VERTICAL STRUCTURE DYNAMIC OF MESOSCALE EDDIES.

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RESUME

L'étude porte sur la circulation en mer d'Alboran. Les données furent collectées pendant l'hiver 1982. Une coupe verticale représentant la densité potentielle montre clairement le tourbillon anticyclonique. Un modèle analitique quasigeostrophique appliqué à la même section donnent des résultats encourageants.

ABSTRACT

In this paper we describe the circulation in the Alboran sea during winter 1982. Contours of potential density compare favourably with an analytical quasigeostrophic model.

INTRODUCTION

The intent of this study is to quantify the anticyclonic Alboran sea gyre using an analytical model. The Alboran gyre is viewed as a rotating warm pool of water surrounded by quiescent water, its major influence on physical properties like density, velocity, pressure is felt in the upper part of the sea with diminishing effect as the depth gets large. The anaytical model is based on work of HENRICK et al (1).

PHYSICAL DESCRIPTION

A physical description of the Alboran sea is given by LANOIX (2). During the 1982 winter cruise organized by SACLANT CENTER, CTD measurements across a partial traversal of the gyre were taken. A similar track was followed earlier by BRYDEN (3) fig. (1).

(Fig. 2) shows part of the section and contouring of potential density, one can see that the isolines are being depressed, evidence of anticyclonic circulation.

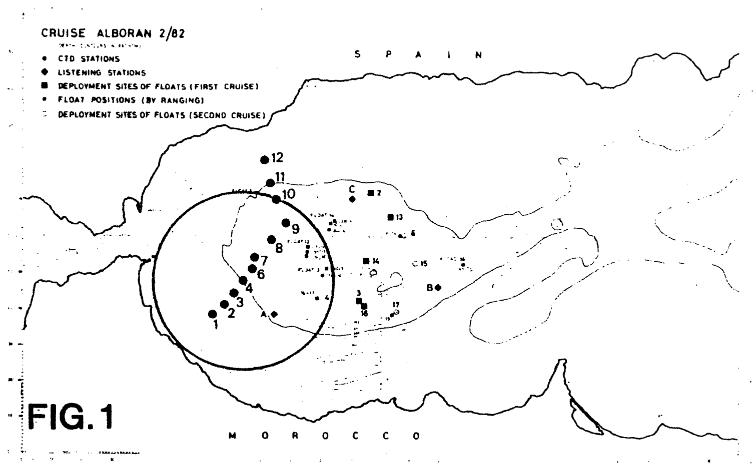

FIG. 1

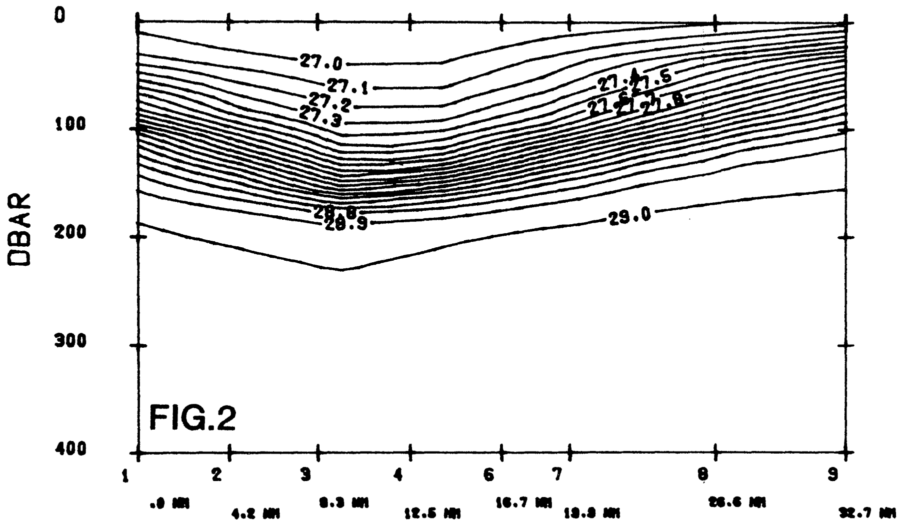

FIG.2

VERTICAL CONTOUR OF PDEN

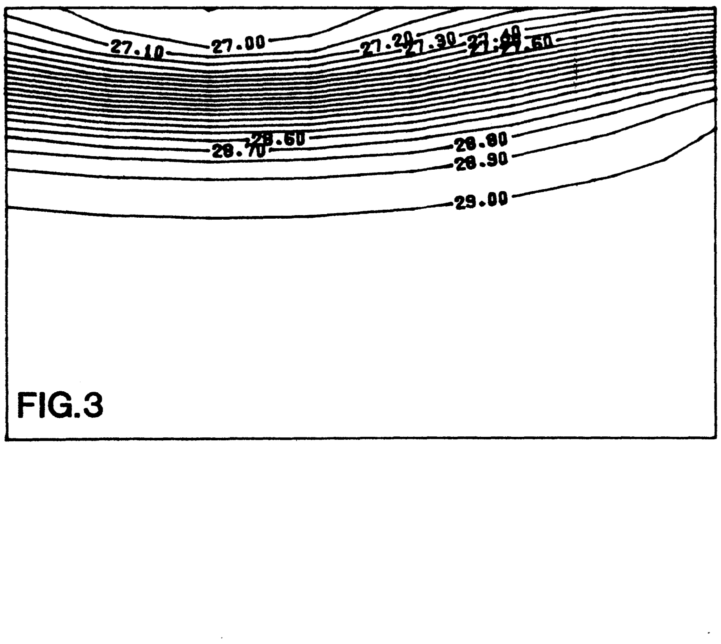

FIG.3

The gyre's center lies on a parallel between stations 3 and 4 (close to latitude 35°50' in agreement with LANOIX). The geostrophic velocity (level of no motion at 400 db) is zero at the center and at the periphery (between stations 10 and 11), The maximum velocity of 1.03 m/s occurs between stations 6 and 7. The eddy's radius is then 25 NM and the Rossby number .25

FORMULATION

The model doesn't explain either formation or decay of the eddy but rather gives a description at a mature stage of development.

The eddy is assumed to be in quasigeostrophic equilibrium, axisymmetric, time indepedent, and frictionless.

We solve the quasigeostrophic potential velocity equation subject to a set of boundary conditions (4). The basic state is a vertically stratified fluid in hydrostatic balance. The potential density of that state is taken as the ensemble average over all the stations between 4 and 11 and approximated by an analytical function. At the periphery and past the level of no motion the pressure fluctuation is zero. At the surface the potential density distribution is approximated by an analytical function.

A vertical normal mode decomposition is used to resolve the vertical structure leading to an eigenvalue equation. We assume that all the energy is in the first baroclinic mode and in order to find the first eigenvalue we must know the velocity at one point (from geostrophic computation). (Fig. 3) shows the potential density isolines, the scale is the same as in fig, (2), we can see that our model retains most of the features of the real gyre.

CONCLUSION

In a complex oceanographic situation (gyre interacting with an incoming jet of Atlantic water) a simple analytical model based on quasigeostrophic theory resolved quantitatively the Alboran gyre. In order to include time dependence and more complex conditions a quasi-geostrophic numerical model of the areas could be developed.

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