**Title**: **Investigating Riverine Freshwater and Dissolved Organic Carbon Exports Across the Western Arctic Through Integration of Measurements and Modeling**

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**BER Program: ESS**

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**Project Abstract**:

This project aims to advance understanding of lateral land-ocean flows of freshwater and dissolved organic carbon (DOC) to coastal zones in Arctic regions. Manifestations of climate change in the Arctic are numerous and include hydrological cycle intensification and permafrost thaw, both expected as a result of atmospheric and surface warming. Field sampling, however, is too often of limited duration to confidently ascertain long-term trends in freshwater and nutrients flows to coastal waters. We use observations and numerical modeling to investigate influences on the fluxes and characterize their spatial and temporal dynamics, export magnitudes, and contemporary and future trends. We recently developed new algorithms for the mobilization and export of riverine DOC in a modeling framework that centers on application of a process-based permafrost hydrological model and digital flow direction network. Model validation leverages data from field measurements, synthesis studies, and modeling studies. The simulations effectively quantify DOC leaching in surface and subsurface runoff and broadly capture the seasonal cycle in DOC concentration and mass loading reported from other studies that use river-based measurements. A marked east-west gradient in simulated spring and summer DOC concentrations of 24 drainage basins on the North Slope of Alaska is captured by the modeling, consistent with independent data derived from river sampling. Nearly equivalent loading occurs to rivers which drain north to the Beaufort Sea and west to the Bering and Chukchi Seas. River basins on the North Slope are characterized by strong north-south spatial variations in runoff and DOC yield, with the former highest across the northern Brooks Range and the latter higher near the coast as influenced by abundant soil carbon stores. Significant increases in surface, subsurface (suprapermafrost), and total freshwater and DOC exports to Elson Lagoon in northwest Alaska are noted over the period 1981–2020. Our results show that increased DOC exports are attributable to warming soils and associated active-layer thickening. Indeed, direct

coastal suprapermafrost freshwater and DOC exports in late summer more than doubled between the first and last five years of the simulation period, with a large anomaly in September 2019 representing a more than fourfold increase over September coastal export during the early 1980s. These changes highlight the need for dedicated measurement programs and modeling studies that will enable improved understanding of climate change impacts on coastal zone processes in Arctic regions.