Lagrangian observations, filament transport and budgets

E.D. Barton and R. Torres

University of Wales - Bangor

Introduction

During the first year of the project there has been no opportunity for sea time for the UWB-a specific tasks, so work has been related to making cruise preparations, liaising with cruises which have taken place to inventory Acoustic Doppler data sets that have been obtained and examining earlier data sets. Cruise preparations have involved purchase and testing of four Argos drifters with holey sock drogues conforming to WOCE standards. These are now ready for test deployment at sea.

Acoustic Doppler Current Profiler data has been recorded on only two OMEX "Charles Darwin" cruises so far. Data have been forwarded to BODC for processing prior to analysis by the UWB-a group.

We have re-examined data from a 1986 experiment in the OMEX II area, comprising drifters, current meters, CTD and SeaSoar surveys. The analysis has been furthered by detailed water mass analysis of the upper 300 m layer in particular. Results are briefly described below, and are being reported in a manuscript in preparation for publication. Other previous work in a NW African filament system, of interest as a comparison to Iberia, is in press (Barton et al., 1998).

Data Analysis

Extensive SeaSoar tows and supporting CTD observations allow detailed temperature-salinity analysis of the upper layer water mass structure over the continental shelf and slope in the OMEX II area. Flow information was provided by four moorings and six Argos tracked drifters, while the overall context was defined by AVHRR images and meteorological data from coastal stations. The data set has previously been examined in terms of definition of the poleward flow dominant at the time and the dispersion of drifters located in the flow (Haynes and Barton, 1990 and 1991) but no detailed assessment of water masses was made.

Results [Pertains to Task II.1.5 and also II.2.1]

The cruise track shown in Figure 1 allowed a determination of the alongshore variation of water mass structure between Cape Finisterre and south of Lisbon with a spatial resolution of approximately 1.5 km alongtrack and 2 m vertically. The observations were in September, following the weakening of summertime upwelling, when a meandering poleward flow was already established as a warm tongue extending along the continental slope to beyond Finisterre. During the cruise however a weak resurgence of favourable winds evoked a brief upwelling response in the northern sector off the Galician Rias, where the wind was stronger than further south. Nearshore shelf currents reversed to equatorward during this time.

A subset of the TS curves along the inshore of the two alongshore SeaSoar transects reveals the wide range of variation alongshore (Figure 2). Most of the Central Waters were the subtropical form of Eastern North Atlantic Central water, but in the north of the region some of the subpolar form was present. The proportion of subtropical ENAW increased southwards. The southernmost area sampled showed a significant salinity maximum just above the central water, related to the poleward current. Over most of the region the typical TS curve indicated a surface layer of warmed, possibly previously upwelled, central water with vertically uniform salinity.

Close to the Rias Baixas, the effect of upwelling due to the wind strengthening was seen as cooler surface temperatures (Figure 2) and also by increased chlorophyll (not shown). However the "upwelling" was clearly enhanced by "outwelling" or outflow from the Rias of much fresher, high chlorophyll water as described by Castro et al. (1997). More generally, near shore water masses in the northern region did not show the homogeneity in salinity found further south; rather, they showed a uniform freshening toward the surface in the upper layer, indicative of mixing between the underlying central water and a near surface low salinity water originating in river outflow.

Futher south, near Cabo Roca, a remnant upwelling filament was observed. A narrow surface intrusion of cold, high chlorophyll, lower salinity water was crossed in both SeaSoar transects and clearly visible in the satellite imagery as a narrow cool ribbon terminating in a cyclonic eddy. This feature had persisted from the summer upwelling despite the general relaxation and development of poleward flow that had occurred. The filament had clearly distinct TS properties (Figure 3), being cooler and fresher than waters immediately to north and south. Of the local waters, the inshore waters to the south were fresher than those further offshore but also those to the north. Again this indicates the significance of fresh water influence probably from the Tagus. Estimates of offshore velocity in the filament indicate geostrophic currents of 0.2 to 0.3 m/s comparable to the overall poleward flow speed observed by drifters and current meters.

Nearshore freshwater influence was also seen at other sites as thin surface layers of much fresher water. At times of strong upwelling these would be less visible because of the strong vertical mixing taking place under wind action.

Discussion

The wide range of TS characteristics over even small areas of the OMEX region and the strong seasonality of alternating upwelling and poleward flow complicate the regime. At the same time, this means that different processes produce strong signals which can be recognized in the analysis. For example the persistent filament off Cabo Roca contrasted strongly with surrounding waters even though it must have been in a stage of decay due to the overall relaxation of upwelling. Though sampling nearshore was insufficient to detect it, the brief upwelling event may have contributed to the persistence of the filament by feeding it new upwelled water inshore of the SeaSoar transect.

References

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Figure 1: SeaSoar track and CTD station positions September 1986 "Bon Entente" cruise.

