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Towards an integrated view of benthic and pelagic processes in the southern North Sea (German Bight)

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The North Sea can be classified as a semi-enclosed shelf on the western-European continent. Atlantic influences are mainly through the Fair Isle current Channel in the North, and through the Strait of Dover in the South. An anti-clockwise circulation prevails, driven by mainly semi-diurnal tides and winds. The German Bight is located in the south-eastern part of the North Sea, and is strongly influenced by continental rivers. The outflow from the rivers Scheldt, Maas and Rhine is carried towards the German Bight with the residual currents. The German rivers Ems, Weser and Elbe directly debouche into the German Bight.
On the shallow shelf, the water column is completely mixed by tidal forces and wind, largely preventing downward flux of particles and instead fostering temporary deposition and resuspension, which influences benthic mineralization. Hence, complex interactions between pelagic and benthic processes occur. Previous budget calculations indicate that the nutrient inventory has to be processed several times to support observed primary production, and, depending on water depth; only 10-20% remineralisation occurs in sediments of the German Bight whereas about 50% of organic matter is remineralised in the sediments of the shallow Wadden Sea.
In this presentation, we use in-situ and ex-situ field data on pelagic and benthic oxygen respiration and benthic nutrient fluxes to assess the intense mineralization activity in the German Bight, the partitioning of benthic and pelagic processes and the factors influencing organic matter mineralization. Measurements of pelagic oxygen respiration based on Winkler titration, in-situ benthic oxygen uptake measurements based on flux-chamber landers and ex-situ incubations of intact sediment cores revealed that benthic remineralisation rates are about an order of magnitude smaller than pelagic rates, in agreement with previous budget estimates. Both benthic and pelagic oxygen respiration show a strong seasonality; with higher oxygen uptake rates in the warm, productive season. During the summer season, oxygen uptake is significantly higher on silty or muddy, organic-rich sediments than on fine sands or gravel. Epi- and infauna, however, increase the benthic oxygen uptake and nutrient fluxes apparently irrespective of the grain size of the underlying lithogenic sedimentary particles or the water depth.
These first results originate from the projects “NOAH - North Sea: Observation and Assessment of Habitats” and “WiMo – Wissenschaftliche Monitoringkonzepte für die Deutsche Bucht / Scientific monitoring concepts for the German Bight”.