Multi-Disciplinary Research Targets Improved Representation of Arctic Ecosystems in Earth System Models

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DOE Office of Science, Climate and Environmental Sciences Division has a current goal to "Develop, test, and simulate process-level understanding of terrestrial ecosystems, extending from bedrock to the top of the vegetative canopy." Beginning several years ago, Arctic ecosystems were identified by DOE as a target for research investments due to their global importance, climatic sensitivity, and significant knowledge gaps. DOE now has major research investments in Arctic ecology. This session will highlight examples of those investments including the National Laboratory-led Next-Generation Ecosystem Experiments (NGEE) Arctic project and the university-led Carbon in Permafrost Experimental Heating Research (CiPEHR) project.

NGEE Arctic, which is now beginning its third year of research in Barrow, Alaska, is planned as a 10-year effort to deliver a process-rich ecosystem model in which the evolution of Arctic ecosystems in a changing climate can be modeled at the scale of a high resolution Earth System Model grid cell. A multi-disciplinary team is conducting research on carbon and water cycle processes associated with changing landscapes on the Arctic Coastal Plain. These complex and heterogeneous ecosystems are influenced by strong surface-subsurface interactions, topography and water distribution, and resulting effects on vegetation dynamics and biogeochemistry. The challenge here is ultimately one of process integration and scaling - how to extend understanding at core, plot, and landscape scales to the needs of models working at the kilometer scale. This requires the close collaboration of field, laboratory, and modeling research so that the knowledge gaps and structure of current models informs process research and vice versa. NGEE Arctic scientists will present a series of presentations illustrating important aspects of the project and demonstrating how this tight model-process coupling can inform and advance research in this area.

In addition, Ted Schuur will report results from five years of an ecosystem warming manipulation near Eight Mile Lake, Alaska, the CiPEHR project, which was established in 2008 to test hypotheses about expected changes in the carbon cycle as a result of warming temperatures and permafrost thaw. The CiPEHR project uses snow fences coupled with spring snow removal to increase soil and permafrost temperatures and open-top chambers to increase growing season air temperatures. Core measurements include monitoring of soil temperature and moisture, thaw depth, water table depth, and carbon dioxide fluxes, and measurements of plant productivity and phenology, soil and plant nutrient status, methane fluxes, and stable and radioactive carbon isotopes in plants and soils.