The Algerian Current Instability: Analytical and Numerical Investigation

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It is well known that the Atlantic water, after a trip around the Alboran Sea gyre(s), flows (guided by the Corilis force) along the Algerian coast as a light water intrusion. This current is unstable, and mesoscale activities generate cyclones and anticyclones, but only the latter ones grow enough to separate from the mean flow.

In order to demonstrate that the GHER 3D mathematical and numerical model is able to reproduce the eddies and instabilities of the Algerian current, an academic test case has been studied. Initially we have a dense water ocean with a southern coast. Along this coast flows a lighter water intrusion in geostrophic equilibrium (Fig.1).

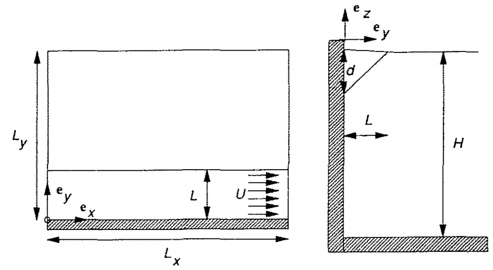

Fig. 1.- Base current

The geometrical and physical values are choosen in such a way that the transport in the lighter water is about 1.4Sv, corresponding to a typical value of the Algerian current (MILLOT, 1991). The boundary conditions in along-shore direction are periodic, which of course triggers the instabilities of a particular wavelenght.

The analytical solution shows that this current is stable in the framework of a reduced gravity model. The question of the type of the instability arises, because nature and direct simulation show strong instabilities.

The numerical grid uses a 2.5kmx2.5km horizontal Arakawa C-grid, with a vertical discretization of 17 levels, with a higher resolution in the light water mass. The time step was 2s for the barotropic part and 240s for the baroclinic one. The day to day variation of the shore current is shown, which gives a nice illustration of the instability growth and the development of an anticyclone accompanied with filaments spreading into the basin. After 50 days, the anticyclone ends up with a diameter 3 times larger then the initial current width, and its centre stays more or less at rest. Figure 2 shows the salinity field as computed after 55 days of simulation.

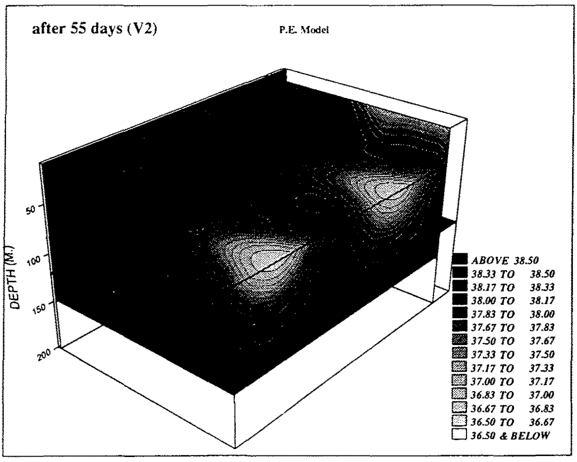

Fig. 2.- 3D view of the Salinity field in the periodic channel. The 3D view is from south-west to north-east. One can clearly see the big anticyclone.

One may question if other boundary conditions than the periodic ones would move the anticyclone northward, or if real topography should be included for this purpose.

REFERENCES

MILLOT C., 1991.- Mesoscale and seasonal variabilities of the circulation in the Western Mediterranean. *Dynamics of Atmospheres and Oceans*, 15, pp. 179-214.