NEW INSIGHTS ON THE IERAPETRA EDDY GENERATION

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Abstract

The paper presents results of a 23-year high resolution simulation of the Mediterranean simulation obtained by running the OPA rigid-lid model forced by ECMWF fields several times. The detailed study of a particular eddy highlights the main simultaneous roles played by the Cretan outflow through the Kassos Strait and by the Asia Minor Current instabilities.

Introduction - The Ierapetra eddy (IE) is a well-known feature of the circulation in the Levantine basin, the most eastern part of the Mediterranean Sea, which was first pointed out by the analysis of POEM observations, as an anticyclonic structure located south-east of Crete. This pattern has then been called by [1] as the Ierapetra anticyclone. Several hypotheses for the IE generation have been proposed concerning the role of the wind [2], of the Mid Mediterranean Jet variations [1] and of the Cretan outflow [3]. But some questions remain open concerning the main processes triggering the IE. In this paper, we focus on the generation process of IE, using a high resolution ocean simulation MED16 [4] forced by ECMWF atmospheric fields, repeated several times. In particular, the strategy of the simulation allows to investigate two different ocean circulations forced by the same winds.

Results - We compare the model outputs for years corresponding to the ECMWF atmospheric forcing of year 2000. The generation of IE is modeled in August of year 20 whereas no generation of IE is noticed during year 11. The circulation features are then checked before the beginning of the generation for this particular sets of results, according to maps of the circulation at 56 m depth. During year 20, the Asia Minor Current (AMC) meanders regularly and small anticyclonic vortices appear embedded in the current. These anticyclonic eddies of about 50 km diameter and of thin vertical shape have a short life-time and are often mixed again with the AMC several kilometers forwards. In July, the AMC highlights a large meander and a small anticyclonic circulation is captured at the south-east corner of Crete. The anticyclonic circulation is sandwiched between Crete and Kassos islands. In August (Fig. 1a), the previous small anticyclonic circulation is still centered at the south-east corner of Crete and, at the same time, subsurface saline Cretan waters outflow through the Kassos Strait. The flow of Cretan waters is deviated around the northeast rim of the anticyclonic circulation in an anticyclonic pathway. It consequences an enhancement of negative vorticity inside the anticyclonic circulation. The IE is now well defined with a strong vertical shape and a core of saline waters at subsurface.

During year 11, the Asia Minor Current follows closely the northern coast and meanders are few and of low amplitude. The Cretan Water outflow remains close to the Cretan shelf. No anticyclonic eddy is noticed close to the Kassos Strait (Fig. 1b).

Conclusion - We argue that the condition to have the generation of an Ierapetra eddy in the model needs two ingredients at the same time: (i) the presence of an anticyclonic vortices generated and bring by the Asia Minor Current between Crete and Kassos islands, and, (ii) the outflow of saline Cretan waters winding round the initial anticyclonic eddy. This result has been confirmed by the analysis of other eddies in the simulation. Thus, the wind role, in the model, is not a sufficient ingredient to generate an Ierapetra eddy.

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References

Fig. 1. Currents at 56 m depth in August (a) of year 11 and (b) 20 of the simulation. Salinities higher than 39 are shaded in grey. One vector over two is plotted.