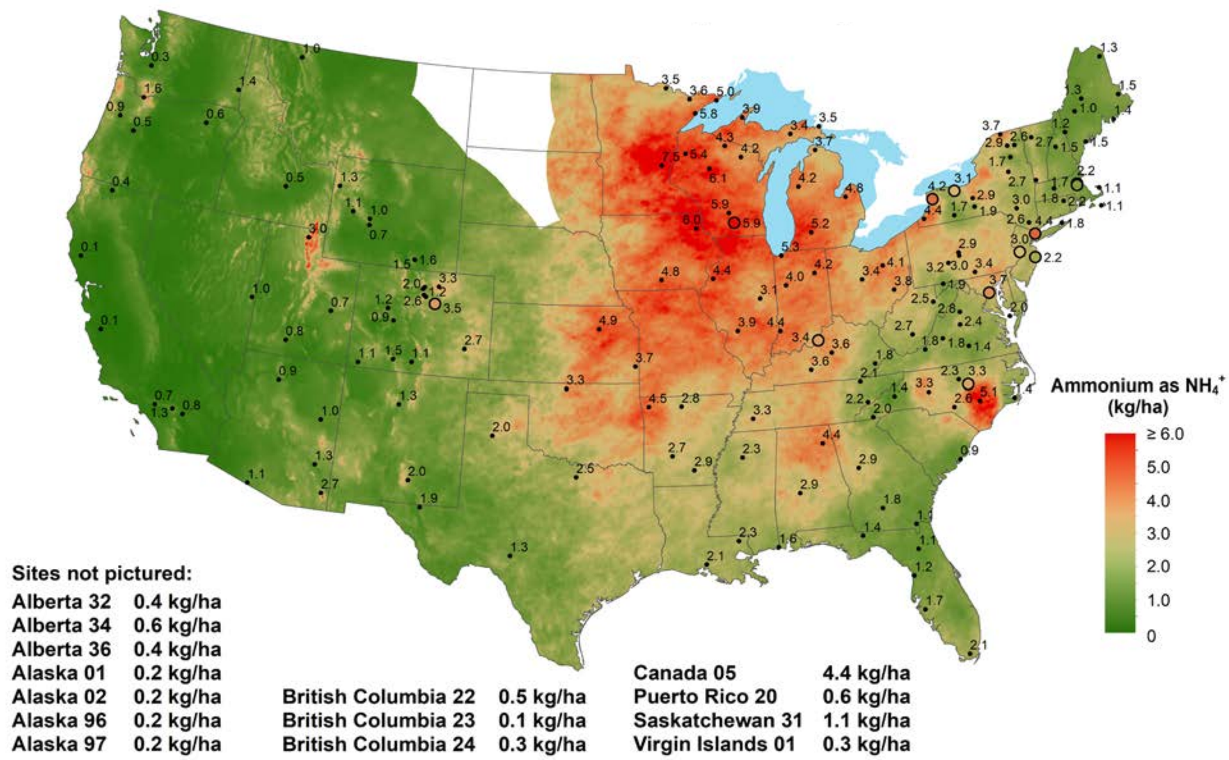
Alberta 32	0.6 mg/L
Alberta 34	0.4 mg/L
Alberta 36	0.5 mg/L
Alaska 01	0.2 mg/L
Alaska 02	0.1 mg/L
Alaska 96	0.2 mg/L
Alaska 97	0.1 mg/L
British Columbia 22	0.1 mg/L
British Columbia 23	0.1 mg/L
British Columbia 24	0.1 mg/L
Canada 05	0.6 mg/L
Puerto Rico 20	0.2 mg/L
Saskatchewan 31	0.7 mg/L
Virgin Islands 01	0.2 mg/L

Sites not pictured:

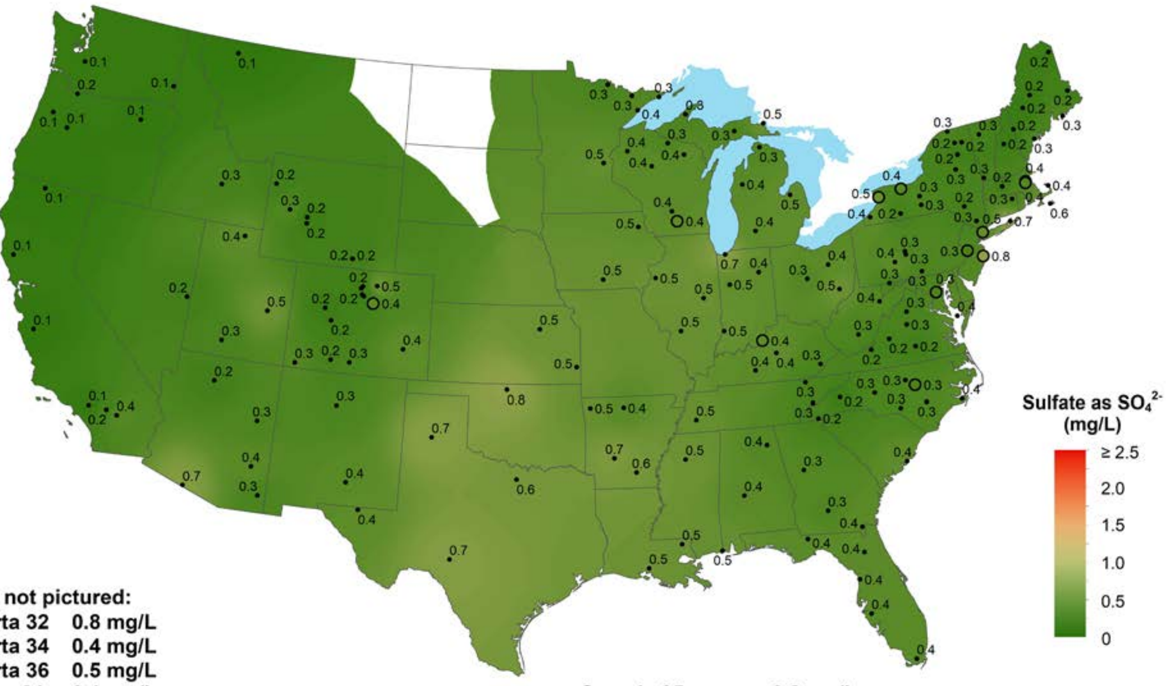
Alberta 32	2 kg/ha
Alberta 34	2 kg/ha
Alberta 36	2 kg/ha
Alaska 01	1 kg/ha
Alaska 02	2 kg/ha
Alaska 96	1 kg/ha
Alaska 97	1 kg/ha
British Columbia 22	2 kg/ha
British Columbia 23	1 kg/ha
British Columbia 24	3 kg/ha
Canada 05	9 kg/ha
Puerto Rico 20	6 kg/ha
Saskatchewan 31	2 kg/ha
Virgin Islands 01	2 kg/ha

Nitrate ion concentration (top) and wet deposition (bottom), 2022.



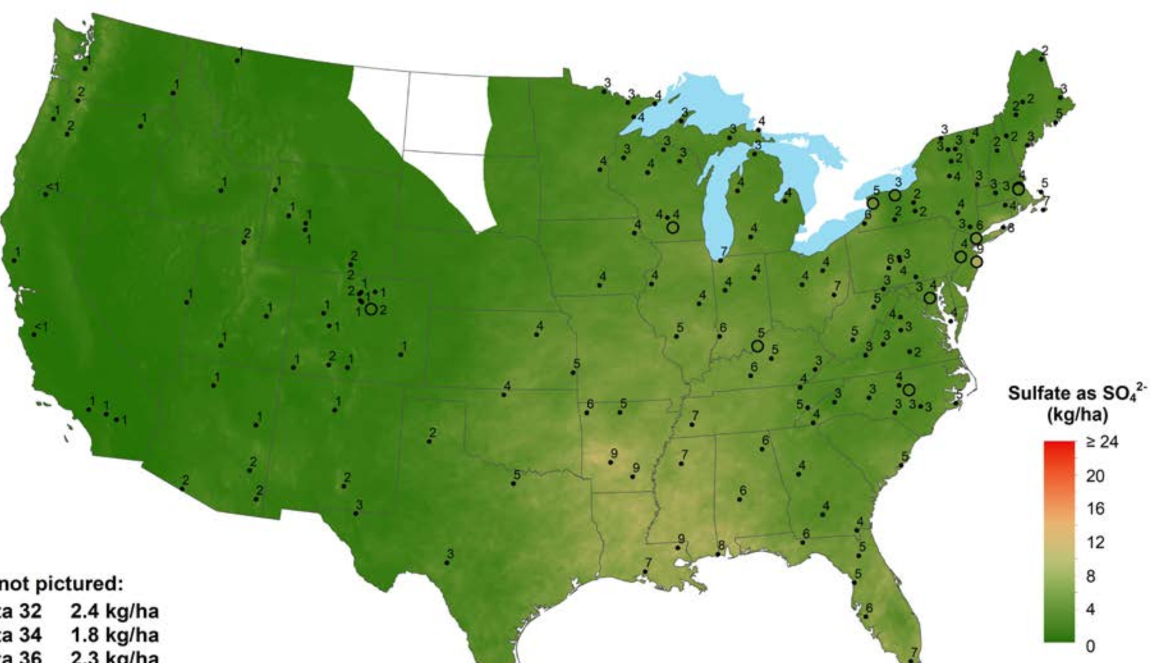


Ammonium ion concentration (top) and wet deposition (bottom), 2022.



Sites not pictured:

