



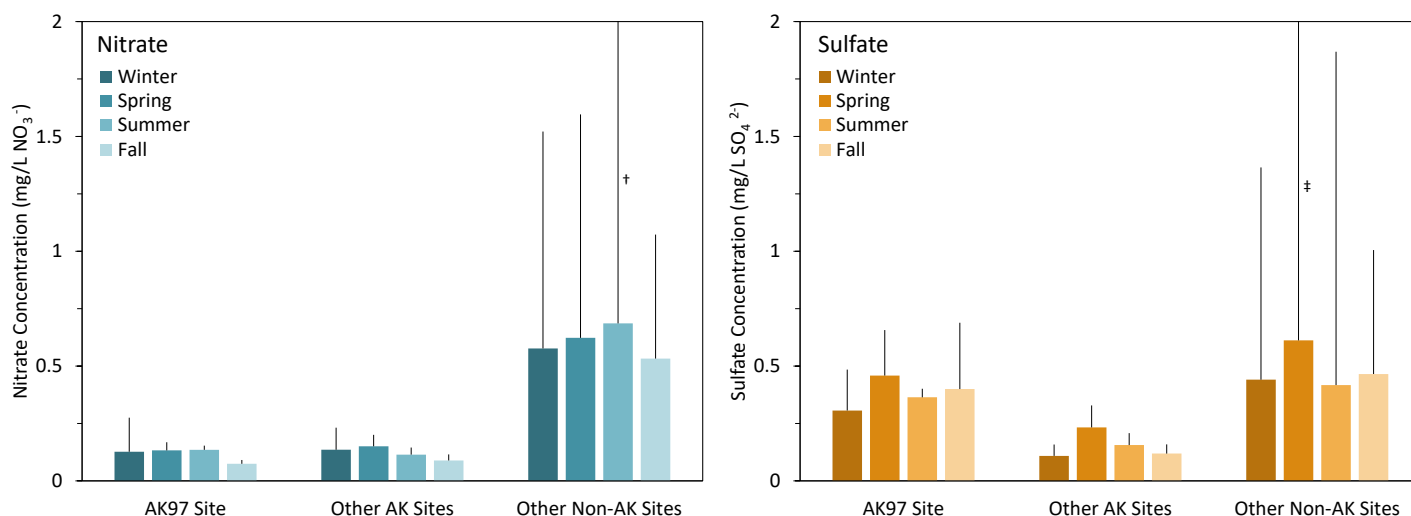
Air Quality

Atmospheric deposition is the process by which airborne pollutants reach the earth's surface. This occurs either through wet deposition from rain, snow, sleet, and fog, or through dry deposition from complex atmospheric processes such as settling, impaction, and absorption. Deposition can include a wide variety of natural and synthetic pollutants, such as inorganic elements (e.g., sulfur, nitrogen, mercury) and both inorganic and organic compounds (e.g., sulfate, nitrate, pesticides). Once deposited, pollutants can have a range of ecosystem effects. Nitrogen and sulfur compounds, for example, can result in acidification of terrestrial and aquatic habitats; eutrophication of freshwater, estuarine, and marine waterways; soil nutrient and base cation leaching; and loss of sensitive species. Arctic and subarctic ecosystems are particularly vulnerable to impacts from the deposition of excess nitrogen and sulfur.

Findings

Wet deposition has been monitored in North America since 1978 by the National Atmospheric Deposition Program's National Trends Network (NTN). This network currently includes 261 active monitoring sites, one of which is operated by the Southwest Alaska Network (SWAN) and Katmai National Park and Preserve. This site (known as AK97) is located in King Salmon, Alaska, and is one of only five active NTN sites in the state.

Recent average nitrate concentrations at AK97 are comparable to those at other Alaska sites, and lower than averages elsewhere on the continent. Recent average sulfate concentrations at AK97 are intermediate between those at Alaska and non-Alaska sites, with a seasonal pattern similar to sites in the Lower 48. Concentrations are useful for determining temporal trends, because they do not depend on the amount of precipitation at the site, which varies annually.



Concentrations of two common pollutants, nitrate (left) and sulfate (right), found in precipitation at the Southwest Alaska Network site, AK97. Concentrations at three other NTN sites in Alaska and 210 NTN sites located elsewhere are shown for comparison. Colored bars represent seasonal averages for the years 2011-2017; black lines indicate standard deviations, where †=1.7 and ‡=2.3 mg/L. Additional data are available at: <http://nadp.sws.uiuc.edu/data/ntn/>.



