Geophysical Research Abstracts
Vol. 20, EGU2018-14122, 2018
EGU General Assembly 2018

Carbon exchanges between a shelf sea (North Sea) and its intertidal coastal region (Wadden Sea)

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The Wadden Sea, a large network of mud and sand flats, borders the North Sea, along the Dutch, German and Danish coasts. The Wadden Sea influences the carbonate chemistry of the adjacent North Sea regions, but there is still debate over how large this influence is. In the beginning of 2017, a state-of-the-art flow-through total alkalinity (TA) sensor was installed onboard the Hafnia Seaways vessel, travelling between Cuxhaven, Germany and Immingham, UK. This flow-through TA instrument, along with pCO_2, salinity, dissolved oxygen, CDOM and chlorophyll fluorescence FerryBox measurements, provided insights on the influence of the Wadden Sea on the North Sea carbon cycling. This is the first study where continuous alkalinity measurements have been successfully acquired from a moving platform (combined with a FerryBox).
The Wadden Sea had a larger influence on the total alkalinity of the adjacent coastal regions than did local rivers, like the Elbe River. The high frequency alkalinity measurements allowed to identify a seasonal cycle, decoupled from salinity and present along the entire transect in the shallow southern North Sea. This seasonal cycle was more pronounced near the Wadden Sea (150-200 μmol kg-1). In addition, a steep TA gradient (> 100 μmol kg-1 over a tidal cycle) between the near-shore and adjacent coastal regions was observed, likely driven by total alkalinity inputs from the Wadden Sea. This high total alkalinity in the southeastern North Sea, could significantly affect the local carbonate buffer, and thus the regional capacity for pCO_2 sequestration.