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Numerical modelling of the benthic-pelagic coupling in coastal marine ecosystems at contrasting sites

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Continental shelves cover less than 5% of the global ocean surface, but play a crucial role in the marine global biogeochemical cycling. Coastal ecosystem dynamics are governed and constrained to a wide extent by the biogeochemical processes occurring in the benthic domain. Such processes define the so called benthic-pelagic coupling (hereafter BPC), i.e. two-way exchange of organic matter (particulate and dissolved) and inorganic compounds. The physically mediated exchanges structuring the BPC are constituted by the sinking and resuspension fluxes of particulate organic matter and by the diffusion of inorganic nutrients. Despite its importance and the continuous enhancement of model resolution, the BPC in global marine ecosystem models is generally roughly approximated. Moreover, observational data focusing on the BPC dynamics are fairly scanty in time and space, thereby hampering model parameterization and validation. The main objectives of this study are to develop and test a numerical model addressing BPC processes and to evaluate ecosystem dynamics in marine areas with different climatic and ecological characteristics. In particular, we here focused on two key interaction processes: the sinking velocity of particulate matter and the diffusive fluxes of inorganic dissolved nutrients at the benthic-pelagic interface. The benthic sub-model has been calibrated accounting for the complex pelagic food web and for the main ecological and physical characteristics of continental shelf areas in different sites: Gulf of Trieste (Italy), St. Helena Bay (South Africa), Svinoy Fyr (Norway). At each study area, the one-dimensional coupled BFM-NEMO modelling system was setup by prescribing temperature and salinity vertical profiles in NEMO, while the shortwave radiation acts as a primary forcing of BFM. Model results have been validated with available in situ data.

Sensitivity tests has been performed to investigate the role of the BPC exchanges in determining the pelagic biogeochemical cycles and to carry out a comparative analysis accounting for each site characteristics.