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**ABSTRACT TITLE:** Development of a Sub-meter Resolution Modeling Framework for Arctic Ecosystems: Coupling CLM and PFLOTRAN and Spatial Scaling Results

**ABSTRACT:** Arctic and sub-Arctic soils currently contain approximately 1700 billion metric tones of frozen organic carbon, approximately 200 times current annual anthropogenic emissions. This carbon is vulnerable to release to the atmosphere as $CO_2$ and $CH_4$ as high-latitude temperatures warm. The NGEE-Arctic project is working to optimally inform process representations in a global-scale model (CLM) with knowledge and understanding gained through direct observation and simulations using a process-resolving model (PFLOTRAN) at sub-meter scales. Polygonal ground, with a characteristic DEM length scale of ~15 m, is a common landscape type that occurs over large parts of Arctic tundra. These ground structures, with high or low centers, dominate the local hydrologic environment, thereby impacting the energy balance, biogeochemical dynamics, vegetation communities, and carbon releases from the subsurface.

In this poster, we first present spatial scaling results of soil moisture in the presence of polygonal features using coupled surface-subsurface flow PFLOTRAN simulations at multiple scales for the study site located near Barrow, AK. We describe the statistical moments of soil moisture fields across spatial resolutions, fractal scaling parameters, and a method to propagate spatial variability based on predicted higher-order moment relationships. Second, we present progress on integrating carbon and nitrogen biogeochemical (BGC) dynamics by implementing a CENTURY-like reaction network in this modeling framework, and the resulting impacts on BGC spatial scaling. Preliminary results demonstrate impacts of abiotic controls (e.g., surface interactions and temperature) on the long-term stabilization of soil organic matter in permafrost conditions. Third, we present preliminary results from the hydrologically coupled CLM-PFLOTRAN model that shows impacts of soil moisture redistribution on the simulated surface energy balance. Finally, we present a framework to extend CLM-PFLOTRAN modeling framework to include subsurface thermal coupling.