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Variational data assimilation for advanced cross-scale ocean modelling.

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Eight of the top ten most populated cities in the world are located by the coast. The improvement of the coastal ocean representation is a key topic to understand the present and near-future ocean state and predict its evolution under climate change conditions.

The coastal ocean is difficult to model due to the presence of complex coastlines, interaction with inland waters, rapid changes in topography and highly space-time variability of the phenomena involved. Unstructured-grid models are used to partially attenuate this source of errors in cross-scale (from open sea to coastal regions) oceanographic modelling. On the other hand, the data assimilation methodologies to improve the unstructured-grid models in the coastal seas is being developed only recently (e.g., Aydogdu et al., 2018; Bajo et al., 2019) and needs more advancements.

Here, we show preliminary results from the coastal ocean forecasting system SANIFS (Southern Adriatic Northern Ionian coastal Forecasting System, Federico et al., 2017) based on SHYFEM fully-baroclinic unstructured-grid model (Umgiesser et al., 2004) interfaced with OceanVar (Dobricic and Pinardi, 2008; Storto et al., 2014), a state-of-art variational data assimilation scheme, adopted for several systems based on structured grid (e.g. regional CMEMS for Mediterranean and Black Seas, marine.cmems.eu).

In OceanVar, Empirical Orthogonal Functions (EOFs) method is used to reduce the dimensionality of computation removing the statistically less significant modes and to correlate observations and model background in the water column; while the increments are spread horizontally using the recursive filter method. While this method is typically only used to model covariances between neighbouring points in a structured grid, the algorithm has now been generalised and successfully implemented also for unstructured grids.

Preliminary results show that temperature and salinity observations from Argo profilers improve the ocean state. Future steps will also include sea level assimilation.

This work is a starting point in order to improve our forecast of local extreme events (e.g. heat waves and storm surge) which are statistically increasing in number and intensity in the

Mediterranean region due to climate change.