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Impact of internal and external alkalinity fluxes on the carbonate system of the larger German Bight

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Rising atmospheric and in turn oceanic CO_2 concentrations cause an ongoing acidification of the marine environment. The pH variations in coastal- and shelf regions can be up to an order of magnitude higher than in the open ocean. The near-shore effects of acidification are difficult to determine, because of the shallow water column and the tight coupling to the benthic environment. Significant variations in fluxes of total alkalinity (TA) exist in association with inflow of nutrients from rivers and pore-water exchange in sediments. TA is an essential part of the carbonate system and hence vital to understand and reliably attribute to the observed decreasing pH values.

Dependencies of carbon fluxes and TA in the North Sea, a shelf-sea of the eastern North Atlantic, considering especially the TA produced in the Wadden Sea, is under debate (Thomas et al.,2009). Based on observations in the southern North Sea in 2001 and 2002 they estimated in a first approach a flux of 72.5 Gmol TA yr^{-1} from the Wadden Sea into the southern North Sea, generated by anaerobic degradation of organic matter. Especially in summer the data reveal a larger amplitude than could be caused by riverine TA alone.

The aim of our study is to verify the estimates of Thomas et al. (2009) and to investigate the sensitivity of TA on riverine input. We use the ecosystem model ECOHAM4 (Lorkowski et al., 2012) with a prognostic treatment of TA that is based on the "explicit conservative form of TA" (Wolf-Gladrow, 2007) in order to simulate pelagic TA changes due to biogeochemical and physical processes. Our focus is on different approaches of simulating riverine input of TA and DIC for the years 2001 to 2009:

1. Fixed concentrations (endmember values) for riverine TA and DIC
2. Monthly concentrations for riverine TA and DIC based on observations in the Elbe estuary and different observations and calculations in other rivers

We compare our results with observations from 2001, 2002 (Thomas et al., 2009) and 2005 (Bozec et al., 2005) and discuss them against the background of sensitivity on these different treatments. Finally, we recalculate the amount of missing TA that is possibly contributed by the Wadden Sea.

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