A FORCED OCEAN-ATMOSPHERE MODEL TO PERFORM LONG-TERM HYDRODYNAMIC RESPONSE INDUCED BY ATMOSPHERIC FORCING WITHIN THE STRAIT OF GIBRALTAR.

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Abstract

This study investigates the response of the Atlantic inflow induced by atmospheric forcing in the Strait of Gibraltar during intense and persistent easterly wind episode. The hydrodynamic response is successfully simulated using a high-resolution oceanic numerical model forced by an atmospheric mesoscale model. Numerical simulations show the raising of the Atlantic-Mediterranean interface along the Morocco’s northern coast indicating the development of upwelling in this area while the interface sinks down near the downweling region in the south Atlantic coast of Spain. The joint action of the high atmospheric pressure over the Mediterranean and the easterly wind drastically reduce the Atlantic inflow.

Keywords: Strait Of Gibraltar, Upwelling, Air-Sea Interactions, Atmospheric Input, Currents

Circulation in the Strait of Gibraltar consists of several concurring processes. One of these processes is the direct action of the winds along the Strait. Dominant easterly/westerly winds appear to originate upwelling/downwelling phenomena, which subsequently will modify the circulation patterns and the interface depth [1, 2 and 3]. It is known that under intense easterly winds upwelling events occur along the Morocco’s northern coast while the downwelling is developed in the south Atlantic coast of Spain. Analysis of one month numerical simulations between September and October 2008, coincident with the GIBRALTAR-08 oceanographic survey period, were performed with a two-dimensional, non-linear, two-layer, free-surface, boundary-fitted co-ordinate, hydrostatic ocean model UCA2.5D [4] at grid resolutions down to 1 km, forced with the Fifth-Generation NCAR / Penn State N*on-hydrostatic*Mesoscale Meteorological Model MM5 [5] fields. The atmospheric model domain has been implemented for the Gibraltar Strait, covering the Western Alboran Sea and small part of the Gulf of Cadiz, while the curvilinear ocean model grid is limited to the Strait of Gibraltar and embedded in the larger atmospheric model domain (see Figure 1 for details).

Simulations have been performed with three different forcing cases to determine the response of the circulation patterns and the interface depth to the atmospheric pressure and wind forcing separately. The first simulation was performed by forcing the ocean model only with surface wind, the second simulation included also atmospheric pressure forcing and the third one has been obtained being forced by atmospheric pressure and surface winds. For the validation process, the different outputs of the model have been compared with a set of *in situ* meteorological and oceanographic data collected during GIBRALTAR-08 survey, which took place in the Strait of Gibraltar onboard the R/V Sarmiento de Gamboa conducted during fall season in 2008.

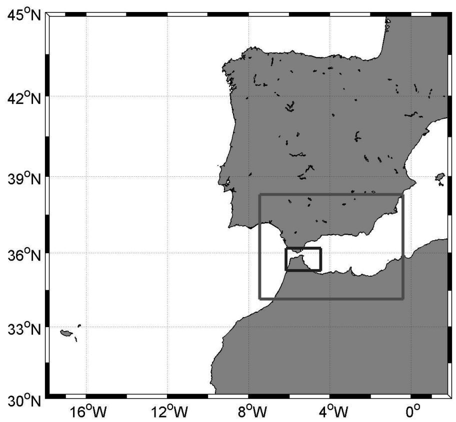

Fig. 1. Spatial coverage of the fine horizontal resolution (1 km in the whole model domain and 0.125 km in the Strait of Gibraltar) ocean model grid (blue box) and the 10 km horizontal resolution MM5 grid (red box).

Model simulations show that the effect of the easterly wind by itself is to decrease the intensity of the Atlantic inflow and the interface depth. Nevertheless, considering the joint effect of the high atmospheric pressure in the western Mediterranean basin, significant reductions in the Atlantic flow could therefore reverse at the same time that the Atlantic-Mediterranean interface raise, taking place the development of upwelling in the Morocco’s northern coast. The numerical solutions closely match the experimental results discussed in [6].

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