Poster #9-11

Implications of SPRUCE Results for the Long-term Carbon Balance of Boreal Peatlands: A Modeling Study Using ELM-SPRUCE

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Uncertainty about land surface processes contributes to a large spread in model predictions about the magnitude and timing of climate change within the 21st century. As components of complex Earth system models such as the Energy Exascale Earth System Model (E3SM), land-surface models provide crucial information about fluxes of water, energy, and greenhouse gases to the atmosphere and oceans. However, the signs and magnitudes of these fluxes depend on multiple competing feedbacks. Global peatlands are an important reservoir of carbon that may be at risk due to climate change and have not traditionally been well-represented in models. The Spruce and Peatland Responses Under Changing Environments (SPRUCE) experiment is applying whole-ecosystem warming to an ombotrophic bog in northern Minnesota to represent a range of possible future conditions and study the ecosystem responses. A version of the E3SM land model, ELM-SPRUCE, has been developed specifically to predict the experimental responses and provide a framework for eventual integration of wetland processes to Earth System models. Specifically, ELM-SPRUCE simulates hummock-hollow microtopography, bog-specific hydrology and Sphagnum moss dynamics, which were previously absent from ELM. Here we calibrate ELM-SPRUCE with observed carbon fluxes, biomass and hydrology. The calibrated model is then subjected to both experimental treatments and long-term climate change. We assess the long-term vulnerability of carbon stocks given the assumptions in ELM-SPRUCE, and the partitioning of carbon dioxide and methane fluxes. We also perform these warming simulations across a range of climates associated with boreal peatlands to place the SPRUCE results in a more regional context.