Study of early summer mesoscale structures and processes of the NW Iberian Margin

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1. Introduction

The hydrography and dynamics of NW Iberian margin in the neighborhood of Cape Silleiro were explored for July 2009, based on a set of in situ and remote sensing observations.

Usually, filaments develop near Cape Finisterre and at 42°N in July and grow until the end of August. During July 2009, anomalous atmospheric conditions brought southerly winds and precipitation (Figure 1). In this way upwelling was not sustained long enough to produce fully developed filaments in the region. Nonetheless, two periods of northerly winds were enough to form an upwelling front extending to the shelf edge, just south of Cape Silleiro.

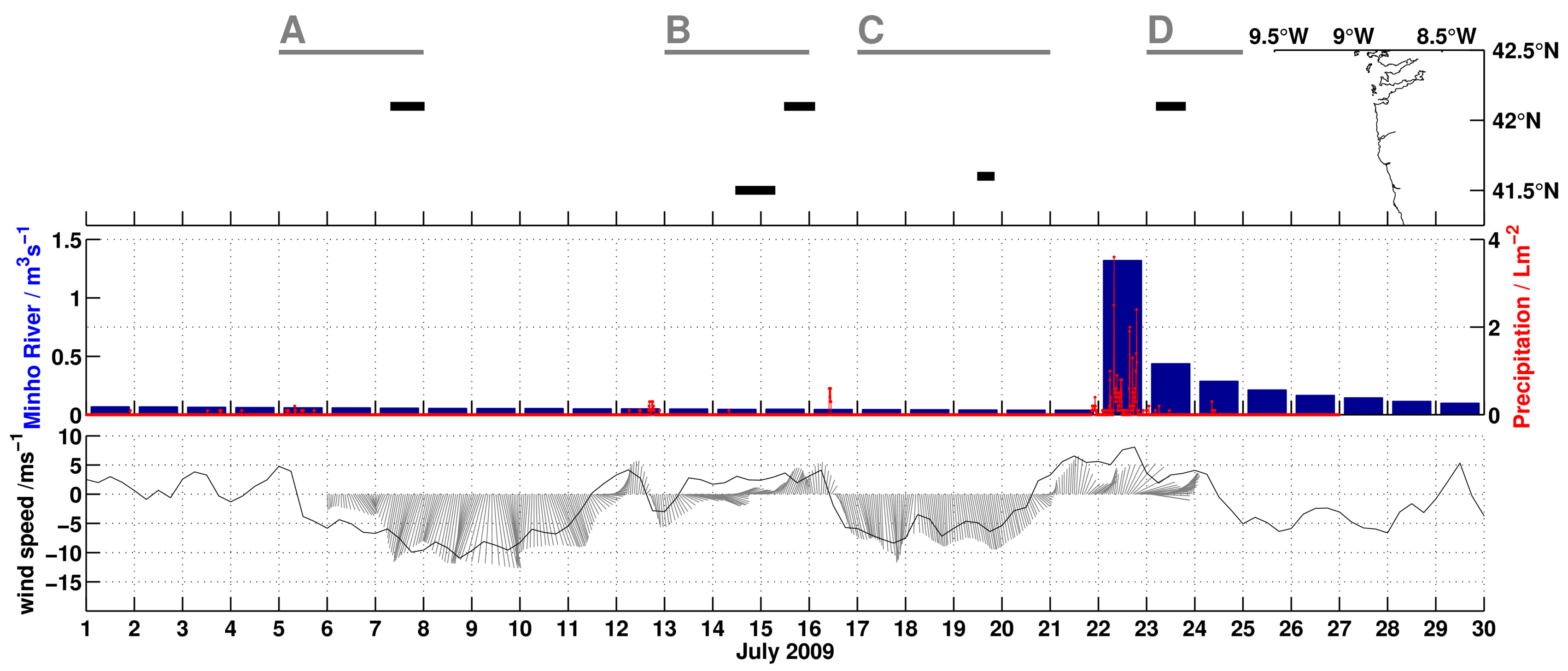


Figure 1. Time series with letters A, B, C and D indicating the periods represented in figure 2, and position of the transects in relation to the coastline to the right. The daily Minho river flux is shown as blue bars, and the precipitation measured at the MeteoGalicia meteorologic station Castro Vicaludo per 10 minutes is shown in red. The bottom panel shows winds measured at the Research Vessel meteorologic station filtered to remove cycles with less than 6h period (stick plot), and the meridional wind component from ERA-Interim reanalysis taken in front of Cape Silleiro (black line) (light blue star in figure 2 maps).

