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Detailed temperature-salinity distribution in the Northeast Atlantic from ship and ARGO vertical casts

Filipe Neves (1), Igor Bashmachnikov (1,2), Angela Nascimento (1), Joana Medeiros (1), Joaquim Dias (1,2), Isabel Ambar (1,2), and Xavier Carton (3)

(1) Center of Oceanography, University of Lisbon, Lisbon, Portugal, (2) Faculty of Scineces, University of Lisbon, Lisbon, Portugal, (3) Laboratoire de Physique des Océans, Université de Bretagne Occidentale, Brest, France.

A new and detailed climatology (MEDTRANS) of climatic temperature-salinity distributions of ocean characteristics in the Subtropical Northeast Atlantic (25 – 45oN and 6 – 35oW) was obtained with 25-m depth interval and 30-km horizontal resolution. Having a special focus on the propagation of the Mediterranean Water (MW), this study was felt necessary since the existing global climatic fields (World Ocean Atlas 2009; Schmidtko et al., 2013; Troupin et al., 2010) do not provide sufficiently detailed or sufficiently reliable mapping at the intermediate water levels. This is particularly critical for mapping of the MW spreading near the Iberian Peninsula.

The main source of the data is the World Ocean Database freely provided by the National Oceanographic Data Center (http://www.nodc.noaa.gov/). The data cover the period from 1950 to 2012 and include OSD (bottle, XCTD, low-resolution CTD casts), CTD (high-resolution CTD casts) and PFL (mainly ARGO float casts) instrument types. All data underwent a rigorous quality control, as well as preliminary filtering for the instrumental and eddy related noise.

The gridding is performed along 53 neutral density surfaces (Jackett and McDougall, 1997) using Barnes' Optimum Interpolation technique (Barnes, 1964). Following the data density distribution, the radius of the Gaussian gridding function decreases towards the Iberian coast. The shape of the gridding function takes into account the influence of bottom topography on the characteristics of oceanic flows. The results are further interpolated into fixed depth levels down to 2000 m depth.

The results suggest that the MEDTRANS climatology brings significantly more details of the distribution of the temperature-salinity structures related to the MW spreading in the Atlantic, of the southeastward penetration of the subpolar/polar water along the eastern slope of the Azores plateau and the King's trough/rise, and of the northwards penetration of the Antarctic Intermediate Water along the African coast. The temperature-salinity maps were used for computation of the geostrophic currents in the upper layer referenced to 1900-m level, revealing several features, all in close correspondence with the ocean circulation theory (Cushman-Rosin, 2010): (i) periodic intensification of the Azores Current (AzC) as it turns south in the quasi-stationary meanders; (ii) inflows and outflows from/to the AzC as it meanders; (iii) strong recirculation of the AzC west of Cruiser-Great Meteor seamounts.

Seasonal variations were computed for the 6-month periods: the "warm" and the "cold" seasons. The seasonality manifested itself in more evident zonal extension of the flows during the warm season. This can be related with the 50% decrease of the wind-stress curl in the northern and central parts of the region and the corresponding decrease of Sverdrup fluxes.

The seasonality in the MW manifested itself in the more saline (and more dense) lower core of the Mediterranean Undercurrent during the warm season, as well as in the further zonal extension of the 36.00 isohaline from the Iberian coast, along 37 – 39oN.

The gridded climatic fields are available at the web-site of the Center of Oceanography of the University of Lisbon (http://co.fc.ul.pt/en/).