TRANSFORMATION OF LEVANTINE INTERMEDIATE WATER TRACKED BY MEDARGO FLOATS IN THE WESTERN MEDITERRANEAN

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Abstract

A clustering methodology is applied to investigate the thermohaline structure of Levantine Intermediate Water (LIW) in the western Mediterranean basin. Sixteen free-drifting hydrographic profilers were deployed in the framework of the MFSTEP project (EUK3-2001-00174) from September 2003. A total of 925 CTD profiles collected up to the beginning of February 2006 have been used in the analysis. The results are in good agreement with the general circulation scheme for intermediate waters in the basin and confirm the hypothesis of a "discrete-continuous" thermohaline structure of LIW.

Keywords : Intermediate Waters, Salinity, Temperature, Western Mediterranean.

In 1985 the hypothesis of a "discrete-continuous" structure of LIW was proposed [1]. According to this idea, the LIW layer can be thought of as an "emulsion" of background water with high temperature and salinity, in which lenses and sheets of even more saltier and warmer waters are dispersed. The background is initially formed by LIW, sunk down to the corresponding isopycnal level in its formation region before circulating at intermediate depths. New volumes of LIW, generated due to density increasing by cooling in winter of water salinizied in summer due to evaporation in the surface layer, continue to sink down to the depth of the isopycnal level of this background water [2]. These saltier and warmer volumes of LIW are eventually broken into smaller ones by mixing processes, mainly of double diffusion nature. The smallest lenses dissipate, maintaining the high temperature and salinity of the background layer.

CTD data from 16 profiling floats (MEDARGO component of the MFSTEP project) operating in the western Mediterranean from September 2003 until the beginning of February 2006 were analysed. Objective cluster analysis [3] was used to classify the ensemble of 925 LIW θ-S curves to unveil classes of differently transformed waters. A maximum radius r=0.05^{o}C was applied so that, to be included in the same cluster, θ-S curves may differ at most in θ by 0.05^{o}C or in S by 0.0125 from the central θ-S curve. As a result seven clusters were obtained. In Fig.1 one can see three main groups of clusters, represented by their centres of mass.

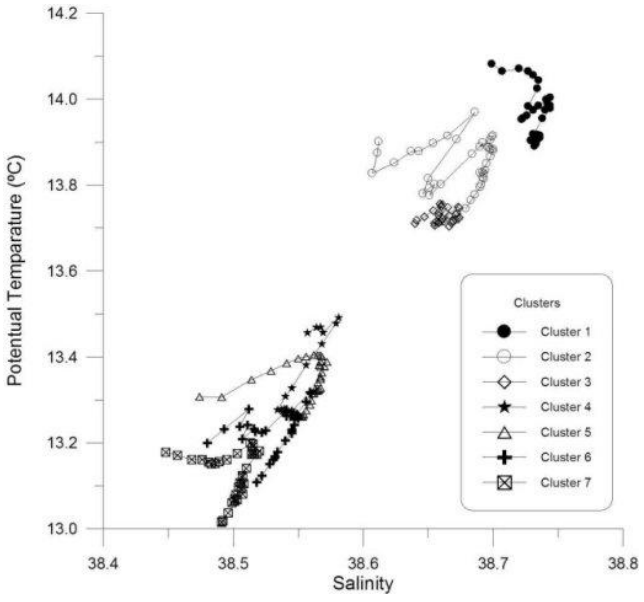

Fig. 1. Representative θ-S curves for 7 clusters.

Clusters 1, 2 and 3 are situated in the saltier and warmer part of the θ-S diagram and correspond to the saltiest LIW located in the Tyrrhenian subbasin. Less saline clusters 5, 6 and 7 include the θ-S curves in the interior of the Provençal and Algerian sub-basins (Fig. 2). θ-S curves included in cluster 4 lie in the channel of Sardinia area and in the central part of the Provençal and Algerian sub-basins marking the transition between less transformed LIW from the eastern part and more transformed LIW from the western part (Fig. 2).

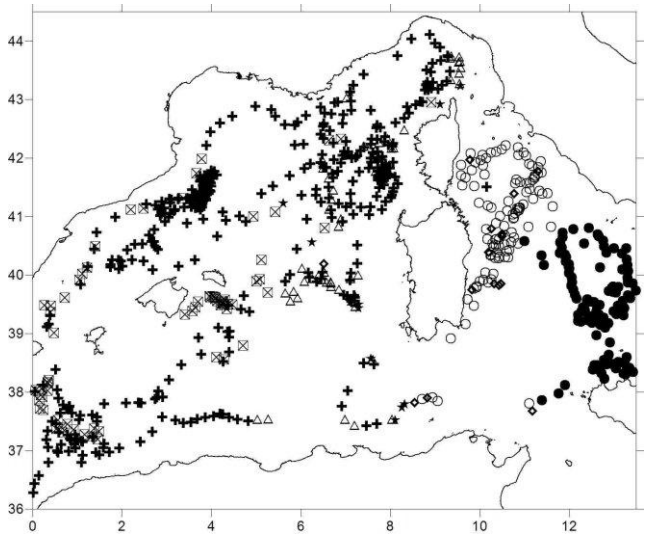

Fig. 2. Float positions, marked according to the cluster they belong to.

The θ-S curves belonging to the largest cluster (number 6) are encountered everywhere west of Corsica and Sardinia, and they should be considered as the background LIW. Less transformed LIW from cluster 5 and more eroded one from cluster 7 are embedded into the area occupied by the background LIW from cluster 6. An interesting fact is that some floats sampled differently transformed LIW in consecutive casts. This means that the floats did not park at the same portion of LIW and that their trajectories were significantly affected by surface drift, during their periodic ascent, surfacing and descent motions to transmit data by satellite link.

The clustering method used to analyze the θ-S curves in the western Mediterranean basin allowed classifying in a canonical, automatic way the spatial distribution of differently transformed LIW. We have also shown that differently transformed intermediate waters were embedded into this background but at specific, different geographical areas of the basin. These results confirm the LIW "discrete-continuous" hypothesis.

References

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