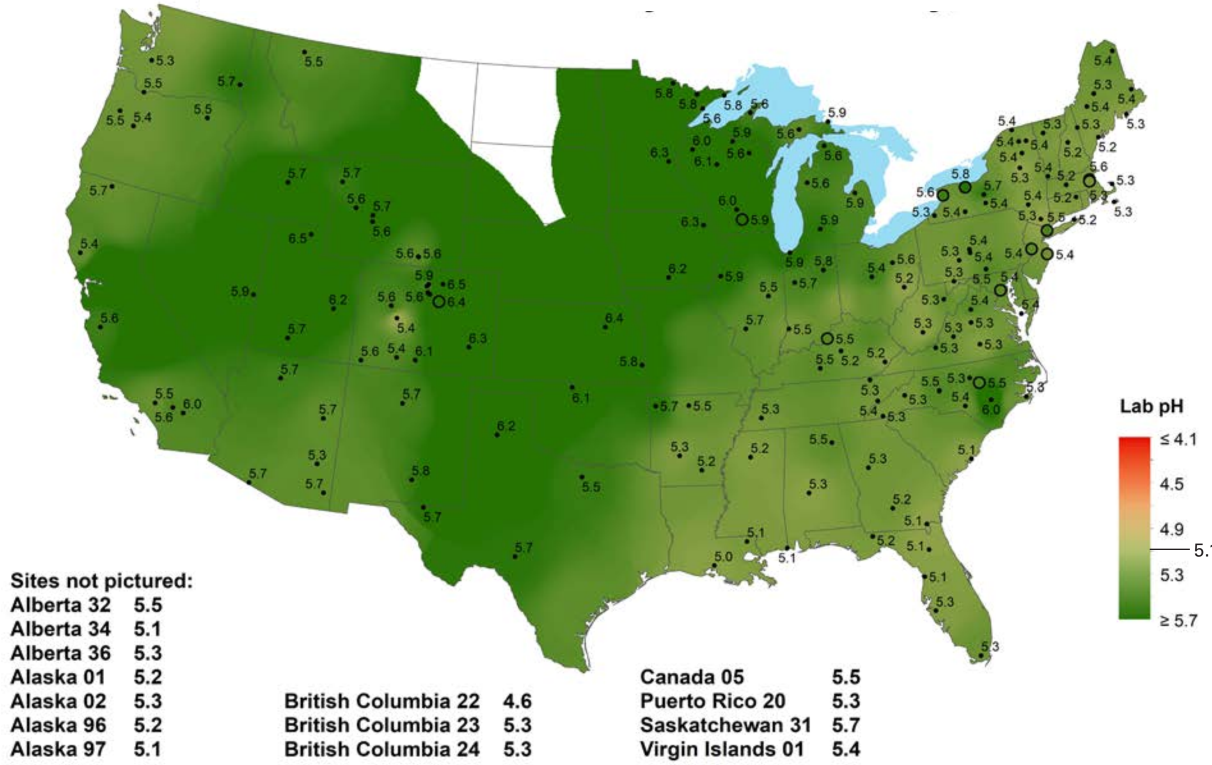
Alberta 32	0.8 mg/L
Alberta 34	0.4 mg/L
Alberta 36	0.5 mg/L
Alaska 01	0.1 mg/L
Alaska 02	0.1 mg/L
Alaska 96	0.1 mg/L
Alaska 97	0.3 mg/L
British Columbia 22	1.0 mg/L
British Columbia 23	0.1 mg/L
British Columbia 24	0.2 mg/L
Canada 05	0.3 mg/L
Puerto Rico 20	0.4 mg/L
Saskatchewan 31	0.3 mg/L
Virgin Islands 01	0.6 mg/L

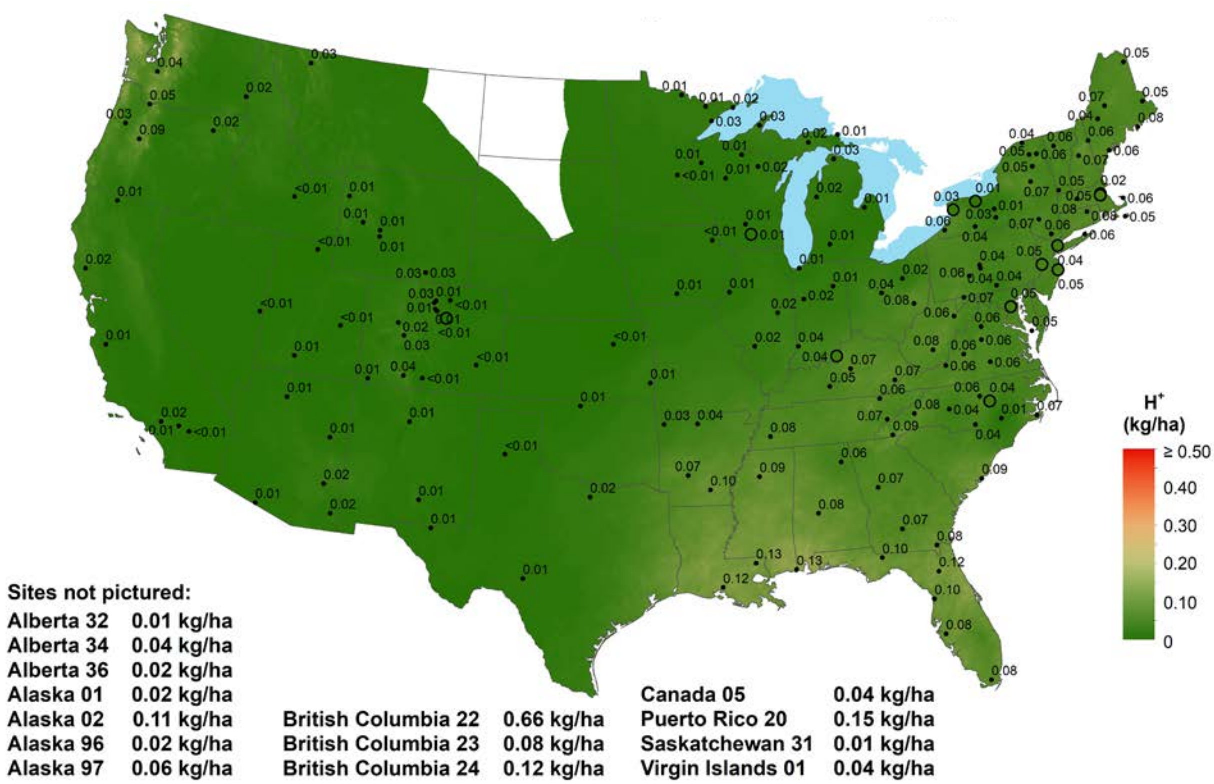


Sites not pictured:

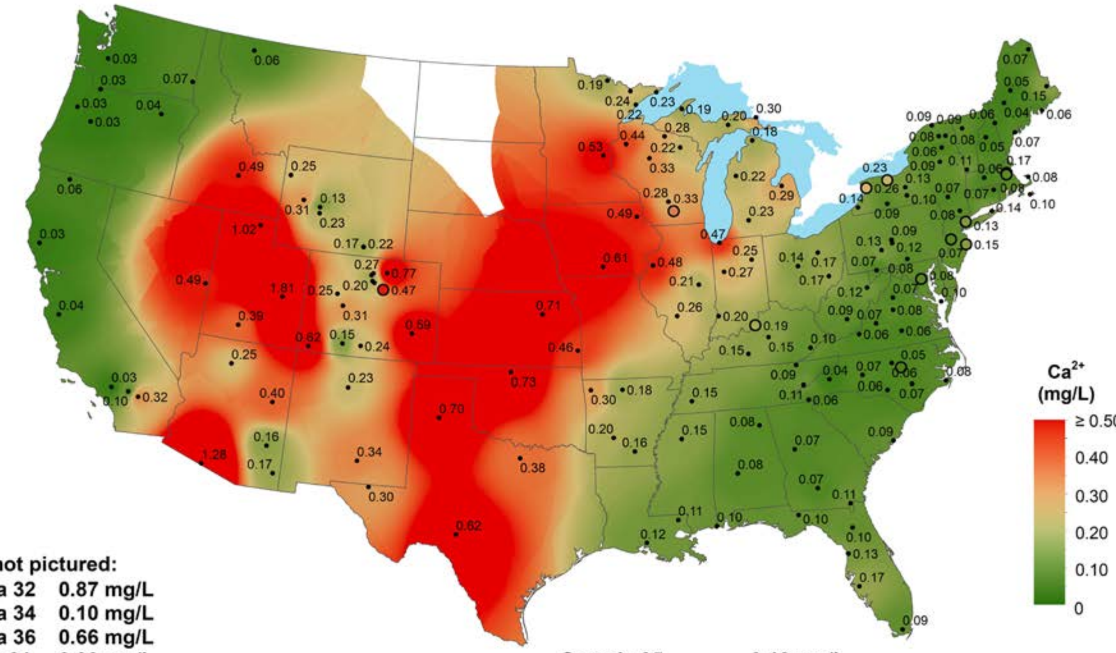
Alberta 32	2.4 kg/ha
Alberta 34	1.8 kg/ha
Alberta 36	2.3 kg/ha
Alaska 01	0.4 kg/ha
Alaska 02	2.6 kg/ha
Alaska 96	0.4 kg/ha
Alaska 97	2.3 kg/ha
British Columbia 22	24.1 kg/ha
British Columbia 23	1.9 kg/ha
British Columbia 24	5.2 kg/ha
Canada 05	4.3 kg/ha
Puerto Rico 20	14.1 kg/ha
Saskatchewan 31	0.9 kg/ha
Virgin Islands 01	5.7 kg/ha

Sulfate ion concentration (top) and wet deposition (bottom), 2022.



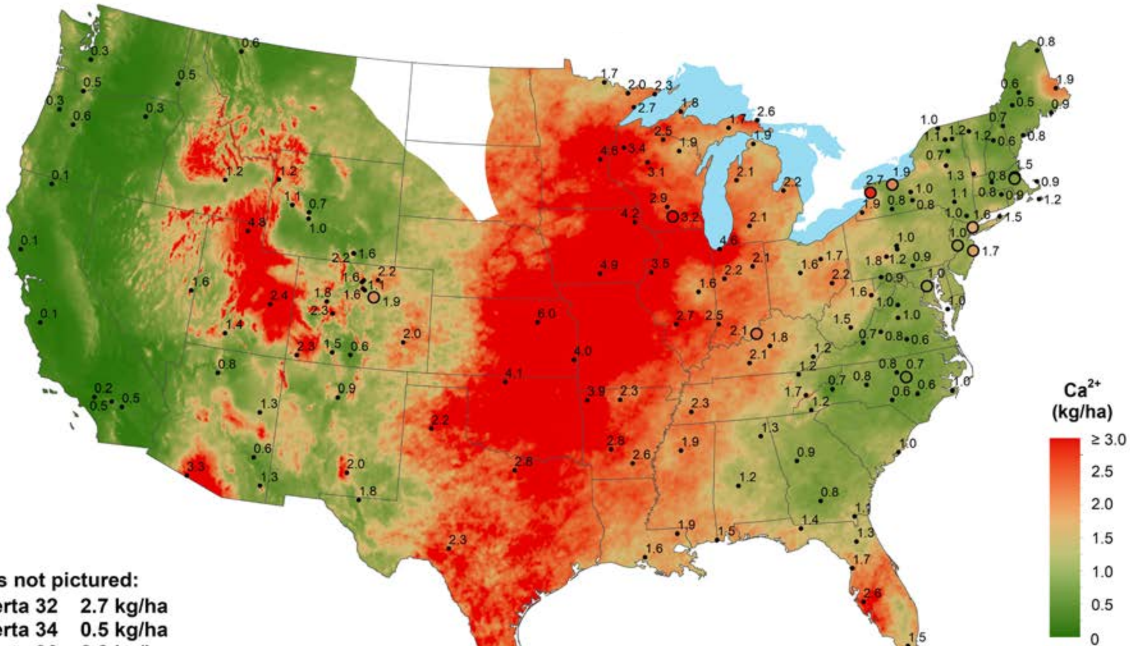


Hydrogen ion concentration as pH (top) and wet deposition (bottom), 2022. Typically, a precipitation pH of less than 5.1 is considered acidic precipitation.



