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Calculation of Wind-Driven Currents in the Mediterranean Sea

M.-A. SAID

National Institute of Oceanography & Fisheries, Kayet Bay, Alexandria (Egypt)

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 :

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

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 :

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

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 particle (V') at the surface is given by :

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

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.

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

References

- Krasuck, V.C. & I.M. Saoskan. 1970. On the calculation of wind-driven currents in the ocean. *Meteorology & Hydrology*, 9 : 68-74 (In Russian).
 Ovchinnikov, I.M. 1966. Circulation in the surface and intermediate layers of the Mediterranean. *Oceanology*, 6(1) : 48-59.
 Synoptic Bulletins. 1970-1977. Moscow, GMC, USSR (In Russian).

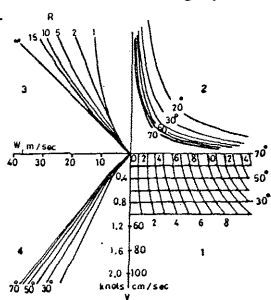


Fig. (1). Monograph for calculating the wind-driven currents. (after Krasuck and Saoskan, 1970).

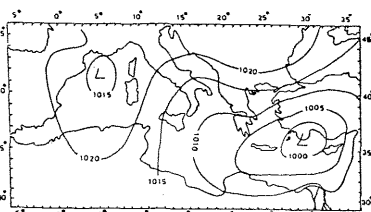


Fig. (2). Distribution of the atmospheric pressure (mb) over the Mediterranean Sea during the period 15-18 January 1976.

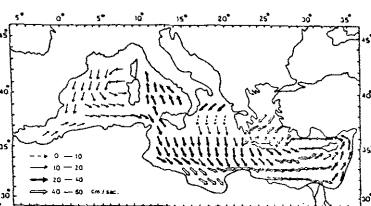


Fig. (3). The calculated wind-driven currents during the period 15-18 January 1976.