

Forests may play overlooked role in regulating climate

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In a study to be published next week in the *Proceedings of the National Academy of Sciences*, scientists led by a team at the University of New Hampshire show that forests may influence the Earth's climate in important ways that have not previously been recognized.

When sunlight reaches the Earth's surface it can either be absorbed and converted to heat or reflected back to outer space, where it doesn't influence the Earth's temperature. Scott Ollinger, a professor at the UNH Institute for the Study of Earth, Oceans, and Space and the department of Natural Resources and the Environment, and colleagues have discovered that, of the total amount of sunlight that falls on forests, the fraction that gets reflected back to space is directly related to levels of nitrogen in their foliage.

While scientists have long known that nitrogen-rich foliage is more efficient at pulling carbon dioxide out of the atmosphere, this new discovery suggests that nitrogen plays an important additional role in the Earth's climate system that has never before been considered.

Specifically, trees with high levels of foliar nitrogen have a two-fold effect on climate by simultaneously absorbing more CO₂ and reflecting more solar radiation than their low-nitrogen counterparts.

Ollinger and UNH colleagues Andrew Richardson, Mary Martin, Dave Hollinger, Steve Frolking, and others, stumbled upon the discovery while poring over six years worth of data they collected from research sites across North America. The study involved a novel combination of

NASA satellite- and aircraft-based instruments, along with meteorological towers from the AmeriFlux network and leaf-level measurements to analyze various aspects of forest canopies. When Ollinger noticed that the overall reflectivity of forest canopies (also known as albedo) rose and fell in conjunction with leaf nitrogen, he had a eureka moment.

"Bits and pieces of evidence for this have been around for years but nobody put them together before because it's a question we hadn't even thought to ask," Ollinger says. "Scientists have long been aware of the importance of albedo, but no one suspected that the albedo of forests might be influenced by nitrogen. And because most of the effect is in the infra-red region of the sun's spectrum, beyond that which human eyes can detect, the pattern isn't immediately obvious."

The newly discovered link between foliar nitrogen and canopy albedo adds an interesting new twist to the understanding of the climate system and raises intriguing questions about the underlying nature of ecosystem–climate interactions.

Changes in climate, air pollution, land use, and species composition can all influence nitrogen levels in foliage, and all of these may be part of a climate feedback mechanism that climate models have not yet examined. Future research planned by the team will involve examining the underlying causes for why the relationship exists and working with climate modelers to determine how the nitrogen-albedo mechanism will influence predictions of climate change.

Source: University of New Hampshire

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