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A comparison study of North Adriatic Dense Water descent using observations in March, 2006 and March, 2009

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North Adriatic Dense Water (NAdDW) forms on the Adriatic shallow shelf, travels southeastward along the Italian slope in a dense vein near the 100 m isobath, and then descends with mixing after it crosses the Palagruža Sill. As it can be much denser than the surrounding water masses, this descent could take the form of cascading especially at the topographic interruption of the Bari Canyon system. Two recent observational programs gathered data on this process in winters with strikingly different NAdDW conditions.

The DART06A international collaborative cruise in March 2006 occurred during a period of strong NAdDW production and export to the southeast, as evidenced by bottom potential densities exceeding 29.7 kg/m^3 along the sill observed by the 12 time-series moorings that spanned it. Further south, both upstream and offshore of the Bari Canyon system, observed temperature/salinity relationships from CTDs show mixing connections between waters deeper than 600 m (densities of 29.3 kg/m^3 and 29.4 kg/m^3) on the Italian slope and spatially unconnected waters at 100 m depth on the nearby coastal shelf (densities > 29.4 kg/m^3).

The AdriaSeismic09 international cruise in March 2009 was organized to examine the spatial pathways and evolution of NAdDW near the sill and canyons, but encountered a period of weak or absent NAdDW production and export. CTDs show that in March 2009 the northern source vein at 100 m depth was present but lower in density (maximum at 29.2 kg/m^3) and was therefore not able to sink in bulk below the slightly denser surrounding waters. However, a thin layer of this water was found descending down the slope near the sill in a bottom-boundary layer through use of the new technique of seismic oceanography. This technique can image vertical thermal gradients with horizontal and vertical resolutions as fine as 7 meters all the way to the bottom.

The temperature-salinity measurements from the two winters show that the bulk of 2009 water was lighter by a critical 0.2 kg/m^3 (or more) mainly because it was fresher (e.g., 38.3 psu versus 38.6 psu). A possible cause for this is the different amounts of Po River input into the Northern Adriatic prior to and during the winter formation period. The Po River had outflow exceeding 3000 m^3/s for almost all of June 2008 and had three outflow events of 4000 m^3/s or more between November 2008 and March 2009. In contrast, there were no events with output as high as 4000 m^3/s from March 2005 to 2006 and total outflow was 54% lower than the comparable period from March 2008 to 2009. Although other factors may also be playing important roles, our results suggest that prior riverine input levels may strongly influence NAdDW descent processes.