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Seasonal nutrient supply and uptake in the Barents Sea

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Main objectives of the study

Investigation of the **supply** of nitrate, ammonium and urea and their **uptake rates** by phytoplankton from early bloom conditions into the post-bloom summer. These rates and the derived ***f*-ratio** provide a measure for **productivity of the ecosystem** over the winter to summer transition.

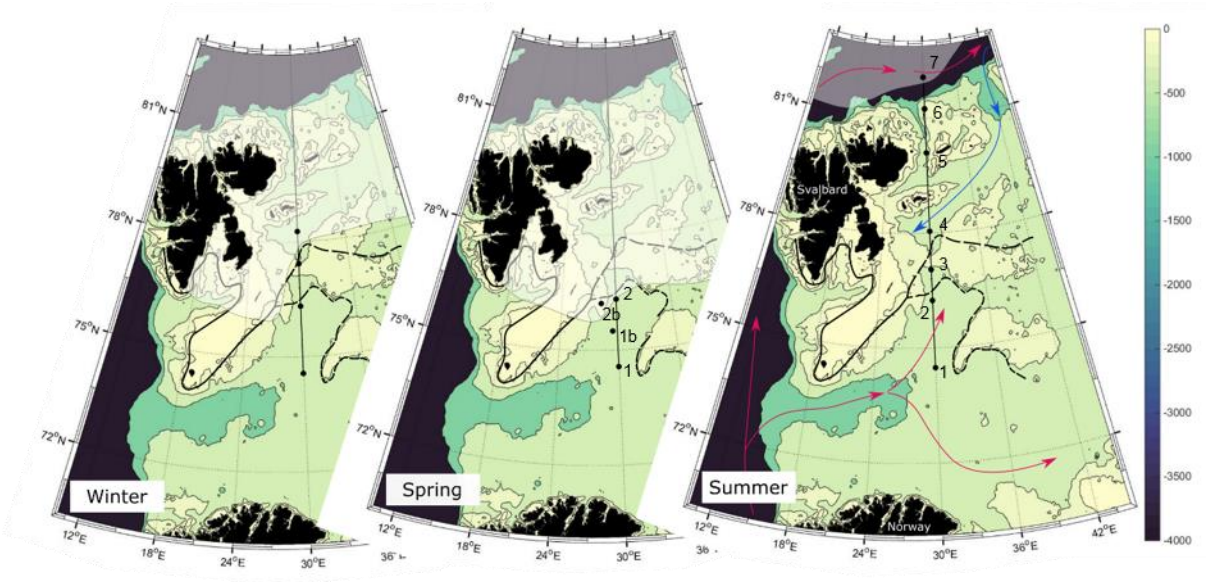

Figure 1. Study site Barents Sea; map with bathymetry. Arrows depict the circulation of the main water masses influencing the investigated transect (Atlantic Water = red, Arctic Water = blue). Water mass circulation and location of the Polar Front (solid line = Polar Front, dashed lines = Southern and Northern Front) are based on Oziel et al./J. Geophys. Res. Oceans (2017). Sea ice cover is indicated by white transparent shading. ^{15}N stable isotope uptake experiments were performed on all stations indicated by black dots (numbered 1, 1b, 2, 2b for spring and 1 to 7 from south to north for summer). The transects along the 30 ° E line of longitude were visited in January, Mid-April to early May and Mid-June to beginning of July 2018 in the framework of Arctic PRIZE (Arctic productivity in the seasonal ice zone).

