

The Effects of Talik Formation on Non-Growing Season Carbon and Nitrogen Cycling Permafrost Ecosystems

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High-latitude warming is expected to increase talik formation -- a unit of unfrozen body in subsurface -- in permafrost across the arctic. The appearance of a perennially unfrozen soil layer represents a drastic shift in subsurface hydrology and is expected to have a significant impact on carbon and nitrogen cycling, especially during the winter months. In this study, we use an integrated ecosystem model, *ecosys*, to investigate how the presence or absence of a talik shifts the connectivity and dependency of key hydrological controls on non-growing season carbon and nitrogen cycling in permafrost ecosystems. Our work focuses on a watershed along the Teller road on the Seward Peninsula in Alaska that has been extensively characterized and monitored by the Next-Generation Ecosystem Experiment (NGEE Arctic). First, we apply a Morris global sensitivity analysis to explore how the observed variation in topography, soil properties, and meteorological inputs across the watershed affects modeled soil temperatures. We then split the model runs into two groups based on the presence or absence of a talik within the run and apply a Bayesian network approach to interpret the complex and interrelated model outputs. Separate Bayesian networks are developed based on the two groups of runs using a constraint-based hill-climbing algorithm. Differences in the network structure are used to interpret how the relationships between key variables for wintertime soil carbon and nitrogen transformations and the exports changes under the talik formation.