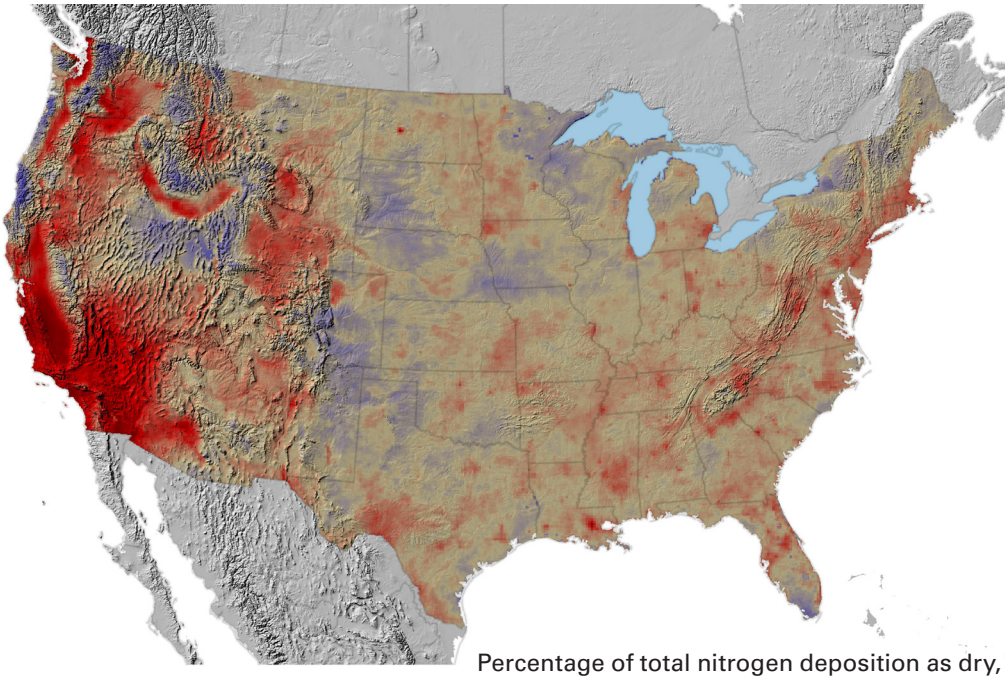
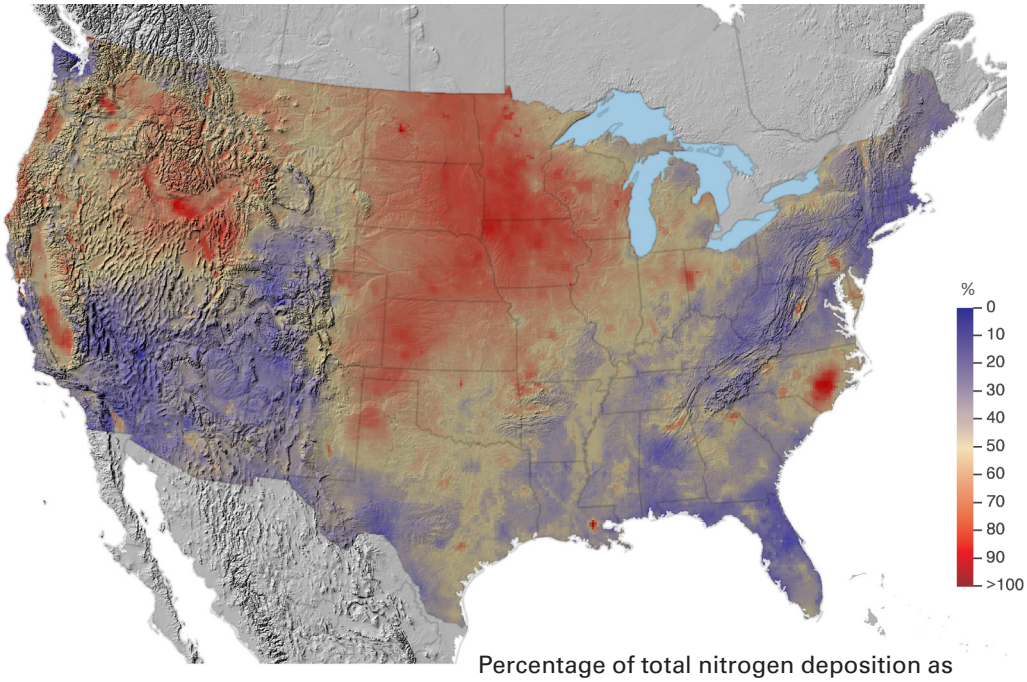
National Atmospheric Deposition Program

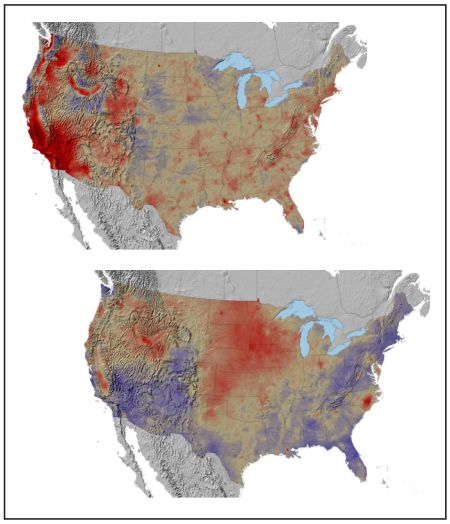
2015 Annual Summary



Percentage of total nitrogen deposition as dry, 2013-2015



Percentage of total nitrogen deposition as reduced nitrogen, 2015



On the cover: NADP's Total Deposition (TDEP) Science Committee, produced a map summary for 2015. The cover shows the 3-year average annual percentage of total nitrogen deposition as dry for 2013 to 2015 (top), and the 2015 annual percentage of total nitrogen deposition as reduced nitrogen (bottom). The full TDEP report is available at http://nadp.isws.illinois.edu/committees/tdep.

When referencing maps or information in this report, please use the citation: National Atmospheric Deposition Program, 2016. National Atmospheric Deposition Program 2015 Annual Summary. NADP Data Report 2016-02. Illinois State Water Survey, University of Illinois at Urbana-Champaign, IL.

Contents

2015 Highlights

The National Atmospheric Deposition Program (NADP) provides fundamental measurements that support informed decisions on environmental issues related to precipitation and atmospheric deposition chemistry, as well as atmospheric mercury and ammonia. NADP data are relevant to scientists, educators, policymakers, and the public. All data are available on the NADP website (http://nadp.isws.illinois.edu). Products available on this site include seasonal and annual averages, time series trend plots, and maps of concentration and deposition.

The NADP is composed of five networks, including the National Trends Network (NTN), the Atmospheric Integrated Research Monitoring Network (AIRMoN), the Mercury Deposition Network (MDN), the Atmospheric Mercury Network (AMNet), and the Ammonia Monitoring Network (AMoN). The table below summarizes the number of measurements from each network in 2015.

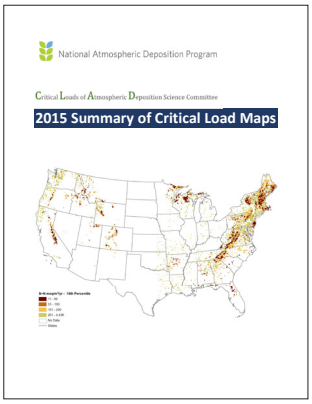
Summary of Network Measurements, 2015

Network	Measurements	Period	No. of sites
NTN	13,287	weekly	265
MDN	5,978	weekly	112
AIRMoN	799	daily	6
AMNet	60,954	hourly/ 2-hourly	25
AMoN	2,400	two week	98

Highlights:

- NADP has been in operation for 38 years, and 31 individual NTN sites have operated continuously since the network was initiated.
- NADP data were used in:
  - 226 journal articles;
  - seven dissertations;
  - seven master's theses; and
  - three books: *American Environmental Policy: The Failures of Compliance, Abatement and Mitigation* by Press & Griswold; *Spatio-temporal Methods in Environmental Epidemiology* by Shaddick and Zidek; and *Air Pollutant Deposition and its Effects on Natural Resources in New York State* by Sullivan.

  For the full publications listing, see http://nadp.isws.illinois.edu/lib/bibliography.aspx.
- Thirty new AMON sites started (44% increase).
- The Spring Subcommittee Meeting was held in Pacific Grove, CA in April.
- The U.S. Geological Survey-led Mercury Litterfall Initiative completed its fourth year of operation. Eighteen sites collected litterfall (e.g., leaves, twigs, etc.) to measure mercury (http://nadp.isws.illinois.edu/newissues/litterfall).
- The Critical Loads Atmospheric Deposition (CLAD) was renewed as a scientific subcommittee.

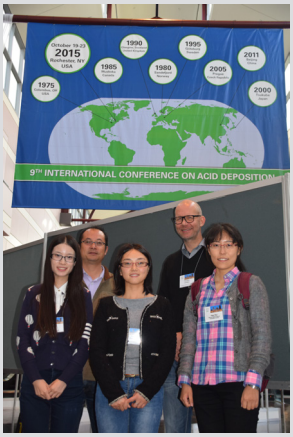


- The CLAD subcommittee published a map summary of critical load determinations for the continental United States. The report is available from the Program Office.
- The NADP continued to convert its precipitation gages to an all-digital network, and 23 sites remain with Belfort mechanical precipitation gages.
- One NTN station began operation at urban locations in Massachusetts in support of the Subcommittee on Urban Atmospheric Monitoring.
- The NADP collaborated with U.S. Geological Survey scientists to measure atmospheric isotopes of mercury at ~20 NADP sites.

- The Total Deposition Science Subcommittee (TDEP) worked with U.S. Environmental Protection Agency (USEPA) scientists to estimate dry deposition of nitrogen and sulfur. They worked with Environment Canada to estimate dry deposition of mercury at each active AMNET site. (http://nadp.isws.illinois.edu/committees/tdep/ tdepmaps/).
- The NADP continued to collaborate with the USEPA to determine organic nitrogen concentrations in wet deposition samples (Coweeta, NC; NC25).
- NADP continued its international efforts:
  - NADP continues its partnership with Taiwan to establish the 12 country Asia Pacific Mercury Monitoring Network (APMMN). The APMMN systematically monitors mercury wet deposition and atmospheric concentrations at stations across East, Southeast, and South Asia. During the year, continuous monitoring was established in Vietnam and in Thailand (http://rsm2.atm.ncu.edu.tw/apmmn/).
  - NADP collaborated with National Autonomous University of Mexico scientists to determine the feasability of cooperative sites along the Gulf Coast of Mexico with NADP operations.
  - USGS and NADP began working with Cuban scientists to improve their analytical methods for NADP analytes. Currently, blind samples are provided for testing, with a goal to operate a small wet deposition network in Cuba.
- NADP hosted the 2015 international meeting of the Deposition of Biogeochemically Important Trace Species (DEBITS) group at the Fall 2015 NADP Meeting. This group is focused on deposition in Africa.
- NADP is part of the planning committee for the 13th International Conference on Mercury as a Global Pollutant (Mercury 2017) to be held in Providence, Rhode Island in July, 2017.

The NADP planned and hosted Acid Rain 2015, the 9th International Conference on Acid Deposition. The conference was held in Rochester, NY in October with 350 global scientists and policy professionals from ~30 countries in attendance, and is held once every five years. There were 7 keynote addresses, 106 oral presentations, and 200 posters during five days. Videos of the keynote speakers and all presentations are available on the meeting website (http://acidrain2015.org/).

ACID RAIN 2015
ROCHESTER, NY, USA



Continent	Attendees
Europe	62
Asia	62
South America	6
Africa	6
United States	194
Mexico and Canada	22
Total regular attendance	352

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. 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 at Urbana-Champaign. The network was established to provide data on amounts, temporal trends, and geographic distributions of the atmospheric deposition of acids, nutrients, and base cations by precipitation.

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. The latest renewal was in Federal Year 2015. 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 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. Due to its experience in organizing and operating a national-scale network, the NADP agreed to coordinate operation of NAPAP's National Trends Network (NTN). To benefit from identical siting criteria and 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.