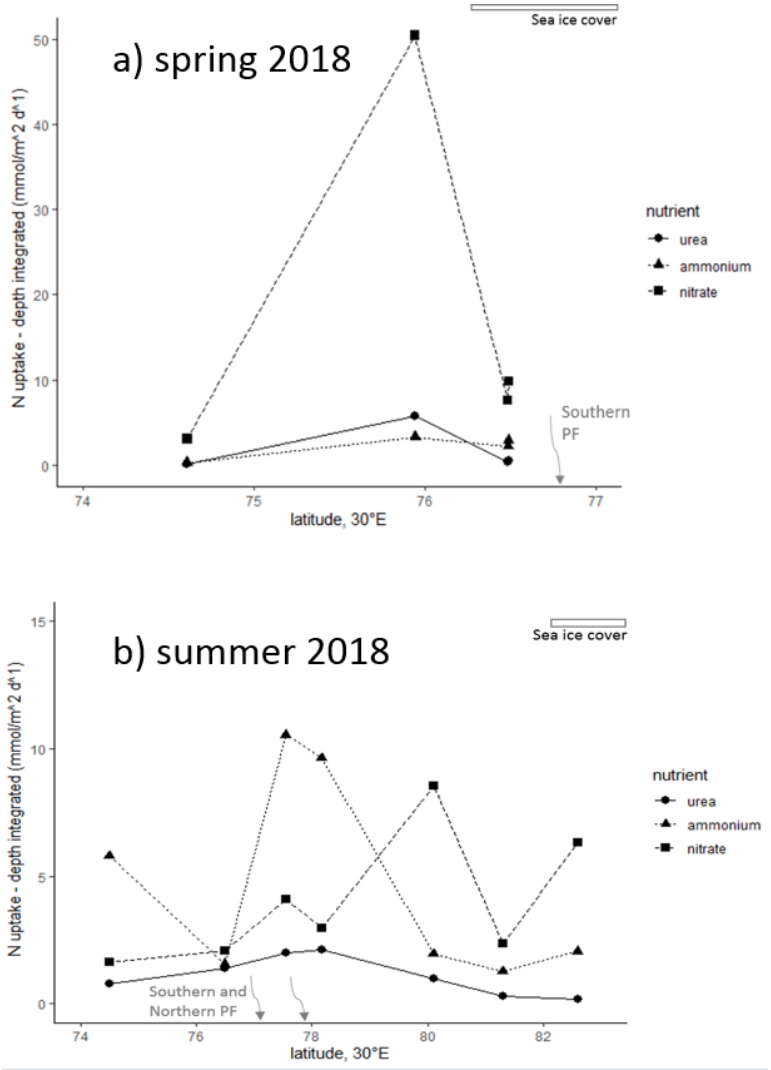

Figure 2. Uptake rate of nitrate, ammonium and urea (in m mol m^{-2} d^{-1}) integrated over two depth (surface depth and subsurface chlorophyll maximum depth) for a) spring (April 2018, note station 2 and 2b are on similar longitude) and b) summer (June 2018) from the southernmost open water station at about 74.5 °N into the ice at 76.5 °N for spring and at 82.6 °N for summer.

depth integrated *f-ratio*

Season	Station								
	1	1b	2	2b	3	4	5	6	7
Spring	0.88	0.85	0.74*	0.74*					
Summer	0.23		0.42		0.27	0.22	0.69	0.32	0.74

Table 1. Estimates of the f-ratio depth integrated over two depths (surface depth and subsurface chlorophyll maximum depth) for spring (April) and summer (June) 2018. Asterisks '' indicate ^{15}N uptake rates were calculated for station 2 and 2b in spring due to missing experimental data. Calculations are based on the ratio in difference between uptake rate in subsurface chlorophyll maximum depth and surface depth at ice stations 6 and 7 in summer where initial conditions for uptake were comparable.*

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Brief Summary

- **Inorganic N** compounds **nitrate** and **ammonium**

Spring: Open water versus ice stations: low uptake rates at the southernmost station 1 (water column not yet stabilised, potential energy anomaly 0.03 J m^{-3}) versus most nitrate already drawn down at ice associated stations.

Summer: Uptake scenario follows established presumptions with **uptake of ammonium dominating in nitrate limited** southern Barents Sea and **highest uptake rates for nitrate associated with the ice edge** and therefore elevated nitrate concentrations.

- **Organic N** compound **urea**

Spring: Urea concentrations are above detection limit (0.06 µM) and contributing to phytoplankton nutrition at station 1b only (south of the ice edge, dominated by Atlantic Water).

Summer: uptake of urea needs to be considered south of the Southern Polar Front dominated by Atlantic Water; **negligible for *f*-ratio calculation north of the Polar Front** (June 2018).

Exception - station 1 which has been ice free all year round:

- spring bloom later compared to ice associate spring bloom
- new production co-limited by nitrate and silicic acid in summer
- phytoplankton assemblage different to all other stations sampled
- highest seasonal new production (g C m^{-2}) for the period March-June 2018.

For more detailed information or any questions, please get in contact: Judith.Braun@sams.ac.uk

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