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Three-dimensional modeling of phytoplankton and zooplankton seasonal distribution in the Iberian upwelling system

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Eastern boundary upwelling systems are well known as highly productive marine ecosystems due to the fertilizing effect of cold, nutrient rich deep water upwelled along the coast of the continents during part of the year. The complex physical-biological interactions that govern the variability of these systems have been explored during recent years for most of them (Benguela, Humboldt and California) with the aid of coupled ocean circulation and bigeochemical models. The Iberian upwelling system is the northern part of the North East Atlantic upwelling and the only upwelling region existing in Europe. A considerable amount of physical and biogeochemical data from historical and recent years observations are available for the region. However, any thorough attempt of modeling the biogeochemical dynamics of the system has been undertaken.

We present a modeling study for the biogeochemical dynamics in the upwelling region along the Iberian coast, shelf and adjacent ocean using the Regional Ocean Modeling System (ROMS) and its biogeochemical module. ROMS is a three-dimensional (3D), high resolution ocean circulation model successfully applied to resolve mesoscale phenomena such as eddies and filaments, both involved in the short-term variability of primary production. The biogeochemical module used is a simple Nitrogen based NPZD-type (Nitrate-Phytoplankton-Zooplankton-Detritus). We adopted a horizontal grid resolution of about 3 km for a 1300 km x 600 km domain (spanning from 34.5º N to 46.5º N and from 5.5º W to 12.5 W). The initial and boundary conditions for the physical variables were given from a parent domain of 10 km resolution for the Northeast Atlantic. The correspondent values for biogeochemical variables were supplied by WOA and SeaWiFS climatological means. The model was forced with mean atmospheric conditions (wind and heat flux) (COADS) along 4 years. Results were compared to satellite observations of chlorophyll concentration in the region.

The outputs of the biogeochemical model reasonably reproduced the seasonal trends in phytoplankton/chlorophyll-a concentration in the study area. Main features reproduced are an offshore spring bloom followed by high chlorophyll concentrations along the coast during the summer upwelling season. Lowest chlorophyll concentrations were reproduced in winter.