A BOUNDARY LAYER MODEL OF THE CIRCULATION IN THE WESTERN COASTAL REGION OF THE NORTHERN ADRIATIC SEA

P. MALANOTTE RIZZOLI+ - F. DELL'ORTO

+ Laboratorio Dinamica Grandi Masse-CNR, S. Polo 1364, Venezia

Very recently, a series of studies has been carried out focusing on the average seasonal conditions relative to late fall and winter in the Northern Adriatic from a phenomeno - logical, theoretical and numerical point of view (Hender - shott, M.C. and Rizzoli, P., 1976; Malanotte Rizzoli, P. and Gazzillo, D., 1976; Malanotte Rizzoli, P., 1977).

In dealing with late fall or winter situation, one can notice that, in most of the hydrological data at disposal, the fields of temperature, salinity, density are vertically mixed to essential homogeneity. During some winters, like those of 1966 and 1972, there was moreover the formation of a pool of water with particularly high density ($\sigma_t > 29.4$) in the northernmost part of the basin. This pool protrudes southward with a characteristic "tail" along the western side of the Adriatic, following isobaths.

A mathematical-numerical model was constructed to describe and reproduce the late fall-winter conditions in the Adriatic Sea (Hendershott-Rizzoli, 1976). Nevertheless, capitalizing upon the observed vertical homogeneity of the hydrological quantities (temperature, salinity, density), the model cannot deal with the western undercoastal strip adjacent to the Italian coastline. In this strip, in fact, also during late fall and winter, the vertical stratification in the hydro - logical quantities is maintained by the important river out flows, concentrated along the north-western Italian side.

A side wall boundary layer analysis is thus performed on the primitive model equations for the main, interior part of the basin. This analysis capitalizes upon a formal expansion procedure of all the field functions in a small characteristic dimensionless parameter, the (dimensionless) horizontal eddy diffusivity. When the interior of the basin is vertically homogeneous, the over mentioned expansion procedure together with the boundary layer analysis lead to a model equation for the Italian undercoastal strip which preserves the observed vertical stratification in the field functions (Malanotte Rizzoli, P. and Dell'Orto,F., 1978).

The side wall boundary layer model equations are specifically:

$$v^s_y = S^s_y = 0$$

$$v^s_z = -S^s_\xi \qquad (1)$$

$$z\, S^I_y\, S^s_{\xi z} = \underline{\bar{\kappa}}\,(S^s_{zzz} + S^s_{\xi\xi z})$$

where subscripts indicate partial derivatives and:

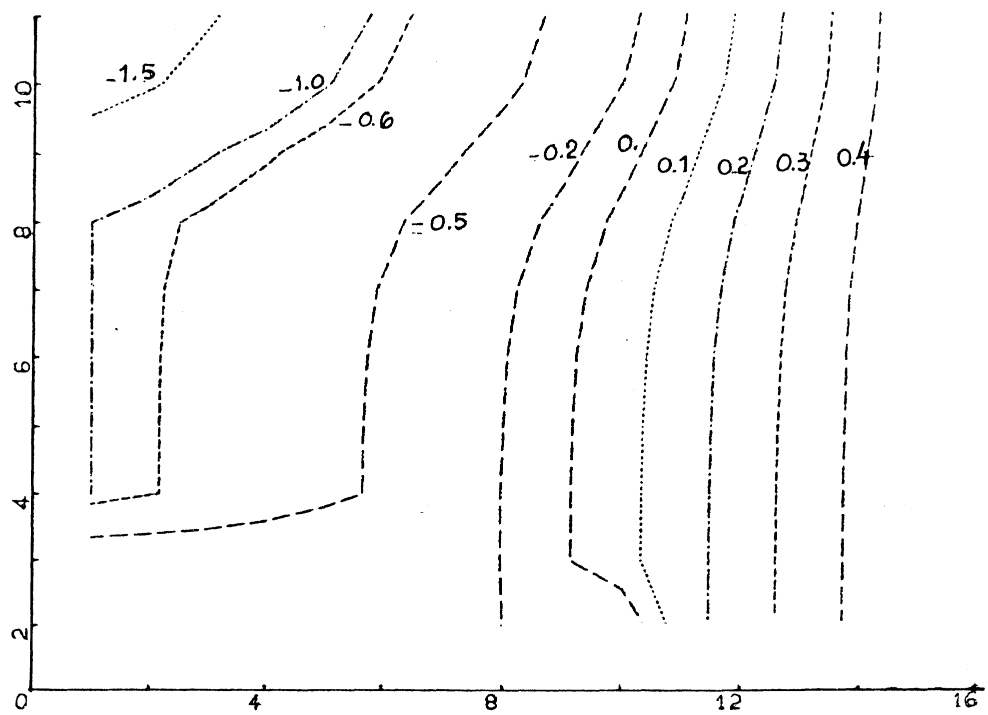
v^s = side wall alongshore velocity field