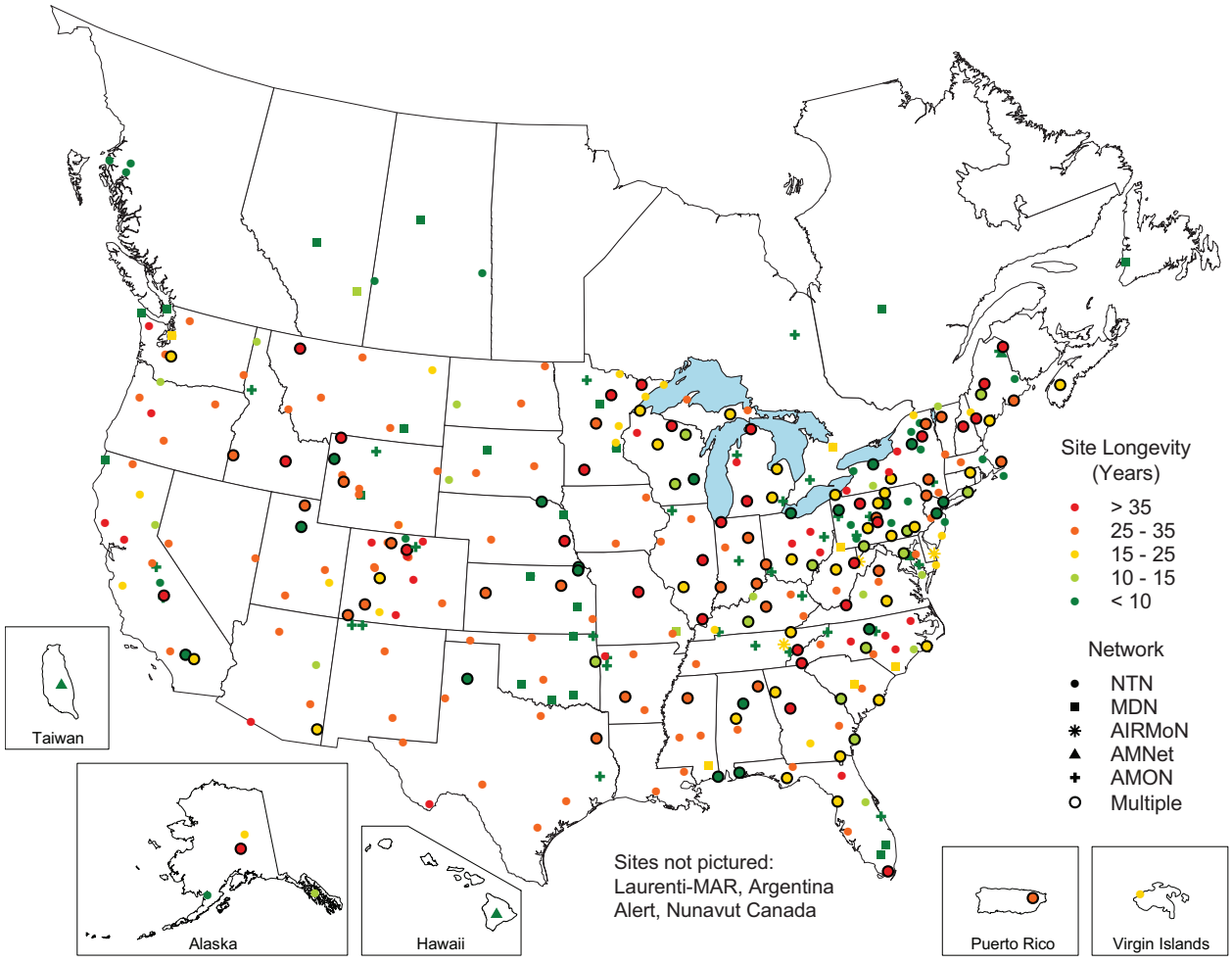
In October 1992, the AIRMoN was formed from the Multistate Atmospheric Power Production Pollution Study (MAP3S), which was operated by the Department of Energy and the National Oceanic and Atmospheric Administration (NOAA). MAP3S measured wet deposition and estimated dry deposition (later discontinued)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

In October 2009, AMNet joined the NADP as its fourth network. AMNet measures the concentration of atmospheric mercury using on site instrumentation.

In October 2010, AMoN joined the NADP. Atmospheric ammonia concentrations are measured every two weeks using passive samplers.

As of December 2015, there are 31 NTN sites that have been in continuous operation since January 1980. The map on the facing page shows active sites in each of the five networks and the length of time that each site has been operating.



Site longevity of active NADP sites in each network.

About the Maps

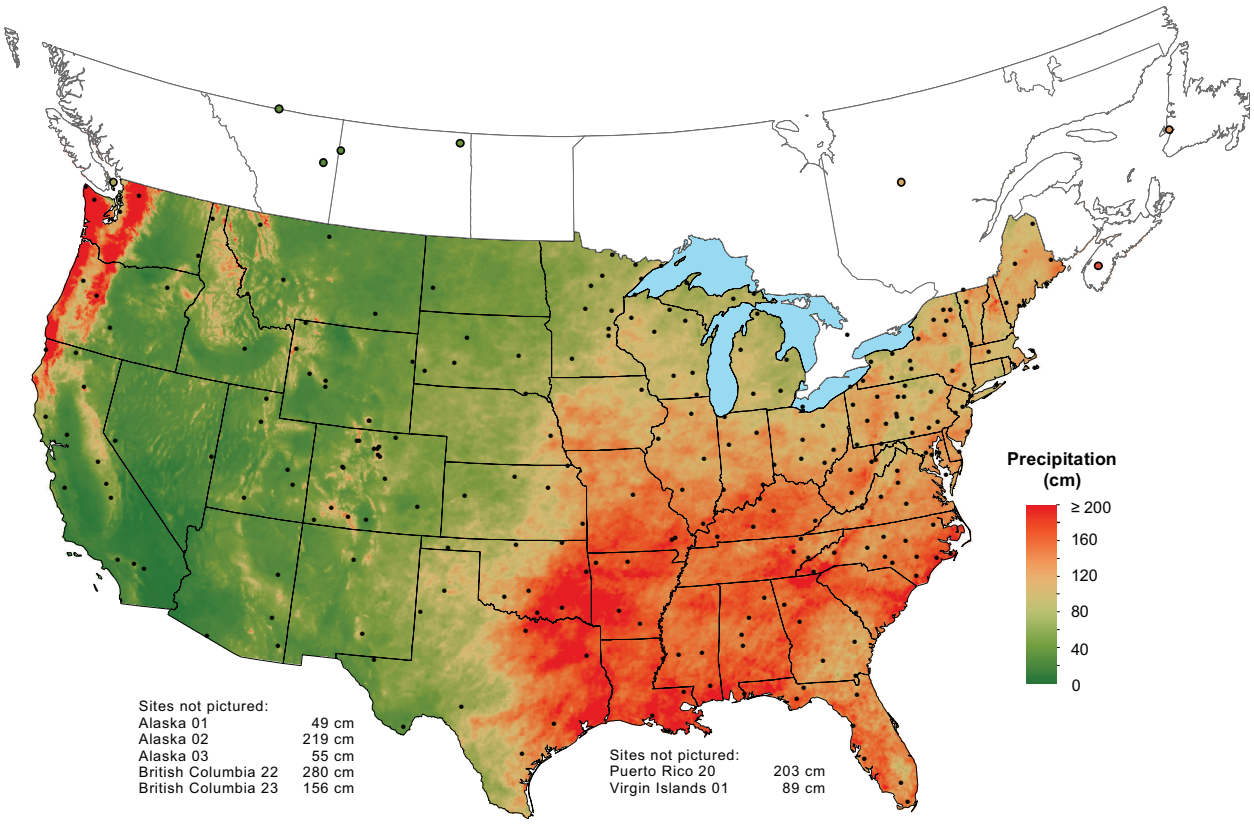
This map series is a principal product of the NADP. It summarizes the results of network operation for the most recent complete calendar year in map form. Additional maps and related geographic information are available on the NADP website.

All map products are restricted to sites that meet completeness criteria (see the NADP website for details). Black dots mark site locations that met NADP completeness criteria in 2015. 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 are represented as 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, Sept. 2016). 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 over 20 km around all NADP network sites (see the NADP website for specific information). PRISM precipitation data are strictly for the continental U.S., so the precipitation gradient north of the U.S./Canadian border is based solely on NADP precipitation data. The resulting precipitation map is used to generate the deposition maps.

The precipitation figure on the facing page has a continuous gradient of color from dark green (low values) to yellow (middle values) to dark red (high values). The dark green region begins at 0 centimeters (cm), extending above 200 cm (dark red). The concentration and deposition maps follow this same format, with specified units on each map. All maps back to 1985 follow the schema and are available in this format from the NADP website.



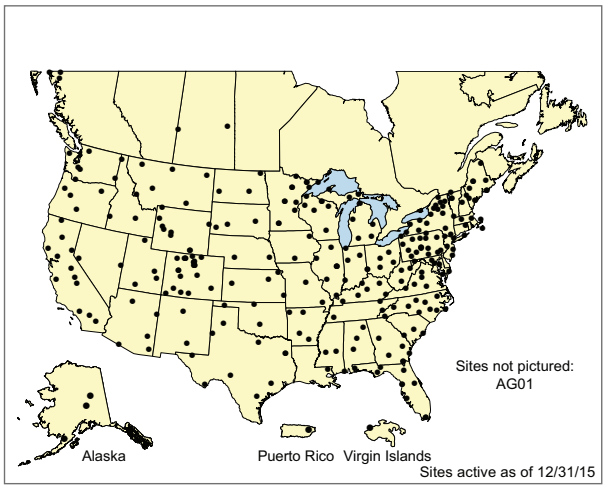
Total annual precipitation for 2015, using precipitation measurements from the NADP and PRISM (in cm).

National Trends Network (NTN)

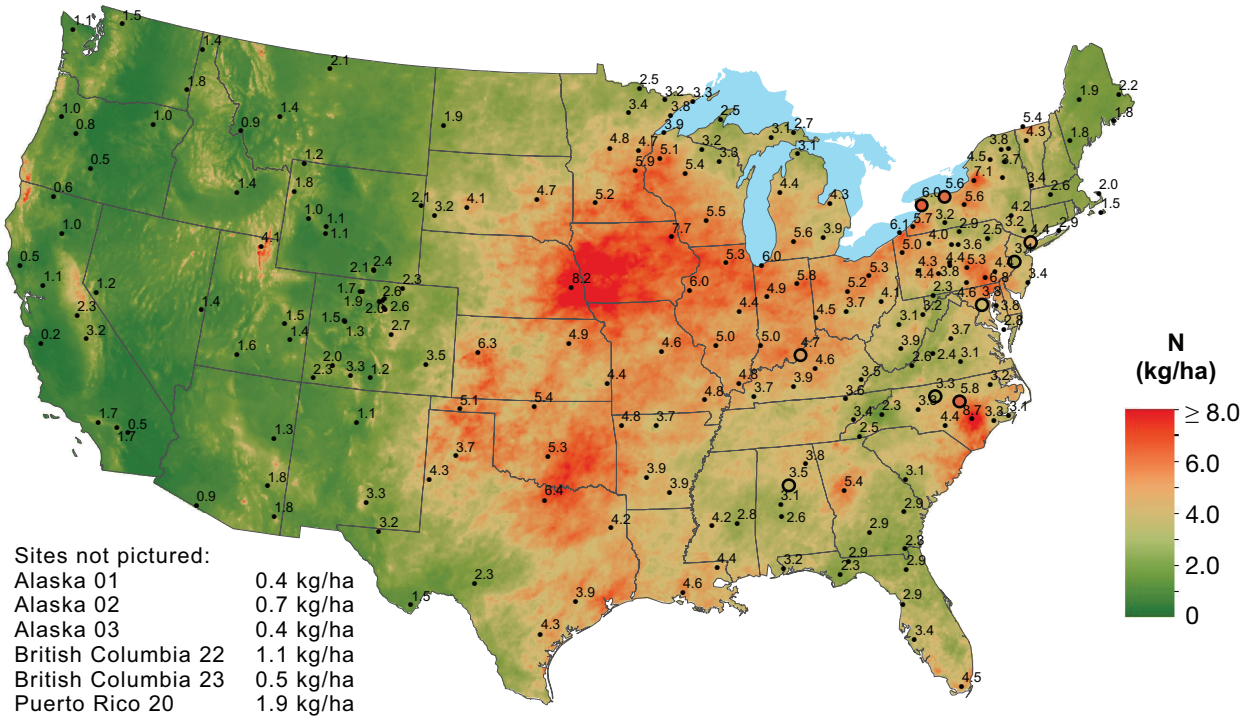
The NTN is the largest North American network that provides a long-term record of precipitation chemistry. Most sites are located away from urban areas and point sources of pollution, although urban sites participate. Each site has a precipitation collector and raingage. The automated collector ensures sampling only during precipitation (wet-only sampling). 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 CAL. All samples are sent to the CAL for analysis of free acidity (H^+ as pH), specific conductance, and calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), sulfate (SO_4^{2-}), nitrate (NO_3^-), chloride (Cl^-), bromide (Br^-), and ammonium (NH_4^+) ions. The CAL analyzes orthophosphate ions (PO_4^{3-}, the inorganic form), but only for quality assurance as an indicator of sample 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 (http://nadp.isws.illinois.edu/ntn/).

NTN Maps

The maps on pages 11 through 19 show precipitation-weighted mean concentration and annual wet deposition for select acidic ions, nutrients, and base cations. Spatial variability in these species can be seen both on regional and national scales. In 2015, 221 of the 265 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^-, and Na^+. Maps of Br^- and K^+ are not included in this report, but are available from the NADP website.

