Peak Constituent Fluxes from Small Arctic Rivers Generated by Late Summer Episodic Precipitation Events

Authors : Shawn G. Gallaher, Lilli E. Hirth

Abstract : As permafrost thaws with the continued warming of the Alaskan North Slope, a progressively thicker active thaw layer is evidently releasing previously sequestered nutrients, metals, and particulate matter exposed to fluvial transport. In this study, we estimate material fluxes on the North Slope of Alaska during the 2019-2022 melt seasons. The watershed of the Alaskan North Slope can be categorized into three regions: mountains, tundra, and coastal plain. Precipitation and discharge data were collected from repeat visits to 14 sample sites for biogeochemical surface water samples, 7 point discharge measurements, 3 project deployed meteorology stations, and 2 U. S. Geological Survey (USGS) continuous discharge observation sites. The timing, intensity, and spatial distribution of precipitation determine the material flux composition in the Sagavanirktok and surrounding bodies of water, with geogenic constituents (e.g., dissolved inorganic carbon (DIC)) expected from mountain flushed events and biogenic constituents (e.g., dissolved organic compound (DOC)) expected from transitional tundra precipitation events. Project goals include connecting late summer precipitation events to peak discharge to determine the responses of the watershed to localized atmospheric forcing. Field study measurements showed widespread precipitation in August 2019, generating an increase in total suspended solids, dissolved organic carbon, and iron fluxes from the tundra, shifting the main-stem mountain river biogeochemistry toward tundra source characteristics typically only observed during the spring floods. Intuitively, a large-scale precipitation event (as defined by this study as exceeding 12.5 mm of precipitation on a single observation day) would dilute a body of water; however, in this study, concentrations increased with higher discharge responses on several occasions. These large-scale precipitation events continue to produce peak constituent fluxes as the thaw layer increases in depth and late summer precipitation increases, evidenced by 6 large-scale events in July 2022 alone. This increase in late summer events is in sharp contrast to the 3 or fewer large events in July in each of the last 10 years. Changes in precipitation intensity, timing, and location have introduced late summer peak constituent flux events previously confined to the spring freshet.

Keywords : Alaska North Slope, arctic rivers, material flux, precipitation
Conference Title : ICMSCC 2023 : International Conference on Marine Sciences and Climate Change
Conference Location : Paris, France
Conference Dates : May 11-12, 2023

Open Science Index, Marine and Environmental Sciences Vol:17, No:05, 2023 publications.waset.org/abstracts/162716.pdf