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On the dense water cascading in the Southern Adriatic Sea during 2012: Setup of a Rapid Environmental Assessment

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In the North Adriatic, Dense Shelf Water (DSW) forms during cold and dry winters by cooling and evaporation. DSW spreads southward along the western shelf reaching the southern Adriatic basin (1200 m deep) after 1-2 months, where sinks through cascading events.

In February 2012, a large Siberian High caused blocking of the Atlantic flow and a westward flow of dry and cold air masses from eastern Russia toward Europe. The North Adriatic experienced a cold spell with large decrease of surface temperature (3˚-6˚C) associated to severe cold and dry Bora wind. The result was the formation of extremely dense shelf water, further made possible by the very limited discharge of the Po river in the preceding autumn.

As contribution to the Italian research programme RITMARE (Italian Research for the Sea), CNR-ISMAR set up a Rapid Environmental Assessment (REA) experiment to study the occurrence, amount, timing and properties of the newly formed DSW. Setting up REA strategies is crucial for several scientific and practical reasons: (i) capturing extreme events to improve our understanding of natural systems in a global-change scenario; (ii) to evaluate their impact on marine systems and the biota; (iii) to address issues related to fluctuating fish stocks as well as (iv) C export and sequestration in the deep sea.

The experiment was designed with an integrated approach, including modeling simulations, mooring deployments and quick-response oceanographic cruises. Based on numerical model ensemble, the arrival time of the DSW at the Gargano Cape was forecasted likely starting after March 15, 2012, thus moorings were deployed few days before. Five moorings were deployed in sites selected on the basis of modelling predictions and geology-driven inferences defining areas where the passage of dense shelf water is most likely to occur. Moorings were equipped with down-looking ADCPs, automatic sediment traps, temperature loggers, recorders of temperature, conductivity and turbidity, and single point current-meters. Two rapid-response cruises were carried out by RV's MinervaUno and Urania in late-March and mid-April, respectively, in order to perform CTD profiles with LADCP, XBT transects and water sampling (TSM, dissolved and particulate matter, plankton, Bacteria and Archaea, etc.).

Overall, the observations matched real-time modelling simulations. The DSW veins were located in the open slope off Gargano, and impacted a 100-km slope stretch all the way to Bari canyon. Speed and direction of currents at the bottom were consistent with the bedform distribution, also in the deepest part of the basin. Cascading was recorded to occur with multiple pulses (variability at daily scale), reaching speeds of 70 cm s^{-1}.

Several open questions on the cascading process can now be addressed based on the newly acquired data. As part of the research programme RITMARE, CNR-ISMAR is now engaged in the design and prolonged deployment of moorings to study the interannual variability in timing of initiation of the cascading process, which takes place every spring, its variability in intensity and duration and the ultimate impact of the dense water on the deep sea. Through this experiment we plan to gain elements to improve our understanding of future evolution of the process and the related possible regime shifts in a likely scenario of surface-water temperature increase over the entire Mediterranean.