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The Mediterranean overflow: New insights and numerical sensitivity from multiply nested model simulations

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In the past 20 years, ocean modellers have paid much attention to either Gibraltar strait dynamics or Meddies formation, which are respectively at the origin and the end of the Mediterranean overflow descent in the Atlantic Ocean. Although the importance of topography is acknowledged on what happens in between, (i) the finest resolution in existing modelling studies is still too coarse (o 2-6km) to properly capture main channels and canyons; (ii) results convergence relative to numerical settings has remained largely unexplored.
Recent progress in the knowledge of the geological properties of the Gulf of Cadiz has indeed revealed the ubiquity of small scales bathymetry structures (o 1km) and a complex system of channels shaped by the Mediterranean Overflow (MO) currents. Taking advantage of a new high resolution bathymetry dataset, we present a refined view of MO splitting and spreading from semi-idealized numerical simulations. A multi grid, two-way nested procedure is used to increase the horizontal resolution in key areas up to 250m, revealing the channelizing effect of bathymetry and the localized nature of mixing along MO pathways.
The impact of vertical coordinate choice is investigated thanks to NEMO generalized vertical coordinate framework. The combination of geopotential and terrain following coordinates is shown to be the best compromise to faithfully represent the steep slopes bordering the basin, minimize pressure gradient errors and properly resolve bottom layers. Results with z-coordinates, as expected, perform relatively poorly leading to excessive entrainment. Sensitivity to vertical mixing schemes as well as horizontal resolution is also explored, providing an extensive set of experiments that complements similar studies in other overflow regions.