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Off shore wind farms change the benthic pelagic coupling in the Belgian Part of the North Sea

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Since Europe enforced renewable energy target figures upon its member states through the implementation of two main European Directives 11 2001/77/EC and 2009/28/EC, the development of offshore wind farms (OWF) has accelerated. Belgium installed OWFs on sandbanks, characterized by permeable sediments, low in organic matter content and a species-poor macrofaunal community with species occurring in low densities.
A detailed monitoring campaign in the immediate vicinity of a wind turbine (1-200m), revealed a significant decrease in median grain size and permeability, coinciding with a 6-fold increase in organic matter content. The observed fining of the sediment is explained by an altered benthic-pelagic coupling in the area. The wind turbines are colonized by an abundant fouling community producing high amounts of detritus and faeces, a continuous additional source of organic matter. The changes in sediment composition, and the availability of additional organic matter resulted in drastic increase in macrofaunal densities (from 1390 ind m-2 to 18600 ind m-2), and a change from a species-poor community to a species-rich community dominated by the ecosystem engineer Lanice conchilega. Large densities of L. conchilega, as observed in our samples, are known to trap fine material from the water column, which can result in a further decrease of sediment permeability in the vicinity of the wind turbines.
A preliminary experiment, where permeable sediments were subjected to artificial fining, showed a decreased penetration depth of advective water currents and a reduced trapping of diatoms by the sediment in finer sediments. Additionally, sediment community oxygen consumption rates, and efflux of NH4+ from the sediment, measured after a simulated phytoplankton bloom, decreased significantly when sediment permeability was reduced.
We hypothesize that the combination of the altered macrofaunal community composition, together with the changes in the physical properties of the sediment matrix, will lead to a change in the biogeochemical properties of the sediment: highly reactive permeable sediments, poor in organic matter will shift towards sediment where organic matter will accumulate. Degradation of organic matter will then no longer be governed by physical processes, but mediated by biological processes (bioturbation, bio-irrigation).