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A new Deep Water formed in the NW Mediterranean in 2005

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The meteorological conditions during winter 2005, with unusually low precipitation and persistency of northerlies over the NW Mediterranean and Balearic sub-basin, caused an alteration of the typical surface temperature and salinity over the region. This situation particularly affected the convection process that produces the Deep Water of the Western Mediterranean (WMDW), which covered a region larger than usual. TS diagrams of CTD casts from a cruise in March 2005 (EFLUBIO) showed that the new WMDW formed during that winter was slightly denser (+0.01 kgm-3), warmer (+0.05C), and saltier (+0.03) that in preceding years. At CTD stations near the continental slope, a colder and even denser water was found (-0.1C and +0.025 kgm-3). Deeper stations sampled in July (TUNIBAL) show a well established water mass stratification in the NW Mediterranean from 1000-1200 m to the bottom.

As part of a pilot program of the International Commission for the Scientific Exploration of the Mediterranean (CIESM), a mooring has been maintained since October 2003 near the bottom in the deepest part of the continental slope (1850 m) off the Catalan coast. The time series of data indicate a clear difference between winter 2004 and 2005. TS values were almost constant until the end of January 2005, when rapid increases of +0.15C in T and +0.05 in S were recorded. By March they started decreasing until -0.33C and -0.05 below 2004 values (density up to +0.05 kgm-3), and one month later gradually increased to new steady values +0.03C and +0.02 (and +0.02 kgm-3) above initial conditions. Near bottom current speed increased suddenly in March (with peak values above 60 cm/s) and then decreased until reaching the usual low values by May.

Two other projects (funded by EU and ONR) placed near-bottom moorings in several submarine canyon heads in the Gulf of Lions. Results obtained during winter 2004 evidenced an active sediment transport through the canyons on this margin, mainly induced by eastern storms and shelf water cascading due to convection processes on the shelf. In winter 2005, the exceptional persistency of northerly winds and the low river discharges contributed to dramatically enhance the shelf water cascading mechanism. Under these conditions, cascading took place without being triggered by eastern storms and begun in mid December 2004 (much earlier than in the preceding year). In the Cap de Creus Canyon (the most instrumented one) this process only affected the canyon head during the first events, but in late January major cascading events reached down to 500 m and 750 m depth. From mid February to early March cascading occurred continuously and maintained cold temperatures and down-canyon steady currents between 40 and 80 cm/s.

Then the origin of the observed dense water mass should be a combination of cascading and the convection process that typically produces the Western Intermediate Water (WIW) in the slope, but much denser than usual, due to the higher surface salinity and persistent winds. The higher surface density may be related to both the low precipitation and the increase of the deep convection in open sea that forced a higher extension of the Levantine Intermediate Water (LIW) compensatory upwelling.