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Monitoring water masses properties by Glider in Sardinia Channel during summer 2014

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1. Summary

In the framework of the EC funded project, PERSEUS (WP3, Subtask 3.3.1: Repeated glider sections in key channels and sub-basin) and with the support of JERICO TNA (EU-FP7), a deep water glider (up to 1000m) was deployed from the R/V Tethys in the Sardinia Channel and has carried out 3 return trips during the period spanning from the 16th of August 2014 to the 19th of September 2014. The Gilder was equipped with CTD, O_2 sensors, Fluorometers (ChlA), back scattering from 470 to 880 nm and was programmed to follow a path close to SARAL satellite track #887. During this experiment, a significant dataset, as never obtained before for this area, has been collected. The innovation stands in the high spatial resolution, in the temporal repetitivity and in the number of parameters sampled simultaneously. The first step of the work will focuses on the analysis of the hydrological properties of the existing water masses in the area.

2. Frame and aim of the experiment

The Sardinia Channel is a zonally oriented passage connecting the Algerian and the Tyrrhenian basins, with a sill depth of about 1900 m. In spite of the considerable amount of work achieved and accurate results obtained about the circulation in the Western Mediterranean Sea, during the last 20 years, the Sardinia Channel is still one of the region where the dynamical processes and water exchanges are not clearly identified. Previous studies (Garzoli S. and C. Maillard, 1979, and Ozturgut Erdogan, 1975) pointed out the complexity of the processes in the region and the role of the bottom topography in sustaining them, and provided a first estimation of the involved fluxes. The main knowledge about the water masses crossing this region mostly concerns the AW (Atlantic Water) and the LIW (Levantine Intermediate Water). Along the Algerian coast, the AW is transported mainly by the Algerian current (AC Millot, 1985) from which the anticyclonic Algerian eddies (AEs, Puillat et al., 2002; Taupier-Letage et al., 2003), often involving surface and intermediate waters, are generated by baroclinic instabilities of the AC itself. The AEs generally remain more or less included in the main AC flow. The AEs alongslope-downstream propagation usually ends in the Channel of Sardinia, where AEs dramatically interact with the bathymetry and can remain almost blocked in the Sardinia Channel area for several months before collapsing (Puillat et al., 2002).
In order to clarify some of these processes, including the behavior of the Algerian current and associated eddies, our methodology is based on a combined approach using glider observations and sea surface features observed by satellite. By autonomously collecting high-quality observations in three dimensions, gliders allow high-resolution oceanographic monitoring and provide useful contributions for the understanding of mesoscale dynamics and multidisciplinary interactions (e.g., Hodges and Fratantoni, 2009). On top of that, the glider route follows the ground track of the satellite SARAL, equipped with a Ka band altimeter (AltiKa), with the view to implement a methodology of analysis as performed by Bouffard et al. (2010).

The main objectives of the project are :
• identification of the physical properties of the surface and intermediate water masses between Northern Tunisian Coast and Sardinia and evaluation of the transport of water, salt and heat through the area
• study of the variability of the physical properties of surface and intermediate water masses through the use of in-situ and satellite data.
• understanding exchanges through sub-basins and the complex interactions through eddies

• validation of the operational hydrodynamic numerical model of the western Mediterranean (http://www.seaforecast.cnr.it/en/fl/wmed.php) through the use of in-situ and satellite data.

3. Preliminary results of the experiment

The glider carried out 6 legs during the period spanning from the 16th of August 2014 to the 19th of September 2014: Leg#1 (16 to 23 August 2014), Leg#2 (23 to 28 August 2014), Leg#3 (28 Aug. to 03 Sept. 2014) Leg#4 (03 to 08 Sept. 2014), Leg#5 (08 to 13 Sept. 2014), Leg#6 (13 to 19 Sept. 2014). As mentioned above, the first aim of this work is to analyze the hydrological properties of the surface and intermediate water masses and their variability, focusing first on T/S properties.
The comparison of the successive T/S diagrams and T/S hydrological sections allows us to quantify the intensity of temporal variability and to assess mixing processes occurring within and between water masses. The core of LIW is clearly observed with S>38.7 psu (T$\sim$13.75 °C, S$\sim$38.75 psu) at depths between 250m and 450m and the spreading of this water mass appears clearly from one leg to the other. According Astraldi et al. (2002), this water mass is coming from the strait of Sicily and outflows into the Algero–Provencal Basin. This water mass should not be confounded with the so-called 'old' LIW, that recirculates to reenter the lower intermediate layer of the area from west to east.
Near the surface, lenses of fresh water are observed at about 50m depth, all along the section, with a typical radius of 20 km. These lenses are generated by the meandering of the Algerian Current, which is advecting MAW first eastward along the Algerian slope, and then, at the vicinity of the Channel of Sardinia, a few lenses (AEs according Puillat et al., 2002) detach from the Algerian slope and propagate along the Sardinian one. We will show that the signature of these lenses are also detected by satellite, both in the altimetric signal and in the sea color radiometric data.

4. References

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