EGU21-8648, updated on 16 Oct 2021
https://doi.org/10.5194/egusphere-egu21-8648
EGU General Assembly 2021

Metabolic alkalinity release from the Elbe estuary to the North Sea

Mona Norbisrath[1], Jeannette Hansen[2], Kirstin Dähnke[1], Tina Sanders[1], Justus E. E. van Beusekom[1], and Helmuth Thomas[1]

[1]Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Geesthacht, Germany (mona.norbisrath@hzg.de)
[2]Institute of Geography, University of Hamburg, Hamburg, Germany

The Elbe is the largest river entering the German Bight. Its estuary is a heavily used waterway connecting the sea to Germany's biggest port in Hamburg. The Elbe navigation channel is continuously dredged, and agricultural fertilizer input from the catchment ensuing large phytoplankton blooms in the river Elbe exerts additional anthropogenic pressure. Biogeochemistry in the estuary is additionally governed by the North Sea and its strong tidal cycles, which ensure an exchange of fresh and marine waters.

The aims were to quantify the release of the carbon species total alkalinity (TA) and dissolved inorganic carbon (DIC) along the Elbe estuary, and to estimate the contribution of aerobe and anaerobe metabolic processes. Therefore, we used water samples collected continuously during a cruise in June 2019, to measure TA and DIC, and the stable isotopes of nitrate. We applied mass balances, to characterize the metabolic activity and detect their effect on the carbon species

The Elbe estuary could be subdivided into two parts: 1) an outer marine driven part, which is dominated by conservative mixing, also visible in higher TA than DIC values, and 2) an inner fresh water part in which metabolic processes play an important role.

We found a strong increase in TA and DIC (several hundred µmol kg^{-1}) in the Hamburg port area, with higher DIC than TA values. We unraveled the water column impacts of nitrification and denitrification on TA and DIC by analyzing the stable isotopes $\delta^{15}N\text{-}NO_3^-$ and $\delta^{18}O\text{-}NO_3^-$, and identified water column nitrification as a dominant pelagic process in the port of Hamburg and in the fresh water part further downstream. Because nitrification cannot explain the significant increase of TA and DIC in the port region, anaerobic processes such as denitrification in the sediment also appear to play an important role.