

Long-Term Changes in Nitrogen Budgets and Retention in the Elbe Estuary

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Eutrophication remains one of the major factors influencing the ecological state of coastal ecosystems. Coastal eutrophication is in turn intimately linked to riverine nutrient loads. At the freshwater side of the estuary, nutrient loads can easily be quantified but estuarine processes including organic matter import from the sea and loss factors like denitrification can modify the actual nutrient loads reaching the coastal seas.

We quantified and localized nutrient retention processes by analyzing changes of nutrient concentrations along the estuary and constructing nutrient budgets. Two methods –the Officer method based on conservative mixing and a new method based on changes in nitrogen concentrations along the freshwater part of the estuary- were compared using long term records for the Elbe River, a major European waterway. Nutrient budgets and dynamics reveal that nutrient retention processes in the water column play a substantial role in the Elbe River. Overall, ~25 mio mol/day N are imported into the Elbe estuary and ~20 mio mol/day DIN is exported, with obvious variations depending on river discharge and season. A nitrogen loss of about 20% falls within the range found in other studies. Whereas in the 1980s a significant part of the nitrogen input was retained by the estuary, in the 1990s and 2000s most of the imported total nitrogen was exported as DIN. At present, the retention of nitrogen –presumably due to increased denitrification– increases again. As these long-term changes in the retention capacity of the Elbe were supported by both methods, the calibrated station-based approach can now be used to calculate nutrient budgets in estuaries where no or only few transect data are available, such as the Weser and Ems estuary. Our presentation will finally discuss the possible impact of increased phytoplankton import from the Elbe River and increased import of suspended matter from the North Sea ecosystem on estuarine nitrogen dynamics.