Monitoring the Oceanic Waters of the Canary Islands: RaProCan

The deep hydrographic section of the Canaries

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Due to the high density and heat capacity of water, the ocean modulates climate in scales much larger than the atmosphere, both spatially and temporally. In order to understand the mechanisms governing this internal variability of the ocean, and therefore climate, it is necessary to have long systematic observations. The Atlantic Meridional Overturning Circulation (AMOC), which is composed by the south- north circulation, transports 18Sv (1Sv=10E6m3/s) of water that carries more that 1.5PW (1PW=10E15W) of heat to the North Atlantic, and therefore plays a determining role in regulating the climate in Europe. An important component of the AMOC is the subtropical gyre, the largest oceanic structure of the North Atlantic. The Canary Islands are immersed in the eastern margin of the subtropical gyre, in the coastal transition zone of the Canary Current Upwelling System and therefore they are an ideal place for the study of the subtropical gyre variability (Figure 1).

With this background, in 2006 the Spanish Institute of Oceanography began (IEO) the program deep hydrographic section around the Canary Islands (Raprocan), in order to establish the scales of variability in the range decadal/subdecadal in the subtropical gyre, specifically in its eastern margin. Based on previous results the observational strategy of Raprocan consists in hydrographic cruises in two seasons, with 50 hydrographic stations around the Canary archipelago. In each one of the stations velocity, temperature, salinity, pressure, oxygen, turbidity and fluorescence is continuously measured (CTD). In each station 24 samples are taken for calibration of the above variables as well as for determination of alkalinity, carbon content and chlorophyll.

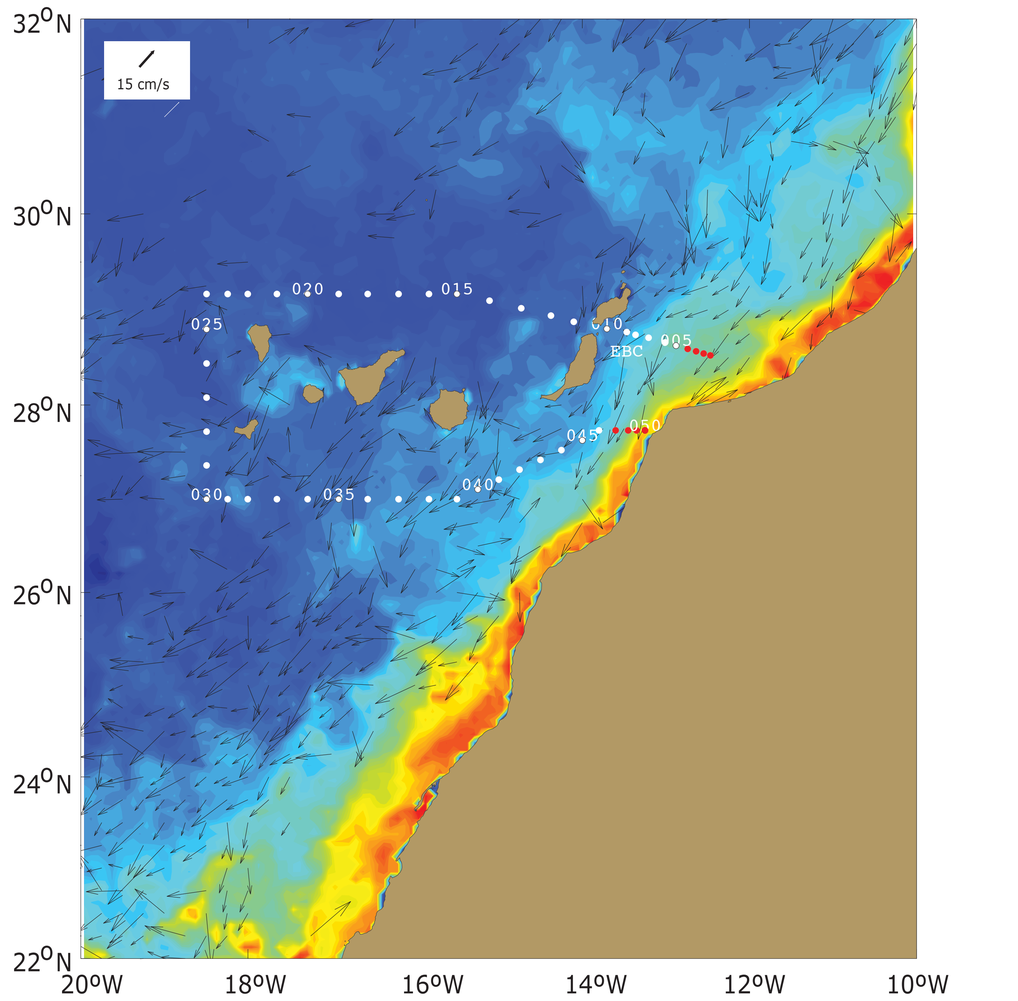

Figure 1. Positions of the 50 hydrographic stations routinely carried out during Raprocan cruises and the long term mooring EBC. Red sations are in waters of Morrocco. The background field is the Chlorophyll-a in logarithmic scale from Modis on December 2013. The black arrows indicate the mean currents as measured by the drifters from the Global Drifter Program between 1999 and 2013 for all the seasons.

