

BOREAS - An International BOREal Ecosystem Atmospheric Study of Canada's West-Central Boreal Forests

Michael J. Apps

The sensitivity of the boreal forest to potentially rapid changes in the global environment is an issue of significant concern with economic, social, and environmental dimensions. The boreal forest is a large, relatively unperturbed-by-industrial-man biome which is almost contiguous in the circumpolar region. Its borders fall entirely within many of the world's developed nations (including Canada, the European and Scandinavian communities, the USA and the USSR), all of which draw heavily on it for economic, social and aesthetic values. Changes in the boreal forest in response to potential changes in the global environment will have profound economic and social consequences for these nations. Moreover, comprising ~30% of the forested land of the world, the boreal forest may play a vital role in the short-term regulation of the physical climate system through its contribution to the global C cycle and through other biophysical feedback effects (e.g. albedo, surface roughness, and biophysical control of evapotranspiration).

Although containing lower species diversity than, for example, the tropical forests, it is a complex biome having complex spatial structures and interacting processes covering a wide range of time scales. To predict the role the boreal forest might play in regulating climate changes, it is first necessary to understand how the forest responds to these changes. One of the significant scientific challenges is the "scaling up" problem: extending scientific understanding of processes at the leaf level (10^{-3} s, 10^{-4} ha) in order to predict response at the whole forest level (10^9 s, 10^6 ha).

A new international study lasting from 1990-1996 will focus on the interactions between the boreal forest biome and the atmosphere to clarify their role in global change. BOREAS (Boreal Ecosystem-Atmospheric Study, god of the North wind) will address the scaling-up issue in two ways: a set of synchronous, nested observations at a series of spatial scales will be made and a system of integrating, synthesizing simulation models will be adapted, developed and tested with these data. The main experiment will take place in 1994 at two 400 km² sites (Prince Albert National Park, Saskatchewan and Nelson House, Manitoba) near the two ecotones of the continental boreal forest. The two sites span a major ecoclimatic gradient in an area where projected climate change is expected to be most significant and most rapid, with both temperature increases (northern site) and soil moisture conditions (southern site) being critical controlling factors of ecosystem dynamics.

Simultaneous ground-based process measurements, tower-based observations, aircraft overflights and satellite imagery will be used to compare, quantitatively, the ecoclimatic processes controlling the exchanges of momentum, water, energy and gas fluxes between the forest surface and the atmosphere. Three intensive, coordinated field campaigns will be conducted during the growing season, with a possible fourth being added for the shoulder (late winter) season. Simulation models of ecosystem productivity and C cycling will be used to synthesize and interpret the nested observations. Canadian scientists are planning a

longer term extension of the BOREAS project with a broader transect through the two BOREAS sites in order to study the ecosystem dynamics on broader scales of time and space.

Mike Apps is a senior research scientist with Forestry Canada, at the Northern Forestry Centre (5320 - 122 Street, Edmonton, Alberta T6H 3S5, Canada). He is a member of the Science Steering Committees of both BOREAS and NBIOME (a Canadian project within the NASA Earth Observing System program) and is responsible for providing national scientific coordination of the climate change research program of Forestry Canada, as well as the Carbon Budget Model of the Canadian Forest Sector. He has been with Forestry Canada for 10 years, the last 5 of which have been devoted to forest ecosystem modelling.

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