# Integrating BGC-Argo predicted profiles via Convolutional Neural Networks into the Data Assimilation of the Copernicus Mediterranean biogeochemical model

A novel Profile Convolutional Neural Network (PPCon) has been incorporated in the data assimilation (DA) framework of the operational Mediterranean Sea Biogeochemical Modeling (MedBFM) system to enhance the assimilative capability of the BGC-Argo dataset. The MedBFM system, which already features the assimilation of ocean color and BGC-Argo profiles of nitrate, chlorophyll, and oxygen, has been extended to include the assimilation of predicted PPCon nitrate profiles. This extension addresses the reduction in BGC-Argo nitrate sensor deployments in recent years and aims at enhancing the model's capability to predict key biogeochemical processes, as nutrients play a fundamental role in driving productivity of the euphotic layer. To test the effectiveness of this approach, a set of observing system experiments (OSE) was performed, measuring the impact that different DA setups have on the prediction of seasonal phytoplankton blooms, stratification dynamics, and nutrient supply at various spatial and temporal scales. In particular, our Mediterranean OSE featured three different setups tested for the year 2019 a simulation with DA of satellite chlorophyll; a multiplatform and multivariate assimilation of satellite chlorophyll and BGC-Argo chlorophyll, nitrate, and oxygen, and a simulation with the addition of reconstructed profiles of nitrate to the last setup. The results show that the addition of reconstructed profiles assimilation had positive effects on the assimilated variables without worsening the non-assimilated ones. Additionally, improvements in the west-east gradient of primary production in the Mediterranean were observed as an effect of a better description of the nutrient vertical distribution and its temporal evolution.

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