EFFECTS OF 2012 WINTER CONVECTION ON THE DEEP LAYER OF THE SOUTHERN ADRIATIC SEA

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Abstract
Winter convection occurred during 2012 in the Northern Adriatic produced an exceptionally dense water, which caused abrupt thermohaline changes in the bottom layer of the Southern Adriatic after its arrival as a bottom-arrested current. We investigate this phenomenon merging data from a fixed point observatory and from drifting profiling Argo floats.

Keywords: South Adriatic Sea, Deep waters, Circulation experiments, Deep sea processes

An unusually harsh and long-lasting (~20 days) episode of Bora wind, which occurred from 24 Jan to 14 Feb 2012 in the Adriatic Sea, was responsible for a large production of very dense water (σ_θ > 30 kg m^{-3}) in the northern basin, where maximum depth does not exceed 250m. Here, we merge Temperature (T), Salinity (S), and current time-series collected at the E2M3A deep-ocean observatory of the Southern Adriatic (41°32' N, 18° 05' E) with CTD (Conductivity-Temperature-Depth) profiles obtained from freely drifting Argo profiling floats to analyse the drastic thermohaline changes which occurred in the deep layer (>1000m depth) of the Southern Adriatic Pit (SAP) after the arrival of the dense water formed on the northern shelf. The signal of that water mass arrived in the Jabuka Pit (middle Adriatic) by the end of February 2012, and its effect was clearly evident in the bottom layer (Fig. 1).

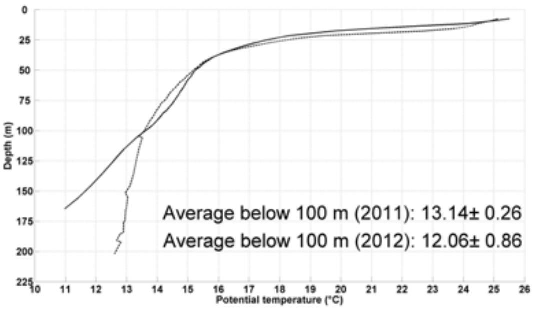

Fig. 1. Average pot. temperature profiles obtained from float data in July-August 2011 (dashed line) and 2012 (solid line) in the Jabuka Pit (middle Adriatic).

Afterwards, its arrival in the SAP interrupted the positive T and S bottom trends observed during the last 5 years, which were quantified by ~0.05°C y^{-1} and ~0.004 y^{-1}, respectively (Fig. 2).

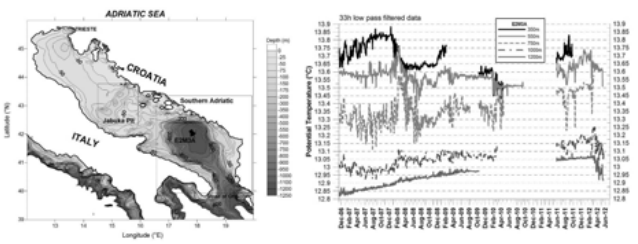

Fig. 2. Map of the Adriatic Sea (left panel) and temperature time series (right panel) at the fixed point observatory E2M3A from 2006 to 2012.

Previous studies report that, presumably, these trends were associated to the combined effect of local mesoscale eddies, large scale circulation changes, and dense water formation processes ([1], [2], [3]). The descent of dense waters of Northern Adriatic origin (NAdDW) caused an abrupt bottom T and S decrease (~0.15 °C and ~0.015, respectively). The corresponding density increase was ~ 0.02 kg m^{-3}. Our data confirm that the deepest part of the SAP undergoes intense modifications only when harsh winter conditions are able to produce a high volume of NAdDW with different properties from those of the previous years. Moreover, they show that the exceptionally dense waters produced on the northern shelf arrived in the central, deepest part of the SAP as a series of individual pulses not earlier than 10 March 2012, while a stronger and prolonged signal that significantly modified the deep water stratification arrived after 10 April 2012. CTD float profiles collected in the Strait of Otranto, which connects the Adriatic Sea with the Ionian Sea, reveal that the Adriatic outflow in July 2012 was characterized by relatively cold and dense water (θ ~13.08°C, S~38.71, and σ_θ~29.25 kg m^{-3}). This fact clearly indicates that the harsh winter conditions, responsible for an exceptional production of very dense water in the Northern Adriatic, caused also strong modifications in the thermohaline properties of the Adriatic outflow with respect to those observed in the previous years ($\Delta\theta$~ -0.2°C, ΔS~ 0.01, $\Delta\sigma_\theta$~ +0.02-0.03 kg m^{-3}).

References
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