ESTIMATION OF THE AMPLITUDE OF THE SEASONAL VARIATIONS AT TWO KEY SITES OF THE MEDITERRANEAN FROM THE MEDATLAS CLIMATOLOGY

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Abstract

This paper gives new estimates of the seasonal variations in two key sites of the western and eastern basins of the Mediterranean : the Gulf of Lions deep water formation region and the Rhodes gyre. The quantification of the permanent climatological signal is important to estimate further mesoscale phenomena. This study is based on a new base created in the frame of the MEDATLAS project, which released and qualified several thousand of new temperature and salinity profiles.

Key-words : temperature, salinity, G.I.S.

Introduction and description of the data set

It is known that the Mediterranean has a renewal time shorter than the Atlantic ocean and is submitted to a higher seasonal and meso-scale variability. Whether the seasonal variations or the mesoscale variability is the dominant process has been debated in the past (1). From more recent experiments like PRIMO (2) and POEM (3), it seems that both processes interfere. It is therefore important for any study, observational or numerical, to be able to quantify properly the amplitude of the climatological mean and seasonal signals. This was one of the objectives of the MEDATLAS project. Preliminary results are presented in this study in two key sites of the western and eastern basins of the Mediterranean : the Gulf of Lions deep water formation region and the Rhodes gyre. Before discussing the first result, a brief overview of the database will be presented.

The MAST MEDATLAS supporting initiative, is related to the international GODAR (Global Ocean Data Archaelogy and Rescue) programme, to safeguard, qualify and disseminate data dispersed in the scientific laboratories. It was initiated by a consortium of several Mediterranean Data Centres including the Hellenic Data Centre (Greece), the IEO Data Centre (Spain), the EPSHOM/CMO (French Navy), IFREMER/SISMER (France) the co-ordinating centre and the ICES (Denmark) supervised the Quality control (QC) procedures. In this frame, almost all of the French, Spanish, Italian and Hellenic laboratories and Hydrographic Services, the MODB database (4) and the IOC/IODE data centre network including the World Data Centre A (5) and the ICES have been contacted by the project partners to archive the data collected since the beginning of the century, and not yet released in the public domain. The database released with the digitised atlas (6) represents now the most complete available dataset, which after elimination of duplicates, amounts to :

Data Type	Cruises	Profiles
ctd	275	15 778
bottle :	1 239	33 976
thermistor	3	29
xbt	292	75 009
mbt	369	81 464

In addition to these data, classified data not yet available to users, have been used for the climatological computations. They consist in about 1000 recent scientific CTD profiles, and 12 603 MBT + 49 183 XBT from the navies.

The yearly distribution of the data per data type shows a continuous sampling from the middle forties to nowadays, with a progressive substitution of MBT by XBT since the seventies, and the appearance of the CTD in 1975. As it can been seen on the two diagrams of Fig. 1 a and b, the time distribution is large enough to avoid bias in the computation.

The monthly distribution of the data shows that there is fewer data during winter time (December, January and February) and that the maximum number of profiles is collected during May, however the number of observation remain important all the year long. In space, data are sparser to the East and South, but regions like the Gulf of Lions and the Rhodes regions have been relatively well investigated for several decades, recently during the PRIMO and POEM experiments.

The profiles have been checked for quality by using a common protocol (7), based on the IOC and MAST recommendations (8). It consists in series of objective automatic checks followed by subjective visual checks for :
1. date and location of the stations ;
2. observations (including broad range checks and comparison with previous climatologies (LEVITUS and MODB).
As a result, a quality flag is added on each numerical value. The data points which appeared correct got a flag=1.

Climatological Analysis

To implement the objective analysis, the bottle and CTD profiles have been interpolated at 28 standard levels from 0 to 4000 m, with the Reiniger and Ross method (9), taking into account only the data points flagged to 1 (correct elements). A further gross validation has then been performed on the interpolated data, which rejected less than 1% of them.

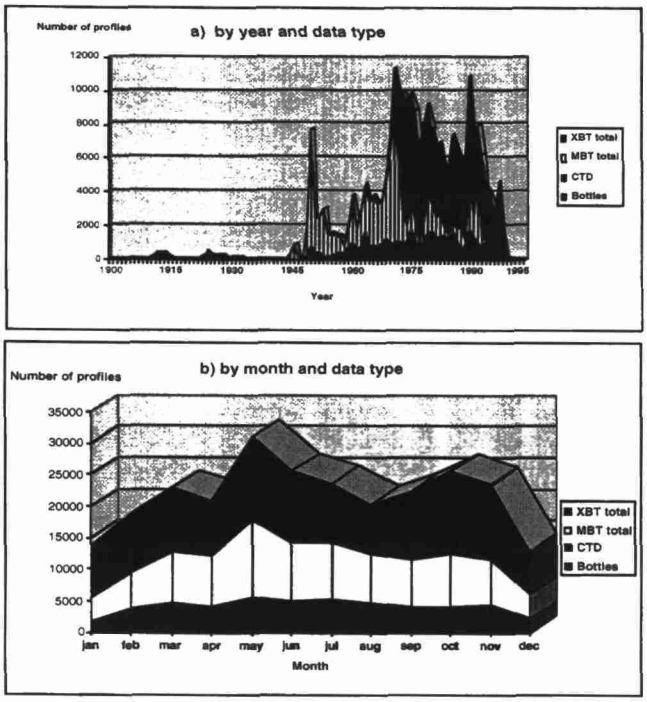

Figure 1 - Time distribution of the profiles

The kriging as discussed in (10), requires to set up numerous parameters prior to the computation, and after sensitivity studies, the adopted values were :
• average mesh size of the irregular adaptive grid : 40-km
• minimum radius inside which at least one observation is requested : 80 km
• maximum radius beyond which observations can not be used : 160 km.
• time resolution according to the data availability on the vertical : monthly from the surface down to 300 depth, seasonally between 400 and 800 m, annually below.

The computed climatological parameters are :
1 - Neural meshing for optimising the grid of calculation according to the data distribution and, to a less extend, to computation criteria.
2 - Neighbourhood search procedure to ensure temporal representativity
3 - Optimal interpolation of mean temperature and salinity, error estimates, variability

For practical use and mapping of the results, the values are afterwards reinterpolated on a regular grid, in such a way that the nodes of the adapted grid coincide with the regular grid and by using a linear combination of the estimated values at the 4 closest adapted nodes. The results include neuronal (irregular) grid and regular reinterpolated (205x73 elements) of average values, errors and other statistical estimates.

Compared climatological variations in the Western and Eastern basins

Seasonal variations are detectable down to 800 m, but the Western basin and Eastern basin present different characteristics. One aspect is that more meso-scale features appears with shorter space scale in the Eastern basin. The temperature distribution at 100 m (Fig. 2, a) February and b) August) show a smoothed however complex general pattern of the water masses. The Gulf of Lions cyclonic circulation and the Rhodes gyre appear as quasi-permanent features.