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Response of Elbe estuary ecosystem to changed riverine nitrogen loads

Johannes Pein, Ute Daewel, Emil Stanev, and Corinna Schrum
Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Geesthacht, Germany (johannes.pein@hzg.de)

The present day Elbe estuary ecosystem dynamics are largely determined by high loads of river borne inorganic and organic nitrogen. Similar to most European tidal rivers, the Elbe estuary is highly eutrophied. The eutrophication leads to high primary production in the shallow limnic reach, followed by heterotrophic decay, sedimentation and summertime oxygen depletion in the deepened channel and harbor area. For several decades, the estuary has been subject to adverse trends regarding the forcing of the heterotrophic turnover: While the ambient temperature increases, the nitrogen loads are decreasing (Radach and Pätsch, 2008). The projected long-term and climatic changes imply these trends to continue (Radach and Pätsch, 2008; Huang et al., 2010). In this study we use an unstructured 3D coupled bio-physical model of the Elbe estuary to study the effect of long-term changes of riverine nitrogen loads onto the estuarine ecosystem. As a first step we change the riverine nitrogen forcing i) reducing equally the dissolved inorganic and organic nitrogen loads by 50 % each, ii) reducing the inorganic load and organic loads by 80 % and 40 %, respectively, iii) reducing both inorganic and organic loads towards pre-industrial levels (Serna et al., 2010). Our results indicate a decrease of primary production and heterotrophic turnover under all scenarios. The decrease of primary production is mainly due to reduced diatom growth. Consequently summertime nitrification and oxygen depletion also decrease. This effect is more pronounced in case of equal reduction of inorganic and organic loads than of strong reduction of inorganic nitrogen loads only. Other than diatoms, cyano-bacteria are less affected by applied changes and associated biomass even increases in comparison with the reference case under scenario ii). In the second part of the study we will increase the temperature forcing to determine to which degree the projected increase of ambient temperatures will affect the projected reduced nitrogen turnover.

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