Hydrography and plankton distributions along the Iberian margin

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Introduction

This report details the work performed by NUI, Galway (formerly UCG) between months 12-24 of the project. Work has involved the analysis of historical current meter data from the Iberian Margin region, together with deployment of mooring arrays in conjunction with IfM and IH. In particular, NUI, Galway's work has concentrated on **Tasks II.1** and **II.2**, relating to hydrographic measurements and analysis of both current and historical data. In addition analysis has been made on net phytoplankton samples taken during cruises *CD105* and *CD110*. Whilst not in the task list, the analysis has helped in interpretation of some of the hydrographic work.

During the 2nd year of the project, NUI, Galway, in conjunction with POL and UWB, help a physics workshop to review progress and synthesis results. Based on the finding of individual groups, schematics for the summer and winter scenarios on the Iberian Margin were produced. Following on from the workshop a modeller's workshop was held to discuss, among other things, how to use the results of the historical data analysis for model validation.

Task II.1.1 Historical analysis

The number of data sets acquired for the historical analysis were increased with the delivery of the MORENA data sets for that project's northern line near 42°N. The southern line has still yet to be obtained from the relevant MORENA participants. Positions and sources of the data used in the analysis are shown in Figure 1. Data essentially consists of the BORDEST data set, data measured in 1994 from the projects OMEX I, SEFOS and MORENA and the present OMEX II-II data sets. Data from 1994 has been highlighted as this data set is being used for model calibration/validation. For this year, the modelling groups have ECMWF meteorological data to drive the models, such that a realistic comparison can be made. These data sets are of a relatively long duration, between 3-24 months.

Figure 2 shows the mean current vectors for two depth ranges, the near surface (upper 400 m) level and a depth range associated with Mediterranean Water (MW) Outflow, between 600-1400 m. The mean flow pattern for the upper layer is a little confused as a consequence of too little data available, which are also measured in different years. Mean flows are relatively small (< 5 cm s^{-1}) and directed, for the most part, along slope. Whilst the majority of vectors show northward mean flow, a few of the vectors indicate southward mean flows on the shelf. This is a consequence of seasonal bias in the time of observation. Mean currents are strongest at the depth range of MW influence, particularly at the southern region of the Iberian margin, where currents are between 5-10 cm s^{-1}. Mean currents are weaker further north at this level.

The seasonal picture for mean flows in the upper layer is shown in Figure 3. Strong (up to 10 cm s^{-1}) poleward flows are apparent in winter months (Nov.-Jan.) along the whole of the Iberian margin region. Weakening and reverse of the flow field is present between May-Aug. Fig 3 shows either a southward (in July) or much reduced poleward (Sept.) mean flows in the northern section near 42°N and reversed monthly means at the SEFOS locations just south of 40°N. The location of a PML OMEX I mooring (38.5°N, 9.75°W) demonstrates interannual variability in the monthly means. Two vectors at that location indicates two measurements of monthly means in 1994 and 1995. Whilst good agreement in monthly means is observed in March or September, large differences were measured in May and July.

The low frequency variability in the flow is also directed along-slope. Variance ellipsoids for the data show the major axis aligned along the isobars for most measurement sites. As with the mean flows, maximum variance decreases further north along the margin. Generally the variance decreases with depth but has a marked maximum of greater than 100 cm^2 s^{-1} at the depth of the MW (Figures not shown). Ellipsoids are more rounded, with larger cross slope variance, further south where variance magnitude is greater. The MORENA time-series, close to the OMEX II-II line, have by contrast, show small cross slope variance, suggesting that flow is constrained along the isobars in the region of the OMEX II-II box. This observation ties in with the measurements of intermediate nepheloid layers from CTC sections during WP II and WP III cruises, which show little extension of the IML off-slope.

One end use for the historical analysis will be the calibration and validation of the hydrodynamical models in OMEX II-II. As stated a comparison will be made for the year 1994 of measured and model data, based on statistical analysis of the low frequency motions and seasonally varying currents. This is underway and initial results were presented at the Plymouth workshop. Those comparisons between measured and modelled data were thought, however, to not be appropriate and a new approach is in progress.

