UNH Institute for the Study of Earth, Oceans, and Space

An Advancement in Remote Sensing Sheds Light on the Relationship between Air Pollution and Forest Health

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DURHAM, N.H. -- From an airplane flying at 70,000 feet, so high that the pilot is technically considered an astronaut, a new adaptation to a remote sensing instrument enables scientists to better study the capacity of forests to suck in excess air pollutants and carbon dioxide from the atmosphere. A paper authored by University of New Hampshire researchers and published in the February issue of Ecology, the leading journal in the field, documents the advancements that this new adaptation brings to understanding forest health.

"Traditional remote sensing instruments are good at seeing different land cover types, but it is extremely difficult to use these instruments to see detailed ecological properties," explains Scott Ollinger, research assistant professor at UNH and lead author. "However, we are using a fairly advanced remote sensing instrument, called AVIRIS (Airborne Visible and InfraRed Imaging Spectrometer), that enables us to see much more detail. For example, rather than just identifying that the forest is a deciduous forest, we can now identify the nitrogen concentration in the forest foliage." The ability to estimate nitrogen in soils helps scientists unravel the complex ways in which humans have altered the environment. Historically, disturbances such as logging have had a nitrogen-depleting effect. More recently, says Ollinger, increases in atmospheric nitrogen pollution from industry and automobiles have contributed to acid rain and lead to problems of stream acidification and water pollution.

Data on nitrogen can also provide rich information on carbon because both nutrients are essential for plant growth and are therefore intimately connected. The amount of carbon a forest can absorb is important information in the debate over whether forests can provide an effective sink for excess carbon dioxide and slow global warming.

Ollinger and other co-authors, including Mary Martin and John Aber at the University's Institute for the Study of Earth, Oceans, and Space and professors of natural resources, and Marie-Louise Smith and Rich Hallett at the U.S. Forest Service, were the first to develop the use of AVIRIS for measuring nitrogen in plant leaves and soil. The spectrometer was originally developed by NASA to be used for mineral exploration.

About the instrument, Ollinger says, "Whereas previous remote sensing instruments might be analogous to a piano with only five keys, this instrument is like a piano with over 200 hundred keys."

While originally testing the spectrometer in flights over the White Mountain National Forest in New Hampshire, the authors came across a foretelling observation.

"In the White Mountains, there's a long history of human land use that includes logging and fires," Ollinger explains. "Soil erosion got to be so bad in the mid-19th century that rivers were filled with silt. Although the forests have since regrown, the effect of these disturbances still shows up today. We can see very interesting differences in the data on nitrogen levels from these impacted places. What this tells us is that how forests respond to air pollutants and climate change depends to a large extent on what humans did a hundred years ago to the land." According to the scientist, this same principle applies in regards to how present-day land use practices may affect future forest responses to climate change.

Over the next few years, with a recent grant for $885,000 from NASA, the authors will be taking their instrument to Brazil, Australia, and sites throughout North America to test their approach worldwide.

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