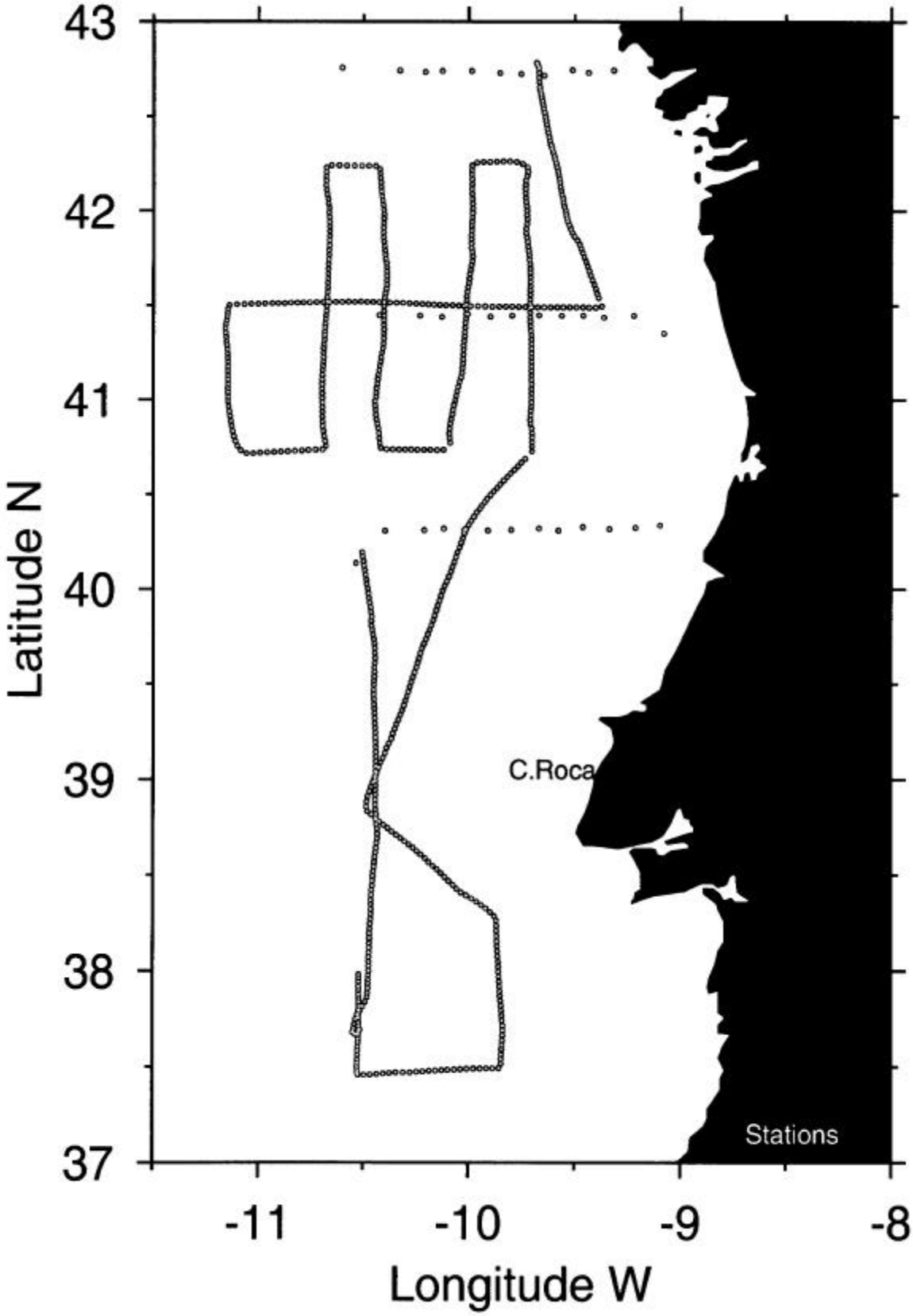

Figure 2: TS curves for selected groups of SeaSoar profiles between Rias baixas and southern Portugal.

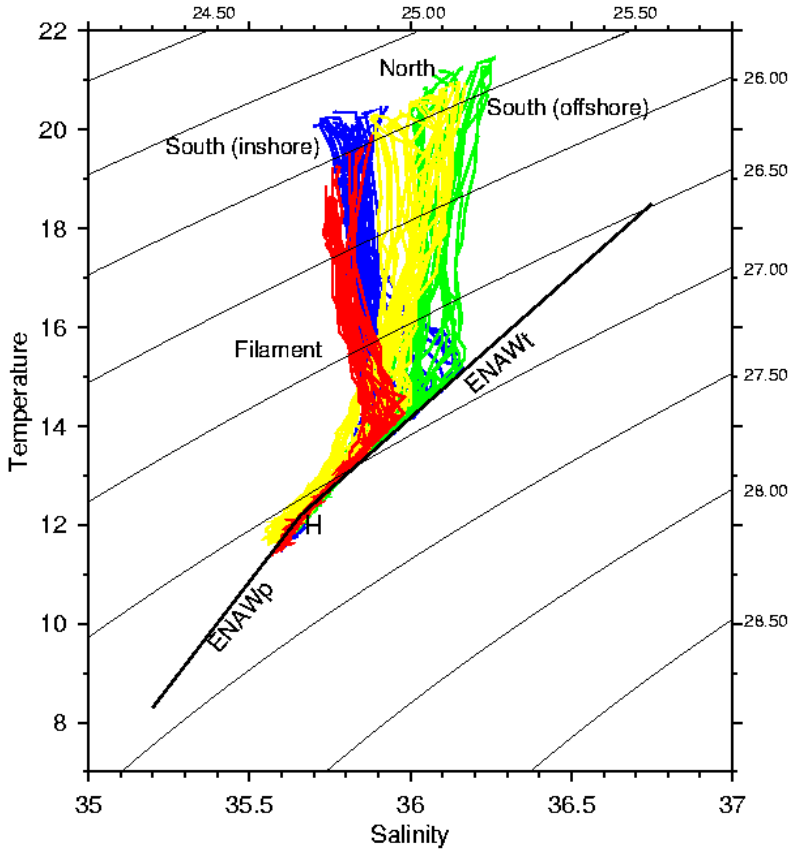

Figure 3: TS curves in and around the remnant upwelling filament off Cabo Roca.