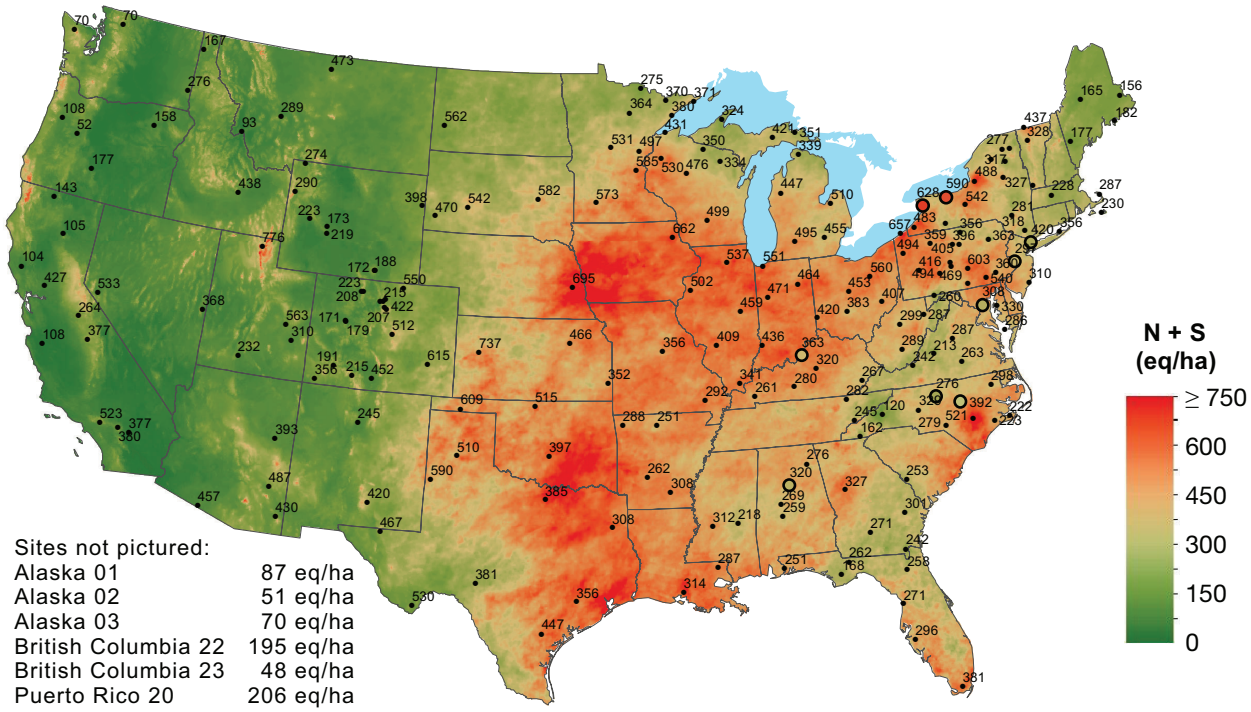


Annual maps for wet deposition of inorganic nitrogen (N, i.e., $NO_3^- + NH_4^+$) and nitrogen + sulfur (N + S) are also included. N + S (i.e., $NO_3^- + NH_4^+ + SO_4^{2-}$) deposition is mapped as hydrogen ion equivalents per hectare (eq/ha).



Sites not pictured:

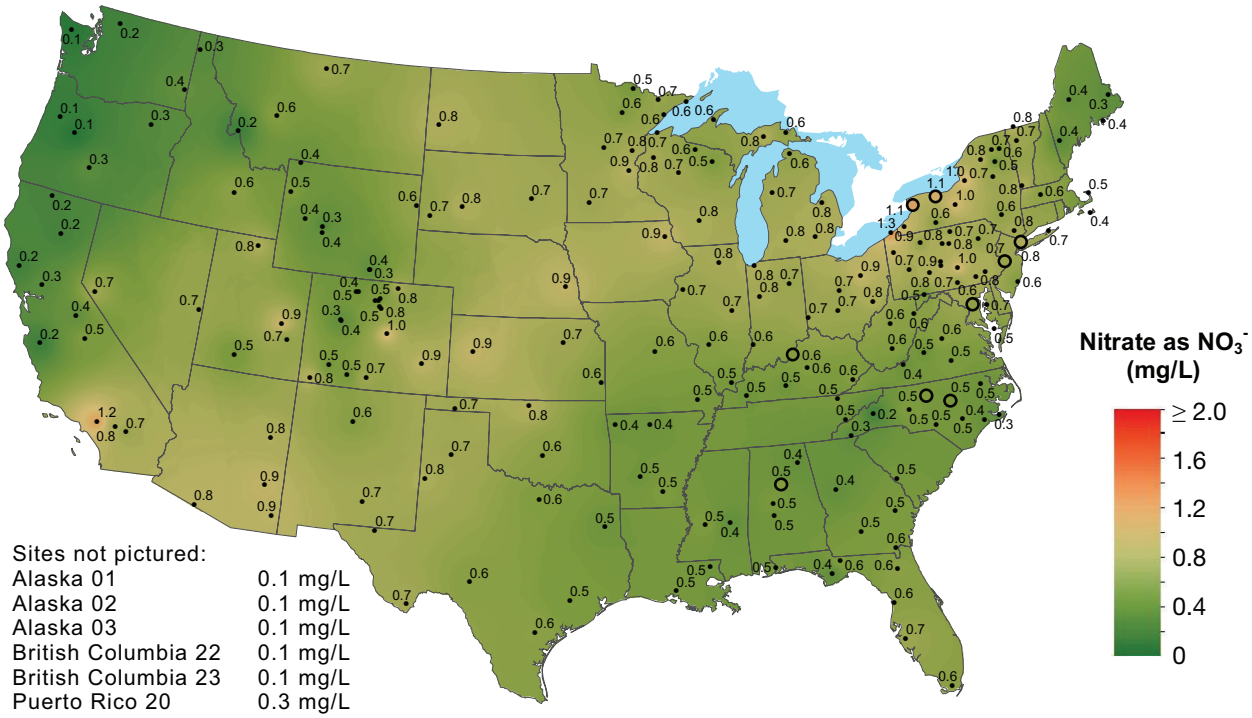
Alaska 01	0.4 kg/ha
Alaska 02	0.7 kg/ha
Alaska 03	0.4 kg/ha
British Columbia 22	1.1 kg/ha
British Columbia 23	0.5 kg/ha
Puerto Rico 20	1.9 kg/ha
Saskatchewan 20	1.7 kg/ha
Saskatchewan 21	1.3 kg/ha
Virgin Islands 01	0.9 kg/ha



Sites not pictured:

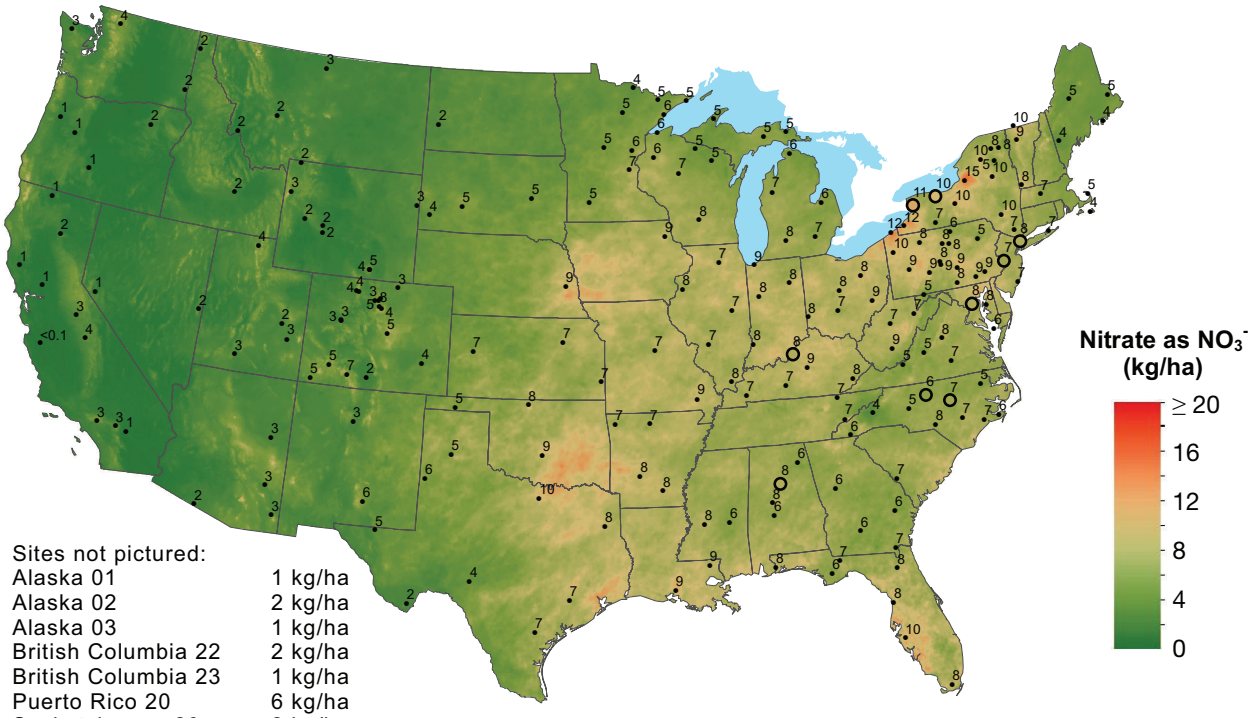
Alaska 01	87 eq/ha
Alaska 02	51 eq/ha
Alaska 03	70 eq/ha
British Columbia 22	195 eq/ha
British Columbia 23	48 eq/ha
Puerto Rico 20	206 eq/ha
Saskatchewan 20	478 eq/ha
Saskatchewan 21	276 eq/ha
Virgin Islands 01	215 eq/ha

Inorganic nitrogen wet deposition from nitrate and ammonium (top) and nitrogen plus sulfur wet deposition from nitrate, ammonium, and sulfate (bottom), 2015.



Sites not pictured:

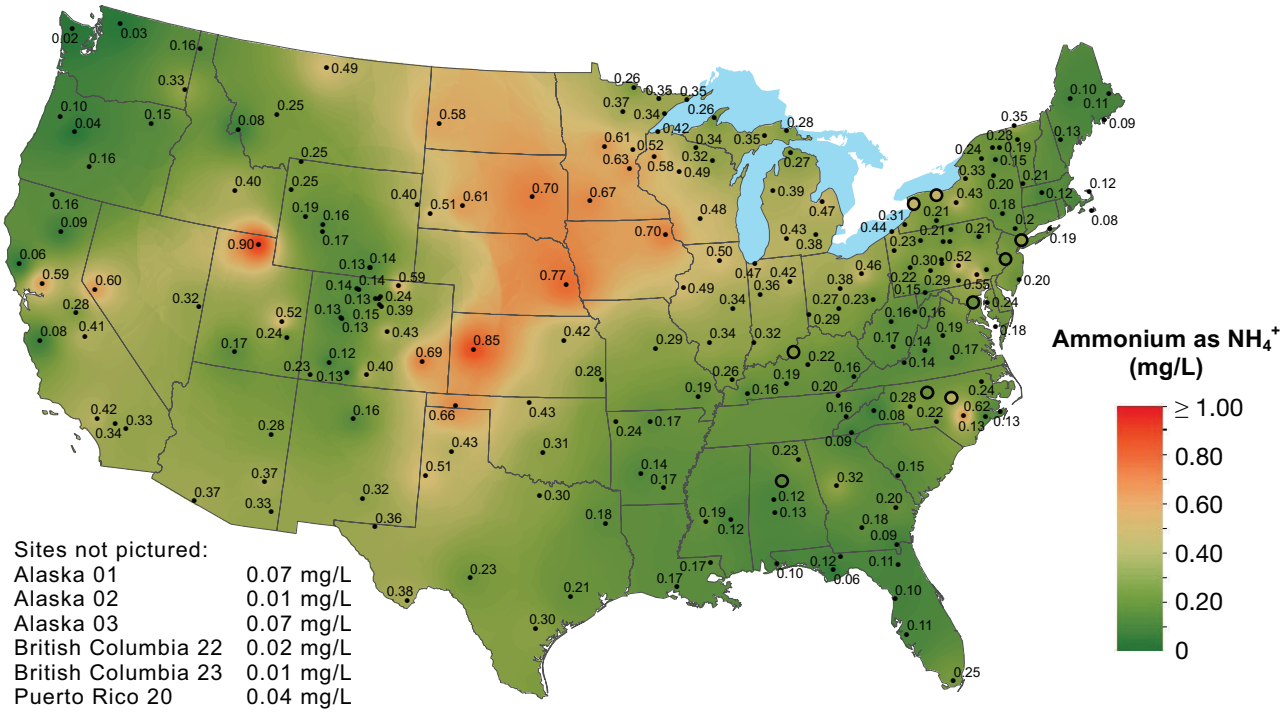
Alaska 01	0.1 mg/L
Alaska 02	0.1 mg/L
Alaska 03	0.1 mg/L
British Columbia 22	0.1 mg/L
British Columbia 23	0.1 mg/L
Puerto Rico 20	0.3 mg/L
Saskatchewan 20	0.8 mg/L
Saskatchewan 21	0.5 mg/L
Virgin Islands 01	0.3 mg/L

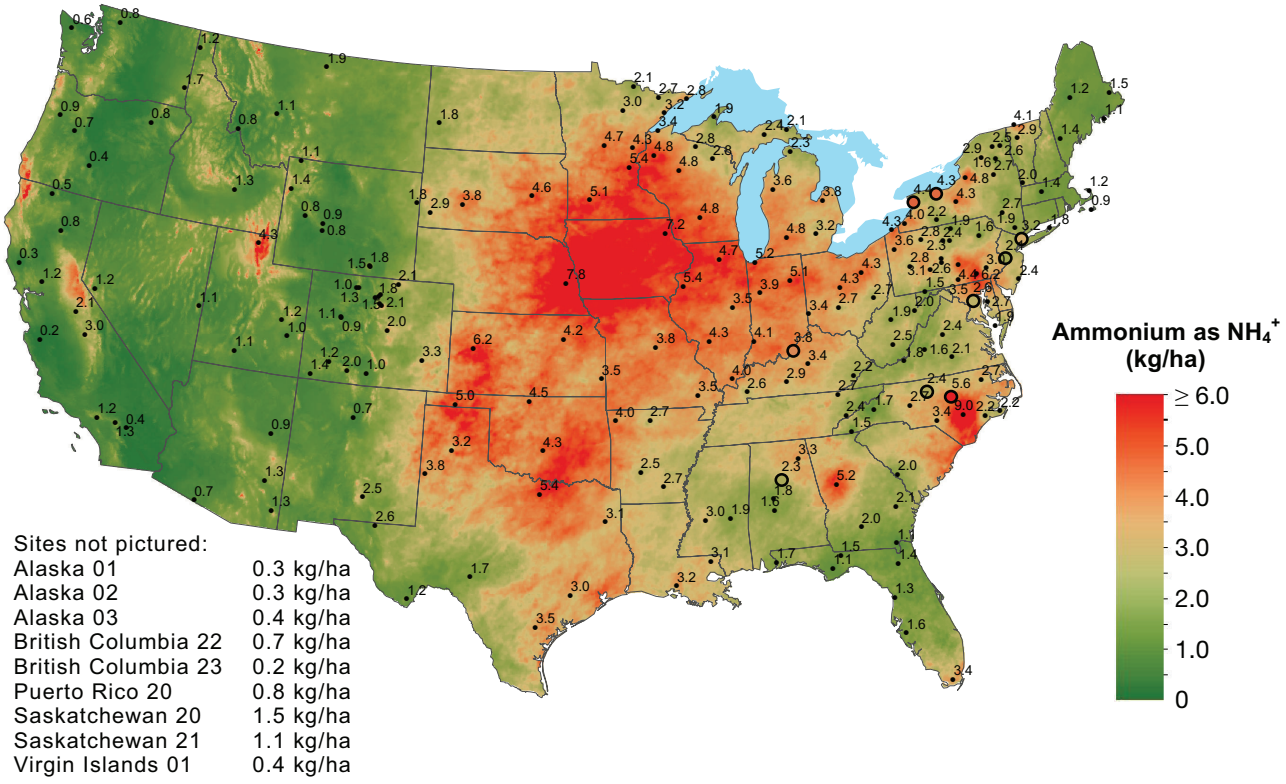


Sites not pictured:

