Geophysical monitoring of hydrological dynamics across an Arctic watershed

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Increasing temperatures are rapidly changing the Arctic ecosystem. Yet, we are missing a predictive understanding of the interactions within the bedrock to atmosphere column that are driving ecosystem evolution and carbon-climate feedback. A critical knowledge gap within these systems are the dynamics of surface water - groundwater interactions, and infiltration and groundwater flow processes, which drive permafrost thaw and biogeochemical processes. Geophysical techniques have been shown to be a valuable tool to assess the intermediate depths (1 - 10's of m) that are particularly important to understanding the impact of climate change on permafrost thaw dynamics and related hydrological dynamics. In this study we compare the results of two geoelectrical monitoring transects that are installed in the lower and upper part of a watershed located in a discontinuous permafrost region, and that are exposed to different temperature and snow regimes.

Given the remote environment, we will first introduce the field setup that allowed us to acquire continuous data throughout the last 3 years. We present the variations in ground conditions and associated changes in data quality, which highlight the expected poor data during the winter season, once the ground is frozen. Comparing the results of the lower and upper monitoring line shows distinct infiltration patterns. The lower transect, which is characterized by warmer temperatures, shows snow infiltration weeks before the upper transect, and a response to rainfall events, which is driven by the distribution of shallow permafrost. The upper transect indicates that summer rainfall events drive distinct infiltration patterns at locations of a deep active layer, as well as variations in the groundwater table. These observations provide additional data that will help in better understanding the complex hydrological processes taking place in discontinuous permafrost environments.