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Overview of nutrient cycling in the sub-Arctic Atlantic regions: insights from nitrate & silicon isotopes

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The environmental consequences of rapid climate change are already becoming apparent in the Arctic. Polar amplification has led to major loss of sea ice, increasing freshwater run-off and a poleward intrusion of Atlantic waters, thereby affecting biogeochemical cycles. Additionally, while primary production in the Arctic has increased by >50% over the last two decades (Lewis et al., 2020), it is still unclear whether Arctic nutrient budgets can sustain this increase on the long-term. Increased primary production in the central Arctic has the potential to reduce nutrient concentrations of Arctic outflow waters and modify their nutrient ratios, having consequences for the Atlantic nutrient budget.

Primary production in the Arctic is principally nitrogen-limited as a result of benthic denitrification on Arctic shelves. This is contrasted by silicon limitation in water masses originating from the Atlantic basin. To untangle the complexities of dual nutrient limitation and to gain insights into the role of Arctic outflows in controlling nutrient export to the North Atlantic, we examine the cycling of both major nutrients, nitrate and silicic acid, in key Arctic seas and straits. Using stable isotopes of dissolved nitrate and silicic acid, we provide new insights into the mechanisms and factors that control nutrient cycling in the Arctic Ocean: nutrient origins, transformation during transport, as well as the relative contribution of primary production, remineralisation and regeneration to water column inventories.

In this study, measurements of nutrient stoichiometry and stable isotopes of dissolved nitrate and silicic acid profiles are presented across the Fram Strait, Labrador Sea (AR7W transect), and the Iceland Basin and Irminger Sea (the Extended Ellett line and the OSNAP-East program). The measured variability in nutrient isotope signatures across the Arctic gateways brings to light the contribution of Arctic-sourced freshwater to the North Atlantic and its potential impact to the North Atlantic nutrient budget with future changes to primary production in these key regions.