Atmospheric Nitrogen Deposition: Measurement, Ecological Consequences and Management Strategies

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Although NO_x emissions from mobile and stationary sources have decreased dramatically in many countries over the past two decades, nitrogen pollution remains a widespread problem. Human activities now perturb the global N cycle to a greater extent than the widely-acknowledged effects on the global C cycle. Once released to the environment, an atom of reactive N can cause multiple effects in the atmosphere, in terrestrial ecosystems, in freshwater and marine systems, and on human health. This sequence of effects is known as the nitrogen cascade.

As emissions of nitrogen oxides have decreased, deposition of reduced N forms (e.g., ammonium) have become an increasingly large fraction of total N deposition. Quantifying N deposition from a complex array of atmospheric N compounds is difficult even at a single location. Measuring N deposition at multiple sites or regionally requires realistic approaches, some of which will be discussed. Ecological and environmental impacts of atmospheric N deposition include: diversity loss in plant communities, acidification of soils and surface waters and associated effects on forest health and aquatic communities, N enrichment of remote lakes and changes in diatom assemblages, coastal eutrophication and dead zones, and harmful algal blooms. Additional impacts include elevated nitrate concentrations in water from forested watersheds, climate change effects, impaired visibility and human health effects. Health effects from N deposition occur by way of degraded air and water quality.

Recently, critical loads of atmospheric N deposition have been established in the U.S. for a variety of ecological effects. This provides a tool to help land managers protect natural resources from the effects of chronic N deposition. However, habitat management strategies for reducing the impacts of excess N are generally labor intensive and costly. Ultimately, N emissions need to be reduced so that N deposition inputs do not exceed the critical loads for ecological effects.