Task 2.1.2 Current meter deployment/analysis

The current meter mooring at 700-m depth on the slope has yet to be recovered. No time on any OMEX II-II cruise was obtained to drag for the mooring. It has been arranged to hire a local vessel out of Vigo to complete this task and an attempt to recover the mooring will be made in July.

Net phytoplankton analysis

During OMEX I, net hauls for phytoplankton were made during cruises west of Ireland and data on the presence/absence and dominance of certain species were used to help in the interpretation of water mass distributions and deduced flow patterns at the shelf edge. In particular, the influence of large topographic features like the Porcupine Bank on the current regime and hence cross shelf exchange, was investigated. It was thought to be worthwhile to perform a similar exercise for the Iberian Margin using net phytoplankton samples taken during cruises *CD105* and *CD110* (Figure 4), such that a seasonal change might be found. The net samples are taken with a 20-µm mesh net hauled vertically in the top 100 m and hence only collect the large-scale fraction of phytoplankton.
Results for the dinoflagellates distributions are consistent with the known hydrographic situation. As might be expected, the samples taken in early summer were much richer in phytoplankton abundance. Species diversity in summer was double that in winter and there were distinct differences between summer/winter phytoplankton communities. In summer, samples were dominated by *Ceratium* spp., in particular C. *furca*. In addition a grouping of sub-tropical to warm temperate forms, which are regularly found in the net flora west of Ireland, was noticeable in summer but poorly represented in winter. Of particular interest, was the presence of *Histoneis* in winter, dominant in some samples, but which were absent in summer samples. Other warm water species were more prevalent in winter. The results are consistent with a winter poleward flow in the slope region bringing a more tropical flora to the area. This would also explain the wide occurrence of the coccolithophorid *Scycospaera apsteinii* in winter samples and complete absence in summer. Non upwelling favourable conditions in June probably accounted for the lack of cross shelf gradient in dinoflagellate abundance and species diversity.

Future work

The final year will concentrate on model validation exercises and producing statistics and flow patterns for the flux estimates, together with an in depth analysis of all OMEX II-II current meter data sets.

