THE SEASONAL DISTRIBUTION AND CYCLING OF NITROGEN AND ORGANIC CARBON-BASED NUTRIENTS IN THE NORTH SEA

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ABSTRACT

Measurements of dissolved inorganic nitrogen (DIN), organic nitrogen (DON) and particulate organic nitrogen (PON) were made in the North Sea. Surface water concentrations of nitrate, ammonium, DON and PON ranged from <0.1-17.8 μM, <0.1-3.0 μM, 1.5-15.2 μM and 0.2-5.6 μM respectively, with DON the dominant fraction of total N at all times. Seasonal variations showed highest mean nitrate in winter due to water column and sedimentary regeneration. DON concentration showed less seasonality but were generally higher in winter, possibly due to resuspension of sedimentary organic matter. In autumn and spring, phytoplankton DON release was likely to be the most significant source of DON as shown by high concentrations of low molecular weight (LMW) DON and positive correlations of DON with chlorophyll *a*. Low total and LMW DON concentrations during summer are probably associated with uptake of the LMW DON fraction by phytoplankton and bacteria. Surface water concentrations of DOC and POC ranged from 41-318 μM and 1.4-79.1 μM respectively, with a spring maximum and similar mean concentrations at other times. Similar to DON, DOC distributions during autumn and spring were strongly correlated with chlorophyll *a*, suggesting phytoplankton extracellular release was an important DOC source at these times. The release of DON by phytoplankton is further supported by results from daily samples collected from an instrumented moored buoy which showed higher DON concentrations during the spring bloom which subsequently declined with biomass. Phytoplankton culture studies also showed DON release equivalent to 7-17% of nitrate uptake. N uptake rates measured using the ^{15}N isotope method during the fieldwork were in the range of 0.01-208 nM N h^{-1} and 0.10-363 nM N h^{-1} for nitrate and ammonium respectively, with ammonium the preferred substrate at all times. The turnover times of nitrate and ammonium were estimated to be <0.01 to 0.85 days, suggesting extensive N recycling.