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Title: High resolution freshwater partitioning with continuous seawater isotopic (δ18O, δ2H) tracing

Abstract: Rapid warming has led to large inputs of surface runoff, precipitation, and glacial melt to the Arctic seas. These freshwater influxes affect ocean composition and circulation, which have widespread and varied impacts across the Arctic depending on the freshwater source. It is therefore important to delineate these different freshwater sources from one another, yet this delineation can be challenging using only physical oceanographic measurements (e.g., temperature, salinity).

Here, we present continuous surface seawater isotopic measurements [δ18O, δD, deuterium excess (d-excess)] from a series of Arctic cruise campaigns, focusing on the Beaufort Sea region. We show that the relationship between seawater δ18O and d-excess is a highly sensitive metric that can be used to identify distinct ocean water masses and to delineate different freshwater sources. Paired with standard physical oceanographic measurements, these continuous isotopic observations enable detailed differentiation of sea ice melt and formation from meteoric sources at spatiotemporal variations not achievable through discrete sampling. Given the diverse isotopic signatures of Arctic freshwater sources and relatively high proportion of freshwater in these ocean waters, we are able to further partition unique freshwater inputs from one another – e.g., delineating waters from the Mackenzie and Yukon Rivers, among other smaller inputs from the North Slope of Alaska. These freshwater sources typically overlap in temperature-salinity space, but emerge as distinguishable waters by their δ18O-d-excess signatures, providing new insights on pan-Arctic freshwater inputs and their mixing relationships. We explore spatial and temporal variations in these freshwater contributions in the Beaufort Sea to better understand how freshwater dynamics influence ocean salinity and its broader connection across the Arctic marine system.

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