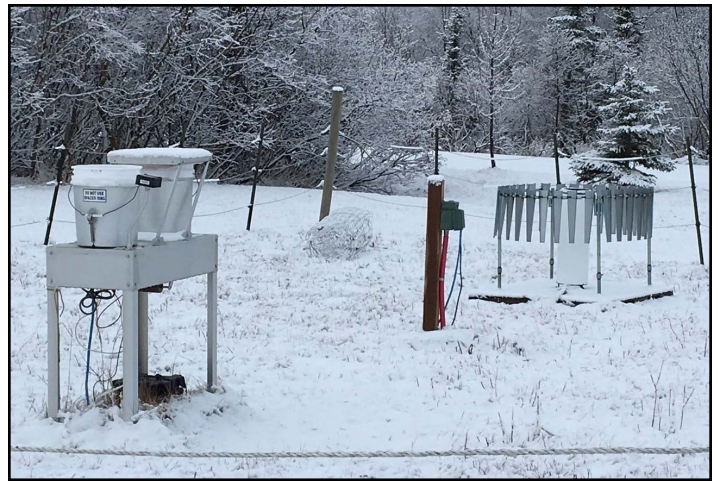


Some ecosystem types, including high-elevation lakes like the one pictured above, are sensitive to the effects of nutrient enrichment and acidification from atmospheric deposition of nitrogen and sulfur. Ecosystems in Katmai are rated as very highly sensitive to acidification and moderately sensitive to nutrient enrichment (Sullivan et al. 2011a and b).

Methods

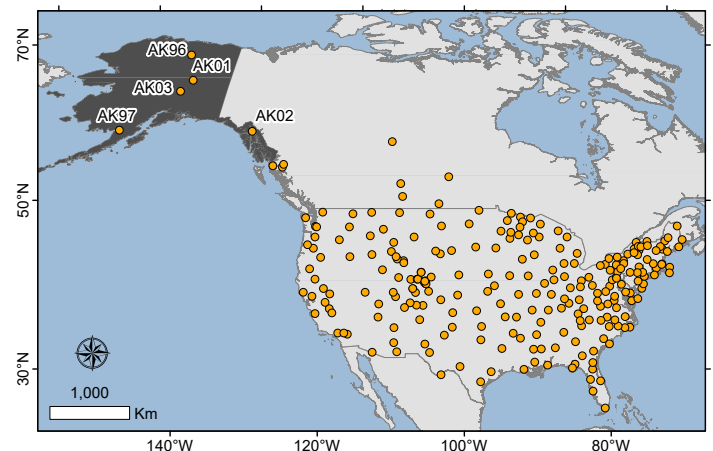
SWAN began monitoring wet deposition in 2009 in order to characterize trends in precipitation chemistry in southwest Alaska. Monitoring methods follow the NTN protocol. According to this protocol, precipitation samples are collected year-round on Tuesdays and sent to a lab in Wisconsin. The lab provides centralized chemical analyses of biologically important anions and cations (such as nitrate, sulfate, and ammonium). It also provides centralized data validation and organization.

Centralization is critical for reliable long-term, large-scale monitoring. With a centralized approach, we have high confidence that the differences observed over time or between sites are actual trends, rather than artifacts of variation between labs or methods.



Every NTN site uses two instruments to monitor wet deposition: a rain gage (right) and a precipitation collector (left). In 2015, the AK97 site at Katmai National Park and Preserve (pictured) was converted to telemetry, so rain gage data are available online in real time at:

<http://nadp.sws.uiuc.edu/siteOps/ppt/default.aspx>.



Only 5 of the 256 currently active NTN sites are located in Alaska (shaded dark gray). AK97 is furthest west of all sites within the network.

References

Sullivan, T. J., G. T. McPherson, T. C. McDonnell, S. D. Mackey, and D. Moore. 2011a. [Evaluation of the sensitivity of inventory and monitoring national parks to acidification effects from atmospheric sulfur and nitrogen deposition: main report](#). Natural Resource Report NPS/NRPC/ARD/NRR—2011/349. National Park Service, Denver, CO.

Sullivan, T. J., T. C. McDonnell, G. T. McPherson, S. D. Mackey, and D. Moore. 2011b. [Evaluation of the sensitivity of inventory and monitoring national parks to nutrient enrichment effects from atmospheric nitrogen deposition: Southwest Alaska Network \(SWAN\)](#). Natural Resource Report NPS/NRPC/ARD/NRR—2011/333. National Park Service, Denver, CO.

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