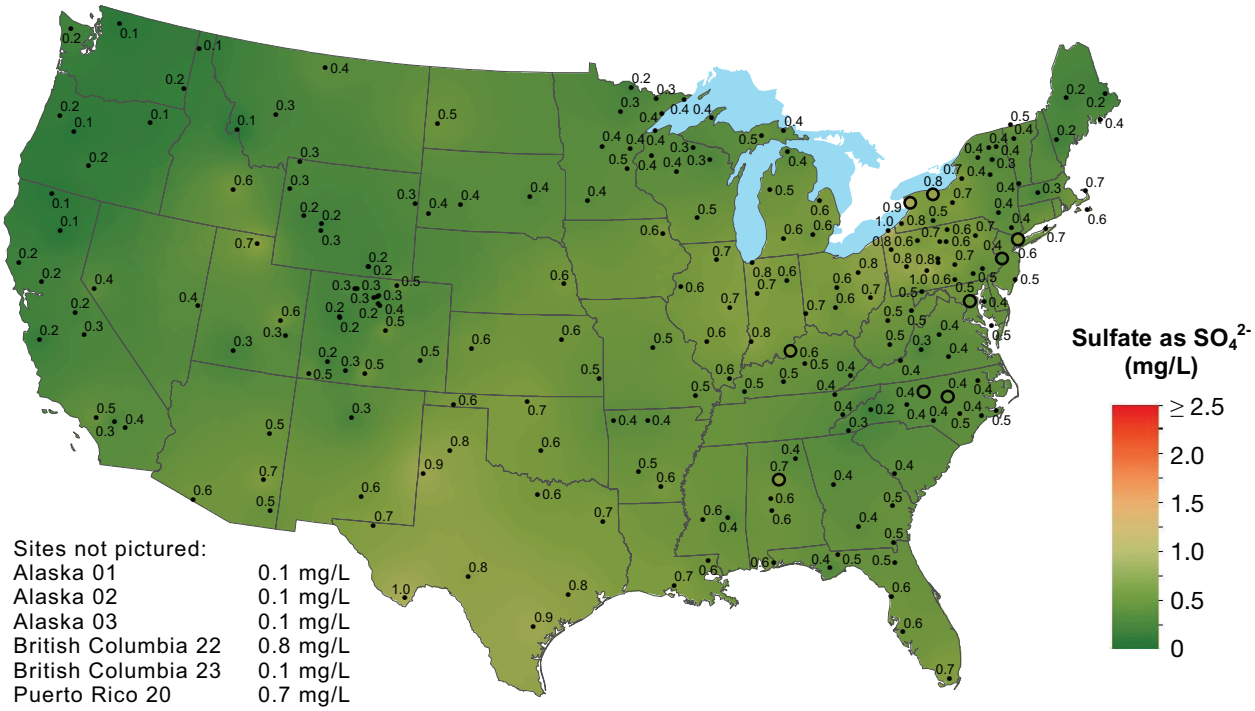
Alaska 01	1 kg/ha
Alaska 02	2 kg/ha
Alaska 03	1 kg/ha
British Columbia 22	2 kg/ha
British Columbia 23	1 kg/ha
Puerto Rico 20	6 kg/ha
Saskatchewan 20	2 kg/ha
Saskatchewan 21	2 kg/ha
Virgin Islands 01	2 kg/ha

Nitrate ion concentration (top) and wet deposition (bottom), 2015.



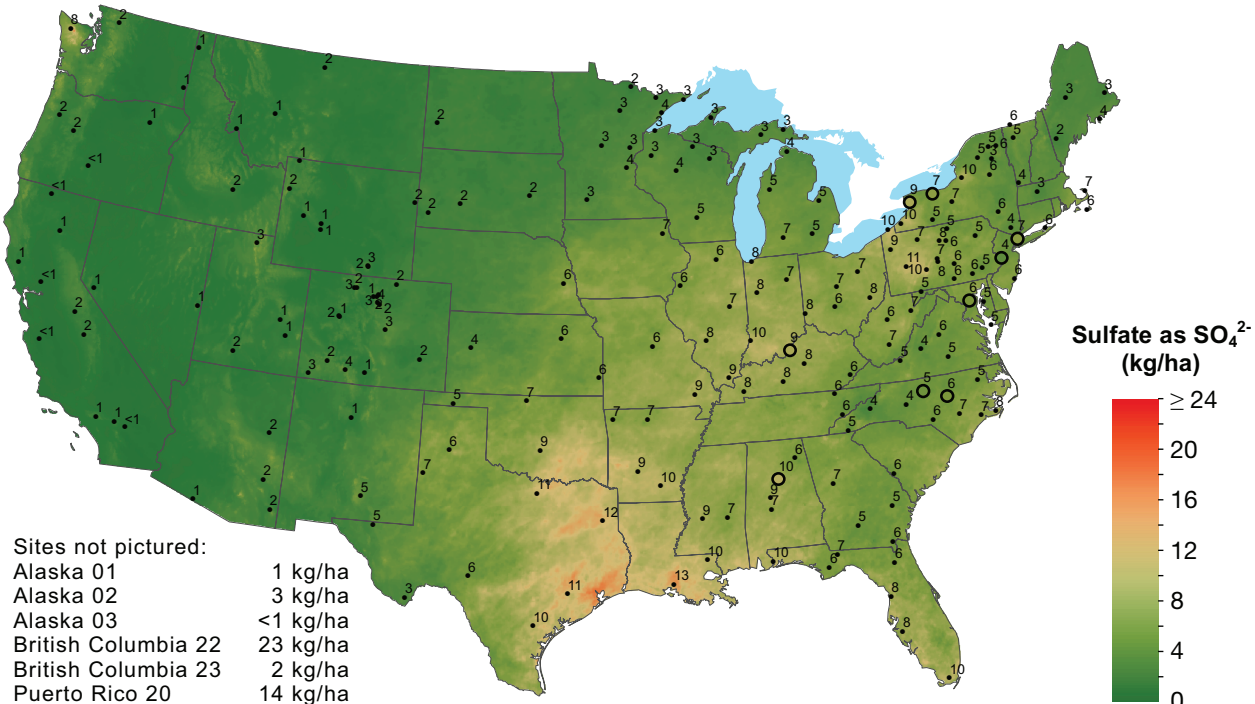


Ammonium ion concentration (top) and wet deposition (bottom), 2015.



Sites not pictured:

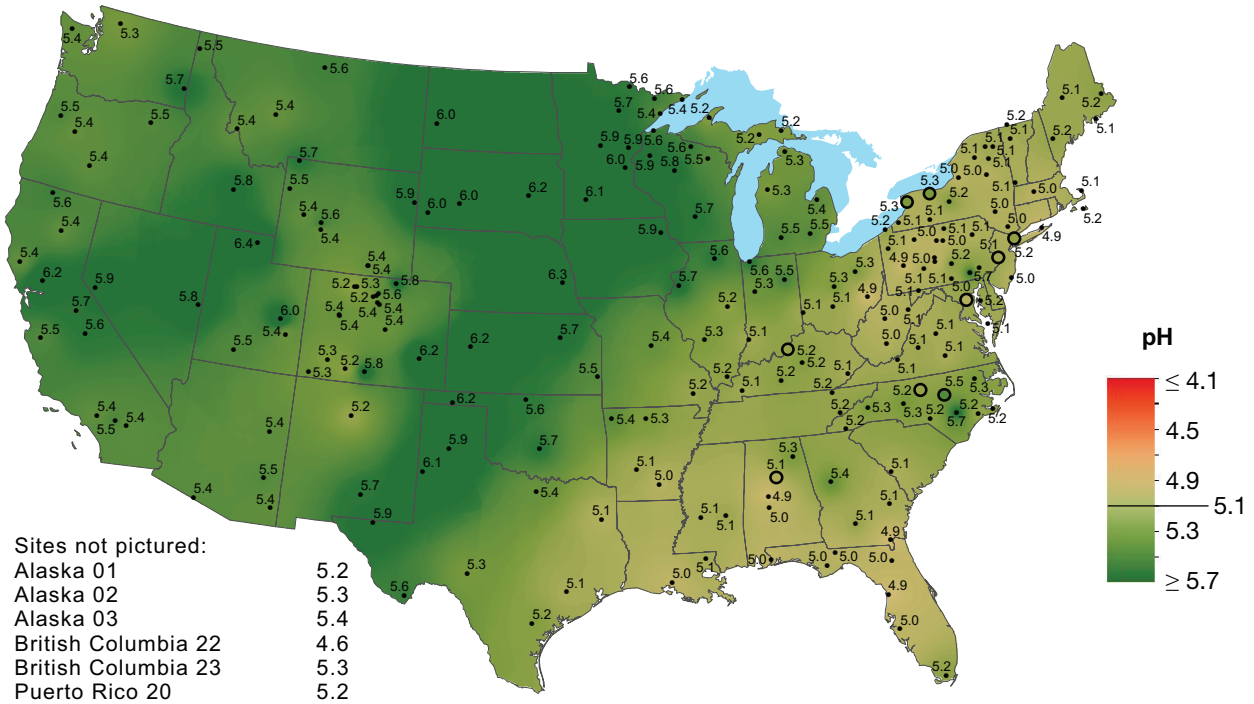
Alaska 01	0.1 mg/L
Alaska 02	0.1 mg/L
Alaska 03	0.1 mg/L
British Columbia 22	0.8 mg/L
British Columbia 23	0.1 mg/L
Puerto Rico 20	0.7 mg/L
Saskatchewan 20	0.5 mg/L
Saskatchewan 21	0.3 mg/L
Virgin Islands 01	0.7 mg/L



Sites not pictured:

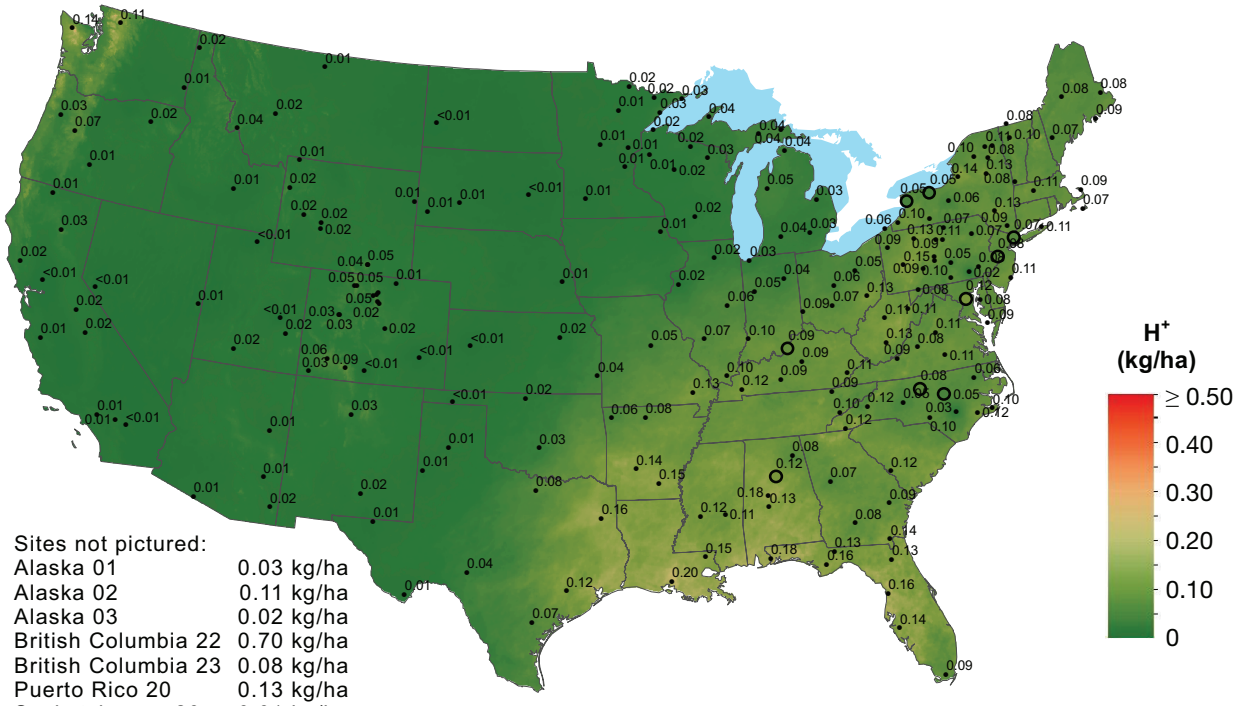
Alaska 01	1 kg/ha
Alaska 02	3 kg/ha
Alaska 03	<1 kg/ha
British Columbia 22	23 kg/ha
British Columbia 23	2 kg/ha
Puerto Rico 20	14 kg/ha
Saskatchewan 20	2 kg/ha
Saskatchewan 21	1 kg/ha
Virgin Islands 01	6 kg/ha

Sulfate ion concentration (top) and wet deposition (bottom), 2015.