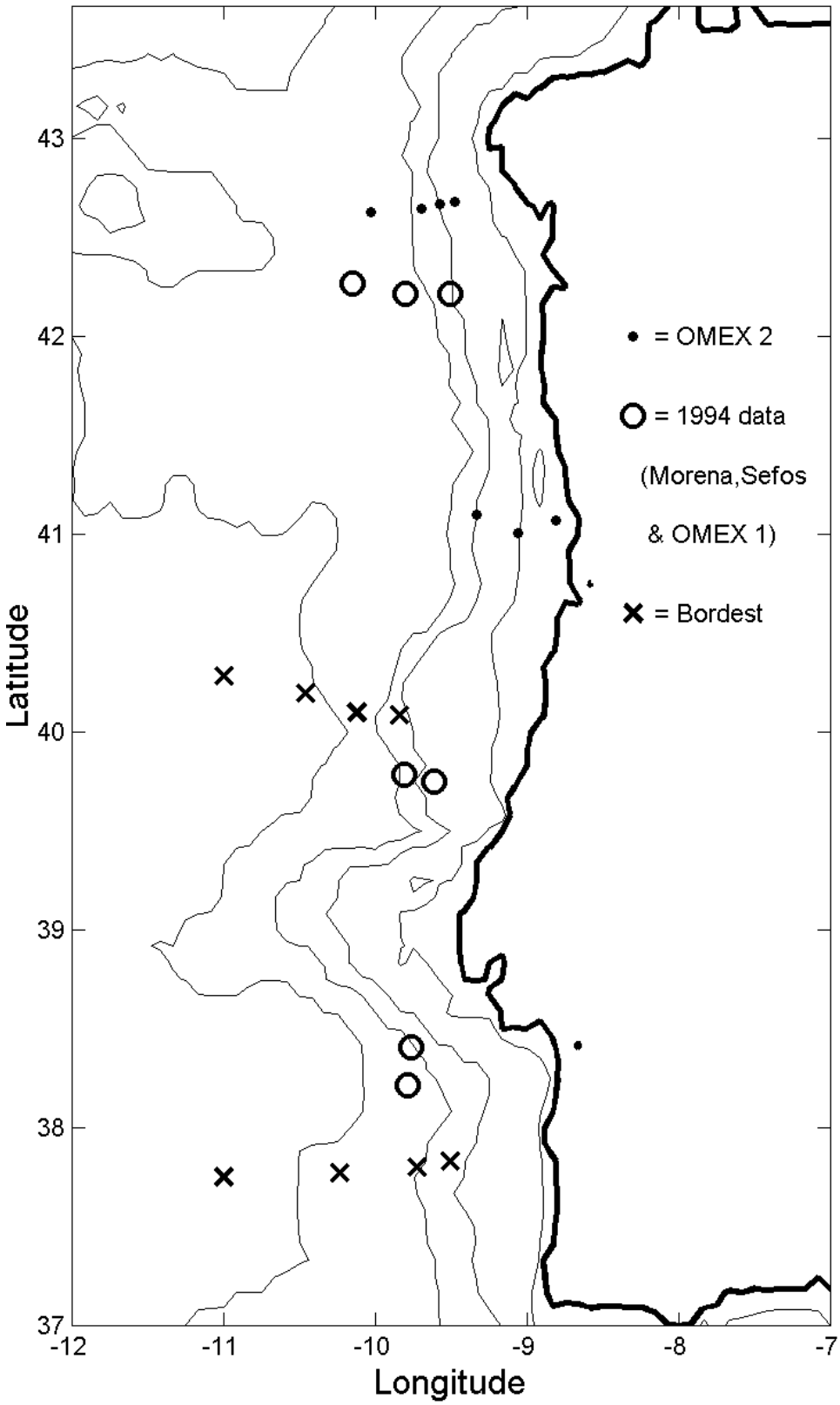

Figure 1. Location of time-series used in the historical analysis and present OMEX II-II sites. 1994 data has been used for model validation.

