Relocatable ocean modelling and forecasting in shelf-coastal areas to support disaster risk reduction

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High-impact ocean weather events and climate extremes can have devastating effects on coastal zones and small islands. Marine Disaster Risk Reduction (DRR) is a systematic approach to such events, through which the risk of disaster can be identified, assessed and reduced via direct observations, thus improving ocean and atmosphere prediction models and the development of efficient early warnings systems. A common user request during disaster remediation actions is for high-resolution information, which can be derived from easily deployable numerical models nested into operational larger-scale ocean models.

The Structured and Unstructured Relocatable Ocean Model for Forecasting (SURF, https://www.surf-platform.org/) has been designed to provide operational ocean forecasting communities with the means to rapidly deploy a nested high-resolution numerical model into larger-scale ocean forecasts. Rapidly downscaling the current, sea level and temperature, and salinity fields is critical in supporting emergency response and DRR planning, which are typically related to very localized areas in the world's oceans. A crucial requirement in a relocatable modelling capability is to ensure all of the interfaces have been tested through low resolution operational ocean analyses, forecasts and atmospheric forcing. The provision of continuous ocean circulation forecasts through the Copernicus Marine Environment Monitoring Service (CMEMS) enables this testing.

Here we focus our attention on the unstructured-grid SURF component, carrying out different implementations in world ocean regions, downscaled from CMEMS analyses and forecasts in different world ocean regions. The specific test cases are oriented to model and forecast: (i) sea level extreme events (e.g. impacts of Hurricane Lorenzo in Azores islands and Medicane Ianos in Greek Islands); (ii) circulation fields in support of search-and-rescue and oil-spill operations (e.g. in Taranto Seas in northwestern Ionian Sea). The platform demonstrates the quality of the initial and lateral boundary condition fields in the CMEMS is high enough to initialize and drive through the boundaries of the SURF nesting. Furthermore, SURF downscaling augments the realism of the ocean conditions by adding geometry, resolution, and specific physical parametrizations for coastal oceans.

The methodology and the platform could be further enhanced by means of automatic interfaces with specific downstream application models and decision support systems oriented to early waning, oil spill forecasting, search and rescue modelling, and ship routing modelling for safe navigation.