

Seasonal variations in the transport and biogeochemical turnover of mainly dissolved organic nitrogen from the Lena Delta to the nearshore Laptev

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Introduction



EISPAC



**Changing
Arctic
Ocean** NERC

CACCOON

 **Helmholtz-Zentrum
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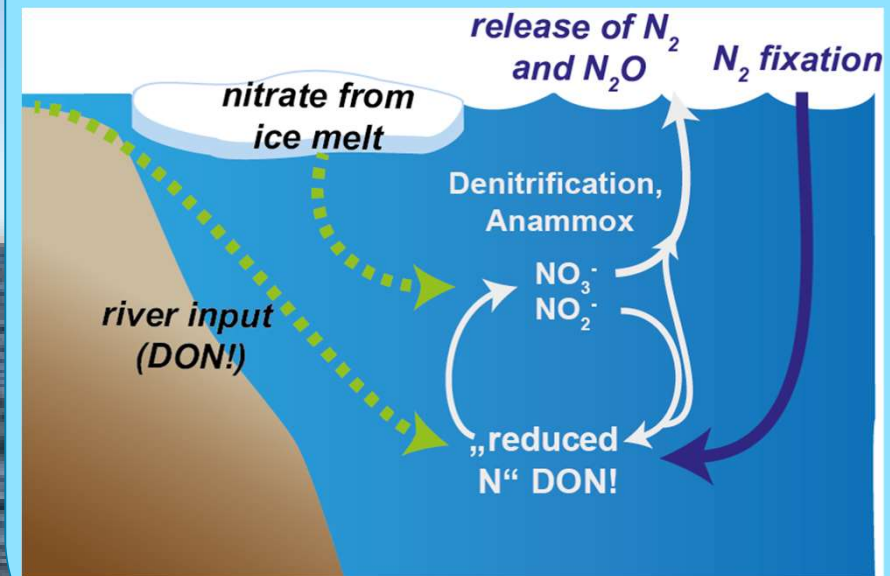


NERC
SCIENCE OF THE
ENVIRONMENT

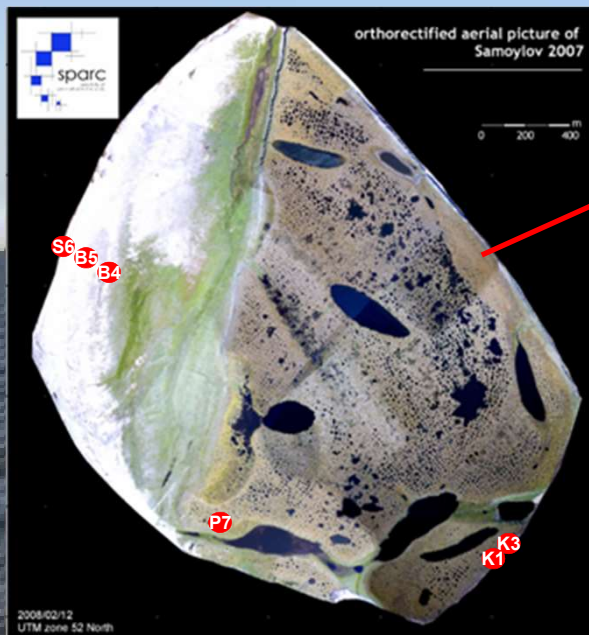
Introduction

- Huge input of fresh water and nutrients from the river into the Arctic Ocean
- Permafrost-affected soils stored high amount of organic matter including carbon and nitrogen
- Nitrogen mainly bonded in organic matter, so that the ecosystems are nitrogen limited
- Global warming and degradation of permafrost release reactive nitrogen
- Higher input into the arctic ocean may stimulate the primary production and further on the food web in the Arctic

