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Modeling the biogeochemical dynamics of the Northern Adriatic Sea with an explicit benthic-pelagic coupling

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A high resolution three-dimensional (physical-biogeochemical) numerical model of the Northern Adriatic Sea has been implemented by coupling the European general circulation model - NEMO (Nucleus for European Modeling of the Ocean, https://www.nemo-ocean.eu/), with the marine biogeochemical model BFM (Biogeochemical Flux Model, bfm-community.eu/).

The modeling system is implemented with a horizontal resolution of about 800 m and a vertical resolution of 2 m, in z coordinates. The NEMO model is off-line nested at its open boundary with the Mediterranean Sea physical model of the Copernicus Marine Environment Monitoring Service (CMEMS, http://marine.copernicus.eu/).

The BFM component of the modeling system now includes a detailed and explicit representation of the benthic biogeochemical cycling (benthic fauna, organic matter, nutrients), as well as the dynamics of the benthic-pelagic processes.

The inclusion of the benthic dynamics in the 3D biogeochemical modeling of a shallow coastal basin, such as the Northern Adriatic Sea, represents an innovative application in the field of coastal and shelf biogeochemistry, since benthic biogeochemical processes can significantly constrain the coastal environmental dynamics.

Simulations have been performed in hindcasting mode with interannually varying physical (surface heat and water fluxes, including river runoff) and biogeochemical (river nutrient load) forcing. Results are validated against available observations from in situ and satellite platforms for sea surface temperatures, chlorophyll-a and dissolved inorganic nutrients, in order to explore the sensitivity of the pelagic environment to the inclusion of an explicit benthic dynamics and to evaluate issues related to model coupling and error/prediction limits.

The study is carried out in the framework of the European Project H2020 "ODYSSEA" (Operating a network of integrated observatory systems in the Mediterranean SEA, http://odysseaplatform.eu/), with the final goal to build an on-line forecasting modeling system of the Northern Adriatic Sea.