

REGIONAL TO GLOBAL TEMPLATE: HIGH LATITUDES AND GLOBAL CHANGE

The northern high latitudes are indisputably undergoing rapid rates of human and climate-driven change. It is a region that is being dramatically forced by "global change" and as such, will likely contribute significant feedbacks to the physical, biological and human dimensions of the Earth System. There currently exists a myriad of campaigns to quantify and understand the causes, impacts, interactions and feedbacks between and within terrestrial, cryospheric, oceanic, social and climate systems. Activities range from individual institutional investigations, national and regional campaigns as well as the upcoming International Polar Year (IPY) in 2007. Northern high latitude investigations include but are not limited to understanding the response to global change in terms of carbon storage and sequestration, land hydrological and energy budgets, the climate system response and impacts of climate change on human activities. Such activities will provide insight into local or regional processes, but there does not exist a coherent strategy to integrate the various process, observation and modeling studies in a global context.

The new Earth System modeling project of the IGBP (Analysis, Integration and Modeling of the Earth System – AIMES) can provide a global context to disparate activities over multiple temporal and spatial scales. We propose to develop a collaboration and coordination among the disparate studies as well as among the IGBP and Earth System Science Partnership (ESSP) programs. We propose to specifically integrate the activities that are investigating carbon and water processes, their implications to the climate system and human activities.

As previously mentioned, the northern high latitudes carbon, water, climate and human systems are responding to global change in at least five ways: (1) changes in carbon storage and sequestration (including CO₂, CH₄, methane clathrates), (2) changes in land hydrological budgets; implications of altered precipitation and evaporation ratios on terrestrial runoff with regard to salinity gradients, permafrost, etc., (3) impacts on natural resources in human communities, (3) potential changes in thermohaline circulation through surface warming, changes to the salinity gradient and altered CO₂ uptake, changes to ocean solubility and uptake rates; (4) changes in high latitude albedo and subsequent positive feedbacks with increased greenhouse gasses; and (5) altered dynamics of extreme events and disturbances.

We propose that AIMES develop a coordination strategy in collaborating with the IGBP Core and ESSP projects and activities outside the international programmes that provides a global context to ongoing and planned terrestrial/aquatic/marine/human high latitude activities that is an integral component of the AIMES Science Plan. An initial survey of various regional and national activities (past, present and planned) includes:

- International Polar Year (IPY; <http://www.ipy.org/>)
- Ecosystem Studies of High Arctic Seas (ESSAS; <http://www.pml.ac.uk/globec/structure/regional/essas/essas.htm>) through the Global Ocean Ecosystem Dynamics project (GLOBEC; <http://www.pml.ac.uk/globec/index.htm>)
- Canadian High Latitude: ArcNet
- Global Terrestrial Network on Permafrost (GTN-P; <http://www.gtnp.org/index.html>)
- Northern Eurasian Earth Science Partnership Initiative (NEESPI; <http://www.neespi.org>)

- Boreal Ecosystem-Atmosphere Study (BOREAS; http://www-eosdis.ornl.gov/BOREAS/bhs/BOREAS_Home.html)
- EuroSiberian Carbon Flux (<http://www.bgc-jena.mpg.de/public/carboeur/projects/eus.html>)

Individual Studies

- Terrestrial, Ecosystem-Atmosphere: McGuire, Oechel, Chapin, Randerson, Apps, Stocks, Harden, Trumbore, Heimann, Schulze,
- Oceanic/Marine: Drinkwater, Ecogreen, Loeng, Sakurai, Sundby, ...
-more.....

AIMES will focus strongly on integrating across scales through regional to global templates in Earth System Modeling and global observations. Data and northern high latitude climate-relevant processes will be coupled to a global modeling framework to facilitate analysis of potential sensitivities and feedbacks. Not even one model has strength in all of the requirements for simulating high latitude feedbacks such as frozen lands, peatlands, wetlands or tundra to taiga vegetation dynamics. Earth System integration across scales and processes in the northern high latitudes is needed to assess the likelihood of major or even de-stabilising feedbacks via the arctic biophysical and biochemical pathways.