Poster #1-22

How Variations in Vegetation Cover, Micro-topography, and Snow Depth Impact Soil Temperature and Respiration in an Arctic Watershed

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Arctic ecosystems are characterized by fine-scale heterogeneity of surface and subsurface structure, with differences in hydrological conditions, soil physical properties, and vegetation cover strongly influencing the distribution of soil carbon content and fluxes across a watershed. This spatial variation poses a unique challenge to upscale soil carbon content and flux measurements from the sub-watershed scale to the regional scales that are used in full-scale climate models. This study focuses on understanding links between surface and subsurface controls on thermal and biogeochemical regimes, and how such links can be used to improve the representation of carbon and nitrogen cycling during the fall and early winter (late shoulder season) in ecosystem models. At a discontinuous permafrost site in a Seward Peninsula watershed near Council, AK, low-altitude Unmanned Aerial System (UAS) images and ground- based measurements were used to investigate links between surface and subsurface properties. UAS-inferred multi-spectral images and a Digital Surface Model (DSM) were used to perform a vegetation classification and hydrological stream flow analysis, and these products were compared with measurements of soil temperature, soil electrical conductivity, and respiration sampled using dark gas flux chambers at multiple points and across multiple years. We found that complex micro-topographical features lead to large inter-site variations in surface wetness regimes that influence vegetation distribution, creating ecotypes that can be distinguished using remotely sensed products and which are characterized by distinct subsurface thermal regimes and methane emissions. Snow packs across the Seward Peninsula were unusually deep during the winter of 2017-2018, contributing to appreciably warmer near-surface soil temperatures the following spring. We found that variations in snow pack depth had the largest effect on interannual variations in growing-season carbon fluxes at the end of the season. In addition, 1-D simulations of water, heat and CO_2 fluxes under the observed atmospheric forcing were performed using *ecosys*, a mechanistic terrestrial ecosystem model. These simulations were used to perform analyses of the effect of soil composition, vegetation cover, and precipitation on subsurface thermal regimes and biogeochemical processes. These simulations show that high snow packs lead to warmer soil temperatures and enhanced CO_2 fluxes during the following late shoulder season. Field data and simulations show that this effect is particularly important in patches of tall shrubs and in micro-topographic lows.