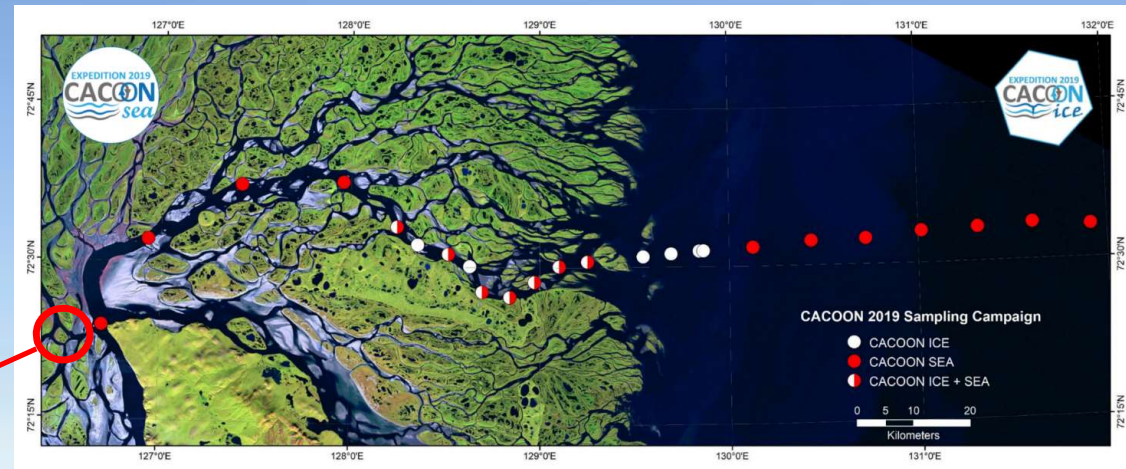
Nitrogen Cycle in coastal Arctic



Soil and Sediment Incubation: Samoylov Island

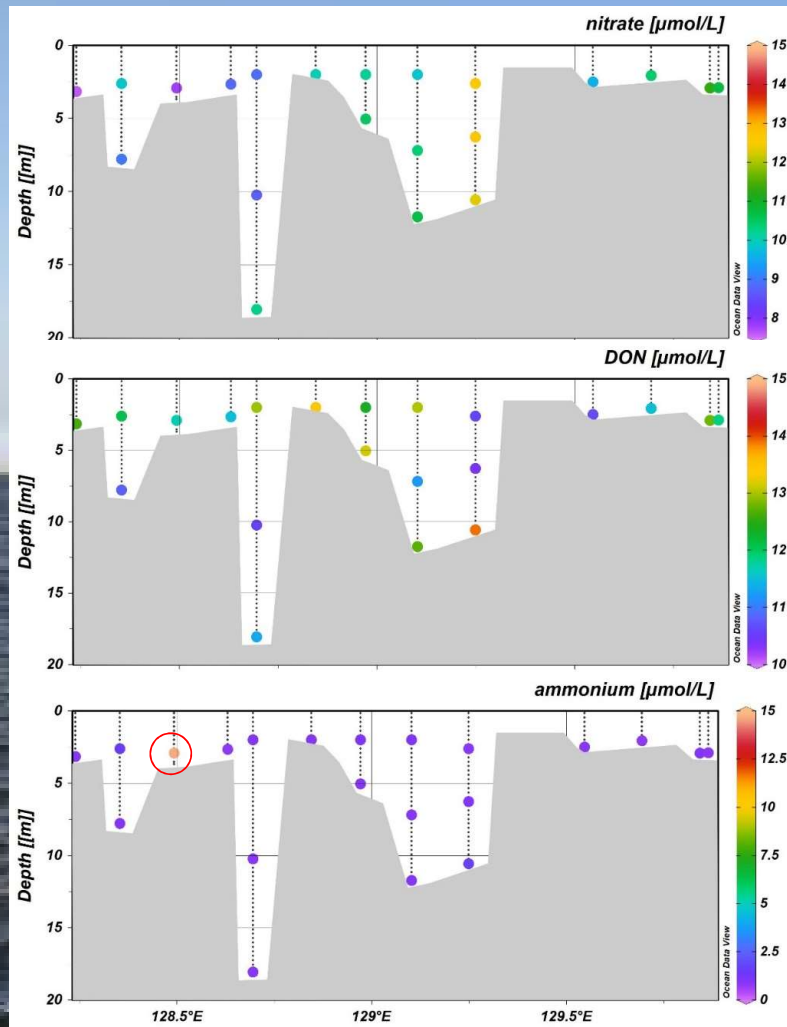


Lena River and Laptev Sea transect



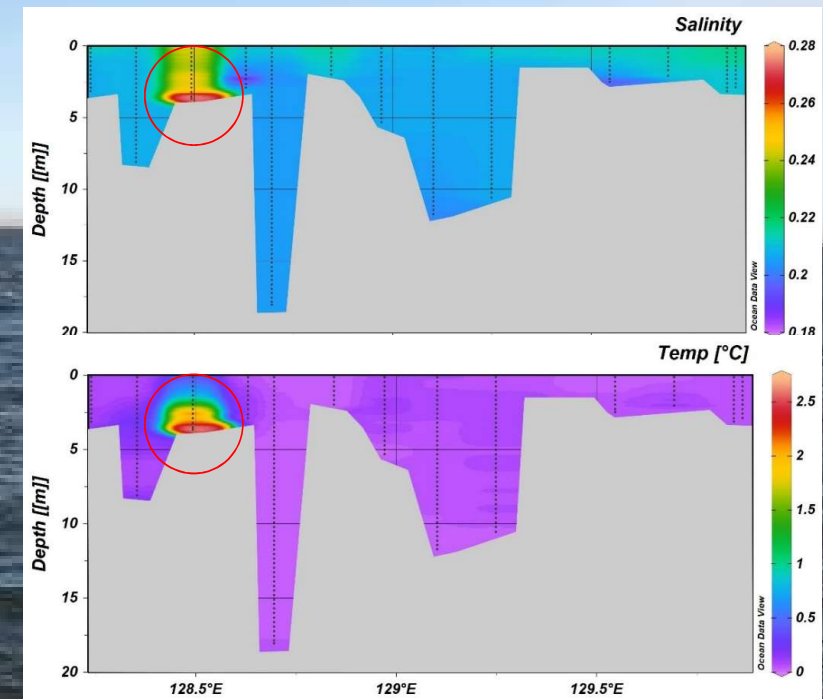
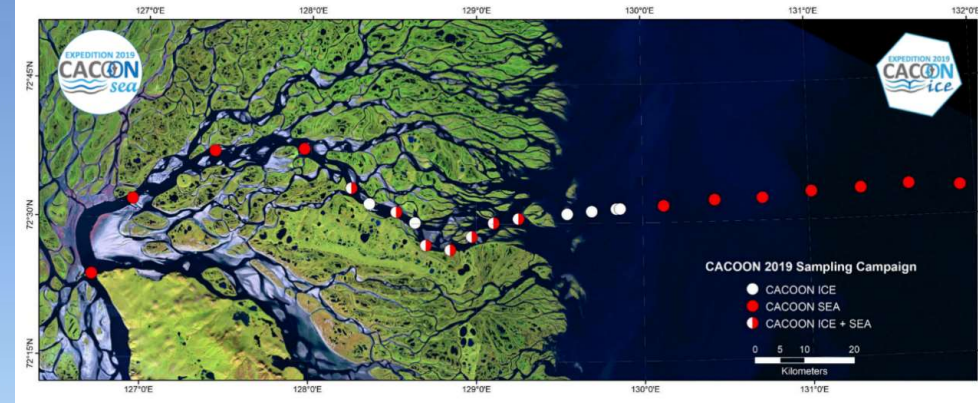
- Quantify the load of nitrogen from the Delta to the coastal waters of the Laptev Sea
