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Enhanced Constituent Fluxes in the Sagavanirktok River on the North Slope of Alaska During the Summer Thaw Season

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The presence of permafrost and seasonality of precipitation and flowing water in high-latitude watersheds drives distinct seasonal patterns in surface water biogeochemistry. Constituent fluxes in and export through Arctic rivers are driven by seasonal transitions during the spring freshet and fall freeze-up, critical periods for quantifying fluvial exports to the coastal ocean. Regional changes in climate on the North Slope of Alaska has led to changing weather patterns, altered hydrogeologic processes, and enhanced disturbance and perturbation of tundra landscapes underlain by permafrost during the summertime open water thaw season. This can affect surface water biogeochemistry and constituent fluxes in streams and rivers that drain tundra landscapes. Freshwater discharge measurements and surface water samples were collected in June – October 2019, 2021, and 2022 from the Sagavanirktok River, the second largest river on the North Slope of Alaska, and from tundra streams that discharge into the river. Samples were analyzed for rare earth elements (REE), minor trace metals, dissolved organic and inorganic carbon (DOC and DIC), and DOC and DIC stable carbon isotope composition. Results reveal variability in surface water chemistry in the Sagavanirktok River during open water seasons that can be related to summertime thaw of seasonally frozen soils and permafrost, regional precipitation patterns, and discharge. Altered surface water REE chemistry and elevated concentrations of iron (Fe) and DOC were observed in the Sagavanirktok River following extreme precipitation on the transitional tundra in the peak of the open water season (2019 and 2022). Mixing estimates performed using end-member constituent concentrations and stable isotope values suggest pulsed inputs of tundra-sourced materials through tundra streams that discharge into main-stem river. Estimated fluxes of Fe and DOC through the Sagavanirktok during subsequent high stream and river discharge were of similar magnitude to those observed during the spring freshet. Results from this study suggest that as the regional climate changes, inputs of tundra-sourced materials to Arctic rivers like the Sagavanirktok River during periods of high hydrologic connectivity following extreme precipitation and high discharge events in the open water thaw season may significantly alter annual constituent fluxes and inputs of materials to the coastal ocean.