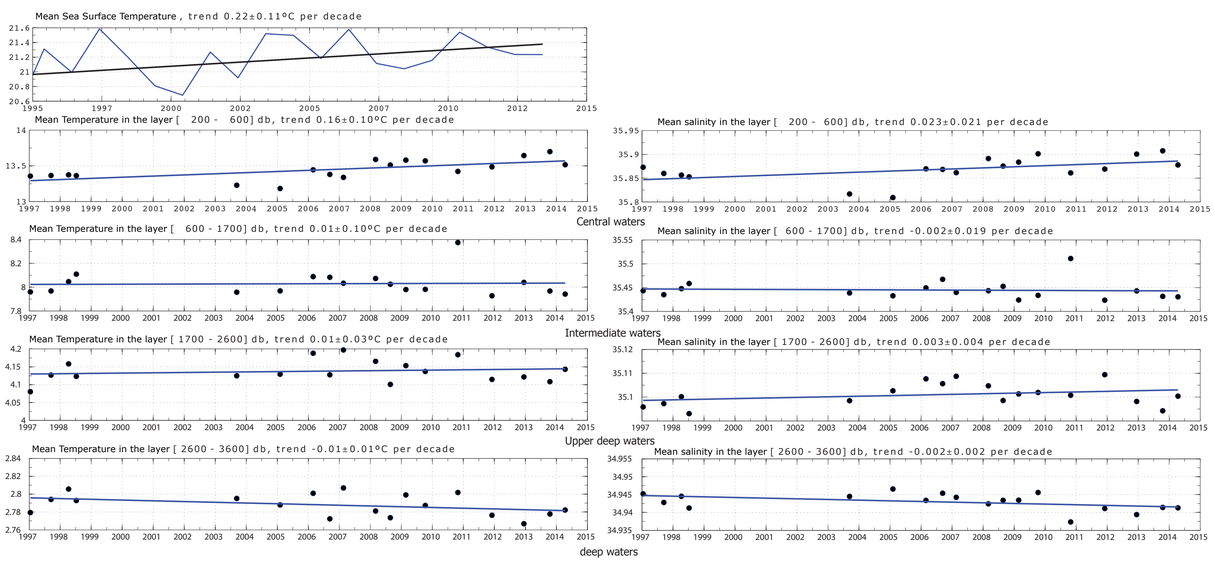

Figure 2. Mean temperature and salinity for the surface, central, intermediate and deep waters in the stations 11-24 of the Raprocan sampling. Under different projects the same stations has been sampled since 1996. The red dots indicate the mean values for each cruise and the blue line is a Sen robust fit.

The warming of the upper 600 m continues at a rate of 0.16±0.10°C/ decade in the oceanic waters and 0.32 C/decade in the waters between Lanzarote and Africa under influence of upwelling off the African coast. At intermitted levels there is not statisticall significat change, neither in temperature (-0.01±0.10ºC/decade) nor in salinity (-0.002±0.004). For the deep waters there is a marginallly statistical significat cooling of -0.01±0.01ºC and fresehing of -0.002±0.002 (Figure 2). Overimposed on the long term trend, there is a subdecadal variability on all the layer, with an amplitude of 0.5ºC for the upper 600m.

Besides the interest in the long term changes, and the impact of the climate change in the oceanic region around the Canary islands, Raprocan aims to understand the seasonal, subdecadal and decadal changes that domitated the ocean dynamics in these region. At seasonal scales there is significat variability in the hydrographic condtions (Figure 3), that have associated changes in the oceanic circulation.