- Identify the main form of nitrogen
- Use the stable isotope and nutrient ratios to identify turnover processes
- Soil and sediment incubations to unravel the degradation of nitrogen from the organic mater

Spring cruise (CACOON Ice)

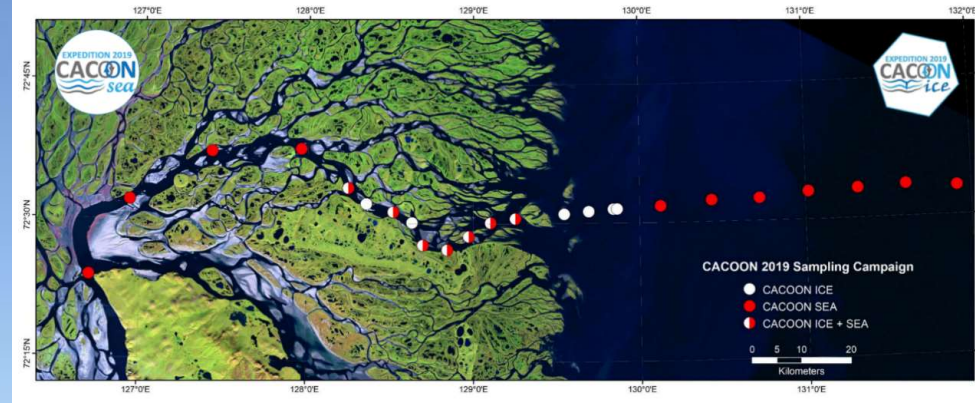


- Slightly increase of nitrate seaward
- Nitrate and DON similar concentration
- Ammonium mostly below detection limit

