DEEP WATER MASS VARIABILITY IN THE EASTERN MEDITERRANEAN

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Abstract
The study of the hydrological properties of water masses in the Eastern Mediterranean revealed abrupt changes in temperature and salinity characteristics of the deep waters. Two events approximately twenty year apart "detach" from the general trends. They present different characteristics that may be due to the different location where the two events were originated. During the mid 60s and early 70s big changes occurred in the Levantine and spread to other basins of the Eastern Mediterranean (Levantine Transient), while during the late 80s and early 90s the Aegean Sea played a key role in the climatic event (Eastern Mediterranean Transient).

Key-words: Eastern Mediterranean Sea, Climatic Changes, Water-mass Characteristics

Introduction

Because of its small dimensions and the complicated topography which divides the basin in several sub-basins, the Mediterranean Sea response to atmospheric forcing is very rapid and on much smaller time scales than those of the global ocean. The recent Eastern Mediterranean Transient (EMT) which occurred in the late 80's and early 90's (1,2), is such an example of a rapid response of the eastern basin's thermohaline circulation and deep-water formation to changes in atmospheric forcing. A careful study of the deep water characteristics shows that this was not a unique case of abrupt changes in the Eastern Mediterranean Sea deep water masses. In order to identify climatic variability features and understand critical processes responsible for the observed variability, oceanographic datasets were analyzed and compared with meteorological data and process oriented model experiments.

Data

Temperature, salinity and density time series over the second half of the last century for the Levantine, Ionian and Cretan Seas were constructed using the MEDATLAS data base, which combines pre-existing databases such as the MODB data set, with more recent data. In this study we focus mainly on the deep water masses and the depth of 2000 *m* is selected as a reference level for deep water monitoring in the Levantine and Ionian basins while the depth of 1000 *m* for the Cretan Sea, which is not far from its mean depth and sill depths. The choice of depths reflects also the availability of data. Figure 1 presents the time series for the three basins.

Discussion

In the deep layers in all regions we can observe positive trends for all three parameters. But the most important feature is the saw-tooth jagged form of the time series revealing two major events, one centered in the mid-70s and the second one approximately 20 years later. The most recent is the well known EMT. The second one is detected in the 70s and concerns a considerable increase of salinity and density. It seems to be only salinity induced (the pulses in salinity are of the same order of magnitude in both cases, while the temperature does not show any signal as it does in the EMT), hence different from the EMT episode and is called Levantine Transient (LT).

The differences between the two events can be attributed to the different origin of the transient deep water masses. During the EMT dense waters of Cretan Sea origin are spreading to the adjacent basins altering the temperature-salinity characteristics of the deep layers (1,2). On the other hand, during the LT, the data indicate that the source lies in the Levantine basin. The formation of very dense waters in the Levantine basin may caused the uplifting of the deep water horizon The new state favored the intrusion of deep waters in the Cretan Sea, producing a decreasing trend in the temperature of the deep waters. With a few years delay the signal is observed in the Ionian basin. The signal resembles that of the Levantine but with weaker amplitude. Although data is not enough to describe the whole cycle of this event, the temperature-salinity anomalies fade rapidly (approximately 10 years).

Changes of the atmospheric forcing (3) and the water budget due to the Nile River dam construction (4), during the late 50s and early 60s the Eastern Mediterranean, are being investigated using meteorological data and process oriented modelling experiments. Such conditions may trigger changes in the thermohaline circulation and water mass formation processes resulting in formation of deep waters with unusual temperature-salinity characteristics. Model experiments showed that the Nile damming combined with cooling events can lead to formation of deep waters with higher salinity in the Levantine basin, compared with the characteristics of the Eastern Mediterranean Deep Water (5). Concluding, it is very interesting to notice the different forms of response of Eastern Mediterranean sub-basins to variability in the atmospheric forcing, underlining the sensitivity of the basin to natural and anthropogenic changes.

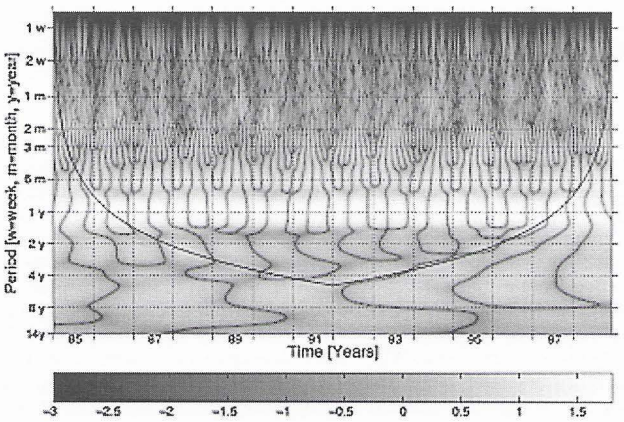

Fig. 1. Potential temperature, salinity and sigma-theta in (a) the Levantine basin (2000 m), (b) the Cretan Sea (1000 m), and (c) the Ionian Sea (2000 m).

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