Sensitivity of a 3D-model biogeochemistry to ocean physics forcing frequency

The frequency of ocean dynamics model output forcing transport-biogeochemical models in off-line coupling configuration can be a critical aspect when mesoscale and high variability dynamics are simulated. In this work, the sensitivity of ocean dynamics frequency on biogeochemistry is evaluated for the Mediterranean Sea biogeochemistry forecasting system of the EU Copernicus Marine Service. The off-line coupling strategy between the biogeochemical and physical components of the Mediterranean Sea operational system is currently based on the forcing of daily mean fields (3-D potential temperature, salinity, current velocity, vertical eddy viscosity, and 2-D wind stress, sea surface height) produced by the coupled NEMO-WW3 modelling system including a 3DVAR data assimilation scheme (OceanVar). The daily means are then linearly interpolated to the integration frequency of the transport-biogeochemical MedBFM system. Here we assess the impact of two different temporal frequencies of the ocean dynamic forcing: 24-hr averages (i.e. the current configuration) and 6-hr averages. The sensitivity of the high frequency forcing, which is related to a finer temporal resolution of the physical processes acting mainly on the vertical dimension, indeed reduces the approximation related to the daily averaging on the vertical transport processes. The impact on the biogeochemical dynamics is investigated and discussed in terms of the temporal evolution and spatial distribution of chlorophyll, oxygen, nitrate, primary production. Improvements of biogeochemical predictions are observed in areas where winter vertical dynamics play a substantial role such as the western Mediterranean area and Ionian Sea. In particular a decrease up to 3% of the basin-scale model uncertainty in Chlorophyll in the 0-30m vertical layer is estimated when model outputs are compared with BGC-ARGO floats, while no appreciable changes are observed contrasting model surface chlorophyll with satellite data. Results suggest that induced higher variability of dynamical processes, quantified as an increase of the 15% of the total kinetic energy, has an important role for the quality of biogeochemical variables, leading to an increase of the 2% of the net primary production in western Mediterranean areas.

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