- Outlier at one station: maybe mixing with sediment (red circle)



Spring cruise (CACOON Ice)



■ Significant differences in the isotope composition

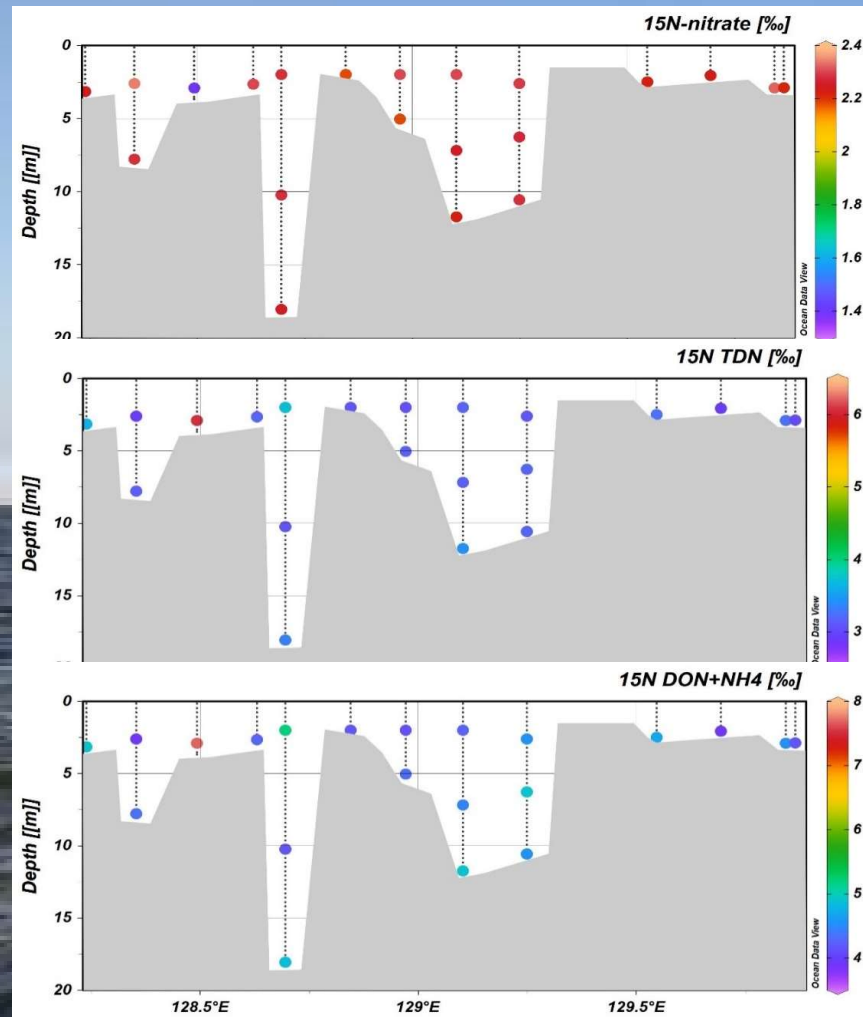
■ Nitrate: $\sim 2,2 \text{ ‰}$

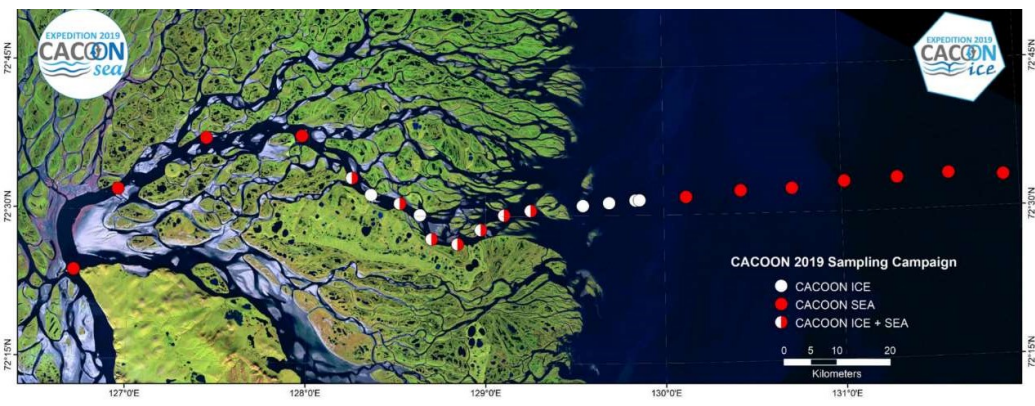
