



A new bio-optical model to estimate phytoplankton primary production: An application in the eastern Mediterranean Sea

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The estimation of phytoplankton primary production provides basic input for the quantification of carbon flux in the ocean because of the strong relationship between available photosynthetic energy at the ocean surface and energy storage by algal photosynthesis.

We used a new version of PhytoVFP (Variable Fluorescence Phytoplankton Production) bio-optical model to calculate phytoplankton primary production (PP) in the euphotic zone.

PhytoVFP is classified as a Wavelength- and Depth-resolved (WRDR) model and is based on the implementation of photosynthetic efficiency (F_v / F_{max}), measured in-situ by the PrimProd probe. An innovation of the model is the reproduction of the daily photoacclimation process by varying photosynthetic parameters (E_k , α and P_{bmax}) along the water column as a function of stratification.

The PhytoVFP model is structured into three main modules: (1) "PAR estimation"; (2) "Photo-acclimation of marine phytoplankton"; (3) "Phytoplankton primary production estimation".

The performance of the PhytoVFP model was evaluated using PAR and ^{14}C primary production measures collected during the SAMCA3 and SAMCA4 oceanographic cruises. The comparison between the measured and calculated radiation showed a good correlation, both in the surface and along the water column ($R^2 = 0.8992$ in the presence, and $R^2 = 0.8747$ in the absence, of clouds) Sensitivity tests, carried out on ϕ_{phie} (photosynthetic quantum yield) and β (photoinhibition parameter), allowed us to identify the best model parametrization which minimized the MAE (Mean Absolute Error). The values assigned to these parameters allowed to have a good correlation between the measured and estimated primary production values ($R^2 = 0.808923$). The results of PhytoVFP model have been also compared with its older version and the Morel (1991) model showing that the MAE of the new version is lower than the other models.

The PhytoVFP model was applied on Primprod data collected during MedGOOS12 cruise in order to analyse the vertical distribution of phytoplankton primary production in the eastern Mediterranean sea.