Poster #1-25

Modeling Drivers of Discontinuous Permafrost on a Hillslope Transect

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Recent studies observed increase in the discharge of Arctic rivers; some hypothesize that this increase is due to thawing and discontinuous permafrost. Understanding conditions resulting in the loss of permafrost, along with the path from continuous permafrost to discontinuous permafrost to seasonally frozen ground, is important to test this hypothesis. In particular, how will changes in permafrost thermal conditions affect subsurface flow pathways? An open talik is a thawed zone extending through the entire permafrost layer. Open taliks play a critical thermal hydrologic role of water redistribution and heat conductance anomalies, which is likely amplified in sloping landscapes. Understanding how local environmental conditions, such as snow distribution, influences talik formation and the thermal hydrologic response of talik formation is necessary to predict complex thermal, hydrologic, and carbon cycle responses in Arctic systems. We used the coupled surface/subsurface permafrost hydrology model ATS (Advanced Terrestrial Simulator) version 0.86 to model an open talik formation by preferentially distributing snow depth along the surface of an inclined modeling domain, representative of a hillslope transect. We used de-trended meteorological data to test talik formation under preferentially distributed snow depth. To test how permafrost thickness affects talik formation we setup the model with five different permafrost thickness ranging from 18m to 45m. For three out of five cases the model developed an open talik allowing water from the seasonally thawed near-surface to be mixed with sub-permafrost waters. In all cases the total water storage in the modeling domain increased. This work indicates that variability in snow depth due to landscape properties can drive significant changes in permafrost hydrology.