■ TDN: $\sim 3,2 \text{ ‰}$

■ DON: $\sim 4,4 \text{ ‰}$

■ No significant biological activity in Winter

■ Source of nitrate and DON leaching from the permafrost soils





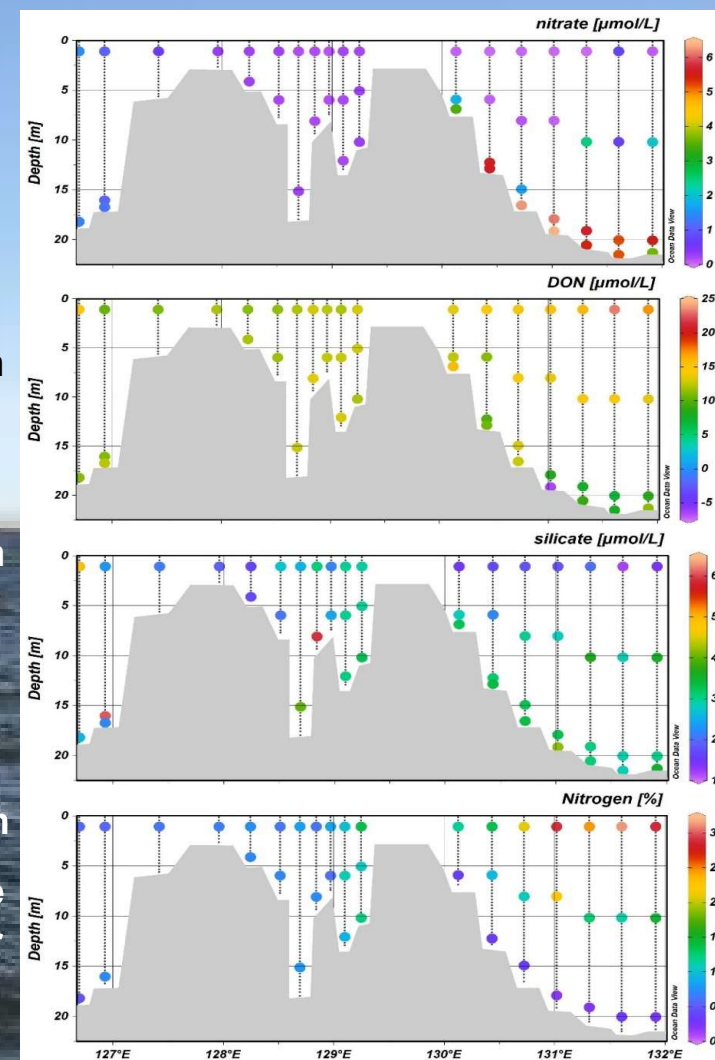
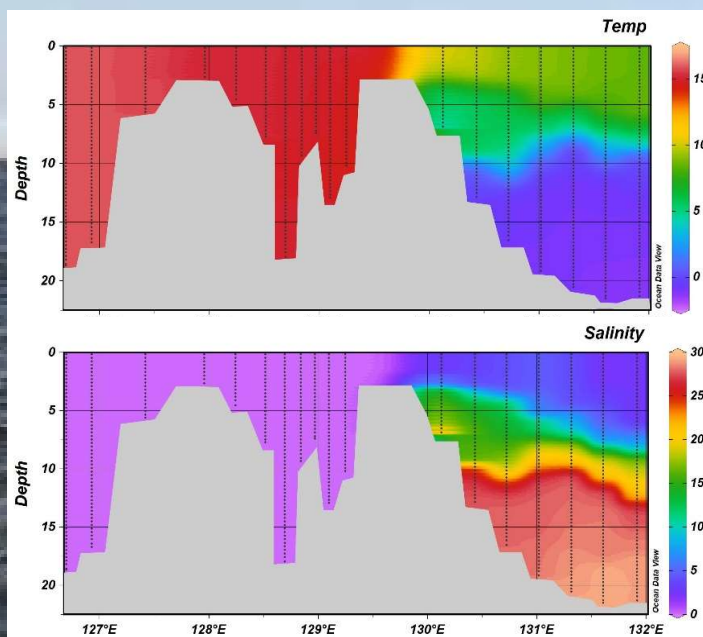
Summer cruise (CACOON Sea)

