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The low frequency circulation over the Nazaré Canyon deduced from a local model nested in a global operational model.

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The numerical modelling of the low frequency circulation near the Nazaré Canyon is a complicated task. Actually the circulation is constrained by local forcing (e. g. wind) but also by non-local phenomena like the Iberian Poleward Current, the poleward propagation of Mediterranean Sea Water, the propagation of coastal trapped waves associated with spatio-temporal variability of the wind, etc. To have an accurate model for the area all these aspects must be taken into account. Clearly this implies a regional model covering a significant part of the Northeast Atlantic. On the other hand an accurate model of the Nazaré Canyon needs a very high spatial resolution (order of 1 km).

To overcome this problem the option was to perform the downscaling of a global operational model to a local model. The results of the global operational model used were provided by the Mercator Consortium, while the local model is MOHID.

Two horizontal resolutions for the local model were tested (0.03º and 0.015º). A vertical discretization similar to the Mercator one was assumed. This paper describes a set of numerical experiences where a sensitive analysis is made for several methods to initialize the local model (Mohid) using results from a large scale operational model (Mercator). Several open boundary conditions were also tested to identify the one that had a better performance. A description of the methodology is presented prior to the results and the results analysis.

The results presented can be divided in two parts: (i) sensitive analysis of the parameters that control the spin up process and the open boundary conditions; (ii) comparison of the numerical results with the known oceanographic features in the computational domain. In the first part variables analyzed were the average kinetic energy, the average variation of the potential energy from the initial condition and mean sea level. The differences between the MOHID higher resolution solution and the Mercator solution are also presented.

As major conclusions we can emphasize the following points:

- The spin-up methodology implemented based in the gradual connection of the forcing terms along a 5 day period is able to produce a solution without significant oscillations for the 0.03º solution;
- The open boundary condition with best performance consists in relaxing temperature, salinity and velocity to the Mercator solution near the boundary altogether with a Flather radiation boundary condition with the sea surface height and barotropic velocities from Mercator as reference solutions;
- Sponge layers along the boundary where the turbulent viscosity is increased exponentially decreases the internal activity associated with the 0.015º solution because it dissipates the waves generated in the domain interior that arrive to the boundary by avoiding reflections;
- With the methodology implemented for the spin up and the open boundary condition, the MOHID solution after a 2 months simulation is able to maintain a spatial variability similar to the Mercator one; especially in the deeper layers;
- The Mercator and Mohid solutions present a similar slope current structure for the study area. This structure is very similar to the one describe in Coelho et al., 2002 for winter conditions;
- The more realistic bathymetry of the MOHID derived a solution with greater variability than the MERCATOR one;
- The increment of MOHID resolution from 0.03º to 0.015 increased dramatically the model solution variability at the scales of the order of 10 km;
- Most of the known features of the circulation in the Nazaré Canyon area come out from the model with the methodology used.