OBSERVING SYSTEM SIMULATION EXPERIMENT OF HYMEX'S SOP2 TO STUDY THE WINTER 2013 CONVECTION EVENT IN THE GULF OF LION.

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Abstract
In winter 2013, deep convection events in the Gulf of Lion have been extensively sampled by a glider network in the HyMeX's SOP2 experiment. OSSE reproducing the real glider missions have been performed with the glider simulator SIGLID in a high-resolution hindcast simulation of the Western Mediterranean Sea during winter 2013. Characteristics of the deep convection events estimated from the simulated gliders are compared with those of the model simulation to validate the methodology and to assess the capabilities of the glider network to sample in time and space this extreme oceanic proccess. Finally, the methodology is used to quantify the renewal of the deep waters using the in-situ glider network observations sampled during SOP2.

Keywords: Gulf of Lyon, Deep waters, Sampling methods, Water convection

Over the last decade, underwater gliders have been increasingly operated to observe the ocean. They are particularly adapted for the study of meso to sub-mesoscale processes as deep convection, as they sample the ocean interior from the surface to a depth of 1 000 m with a high vertical resolution of a few meters, associated to an horizontal resolution of about 2 to 4 km.
In the framework of HyMeX's SOP2, a network of gliders has been deployed in the Western Mediterranean Sea during winter 2013 (Fig. 1). This experiment provided a substantial sampling of the ocean interior at the time when an intense deep ocean convection event occurred. The understanding of the processes involved is particularly important from dynamical, hydrological, biogeochemical and climatological perspectives.

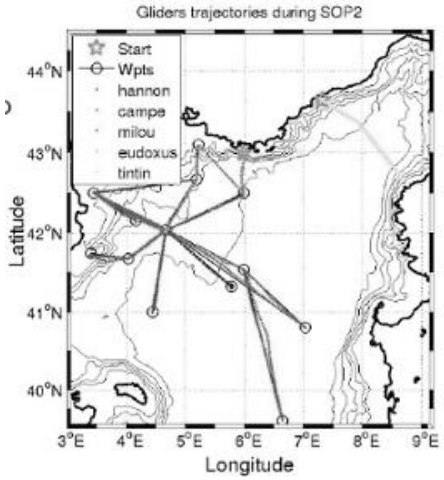

Fig. 1. Trajectories of the 5 gliders during the SOP2 experiment, from January to March 2013.

The dense in-situ dataset provided by the glider network has been used to evaluate the characteristics of the deep convection events [1]. With a multi-scale objective analysis method, the gliders data have been interpolated over the Gulf of Lion on a 10km by 10km horizontal grid, for different time periods ranging from 10 days to the season. An analysis of the interpolated fields has been undertaken to characterize the deep convection event. The convection area has first been estimated from the surface temperature and salinity fields for successive time periods (Fig. 2). The temperature of the intermediate waters (LIW, from 400 to 600 m depth) and the mixed-layer depth have also been estimated as indicators of vertical mixing. The temporal evolution of the energy content has been examined and a first estimate of the newly formed deep waters volume is provided.

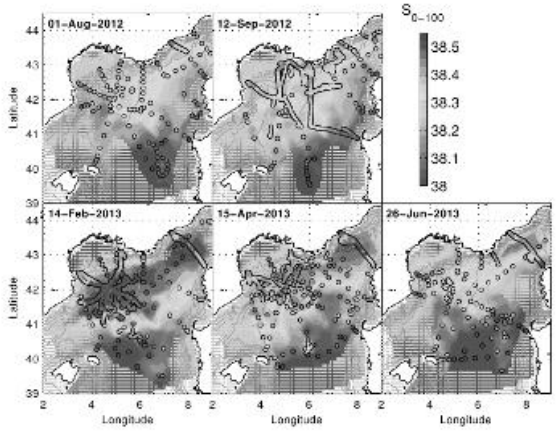

Fig. 2. Surface salinity in the Gulf of Lion constructed from the objective analysis of the in-situ data (gliders and CTD) collected between 08-2012 and 06-2013.

An Observing System Simulation Experiment (OSSE) has been performed, that simulates the SOP2 glider data sampling with the numerical glider simulator SIGLID [2] in a high resolution hindcast ocean simulation of the Mediterranean Sea. The glider simulator samples the 4D dynamical fields provided by the ocean numerical model along sawtooth trajectories reproducing those of the real gliders during their deployments at sea. The numerical simulation used is an hindcast of the Mediterranean sea during the winter 2013, performed with NEMO-MED36v75 model configuration (horizontal resolution of 2-3 km) forced by ARPERA atmospheric data set. The simulated glider data set has then been processed in the same way as the real glider data set, providing the characteristics of the deep convection event in the model simulation (deep convection area, volume of deep water formed,...). A comparison between estimates from simulated gliders and the ones based on the full simulation fields allows to test the performance of the methodology and to quantify the errors associated with the glider network undersampling in time and space.

References

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