O-V6

Estimation of covariance fields in the Ionian from P.O.E.M. Data

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We present an extensive analysis of hydrological data in the Northern Ionian Sea. This data set merges italian and greek data sets from the POEM-V-87 general circulation survey of september 1987 and covers the Northern Ionian Sea as shown in Fig. 1. The goal of this study is to calculate the covariance matrices for various physical fields such as temperature, salinity and dynamic height.

The data set consists of about 150 stations of CTD casts which were used to calculate the dynamic height profiles at 11 standard depths (5, 30, 75, 125, 175, 250, 400, 600, 800, 1100 and 1650 meters) referred to 2000 meters (or about the average depth of the region shown in Fig. 1). These standard depths were chosen because they reproduced the continuos dynamical mode eigenvalues for the first four modes whithin a few percent of accuracy (first , second and third Rossby radii of deformation are 11.4 km, 5.8 km, 3.9 km respectively).

The dynamic height covariance matrices show a well defined correlation scale which decreases with depth and is shaped elliptically, with the ratio of minor to major axis encreasing with depth. In Fig. 2 we show a $600 \times 600\ km^2$ domain of contoured covariance function for the 250 m level, in the middle of the Levantine Intermediate Water (LIW) layer. The data have been binned into $75 \times 75 km^2$ bins since the nominal station spacing is half a degree of latitude and longitude. The covariance function has a larger zonal than meridional scale at all levels below 30 meters indicating the presence of a large scale trend and the tendency for the motion to be highly correlated in the zonal direction. Despite this anisotropy we calculated the decorrelation scale, a, and decay scale, b, of the covariance function as if it was a perfect circle and decaying as a gaussian function. We estimated that $a = 150\ km$, $b = 100\ km$ at 5 and 30 m; $a = 120\ km$, $b = 80\ km$ at 75 m and $a = 90\ km$, $b = 60\ km$ at all the remaining levels. Furthermore we note that the covariance matrix shows secondary peaks at some of the LIW levels indicating the presence of multiple scales in the field.

Fig. 1

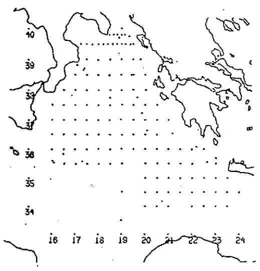
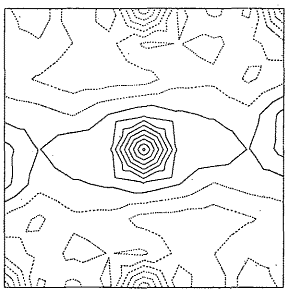


Fig. 2



The salinity, S, and temperature , T, covariance matrices are similar between themselves in the LIW and deep layers but not at the surface where the salinity shows a larger decorrelation scale with respect to the temperature field. Below 250 m. and above 600 m, the T and S covariance functions are elliptically shaped with the major axis oriented in the NE-SW direction while the dynamic height covariance has its major axis aligned in the zonal direction. This indicates that salinity and temperature effects are compensating at these levels where LIW is present. Below 600 m the T and S covariances become similar to the dynamic height ones, showing the alignement of their major axis in the zonal direction.

O-V7

Does the Almeria-Oran Front disappear sometimes?

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One of the most important fronts in the Western Mediterranean is the well known Almeria-Oran front, in the eastern limit of the Alboran sea. It has been described by several authors (see Tintoré et al., 1988, for a synthesis on the subject) as the western limit of the Mediterranean waters at surface (S>37.5). It can be traced not only by the important salinity gradients but also by temperature, fluorescence, nutrients, and, of course by the density. This properites contribute to the possibility to see this front markedly by satellite images (infrared or visible).

This front is a dynamical feature over all the surface layer up to 150-200 m depth but sometimes, due to the intense thermocline in summer, it can be hidden below, while in winter, the surface signature of the front appears clearly.

With this background, a cruise was planned for March 1990 to do an intense study of the front: CTD stations, XBTs, two current-meter moorings, TS, fluorescence and Doppler current-meter underway measurements, and AXBT flyghts. The cruise was done from 5 to 21 March 1990. Unfortunately, the area was only covered partially because the bad weather conditions did not allow us to work for many days and only one of the planned flyghts was successful. The current-meters are still there and they will be recovered next month. Nevertheless, the whole information still has some sense and we present here a summary of the "very hot" first results, three weeks after the end of the cruise.

The main result was that **the front was not there.** No important gradients of density were found and surface salinity was everywhere neatly lower than 37.5 (fig. 1). TS diagrams show always the signature of the Atlantic water over all the region. The continuous underway TS analysis in the way back to Barcelona showed high salinities only north of the Eivissa channel (38°30'N) and only the stations in this channel did not show the signature of the Atlantic water. The field of doppler measured currents and the geostrophic calculations show the main path of the Atlantic water coming from Gibraltar (fig. 2) which is very similar to the classical picture obtained by Lanoix (1974) in summer.

It is still too early and the information obtained in the cruise needs a more detailed study to draw some conclusions on this results but some idea can be exposed now. The winter 1990 has been very warm and water remained stratified in temperature (in most places temperature was over 15°C in the first 50 m, which indicates that this was not a recent warming of surface water but that winter processes were not strong enough to delete the last summer stratification). Under these circumstances, the Atlantic water had been spreading over all the region during all the winter while the Mediterranean water remained in depth. Bearing in mind this situation, we can see a conspicuous front near Cape Gata (fig. 1) which separates the most recent Atlantic water from the older one. This particularity is corroborated by the TS diagrams of the stations in its vicinity (fig. 3). This remainder of front can be the "seed" of the Almeria-Oran front. By mid April a French cruise will be done in the area and we will see if this new information can help to be more concludent.

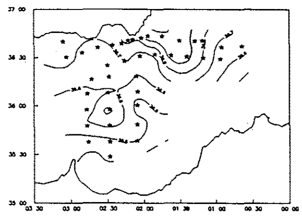

Figure 1. Salinity distribution at 10 m depth

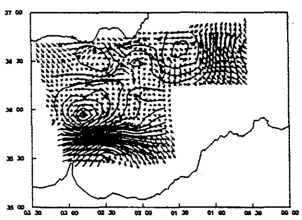

Figure 2: Dynamic height and Doppler measured currents at 10 m depth

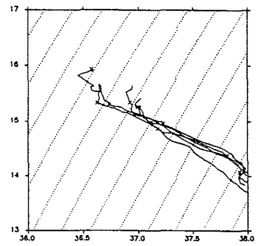

Figure 3. TS diagram of stations in the vicinity of the front.

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