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Evaluating Ecotypes as a means of Scaling-up Permafrost Thermal Measurements in Western Alaska.

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In many regions, permafrost temperatures are increasing due to climate change and in some cases permafrost is thawing and degrading. In areas where degradation has already occurred the effects can be dramatic, resulting in changing ecosystems, carbon release, and damage to infrastructure. Yet in many areas we lack baseline data, such as subsurface temperatures, needed to assess future changes and potential risk areas. Besides climate, the physical properties of the vegetation cover and subsurface material have a major influence on the thermal state of permafrost. These properties are often directly related to the type of ecosystem overlaying permafrost. Thus, classifying the landscape into general ecotypes might be an effective way to scale up permafrost thermal data.

To evaluate using ecotypes as a way of scaling-up permafrost thermal data within a region we selected an area in Western Alaska, the Selawik National Wildlife Refuge, which is on the boundary between continuous and discontinuous permafrost. This region was selected because previously an ecological land classification had been conducted and a very high-resolution ecotype map was generated. Using this information we selected 18 spatially distributed sites covering the most abundant ecotypes, where we are collecting low vertical resolution soil temperature data to a depth of 1.5 meters at most sites. At three additional core sites, we are collecting air temperature, snow depth, and high vertical resolution soil temperature to a depth of 3 meters. The sites were installed in the summers of 2011 and 2012; consequently, we have at least two years of data from all sites.

Mean monthly and mean annual air temperature and snow depth for all three core sites are similar within the 2012-2014 period. Additionally, the average air temperature and snow depth from our three cores sites compares well with that of a nearby meteorological station for which long-term data is available. During the study period snow depth was anomalously low during both winters, while mean monthly and annual air temperature was similar to the long-term average the first year and considerably warmer (warm winter) the second year. Our results indicate that it is possible to extract information about subsurface temperature, active layer thickness, and other permafrost characteristics based on these ecotype classifications. Additionally, we find that within some ecotypes the absence of a moss layer is indicative of the absence of near surface permafrost. As a proof of concept, we used this information to translate the ecotype landcover map into a map of mean annual ground temperature ranges at 1 m depth. While this map is preliminary and would benefit from additional data and modeling exercises (both ongoing), we believe it provides useful information for decision making with respect to land use and understanding how the landscape might change under future climate scenarios.