About the origin of the Mediterranean Waters warming during the twentieth century

The manuscript aims at explaining the origin of the Mediterranean Waters warming during the twentieth century considering in situ temperature and salinity profiles from MEDATLAS data set over a time period 1943-2000 and extending the analysis time period using RADMED monitoring data which span the time period 1992-2015 over the Spanish waters of the Western Mediterranean. A box model has been implemented to simulate the steady state of the Atlantic-Mediterranean system and the averaged observations have been used to initialize the model. The atmospheric forcings have been taken from the literature and 3 model configurations have been tested in order to reproduce the observed water masses characteristics and trends.

The computed trends from the data are consistent with the once already present in literature, as expected, since the MEDATLAS data set has been already used for this purpose in other publications. The box model is able to reproduce the computed water mass properties and the computed trends only if evaporation and heat flux are increased. Not always the trends are statistically significant due to data sparseness.

General comments

The manuscript tries to answer to a crucial question about the warming tendency of the Mediterranean Basin, but the results are not acceptable for publication due to the following reasons:

1. The paper methodology is obsolete, superficial and the results not cleat. None substantial contribution to scientific progress about the topic of discussion has been found in terms of concepts, ideas, tools, or data.
2. The in situ observations used for the analysis are from MEDAR/MEDATLAS dataset (2002!) which actually does not present observations in the boxes considered for the analysis in figure 1 till 1948 (see Figure A the temperature and salinity temporal data distribution from Medatlas II). I would recommend to start the analysis from 1950-1955 if you not find additional observations. The authors could have considered additional data sets like SeaDataNet, World Ocean Data Base, the EN4, the Copernicus is situ TAC products in order to consider all the available observations. Data sparseness has been frequently mentioned to motivate the lack of robust results but none effort has been done to overcome it. It is not acceptable when dealing with climate change issues and long term trends estimation.
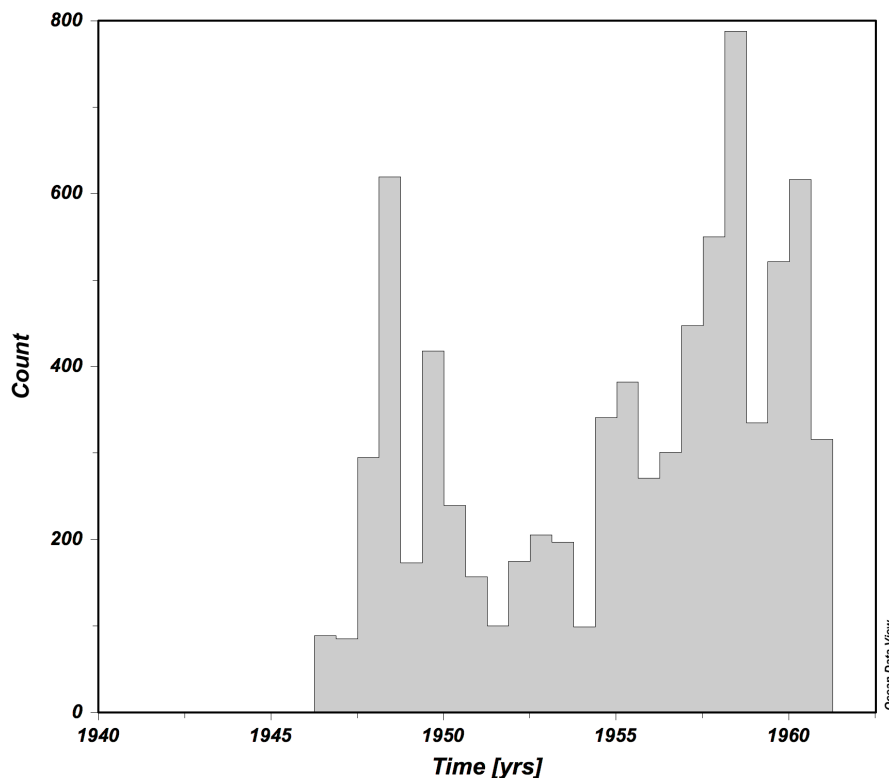
Figure A- MedatlasII temperature and salinity data time distribution over the time period 1940-1960 in the whole Mediterranean Sea.

