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ARCTIC OCEAN NUTRIENTS AND CARBON BIOGEOCHEMISTRY STUDIES FROM THE EMERGING PAN-ARCTIC HYDROGRAPHIC ARRAY

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Prompted by the rapid changes taking place in the Arctic environment, we have made use of the emerging pan-Arctic observational array to compute transports of nutrients and carbon (DIC) across the main Arctic Ocean (AO) gateways; Davis Strait, Fram Strait, Barents Sea Opening and Bering Strait. Using a quasi-synoptic hydrological and hydrochemical data set from 2005, we have produced physically mass-balanced budgets for the above biogeochemical properties. This has allowed us to infer large-scale biogeochemical processes within the AO (e.g., sinks, sources). We found the AO to be a net exporter of silicate and phosphate, supplying 15.7 kmol s^{-1} and 1.0 kmol s^{-1} to the North Atlantic (NAtl). While the nitrate budget is balanced, denitrification in the AO (14-66 kmol-N s^{-1}) implies additional N sources exist. Silicate is provided mainly by rivers (80%), but known sources of N and P account for <12% and <7% of the nitrate and phosphate imbalance, respectively. We also provide an alternative estimate of AO denitrification (17 kmol-N s^{-1}), consistent with previous estimated lower bounds. Given the nitrate and phosphate imbalances, we investigated the role of dissolved organic nutrients in closing these budgets. We calculate a budget for the upper 100 m of the water column, where organic nutrients 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, the AO becomes an exporter of both DON (-3.2 kmol s^{-1}) and DOP (-1.7 kmol s^{-1}). Concerning DIC, we calculated a summer-time net export of -231 Tg C yr^{-1} to the NAtl, of which -166 Tg C yr^{-1} are estimated to be due to uptake of CO_2 from the atmosphere. We have also estimated an interior transport (below a mixed layer of 50 m) of -61 Tg C yr^{-1}, which -by the application of a carbon famework- is estimated to be largely driven by the biological carbon pump. In terms of dissolved inorganic nutrients and DIC, our studies provide baseline calculations against which other and future estimates can be compared. In terms of dissolved organic nutrients, questions still remain. The emerging pan-Arctic array represents an invaluable scientific platform with the potential to address not only physical oceanography questions, but also biogeochemical questions of relevance to our understanding of the changing Arctic environment.