2. Outline:

High-resolution Vessel Mounted Acoustic Doppler Current Profiler (VMADCP) and towed CTD (SeaSoar) offshore surveys revealed poleward currents offshore of 10.6°W, with signature in temperature and salinity between 10°W and 11°W, showing that the Iberian Poleward Current (IPC) was fully developed during July 2009 (Figure 2 A and D). The evolution of salinity suggests that the interior core of the IPC was displaced onshore in July, while SST images suggest offshore displacement of the surface layer.

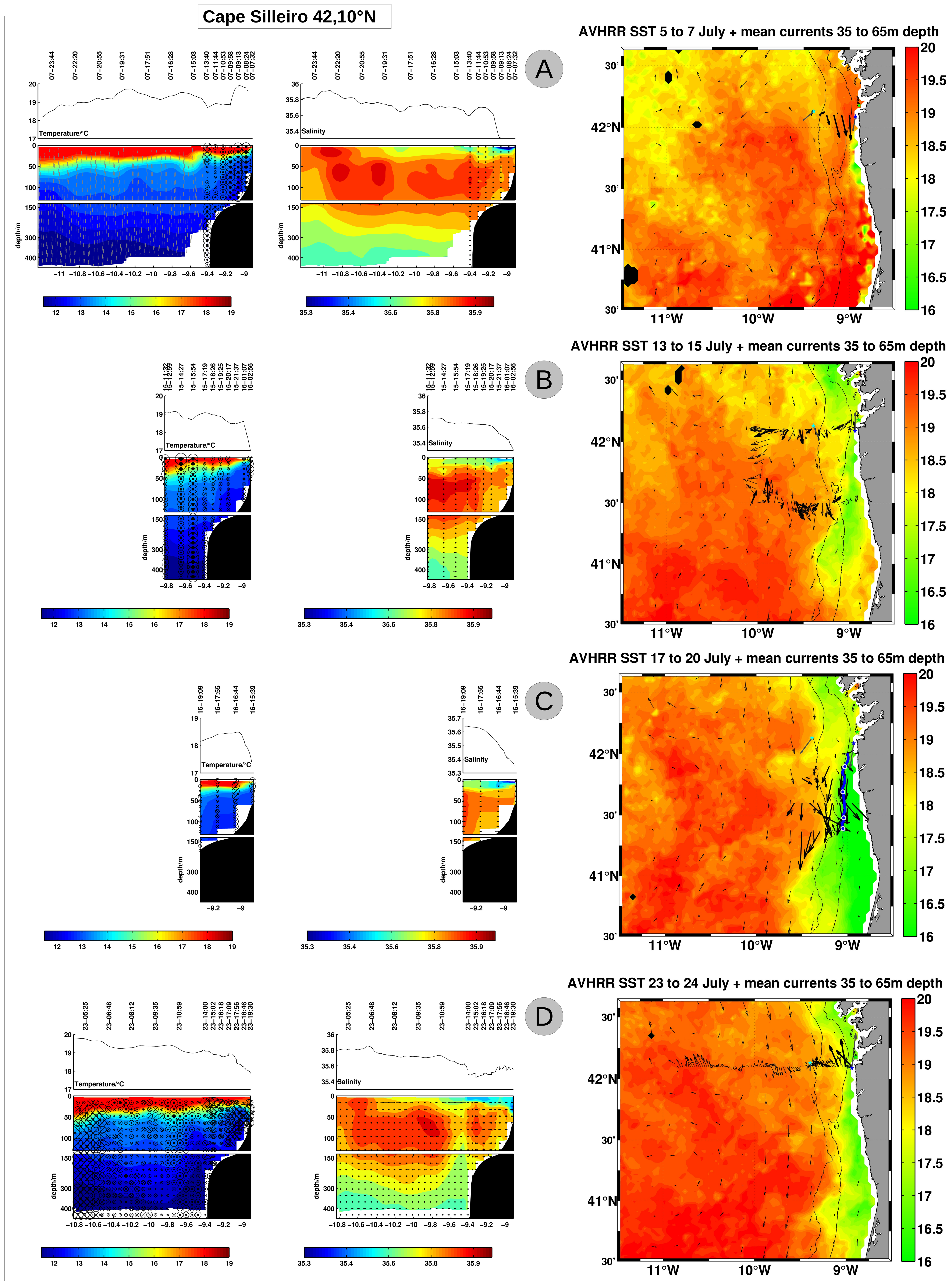
On the coastal side, zonal sections of standard CTD casts, and Lagrangian surveys were made, in order to characterize the early stages of upwelling in this region, which is key to the origin of filaments. The circulation is mostly ruled by the wind patterns.

