ATMOSPHERIC DEPOSITION

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PROJECT LOCATION

Adirondack Park in New York. Source: E&S Environmental Chemistry, Inc.

CONTACT INFORMATION

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KEYWORDS

- Acid deposition
- Acid neutralizing capacity
- Adirondack
- Critical load
- Nitrogen
- Sulfur

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New York Energy Smart
EMEP
Environmental Monitoring, Evaluation, & Protection

NYSERDA
New York State Energy Research and Development Authority

Critical Loads of Sulfur and Nitrogen Deposition to Protect and Restore Acid-Sensitive Resources in the Adirondack Mountains

PROJECT FOCUS

Middle Settlement Lake in the Adirondacks. Source: E&S Environmental Chemistry, Inc.

This project represents a multi-disciplinary effort to establish critical loads for airborne sulfur (S) and nitrogen (N) deposition in the Adirondack region of New York. Critical loads are threshold levels of exposure to pollutants, below which specific sensitive elements of an ecosystem show no significant negative impact. Airborne S and N are two pollutants that result from fossil fuel combustion and contribute to acid deposition (sometimes called acid rain). The project will build upon the results of another recently completed, EMEP-sponsored project, for which the same research team modeled the acid-base response of Adirondack lakes to historic acid deposition and several scenarios of future emissions controls.

The major focus of the current project is to calculate model-based estimates of S and N critical loads for aquatic and forest resources in the Adirondacks. This will help guide protection and recovery efforts directed at Adirondack resources impacted by S and N deposition.

CONTEXT

Ecosystem damage from air pollution in the Adirondacks has been substantial. Efforts to characterize and quantify this damage, and to examine recent recovery, have focused on surface and subsurface waters, soils, and forests. Biological dose-response functions for zooplankton and fish for Adirondack lakes have been developed. These data help identify chemical indicators for defining and calculating critical loads. This project will refine linkages among water chemistry, zooplankton, fish, soil chemistry, and foliar chemistry in the context of specifying critical loads for S and N deposition.

PROJECT IMPLICATIONS

This project is intended to enhance understanding of the extent to which current and future S and N emissions reductions will lead to ecosystem recovery in the Adirondacks. Greater understanding of S and N critical loads in the region will provide resource managers and policymakers with an improved basis to guide emissions reduction goals and policies, evaluate incremental improvements, and conduct cost/benefit analyses. The major objectives are to classify and map Adirondack lakes according to their critical loads; evaluate the sensitivity of critical load calculations for Adirondack lake watersheds; and refine algorithms of biological response to acid deposition for use in critical load calculations for the Adirondack region.

PROJECT STATUS
Ongoing

Critical loads of acid deposition are established to protect against acidification of soils and drainage water that might cause damage to vegetation or aquatic biota. Source: E&S Environmental Chemistry, Inc.

Little Tupper Lake, located within the William C. Whitney Wilderness Area in the Adirondack Park. Source: E&S Environmental Chemistry, Inc.

METHODOLOGY

The study areas for this project include a group of 44 statistically selected lake watersheds and another group of lakes for which chemical and biological long-term monitoring data are available. Linkages will be explored between biological response functions and chemical criteria values for lake water, forest soil and foliar chemistry. Critical load results will be simulated for approximately 100 lake watersheds, extrapolated to the larger population of acid-sensitive lake watersheds, and mapped across the region.

Characteristics of the soil largely govern the critical load of S and N deposition that will be protective of aquatic and terrestrial resources. Source: E&S Environmental Chemistry, Inc.

In order to simulate aquatic, edaphic (soil conditions in relation to plant communities), and forest effects, two principal models, MAGIC and PnET-BGC, will be used as critical load simulation and integration tools. A subset of 44 statistically selected watersheds will be modeled, plus 32 of the most intensively-studied acid-sensitive lake watersheds, and a group of about 30 lake watersheds modeled by EPA for the Direct Delayed Response Project. Model results will be extrapolated to the entire regional population of lakes with acid neutralizing capacity less than 200 μeq/L.

Once model results have been extrapolated to the larger population of regional lakes, the results will be mapped. Mapping will be based on development of multivariate relationships between modeled critical loads and mappable landscape features that correlate with critical loads. This research effort will explore aspects of the integrated landscape of the study watersheds, using primary watershed features and also modeled and monitored biogeochemical responses to atmospheric inputs of S and N. PnET-BGC applications will be used to explore the underlying biogeochemical processes and assumptions that control the critical load of acid deposition to Adirondack ecosystems. Algorithms of the biological response to acid deposition will be developed, tested, and refined for use in critical load calculations, and the use of biological indicators will be evaluated.

FINDINGS

A small stream in the Adirondacks. Source: E&S Environmental Chemistry, Inc.

Model calibrations are ongoing. Biological response algorithms are also being evaluated for further refinement. The planned modeling approach was presented at a meeting of the Critical Loads Ad Hoc (CLAD) committee of the National Atmospheric Deposition Program (NADP), and feedback has been obtained from CLAD representatives.

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