THE AEGEAN - LEVANTINE EDDY RESOLVING MODEL (ALERMO): IMPLEMENTATION AND CLIMATOLOGICAL RUNS

Gerasimos Korres[1]* and Alex Lascaratos[2]

[1] Dept. of Marine Sciences, Aegean University Mytilen, Greece - mkorres@aegean.gr
[2] Dept. of Applied Physics, University of Athens, Greece - alasc@oc.phys.uoa.gr

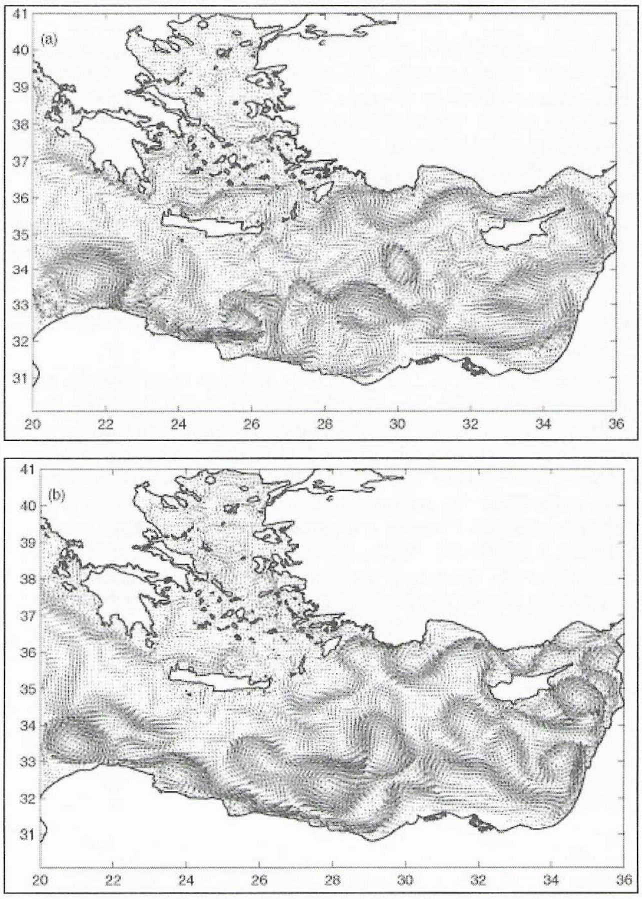
Abstract

Within the MFSPP project, an eddy resolving ocean model of the Aegean and Levantine basins (ALERMO) has been developed. This model acts as an intermediate between the basin scale OGCM and the high-resolution shelf models within the same project. In this paper we present the development of the model, the nesting technique with the basin scale OGCM as well as results from its climatological runs.

Keywords: models, Levantine basin.

The numerical model

The ALERMO model is based on the Princeton Ocean Model (POM), a primitive equation, 3-D circulation model [1]. The model has a bottom - following vertical sigma coordinate system, a free surface and a split mode time step. Potential temperature, salinity, velocity and surface elevation, are prognostic variables. The ALERMO model has one open boundary located at 20° E (see fig.1). The computational grid has a horizontal resolution of 1/20°x1/20° and 30 sigma layers in vertical with a logarithmic distribution near the surface resulting in a better representation of the surface mixed layer. ALERMO includes parameterization of the Dardanelles outflow and rivers runoff. It is forced with climatological wind stress, total heat flux and evaporation/precipitation fields. The wind stress and evaporation fields are derived from the ECMWF 1979 - 1993 meteorological parameters data set, while precipitation is obtained from Jaeger [2] monthly precipitation climatology. The total heat flux fields used here, are diagnosed from the OGCM climatological model run. Correction terms (in terms of weak relaxation to SST and SSS climatologies) are also used to account for imperfect knowledge of the heat flux, evaporation and precipitation fields.



Fig, 1: a) Winter subsurface circulation pattern b) Summer subsurface circulation pattern.

Nesting technique

Nesting is a finite-difference technique to simulate a high-resolution domain embedded in a coarse resolution model. In our case, the fine resolution model is ALERMO which is one-way nested along its western boundary (located at 20°E) with the global Mediterranean OGCM [3] constraining volume transport to be conserved between the two models. The condition for the normal barotropic velocity at the open boundary is a modified Flather [4] condition that efficiently allows interior disturbances (possibly due to mismatches between coarse and nested values) to pass out through the lateral boundary. On the other hand, the tangential barotropic velocity at the open boundary as long as baroclinic velocities are directly prescribed from the OGCM. To update the temperature and salinity at the open boundary we use an upstream advection scheme whenever the normal velocity is directed outwards from the modeling area. In cases there is inflow through the open boundary, temperature and salinity are prescribed directly from the interpolated OGCM temperature and salinity profiles. Finally, for the free surface elevation at the open boundary we have adopted a zero-gradient condition.

Discussion of model results

In fig.1a and 1b we present the subsurface (30m) winter (mid February) and summer (mid August) circulation patterns corresponding to the 2nd year of the climatological integration of the model. The circulation patterns suggest that the model can successfully reproduce all the main general circulation characteristics of the area (Mid Mediterranean Jet, Asia Minor Current, Rhodes cyclonic gyre, Mersa-Matruh and Shikmona anticyclonic gyres). Both winter and summer circulation patterns are very rich in mesoscale structures, which are mainly intensified during the summer period. Important seasonal variability characterizes the easternmost Levantine basin and the southern central Levantine. In the former we see the recurrence of the Shikmona anticyclone between winter and summer while in the latter the Mersa-Matruh gyre is showing large variations in strength, form and position. The Mid Mediterranean Jet (MMJ) is well formed and shows seasonal variations in its pathways. During winter it flows along the northern border of the Mersa-Matruh gyre. Along its eastward pathway there are several meanderings taking place which in some cases result in anticyclonic eddy detachments to the north. During summer the MMJ remains hugged to the African coast up to 29oE while the Mersa-Matruh gyre appearing as a three-lobe structure is completely to the north of the jet. During this period, Mersa-Matruh expands spatially and strengthens. As a result the Rhodes gyre is pushed to the north.

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References

1- Blumberg, A.F., and G.L.Mellor, 1987: A description of a three-dimensional coastal ocean circulation model, in Three-Dimensional Coastal Ocean Circulation Models, *Coastal Estuarine Sci.*, vol. 4, edited by N.S.Heaps, pp. 1-16, AGU, Washington, D.C.
2- Jaeger., L., 1976: *Monatskarten des Niederschlags fur die ganze Erde. Berichte des Deutschen Wetterdienstes* 18(139), 1-38.
3- Mediterranean Forecasting System Pilot Project (MAS3-CT98-0171): Second year scientific report.
4- Flather, R. A., 1976: A tidal model of the northwest European continental shelf. *Mem. Soc. R. Sci.* Liege, Ser. 6, 10, 141-164.