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Science HIGHLIGHTS

FOREST HYDROLOGY

Is climate change linked to elevated levels of sulphur in forest watersheds?

A multi-disciplinary team of researchers is finding elevated levels of sulphur in an Ontario watershed despite significant progress on acid rain

Fred Beall and a team of meteorologists, biogeochemists, foresters, hydrologists, and fish and wildlife biologists are studying "catchment wetness"—how wet or dry a watershed is—and finding links between climate change and levels of sulphur.

"Drier conditions are exposing soils normally saturated with water to oxygen. This is releasing stored sulphur and delaying the recovery from acid rain," says Beall, a research scientist with the Canadian Forest Service–Natural Resources Canada who works at the Turkey Lakes Watershed in Northern Ontario.

Recovery could take decades

Sulphur is a key component of acid rain. Sulphur emissions react with water molecules to produce acids. These acids harm forests, water and soils, killing insects and aquatic life-forms as well as damaging human health. Lakes and soils in different regions have different capacities to neutralize acids they receive. Dramatic reductions in acid rain have been achieved since the 1991 Canada–U.S. Air Quality Agreement. But re-establishing equilibrium in sensitive watersheds could take several years, perhaps even decades, especially if higher average temperatures cause watersheds to be drier, permitting more stored sulphur to be released.

Situated about 50 kilometres north of Sault Ste. Marie, the Turkey Lakes Watershed is an undisturbed, completely forested basin of mixed hardwoods home to four interconnected lakes. It has been the site of continuous monitoring and research since 1980. "We have seen a three degree [Celsius] rise in average annual air temperature in 30 years. This is far above any predicted rise," Beall says. The cause, he indicates, is likely due to significant warming of nearby Lake Superior over the last 100 years. The waters of Lake Superior have warmed significantly more than the global temperature rise generally attributed to climate change.

Collaborating with U.S. researchers

Beall and his colleagues are also contributing to a larger research project covering 15 watersheds in southeastern Canada and the U.S. northeast. The researchers are comparing "sulphur budgets"—the amount of sulphur inputs and outputs in a given area—to determine how vulnerable lakes and forests are to acidification. To help policy makers develop more precise sulphur targets, scientists have

Overview

Rising temperatures over the last 30 years in the Turkey Lakes watershed are leading to drier conditions.

Drier conditions are exposing soils normally saturated with water to oxygen. This is releasing stored sulphur and delaying the recovery from acid rain.

Turkey Lakes Watershed

Canada

long used the concept of a critical load—the amount of sulphur a region can receive without significant damage to its ecosystem. Ultimately, this work could influence national policy development in the U.S. and Canada around acid rain and sulphur levels.

"Compared to the 1980s, things have improved. But there may be a tipping point. Any site has a finite capacity to absorb sulphuric acid and as temperatures rise, we may reach that tipping point despite major reductions in acid rain," Beall says. "Next we want to investigate if disturbing a forest (e.g. through harvesting or forest fires) makes the effects of acid rain worse." Because the Turkey Lake project has an established record of continuous monitoring and research, Beall and his colleagues are well-positioned to provide research that should have a lasting and positive impact on forest watershed health through improved knowledge of ecological processes.

Batchawana Lake, Turkey Lakes Watershed