Sites not pictured:

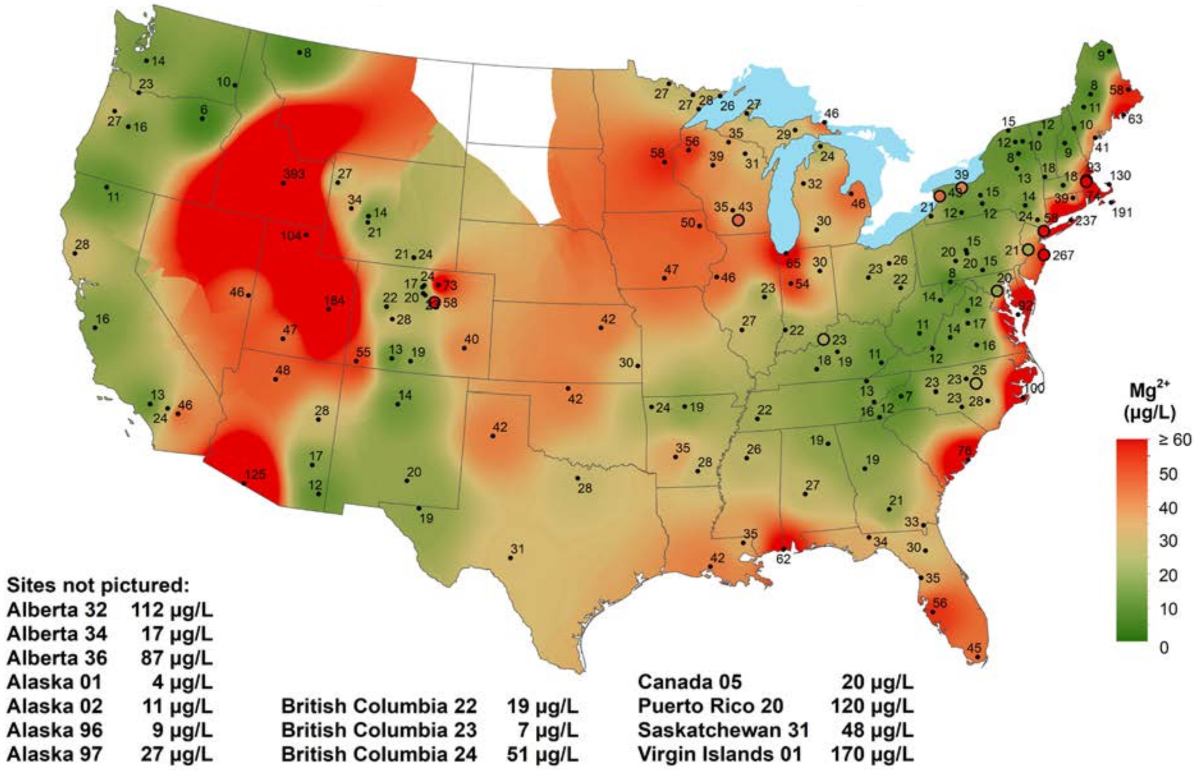
Alberta 32	0.87 mg/L
Alberta 34	0.10 mg/L
Alberta 36	0.66 mg/L
Alaska 01	0.03 mg/L
Alaska 02	0.02 mg/L
Alaska 96	0.10 mg/L
Alaska 97	0.03 mg/L
British Columbia 22	0.04 mg/L
British Columbia 23	0.02 mg/L
British Columbia 24	0.04 mg/L
Canada 05	0.13 mg/L
Puerto Rico 20	0.10 mg/L
Saskatchewan 31	0.23 mg/L
Virgin Islands 01	0.13 mg/L

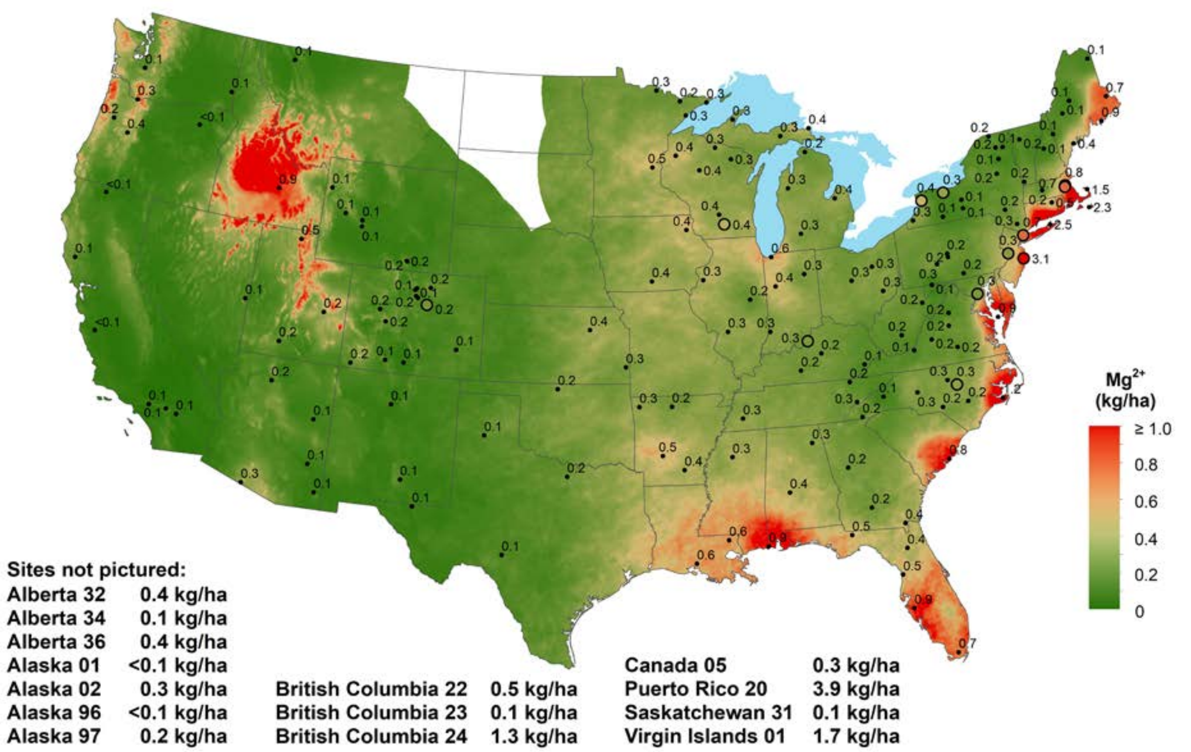


Sites not pictured:

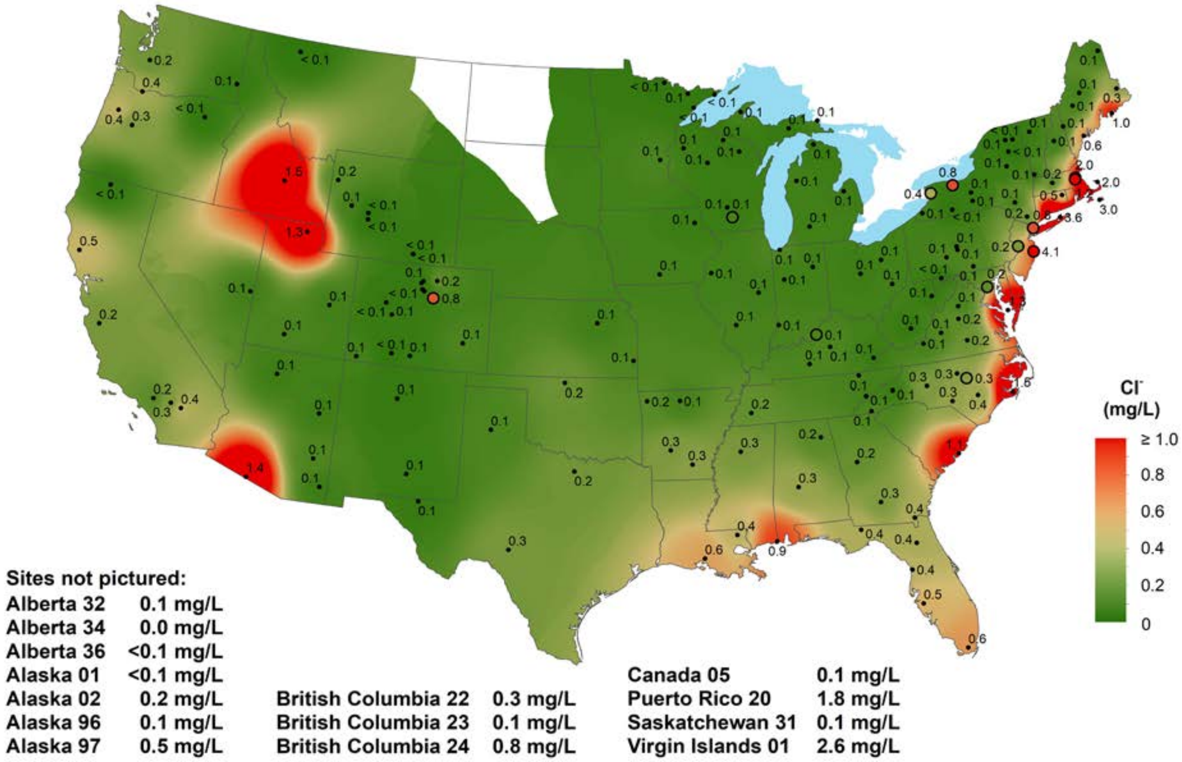
Alberta 32	2.7 kg/ha
Alberta 34	0.5 kg/ha
Alberta 36	2.8 kg/ha
Alaska 01	0.1 kg/ha
Alaska 02	0.5 kg/ha
Alaska 96	0.3 kg/ha
Alaska 97	0.3 kg/ha
British Columbia 22	0.9 kg/ha
British Columbia 23	0.3 kg/ha
British Columbia 24	0.9 kg/ha
Canada 05	1.8 kg/ha
Puerto Rico 20	3.2 kg/ha
Saskatchewan 31	0.7 kg/ha
Virgin Islands 01	1.3 kg/ha

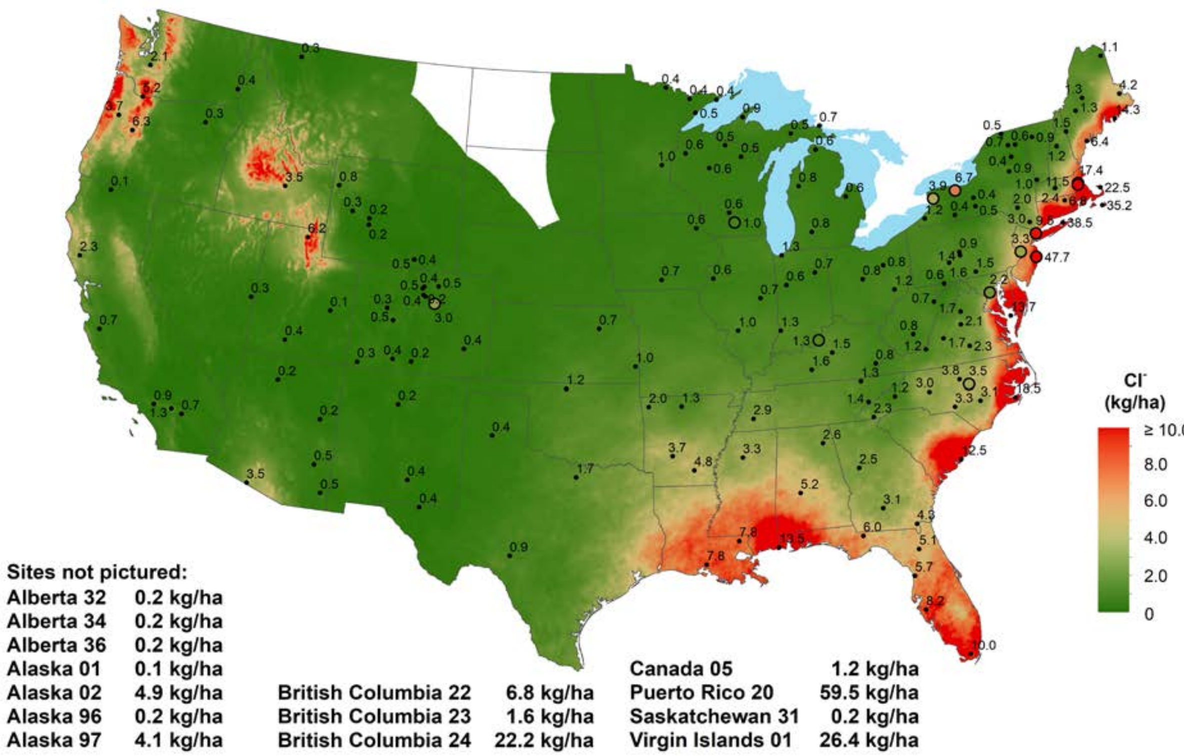
Calcium ion concentration (top) and wet deposition (bottom), 2022.



