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Nitrogen isotope and mass balance approach in the Elbe Estuary

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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 coastal waters, microbial nitrogen turnover and removal has a particular significance. Nitrification as well as other nitrogen-based processes changes the natural abundance of the stable isotope, which can be used as proxies for sources and sinks as well as for process identification. The eutrophic Elbe estuary in northern Germany is loaded with fertilizer-derived nitrogen, but management efforts have started to reduce this load effectively. However, an internal nitrate source in turn gained in importance and the estuary changed from a sink to a source of dissolved inorganic nitrogen: Nitrification is responsible for significant estuarine nutrient regeneration, especially in the Hamburg Port. In our study, we aimed to quantify sources and sinks of nitrogen based on a mass and stable isotope budget in the Elbe estuary. A model was developed reproduce internal N-cycling and associated isotope changes. For that approach we measured dissolved inorganic nitrogen (DIN), particulate nitrogen and their stable isotopes in a case study in July 2013. We found an almost closed mass balance of nitrogen, with only low lost or gains which we attribute to sediment resuspension. The isotope values of different DIN components and the model approach both support a high fractionation of up to -25‰ during nitrification. However, the nitrogen balance and nitrogen stable isotopes suggest that most important processes are remineralization of organic matter to ammonium and further on the oxidation to nitrate. Denitrification and nitrate assimilation play a subordinate role in the Elbe Estuary.