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Thermohaline variability and mesoscale activities observed at the E2M3A deep site in the south Adriatic Sea

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The south Adriatic Sea is recognized as a dense water formation site which is able to oxygenate the deep layer of the whole eastern Mediterranean Sea. The entrance of salty water from the Ionian Sea represents a preconditioning factor for the deep convection which can occur during winters characterized by particularly vigorous air–sea heat exchanges.
Continuous sampling measurements are strictly essential to better understand the deep convection. For that reason, the south Adriatic Sea has been constantly monitored by means of the E2M3A deep mooring site located in its central part (Latitude 41° 50' N, Longitude 17° 45' E, maximum depth 1250m) since 2006. Temperature, salinity and currents time series at the E2M3A site from 2006 till 2010 are analyzed. They represent currently the longest timeseries available for this region. Moreover, their integration with data obtained from several oceanographic cruises provides the necessary spatial distribution of the thermohaline properties in the study area.
Here we report on the abrupt temperature and salinity decrease particularly evident down to 600m depth from March 2008 on. In fact, the intermediate layer shows a maximum temperature and salinity decrease of $\sim$0.3°C and $\sim$0.06 respectively, clearly evident after each severe winter. The bottom layer ($\sim$1200m) shows an opposite behaviour: it suffered an unforeseen and continous temperature and salinity increase (linear trend of $\sim$0.05 °C y-1 and $\sim$0.004 psu y-1respectively) during the whole observational period.
The results show a strong relationship between the recently discovered variability of the Ionian surface circulation (Gačić et al. 2010) and the thermohaline variability observed in the south Adriatic. In particular, we demonstrate here the role of the winter convection in trasferring fresher surface waters towards deeper layers triggering salt content changes in the Adriatic.

The intrusion of fresher water at the depth of about 700-800m noticed in the mooring area from April 2008 onwards is probably imputable to the advection of dense waters of north Adriatic origin. Indeed, severe winter conditions during early 2008 facilitated the dense water formation both in the north and in the south Adriatic.

Interestingly, currents measurements reveal the passage of mesoscale eddies which can produce sudden themohaline changes along the water column for time windows up to 10-15 days. The comparison between time series and satellite images (Chl-a surface distribution) reveals, for the first time in this region, that they act along the water column from the surface untill the bottom. Cyclonic eddies appears more frequently in the proximity of the mooring than anticyclonic ones. We conclude that their effects are twofold: the contribution to the restratification of the water during the post convection phase by exchanging the buoyancy between the mixed path and the surroundings water and the transfer of heat and salt between the deep and the intermediate layer.

Reference:
Gačić, M., Borzelli G. L. E., Civitarese G., Cardin V., and Yari S., 2010: Can internal processes sustain reversals of the ocean upper circulation? The Ionian Sea example. Geophys. Res. Lett., 37, L09608, 5 pp., doi:10.1029/2010GL043216.