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BOSTON UNIVERSITY RESEARCHERS LOCATE WHERE NORTHERN FORESTS STORE CARBON

Boston University researchers and their NASA and European colleagues have mapped for the first time the location of forest areas in the northern hemisphere that serve as major "carbon sinks" - specific areas where carbon from the atmosphere is stored in the wood of trees. The researchers also determined that for the past 20 years forests in America, Europe, and Russia have been storing nearly 700 million metric tons of carbon per year. The carbon, taken in by trees as carbon dioxide (CO_2), comes primarily from the burning of fossil fuels and amounts to about 12 percent of the yearly carbon emissions caused by industrial activity around the world.

Knowing where carbon is stored - and how much is stored - is a first step in piecing together the puzzle of how greenhouse gases affect climate change. It allows researchers to determine how much CO_2 from industrial emissions remains in the atmosphere. Atmospheric accumulation of CO_2 is considered to be the chief cause of global warming.

Past analyses of changes in the concentration of CO_2 in the atmosphere have suggested that the northern mid- and high-latitudes make up a sink that takes up about one to two billion tons of carbon a year, or, 15 to 30 percent of yearly industrial carbon emissions worldwide. The geographic details of this northern sink, however, have remained elusive. Until now.

Using NASA-developed satellite data in combination with ground-based forest inventories, the researchers developed detailed maps that show differences in the rate of carbon storage in forests above the 30th parallel. For example, forests in the United States soaked up 140 million tons of carbon a year - about 11 percent of the country's annual carbon emissions. In Canada, however, most needleleaf forests were found to be losing carbon.

Most forests in the study were found to be storing carbon, although the rate of storage, measured in tons of carbon per hectare of forest per year, varied. The rate was highest in Europe (a little less than a ton - 0.84 - per hectare) and America (0.66), and least in Canada and China (0.29), while the rate for Russia was in-between (0.44).

The researchers offer several possible explanations for the differences and for why most forests are storing carbon: a longer growing season because of climate-warming, fire suppression and forest re-growth in the United States, better forest management in the Nordic countries, and declining harvests in Russia. As for why some Canadian forests are losing carbon, they suggest insect infestations, which can retard growth or destroy trees, and an increase in the incidence of fires, which reduce forest size, as causes.

The mapping technique the researchers devised relates forest "greenness" to inventory data compiled on the ground on the volume of stem wood in specific forest plots situated in 171 provinces in six countries. "Greenness" was derived from satellite observations of the amount of red and near-infrared wavelength solar radiation reflected by green leaves. Altogether, the researchers mapped about one and a half billion hectares of northern forests.

"This study has important scientific, economic, and policy implications," says Boston University researcher Robert Kaufmann. "It deconstructs the mystery of the land carbon sink by providing geographically detailed maps of forest carbon pools, sources, and sinks." In addition, the wood volume maps and the study's remote-sensing mapping technique are valuable tools for the forest industry. "But also," says BU's Ranga Myneni, lead author, "some of the carbon sinks we identified are key to realizing the Kyoto Protocol."

The Kyoto Protocol is an international plan for reducing greenhouse gas emissions by the industrialized nations to which most nations of the world have agreed. "The Protocol allows, within certain limits, counting some carbon sinks - and even the trading of sinks - as part of a nation's emissions reduction commitment," says Jiarui Dong, co-lead author and also of Boston University. "We now know where many of these sinks are and how much they can reduce emissions."

The findings of the NASA-funded study will be published in the December 18th issue of the Proceedings of the National Academy of Sciences of the USA. An electronic version of the article will appear in an early edition of PNAS on December 11th at www.pnas.org.

The team of authors includes: from Boston University, Jiarui Dong, Robert Kaufmann, Ranga Myneni, and Liming Zhou; the European Forest Institute and the University of Helsinki, Jari Liski; the International Institute for Applied Systems Analysis, Austria, and the University of Helsinki, Pekka Kauppi; the NASA Goddard Space Flight Center, Compton Tucker; the St. Petersburg Forest Ecological Center, Russia, Vladislav Alexeyev; and, the University of Arizona, Tucson, Malcolm Hughes.

Additional information is available on the Internet at:
http://cybele.bu.edu/ and
http://www.gsfc.nasa.gov/topstory/20011204carbonsink.html