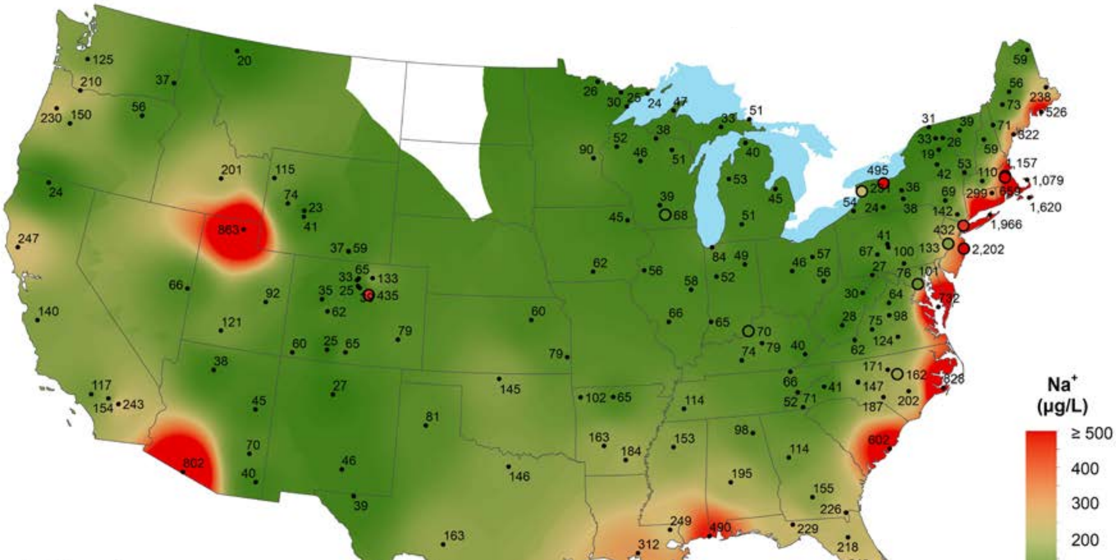


Magnesium ion concentration (top) and wet deposition (bottom), 2022.



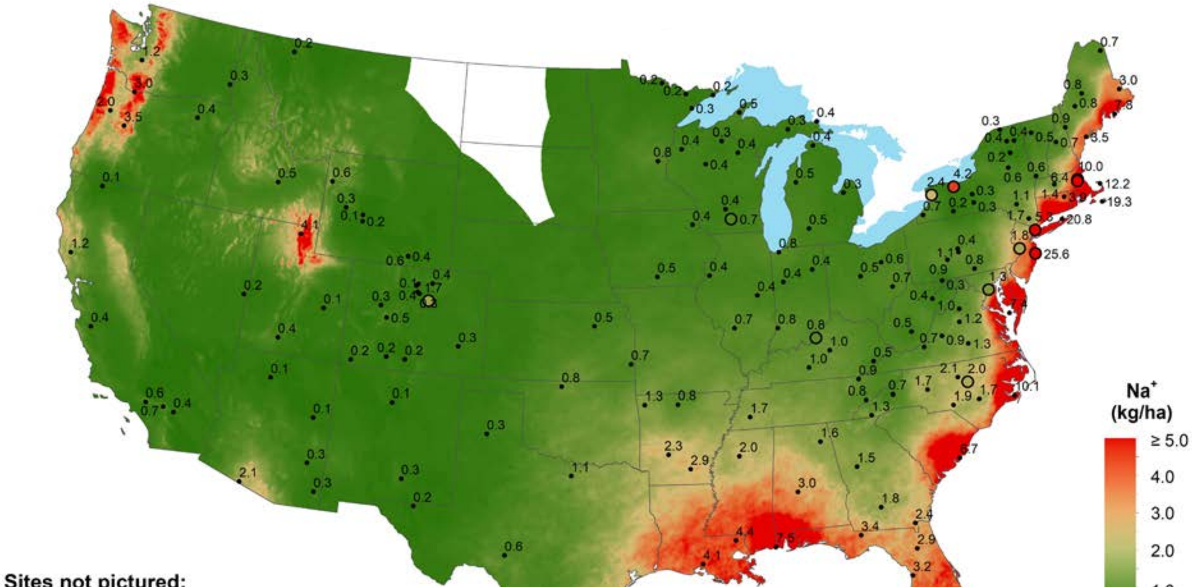


Chloride ion concentration (top) and wet deposition (bottom), 2022.



Sites not pictured:

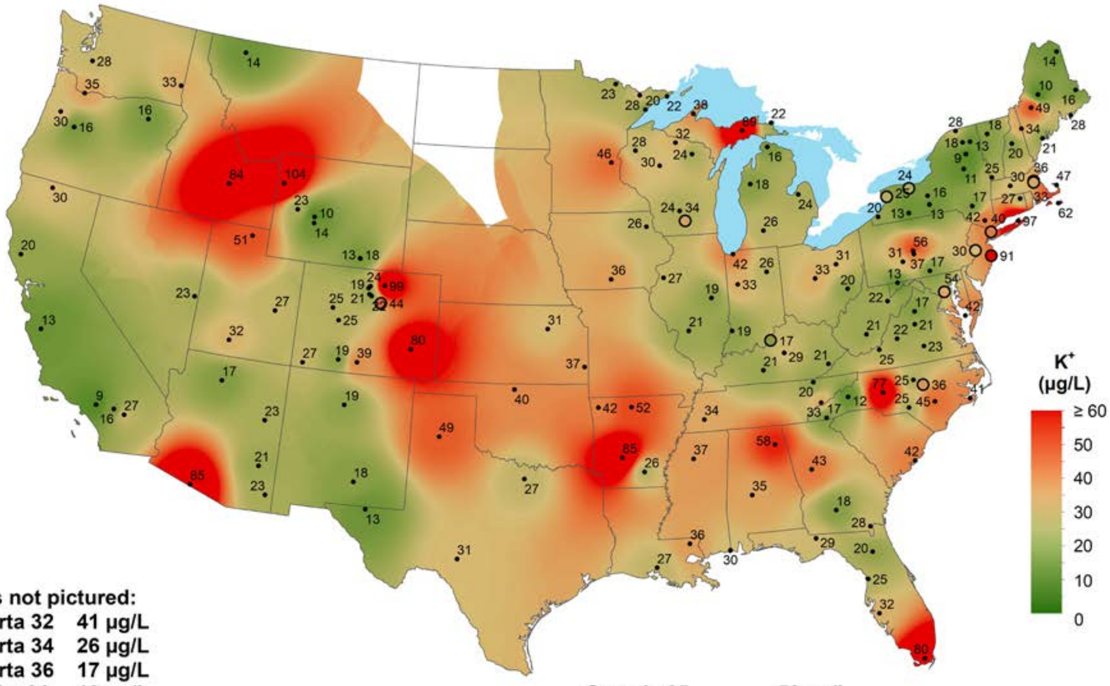
Alberta 32	60 µg/L
Alberta 34	25 µg/L
Alberta 36	27 µg/L
Alaska 01	22 µg/L
Alaska 02	111 µg/L
Alaska 96	35 µg/L
Alaska 97	238 µg/L
British Columbia 22	220 µg/L
British Columbia 23	58 µg/L
British Columbia 24	455 µg/L
Canada 05	51 µg/L
Puerto Rico 20	1000 µg/L
Saskatchewan 31	40 µg/L
Virgin Islands 01	1430 µg/L



Sites not pictured:

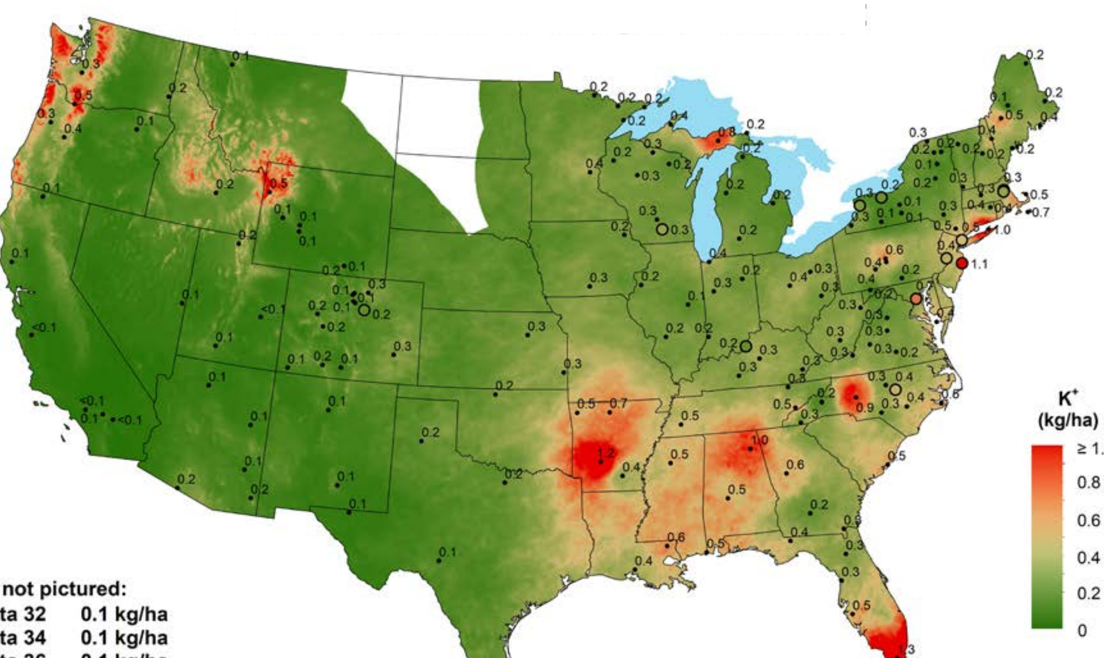
Alberta 32	0.2 kg/ha
Alberta 34	0.1 kg/ha
Alberta 36	0.1 kg/ha
Alaska 01	0.1 kg/ha
Alaska 02	2.7 kg/ha
Alaska 96	0.1 kg/ha
Alaska 97	2.1 kg/ha
British Columbia 22	5.2 kg/ha
British Columbia 23	0.9 kg/ha
British Columbia 24	12.0 kg/ha
Canada 05	0.7 kg/ha
Puerto Rico 20	32.3 kg/ha
Saskatchewan 31	0.1 kg/ha
Virgin Islands 01	14.6 kg/ha

Sodium ion concentration (top) and wet deposition (bottom), 2022.



