Earth System Modeling and Field Experiments in the Arctic-Boreal Zone – Report from a NASA Workshop

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Early climate modeling studies predicted that the Arctic Ocean and surrounding circumpolar land masses would heat up earlier and faster than other parts of the planet as a result of greenhouse gas-induced climate change, augmented by the sea-ice albedo feedback effect. These predictions have been largely borne out by observations over the last thirty years. However, despite constant improvement, global climate models have greater difficulty in reproducing the current climate in the Arctic than elsewhere and the scatter between projections from different climate models is much larger in the Arctic than for other regions. Biogeochemical cycle (BGC) models indicate that the warming in the Arctic-Boreal Zone could lead to widespread thawing of the permafrost, along with massive releases of CO_2 and CH_4, and large-scale changes in the vegetation cover in the ABZ. However, the uncertainties associated with these BGC model predictions are even larger than those associated with the physical climate system models used to describe climate change. These deficiencies in climate and BGC models reflect, at least in part, an incomplete understanding of the Arctic climate system and can be related to inadequate observational data or analyses of existing data.

A workshop was held at NASA/GSFC, May 22-24 2012, to assess the predictive capability of the models, prioritize the critical science questions, and make recommendations regarding new field experiments needed to improve model subcomponents. This presentation will summarize the findings and recommendations of the workshop, including the need for aircraft and flux tower measurements and extension of existing in-situ measurements to improve process modeling of both the physical climate and biogeochemical cycle systems. Studies should be directly linked to remote sensing investigations with a view to scaling up the improved process models to the Earth System Model scale. Data assimilation and observing system simulation studies should be used to guide the deployment pattern and schedule for inversion studies as well. Synthesis and integration of previously funded Arctic-Boreal projects (e.g., ABLE, BOREAS, ICESCAPE, ICEBRIDGE, ARCTAS) should also be undertaken. Such an effort would include the integration of multiple remotely sensed products from the EOS satellites and other resources.