S^s = side wall (dimensionless) density field

S^I = interior density field

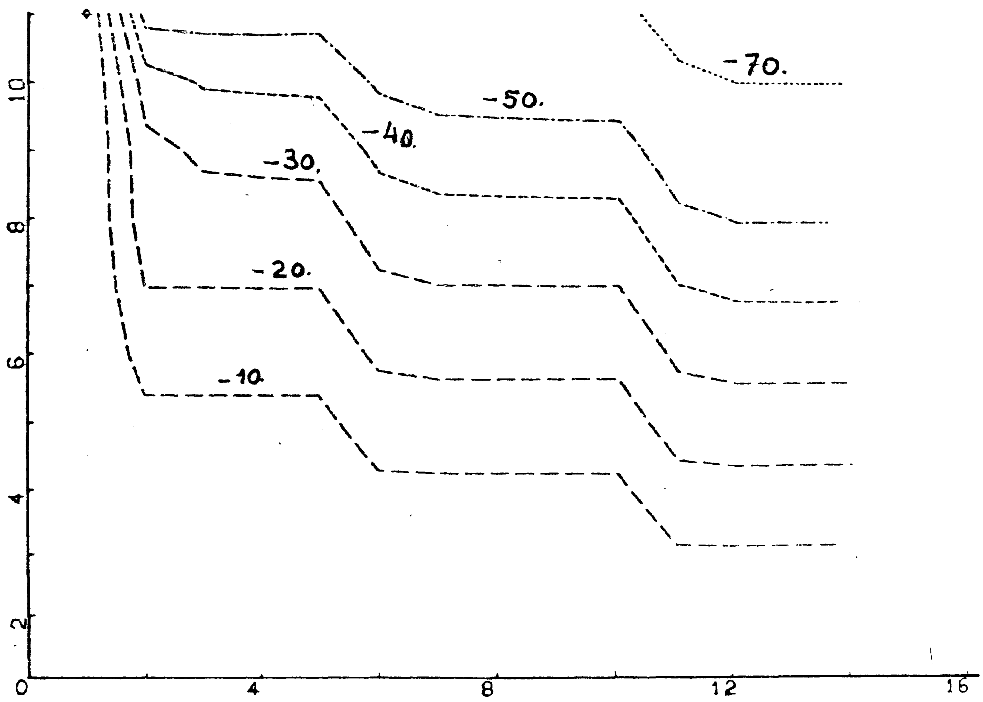
z, ξ are respectively, vertical and East-West (normal to the coast) coordinates.

Preliminary numerical runs were carried out, by allowing first the general model to evolve in time. At every successive time stepping, the boundary layer model was thereafter numerically integrated, using the previously determined interior density field in the model equations (1) and the relative boundary conditions. These latter ones were imposed using the experimental evidence furnished by the oceanographic campaign carried out during Winter 1972 (Malanotte Rizzoli, P., 1977). Typical numerical Adriatic cross-sec-



Typical cross-section density distribution for $S^S = 2(\sigma_t - 29.0)$.

FIGURE 1



Typical cross-section alongshore velocity distribution in dimensionless units.

tions for the boundary velocity and density fields are given in fig. 1.

The cross-section density distribution of fig. 1 shows the characteristic vertical density stratification as obtainable by the experimental evidence in the undercoastal region of about 15-20 km width.

The cross-section alongshore velocity distribution of fig. 1 shows the general trend for the velocity to be in southward direction (negative intensity), thus reproducing in good qualitative agreement the characteristic and concentrated littoral current which flows southward along the Italian side.

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