Sites not pictured:

Alberta 32	41 µg/L			Canada 05	50 µg/L
Alberta 34	26 µg/L	British Columbia 22	13 µg/L	Puerto Rico 20	46 µg/L
Alberta 36	17 µg/L	British Columbia 23	13 µg/L	Saskatchewan 31	45 µg/L
Alaska 01	10 µg/L	British Columbia 24	27 µg/L	Virgin Islands 01	65 µg/L
Alaska 02	8 µg/L				
Alaska 96	15 µg/L				
Alaska 97	18 µg/L				



Sites not pictured:

Alberta 32	0.1 kg/ha			Canada 05	0.7 kg/ha
Alberta 34	0.1 kg/ha	British Columbia 22	0.3 kg/ha	Puerto Rico 20	1.5 kg/ha
Alberta 36	0.1 kg/ha	British Columbia 23	0.2 kg/ha	Saskatchewan 31	0.1 kg/ha
Alaska 01	<0.1 kg/ha	British Columbia 24	0.7 kg/ha	Virgin Islands 01	0.7 kg/ha
Alaska 02	0.2 kg/ha				
Alaska 96	<0.1 kg/ha				
Alaska 97	0.2 kg/ha				

Potassium ion concentration (top) and wet deposition (bottom), 2022.

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Mercury Deposition Network (MDN)

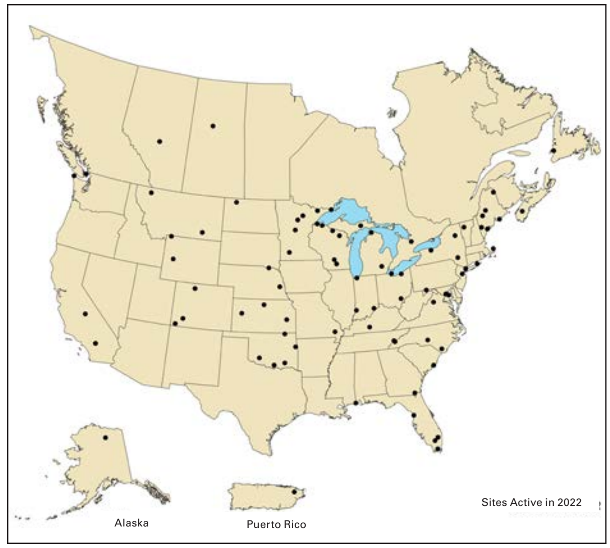
The MDN is the only network providing a long-term record for the concentration of mercury (Hg) in precipitation in North America. MDN sites follow standard procedures and use approved precipitation collectors and rain gages. The automated collector is similar to the NTN collector, but it is modified to preserve mercury. Site operators collect samples every Tuesday morning. Chemical analysis of the MDN samples is performed by the NADP laboratory.

All MDN samples are analyzed for total mercury concentration. The NADP reviews field and laboratory data for accuracy and completeness, and identifies samples that were mishandled, compromised by equipment failure, or grossly contaminated.

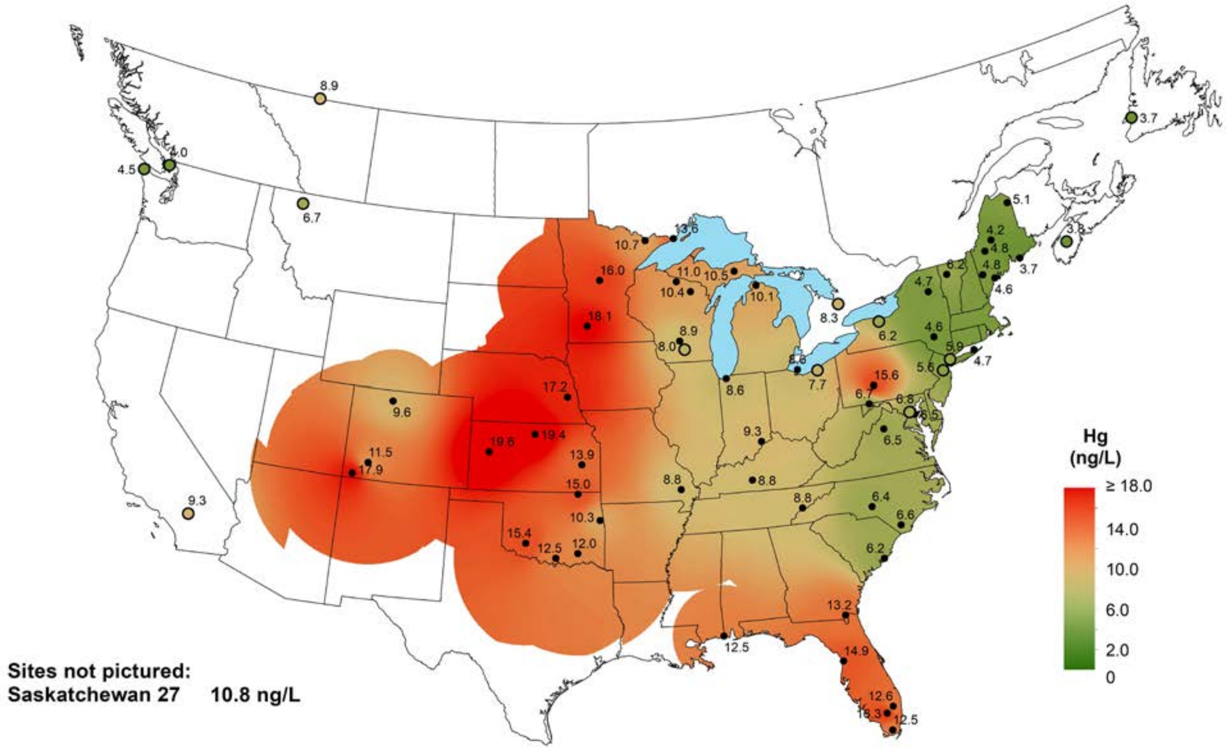
As of December 2022, there were 85 active MDN sites. Data from the MDN is available on the NADP website (http://nadp.slh.wisc.edu). Subsamples of MDN precipitation were analyzed for methyl mercury (MeHg) at 7 NADP sites through the end of June, when methyl mercury analysis was discontinued. Details about sample collection and analysis are available on the NADP website.

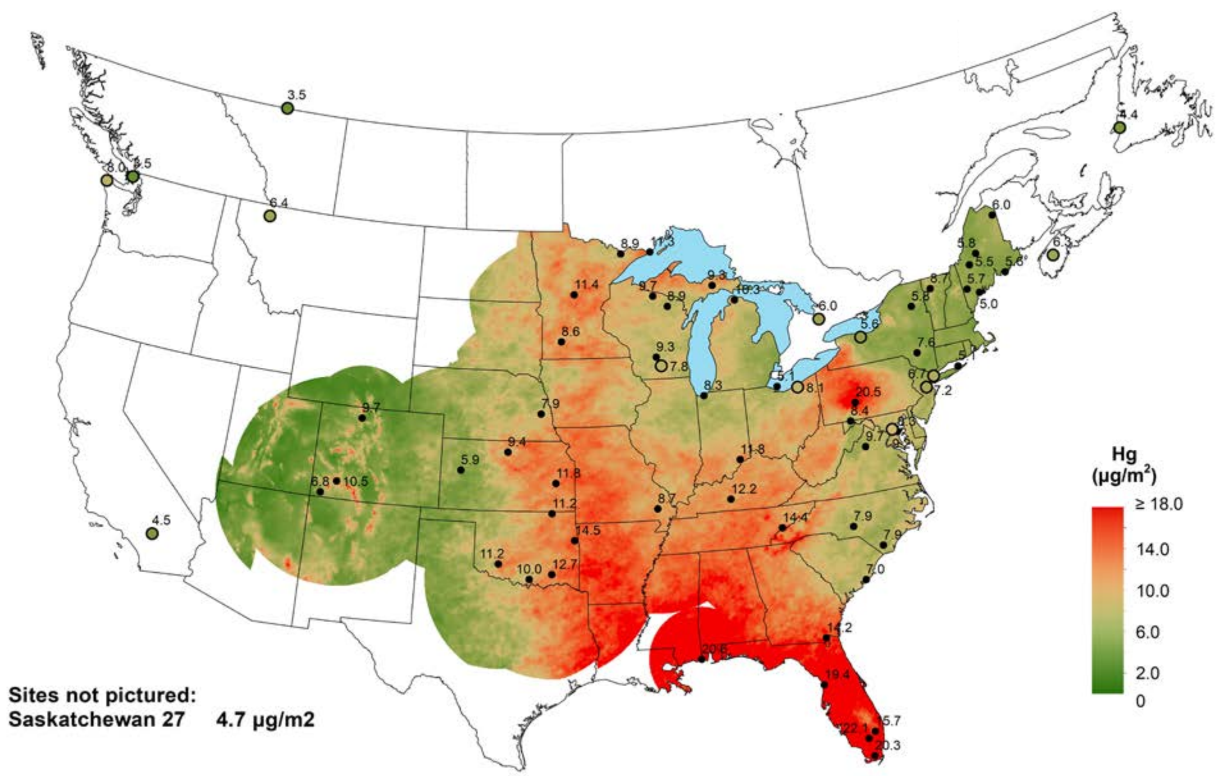
MDN Maps and Graphs

The maps on page 25 show spatial variability in the precipitation-weighted mean concentration and wet deposition of total mercury across the United States.



Only sites meeting NADP completeness criteria are included. In 2022, 65 of 85 active sites met these criteria. Large variations in both mercury concentrations and wet-deposition are observed across the nation.





