



Long-term changes in nitrogen dynamics the Elbe estuary?

Annika Eisele, Tina Sanders, Kai Wirtz, and Justus van Beusekom
Helmholtz-Centre Geesthacht, Geesthacht, Germany (annika.eisele@hzg.de)

Estuarine turnover and retention processes of land-derived nutrients is an essential factor modifying the eutrophication status of coastal ecosystems. Our study aims to identify spatial hotspots of biogeochemical turnover and temporal changes in nutrient retention rates. For this, we adopted or developed three empirical methods for estimating retention rates: (1) the Officer method based on conservative mixing, (2) a new station-based approach calculating changes in nutrient concentrations between monitoring stations, and (3) an evaluation procedure using stable isotopes. We applied the three methods to long-term records for the Elbe River, a major European waterway, revealing that retention in the Elbe estuary peaks during summer, but also displays considerable long-term trends. While in the 1980s we found high retention values especially for nitrate up to $\sim 40\%$, the retention capacity is clearly diminished since the 1990s with maximal retention values of 25%. Nowadays the port of Hamburg is a hotspot of N turnover with high nitrification rates. Nevertheless, due to low oxygen values and high concentrations of organic material in the port area, we assume also denitrification processes to be essential for the estuarine functioning of the Elbe estuary. Our analysis identified discharge, or residence time, resp., POC load, and temperature as dominant factors explaining the variability in N loss along the estuary.