Research project

‘Pollution transport by submesoscales in the open ocean’

Within the H2020 project ‘IMMERSE’, the University of Bologna will explore the impact of submesoscale processes on the transport of oil pollution and their environmental impacts using MEDSLIK-II. The expectation is that resolving the submesoscale leads to more accurate predictions of pollutant advection-diffusion and, therefore, their impacts on the coastal environment. The relocatable ocean platform SURF, based on the NEMO code, will provide velocity fields from submesoscale-permitting models, using multiple model nests to 2-300m focusing in different European Sea regions. The numerical experiment output datasets will be arranged in an appropriate database to be made available to the community.

Elements of the research and development work to be carried out are below listed:

1. Recode/re-engineering Medslik-II model source code
2. Optimize the relocatable ocean prediction system SURF, adapting it to the new release of NEMO.
3. Perform submesoscale-permitting simulations using multiple nesting approach to achieve an open ocean horizontal resolution of 2-300 m.
4. Simulate the transport of an oil spill using velocity fields from the submesoscale-permitting experiments and analyze the role of submesoscale motion on Lagrangian transport
5. Validate the results against the new satellite data (SENTINEL-3) and available in situ observations.

Activity Plan

The research activity will be based upon numerical experiments on the computational infrastructure of the Bologna DIFA. The first step will be re-engineering the oil spill source code (Medslik-II) and optimize the relocatable ocean platform SURF. After that, submesoscale-permitting simulations will be carry out using multiple nesting approach to achieve an open ocean horizontal resolution of 2-300 m. Sensitivity experiments will be performed with respect to a) horizontal and vertical resolution; b) explicit parameterization of viscosity and diffusivity; c) the numerical schemes available in the existing and new version of the NEMO codes. Using the high resolution velocity fields obtained, the transport of an oil spill will be simulated and the role of submesoscales will be analysed for the Lagrangian transport. The results of our nested model simulations will be compared with the current Copernicus Marine Environment Service (CMEMS) open data sets and validated against the new satellite data (e.g. SENTINEL-3) and available in situ observations.