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A nested model of seasonal circulation in the Gulf of Trieste (northern Adriatic) and the superposition of tides in a circulation model of the Adriatic Sea

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Numerical simulations of seasonal variations of the circulation in the Gulf of Trieste and its surroundings were performed within the framework of the regional ADRICOSM project. The Princeton Ocean Model (POM) was applied with grid cells with horizontal dimensions of 0.5 km x 0.5 km in 11 sigma layers (ACOAST-1.2 model). Variations in the circulation were observed within a 'perpetual year'. Surface boundary conditions like wind stress and evaporation minus precipitation were obtained from the ECMWF, gridded to a much finer model grid. Climatological fields of temperature (T) and salinity (S) resulted from the run of the ASHELF-1 model (Zavatarelli and Pinardi, 2003), which covers the northern Adriatic Sea, and is conducted by another group (the INGV in Bologna). They were also regridded to this model grid which is three times finer. The open boundary (OB) conditions were derived from the ASHELF-1 model into which the ACOAST-1.2 is one-way nested.

The analysis of results was performed for the winter. At the place of the coastal oceanographic buoy the resulting circulation pattern looks very similar to the observed one, with a wind-driven outflow at the surface of the Gulf's interior and an inflow at depth along the southern coastline. Cyclonic vortices in the Gulf need clarification as does the detachment of the surface outflow from the southern coastline. This detached flow carries the fluid across the Gulf towards the coastline at the other (north-western) side of the Gulf, where it leaves the Gulf.

POM was also applied in a simulation of tides in the Adriatic Sea. The model is composed of grid cells with horizontal dimensions of 5 km x 5 km in 21 sigma layers, which are denser near the sea-surface and near the sea-floor. First model simulations were for model calibration, so that the model match with the observations at tidal gauge stations is suitable (the vectorial difference in cm). The model run was performed for a homogeneous density field (T = 13 ^{0}C, S = 38 PSU), clamped OB conditions for T and S, and for the radiation condition for the external (depth averaged) velocity and for the total velocity. The resulting semidiurnal tidal waves with an amphidromic point in the Adriatic and the diurnal waves without it ressemble well known patterns. The incorporation of tidal dynamics in a prognostic circulation model was performed within the framework of the EU project MFSTEP. The method was applied in a climatological circulation model of the Adriatic that has the same architecture. The tidal velocities along the vertical OB plane from the first run were incorporated into the OB conditions of a new run. Along the OB plane the total velocity was a sum of tidal velocity and circulation velocity (external and internal). The upstream radiation OB conditions were applied for T and S, and no OB condition for the SSE. The resulting velocity field in the Adriatic Sea shows pronounced tidal modulation of the circulation in the northern part of the Adriatic with significant modulation of the vertical shear of horizontal velocity components and almost no effect in the much deeper southern part of the Adriatic.

References

Zavatarelli M. And N. Pinardi, 2003. The Adriatic Sea modelling system: a nested approach. Annales Geophysicae, 21, 345-364.