O-IV4

DIURNAL VARIATIONS OF THE SEA SURFACE THERMAL BALANCE COMPONENTS ON THE ROMANIAN BLACK SEA SHELF

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During 1979-1985, hourly hydrological and meteorological measurements have been carried out in 15 multidiurnal anchored stations in the central area of the Romanian Black Sea shelf. Direct measurements of the incoming and reflected solar radiation have been suplemented with determination of the longwave backradiation flux (Q_B) and of the latent (Q_E) and sensible (Q_H) heat fluxes computed using bulk aerodynamic formulas (1). The results have been processed using a special computer program in order to obtain the parameters of the liniar or parabolic trend, as well as the amplitude and phase of the diurnal oscillation, using the Gauss method for solving the set of normal equations derived from the least square method.

The available data cover the period extending from April to October and have been collected in various hydrological and meteorological conditions. The analysis shows that the averages of the heat losses are smaller in April-June (warming of the surface layer) and higher in August-October (beginning of the cooling period). Due to the contribution of the solar radiation (though smaller in spring), the total balance is positive in the first period, while in the second period the averages of the total balance are negative. Also, the heat losses at the sea surface are mainly due to evaporation in the second period, while in the first period the backradiation prevails (though the values of Q_B are smaller than those for the second period). The normalized residual errors are small, thus reflecting a good agreement between the original values and those computed by superposing a diurnal oscillation on a fairly nonlinear trend. The nonlinear character is more pregnant only for the total loss and the global balance due to the phase differences between their components.

As for the amplitude of the diurnal oscillations, no significant seasonal variations can be found, except for the latent heat flux Q_E, which has higher amplitudes in the second period.

The analysis is very useful in determining the fast changes of the thermal structure of the upper layer of the sea.

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O-V1

A NUMERICAL STUDY OF BAROCLINIC SHEAR INSTABILITY ALONG THE NORTH AFRICAN COAST

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Numerical hydrodynamic ocean circulation models are used to examine the instability mechanisms for the generation of mesoscale eddies along the north African coast. In particular two-active-layer reduced-gravity and finite-depth models are used.

There are many physical factors which exert an influence on the circulation hydrodynamics of the western Mediterranean; wind stress, hydraulic forced flow (inflow/outflow through the Straits of Gibraltar and Sicily), thermo/haline circulation, and topography. The purpose of this study is to examine the influence of hydrodynamic flow instabilities on the generation of mesoscale eddies along the Algerian coast of north Africa.

There are many features of the general surface circulation of the western Mediterranean Sea (Allain, 1960; Bethoux, 1980; Ovchinnikov, 1966) which appear to be either a direct response to hydraulic force flow, e.g. the North African current, or wind stress, e.g. the circulations in the Tyhrennian, Ligurian and Balearic Seas and in the Provencal and northern Algerian Basins. However, recent satellite imagery shows considerable mesoscale eddy activity within the western Mediterranean, particularly along the Algerian coast. These eddies appear to be the result of either barotropic and/or baroclinic flow instabilities.

The numerical models used in these experiments are two-active-layer, reduced-gravity and finite-depth, hydrodynamic, primitive equations models on a β-plane with a horizontal grid resolution of $.1^{\circ}$ by $.05^{\circ}$. The two-active-layer reduced-gravity model is designed to simulate a three-layer western Mediterranean with the first-active layer representing the inflowing Atlantic water and the second-layer representing the intermediate water isolated from the bottom topographic effects by an infinately deep and inert lower layer. The two-layer finite-depth model simulates a two-layer system with inflowing Atlantic water in the upper-layer and Mediterranean deep water in the lower-layer. This version includes the topographic effects.

The model equations are solved using the explicit (reduced-gravity) and semi-implicit (finite-depth) versions of the Hurlburt and Thompson (1980) semi-implicit model with two important modifications: 1) the ability to handle realistic coastline geometry added by A. Wallcraft (personal communication) and 2) the outflow boundary conditions are modified Orlanski (1976) radiation boundary conditions.

The model was driven by specifying the inflow through the Strait of Gibraltar in the upper-layer and the Strait of Sicily in the second-layer. The inflow velocity in the upper-layer was chosen to yield an inflow volume transport on the order of 1.6 Sv (where Sv = 10^6 m^3/sec). While the inflow in the second-layer was varied, depending on the particular case study, from no inflow in this layer to a maximum of 1.2 Sv.

The results from the two-active-layer reduced-gravity model case studies indicate that baroclinic shear instability is a plausible mechanism for the formation of eddies along the Algerian coast. The direction of propagation of the eddies and meanders of the north African current appear to be a function of the velocity field in the second-layer. With high westward current speeds in the second-layer, the eddies tend to drift northwestward. However, as the westward current speed is decreased, the eddies tend to move towards the eastnortheast. Satellite observations suggest the eastnortheast path and in situ observations suggest a weak flow in the intermediate layer which is consistant with the model results.

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