Greening of the Arctic: An IPY initiative


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Abstract: One of the key goals of IPY will be to characterize, monitor, and model the rapid and dramatic changes to terrestrial vegetation that are expected to occur across the circumpolar Arctic as a result of climate change. Changes in the biomass of terrestrial ecosystems will likely affect the permafrost, active layer, carbon reserves, trace-gas fluxes, hydrological systems, biodiversity, wildlife populations and the habitability of the Arctic. Changes in green biomass can be expected across the entire bioclimate gradient from tundra to the coldest parts of the Arctic. The Greening of the Arctic (GOA) initiative consists of a group of scientists who are part of four major components that will examine the spatial and temporal trends of greening in the Arctic, how these trends are affecting the indigenous people of the Arctic, and communicate the results of the study to students, scientists, government agencies, and the general public.

Component I: Sea Ice – Land-surface temperature – Greening relationships

This component will examine in detail the 24-year record of greenness across the entire circumpolar Arctic as measured by the normalized difference vegetation index (NDVI) using satellite imagery (AVHRR and MODIS). The study will document historical trends of NDVI, areas of major increases or decreases in the NDVI, and link these trends to changes in sea-ice cover, land-surface-temperatures (LSTs), snow-cover, bioclimate subzones, vegetation type, glacial history, and other variables in a circumpolar GIS database. Modeling studies will use the past trends in NDVI to predict future distribution of arctic vegetation using the BIOME4 model. Transient dynamics of the vegetation will be examined using the ArcVeg model. This component is already funded as an ARCSS Synthesis project.

Component II: Human dimensions of greening on the Yamal Peninsula, Russia

This part of the study is linked to the Circumpolar Arctic Ranger Monitoring and Assessment (CARMAP) project. It will examine the interactions between greening trends, the range and forage of the reindeer of the Nenets people, and the regional sea-ice conditions. The Russian component is funded by the NASA/USDA Land Cover Land-Use Change Initiative and is part of the Cold Land Process in NEESIP (CLPN). NEESIP is the Northern Eurasia Earth Science Partnership Initiative, an interagency research program that is capitalizing on a variety of remote sensing and modeling tools to achieve a better understanding of Northern Eurasian terrestrial ecosystem dynamics.

Component III: Arctic Geobotanical Atlas (AGA)

The AGA is an outreach/education component of the project that uses a variety of tools to help students, educators, scientists, land managers, and the public understand issues related to the greening of the Arctic. Users can download and use online GIS data from the Circumpolar Arctic Vegetation Map and other maps at several sites using the AGA transects, in combination with other remote-sensing products. This component is funded by an NSF grant. Linkage of the project to the University of the Arctic and Integrative Graduate Education and Research Traineeship (IGERT) will also occur in relationship to the human dimensions aspects of the project.

Component IV: North American Arctic Transect (NAAT)

The NAAT proposal is pending in NSF. It would: (1) Create a legacy dataset of baseline information that represents the full range of zonal vegetation types in the Arctic. (2) Coordinate the science and data management of numerous projects interested in using the NAAT within the context of IPY. (3) Communicate the results of the studies through a three-part educational/assessment component that includes an Arctic Field Ecology course, contributions to a new "Arctic Geobotanical Atlas" web site, and a field trip for the 9th International Conference on Permafrost.

The project will serve as a magnet for other studies interested in examining all aspects of change along the Arctic climate gradient. The science part of the project will focus on collecting plant biomass data, which are critical to understanding the causes of a recent large increase in the greenness of the Arctic that has been detected with satellite-based sensors. Biomass, leaf-area, spectral data and other site information will be collected from each location along the NAAT to provide a baseline against which to monitor future changes. The NAAT will be a component of the Arctic Observing Network (ADN) affiliated with the flagship observatory at Toolik Lake, AK.

Literature cited:
Climatic Change Research Program, Whitehorse, Canada; University of British Columbia, University of Alberta, University of Delaware, The Ecosystem Center, Woods Hole, MA

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