EFFECTS OF THE EASTERN MEDITERRANEAN SEA CIRCULATION ON THE THERMOHALINE PROPERTIES AS RECORDED BY FIXED DEEP-OCEAN OBSERVATORIES

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Abstract
The anti-correlated behaviour in terms of thermohaline variability between the Adriatic and Cretan Seas is verified analysing long-term high-frequency time-series from fixed observatories. From our analyses, the travel time of the Levantine/Cretan Intermediate waters from the Cretan to the Adriatic resulted of about 1.5 yrs. Further analyses performed on time-series and float data gathered in the easternmost Ionian region reveal an interesting thermohaline variability associated with the periodical reversals of the North Ionian Gyre (NIG). In particular, salinity in this region increases when the NIG is anticyclonic and vice-versa.

Keywords: Circulation, Time series, Water transport, South Adriatic Sea, Aegean Sea

Temperature and salinity time-series from three fixed observatories in the Eastern Mediterranean Sea are investigated using multi-annual (2006-2014), high-frequency (up to 3 hours sampling rate) data. Two of the observatories are deployed in areas of dense water formation (DWF, the Southern Adriatic Sea, E2-M3A; the Cretan Sea, E1-M3A). The third one (Southeast Ionian Sea, PYLOS) lays directly on the intermediate water masses pathway that connects the DWF sources (Fig. 1).

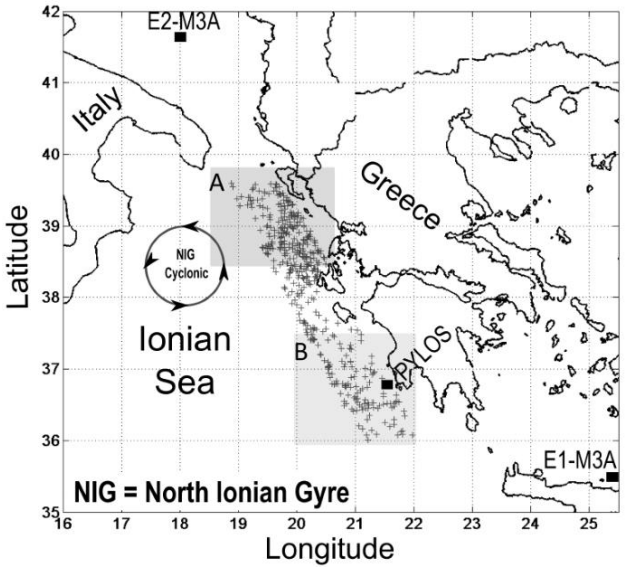

Fig. 1. Geographical distribution of the data. The black squares indicate the moorings position, the crosses indicate the float profiles gathered in the period 2004-2014 (http://marine.copernicus.eu).

The long-term variations of the hydrological properties at the observatories reflect the oscillating large-scale circulation modes of the basin (i.e. BiOS-Bimodal Oscillating System and internal thermohaline pump theories). In particular, an anti-correlated behaviour of the intermediate layer (200-600m) salinity between the Adriatic and Cretan/Ionian Sea observatories in the period 2006-2014 is verified and discussed (Fig. 2). This behaviour is directly linked to reversals of the NIG, which appeared anticyclonic during 2006-2011 and turned cyclonic after 2011. Statistical analysis suggests that the travel time of the intermediate salinity maximum signal associated with the Levantine/Cretan Intermediate waters (LIW/CIW), between the Cretan and Adriatic Sea, is roughly 1.5 years. This result is supported by the analysis of additionally presented ARGO data (Fig. 2) collected along the main route of LIW/CIW in the easternmost Ionian region. They revealed that the travel time of the LIW/CIW between the southeastern Ionian and the approaches to the Strait of Otranto is less than 1 year.

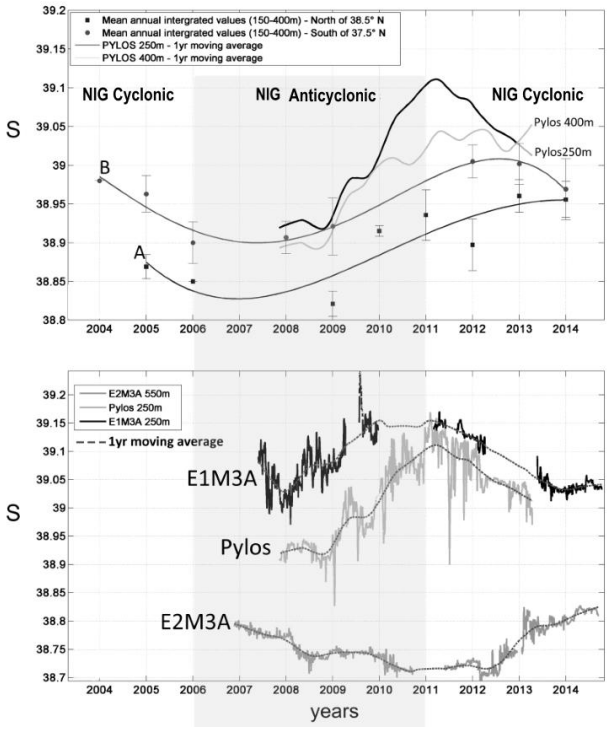

Fig. 2. Upper panel: the 4th order polynomial fit curve over the annual mean integrated float data in the layer 150-400m for area north of 38.5°N (zone A in Fig.1) and south of 37.5°N (zone B in Fig.1). Data from PYLOS have been superimposed. Lower panel: data from the three moorings.

We argue that the understanding of such oscillations provides important foresight on future DWF events, as increased salinity may act as a crucial preconditioning factor for DWF processes. Additionally, energy spectrum analysis of the time-series revealed interesting short-term variability (~15 days) connected to mesoscale activity at the observatories, both in the Adriatic and in the Cretan Sea. Hence, the network of permanent observatories able to monitor oceanographic parameters at high sampling rates may play a key role in understanding both climatic and oceanic processes and trends.

References

1 - Bensi M., D. Velaoras, V.L. Meccia, V. Cardin, 2016. Effects of the Eastern Mediterranean Sea circulation on the thermohaline properties as recorded by fixed deep-ocean observatories. Deep-Sea Res. I, 112: 1-13, http://dx.doi.org/10.1016/j.dsr.2016.02.015