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

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Pan-arctic rivers transport a huge amount of nitrogen to the Arctic Ocean. The permafrost-affected soils around the Arctic Ocean contain a large reservoir of organic matter including carbon and nitrogen, which partly reach the river after permafrost thaw and erosion.

Our study aims to estimate the load of nitrogen supplied from terrestrial sources into the Arctic Ocean. Therefore, water, suspended particulate matter (SPM) and sediment samples were collected in the Lena Delta along a (~200 km) transect from the center of the Lena Delta to the open Laptev Sea in late winter (April) and in summer (August) 2019. In winter, 21 sample from 13 stations and in summer, 51 samples from 18 stations were taken. 9 of these sampling stations in the outer delta region were sampled in both seasons.

We measured organic and inorganic nitrogen and the 15N stable isotopes composition of all three sample types to determine sources, sinks and processes of nitrogen transformation during transport.

In winter, the nitrogen transported from the delta to the Laptev Sea were mainly dissolved organic nitrogen (DON) and nitrate, which occur in similar amounts. The load of nitrate increased slightly in the delta, while no changes to the isotope values of DON and nitrate were observe indicating a lack of biological activity in the winter season. However, lateral transport from soils was a likely source. In summer, nitrogen was mainly transported as DON and particulate nitrogen in the SPM fraction, including phytoplankton.
The nitrogen stable isotope values of the different nitrogen components ranges between 0.5 and 4.5 ‰, and were subsequently enriched from the soils via SPM/sediment and DON to nitrate. This indicates that nitrogen in the soils mainly originates from nitrogen fixation from the atmosphere. During transport and remineralisation, biogeochemical recycling via nitrification and assimilation by phytoplankton led to an isotopic enrichment in summer from organic to inorganic components. In the coastal waters of the Laptev Sea, the river waters are slowly mixed with marine nitrate containing waters from the Arctic Ocean, and a part of the riverine organic nitrogen is buried in the sediments.

We assume that the ongoing permafrost thawing and erosion will intensify and increase the transport of reactive nitrogen to coastal waters and will affect the biogeochemical cycling, e.g. the primary production.