SUBSURFACE (350 M) CIRCULATION IN THE MEDITERRANEAN SEA BASED ON ARGO DATA

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Abstract

The trajectories of 38 Argo floats, deployed in the Mediterranean Sea between October 2003 and September 2009, are used to create a dataset of velocities at 350 m and to study the subsurface circulation in regions with good data coverage. The float subsurface velocities and the pseudo-Eulerian statistics computed from them show typical circulation pathways, which can be related to the motion of the Levantine Intermediate Water.

Keywords: Intermediate Waters, Currents, Eastern Mediterranean, Western Mediterranean

Among all the floats deployed in the Mediterranean Sea, we have selected 38 instruments according to their cycle characteristics. They were deployed as part of the MFSTEP project in 2003 and are referred to as MedArgo floats. Each float descents from the surface to a programmed parking depth of 350 m, where it remains for about 4 days before reaching the profile depth, that is generally 700 m but extends to 2000 m every ten cycles. At the end of each cycle the float remains for about 6 hours at the sea surface, where it is localised by, and transmit the data to, the Argos satellite system [1].

The Argos positions were used to determine the subsurface currents through three different steps: the first provides rough estimates of subsurface velocities (V_{old}) [2]; the second produces the best surface displacement [3]; the third provides the subsurface displacement (V_{350}) that involves the use of the average vertical speed of the float and an approximation of current shear in the upper water column [4]. From the comparison between V_{old} and V_{350} and the results of the statistical analysis computed on V_{350}, we select only the best estimates of velocities (variance explained/total variance > 0.8) to produce the final dataset V_{350}^{end} (Fig.1) [4].

The V_{350}^{end} velocities reach the maximum values of ~ 33 cm/s east of the Balearic Islands and in the Ierapetra Eddy; high speeds (larger then 20 cm/s) are also found in the north and central regions of the Liguro-Provençal-Catalan basin and in some eddies of the Eastern basin, whereas the Liguro-Provençal, Algerian and Libyan-Egyptian Currents are characterised by maximum speeds of 15 cm/s.

The pseudo-Eulerian statistics, computed with V_{350}^{end}, show typical circulation pathways related to Mediterranean subsurface currents and to the motion of the Levantine Intermediate Water. In the Western Mediterranean basin, the velocity field reveals the characteristic cyclonic paths in the Tyrrhenian, Liguro-Provençal and Algerian sub-basins, as well as the Algerian and Liguro-Provençal-Catalan currents, where it reaches the maximum intensities (12-14 cm/s). In the southern Ionian Sea, the float velocities show a dominant anticyclonic circulation between 32°-36° N and 16°-20.5° E, in which the southern limb corresponds to a north-westward flow located on the African continental slope. The rest of Eastern Basin is dominated by mesoscale and sub-basin scale circulation eddies, with maximum values of mean velocity (~ 12 cm/s) located south of Crete (Ierapetra eddy) and south of Cyprus. All over the Mediterranean Sea the EKE has strong gradients compared to MKE.

In the regions with significant bathymetry gradients, that is mostly along the continental shelf slope, subsurface currents are driven by topography and the along-isobath components of velocity have values larger then the across-isobath components. Speeds have mean values of ~5 cm/s and reach 20-27 cm/s east of the Balearic Islands, in the Cretan Passage and in the southern entrance of Tyrrhenian Sea.

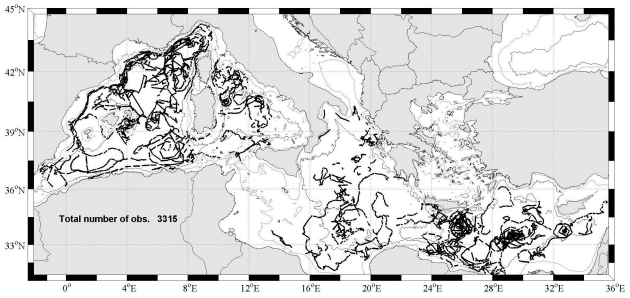

Fig. 1. Subsurface raw trajectories of the MedArgo floats between October 2003 and September 2009.

References

1 - Poulain P.-M., Barbanti R., Font J., Cruzado A., Millot C., Gertman I., Griffa A., Molcard A., Rupolo V., Le Bras S., and Petit de la Villeon L. , 2006. MedArgo: a drifting profiler program in the Mediterranean Sea, *Ocean Sci*., 3: 1901-1943.

2 - Lebedev K.V., Yoshinari H., Maximenko N.A., and Hacker P.W., 2007. Velocity data assessed from trajectories of Argo floats at parking level and at the sea surface, *IPRC Technical Note*, 4 (2).

3 - Park J.J., Kim K., King B.A. and Riser S.C. , 2005. An advanced method to estimate deep currents from profiling floats, *J. Atmos. Ocean. Tech*., 22 (8): 1294-1304.

4 - Menna M., and Poulain P.-M. ,2009. Valutazione delle correnti sub-superficiali nel Mediterraneo da float Argo, *Technical Report* 2009/95-OGA-15-SIRE, pp. 1-63, Trieste.