Ocean Science
Discussions

EGU

Interactive comment on "About the origin of the Mediterranean Waters warming during the twentieth century" *by* María del Carmen García-Martínez et al.

Anonymous Referee #1

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1. General Comments

This work investigates long-term trends in thermohaline properties of the Mediterranean Waters during the twentieth century based on data from the MEDAR/MEDATLAS dataset. It also tries to evaluate the causes of the observed changes employing a simple box model analysis. These subjects are not only locally relevant, since the Mediterranean Overflow Water (MOW) spreads westward at intermediate depths through the subtropical North Atlantic Ocean. Thus, long-term changes in the Mediterranean Waters, precursors of the MOW, can possibly have global impacts.

After a careful reading, I found that the present version of the MS needs a profound

revision before being accepted for publication. There are a lot of important information that is missing and some methodological issues that need to be addressed. My overall evaluation is that the MS is not yet mature to be published.

2. Specific Comments

I have three main comments:

1) The paper lacks a major finding. After reading the introduction (in the way that is presented now), I was not convinced of the need of another paper in the subject. As the authors point out, there are already several published papers on the same topic, sometimes with conflicting results. So, What does this study brings up which is new? It is not clear. I asked myself: (i) does the paper analyze new data? It seems that the answer is no, because other papers cited by the authors (e.g. Vargas-Yáñez 2005) also use the same database; (ii) do the authors employ a new methodological approach? It also does not seem to be the case; (iii) does this paper reconcile the previous conflicting results as was mentioned? I couldn't find any indication. My suggestion is that the authors need first to think deeply about two things: why a new paper is needed in this topic, and what is the specific novel result in the paper. The introduction should be written in a way that leads the readers into these two points.

2) My second concern is about the data. Long-term changes in thermohaline properties of deep waters are normally very small, albeit indicating important differences. In order to be able to detect these small signals (beyond reasonable doubt) we need accurate measurements, preferentially in the same locations. The things are a bit more complicated for evaluation of long-term salinity changes, because of the large uncertainties in salinity measurements when compared with the small variability typical of deep waters. Additionally, the way we measured salinity throughout the 20th century has changed a lot. These data issues have never been discussed in the MS. Indeed, there is no section describing the MEDAR/MEDATLAS dataset. Are the authors only using CTD profiles? Are the measurements (especially salinity) calibrated against in

situ observations from bottles? Are the profiles Quality-Controlled? What is the accuracy for temperature and salinity measurements? Did the accuracy change throughout time? Are the authors using XBT data? If yes, have the XBT data been corrected for the fall-rate changes? What is the period covered by the MEDAR/MEDATLAS data the authors are using? From the data analysis section, I understood that it is between 1943-2000. How many profiles in total? How many profiles by region? Have the number of profiles been steady throughout the time? etc, etc . . .. The authors need to include a section describing this kind of thing, so we can evaluate the results. For now it is very hard, if not impossible, to understand. I am unsure if the computed trends, especially in salinity, are outside of the margin of error.

3) My third concern is methodological. Appropriate statistical tools to deal with auto-correlated and inhomogeneous datasets are needed to investigate long-term trends in intermediate-deep waters from observations. This subject is not adequately discussed in the MS, although the group has authored several papers dealing with methods. I would expect to hear something about effective degrees of freedom, but there is nothing written about that. Since the authors are working with time series, I suggest them to consider more adequate methods to extract trends from short and noisy time series. Other examples of concern in the methods: Are there enough data to divide the Mediterranean into 11 different regions? What was the criterion used to divide in 11 regions? How many profiles by region/year/month? Is the number of profiles seasonally biased? Regionally biased? Data inhomogeneity can cause large biases and aliases, impacting the computed linear trends. I also have tried to understand why so many different averages (page 4) have been calculated in relation to the objectives of the work. I strongly suggest the authors not only describe the methods but also to explain the reasons for their choices. It is also not clear why the authors did not use an atmospheric reanalysis product to obtain the evaporation and heat fluxes in their box model, similar to Lozier and Sindlinger (2009). The authors could have used for example MERRA-2, NCEP or another reanalysis product. In this way they could better interpret their results. For instance, the authors state that an increase of 5-7% in

evaporation and reduction in oceanic heat losses of 0.4-0.5 W/m2 could explain the observed change. Evaporation depends on the latent heat flux, which is a component of the heat flux budget. Therefore, the two results may not be independent.

3. Minor comments

a. There are acronyms not defined, for example, WMED and EMED (It is also needed to define the geographic area the authors are considering). L#101 MEDARS/MEDATLAS, L#104 RADMED, L#146 CTD etc. . . Please check all throughout the text.

b. Number of decimal places in trends also needs to be checked throughout the text. Some of these seem to be well above the sensor's accuracy.

c. Which are the scales of salinity and temperature reported? TEOS-10? PSS-78?

d. There are references with missing information. Please check.

e. Figures also need improvements. For example, in Figure 5 there is no red curve, so I don't know what the red axis is about. I am also not sure why creating displaced axes in several figures.

f. I would consider putting figure 1 in the introduction to help the readers.

g. In general, English also needs some improvement.