LENA

- Decrease of nitrate and silicate from the center of the Delta
- Increase of nitrogen in SPM
- Evidence for a phytoplankton bloom in the Delta

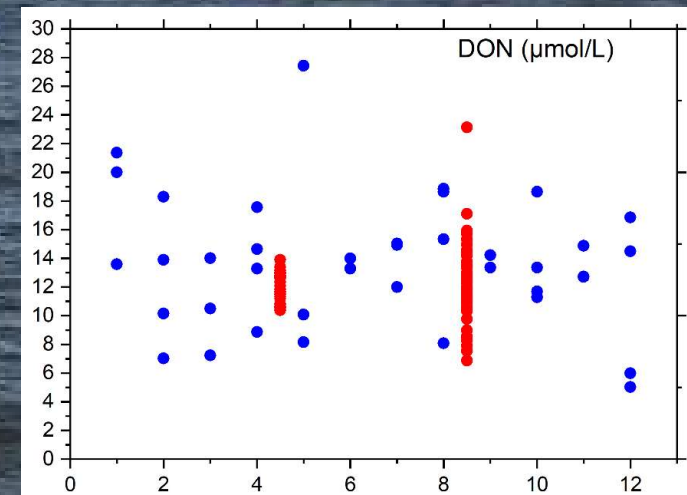
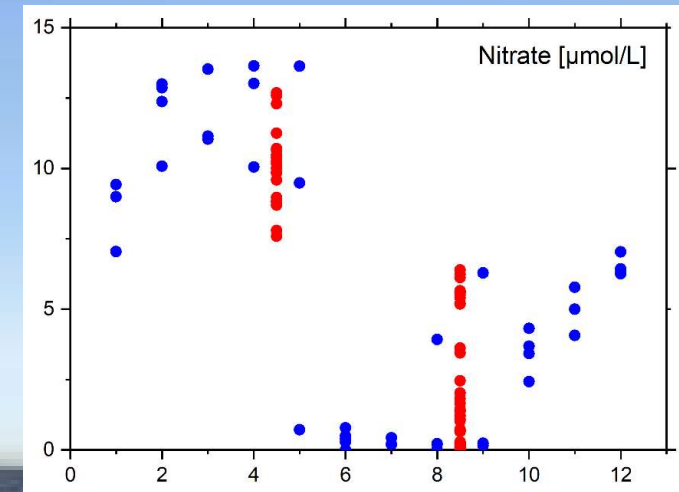
LAPTEV SEA

- Strong stratification
- Marine water silicate and nitrate rich
- No DIN, but DON transport from the Delta into the Laptev sea in summer
- Phytoplankton bloom in the surface water