Sites not pictured:

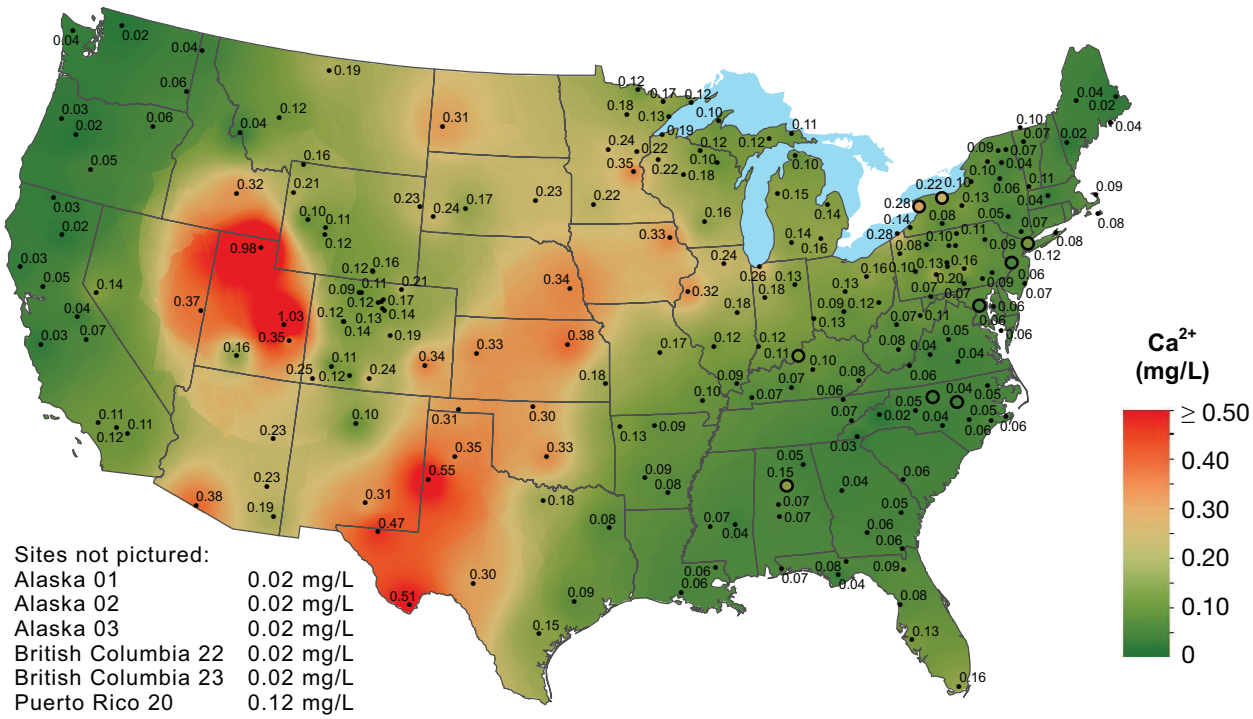
Alaska 01	5.2
Alaska 02	5.3
Alaska 03	5.4
British Columbia 22	4.6
British Columbia 23	5.3
Puerto Rico 20	5.2
Saskatchewan 20	5.8
Saskatchewan 21	5.7
Virgin Islands 01	5.2



Sites not pictured:

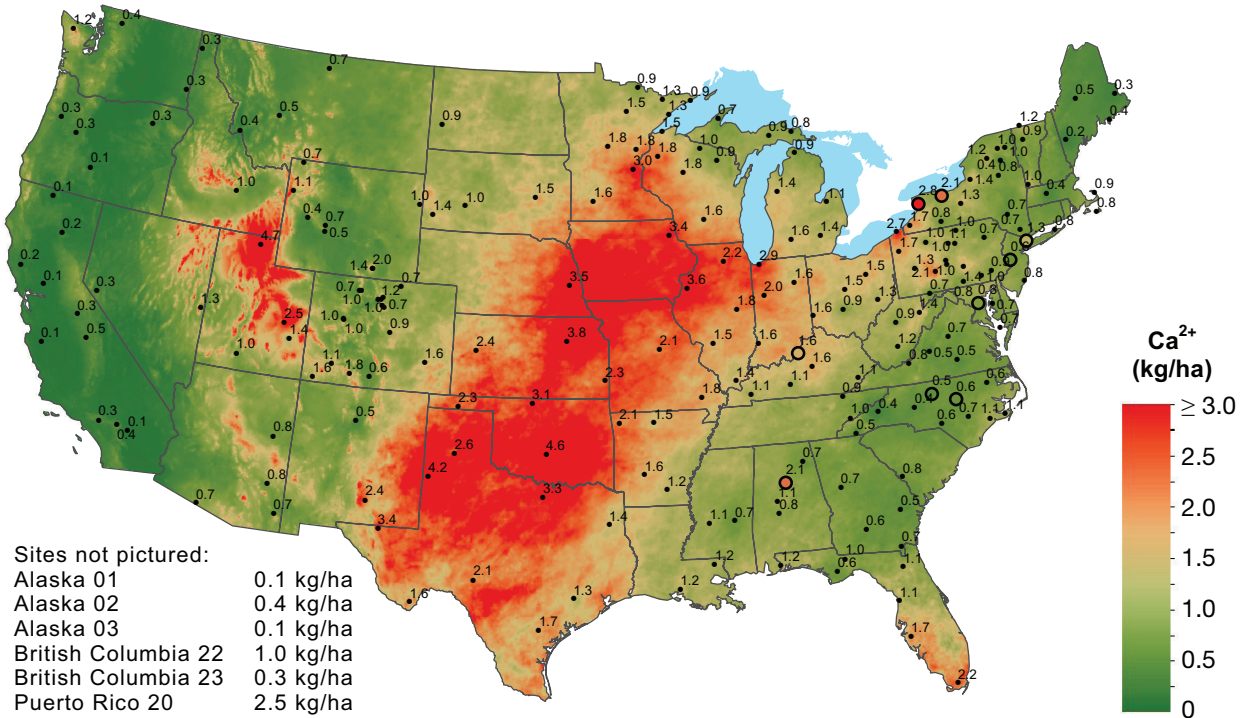
Alaska 01	0.03 kg/ha
Alaska 02	0.11 kg/ha
Alaska 03	0.02 kg/ha
British Columbia 22	0.70 kg/ha
British Columbia 23	0.08 kg/ha
Puerto Rico 20	0.13 kg/ha
Saskatchewan 20	<0.01 kg/ha
Saskatchewan 21	0.01 kg/ha
Virgin Islands 01	0.06 kg/ha

Hydrogen ion concentration as pH (top) and wet deposition (bottom), 2015.
Typically, a precipitation pH of less than 5.1 is considered acidic.



Sites not pictured:

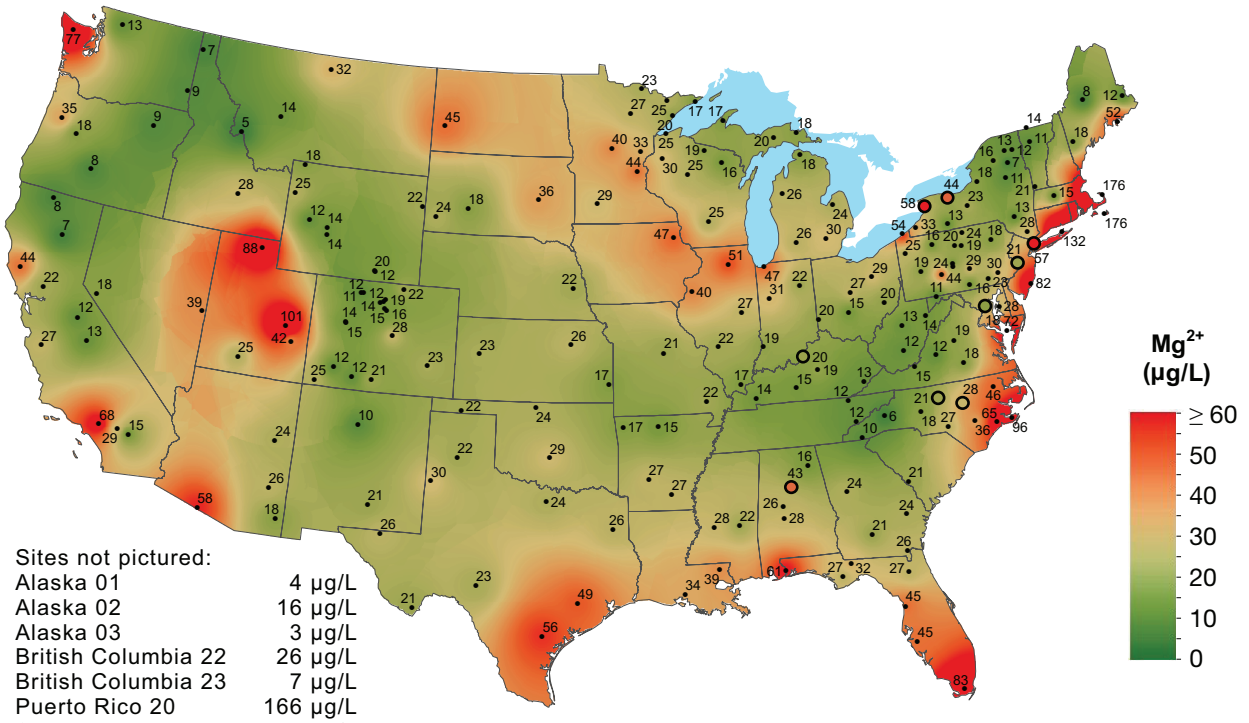
Alaska 01	0.02 mg/L
Alaska 02	0.02 mg/L
Alaska 03	0.02 mg/L
British Columbia 22	0.02 mg/L
British Columbia 23	0.02 mg/L
Puerto Rico 20	0.12 mg/L
Saskatchewan 20	0.27 mg/L
Saskatchewan 21	0.16 mg/L
Virgin Islands 01	0.11 mg/L



Sites not pictured:

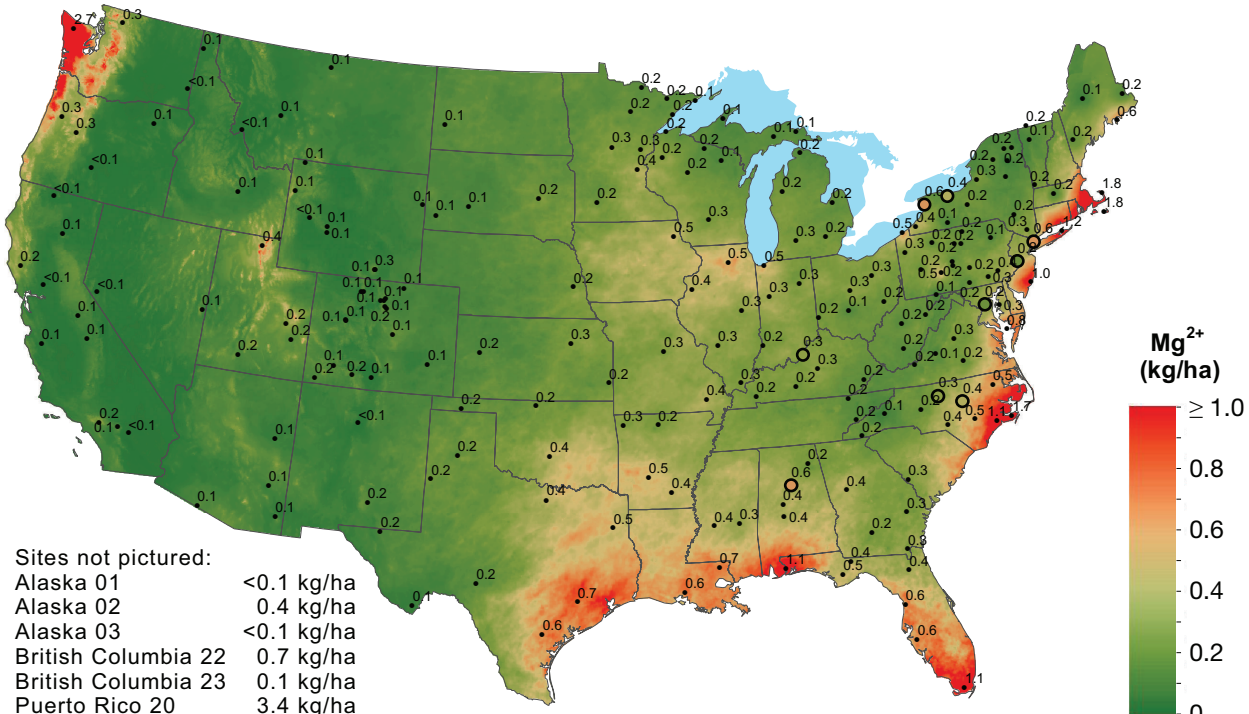
Alaska 01	0.1 kg/ha
Alaska 02	0.4 kg/ha
Alaska 03	0.1 kg/ha
British Columbia 22	1.0 kg/ha
British Columbia 23	0.3 kg/ha
Puerto Rico 20	2.5 kg/ha
Saskatchewan 20	0.9 kg/ha
Saskatchewan 21	0.7 kg/ha
Virgin Islands 01	1.0 kg/ha

Calcium ion concentration (top) and wet deposition (bottom), 2015.