Period A: Early stage of an upwelling period, after a long period of downelling favourable winds concentrating warm and fresh surface waters on the inner-shelf. The northerly winds of the previous days were responsible for the southward currents in the continental shelf.

Period B: After the first upwelling period, weak variable winds are observed. Both transects, in front of Cape Silleiro and Minho River, show a cold water southward current over the continental slope interacting with the poleward current offshore of 9.5°W.

Period C: Northerly winds return, with southward currents around all shelf. The Cape Silleiro transect was made at the beginning of the upwelling period, without enough time to change from the previous downwelling regime. The effect of the upwelling regime can be visualized in the Minho River transect, with stronger southward alongshore currents than in period B, and more pronounced horizontal thermal front. The drifter buoy followed the 100m bathymetric southward during the four days, slowing down on the last day with weaker northerly winds. The cold water filaments at 41°N and at 42°N are fed by this kind of bathymetry following cold water jet, located on regions with a wider continental shelf.

Period D: Strong southerly winds were observed, after a large Minho River outflow and precipitation on the region. It resulted in northward currents in front Cape Silleiro, transporting fresh water from Minho River and downwelling of surface warm and fresh waters nearshore.



3. Conclusions:

The IPC was evident in summer 2009 and interacted with the coastal waters and the shelf topography. Those interactions appear to be responsible for the main forcing mechanisms of the small scale filaments observed in this study. Ongoing numerical model simulations for the same period will contribute to further understanding of upwelling dynamics and filament development in this region.

