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Evidences on eddy variability and density currents in the deep flow of the Strait of Otranto

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The Strait of Otranto is 70 km wide channel connecting the Adriatic and the Ionian Seas (Mediterranean) over the 800 m deep sill. On average, a northward/southward inflow/outflow takes place along the eastern/western coast of the channel. In particular, the outflow of the Adriatic Dense Water (AdDW) occurs as a density-driven current in the bottom layer pressed against the western continental margin.

In the framework of the Italian national project VECTOR ("VulnErabilità delle Coste e degli ecosistemi marini italiani ai cambiamenti climaTici e loro ruolO nei cicli del caRbonio mediterraneo") the vein of the AdDW was monitored in the period Nov2006-Apr2007. Three moorings (V2, V3 and V4), about 13 km apart, were deployed in the bottom layer along the E-W section at the southernmost and deepest end of the strait. They were equipped with RDI upward-looking ADCPs (Acoustic Doppler Current Profiler), bottom RCM current-meters and SBE-CT (Conductivity and Temperature) instruments. The current–meter at the deepest mooring (V4) mounted also a turbidity sensor. Rotational events at the ten-day time scale are observed in the current records. In particular, two strong events are evident on the 8-11 and on the 20-24 December 2006. Cross-correlation and rotary spectral analysis of current time-series at the outermost and central mooring reveal the concomitant occurrence of the rotation in the opposite sense. These rotational events have been explained in terms of the passage of mesoscale eddies (diameter of few tens of kilometers and velocity propagation of 15 cm/s toward south). The assumption is that the eddy formation mechanism is due to the stretching of the high potential vorticity water column over the Strait sill to the north.

The footprint of mesoscale eddies is also clearly evident both in CT and turbidity records. A detailed look into the two December events, when the eddy passage is assumed, shows a number of coincidences: temperature and salinity drop at V3 and V4; turbidity rises at V4; eastward velocity is maximum at V3 and V4. More precisely, the turbidity maximum occurred in concomitance with the beginning of the rotational event, when the currents are directed from the continental slope towards the centre of the Strait and are rather strong (up to 20 cm/s). As soon as the current turns southward the turbidity reduces and reaches the background levels. A detailed bottom topography of the zone, obtained from a multibeam survey, revealed existence of a canyon, about 2 km wide and 15 km long, just 3 km upstream of the measurement transect. This structure deepens in the E-W direction from the shelf (200 m) to the bottom of the Strait (800 m). The canyon probably represents a conduit for cross-shore water and bottom sediment transport from the western shelf down to the abyssal depths at least about 40 km from the mouth of the canyon. Moreover, eddies on their passage trap colder and less saline Adriatic outflowing waters from the shelf-break area (T and S drop). Location V2 (shallowest station) is out of its trajectory, being shallower and to the west with respect to the mouth of the canyon. This might be corroborated by temperature/salinity signal at V2, for which no correspondence with the other two locations is seen. Moreover, salinity at V2 rises during the first event, which may be due to the more saline intermediate waters that are trapped and advected by the eddy from the centre of the channel toward the shelf break.

We would like to stress that the presence of possible density currents and associated sediment transport has been hinted for the first time, thanks to the opportune mooring equipment and high resolution multibeam survey.