Report on the different thermohaline features recorded in the outer part of the Gulf of Trieste (Northern Adriatic) in July 1990 and 1991

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In the frame of the Alpe Adria Project the thermohaline and density structure were recorded in the outer part of the Gulf of Trieste (TR. 3 and TR. 4) in July 1990 and 1991 (Fig. 1). Measurements were carried out using a CTD Idronaut mod. 401 multiparameter probe.

An analysis of the data leads to the identification of two welldistinct thermohaline situations. In the spring and at the beginning of summer 1990 the volume of freshwater injected in the basin by the Tagliamento and Isonzo Rivers was lower than in the previous years, contributing to the absence of a light surface layer with low salinity and high buoyancy and of a thermohaline discontinuity. This condition led to radiative heating of the whole water column, including the deep higher-density nucleus formed in winter. The absence of freshwater inflows caused the drifting of high-salinity water masses from the Middle Adriatic and their spreading over the Gulf up to the surface layers, thanks to the absence of thermohaline stratification and to the presence of comparable density water. This water advected from the south showed the following values: a) in the outer part of the Gulf: temperature 21.70 ± .03°C, salinity 37.54 ± .01 PSU and γt 26.27 ± .01 kg m ; b) in the inner part: temperature 22.51 ± .05°C, salinity 37.44 ± .01 PSU and γt 25.95 ± .02 kg m . (1)

In 1991 fluvial inputs created a situation that was the opposite of the 1990'one. The presence of a surface layer with low salinity and high buoyancy, separated from the dense waters of the bottom layer by a well-defined pycnocline which was extended over most of the water column (3-12 m). This situation limited radiative heating to the surface mass, maintaining a deep low-temperature nucleus. These thermohaline conditions greatly reduced the influence of advection waters coming from the Middle Adriatic. In July 1991, in fact, such inflows scarcely affected the Gulf of Trieste (Fig. 2).

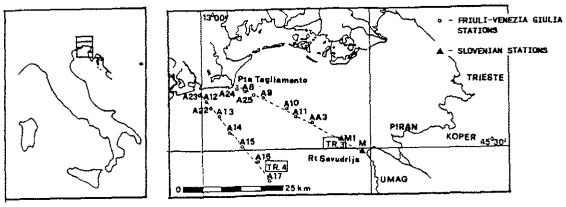

Fig. 1.- Distribution of the sampling sites

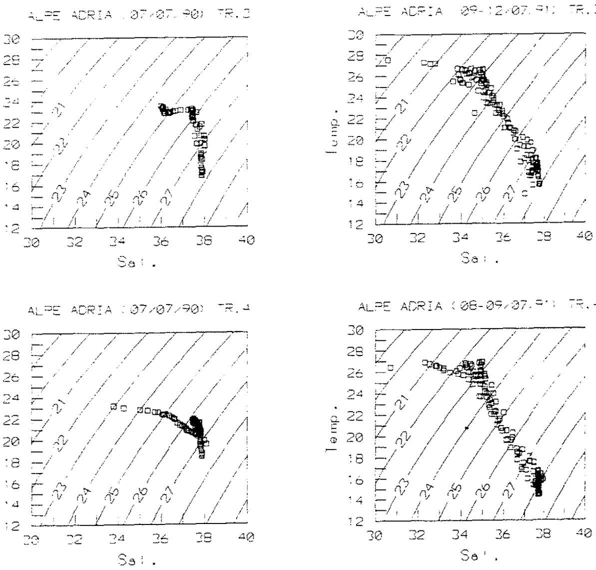

Fig. 2.- Temperature and salinity distribution in july 1990-1991 measurement carried out using a CTD multiparamenter probe.

(1) The confidence limits of the means are obtained from the standart error

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Transmission of the seiche energy through the Otranto Strait

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Thirteen episodes of seiches, recorded at three locations along the east Adriatic coast between 1963 and 1986, were analysed. Energy spectra of residual sea levels showed that the first Adriatic mode, whose period is 21.6 hours, dominated over the others. Therefore, a band-pass filter was applied to isolate this oscillation. Intervals with free oscillations only were determined by analysing envelopes of filtered residuals. Envelopes covering the separated intervals were represented by exponential curves wherefrom decay times were estimated. The average decay time obtained in that way for three analysed stations (Bakar, Split and Dubrovnik) equalled 3.3 ± 1.2 days. This compared favourably well with results published by GODIN and TROTTI (1975) for the Trieste station.

Two flat-bottom models were used to interpret the empirical results. The first model, incorporating linear bottom friction (DEFANT, 1961), reproduced the average decay time with the bottom-friction coefficient k = 1.74 x 10^{-3} m s^{-1}. The second model, reproducing energy transmission through the open boundary, required a coefficient of energy transmission b = 0.063 (implying that 22% of the seiche energy is transmitted through the Otranto Strait). In such a manner maximal values for the two coefficients were determined.

Finally, a numerical model was developed in order to describe damping caused by both mechanisms. The real topography of the Adriatic Sea was taken into account. A series of computations for different possible values of coefficients k and b were carried out. An example of elevations obtained is given in Fig. 1. Using the empirically obtained decay time and values of k which had previously been determined for the Adriatic (ORLIC, 1987) it was possible to estimate values of b. It was found that for k reaching the minimal value detected in the Adriatic (0.5 x 10^{-3} m s^{-1}) b equals 0.018. In that case 7% of the seiche energy passes through the Otranto Strait. The model allowed the maximal value of k = 0.74 x 10^{-3} m s^{-1} when, of course, b equals zero and the seiche energy is perfectly reflected back into the Adriatic. It might be concluded that only a small percent of the seiche energy incoming to the Otranto Strait is transmitted to the Ionian Sea. Both the shape and closeness of the Adriatic Sea make the seiches persistent.

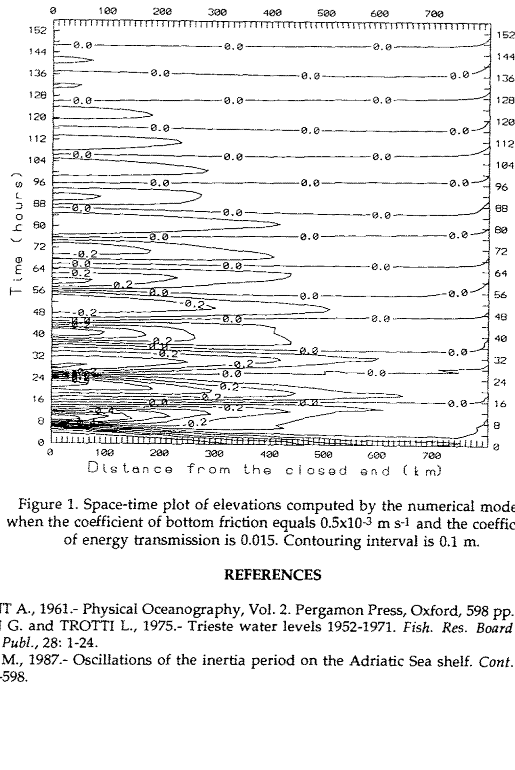

Figure 1. Space-time plot of elevations computed by the numerical model, when the coefficient of bottom friction equals 0.5x10^{-3} m s^{-1} and the coefficient of energy transmission is 0.015. Contouring interval is 0.1 m.

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