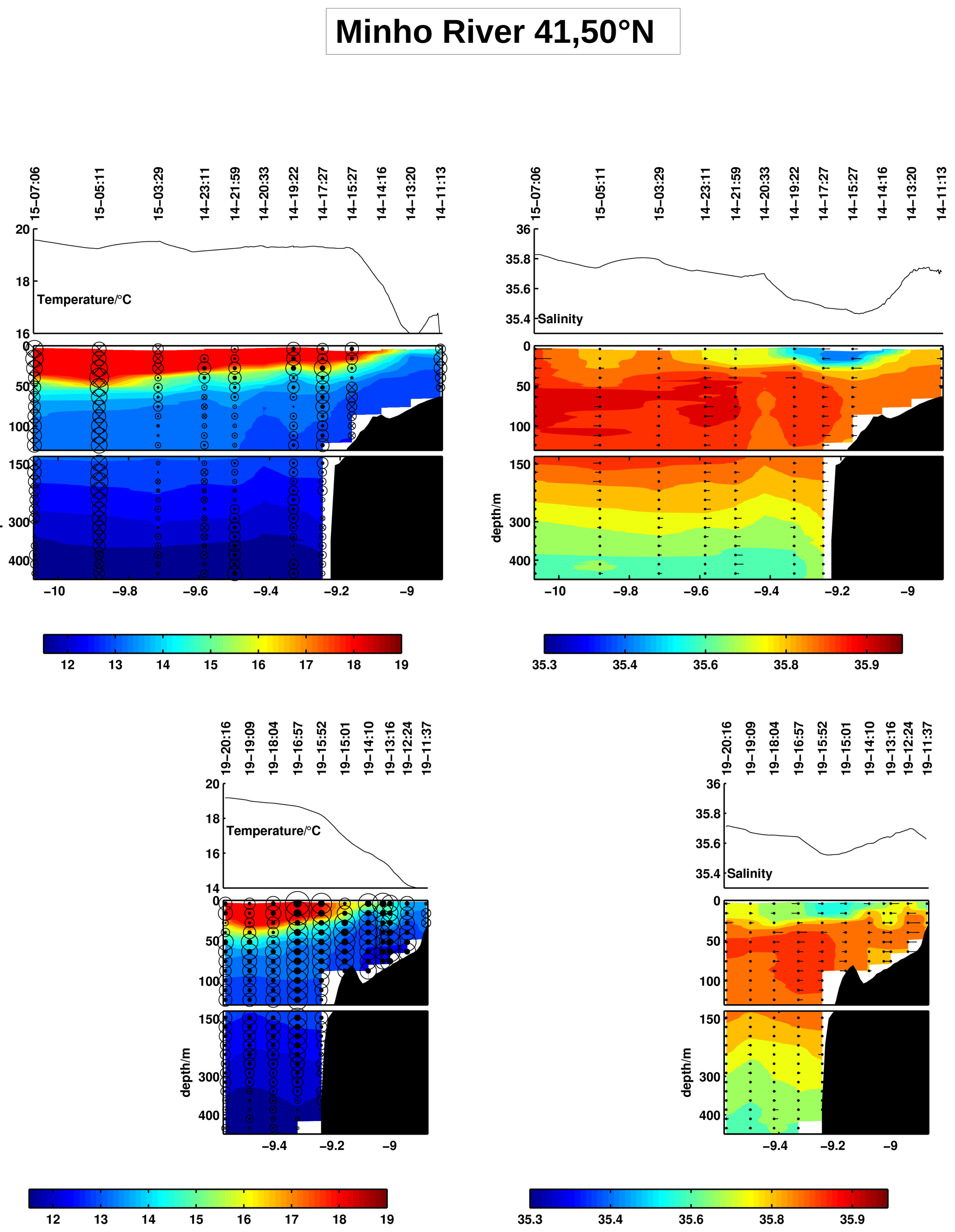


Figure 2. Sequence of 4 periods identified as letters A, B, C and D in figure 1 [top to down] showing the available zonally oriented vertical transects of temperature and salinity in front Cape Silleiro (41,10°N) [left column] and south of Minho River mouth (41,50°N)[right column]. Each transect has on the top the day and hour of each CTD cast and the underway surface temperature and salinity from the thermosalinograph. When available, currents measured with LADCP or VMADCP are shown. The meridional component represented by crosses (poleward) and circles (equatorward) over the temperature transects (larger circles mean more intensity). The zonal component with dot-lines over the salinity (dot on the right means offshore direction).
In the middle column, for each period, are represented the average SST from AVHRR satellite data. Calculated geostrophic currents from the AVISO sea level anomaly dataset are superimposed as the grid of light arrows. For the periods depicted, the currents from the available LADCP (bold arrows) and VMADCP between 35m to 65m depths are also shown. On period C, the trajectory of a drifter buoy at the surface is shown in blue (during period C, moved from north to south). Black thin lines represent the 100m and 200m bathymetry.

4. Aknowledgements:
This work was made under the framework of the multidisciplinary project "Canaries-Iberian Marine Ecosystem Exchanges (CAIBEX)" (CTM2007-66408-C02-01/MAR)(Spanish Ministry of Education and Science). NGF Cordeiro was supported by the Portuguese Science and Technology Foundation (FCT) through PhD fellowship SFRH/BD/101070/2014.

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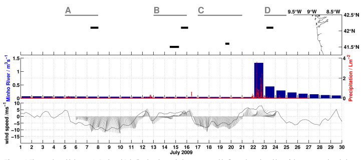

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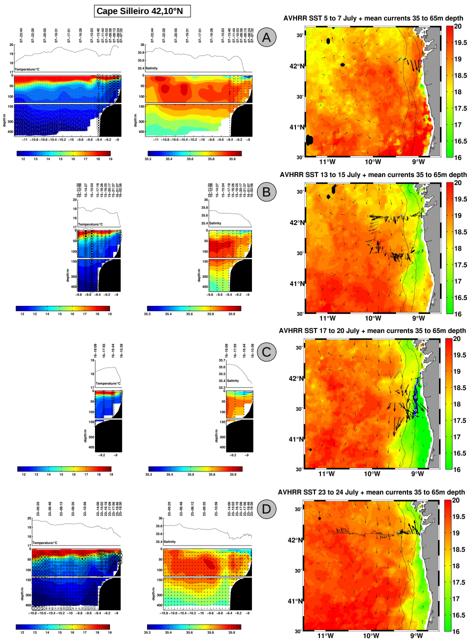

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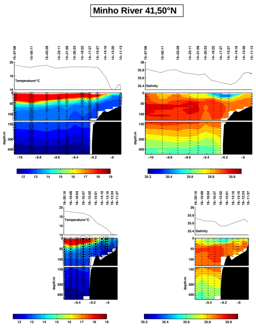

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