INTEGRATION OF CHLOROPHYLL COASTAL OBSERVATIONS AND THE COPERNICUS–MED-MFC BIOGEOCHEMICAL MODEL THROUGH VARIATIONAL DATA ASSIMILATION

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Abstract
A variational data assimilation scheme has been developed in order to integrate coastal chlorophyll observations in the Copernicus Marine Environment Monitoring System (CMEMS) biogeochemistry model of the Mediterranean Sea. The chlorophyll concentrations assimilated in the coastal areas are L4 MODIS satellite observations from CMEMS-OCTAC. The new assimilation scheme consists of an upgrade of the 3DVAR variational method already in use in the nominal forecast system for the CMEMS Mediterranean Biogeochemistry. Integration of the new assimilated variable with in-situ coastal data provides a proper description of the coastal-off shore gradient, of the seasonal cycle of chlorophyll and of the occurrence of local bloom events.

Keywords: Mediterranean Sea, North Adriatic Sea, Models, Coastal waters, Ocean colours

Matherials and methods
The integration of model simulations and observations can be an useful tool for an effective description of biogeochemical properties in coastal areas, compensating for the relatively scarcity of homogeneous biogeochemical observation systems and low resolution of basin-wide model system.
The 3DVAR-OGSTM-BFM model routinely provides forecasts of Mediterranean Sea biogeochemistry in the framework of CMEMS, and it is composed by a biogeochemical model specifically developed for the Mediterranean Sea (OGSTM-BFM, [1]) coupled with a variational assimilation system (3DVAR, [2]).
Through the assimilation, satellite observations of chlorophyll concentration in open sea and in coastal areas are integrated in the forecast produced by the model. The assimilation scheme has been developed and operationally integrated in the forecast system during the EU MyOcean and Myocean2 projects and it is based on an opportune decomposition of the background error covariance matrix in three operators: vertical operator, horizontal operator and biogeochemical operator [2].
For the assimilation of coastal observations the background error covariance matrix decomposition has been upgraded inserting new vertical and horizontal operators, which have been designed accounting for the biogeochemical dynamics and statistics of the coastal areas.
The satellite observations used in the assimilation are provided by ISAC GOS CNR (Rome, Italy) through an algorithm specifically developed for Mediterranean case I and II waters [3].
The insitu data to be integrated with the model framework are chlorophyll coastal observation available at the Seadatanet chemistry portal.

Results
The 3DVAR-OGSTM-BFM model with open sea and coastal assimilation of satellite chlorophyll has been run for one year at 1/16° of spatial resolution. The results of the assimilation run have been compared with the available independent observations (in situ), showing that variational data assimilation can successfully integrate model and observations information providing a better knowledge of status and processes in coastal areas.
The integration of model and observations through the assimilation improves the description of the chlorophyll seasonal signal and local events in coastal areas, providing a correction of the timing and magnitude of local blooms. The comparison with in situ observations shows significant improvements in the results in the Northern Adriatic region; in this high productive coastal area the assimilation significantly reduces (up to 50%) the underestimation of chlorophyll concentration of the run without assimilation (Fig. 1).

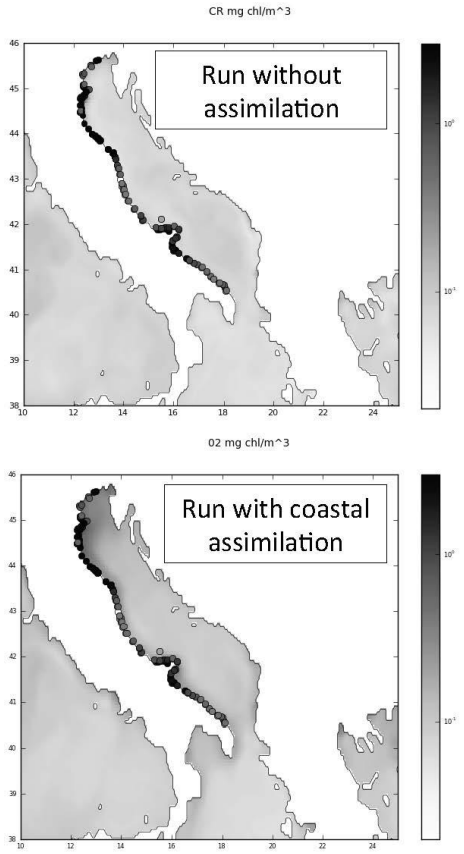

Fig. 1. Annual mean of chlorophyll in Adriatic Sea: model results (colormap) and in situ observations (dots)

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