Comparison to Arctic GRO long-term data

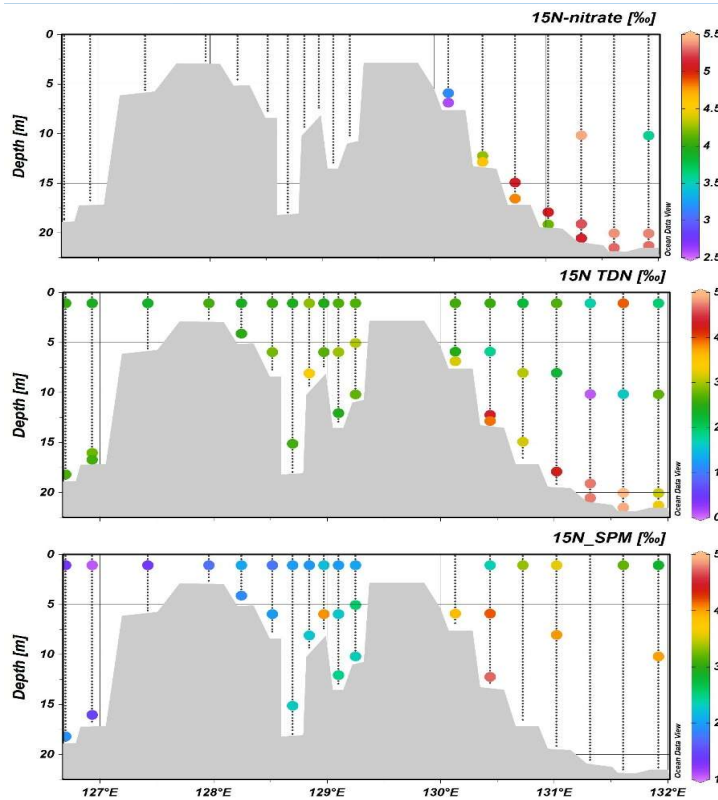
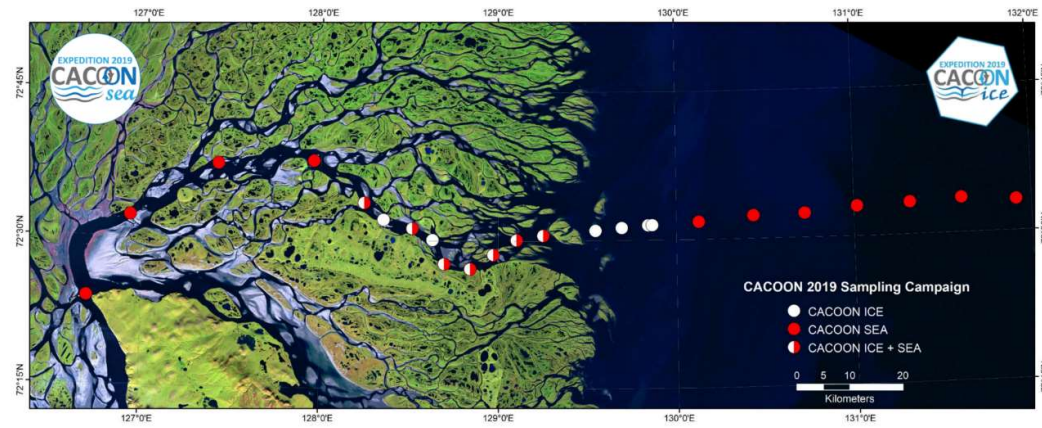
● Arctic GRO
● Lena Winter /summer



Isotopes

- ^{15}N TDN in the river $\sim 2.5\text{‰}$
- Enrichment in the surface water of the Laptev Sea indicate uptake by Phytoplankton
- ^{15}N nitrate in the marine water is enriched up to 5‰
- bloom in the Delta indicate by the enrichment of ^{15}N in SPM

