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Physical drivers of biogeochemical processes in the Mediterranean Sea: Comparison between two different hydrodynamic models

V.L. Meccia (1,2), A. Crise (1), C. Solidoro (1), and P. Lazzari (1)

(1) Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Borgo Grotta Gigante 42/C - 34010 - Sgonico (TS), Italy. Tel: (+39) (040) 21401 - Fax: (+39) (040) 327307 , (2) International Centre for Theoretical Physics, Strada Costiera 11 - 34014 - Trieste, Italy. E-mail: vmeccia@ogs.trieste.it

Some differences in the outputs of two coupled hydrodynamic-biogeochemical models in the Mediterranean Sea are found when both simulations are compared in the same period of time. Physical variables derived from the hydrodynamic model Océan Parallélisé (OPA) are used in order to forced a biogeochemical-transport model (OPATM-BFM) developed at OGS with two different purposes: operational, in the frame of VECTOR Project, and climatological, in the frame of MERSEA Project. Although the hydrodynamic model and its atmospheric forcing (ECMWF analysis) are the same, they have different configurations –some examples are the vertical discretization, the vertical eddy diffusivity parameterization and the incorporation or not of data assimilation- for the operational and the climatological simulations. The first one has been provided by M. Pinardi and coauthors (INGV, Italy) while the second one is provided by K. Béranger (ENSTA, France). In this sense, it is expected that the discrepancies found in biogeochemical processes would be driven only by differences in the physical forcing. This implies that both configurations of the hydrodynamic model lead to different representations of the physical processes that take place in the Mediterranean Sea and that are important drivers of biogeochemistry.

In this work, a comparison between the two different configurations of the hydrodynamic model is performed along the full 2007 year. Our aim is to identify those physical processes that are the main driving forcing of biogeochemical cycle in the upper layer. In that sense, it has been identified the vertical processes as the most relevant in the area of study. This is because through these, that also parameterize convection, nutrients coming from deep layers can reach the euphotic layer favoring new production. Nevertheless many processes are implicitly involved in vertical ones across the euphotic zone since they can be occurred, for example, by vertical diffusion, vertical advection, upwelling/downwelling events, seasonal mixing. That way, our analysis and comparison are focused on vertical processes in upper layer in the Mediterranean Sea.

Some physical parameters have been selected as representative indicators in order to perform the comparison and monthly means values of those parameters have been computed to study the seasonal cycle. In order to facilitate the interpretation, the Mediterranean Sea has been divided into 11 sub-basins. Our preliminary results show that the largest differences between both configurations are found in winter, particularly in February, when the mixed layer depth is deeper and so, the processes of mixing are more important. Particularly, it seems that the operational configuration tends to mix more than the climatological one, particularly in the northern and eastern sub-basins. Nevertheless, both configurations tend to reproduce a more similar response in the western Mediterranean. Currently, we are still analyzing some other aspects and it seems that mainly the incorporation of data assimilation together with the different vertical eddy diffusivity parameterization conduct to the main differences in the northern and eastern Mediterranean.

Our results have implications in the interpretation of the modeled biogeochemical cycles since those simulations are forced by physical variables derived from both configurations of the hydrodynamic model. This experience will be very useful in understanding the difference between hindcasts and scenarios as requested by climatic studies.