Sites not pictured:

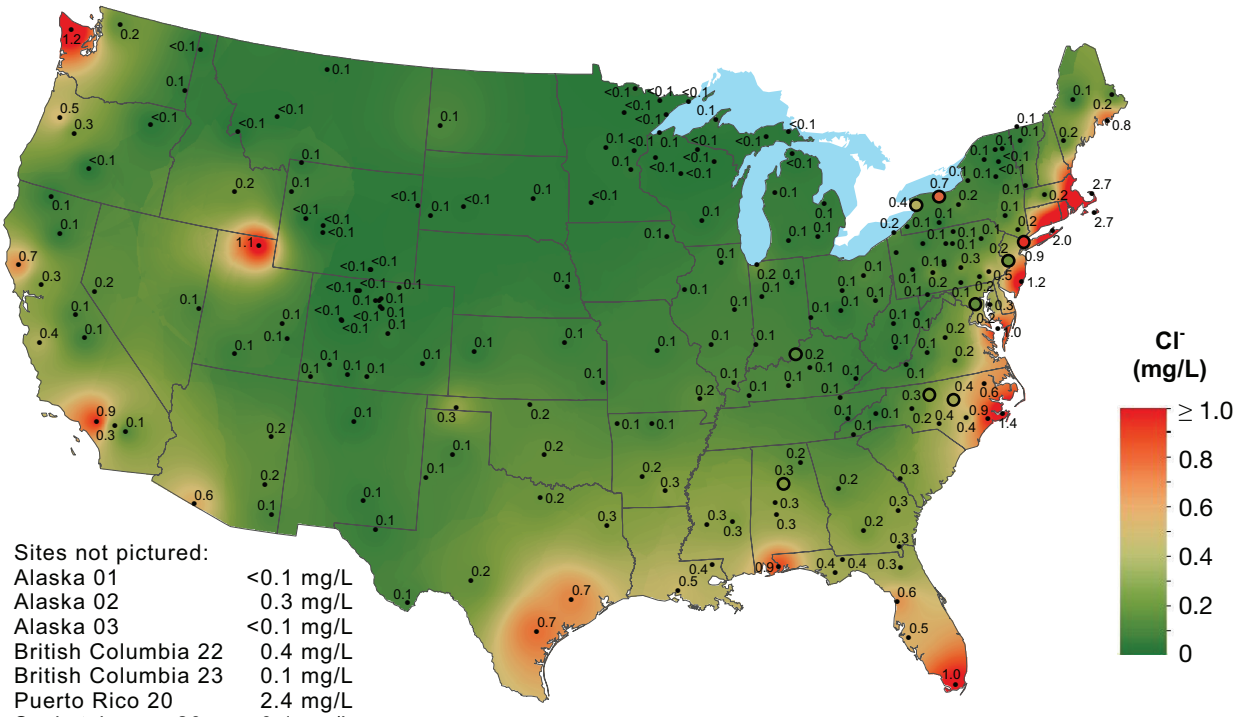
Alaska 01	4 µg/L
Alaska 02	16 µg/L
Alaska 03	3 µg/L
British Columbia 22	26 µg/L
British Columbia 23	7 µg/L
Puerto Rico 20	166 µg/L
Saskatchewan 20	60 µg/L
Saskatchewan 21	40 µg/L
Virgin Islands 01	172 µg/L



Sites not pictured:

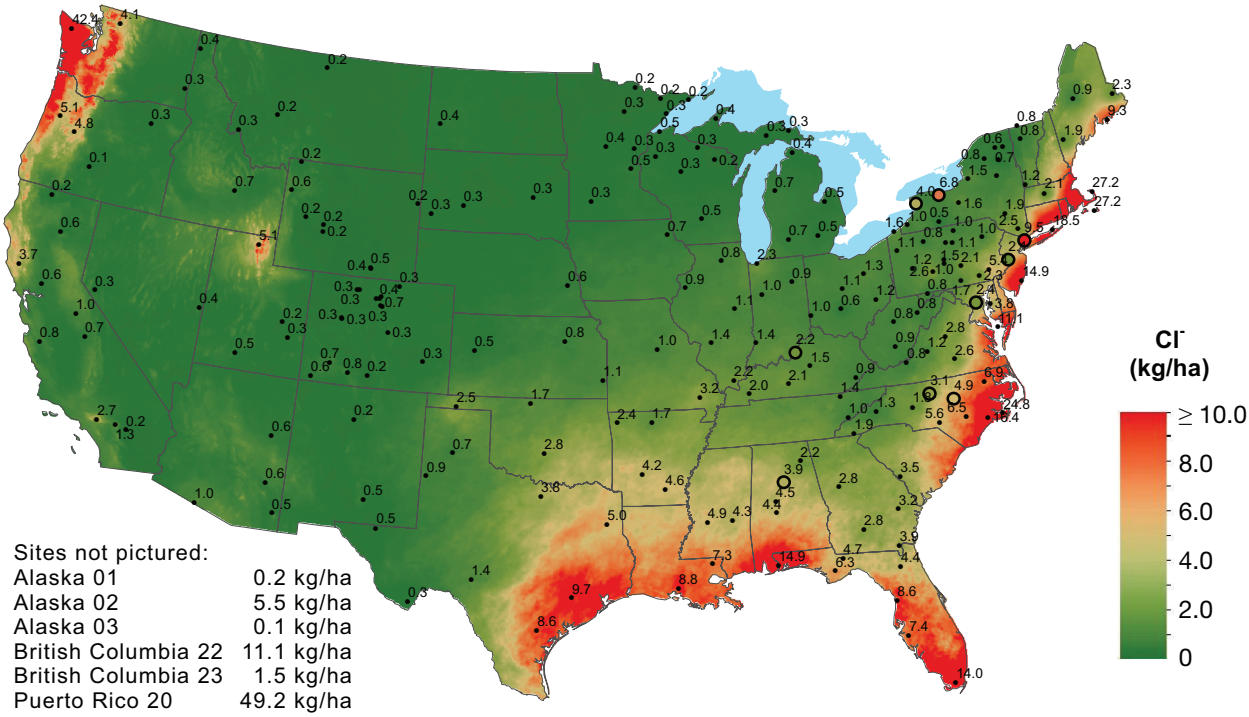
Alaska 01	<0.1 kg/ha
Alaska 02	0.4 kg/ha
Alaska 03	<0.1 kg/ha
British Columbia 22	0.7 kg/ha
British Columbia 23	0.1 kg/ha
Puerto Rico 20	3.4 kg/ha
Saskatchewan 20	0.2 kg/ha
Saskatchewan 21	0.2 kg/ha
Virgin Islands 01	1.5 kg/ha

Magnesium ion concentration (top) and wet deposition (bottom), 2015.



Sites not pictured:

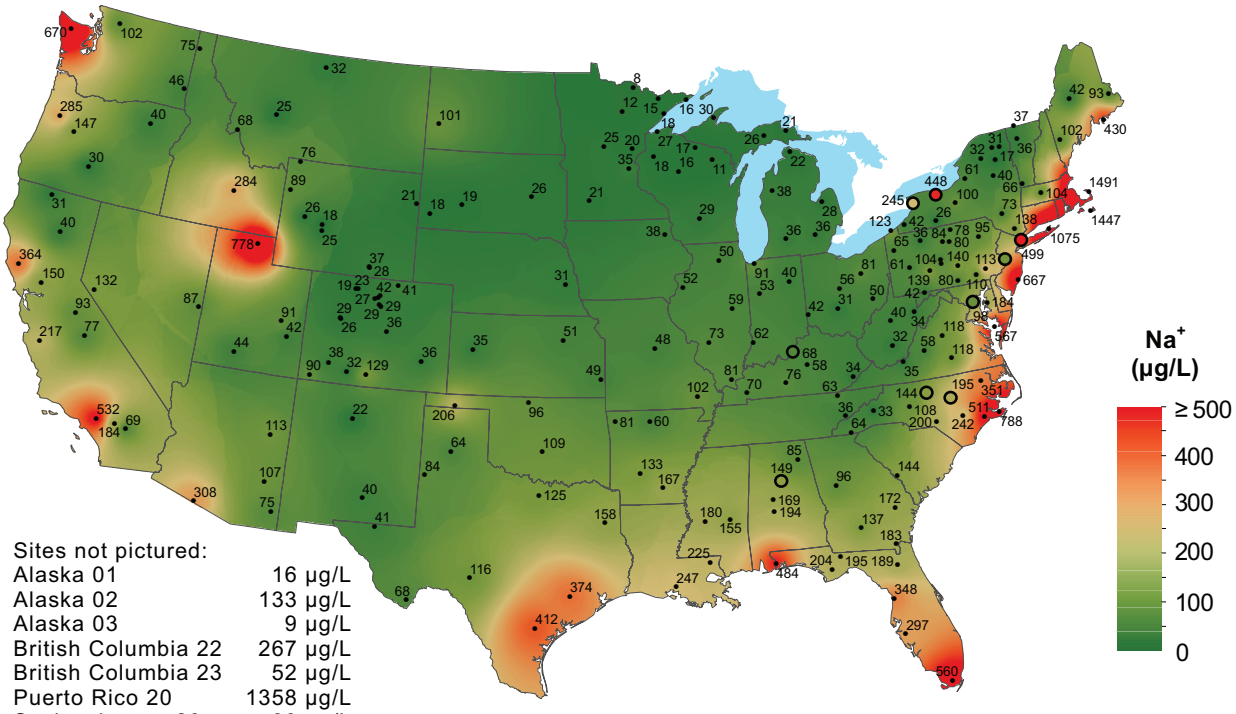
Alaska 01	<0.1 mg/L
Alaska 02	0.3 mg/L
Alaska 03	<0.1 mg/L
British Columbia 22	0.4 mg/L
British Columbia 23	0.1 mg/L
Puerto Rico 20	2.4 mg/L
Saskatchewan 20	0.1 mg/L
Saskatchewan 21	<0.1 mg/L
Virgin Islands 01	2.6 mg/L



Sites not pictured:

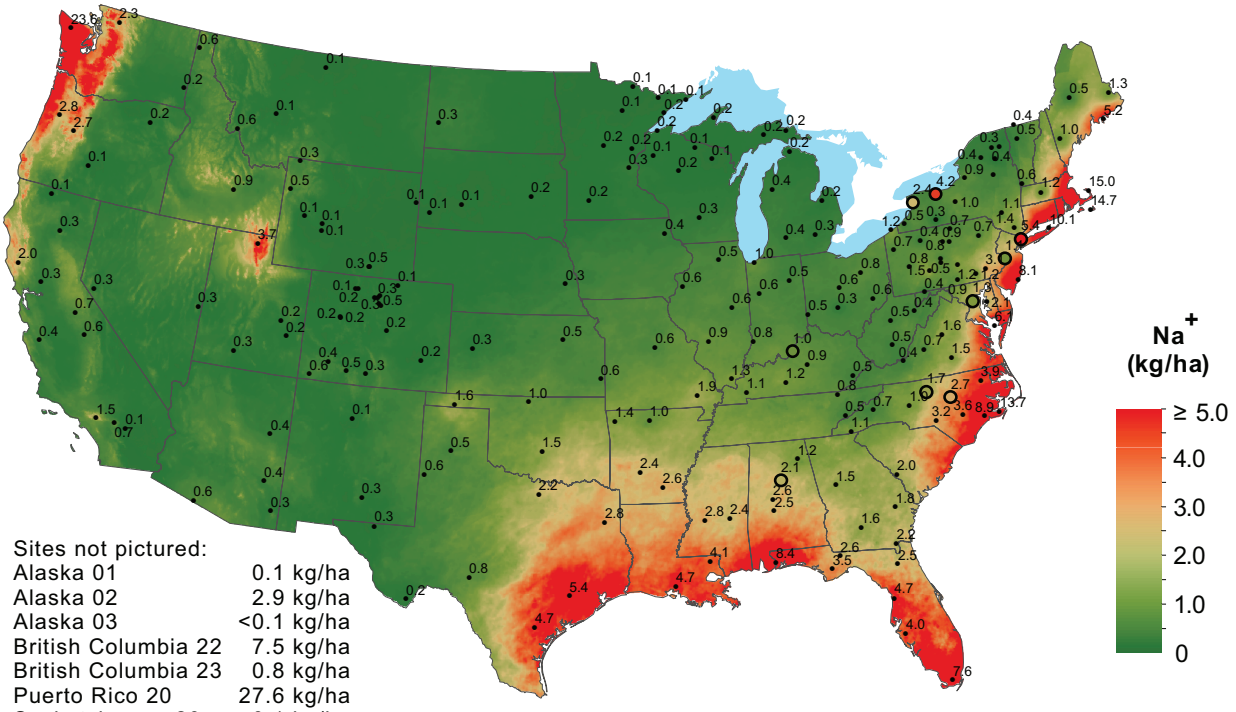
Alaska 01	0.2 kg/ha
Alaska 02	5.5 kg/ha
Alaska 03	0.1 kg/ha
British Columbia 22	11.1 kg/ha
British Columbia 23	1.5 kg/ha
Puerto Rico 20	49.2 kg/ha
Saskatchewan 20	0.2 kg/ha
Saskatchewan 21	0.2 kg/ha
Virgin Islands 01	22.8 kg/ha

Chloride ion concentration (top) and wet deposition (bottom), 2015.



