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Consequences of nutrient load reductions for carbon and alkalinity dynamics within the region of freshwater influence of River Elbe

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Since the early eighties of the 20th century nitrogen and phosphorus loads of the River Elbe, a river entering the North European Shelf at the southeastern coast, have decreased by a factor of about four. This resulted in a reduction of the eutrophication status in the adjacent German Bight and the coastal waters west of Denmark. In addition, benthic carbon and alkalinity pools have changed due to 1- changed carbon loads and, 2- changed decay pathways of benthic organic carbon.

We investigate the consequences of observed nutrient and organic loads by rivers with a 3D-biogeochemical model including a 3D-early diageneses model within the sediment for the time 1979 - 2014.

The results show a strong decrease of benthic carbon rather due to decreasing nutrient loads and subsequent autochthonous biological production than changes in organic loads. The export of inorganic carbon from the sediment is related to the magnitude of benthic organic carbon and cannot explain the strong decrease of the benthic POC pool. During the time until the early nineties aerobic degradation increases, whereas denitrification and sulfate reduction as organic matter degradation pathway decreases.

Alkalinity production due to benthic organic matter degradation decreases over the first half of the investigated time interval and keeps constant during the second half. Denitrification and sulfate reduction dominate the mechanisms decreasing the alkalinity export. Benthic nitrification consuming alkalinity strongly increases during the first half of the time dampening the decrease of alkalinity export.