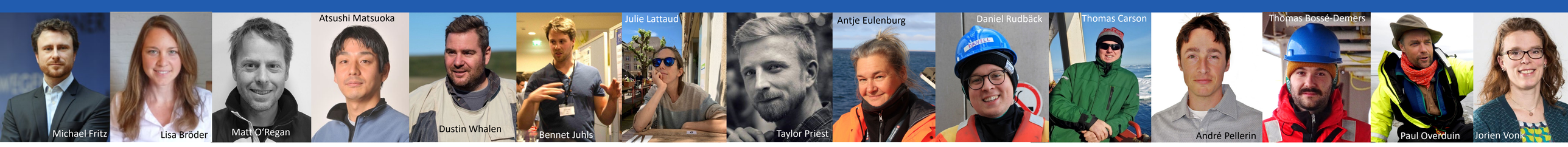
The footprint of permafrost carbon on the Canadian Beaufort Sea Shelf

Michael Fritz[1], L. Bröder[2,9], M. O'Regan[3], A. Matsuoka[4], D. Whalen[5], B. Juhls[1], J. Lattaud[2], T. Priest[6], A. Eulenburg[1], D. Rudbäck[3], Th. Carson[5], A. Pellerin[7], T. Bossé-Demers[8], P. Overduin[1], K. Schwarzkopf[1], J. Vonk[9]

[1]Alfred Wegener Institute, Potsdam, Germany; [2]ETH Zürich, Switzerland; [3]Stockholm University, Sweden; [4]University of New Hampshire, USA; [5]Natural Resources Canada; [6]MPI for Marine Microbiology, Bremen, Germany; [7]Université du Québec à Rimouski, Canada; [8]Université Laval, Canada; [9]Vrije Universiteit Amsterdam, The Netherlands

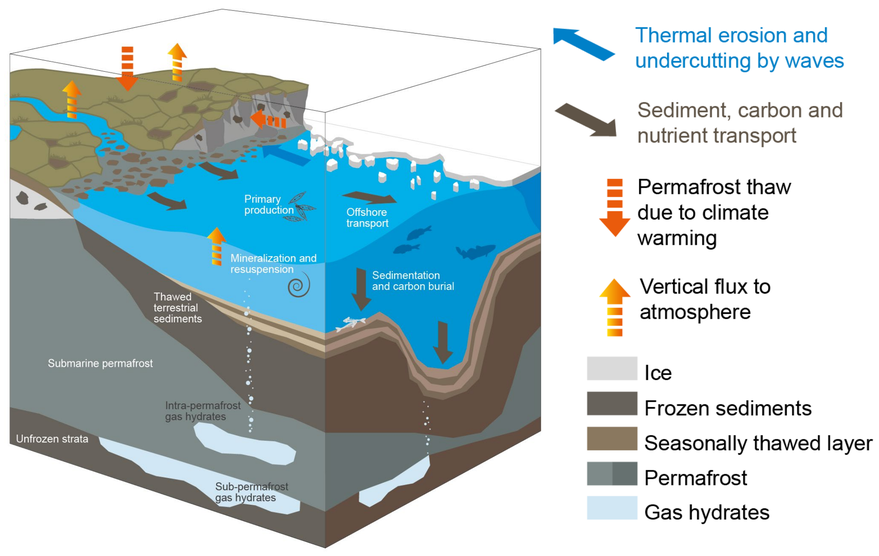


Arctic continental shelves are strongly impacted by rising air temperatures and declining summer sea-ice extent. Permafrost coasts erode rapidly, subsea permafrost thaws, and river runoff is increasing. This together affects associated particulate and dissolved matter fluxes, with direct consequences for the marine environment. The multi-disciplinary PeCaBeau project aims to track the fluxes, transport and degradation of organic material originating from permafrost landscapes along the land-to-ocean continuum.

