Poster #1-13

Quantifying the Interactions between Soil Thermal and Physical Characteristics, Hydro- geomorphological Conditions and Vegetation Distribution in an Arctic Watershed

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Improving understanding of Arctic ecosystem functioning and parameterization of process-rich hydro-biogeochemical models require advances in quantifying ecosystem properties, from the bedrock to the top of the canopy. In Arctic regions having significant subsurface heterogeneity, understanding the link between soil physical properties (incl. fraction of soil constituents, bedrock depth, permafrost characteristics), thermal behavior, hydrological conditions and landscape properties is particularly challenging yet is critical for predicting the storage and flux of carbon in a changing climate. This study takes place in Seward Peninsula Watersheds near Nome AK and Council AK, which are characterized by an elevation gradient, shallow bedrock, and discontinuous permafrost. We use a variety of ground-based and aerial measurements together to identify the various subsurface hydro-thermal behaviors in the watershed and to evaluate the multi-dimensional relationships between subsurface and surface properties. To characterize permafrost distribution where the top of permafrost cannot be easily identified with a tile probe (due to rocky soil and/or large thaw layer thickness), we developed a novel technique using vertically resolved thermistor probes to directly sense the temperature regime at multiple depths and locations. These measurements complement electrical imaging, seismic refraction and point-scale data for identification of the various thermal behavior and soil characteristics. Also, we evaluate linkages between the soil physical-thermal properties and the surface properties (hydrological conditions, geomorphic characteristics and vegetation distribution) using UAV- based aerial imaging. Data integration and analysis is supported by numerical approaches that simulate hydrological and thermal processes. Overall, this study enables the identification of watershed structure and the links between various subsurface and landscape properties in representative Arctic watersheds. Results show very distinct trends in vertically resolved soil temperature profiles and strong lateral variations over tens of meters that are linked to zones with various hydrological conditions, including the presence of preferential flow paths in the subsurface. The results also show the presence of several meter thick supra-permafrost zones whit presence of unfrozen water year-round. Finally, significant spatial co-variability exists between permafrost characteristics, vegetation, and geomorphology with graminoid covered area corresponding to zones with most shallow permafrost. The interaction between the various compartments is of strong interest to understand the evolution of the landscape and the permafrost distribution. The obtained information is expected to be useful for improving predictions of Arctic ecosystem feedbacks to climate.