Increased warming trend of the Mediterranean outflow into the North Atlantic Ocean

Jesús García-Lafuente [(1)], Simone Sammartino[(2)], Ricardo Sánchez-Leal[(3)], Irene Nadal-Arizo[(1)], Cristina Naranjo[(1)]

[(1)] Physical Oceanography Group, Instituto Biotecnología Y Desarrollo Azul (IBYDA), University of Málaga, SPAIN
[(2)] Physical Oceanography Group, Instituto Ingeniería Oceánica (IIO), University of Málaga, SPAIN
[(3)] Spanish Institute of Oceanography, Cadiz Oceanographic Center, SPAIN

Keywords: *Mediterranean outflow, warming trend, Levantine Intermediate Water, Western Mediterranean Deep Water, Strait of Gibraltar, Buoyancy fluxes*

Thermohaline properties of near-bottom (about 15m above seafloor) Mediterranean waters that form part of the Mediterranean outflow (MOW) have been monitored since 2004 at the Espartel Sill in the Strait of Gibraltar, the westernmost gate before the MOW spreads in the Gulf of Cadiz and the Atlantic Ocean (Sammartino et al. 2015; doi:10.1002/2014JC010674). Monitored near-bottom water shows a surprising warming trend of 0.339 ± 0.008°C decade^{-1} from 2013 onwards, which is one order of magnitude greater than the usual deep waters trends reported in the Mediterranean (García-Lafuente et al. 2021; doi:10.3389/fmars.2021.613444). The origin of such trend might be the concomitant warming of deep waters unnoticed so far, which is not likely taking into account the observational effort being carried out in the basin, or the progressive increase of the contribution of the warmer and saltier Levantine Intermediate Water (LIW) in the MOW at the expense of the colder and fresher Western Mediterranean Deep Water (WMDW) counterpart. ERA5 climatic reanalysis points at average negative buoyancy flux anomalies in the Mediterranean basin during the period 2013-to-present, which implies reduced WMDW formation rates in the convection areas. Increased volume of LIW in the outflow would compensate the WMDW deficit in the MOW, thus explaining the temperature trend. The warming, in turn, will produce a more buoyant MOW in the Gulf of Cadiz with consequences to be investigated in the future.

Sammartino, S., García-Lafuente, J., Naranjo, C., Sánchez-Garrido, J.C., Sánchez-Leal, R., Sánchez-Román, A. 2015. Ten years of marine current measurements in Espartel Sill, Strait of Gibraltar. Journal of Geophysical Research, 120, 6309-6328. DOI:10.1002/2014JC010674.

García-Lafuente, J. Sammartino, S, Huertas, I.E., Flecha, S., Sánchez-Leal, R., Naranjo, C., Nadal, I., Bellanco, M.J. 2021. Hotter and weaker Mediterranean outflow as a response to basin-wide alterations. Frontiers in Marine Sciences, 8, 613444, doi:10.3389/fmars.2021.613444.