MARINE-EO project: Monitoring and forecast of eutrophication around fish farms, a Maliakos Gulf case (Eastern Mediterranean).

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Maliakos Gulf corresponds to mesotrophic waters that can reach eutrophic conditions and are occasionally subject to Harmful Algal Blooms (HAB) (Varkitzi et al. 2018). At the same time, it is an important fish farming and aquaculture production area. A large issue is thus related to the monitoring and forecasting of the risk of occurrence of algae blooms in the Gulf. For this purpose, the present study couples predictions from a high-resolution numerical ocean model with satellite observation to improve the monitoring and anticipation of threats for the local fish farms induced by occasional eutrophication.

This solution is developed in the frame of the MARINE-EO project (https://marine-eo.eu/). It combines satellite observation with high-resolution ocean modelling to provide detailed information as a support to fish farms management and operations. It is implemented in an operational platform, which provides continuous information in real time as well as short term predictions. The deployed solution uses CMEMS physical products as an input data and offers to refine this solution in order to provide a local information on site using a downscaling strategy. High resolution satellite products and ocean modelling allow to include the impact of local coastal processes on currents and water quality parameters to provide a proper monitoring and forecasting solution at the scale of a specific fish farm.

To model specific eutrophication processes, a NPZD (Nutrients-Phytoplankton-Zooplankton-Detritus) biogeochemical model is used. Included in the MOHID Water modelling system, the water quality module (Mateus, 2006) considering 18 properties: nutrients and organic matter (nitrogen, phosphorus and silica biogeochemical cycles), oxygen and organisms (phytoplankton and zooplankton) was deployed in the western Aegean Sea. The simulated chlorophyll a concentrations are used to compute a risk level for the eutrophication occurrence. To complete this indicator, another risk level was based on the eutrophication variation following Primpas et al. (2010) formulation. In addition to model forecasts, ocean color observations from the Sentinel-2 MSI and Landsat-8 OLI sensors are used to provide high resolution chlorophyll a concentrations maps in case of bloom events. The processing chain uses the sixth version of the Quasi-Analytical Algorithm initially developed by Lee et al. (2002) and an empirical relation based on a database
built using the HydroLight software to compute chlorophyll a concentration.

Two past eutrophication events monitored in situ (Varkitzi et al. 2018) were studied to assess the accuracy of the developed tool. Although few in situ data were available on environmental input (as rivers flow and nutrient concentrations), it was possible using statistics to reproduce qualitatively these blooms. Finally, an operational demonstration was conducted during 2 months of the 2020 autumn season, to showcase real time monitoring and predictive perspectives.