Sites not pictured:

Alaska 01	16 µg/L
Alaska 02	133 µg/L
Alaska 03	9 µg/L
British Columbia 22	267 µg/L
British Columbia 23	52 µg/L
Puerto Rico 20	1358 µg/L
Saskatchewan 20	30 µg/L
Saskatchewan 21	12 µg/L
Virgin Islands 01	1429 µg/L



Sites not pictured:

Alaska 01	0.1 kg/ha
Alaska 02	2.9 kg/ha
Alaska 03	<0.1 kg/ha
British Columbia 22	7.5 kg/ha
British Columbia 23	0.8 kg/ha
Puerto Rico 20	27.6 kg/ha
Saskatchewan 20	0.1 kg/ha
Saskatchewan 21	0.1 kg/ha
Virgin Islands 01	12.7 kg/ha

Sodium ion concentration (top) and wet deposition (bottom), 2015.

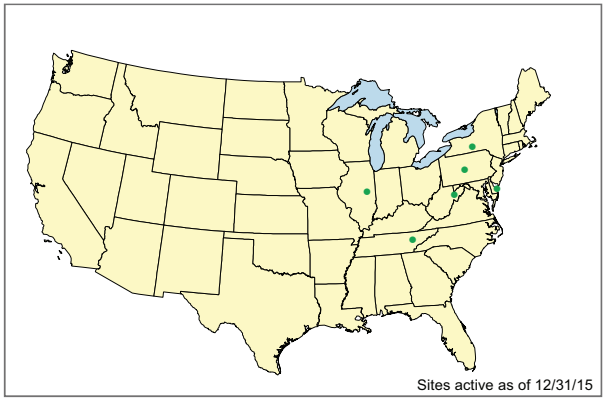
Atmospheric Integrated Research Monitoring Network (AIRMoN)

AIRMoN samples are collected daily within 24 hours of the start of precipitation, often providing data for individual storm events. Single-storm data facilitate studies of atmospheric processes and the development and testing of computer simulations of these processes, such as the NOAA/HYSPLIT fate and transport model. Back trajectories for all AIRMoN samples are provided at http://nadp.isws. illinois.edu/AIRMoN.

AIRMoN sites are equipped with the same wet-only deposition collector used at NTN sites. All AIRMoN sites operate digital raingages to report total precipitation. Each site also has a standard stick-type precipitation gage as a backup.

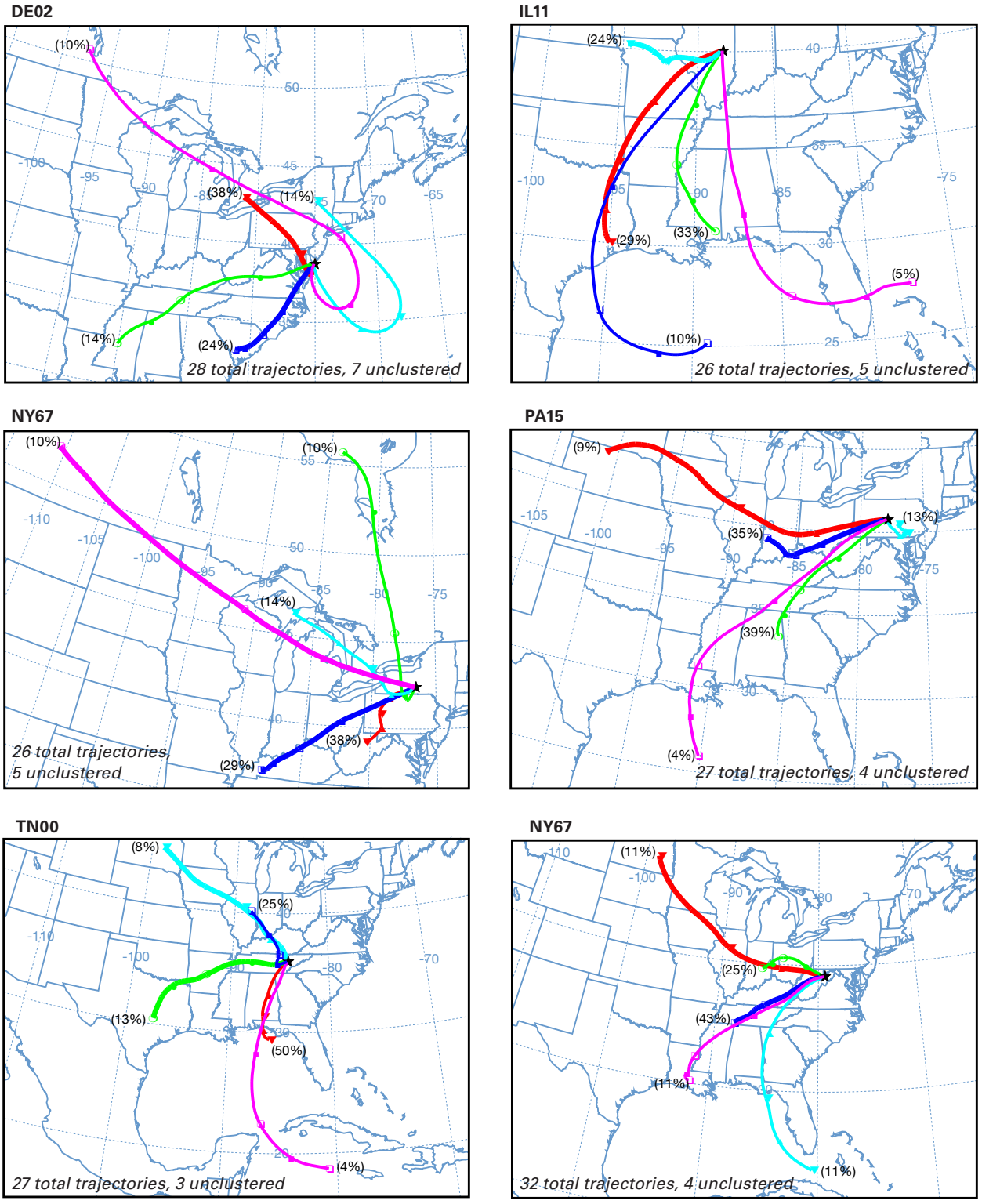
Samples are refrigerated after collection and are shipped in chilled, insulated containers to the CAL for analysis. Samples remain refrigerated until they are analyzed. Refrigeration helps retard potential chemical changes, such as with H^+, NH_4^+, and PO_4^{3-}. Chemical analyses and data screening procedures for AIRMoN and NTN are similar. Data from the AIRMoN are available on the NADP website (http://nadp.isws.illinois.edu/airmon/).

The back trajectory plots on page 21 (using NOAA's HYSPLIT model {February 2016 revision 802}) are clusters of back trajectories for the six AIRMoN sites (DE02, IL11, NY67, PA15, TN00, and WV99),



suggesting the general pathways of air reaching the individual sites that resulted in the highest 25% of S + N deposition (equivalents/hectare) during 2015. The cluster routine combines trajectories to five clusters.

The clustered trajectories were 48-hour back trajectories originating at 1000 meters above each station, and beginning at the midpoint of the precipitation event. The back trajectories were based upon the Global Data Assimilation System (GDAS) meteorological data for calculations. Clusters were produced using the 48th hour trajectory position and mean vector from this point. Total number of clusters used and unclustered are included for each site.

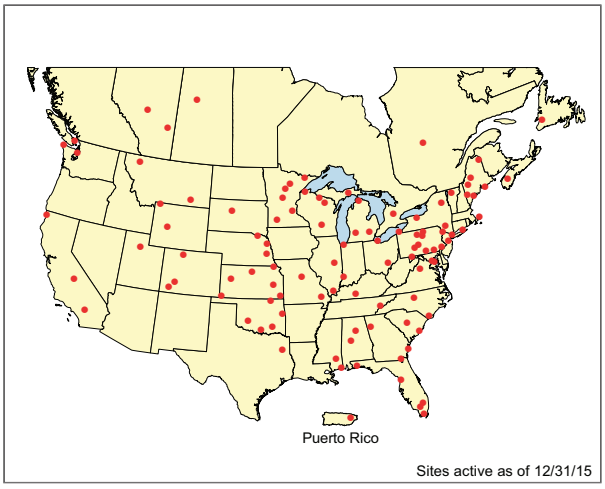


Clustered 48-hour back trajectory pathways originating at 1000 meters above each AIRMoN station at the time of precipitation. Trajectories represent air flow resulting in S + N depositions above the 75th percentile during 2015. The 5 pathways show a relative number and the percent of individual trajectories included in the trajectory cluster ("average" pathway). Heavy back trajectory lines represent the clustered trajectories that result in the two highest average depositions.

Mercury Deposition Network (MDN)

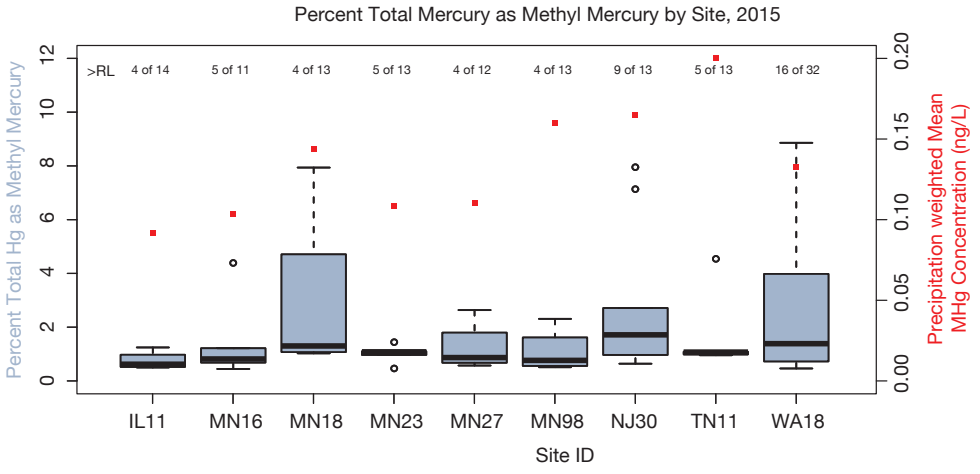
The MDN is the only network providing a long-term record for the concentration of mercury (Hg) in precipitation in North America. MDN sites follow standard procedures and use approved precipitation collectors and raingages. The automated collector is similar to the NTN collector, but it is modified to preserve mercury. Site operators collect samples either every Tuesday morning or daily within 24 hours of the start of precipitation. In 2015, the Yorkville site in northwestern Georgia (GA40), the Birmingham site in Alabama (AL19), and the Pensacola, Florida site (FL96) collected daily samples. Chemical analysis of the MDN samples is performed by the Mercury Analytical Laboratory (HAL) at Eurofins Frontier Global Sciences, Inc., Bothell, Washington.

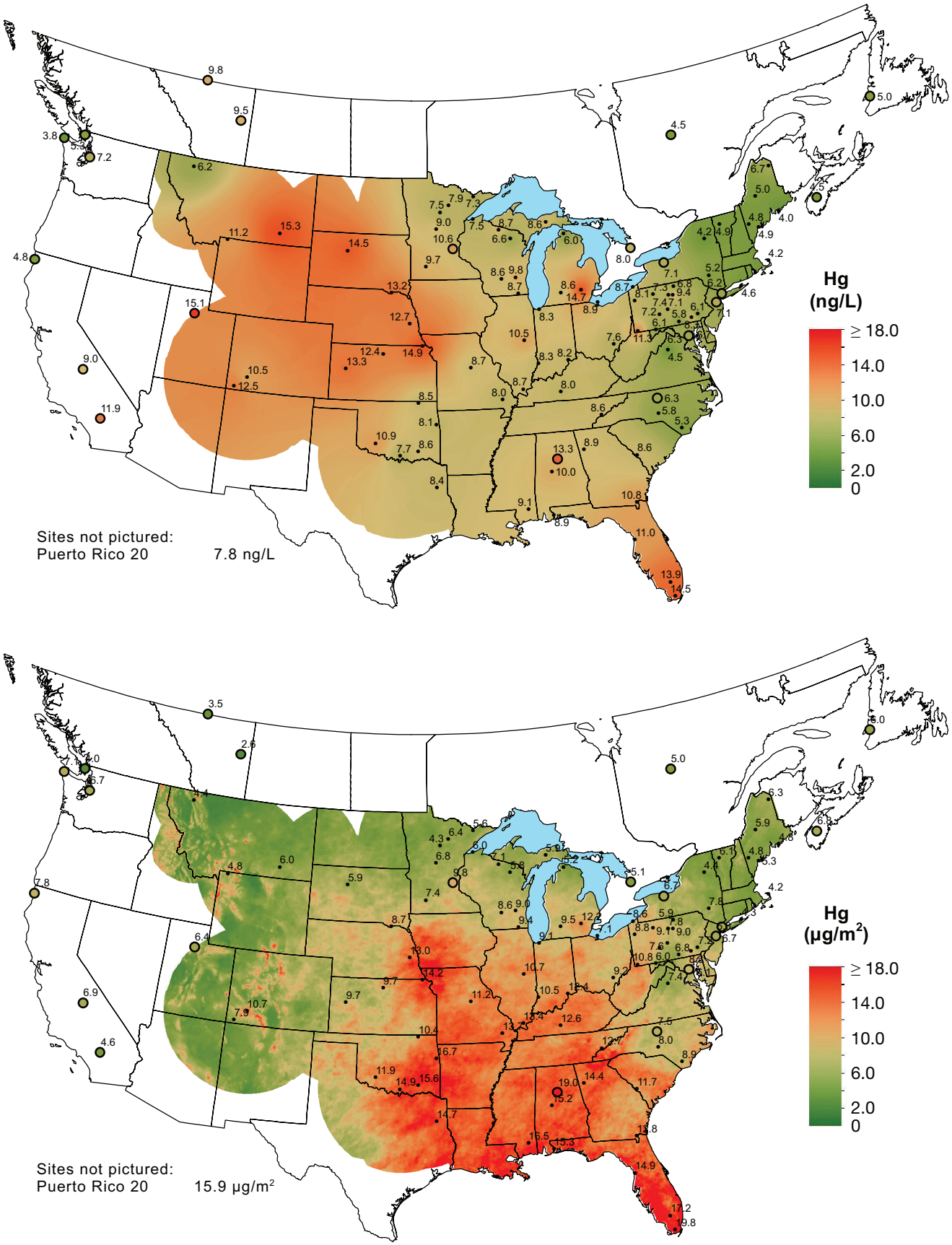
All MDN samples are analyzed for total mercury concentration. The HAL reviews field and laboratory data for accuracy and completeness, and identifies samples that were mishandled, compromised by equipment failure, or grossly contaminated. Data from the MDN are available on the NADP website (http://nadp.isws.illinois.edu/mdn). Subsamples of MDN precipitation were analyzed for methyl mercury (MeHg) at 13 NADP sites. Details about sample collection and analysis are available on the NADP website.