3. The extension of the analysis till 2015 only considering the Spanish waters monitoring observations is not scientifically sound when the Copernicus Marine service provides both Near Real Time and REPprocessed data starting from 1950 till 2017 and 2016 respectively. It provides also global OA maps used in recent publications to estimate the Ocean Heat Content anomaly and trend (see Ocean State Report 2016).

4. The statistical analysis is very weak without any detail about the data distribution, the number of data per box.

5. The implementation of a box model is not able to answer to the posed question and in many cases the author recommends the use of satellite data or 3D models. Once again, the Copernicus Marine service provides many satellite and reanalysis products, both global and regional, covering the analysis period and it is advisable to consider these products to substantiate the results.

6. The manuscript is not well organized, the experimental design is confused and not clearly described, the results section is superficial, the figures are not well described in the captions, the discussion and conclusions sections presents many repetitions from the introduction, while the conclusions are briefly stated at the end.

Specific Comments

Abstract
- It should better specify the period considered in the analysis.
- *"A new analysis of MEDAR data…"* What is novelty of your approach?

- There are some errors in the English, thus I recommend to take care about the language before a new submission
- The use of conditional in many sentences make the paper weak, especially when mentioning the results in the last phrase. The verb is wrong.
- The Western Mediterranean Transition, its causes and effects, have been already studied in recent papers (not listed here), thus I recommend to read and cite them.

Introduction

- Line 60→ Line 65: A lot of literature has been dedicated to this and your superficiality is not allowed. Please consider more recent papers (i.e. Pinardi et al., 2015; Schroeder et al. 2017, von Schuckmann et al. 2016)
- Line 95: What is the relationship between the Ebro damming and the AW salinization?
- Line 102-103: actually, you are considering not the twentieth century but the 1943-2000 time period and since there are no data until 1948 I would change the analysis time period in the second half of the century.
- Line 103: which transients? EMT and WMT? It is not clear.
- Line 105-107: The intent to use the box model is very limited, moreover you should at least state clearly which one are the hypothesis you are considering.

Data and Methods

- Line 114-115: Almost all regions do not present data in the forties, what is the statistical significance of your temperature and salinity monthly averages in these years?
- What is the reason to compute monthly than seasonal and then yearly averages, is it a robust approach? Then you average spatially in the EMed and WMed and then again to get the Med average. I consider this approach very superficial, especially when trying to compute long term trends. None consideration about the different instrument types of observations and consistency issues. Did you consider XBT data, which correction did you apply?
- How did you propagate the error from your monthly averages per each region to your annual Med profiles or to the AW and MW annual properties?
- Line145: a data distribution map is advisable.
- Line 149-150: this is not clear at all.
- Line165-178: sensitivity tests and results should go here to motivate your model implementation.
- Section 2.4 is very superficial, there is not a detailed description of the experimental design.

Results

- Section 3.2, Lines till 285: they should go in the methodology description. Only here ee know that you are running the model for 1000yrs with a time step of 1 year. You are presenting the sensitivity tests results here and they should go in 2.5. You should motivate your chose at line 175.
- For the three sensitivity test the spin up time of the model is 200 years, why did you run it for 1000 years before testing your hypothesis?
- Again you are presenting results without explaining your experimental design.

Discussion and Conclusions

- Lines till 330 should be part of the introduction, what's their meaning here?

- Lines 340 and Lines 355: if you think that these studies should be made considering 2D circulation models why did not you use them. Copernicus Marine service provides many reanalysis products for the Med region and you did not even mention them).
- Lines 385-395 is a repetition of the introduction
- Lines 410-415: you are describing only here figure 7c and d, why? They shourd go in the results.