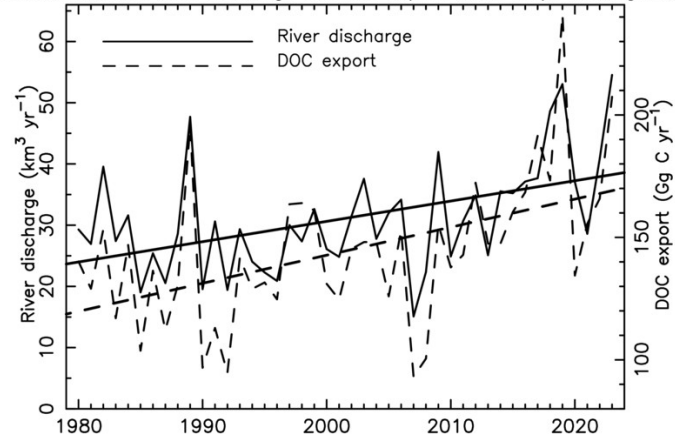


Simulated Annual River Discharge and DOC Export, North Slope Drainage Area



(left) Lagoons, bays, and sounds along the Northern Alaska coast into which freshwater flux and DOC exports are estimated. (right) Annual total river discharge and DOC export from all North Slope drainage areas for the simulation period 1980–2023.

Problem: Understanding how hydrological inflows and manifestations of climate change such as permafrost thaw and hydrological cycle intensification influence estuaries across northern Alaska is limited by a paucity of measured data, necessitating the application of suitably scaled numerical process models.

Method: The Permafrost Water Balance Model was driven with daily meteorological data over the period 1980-2023. Simulations were made across the North Slope of Alaska at 1 km resolution, and validated against DOC concentrations and discharge sampled from rivers and gridded active-layer thickness data.

Finding: Exports to specific lagoons, bays, and sounds demonstrate how landscape composition, terrestrial drainage basin size, and estuary area modulate watershed influence on coastal ecosystems. Freshwater discharge and DOC export increased over the four decades, associated with changes in precipitation and permafrost thaw. Surface and supra-permafrost subsurface fluxes also increased, with pronounced rises in contributions via subsurface flow during summer and autumn. These changes have the potential to substantially impact salinity and trophic conditions along Alaska's Beaufort Sea coast.

Impact: Results highlight the value of model-data syntheses that resolve regional-to-local scale fluxes where observational measurements are sparse, and provides novel quantitative export metrics that will be useful to researchers, resource managers, and other stakeholders.