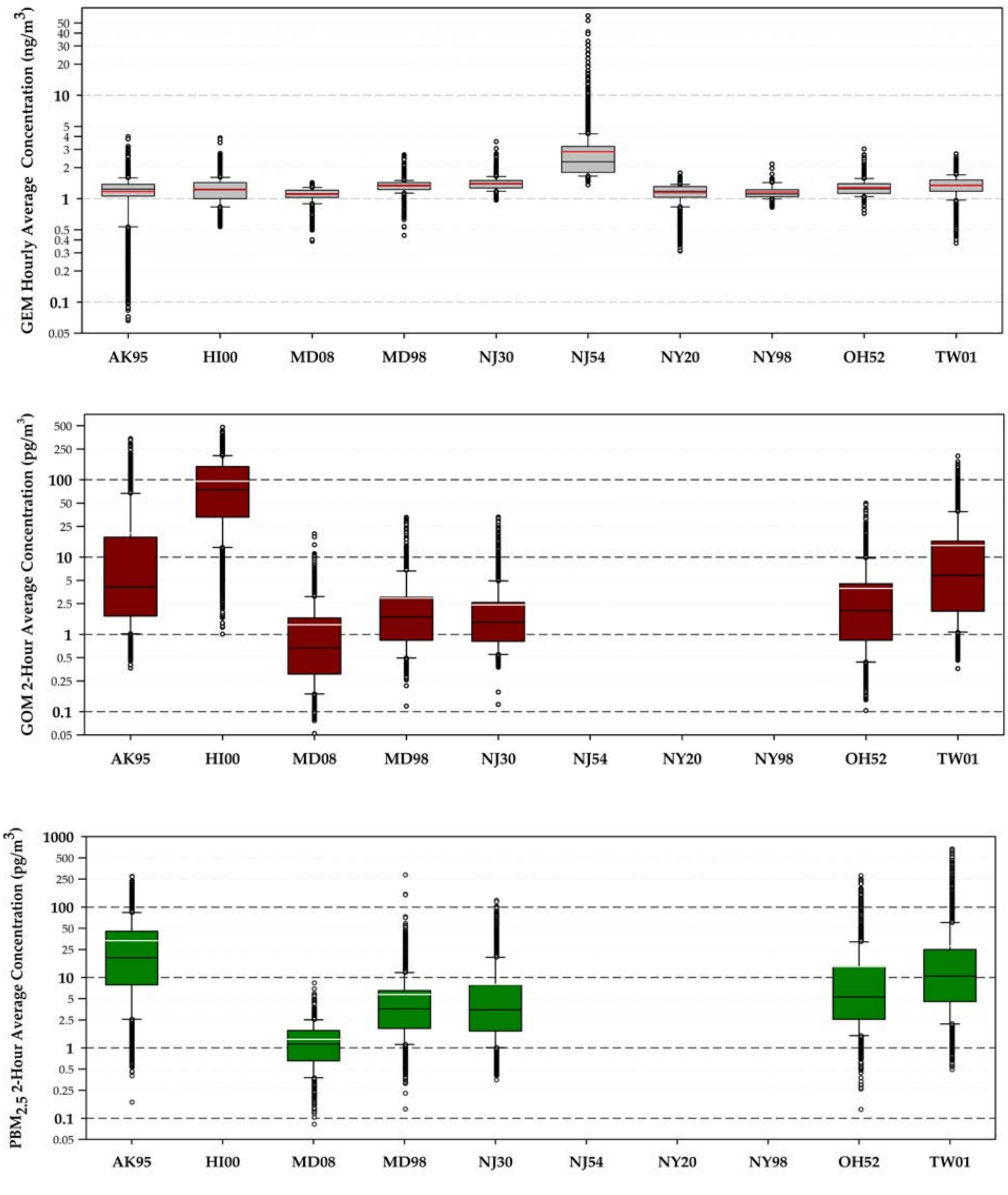
Total mercury concentration (top) and wet deposition (bottom), 2022.

Atmospheric Mercury Network (AMNet)

AMNet sites measure ambient atmospheric mercury using automated, continuous measurement systems in order to understand the impact of atmospheric mercury on deposition. Quality-assured measurements are made using NADP standardized methods.

AMNet measurements are made continuously (five minute and two-hour averages). Data is qualified and averaged to one-hour (gaseous elemental mercury, GEM) and two-hour values (gaseous oxidized mercury, GOM, and particulate bound mercury, $PBM_{2.5}$). As of December 2022, there were 10 AMNet sites. Data from the AMNet are available on the NADP website (https://nadp.slh.wisc.edu).

The figures on page 27 show the distribution of atmospheric mercury concentrations for each site. The top figure shows the distribution of GEM (shaded grey area) for all sites reporting data. GEM is reported in nanograms per cubic meter (ng/m^3). The middle figure shows the distribution of two-hour atmospheric concentrations of GOM (red shaded area) and the bottom figure shows $PBM_{2.5}$ (green shaded area) in picograms per cubic meter (pg/m^3). Concentrations are plotted logarithmically, and with different scale ranges, to highlight the range of measured values for each site.



Hourly GEM concentration in ng/m3 for each AMNet site (top) and 2-hour GOM and $PBM_{2.5}$ concentrations in pg/m3 for each speciating AMNet site (middle and bottom) in 2022. For each data set, the mean value is indicated as a red (GEM) or white bar (GOM and $PBM_{2.5}$) and the median is indicated as a black bar. Sites with no GOM and $PBM_{2.5}$ data shown did not monitor for speciated mercury.

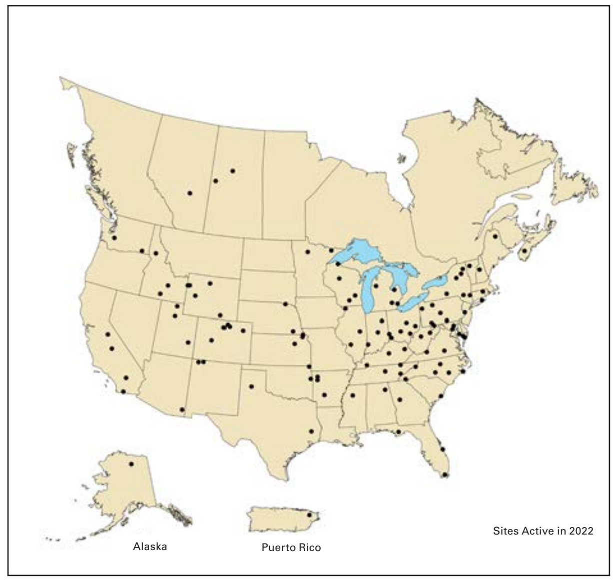
Ammonia Monitoring Network (AMoN)

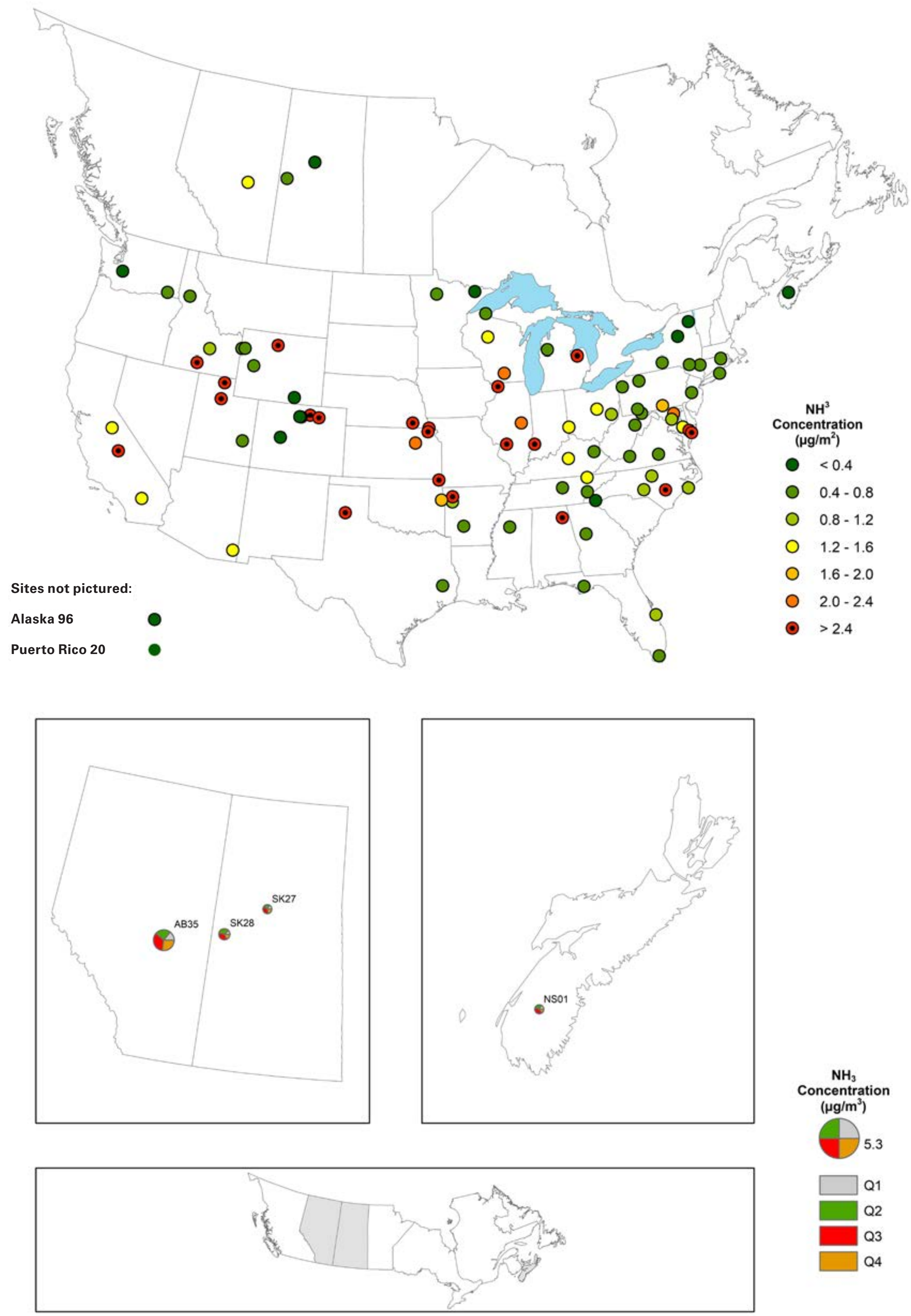
The AMoN measures atmospheric concentrations of ammonia (NH_3) gas. The network uses a passive diffusion-type sampler that provides cost-effective, accurate, and time-integrated measurements.

Sampling occurs over a two-week period, and all sites collect additional quality assurance samples on a rotating basis. This data is used to assess long-term NH_3 trends and changes in atmospheric chemistry, and to provide information for model development and verification.

