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Sub-surface small scale eddy dynamics from multi-sensor observations and modelling

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Mesoscale and submesoscale hydrodynamic features (hereafter (sub)mesoscale) are particularly essential for the understanding of the horizontal and vertical exchanges and transport of heat and biogeochemical properties. Such dynamics are however difficult to observe and to characterize given the wide spectrum of temporal and spatial variability of physical processes with which they merge and interact, thus requiring the development and exploitation of space-time high resolution observing systems.In support to the Balearic coastal observatory implementation and to properly address the scientific issues associated with the oceanic variability characterization, an observational programme has been conducted in the Balearic Sea (Western Mediterranean).

In this framework, a glider mission has been carried out almost simultaneously and well co-localized along JASON 1 and JASON 2 satellite altimetric tracks in order to characterize small-scale horizontal oceanic currents. The coastal altimetry-derived current computation has been improved by using a new strategy and experimental data from the PISTACH (Prototype Innovant de Système de Traitement pour les Applications Côtières et l'Hydrologie) project whereas a recent methodology has been applied to estimate absolute glider currents both at surface and depth. In complement, the synoptic view from satellite sea surface temperature before and during the glider missions has allowed to provide a detailed picture of associated main surface structures. A high resolution configuration of the Regional Oceanic Model System (ROMS) forced by the Weather Research Forecast (WRF) atmospheric model was also carried out.

The multi-sensor observations and the model outputs analysis have revealed the presence of coherent permanent and non permanent signals, respectively the Balearic Current, the Northern Current and a (sub)surface small-scale (<30km extend), deep (> 180m) and relatively intense (>15cm/s) anticyclonic eddy. Several comparisons made between the model output and the multi-sensor dataset, both at surface and in the ocean interior, clearly show the model is able to reproduce realistically in space and time the observed patterns. The ROMS simulation has therefore been exploited to identify the origins and associated mechanisms. From this numerical approach, it turns out the small-scale eddy vorticity appears to be controlled by local salinity gradients arising from strong instable interactions at the interface between southward salty water and a large-scale anticyclonic eddy of recently modified Atlantic Water entering northward through the Ibiza strait.