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Landscape-driven carbon export from small coastal permafrost watersheds

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Ongoing climate warming in the western Canadian Arctic is leading to thawing of permafrost soils and subsequent mobilization of its organic matter (OM) pool. Part of this mobilized terrestrial OM enters the aquatic system as dissolved organic matter (DOM) and is laterally transported from land to sea. Mobilized DOM is an important source of nutrients for ecosystems as it is available for microbial breakdown, the consequent turnover of the dissolved organic carbon (DOC) fraction of DOM serving as a potential source of greenhouse gases. We are beginning to understand spatial controls on the release of DOM as well as the quantities and fate of this material in large arctic rivers, but these processes remain systematically understudied in small, high-arctic watersheds, despite the fact that these particular watersheds experience strongest warming.

We sampled soil (active layer and permafrost) and water (porewater and stream water) from two small catchments along the Yukon coast, Canada, during the summers of 2018 and 2019. We assessed the organic carbon quantity (using DOC and soil OC content), quality (d^{13}C-DOC, C/N ratios and optical properties including components modelled with EEMs-PARAFAC), the turnover of DOM through incubation experiments as well as nutrients and stable water isotopes. We classify and compare different landscape units by quantitative and qualitative change across gradients from soil stocks down to the catchment outflow.

Our results show that substantial variation in DOC concentrations exists among various landscape units as well as between active layer and permafrost. We find high soil carbon stocks and leaching potentials from these coastal tundra soils. Moreover, we find that permafrost DOM is utilized rapidly upon thaw. Using remote sensing-based landscape classification, we are planning to upscale carbon and nutrient fluxes for the panarctic coastal zone to account for small yet

numerous high-arctic watersheds in lateral terrestrial OM transfer from land to sea Under current climate projections and with continued permafrost thaw altered lateral fluxes may have profound impacts on the arctic aquatic ecosystem and arctic carbon cycling.