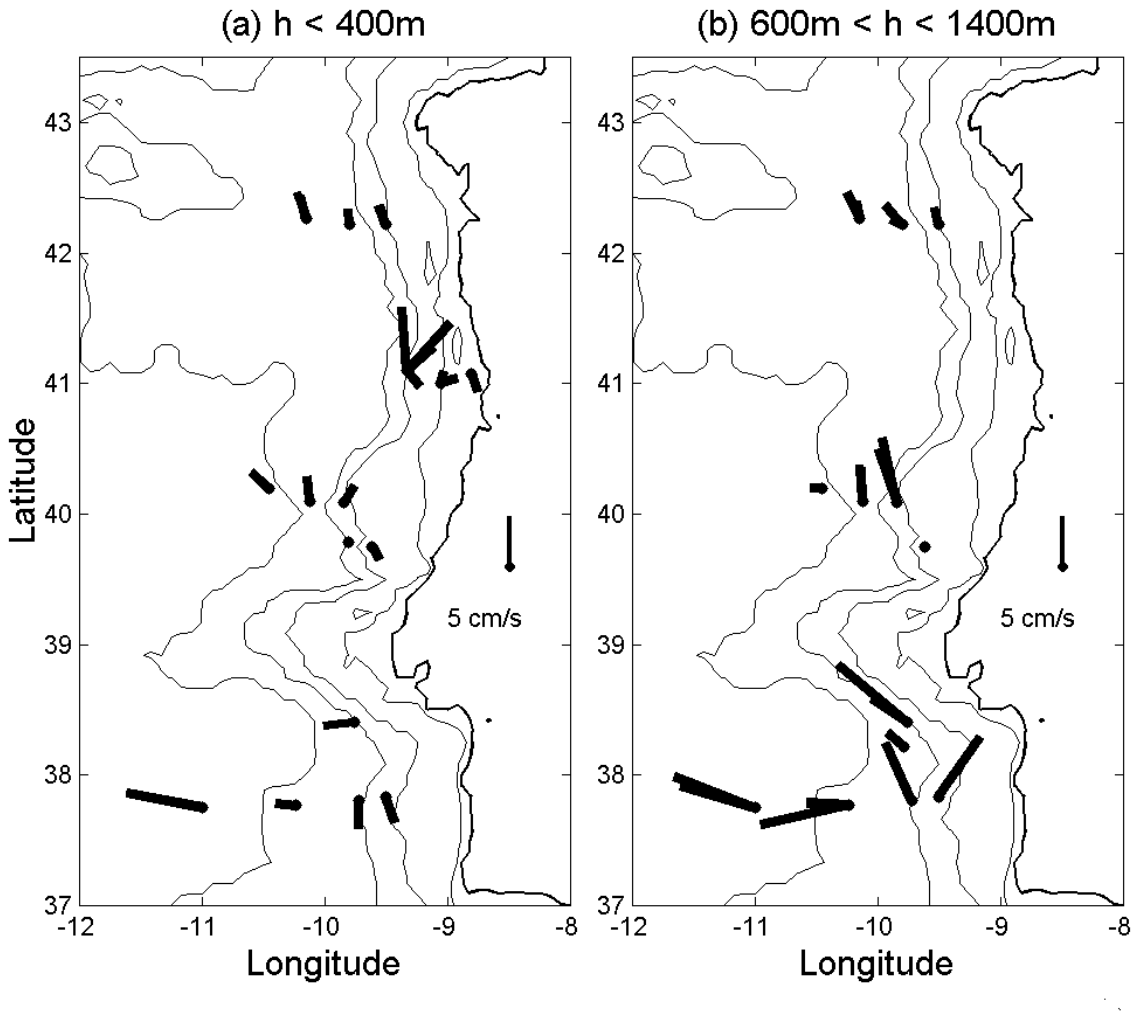

Figure 2. Mean current vectors for data in two depth ranges (near surface and MW level) from archived data sets.

