



Hydrochanges Gibraltar Campaign - characterization of Mediterranean Outflow through the Strait of Gibraltar

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The precise characterization of the Mediterranean outflow through the Strait of Gibraltar is a very well known issue although a question rather far to be resolved completely. Many scientific efforts have been invested to try to define the exact composition and evolution of the Mediterranean waters (MWs) raising at the entrance of the strait and crossing one of the most dynamically active sites of the worldwide oceans. In the framework of the Hydrochanges European programme, the “Gibraltar International Campaign” was carried out onboard the R/V Tethys II by the French Mediterranean Institute of Oceanography (MIO) in June 2012, with the chance to perform a series of high-resolution CTD meridional transects. The instrument used is a Moving Vessel Profiler (MVP), a towed free-falling CTD, which enables a very high spatial resolution semi-autonomous monitoring of the column water. This work presents the hydrological data set retrieved in the campaign and proposes their usage as tool for the characterization of the composition and the evolution of the Mediterranean outflow along the strait. Two main assumptions are discussed: the generally accepted hypothesis of only two main Mediterranean waters crossing the strait, the Levantine Intermediate Water (LIW) and the Western Mediterranean Deep Water (WMDW), and the novel theory, principally supported by the MIO group since last years, of the presence of up to four Mediterranean waters raising at the strait entrance: two intermediate waters, the LIW and the Winter Intermediate Water (WIW) and a further dense water, the Tyrrhenian Deep Water (TDW) flanking the WMDW. In both cases the mixing within these MWs and between them and the Atlantic inflowing waters, namely the Surface Atlantic Water (SAW) and the North Atlantic Central Water (NACW), are analyzed and discussed. A classical mixing triangle approach is proposed for the first assumption, with the definition of a third vertex as a general Atlantic water, and a novel approach based on a simplified cluster analysis of the Temperature/Salinity/Density diagrams of the transects, is applied to the six water masses considered in the second assumption. The latter is also applied to the GIBEX2 (Gibraltar Experiment) dataset in order to confirm, by a completely subjective approach, the rather arbitrary definition of the MWs accepted so far. A clear differentiation of the MWs along the cross-strait direction is observed, with intermediate waters laying on the northern Spanish slope and the denser ones flowing along the southern slope. However, this structure is deeply modified by the very strong mixing occurring in the strait and it ends to nearly disappear at west of the Camarinal Sill. The temporal variability, strictly related to the tidal dynamics, is very high, inducing strong changes in this structure throughout the strait, up to substantially modify it. In order to investigate this temporal variability, the recent series of current and thermohaline characteristics of the MWs, sampled simultaneously at Espartel and in two (north and south) extremes of the Camarinal Sill by the Physical Oceanography Group of the University of Málaga, have also been examined with interesting results on the characterization of the outflow evolution along the strait.