NEW HYDROGRAPHIC SCENARIOS IN THE WESTERN MEDITERRANEAN AS A CONSEQUENCE OF THE EMT PROPAGATION

G.P. Gasparini *, K. Schröder , E. Tesi , A. Vetrano , M. Astraldi
CNR - ISMAR / Sezione di La Spezia, Forte Santa Teresa, 19036 Pozzuolo di Lerici, Italy - gasparini@sp.ismar.cnr.it

Abstract
Recent studies have definitively shown the high sensitivity of the Mediterranean Sea to the effects produced by the large-scale atmospheric systems. The rapid response of this basin, when compared with the ocean time scales, makes the interannual variability of the circulation an important signal that, in some regions, may prevail on the annual cycle. A long-term monitoring of the hydrographic properties of water masses across the Sicily Strait, initiated in the second half of the 80's, permitted the identification of the important interannual variations in the water exchange between the eastern and the western basin and to follow the evolution of the water mass characteristics under the influence of the so-called Eastern Mediterranean Transient (EMT). The well known changes in the deep thermohaline circulation of the Eastern Mediterranean led to significant changes in the western basin, modifying the outflow characteristics through the Sicily Strait and consequently those of other western water masses starting since early 90's.
Keywords : Hydrography, Western Mediterranean.

The deep water of the Western Mediterranean Sea is known to have become warmer and saltier since about the 1950s. Many authors have attempted to explain these deep trends, attributing them to an increase in surface salinity in both the Eastern and the Western Mediterranean and speculating on connections to the changing environmental conditions, e.g. the greenhouse effect, local atmospheric conditions, and river damming. An acceleration of this trend was observed during the late 90's and was attributed [1, 2] to a first sign of the influence of the Eastern Mediterranean Transient (EMT) in the Western Mediterranean.

The well known changes in the deep thermohaline circulation of the Eastern Mediterranean Sea, the EMT, which modified the outflow characteristics through the Sicily Strait, led to significant changes in the Western Mediterranean Sea since the early 90's [2].

It was possible to follow the evolution of the water mass characteristics under the influence of the climatic transient. It is only after 1988 that a clear change is observed in the central region of the Strait: the salinity of the intermediate layer increases progressively until 1992, followed by a sudden drop which lasts until 1997. During that period the EMT has the maximum influence in the Strait. Subsequently, the new phase begins and continues over the years to follow. The available observations also allowed us to establish that the EMT reached the Tyrrhenian entrance between April and May 1992 due to a huge, impulsive amount of salt and cold water mass [2]. After a first modification in the deep layer, significant changes have been observed in the intermediate layer.

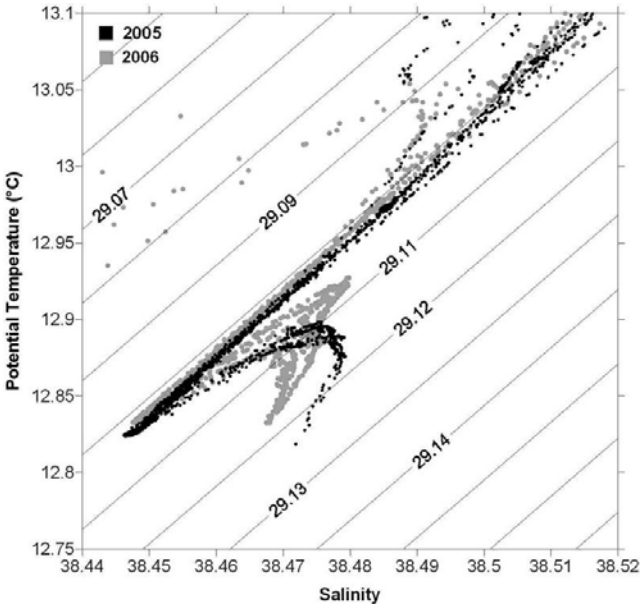

Fig. 1. θ-S diagram in the deep layer in 2005 and 2006

An important factor controlling the deep water formation process in the Gulf of Lions is the salt distribution in the water column and more specifically the LIW salt content. The further enhancement of the salt increase, present in the LIW layer for a long time, makes the western basin more prone to produce warmer and saltier deep waters.

In the deep water formation area and in the "spreading region" of the Western Mediterranean Deep Water (WMDW), in particular in the Gulf of Lions, the Ligurian Sea, the Balearic Sea, the Algero-Provençal Basin and the Algerian Basin, peculiar θ-S shapes were found in spring 2005, showing the presence of a recently formed layer of WMDW, spreading at the bottom of the whole Algero-Provençal Basin (Figure 1). It was characterized by unusual θ-S shapes, as its temperature, salinity and density were higher with respect both to the resident deep waters and to the climatological values. The influence of the EMT on the western deep water formation processes appears the most suitable candidate to explain these observations [3]. If exceptionally severe weather conditions during winter 2004-2005 were responsible for an extensive deep water production [4], the highly saline and warm characteristics can be attributed to the progressive salt and heat accumulation in the north-western Mediterranean during the previous years. The persistency of that structure has been confirmed during 2006, when similar deep water was detected in the western basin. The deep water production during winter 2004-2005 and 2005-2006 confirms an enhancement of the interannual variability in the WMED hydrographic conditions and suggests that the EMT influence on the WMED is far to be concluded, especially if high levels of salt and heat are maintained in the Eastern Mediterranean outflow. Investigation of spreading of those new waters evidences how the EMT, beside modifying the WMED hydrographic characteristics, was able to deeply influence key processes characteristic for this basin, with significant consequence on the exchanges through the Gibraltar Strait [5].

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