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# The Elbe river estuary including the Port of Hamburg - an important Nutrient filter and source for reactive Nitrogen?

Tina Sanders, Juliane Jacob, and Kirstin Dähnke
Helmholtz Zentrum Geesthacht, Institute for Coastal Research, Geesthacht, Germany(tina.sanders@hzg.de)

The supply of bioavailable nitrogen is crucial to primary production in the world's oceans. Especially in estuaries, which act as a nutrient filter for costal waters the N-cycle has a particular significance and nitrogen sources for primary production and microorganisms are dissolved inorganic nitrogen (DIN, mostly ammonium and nitrate) but also dissolved organic nitrogen (DON) or particulate nitrogen. Reactions in this N-cycle are mainly driven and controlled by microorganisms, with nitrification, the step-wise oxidation of ammonia via nitrite to nitrate, taking a key role in estuarine nutrient regeneration.
Due to fertilisation, the Elbe estuary is loaded with nitrogen. In the past, it acted as nitrogen sink, but today the situation has changed and the estuary has, despite a decrease of absolute DIN concentrations, turned from a sink to a source of nitrogen. Especially the port of Hamburg in the upper Elbe estuary appears to be an active source of dissolved reactive nitrogen, but its role in filtering nutrients is yet to be fully understood and quantified
On 6 cruises from August 2011 to October 2012, we measured nutrient concentrations, [U+F064]15N and [U+F064]18O of nitrate and nitrification rates along transect from the river mouth through the tidal river to the port of Hamburg. Reactive nitrogen in the river is mainly available as nitrate; ammonium was only detectable during winter time and in the port of Hamburg. There in the port, [U+F064]15N and [U+F064]18O of nitrate decrease rapidly downstream. Both the changing isotope signals and high nitrification rates suggest combined nitrification/denitrification in the port of Hamburg, where the riverbed is routinely dredged for deepening and expanding.
Our results show that the Elbe River, and especially the port area, is a significant source of reactive nitrogen for downstream regions. Nitrification, occurring at high rates, actively recycles and adds nutrients to the already elevated anthropogenic nitrate loads in the river. This is underscored by high turnover rates in the port, which obviously actively regulates nitrification and overall N-cycling in the Elbe estuary.