O-VI18

ESTIMATION OF THE VERTICAL VELOCITY IN THE EASTERN MEDITERRANEAN SEA

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This paper deals with a simple model of calculating the vertical velocity of the Eastern Mediterranean Sea currents during the summer and winter seasions and to obtain a more detailed spatial representation of the sea-water motion. On the basis of the results of calculations of the horizontal circulation the vertical velocity can be estimated using the equation of continuity (Taslakof et al 1980):

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 \qquad (1)$$

where u and v are the horizontal components of the current velocity in the x and y directions respectively.

The appropriate boundary conditions are as follows:
at the sea surface

$$Z = 0, \quad W = 0$$

and at the depth Z

$$W = -\int_0^z \left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \right) dZ \qquad (2)$$

the geostrophic balance equations are given by

$$2\omega \sin\phi \cdot v = \frac{1}{\rho}\frac{\partial P}{\partial x}$$
$$-2\omega \sin\phi \cdot u = \frac{1}{\rho}\frac{\partial P}{\partial y} \qquad (3)$$

where $2\omega\sin\phi$ is the coriolis parameter
$\frac{\partial P}{\partial x}$ and $\frac{\partial P}{\partial y}$ are the horizontal pressure gradient.
ρ the sea water density.
From equation (3) and by integration (2) we can obtain that

$$\frac{1}{2\omega\sin\phi} \cdot \frac{\partial(2\omega\sin\phi)}{\partial y} \cdot v = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}$$

or

$$\frac{\mathrm{ctg}\,\phi}{R} \cdot v = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \qquad (4)$$

R is the radious of the earth
from equations (2) and (4)

$$W = -\frac{\mathrm{ctg}\,\phi}{R}\int_0^z v \, dZ \qquad (5)$$

The horizontal compoenets of current (u,v) were calculated using the dynamic method (Said, 1984). The reference level was taken at 1000-deciber surface for both summer and winter seasons.

RESULTS

Fig. (1), illustrates the vertical current velocity at 50 m level during the summer season. From this figure the areas of water rising are coincide with the central part of the Levantine cyclonic gyre. Sinking in the Eastern Mediterranean is found in the Libyian Sea and the borders of the cyclonic gyre exists in the Levantine Sea. The values of the vertical velocities in the Eastern Mediterranean were of order of 10^{-4} cm/sec.

The distribution of the vertical velocity at the other levels (50 m, 100 m 250 m and 300 m) during the summer and winter seasons have the same character as that was observed in fig. (1).

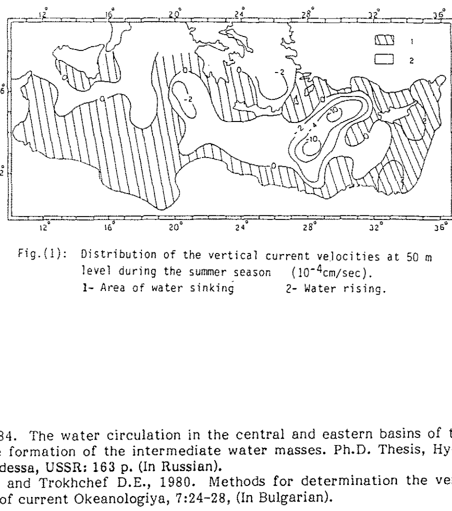

Fig.(1): Distribution of the vertical current velocities at 50 m level during the summer season (10^{-4}cm/sec).
1- Area of water sinking 2- Water rising.

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O-VI19

PHYSICAL OCEANOGRAPHIC ASPECTS OF THE
WESTERN AEGEAN SEA : NORTH EUBOIKOS GULF

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ABSTRACT

Temperature and salinity data, collected in 1983, are used to investigate hydrographic conditions in the North Euboikos Gulf (Western Aegean, Greece). Eulerian current measurements are also examined to study spatial and temporal variations of near-surface and near-bed currents.

INTRODUCTION

The North Euboikos Gulf, on the eastern coast of the Greek mainland, is an elongated embayment, with depths below 100m at its southern section, but reaching 420m in the northeast (Fig. 1). It is joined with the South Euboikos Gulf through the Euripus Channel (sill depth 8m; width 40m) and with the western Aegean Sea through the Oreos Channel. The area is of particular interest for environmental studies because it receives freshwater from underwater springs, which are found particularly in its southern section (1), (2) and (3) and also the slag from the "LARKO" iron-nickel alloy smelting plant. This contribution is concerned with an initial assessment of physical oceanographic conditions in the North Euboikos Gulf and the Oreos Channel.

