THE EFFECT OF THE BORA ON THE ADRIATIC SEA: A COMPARISON WITH TWO THREE-DIMENSIONAL OCEAN MODELS

N. Rachev[1]*, D. Dietrich[2], S. Piacsek[3] and R. Purini[4]

[1] Dept. of Meteorology and Geophysics, University, Sofia, Bulgaria - nick@phys.uni-sofia.bg
[2] AcuSea, Inc., Albuquerque, NM, USA
[3] Naval Res. Laboratory, Stennis Space Center, MS, USA
[4] Istituto Talassografico-CNR, Trieste, Italy

Abstract

This paper refers to the comparison of two three-dimensional (3D) numerical models for the Adriatic Sea when the atmospheric forcing is represented by a simple bora wind. Starting with the same initial condition and considering the basin closed at the Otranto Strait, after five days of simulated time both models reproduce quite well some characteristic phenomena induced by this wind (for instance, the upwelling along the Albanian coast and the horizontal gradient of the sea level in the northern areas). Since some differences are noticed for other features (i.e. the horizontal velocity field and the absolute value of the above mentioned gradient) further studied are required.

Keywords: Adriatic Sea, Models.

Echoing a recent paper addressed to the Lake Michigan [1], two 3D ocean models have been applied to the Adriatic Sea for the better understanding of the effect of meteorological forcing (in the present case, the bora wind) on the marine circulation. The first model is the DieCAST - z-level coordinates, "rigid lid" approximation. The second one is the POM - sigma coordinates, free surface. Since the terrain-following coordinate system is more convenient for coastal processes as upwellings while the z-level system is more appropriate for areas characterized by strong bottom variations, a comparison between the two models is particularly useful for the Adriatic because it is a semi-enclosed basin with relevant topographic changes. Moreover, recalling that the bora induces intense upwelling phenomena along the Albanian coast and noticeable sea-level variations in the northern coastal areas, this basin needs particular care when a particular numerical model is chosen for describing the most relevant features of its dynamics. In the following we describe briefly the main results of this study.

After five days of simulated time with a constant and simplified bora affecting the whole basin [2], both models give similar horizontal patterns for the temperature and salinity fields. They produce a strong upwelling along the Albanian coast although the DieCAST shows less computational noise with respect to the POM. This statement is confirmed by the vertical distributions of temperature (Fig. 1 a,b), salinity, zonal and meridional velocities for a transect at the latitude of 41N. Vertical distributions of meridional velocity are quite similar for both models until five days of simulation. However, some differences are evident along Albanian coast if the simulations are carried out for ten days (Fig. 1 c,d). Regarding the surface velocities, the POM shows large sub-basin gyres (Fig. 2) quite different from the DieCAST that produces large scale meanders (Fig. 3). This difference appears remarkable in the southern Adriatic where the above mentioned upwelling appears. Finally, the comparison between the equivalent surface anomaly (DieCAST) and the free surface (POM) shows similar structures (Figs 2, 3). In particular, both models produce the well known sea level gradient between Venice and Trieste, though the DieCAST underestimates such a parameter because its inherent approximation for the surface pressure.

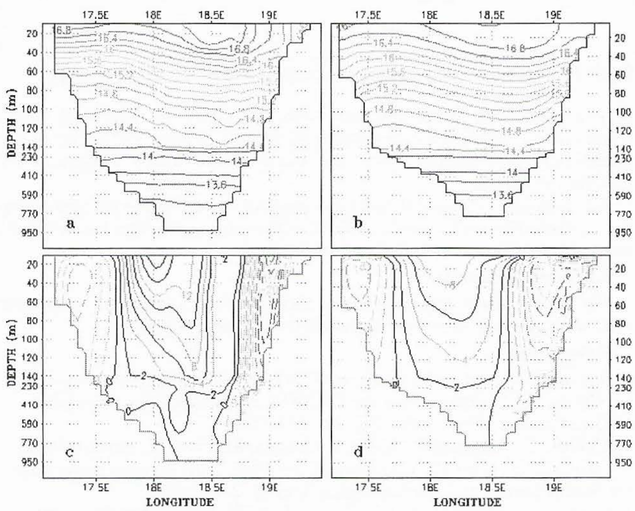

Figure 1. Zonal cross section at 41N of temperature distribution simulated by (a) POM and (b) DieCAST after 5 days. Zonal cross section at 41N of meridional velocity simulated by (c) POM and (d) DieCAST after 10 days.

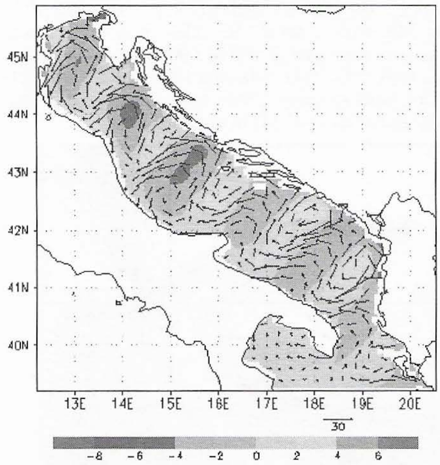

Figure 2. POM: simulated sea surface currents and free surface elevation.

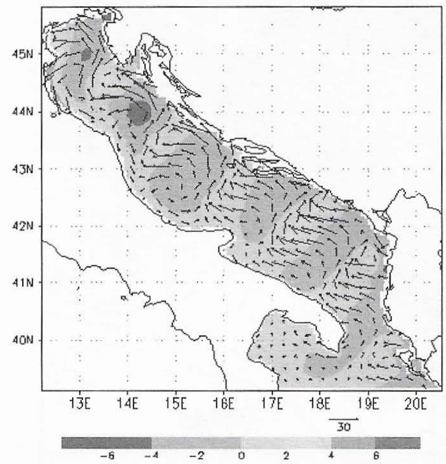

Figure 3. DieCAST: simulated sea surface currents and equivalent free surface anomaly.

In conclusion, although the two models are based on different numerical schemes and different turbulence closure parameterizations, their use for the Adriatic Sea seems to produce similar features with the exception of the sea level values in coastal areas and the current patterns. Based on this preliminary results, further studies are now scheduled keeping in mind the comparison of model simulations with experimental data sets.

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