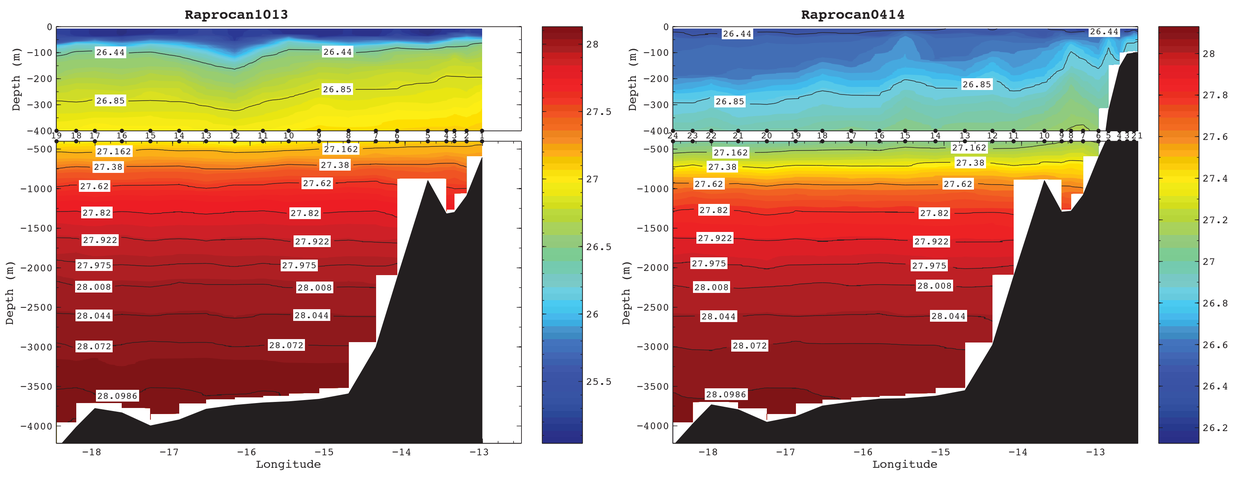

Figure 3. γ_n vertical distribution for the northern section in two cruises carried out in fall (October) and spring (April).

The Canary Current presents a seasonal cycle, with the minimum transport occurring during fall, when it only carries 3 Sv (Figure 4). During this season, the transport is concentrated between the islands of Tenerife and Lanzarote and in the first 400 meters. The Seasonal cycle of the Atlantic Meridional Overturning Circulation (AMOC) seems to be dominated by the seasonal changes in the Canary Current.

To complement the cruise observations, since 2013, Plocan is providing seasonal glider data (Figure 5) that permits to increse the signal-to-noise ratio of the transport estimates.

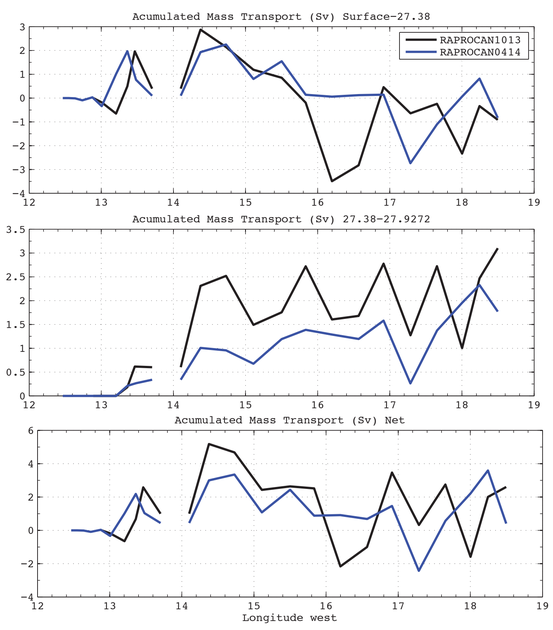

Figure 4. Accumulated geostrophic transport during Fall and Spring for the upper, intermediate layers and the net transprot in the whole water column.

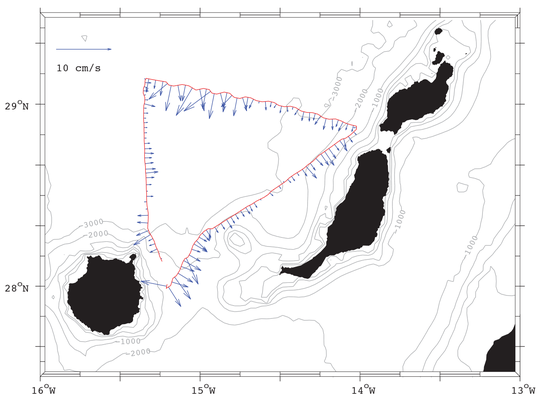

Figure 5. Mean geostrophic velocity (0-100m) for the upper 600m as obtained using glider data provided by PLOCAN during October 2014.

RAPROCAN is a project lead by the **Spanish Oceanographic Institute** and carried out in collaboration with the **University of Las Palmas de Gran Canaria** and with the **Oceanic Platform of the Canary Islands** that permitts to understand the long-term changes happening in the oceanic waters around the Canary Islands