Simulating bio-optical properties in the Mediterranean Sea.

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We present the results of a series of simulations performed by a multi-spectral bio-optical model developed in the framework of the BIOPTIMOD Service Evolution project for the Copernicus Marine Environment Monitoring System (CMEMS-SE). In this research, we integrate the CMEMS Mediterranean Sea biogeochemical model MedBFM (multi-stoichiometric, phytoplankton functional types -PFT- based) with a bio-optical model able to resolve light propagation along the water column with 25 nm resolution in the visible range. Recent optical data streams provided by novel observations platforms, such as the Biogeochemical Argo floats (BGC-Argo) and the multi-spectral satellite sensors (ESA-CCI and Sentinel-OLCI), are used for the model validation. Our approach aims to improve the quality and reduce the uncertainty of paramount CMEMS biogeochemical products such as phytoplankton biomass and primary production.

We present: 1) the optical dataset gathered from BGC-Argo floats and satellite sensors; 2) the multi-spectral upgrade of the bio-optical model including specific PFT optical properties and CDOM formulation; 3) the assessment of the new bio-optical model within the CMEMS quality framework with particular reference to Remote Sensing Reflectance (Rrs) data and to light attenuation as inferred from BGC-Argo floats.

In particular, the analysis of Rrs spatial and temporal variability allows to evaluate the skill of different parameterizations for PFT (e.g. photochemical efficiency) and CDOM dynamics (e.g. photobleaching rate), using an ensemble of multi-annual 3D simulations.

The role of the CDOM deep inventory and river discharge in modulating light attenuation is also evaluated. Results indicates that the novel bio-optical model allows to reconstruct the West-East DCM gradient as a self-emergent property.

Major impacts of the project, potentially strategic for CMEMS users, involve: the improvement of CMEMS biogeochemical products quality, the development of new optics-related biogeochemical products for CMEMS, and the strengthening of the scientific and technological links with the new generation of marine bio-optical sensors, which may also support a stronger collaboration between modelling, remote sensing and experimental communities.