METHODS

Water temperature and salinity data from selected depths, were obtained using conventional instrumentation. Eulerian current observations were made, in the near-surface and near-bottom layers, with the help of self-recording current meters (Aanderaa RCM4); these were deployed using an L-shaped mooring array with two anchors and subsurface buoyancy.

RESULTS AND DISCUSSION

The analysis of temperature and salinity distributions, in the North Euboikos Gulf during summer (August), indicated a surface mixed water (24.0-25.0°C, 37.0-37.1) layer (extending down to about 20m), a thermocline, an intermediate layer of minimum salinity (36.65 at 50m) and a fairly homogeneous bottom layer of low temperature (12.0-13.0 °C) and of relatively higher salinity (37.2-37.4). In autumn (November), due to convectional mixing, the surface mixed layer (16.0-16.5 °C, 37.1-37.2) extended deeper (down to around 50m). The intermediate layer of minimum salinity was observed at 75m.

In the Oreos Channel, sea water salinity increased with increasing depth. The intermediate layer of minimum salinity was not formed here. Seasonal salinity observations carried out in the South Euboikos Gulf, by other investigators (4), indicated that, throughout the year water salinity here, remains higher than 37.5 and, in general, increases with increasing depth. A likely mechanism for the formation of the intermediate layer of minimum salinity, in the North Euboikos Gulf, is mixing between the sea water and freshwater supplied by underwater springs (Fig. 2).

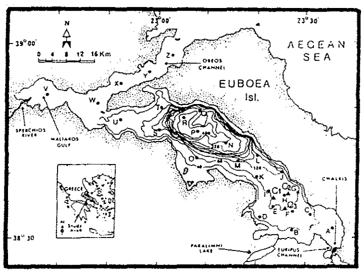

Fig. 1 The study area (depth contours in m), showing the location of the oceanographic sampling stations (●) and the current meter stations (▲).

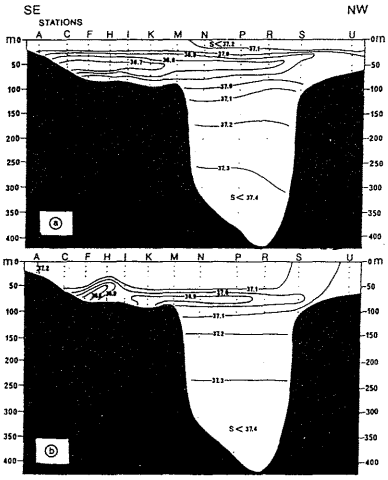

Fig. 2 Vertical distribution of salinity along a central section: (a) during summer, and (b) during autumn. For location of stations, see Fig. 1.

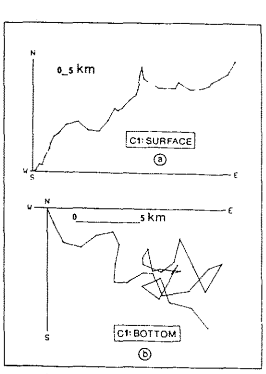

Fig. 3 Progressive vector (PVD) diagrams for daily residual water movements in the North Euboikos Gulf (Station C1): (a) near-surface between 22/08/83 and 26/09/83; and (b) near-bed between 22/08/83 and 26/09/83. For location of Station see Fig. 1.

Upper layer salinity in the Oreos Channel decreased eastwards, suggesting that surface water of relatively low salinity is likely to be found in the western Aegean Sea, this being due to spreading of brackish water from Thermaikos Gulf (5) and the Black Sea (6), (7) and (8).

In the North Euboikos Gulf, currents are, generally, weak; that is, of the order of 5-15 cm s^{-1} at the near-surface layer, reducing to <5 cm s^{-1} in the near bed layer. Near-surface daily residual currents are predominantly towards the northeast; they appear to be the response of the embayment waters to long-term meteorological conditions with cycles of 5-7 days. Changes in direction of daily residual currents are particularly noticeable in the near-bed layer (Fig. 3).

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