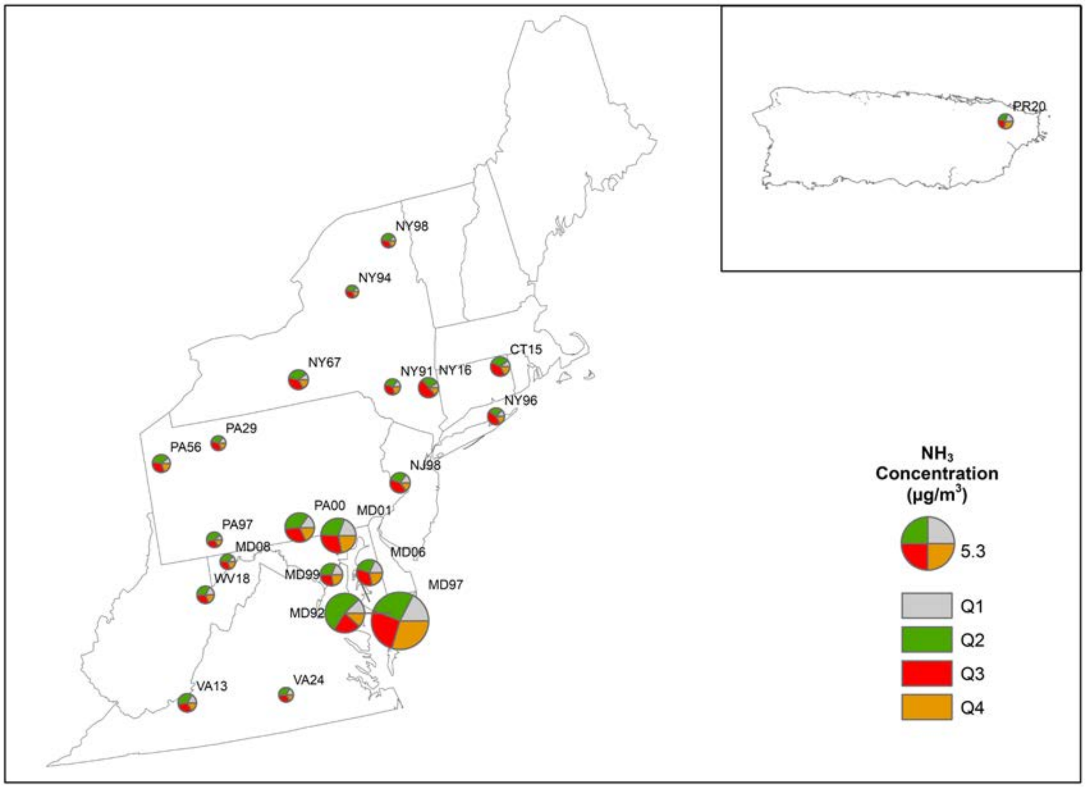
As of December 2022, there were 94 AMoN sites. Data from the AMoN are available on the NADP website (https://nadp.slh.wisc.edu).

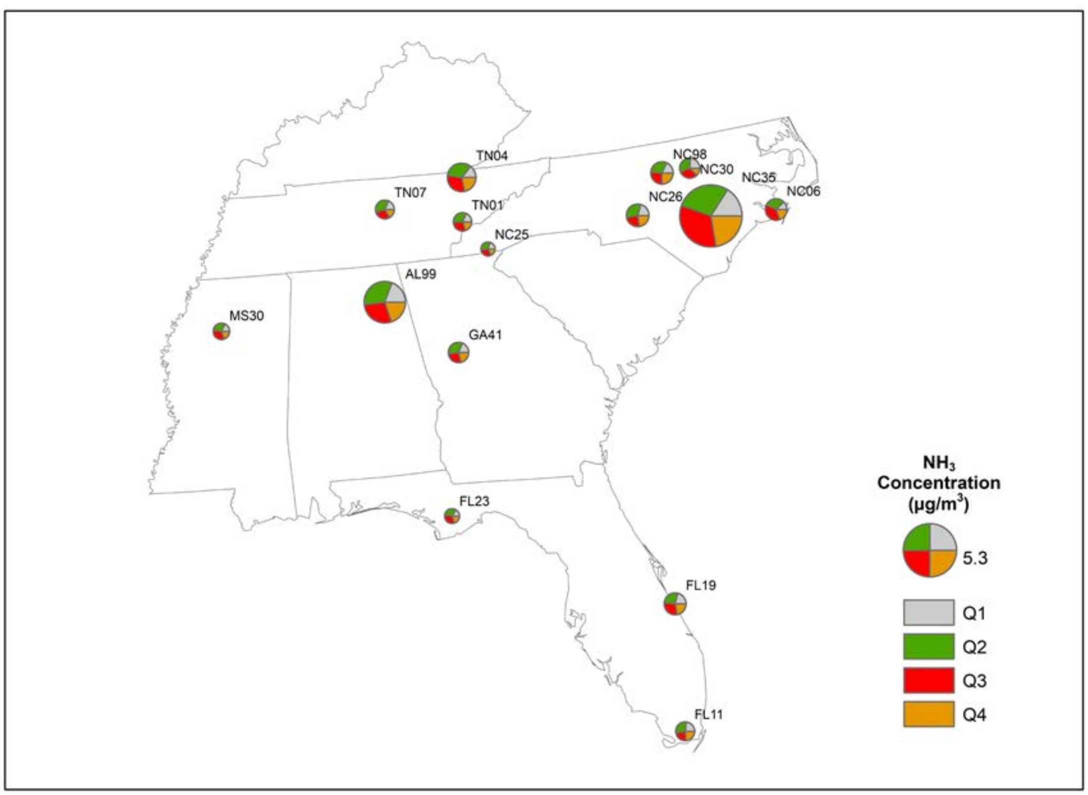
The figures on pages 29-32 show the distribution and seasonality of gaseous ammonia concentrations for each site meeting completeness criteria. In the first figure, circles represent annual average concentrations in micrograms per cubic meter (µg/m^3) at each site. In the following figures, the relative concentration for each site is shown for each calendar quarter. The size of the wedge is the relative percentage for the quarter. The area of the pie chart is proportional to the annual average for the site.



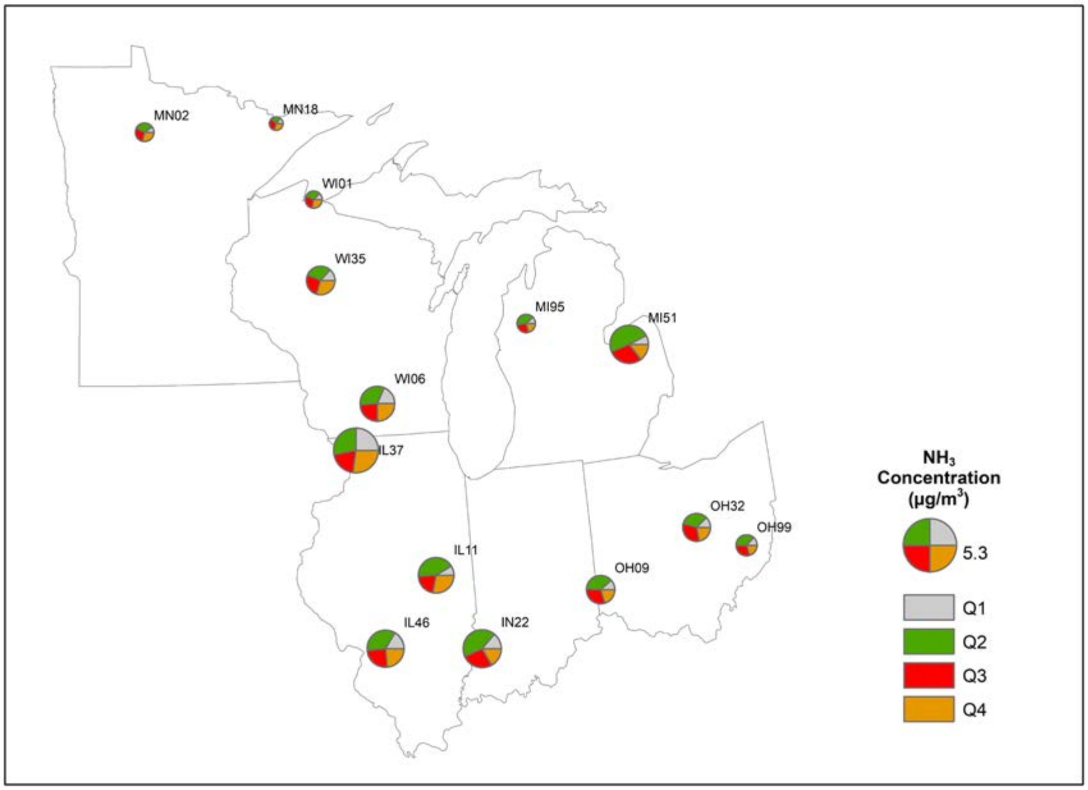


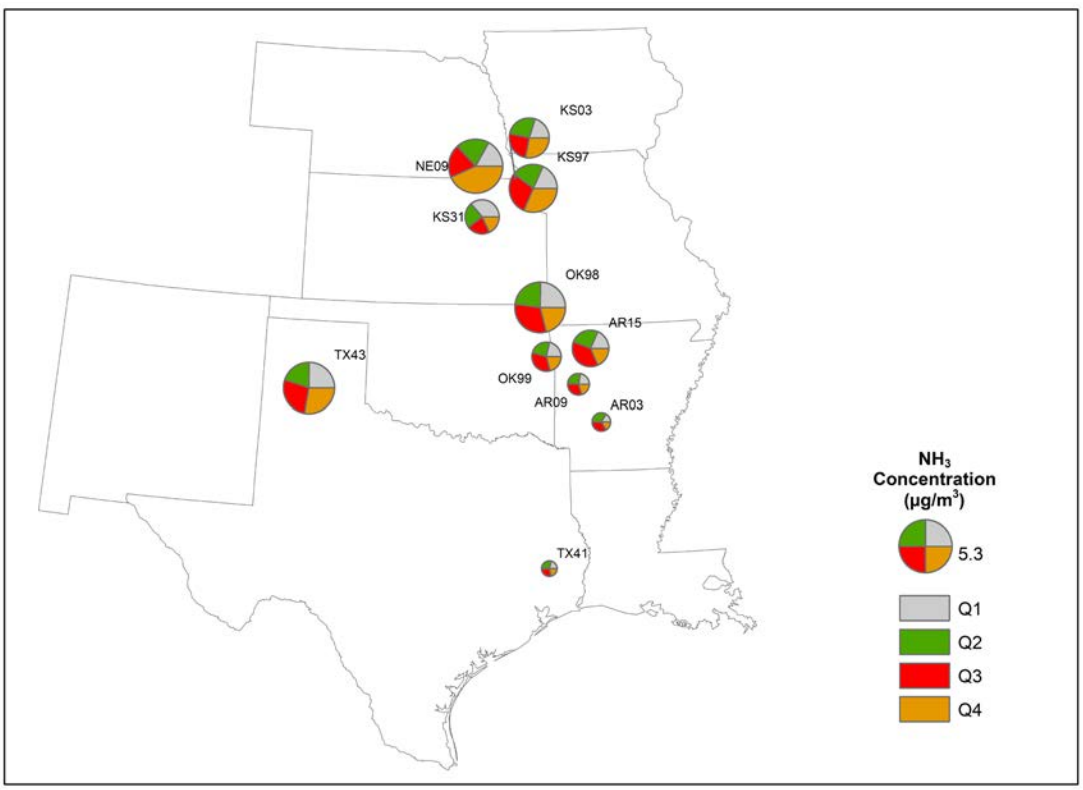
Average ammonia concentrations as measured by AMoN (first figure), and quarterly relative percentage (Q1 = January, February, March, etc.) for each AMoN site (in the subsequent figures), 2022. Size of the symbol in the bottom plot is relative to the annual concentration.