MDN Maps and Graphs

The maps on page 23 show spatial variability in the precipitation-weighted mean concentration and wet deposition of total mercury. Only sites meeting NADP completeness criteria are included. In 2015, 100 of 112 active sites met these criteria. Spatial variability of total mercury can be seen on regional and national scales. The graph below shows the distribution of methyl mercury concentrations (shaded boxes) as a percentage of total mercury. The precipitation-weighted mean of the methyl mercury concentrations in ng/L is represented by the red dot.





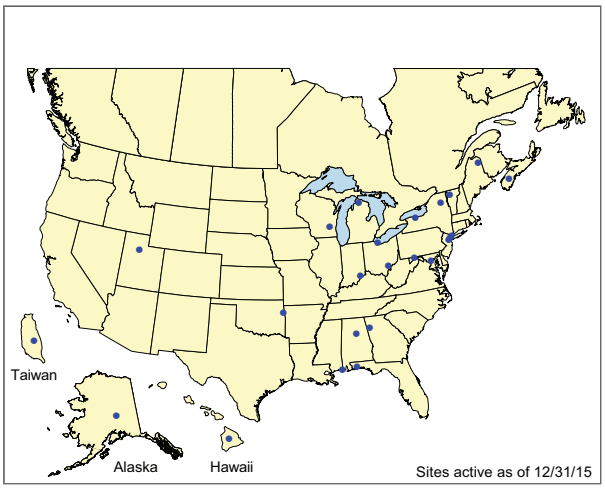
Total mercury concentration (top) and wet deposition (bottom), 2015.

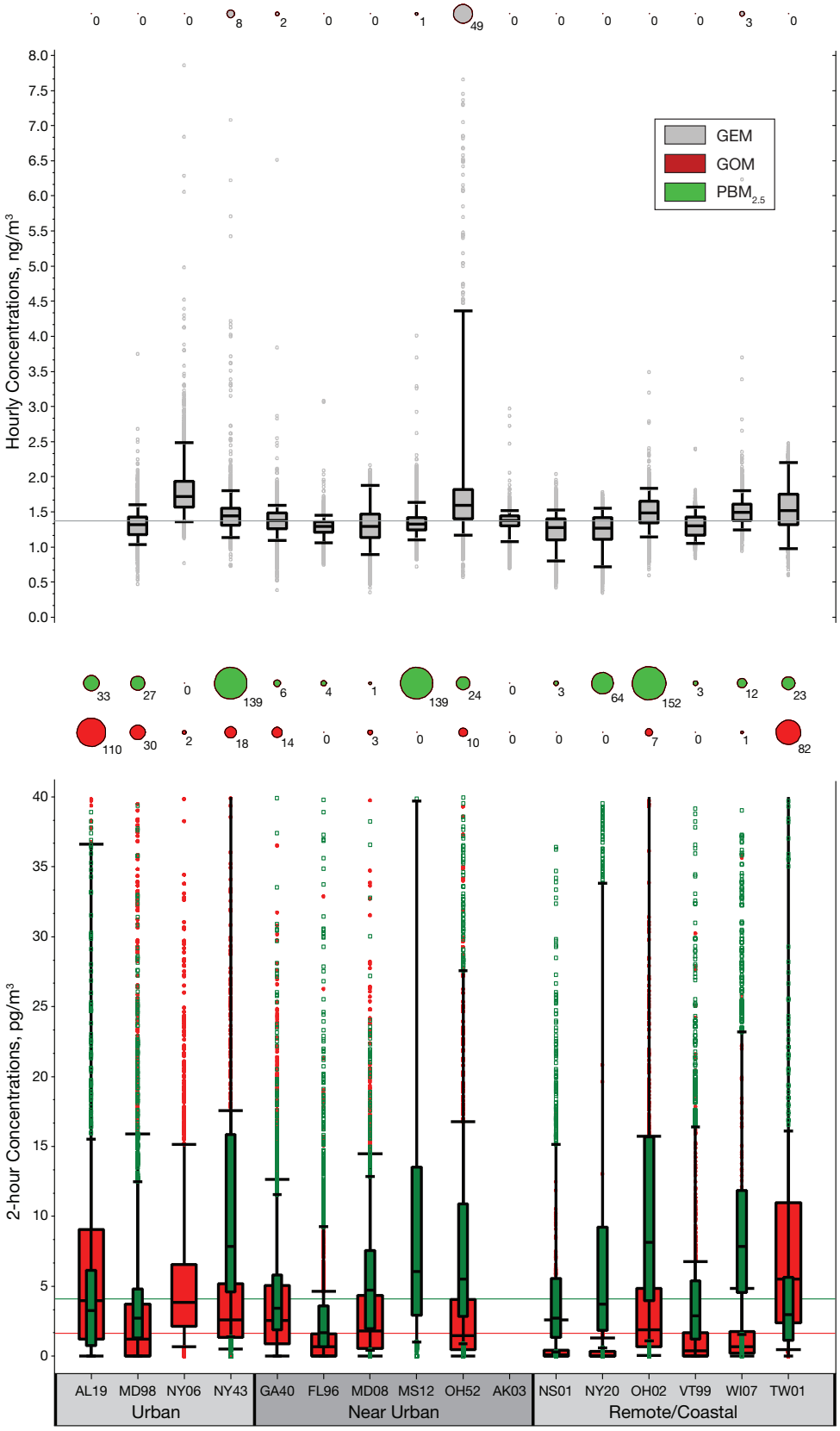
Atmospheric Mercury Network (AMNet)

AMNet sites measure atmospheric mercury that contributes to mercury deposition using automated, continuous measurement systems. Quality-assured measurements are made using NADP standardized methods.

AMNet measurements are made continuously (five-minute and two-hour averages). Data are 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 2015, there were 25 AMNet sites. Data from the AMNet are available on the NADP website (http://nadp.isws.illinois.edu/amn/).

The figures on page 25 show the distribution of atmospheric mercury concentrations for each site meeting completeness criteria in 2015. The top figure shows the distribution of GEM (grey shaded area) in nanograms per cubic meter (ng/m^3). The bottom figure shows the distribution of two-hour atmospheric concentrations of GOM (red shaded area), and $PBM_{2.5}$ (green shaded area) in picograms per cubic meter (pg/m^3).





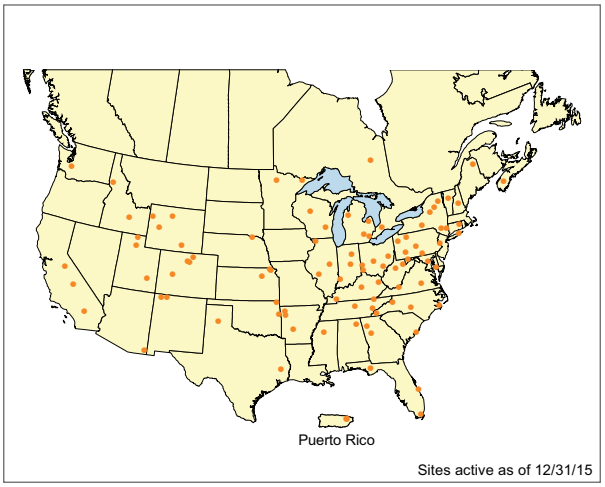
Hourly GEM concentrations in ng/m³ for each AMNet site (top) and 2-hour GOM and $PBM_{2.5}$ concentrations in pg/m³ for each AMNet site (bottom), 2015. The bubble charts indicate the number of valid observations for GEM values above 8 ng/m³, and GOM and $PBM_{2.5}$ above 40 pg/m³, the upper limit shown with the box plots. Horizontal lines in each graph represent the respective 2015 median values.

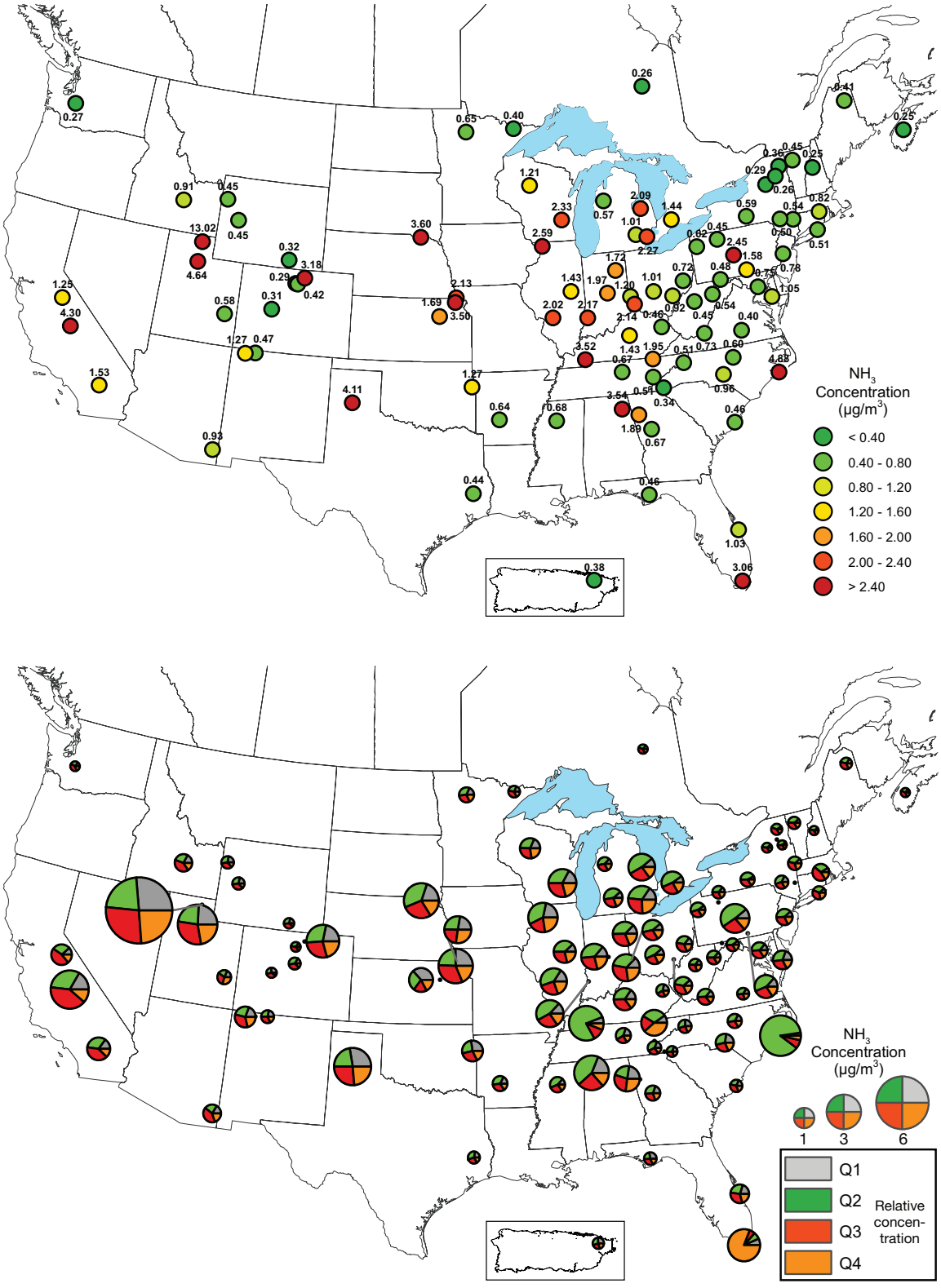
Ammonia Monitoring Network (AMoN)

The AMoN measures atmospheric concentrations of ammonia (NH_3) gas. The network uses a passive diffusion-type sampler. This allows for cost-effective, straightforward, and simple measurements. Observations are made over a two-week period with some sites measuring in triplicate. This provides an integrated and quality-assured estimate of ammonia in the air. These data are used to assess both long-term NH_3 trends and changes in atmospheric chemistry and provide information for model development and verification.

As of December 2015, there were 98 AMoN sites. Data from the AMoN are available on the NADP website (http://nadp.isws.illinois.edu/amon/).

The figures on page 27 show the distribution and seasonality of gaseous ammonia concentrations for each site meeting completeness criteria. In 2015, 91 of 98 active sites met these criteria. In the top figure, circles represent annual average concentrations in micrograms per cubic meter ($\mu g/m^3$) at each site. In the bottom figure, 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 (top), and quarterly relative percentage (Q1 = January, February, March, etc.) for each AMoN site (bottom), 2015. Size of the symbol in the bottom plot is relative to the annual concentration.

National Atmospheric Deposition Program

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All NADP data and information, including color contour maps in this publication, are available free of charge from the NADP website: http://nadp.isws.illinois.edu. Alternatively, contact: NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820, Tel: (217) 333-7871, Fax: (217) 333-0249, E-mail: nadp@isws.illinois.edu.

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