O-IV10

Horizontal Circulation of the Eastern Mediterranean Waters during the Winter and Summer seasons

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ABSTRACT

The water circulation of the Eastern Mediterranean at the free sea surface and at the 50, 100, 300 and 500 db surfaces was computed during the winter and summer seasons using the dynamic method. The reference level was taken at the 1000 db surface. The used data were taken from 1338 hydrographic stations collected from several expeditions carried out by different countries during the last 20 years (1963-1982). 680 stations were collected in the winter season and 658 stations in summer (obtained from the Hydrographic Data Centre B, Moscow). Vertically unstable stations were either corrected for temperature or salinity or rejected if many levels of instability were observed. The average values of temperature and salinity of these collected data were computed, using the optimum interpolation of the correlation algorithm, in stations distributed in a regular net one degree longitude by one degree latitude for winter and summer seasons.

The fulfilment calculations evidenced the considerable stability of the geostrophic water circulation in the eastern and central basins of the Mediterranean Sea. The most existence features of the geostrophic circulation during the winter and summer seasons were : the vast cyclonic gyre in the Levantine Sea, enveloping the southern part of the Aegean Sea; the cyclonic gyre in the Ionian Sea; and the anticyclonic gyre in the Libyan Sea and near the Egyptian coast.

These main features of the dynamic relief were also observed by several authors, and testified the stability of the Mediterranean water circulation through long standing survey. However, some distinctions were obtained from the present work when comparing with the previous works.

The geostrophic current velocity varied between 5-10 cm/sec in the Libyan Sea, 15-25 cm/sec near the Egyptian coast and between 35-40 cm/sec in the eastern part of the Levantine Sea. At the straits of Crete island, it reached 15-30 cm/sec. Particular noticeable differences between the winter and summer surface current velocity in the eastern and central basins of the Mediterranean Sea were not found.

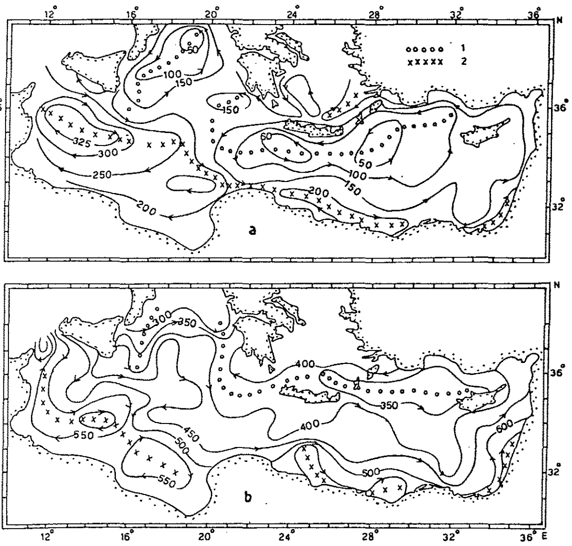

Fig.(1). Dynamic relief (dyn. mm.) of the free sea surface during : a- winter and b- summer seasons.
1- depression and 2- crest of the dynamic relief.

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O-IV11

Calculation of Wind-Driven Currents in the Mediterranean Sea

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The average wind speed over the Mediterranean Sea is not more than 6-7 $m.sec^{-1}$. This wind causes a current at the sea surface with an average velocity of about 5 cm sec^{-1} (Ovchinnikov, 1966). The aim of the present work is to calculate the wind-driven current in the Mediterranean Sea, on the basis of Ekman's formula, using Krasuck and Saoskan's method (1970). The atmospheric pressure gradient, the curvature of the isobars and latitudes are the main parameters in calculating the wind-driven currents.

The velocity of the wind-driven current according to the empirical correlation which depends on the wind speed W and the geographical latitude ϕ is given by :

$$V = \frac{KW}{\sqrt{\sin \phi}} \qquad (1)$$

The coefficient K represents the relation between the current velocity and the wind speed. The transmission of wind energy to the sea is carried out by several processes. One of them is the energy transmission throughout the tangential wind stress, which is given by :

$$\tau = C \rho W^2 \qquad (2)$$

where, τ - wind stress, ρ - air density, W - wind speed, and C - coefficient of tangential wind stress. The second process, is the orbital wave motion. In this case, the velocity of water particla (V') at the surface is given by :

$$V' = \left(\frac{\pi H}{L} \right) C_0 \qquad (3)$$

where, H - wave height, L - wavelength, and C_0 - wave velocity.

On the basis of the mentioned above, particularly the intercommunication between wind, wave and currents, a monograph (Fig.1) was constructed by Krasuck and Saoskan (1970) for simplifying the problem of short-term prediction of the wind-driven currents in the ocean. In order to select the synoptic situation which causes strong drift current at the sea surface, the weather charts of January, February and March for eight winter seasons were analysed (Synoptic Bulletin, 1970-1977). From these charts, the cyclons appeared during winter once or twice in a month. The more considerable pressure gradient over the Mediterranean Sea was observed during the periods 28-31 January 1975 and 15-18 January 1976. During these periods the atmospheric pressure in the centres of the cyclons over the sea was less than 1000 mb (Fig.2).

The obtained surface circulation pattern of the Mediterranean waters from the pure wind-driven current calculation during the period of investigation (15-18 January, 1976) is shown in Fig.3. The calculated velocity values of the drift current are in general more than 20 $cm.sec^{-1}$. The highest values (40-60 $cm.sec^{-1}$) are observed in the along the Libyan and Egyptian coasts and in the southern part of the Aegean Sea. The lowest values (10-20 $cm.sec^{-1}$) are observed in the Western Mediterranean and in the northern part of the central basin.

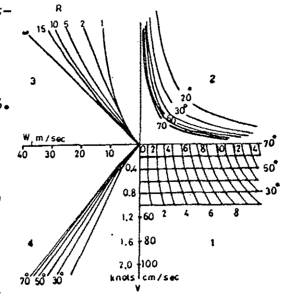

Fig.(1). Monograph for calculating the wind-driven currents. (after Krasuck and Saoskan, 1970).

The obtained wind-driven current scheme of the Mediterranean is agreable mostly with the previous circulation models based on either dynamic and/or numerical methods.

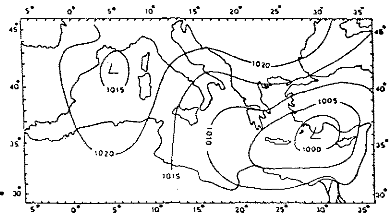

Fig.(2). Distribution of the atmospheric pressure (mb) over the Mediterranean Sea during the period 15-18 January 1976.

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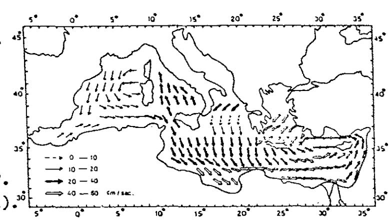

Fig.(3). The calculated wind-driven currents during the period 15-18 January 1976.