MODIFIED ATLANTIC WATER IN THE SE LEVANTINE BASIN (1995-2003)

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Abstract

The seasonal and inter-annual variability of the Modified Atlantic Water (MAW) in the Levantine Basin, particularly in the broader area south of Cyprus, is examined based on new data sets collected in the frame of the CYBO (Cyprus Basin Oceanography), CYCLOPS (Cycling of Phosphorous in the Mediterranean) and HaiSec (Long-term Haifa Section) projects, carried-out between 1995-2003. This new high resolution data sets provide quite strong evidence on the existence and the spatial/temporal fluctuation of the MAW and of the MMJ (Mid Mediterranean Jet). The MAW was traced during summer and winter to flow eastward, as transferred by the MMJ. The MMJ was well pronounced, both from in-situ and satellite SST, to meander eastward close to the south of Cyprus, along the periphery of the Cyprus eddy and of the re-appeared Shikmona gyre. The present investigations vividly shown that the MMJ in fact is a major driving mechanism responsible for the eastward spreading of the MAW in the Levantine Basin.

Keywords: Levantine Basin, Mid Mediterranean Jet, Modified Atlantic Water

Preface

One of the most variable water masses of the Levantine Basin is the subsurface less saline MAW. The high rates of the summer heating and evaporation, dominating the Levantine Basin, transform the upper layer of MAW to the most saline and warm (up to 39.6 ppt and 29 deg. C in summer 2003) surface waters in the Mediterranean. Generally, the inflow of the MAW in the Mediterranean is the result of the water volume compensation for the sea water evaporation in the Levantine Basin and the outflow of the Levantine Intermediate water (LIW) in to the North Atlantic [1]. The MAW, after its entry into the Mediterranean through the Gibraltar, spreads as far east as the Levantine Basin. There the MAW can be found as a subsurface layer spanning from 50 to 80 meters [1,2,3]. During mid 80's [3,4] it was observed that the main mechanism for transferring the MAW within the eastern sub-basin was the Mid Mediterranean jet. It is considered that this jet is the result of the interaction between cyclonic (Rhodos gyre) and anti-cyclonic (Mersa Matruch and Shikmona gyries) activities with the eastward movement of the waters passing the Cretan passage.

Results and Discussion

In this paper we examine more than 15 seasonal cruises held in the Levantine Basin with the frame of CYBO, CYCLOPS and HaiSec projects between 1996-2003 (Fig. 1). It is apparent that the MMJ, which carries the MAW in the area, enters from the southwest (Fig. 2), meanders eastward along the periphery of the Cyprus eddy and periodically bifurcates along the western coast of Cyprus. Recurrent Cyprus and Shikmona eddies, as well as, smaller scale cyclonic and anticyclonic eddies increase the complicatedness of the flow path of the MMJ and subsequently of the MAW transport. During summer the minimum salinity layer is well defined at a depth below the thermocline of about 50m and with a value as low as 38.65-38.75 psu, while during winter (as in January 1999) can be found with similar or higher salinities. However, during severe winter weather conditions the present of the MAW is difficult to be traced, either was complete vanished due to winter mixing processes. Moreover, the MAW during winter was found to occupy also the surface layer down to 100 meter, in the area offshore of southwest Cyprus, before its interaction with the Cyprus eddy.

In the last three years the significant spatial displacement of the Cyprus eddy to the west (60 nm from it original position) caused an even more complicated flow path for the MMJ. Particularly, in May 2001 the northward extend of the Cyprus eddy caused for a short period the restriction of the eastward transfer of the MAW. The flow path of the MMJ was now northward, as opposed to its usual eastward direction. Moreover, a secondary new anticyclonic eddy established between southeast of Cyprus and offshore Lebanon, resulted in a more complicated displacement for the MAW. It was observed bellow this new anticyclone at greater depth than usual (down to 200m). The latter suggests that the MAW after its eastward advection along the Cyprus eddy was picked up by the new anticyclone.

References

1 - Ovchinnikov *et. al.*, 1976, Hydrology of the Mediterranean Sea, Gidrometeoizdat, Leningrad.

2 - Hecht *et al.*, 1988. Currents, water masses, eddies and jets in the Mediterranean Levantine Basin. *J. Phys. Oceanography*, 18, 10: 1320-1353.

3 - Ozsoy *et al.*, 1991. A review of the Levantine basin circulation and its variability during 1985-1988. *Dyn. Atmos. Oceans*, 15: 421-456.

4 - POEM group, 1992. General circulation of the eastern Mediterranean sea. *Earth Sci. Rev.*, 32: 285-309.