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THE ARCTIC OCEAN NUTRIENT BUDGET; TRANSPORT OF DISSOLVED INORGANIC AND ORGANIC NUTRIENTS ACROSS THE ARCTIC OCEAN BOUNDARIES

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Changes in the hydrological cycle in the Arctic environment have resulted in increased runoff into the Arctic Ocean (AO), affecting the quality and quantity of nutrient inputs. While the effects this may have within the AO interior are not well understood, the ultimate fate of nutrients is of wider relevance as they can potentially support primary production elsewhere. In a recent study based on the pan-Arctic observational array we provided physically based mass-balanced transport estimates of nitrate, phosphate and silicate for the AO, which represent baseline calculations against which other and future estimates can be compared. We computed nutrient transports across the main Arctic Ocean gateways (Davis Strait, Fram Strait, Barents Sea Opening and Bering Strait) using an inverse model-generated velocity field in combination with a quasi-synoptic assemblage of hydrological and hydrochemical data. Oceanic budget computations show that the Arctic Ocean is a net exporter of silicate and phosphate to the North Atlantic (NAtl), supplying -15.7+/-3.2 kmol s^{-1} and -1.0+/-0.3 kmol s^{-1}, respectively. While the nitrate budget is balanced, denitrification estimates in the AO (14-66 kmol-N s^{-1}) imply additional nitrogen sources must exist. Silicate is mostly provided by river inputs, but known sources of N and P seem to account for less than 12% and 7% of the nitrate and phosphate imbalance, respectively. Using dissolved organic nutrient data from the Nordic Seas and the Labrador Current in combination with data from the literature, we address the hypothesis that transports of dissolved organic nitrogen (DON) and phosphorus (DOP) help closing the AO nutrient budget. We characterise nutrient concentrations associated with Atlantic Water inflow and Polar Water outflow and calculate a budget for the upper 100 m of the water column, where organic nutrient mostly occur. Results indicate a DON import of 7 kmol s^{-1}, which would account for 10-50% of denitrification estimates. The net DOP transport is only 0.06 kmol s^{-1}. However, in the Labrador Current both DON and DOP concentrations are high down to 400 m, and when this is taken into account, then the AO becomes an exporter of both DON (-3.2 kmol s^{-1}) and DOP (-1.7 kmol s^{-1}). The emerging pan-Arctic array represents an invaluable scientific platform with the potential to address not only physical oceanography questions, but also biogeochemical questions. In the cases above, generating seasonal data would greatly improve our understanding of the AO nutrient budgets under current and future climate change.