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Skill assessment of the coupled physical-biogeochemical operational Mediterranean Forecasting System

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The Mediterranean Monitoring and Forecasting Centre (Med-MFC) is one of the regional production centres of the European Marine Environment Monitoring Service (CMEMS-Copernicus). Med-MFC operatively manages a suite of numerical model systems (3DVAR-NEMO-WW3 and 3DVAR-OGSTM-BFM) that provides gridded datasets of physical and biogeochemical variables for the Mediterranean marine environment with a horizontal resolution of about 6.5 km. At the present stage, the operational Med-MFC produces ten-day forecast: daily for physical parameters and bi-weekly for biogeochemical variables.
The validation of the coupled model system and the estimate of the accuracy of model products are key issues to ensure reliable information to the users and the downstream services.
Product quality activities at Med-MFC consist of two levels of validation and skill analysis procedures. Pre-operational qualification activities focus on testing the improvement of the quality of a new release of the model system and relays on past simulation and historical data. Then, near real time (NRT) validation activities aim at the routinely and on-line skill assessment of the model forecast and relays on the NRT available observations.
Med-MFC validation framework uses both independent (i.e. Bio-Argo float data, in-situ mooring and vessel data of oxygen, nutrients and chlorophyll, moored buoys, tide-gauges and ADCP of temperature, salinity, sea level and velocity) and semi-independent data (i.e. data already used for assimilation, such as satellite chlorophyll, Satellite SLA and SST and in situ vertical profiles of temperature and salinity from XBT, Argo and Gliders)
We give evidence that different variables (e.g. CMEMS-products) can be validated at different levels (i.e. at the forecast level or at the level of model consistency) and at different spatial and temporal scales.
The fundamental physical parameters temperature, salinity and sea level are routinely validated on daily, weekly and quarterly base at regional and sub-regional scale and along specific vertical layers (temperature and salinity); while velocity fields are daily validated against in situ coastal moorings. Since the velocity skill cannot be accurately assessed through coastal measurements due to the actual model horizontal resolution ($\sim$6.5 km), new validation metrics and procedures are under investigation.
Chlorophyll is the only biogeochemical variable that can be validated routinely at the temporal and spatial scale of the weekly forecast, while nutrients and oxygen predictions can be validated locally or at sub-basin and seasonal scales. For the other biogeochemical variables (i.e. primary production, carbonate system variables) only the accuracy of the average dynamics and model consistency can be evaluated.
Then, we discuss the limiting factors of the present validation framework, and the quality and extension of the observing system that would be needed for improving the reliability of the physical and biogeochemical Mediterranean forecast services.