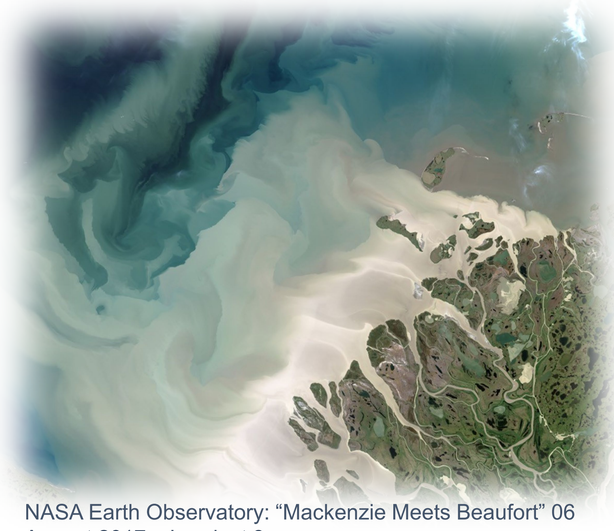
Permafrost coastal erosion

Photo: Don Forbes, Yukon coast, Canada.

Impacts of thaw, erosion and river discharge in the Arctic nearshore zone

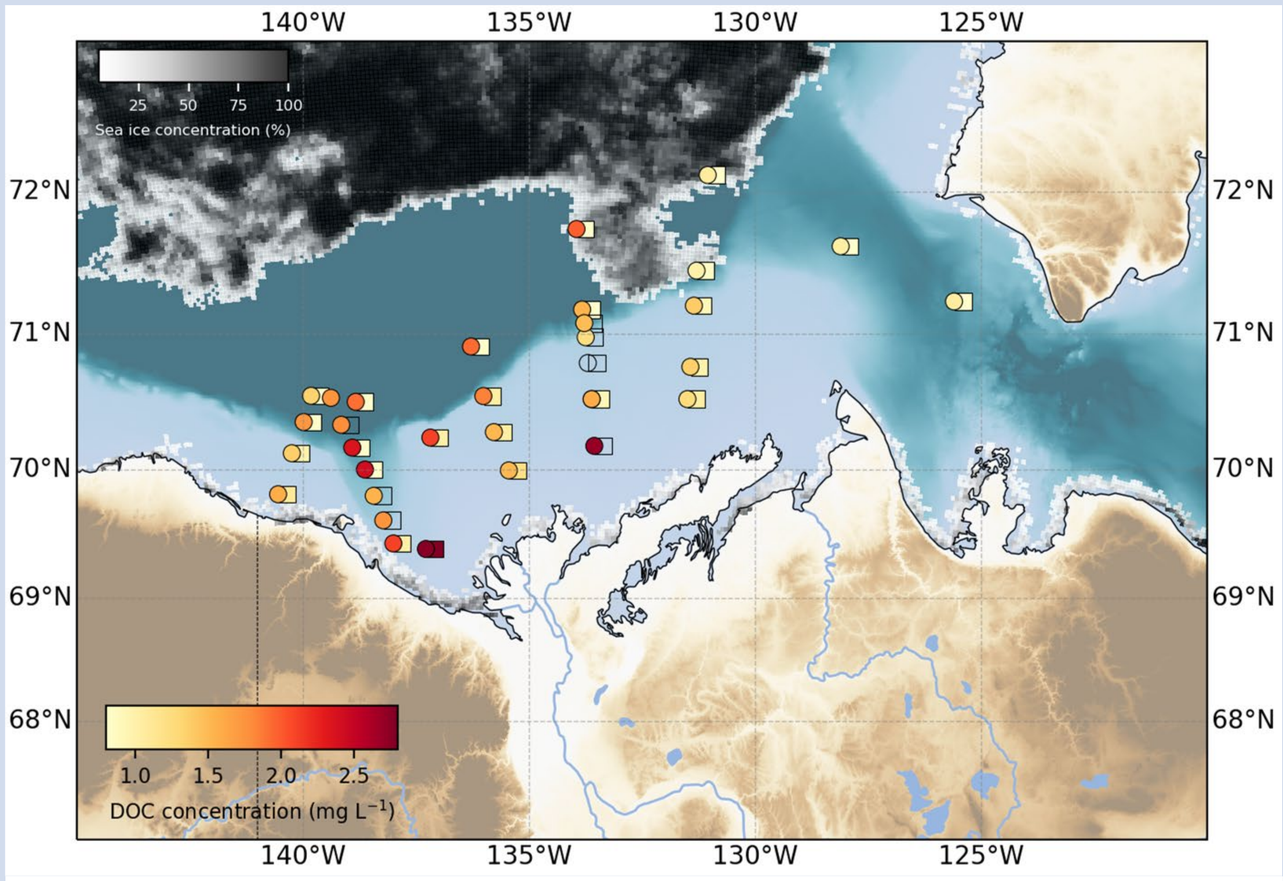


Mackenzie River discharge

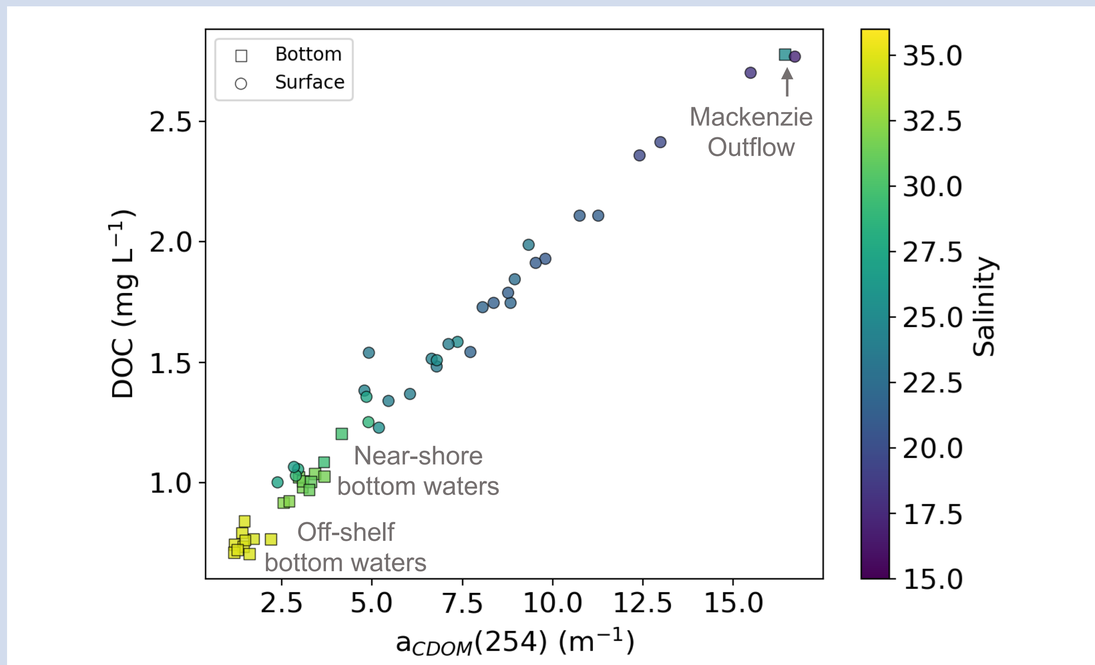


NASA Earth Observatory: "Mackenzie Meets Beaufort" 06 August 2017 – Landsat 8

Water column – Dissolved Organic Carbon



Dissolved organic carbon (DOC) concentrations in surface (◯) and bottom waters (□) displayed as circles and squares, respectively, with higher values for surface waters.



Absorption (at 254 nm) is used to quantify colored dissolved organic matter (CDOM). It can be measured remotely via satellites and serves as a good tracer for DOC, as absorption and DOC concentrations in surface waters (◯) are closely correlated. The correlation between salinity and DOC concentrations indicates that most of the DOC is supplied by fresh river water and thus of terrestrial origin, which is supported by the high values close to the Mackenzie River mouth. Bottom water DOC concentrations (□) are generally low, especially for deeper stations off-shelf.

Water column – Particulate Organic Carbon

Particulate organic carbon (POC) concentrations in surface (◯) and bottom waters (□) generally decrease with increasing distance from the coast. On the shelf, bottom waters display higher concentrations than surface waters, contrary to off-shelf stations.

Radiocarbon content (expressed as fraction modern, F^{14}C) was high for POC in surface waters (◯), indicating a large contribution of recent (marine) biomass. Bottom water POC (□) had significantly lower F^{14}C values, implying higher contributions of older (terrestrial) organic matter, possibly mobilized by ongoing permafrost thaw. Closest to the Mackenzie river mouth, POC concentrations were highest and F^{14}C lowest for surface waters, similar to near-shore bottom waters. Ice-covered stations were low in POC and F^{14}C.