Using a benthic-pelagic coupled hydrobiogeochemical model to assess long-term carbon storage in the sediment of the Southern Bight of the North Sea

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Upon understanding of a huge potential of the coastal ocean to sequester carbon from the atmosphere and therefore its role in mitigation of negative consequences of the human-induced climate change, the scientific community has been trying to assess this potential using ocean models. In this attempt, it came across various challenges, such as using a sufficiently high horizontal and vertical resolution to correctly resolve hydrodynamic and biogeochemical processes typical for the coastal ocean; using a correct forcing at the open boundaries; a proper estimating of a land runoff, particularly through a river network; and a correct parametrization of various processes affecting carbon fluxes in the sediment and in the water column. One of the most challenging parts has been parameterizing the connection between benthic and pelagic realms, due to various processes at the water-sediment boundary, which are hard to measure in the field and calibrate in the model, such as erosion/deposition of particulate matter, and entrainment, release and diffusion of solutes.

Due to its particular geographic location, the shallow, tidal North Sea, surrounded by developed countries, has long been a subject of numerous studies, targeting its carbon storage capacity. Here, we combine a hydrodynamic model ROMS, coupled with a wave model SWAN, coupled with a biogeochemical model of the water column developed by Fennel *et al.* (2006), coupled with a diagenetic model of the sediment bed OmexDia (Soetaert *et al.*, 1996) through a framework HydroBioSed, which is set for the North Sea for a purpose to predict its capacity to store organic carbon until the year 2100, and modified to account for anthropogenic processes, such as building of offshore wind farms, whose biofouling fauna can sequester up to 1 kg of carbon per day from a single foundation, according to the recent estimates. Our coupled model, calibrated and validated using data from satellite imagery, stationary observations and field campaigns, has shown a good skill in hindcasting biogeochemical and physical processes and therefore suitable for long-term predictions of carbon sequestration using forcing from low-resolution Earth system models through downscaling, that is a goal of CE2COAST project (downscaling global change to regional to local coastal ocean systems).

References

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Keywords
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