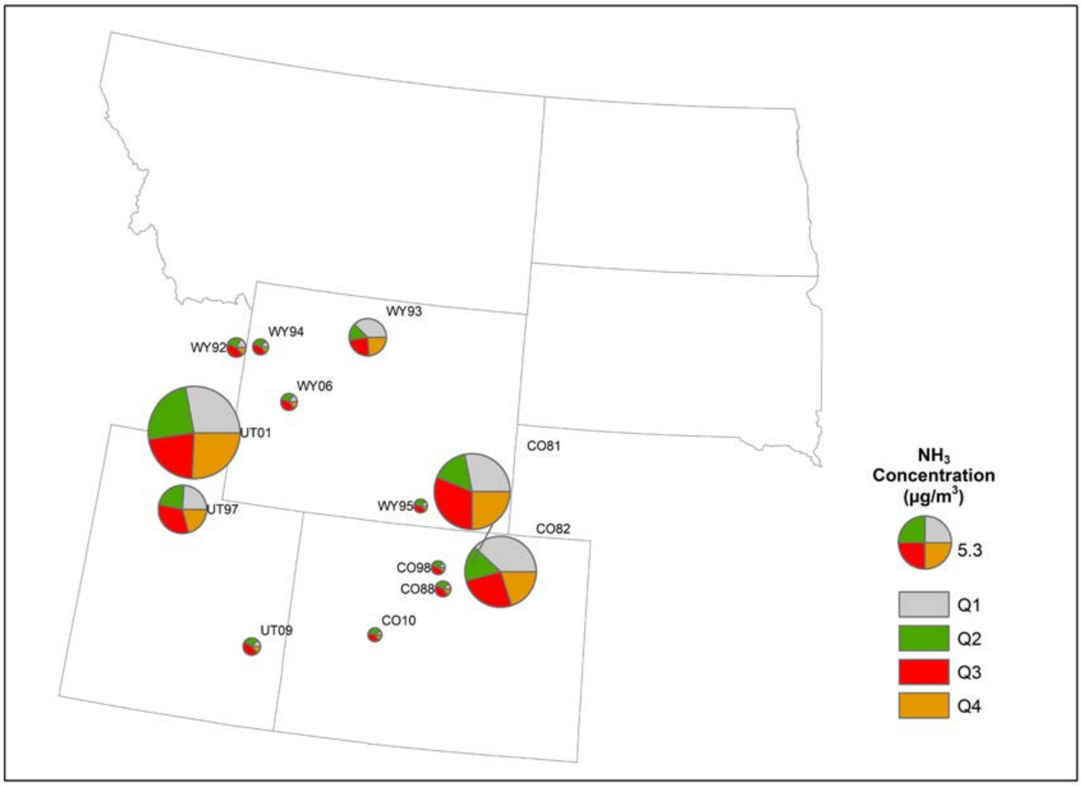


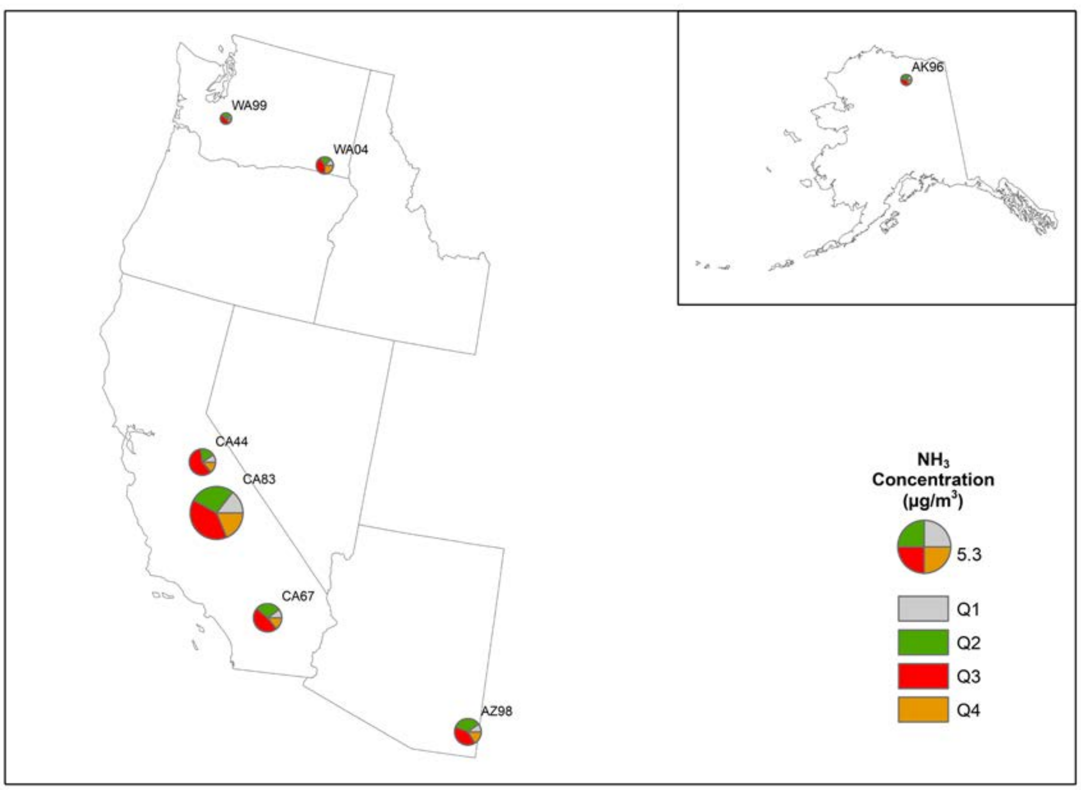
Quarterly relative percentage (Q1 = January, February, March, etc.) for each AMoN site (all figures), 2022. Size of the symbol in the bottom plot is relative to the annual concentration.





Quarterly relative percentage (Q1 = January, February, March, etc.) for each AMoN site (all figures), 2022. Size of the symbol in the bottom plot is relative to the annual concentration.





Quarterly relative percentage (Q1 = January, February, March, etc.) for each AMoN site (all figures), 2022. Size of the symbol in the bottom plot is relative to the annual concentration.

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Mercury Litterfall Network

MLN sites measure concentrations of total mercury found in plant biomass litterfall associated with a forest overstory (leaves, twigs, debris, etc.) that fall to the forest floor. The network uses four passive collection samplers per site. The collectors are placed on the ground in randomized locations each year to estimate the deposition of biomass and associated total mercury.

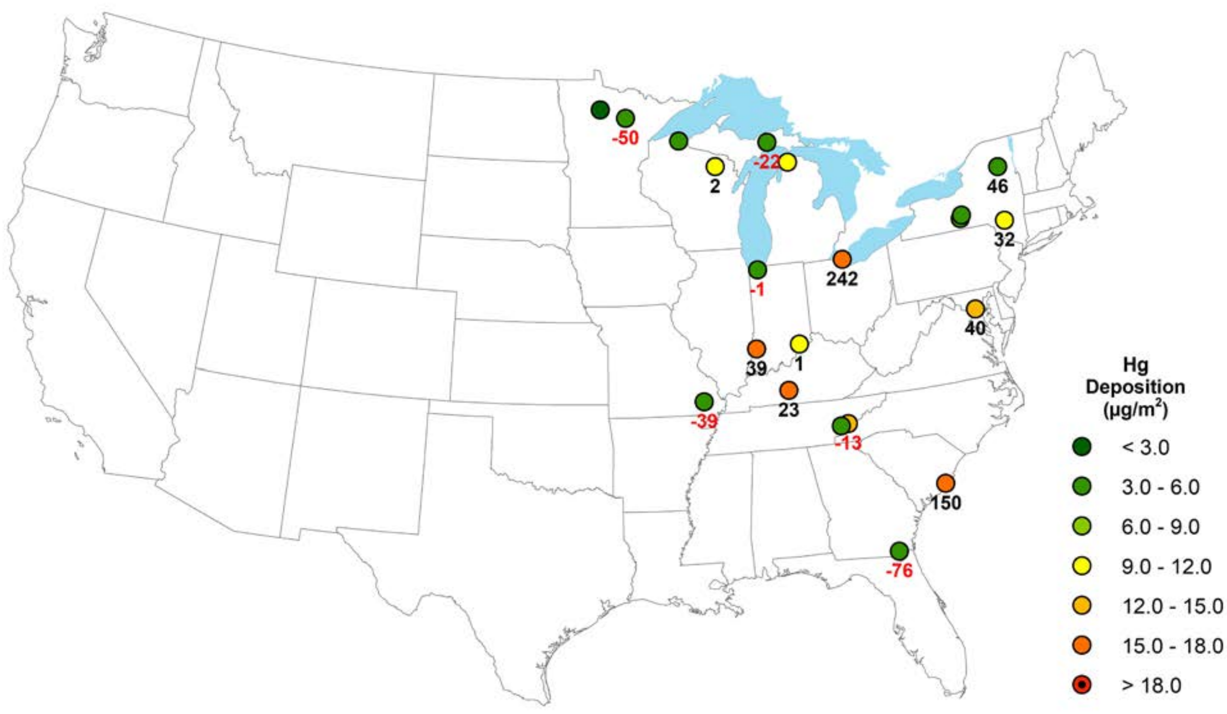
Sampling occurs over a several month period (generally September to December) with monthly biomass collections retrieved from each collector. These monthly collections are dried, composited by collector, and ground. Total mercury is measured in each of the four composites, and a weighted mean seasonal mercury concentration (ng Hg/gram biomass) is calculated. Using the seasonal mercury concentration and seasonal biomass deposition (g/m^2/season), a flux of mercury (µg Hg/m^2/season) to the forest floor is calculated.

Sites Active in 2022

This data is used to assess deposition in this manner, for further study and comparisons to traditional wet and dry deposition of mercury in MDN and other measures. These measurements can be used for trends over time, and to provide information for model development and verification.

As of December 2022, there were 23 MLN sites. Data from the MLN are available on the NADP website (https://nadp.slh.wisc.edu).

The figures on page 35 show the total mercury concentration and deposition in biomass for the sampling season. The top figure shows the average concentration of total mercury per gram of biomass (ng Hg/g biomass) over the sampling season at each site. In the bottom figure, the total mercury deposition is shown as a function of the total biomass deposited at each site (µg Hg/m^2/season). The numerical value associated with each site is the percentage above (black, positive) or below (red, negative) total mercury deposition as compared to the wet deposition of total mercury at the same site.



Average total mercury concentration in biomass (top), and mercury flux with biomass per season (bottom), 2022. Numerical values in the lower figure are percentages of mercury biomass flux more than (black) and less than (red) the colocated MDN wet deposition flux.

National Atmospheric Deposition Program

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, the 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. 2019-39132-30121. 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.

Madison, WI: October 2023

http://nadp.slh.wisc.edu

All NADP data and information, including color contour maps in this publication, are available free of charge from the NADP website: https://nadp.slh.wisc.edu. Alternatively, contact: NADP Program Office, Wisconsin State Laboratory of Hygiene, 465 Henry Mall, Madison, WI 53706, Tel: (608) 263-9162, E-mail: nadp@slh.wisc.edu.

The NADP Program Office is located at the Wisconsin State Laboratory of Hygiene (WSLH), at the University of Wisconsin–Madison.