An Evaluation of Ecotypes as a Scaling-up Approach for Permafrost Thermal Regime in Western Alaska

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Introduction

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 changes to 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. Thus, classifying the landscape into general ecotypes might be an effective way to scale up permafrost thermal data.

Methods & Study Area

We selected an area in Western Alaska, the Selawik National Wildlife Refuge, which is on the boundary between continuous and discontinuous permafrost (Figure 2). This region was selected because an ecological land classification had been conducted and a very high-resolution ecotype map was generated (Figure 3). Using this information we identified 18 spatially distributed sites covering the most abundant ecotypes and three additional core sites (see above). The sites were installed in the summers of 2011 and 2012; consequently, we have two years of data from most sites.

Results

A Cluster Analysis based on the Euclidean distance between the time-series of daily average ground temperature at 1 meter from each site was used to group sites (Figure 5). Our results indicate that it is possible to obtain information about subsurface temperature, active layer thickness, and other permafrost characteristics based on these ecotype classifications (Figure 6).

Climate Summary

- Mean monthly and mean annual air temperature (MAAT) and mean annual ground temperature (MAGT) for the measured period (Figures 3 & 6).
- Mean monthly and mean annual air temperature (MAAT) and average snow depth (Figures 3 & 6).
- Mean monthly and mean annual air temperature (MAAT) and mean annual ground temperature (MAGT) for the measured period (Figures 3 & 6).
- Mean monthly and mean annual air temperature (MAAT) and mean annual ground temperature (MAGT) for the measured period (Figures 3 & 6).

Ground Temperature Analysis

- A Cluster Analysis based on the Euclidean distance between the time-series of daily average ground temperature at 1 meter from each site was used to group sites (Figure 5).
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Discussion

The result of reclassifying the ecotype map (Jorgenson et al. 2009) into a map of MAGT at 1 meter depth for the Selawik NWR.

Figure 9.

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