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Nitrogen processes in water column and sediment of two tributaries to the North Sea

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The supply of bioavailable nitrogen is crucial to primary production in the world's oceans. Especially in shelf seas worldwide, high loads of anthropogenic reactive nitrogen in the tributaries have caused problematic eutrophication. The estuaries act as a nutrient filter for coastal waters, and microbial nitrogen turnover and removal can significantly alter nutrient loads. Overall, the estuaries themselves can act as nitrogen sources or sinks depending on the predominant microbial process, environment conditions and geomorphological characteristics.
The aim of our study was to investigate nitrate regeneration and nitrification in the eutrophic Elbe and Ems estuaries, two German tributaries to the North Sea. Both estuaries are loaded with fertilizer-derived nitrogen, but management efforts have started to reduce this load effectively. During transect cruises in the Elbe and Ems estuaries, we measured dissolved inorganic nitrogen, dual stable isotopes of nitrate and nitrification potentials in the water column and in the sediment. We found similarities and clear differences between the Elbe and Ems estuaries. In both estuaries, nitrification played an important role in regenerating the water column nitrate load, with gross rates of up to 7 μmol L-1 d-1 in the water column of the Ems and Elbe estuary. Nevertheless, there was a clear difference in denitrification activity in the sediments resulting in different net nitrification rates. Overall, the highly turbid Ems estuary acted as a nitrate sink but still had a high load of nitrate. The Elbe estuary, in contrast, was a net source of nitrate, even though bulk nitrate concentration was lower than in the Ems estuary.