**Lena Delta region
source of reactive
nitrogen**



Soil Incubation in Lena water

P7: Polygon rim

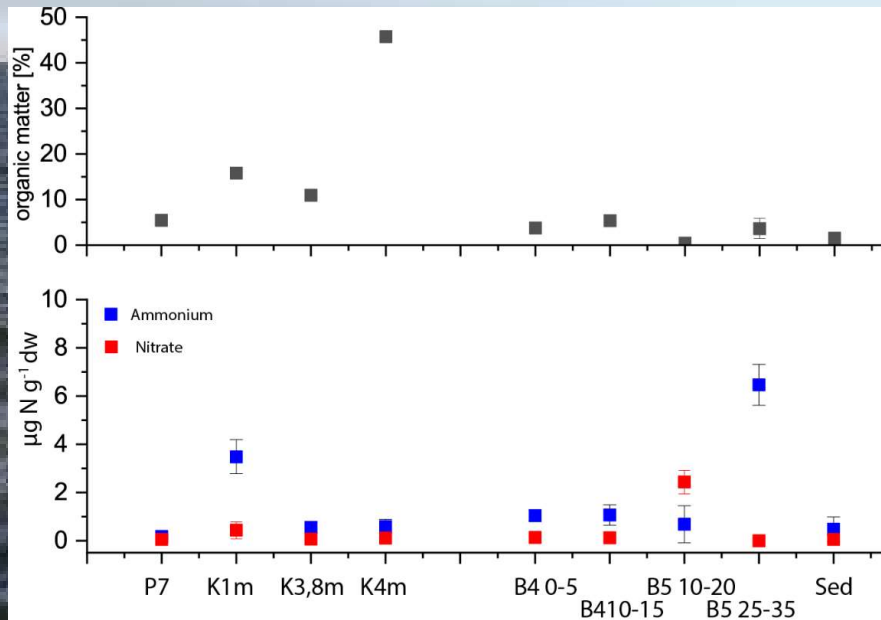
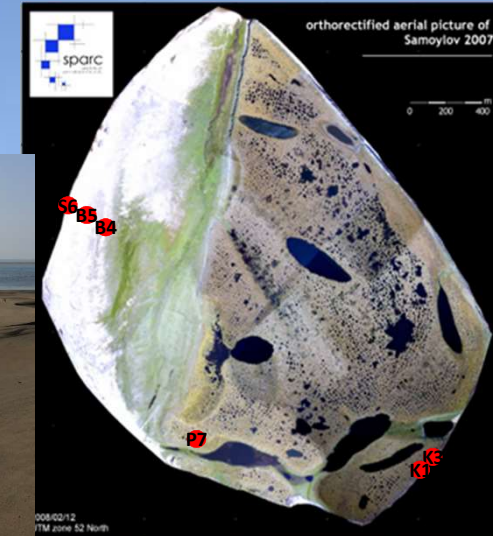
K3: Cliff: Ice wedge

K1: Cliff: Polygon center

B4: Beach with vegetation

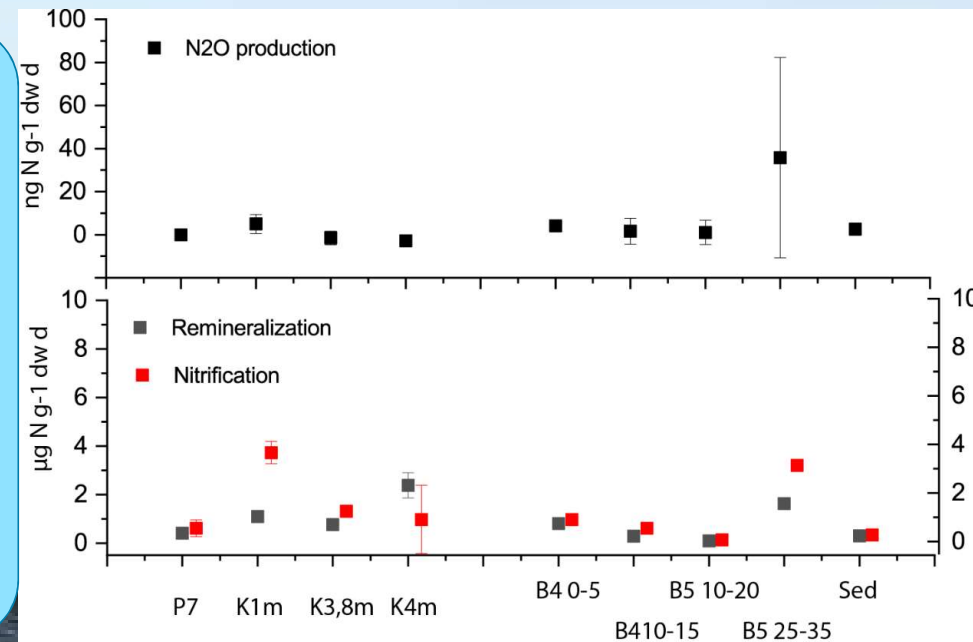
B5: Beach without vegetation

S6: Sediment Lena



Lateral release of remineralised nitrogen into the Lena River

Potential N_2O emission from the organic rich layer at the beach



Take home messages:

- Lena Delta source for reactive nitrogen to the Laptev Sea
 - Main nitrogen form is DON and particulate N, nitrate during ice cover period
 - Release of reactive nitrogen from soils increase potentially N₂O emissions
 - In summer active Phytoplankton uptake indicated by ¹⁵N stable isotope analyses
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- Thawing permafrost will increase the release and load of reactive nitrogen to the Arctic Ocean

Vielen Dank.

If you have any questions:
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