Arctic biogeochemical and optical properties of dissolved organic matter across river to sea gradients

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Science Question

Arctic landscapes are warming and becoming wetter due to changes in precipitation and the timing of snowmelt, which consequently alter seasonal runoff and river discharge patterns. These changes in hydrology along with thawing of permafrost lead to increased mobilization and transport of terrestrial dissolved organic matter (DOM) to Arctic coastal seas where significant impacts on biogeochemical cycling can occur. Our sampling characterized optical and biogeochemical properties of DOM during high and low river discharge for the Yukon River-Bering Sea system and low discharge outflow of two small Alaska North Slope rivers, Hulahula River and Jago River, into Beaufort Sea.

Analysis

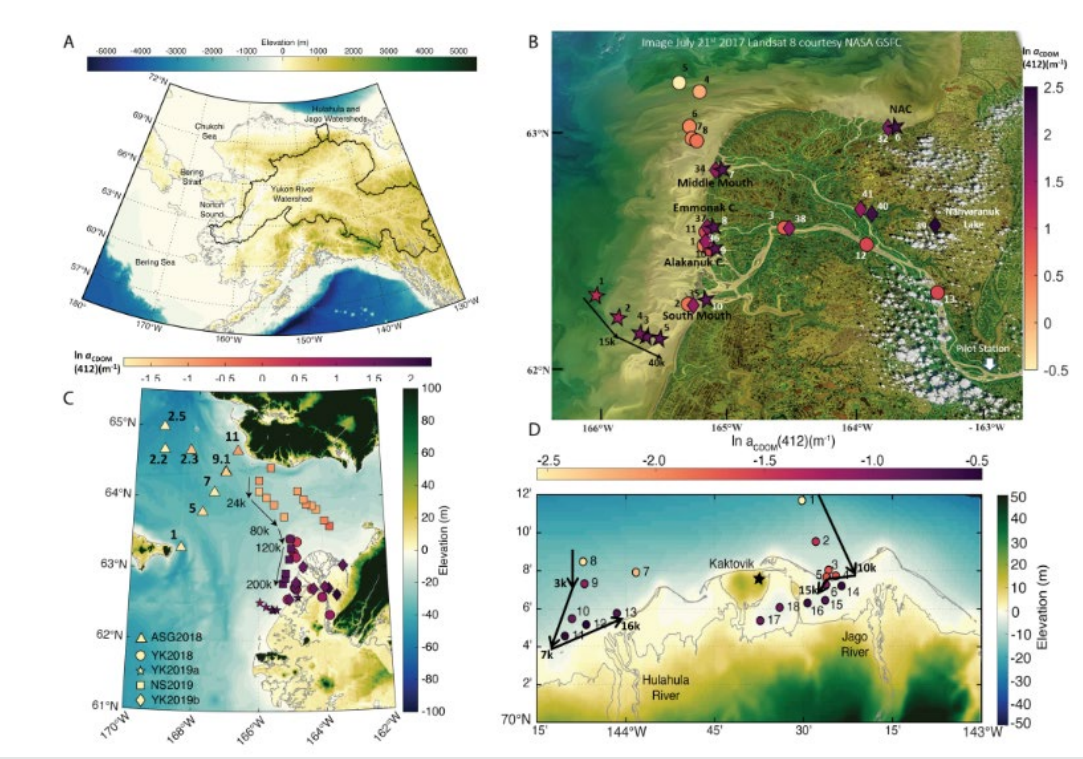
Measurements of CDOM optical properties and DOC concentration allowed detailed characterization of seasonal and inter-river variability of organic carbon.

Results

DOC and CDOM were highly correlated to river flow, and Yukon river had overall higher concentration (and river flow) than North Slope rivers. CDOM to DOC relationships were robust across systems and seasons indicating some universality to CDOM composition despite the very different river hydrology. Yukon River functions largely as a ”pipe” during high discharge exporting terrigenous DOM into coastal plume where physical and biogeochemical transformations take place; during lower flow summer period, river-borne material is subject to both transformations and inputs within the lower river and delta resulting in more degraded DOM reaching the plume waters and coastal sea.

Significance

The rapidly changing Arctic and the potential for river-ocean carbon processes to impact the global carbon cycle makes characterization in these coastal systems paramount. We can now better use remote sensing and modeling capability to understand the large-scale impact of rivers on the coastal Arctic organic carbon cycle.



The study region in Alaska (A) showing the two watersheds, (B) a Landsat-8 image of Yukon River delta and plume extent with sampling locations from 2018 and 2019 colored with the measured CDOM absorption at 412 nm, (C) the northern Bering Sea with CDOM at 412 nm from 2018 and 2019, and (D) the North Slope survey locations in the Beaufort Sea from August 2019.