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Silvus Borealis [1]

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A multi-scale project leads to understanding the carbon flux between terrestrial ecosystems and the lower atmosphere.

- About Oak Ridge National Laboratory (ORNL) DAAC [2]

The relation between atmospheric carbon dioxide concentration and beavers may not be readily apparent to the average person. As a scientist interested in the flux of carbon into and out of boreal wetlands, and a participant in the Boreal Ecosystems Atmosphere Study (BOREAS), the connection seems more obvious to Nigel Roulet.

The BOREAS experiment was set up as a short term, multiscale project. Data collection ranges from local, in-situ measurements to regional measurements obtained using remote sensing techniques. The experiment was designed with the intent of gaining better understanding of the energy and gas fluxes between the boreal forest and the lower atmosphere. By varying the scale of data collection it is hoped that improved climate models can be developed to predict temperature and precipitation patterns in these mid-latitude regions. It is expected that output from these process models can then be incorporated into ecosystem models to more accurately represent global climate variation.

"One of the approaches of the BOREAS experiment was to use landscape, ecosystem modeling. You model individual fluxes within the ecosystem and then use remote sensing information to scale up," explained Roulet, professor and director of the Centre for Climate and Global Change Research at McGill University.

For scientists, such as Roulet, the predominant concern is to better understand the carbon flux between terrestrial ecosystems and the lower atmosphere. Researchers are trying to account for the atmospheric distribution of carbon by identifying its sources and sinks.

Debate abounds as to the location of carbon sinks. The common perception is that the oceans account for a large proportion of carbon dioxide uptake. It is unclear what percent of the carbon budget is attributable to oceanic uptake and what is attributable to terrestrial and atmospheric uptake.

The carbon sink which appears to exist over the boreal forests is a recent phenomenon, only since the late 1980s and 1990s, said Roulet. The scientific reason for its presence remains unclear, although there are several theories that are currently being tested. However, forests absorb carbon when the fixation of CO2 by the plants exceeds ecosystem respiration. The flux of carbon into forest ecosystems should equal the flux of carbon out of these systems, ensuring a balance between CO2 levels and vegetation growth. Initially, increased atmospheric carbon had caused a jump in vegetation growth in the boreal forests. This process, however, seems to be slowing, resulting in lower amounts of carbon being recycled through the ecosystem.

Roulet's BOREAS team looked specifically at beaver ponds, which create and release significant amounts of methane gas into the atmosphere. "Wetlands make up from 25 to 50 percent of the Canadian boreal forest and beaver ponds constitute about seven percent of this total wetland area. We found that beaver ponds are one of the largest wetland sources of methane. So we knew that they were 'hot spots' in terms of methane emissions," said Roulet.

"The more interesting result, since we already knew that beaver ponds were large methane sources, is that we also found them to be large sources of carbon dioxide," said Roulet. "This means that they are a source of carbon dioxide to the atmosphere among forest ecosystems that are carbon sinks. The ponds have a large unit areas' source strength, so they can offset some of the sink occurring in the forest. Through analysis of air photos and remote sensing, we will determine the areal extent of beaver ponds and then we can estimate their role in the boreal carbon budget," said Roulet.

Resource(s)

BOREAS was a three year study completed in December 1996, consisting of 85 different science teams, divided into six areas of expertise. Although a short term project, the variety of measurements and observations of physical processes, can aid in the development of improved process models. Thus far, according to scientists involved in the project, funding continues for the short term to continue support for some of the instruments and study sites. A special issue of the Journal of Geophysical Research, due Spring 1997, will describe the research conducted in BOREAS.

Transfer of the BOREAS data to the Oak Ridge National Laboratory (ORNL) DAAC began December, 1996. Initial data sets will consist of satellite image files (GOES-7, Landsat Thematic Mapper (TM), AIRSAR, and NS001), with GOES-7 images being the first data available. Users will have the option to browse sample images before retrieving data. The field measurements are expected to be the last data made available.

The process of transferring the BOREAS data and associated documentation (consisting of more than 13,000 files, organized into approximately 320 data sets) is expected to take over a year. The data will be available to the public as they are incorporated into the ORNL archive and have been approved for release by BOREAS and the principal investigator of each project.

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