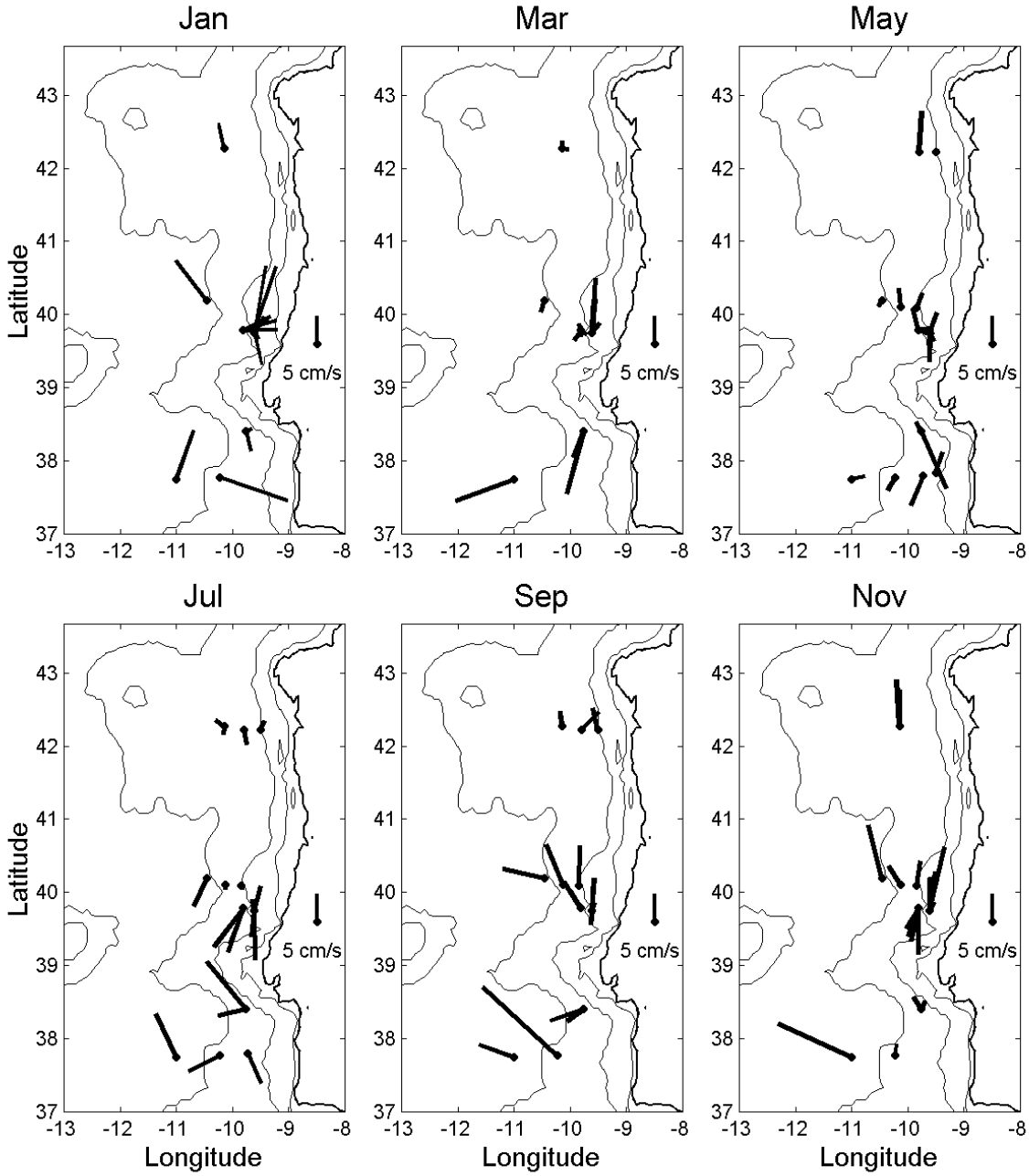

Figure 3. Monthly current means for current-meters < 600 m depth.

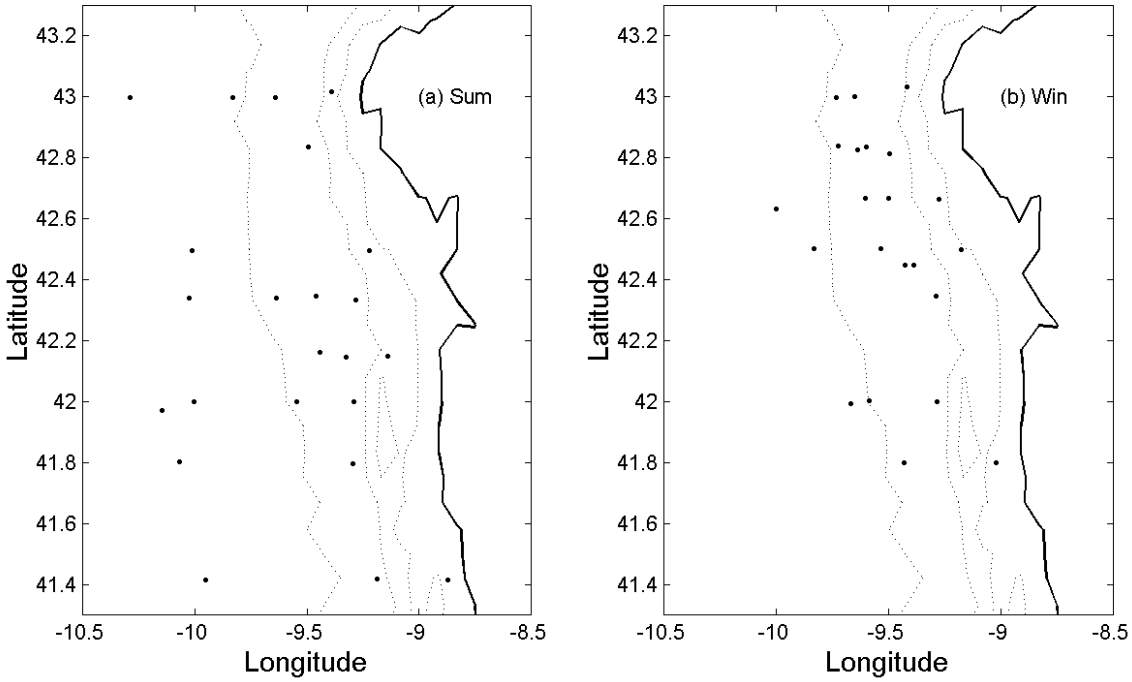

Figure 4. Location of phytoplankton net hauls for (a) *CD105*, Summer, and (b) *CD110*, Winter.