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ON THE FINE STRUCTURE OF THE SEASONAL THERMOCLINE OFF CONSTANȚA

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ABSTRACT:

Several continuous temperature profiles made in 1977 over the Romanian continental shelf revealed, for the first time, the existence of a fine structure with characteristic horizontal space scale of the order of 10-15 km and verticale scales of 2-5m. Repeated profiling in a fixed point allowed the time evolution of the fine structure to be observed.

The development of the seasonal thermocline is governed by incident radiation flux, heat balance at sea surface and mechanical action of the wind. Several observations revealed, however, that instead of a single transition layer, a step-like structure can develop in both seasonal and main thermocline (1,5).

During 1977, vertical temperature profiles recorded with a bathythermograph in several points of the Romanian Black Sea shelf revealed such complex structures of the seasonal thermocline. In such cases, the transition between the upper layer and the intermediate cold layer was made-up by several quasihomogeneous layers separated by thin interfaces with sharp temperature gradients.

The maximum temperature gradients were observed in the

shallow waters, 2o m deep (Fig.1), where three homogeneous layers of 22.8°C, 19.3°C and 7.4°C were separated by transition sheets where temperature gradients reached 2.4°C/m and, respectively, 8.4°C/m.

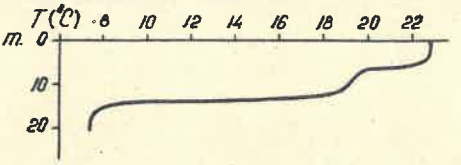

Fig.1 - Temperature profile recorded in shallow waters, July 1977.

The measurements carried out in a hydrological section 3o n mi long showed that the horizontal extent of such a structure is limited to a couple of tens of kilometers.

Thus, in the lo n mi offshore station, the seasonal thermocline represents a continuous temperature decrease between lo m and 34 m (Fig.2). At 2o n mi, the thermocline is made by five quasihomogeneous layers, 2-4 m thick, between 6 and 28 m depth. At 3o n mi, the structure of the thermocline is strongly different, being formed by only two homogeneous layers (Fig.2).

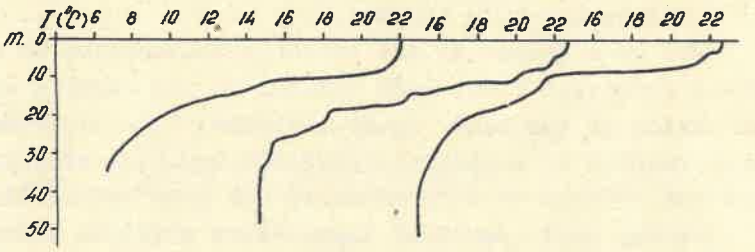

Fig.2 - Temperature profiles recorded at lo,2o and 3o n mi off Constantza, June 1977.

Fifteen days later the measurements made in the same points also revealed the presence of a fine temperature structure (Fig.3). Again, the horizontal extent of such a structure did

not exceed 15 km, the thickness of the homogeneous layers being the same as before, and the gradients in the transition sheets reaching 2.3°C/m.

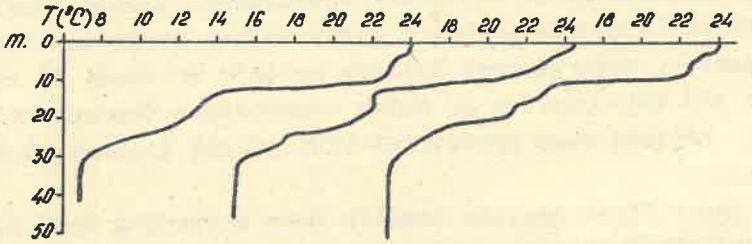

Fig.3 - Temperature profiles recorded at 20,25 and 30 n mi off Constanța, July 1977.

The repeated observations made over a three day period at the offshore end of this section (30 n mi distance from shore), allowed the short time evolution of the vertical temperature profile to be analysed. The general situation was characterised by a continuous trend of increasing the surface temperature, especially by the end of the observation period. The results (Fig.4) showed the continuous deepening of the quasihomogeneous layers 3-5 m thick, and the generation of some new such layers above the preceeding ones.

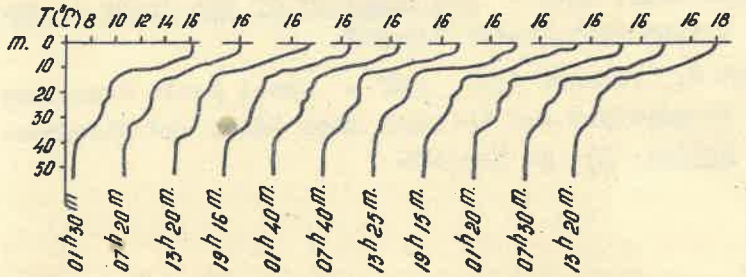

Fig.4 - Time evolution of the seasonal thermocline fine structure 30 n mi off Constanța.

The existence of a multilayered structure of the seasonal thermocline may be explained by the sawtoothlike variation in the incoming solar radiation (2), which governs the deepening of the interface (3), or by the successive mixing action of the storms (4). For the investigated period, these structures could be generated by a combination of these two mechanisms. Indeed, the air temperature at Constanța showed a sawtoothlike evolution during May-July period, with several heating periods of about 15 days separated by 3-6 days periods in which temperature dropped by 4-6°C. These cool periods were associated with strong lasting winds of 8-12 m/s.

These first results require more intensive work in order to obtain further information about this phenomenon which is essential for studying the vertical stability of the water column, the vertical turbulent heat transfer and the internal waves propagation.

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