

## ***Interactive comment on “Physical forcing and physical/biochemical variability of the Mediterranean Sea: a review of unresolved issues and directions for future research” by P. Malanotte-Rizzoli et al.***

**Anonymous Referee #4**

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Review of the ms with the Title: Physical forcing and physical/biochemical variability of the Mediterranean Sea : A review of unresolved issues and directions for future research Author(s): P. Malanotte-Rizzoli et al. MS No.: os-2013-31 MS Type: Review Article Special Issue: Physical, chemical and biological oceanography of the Mediterranean Sea

General comments The ms is of interest because provides new directions for further studies in the Mediterranean sea, mainly in physical and dynamical processes and secondly for chemical- biological ones. The overview of the existing characteristics of the

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Med in the ms must not be limited to POEM and PRIMO, but to take into account also results from previous to the above projects works, as well as from recent contributions, which based on in-situ data and on numerical applications assimilating in-situ data. References to key and important works are missing, such as for example to the French and Russians pioneers in the Med, back in 50s and 60s, and of the new contributions in the frame of works funded by the EC, such as for example the CYCLOPS project, and of several other national or bilateral projects throughout the basin. The important role of the operational ocean forecast in obtaining reliable information of the physical and dynamical conditions in the entire Med, thanks to the assimilation of in-situ data and of the satellite altimetry is almost absent from the ms. The ms include suggestions for further studies in the Med that are already were addressed, as for example: a) the definition of the flow features in the E. Med, b) the AW flow path in the E. Med using in-situ data; c) the use of high resolution forcing, d) the quality control of data and the new data bases generated during EC funded projects such as SeaDataNet, EMODNET, MyOCEAN, e) the application of high resolution numerical flow models assimilating in-situ data and satellite altimetry. The latter is well covered the last 6-7 years in the frame of several EC funded projects, such as those of MFSTEP, ECOOP, MERSEA, Myocean with downscaled operational models, with resolution 1 km and even in some cases down to 500 m, all nested hierarchically in the regional Med model. While the AW in the E Med is known that is a sub-surface water mass and its flow bath can be defined using only in-situ data, description of the flow is provided in the ms from a certain number of works, which based on the use of SST or surface drifters. In contrary, nothing is mentioned about recent works assimilating thousand of drifters and in-situ data, both showed a clear picture of the AW flow bath in the E Med. The famous story with the so called generation of eddies along the coastal current in the W. Med, derived using SST images is not applicable for the E. Med.

A major revision is necessary to correct, add and improve the ms.

Specific comments:

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Abstract Interesting about the importance of the Med to the World Ocean, but not enough coverage about the topic of the ms. It is known that the renewal of the Med waters take something around 70-100 years. Is the small volume of 0.xx of the Med waters able to influence the World Ocean thermohaline circulation?

#### Introduction

Page 5 Since POEM there were several programs, at European and national levels which added knowledge regarding the Med sea and its of worth to refer them.

Page 6 Section 2.1 What about the use of numerical models assimilating in-situ and satellite altimetry?? 3rd paragraph: Propose to the authors to take into account the discussion about from the recent book "The climate of the Mediterranean, P. Lionello ed. 2012

Page 7 Section 2.2 1st paragraph: The AW in the W. Med flow at surface then at sub-surface in the E. Med. Add reference to Gertman et. al. 1991 (CIESM conference) regarding the formation of deep waters in the NW Levantine. 2nd paragraph: Modify the sentence "The flow is unstable .... This is not true for the E. Med. The use of SST to derive the circulation in the E. Med is not applicable. Use the analysis of in-situ data. There are thousands of in-situ data after POEM collected across the E. Med. Add more references regarding the flow features and flow pattern in the E. Med to works after POEM, used in-situ and numerical models with assimilation of in-situ data. 3rd paragraph: The switch of the deep water formation from Adriatic to Aegean was also reported in 50s-70s to occur periodically, add references to those papers. 4th paragraph: Make clear here that the authors promoting the story that the E. Med eddies generation is based on the analysis on SST, while the other authors not supporting such a story are based on in-situ data, as well numerical models assimilating in-situ data. Add missing references to new papers after POEM.

Page 8 1st paragraph. The expressed need to develop a combination of observation and modeling is already done in the frame of the operational ocean forecasting. The au-

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thors to look the MONGOOS (former MOON) developments. Add references to those works. 3rd paragraph (regarding the Specifics issues) Several projects were carried out to understand the long term variability of the circulation in the Med. Add references to some of these. 5rd paragraph (regarding the Specifics issues) The proposed ways for observation here are out of days. Nowadays Argo floats (EuroArgo, MedArgo) and glider (EGO, GROOM) are the modest and efficient way for in-situ monitoring of the Med, from surface to the deep.

Page 9 Section 2.3 1st paragraph: add reference to CYCLOPS project and those of other similar activities. 2nd paragraph: The E. Med, particularly the SE. Levantine is extremely oligotrophic compared to the W. Med. The authors to look the results -papers of the CYCLOPS project regarding the nutrients limitation, are different for W.Med and different for E. Med. 6th paragraph: (regarding the Specifics issues): There is a number of recent experiments for the Gibraltar dynamics, the authors to look for these papers (a French project).

Page 10 1st paragraph Nowadays the operational oceanography systems (MONGOOS) and those of MyOcean already provide daily data to support the trace of the bio-chemical processes in the Med. Add references here.

Page 11 Section 2.4 1st paragraph The authors to look the results of the CYCLOPS project in order to improve the description in this paragraph. 4th paragraph (regarding the Specifics issues) The story of the generation of eddies is not applicable for the E. Med. Page 14 Section 3.1 2nd paragraph. It is not clear up to which water depth the stability is reduced, its too general. Modify improve this part.

Page 15 3.2 1st paragraph: The discussion about the circulation and constrains with smaller scales and the shelf/slope to be deleted. It's a general one and does not add anything here. Page 16 1st paragraph: To much description of the circulation based on works used SST. There are no any works based on in-situ data describing the circulation?? 2nd paragraph The AW in the E. Med is a subsurface one. The eddies are

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stable and are not generated by the current as Gerin et al 2009, who used surface drifters. In contrary, Menna et al 2012 come to a different conclusion when assimilated thousand of drifters with the geostrophy. The story mentioned in this paragraph regarding the circulation, unstable eddies, eddies generation in the E. Med are based on SST images only and on one numerical simulation, the results of which are far from the ground truth. In contrary, the works based on in-situ data and numerical models with assimilation of in-situ data show a different picture of the flow dynamics in the area.

4th paragraph (regarding the Specifics issues) What is proposed here is already exist. In the Med such models with in-situ data assimilation exist (MONGOOS), MyOcean. Section 3.3 Page 19 1st paragraph The role of Meddies (Mediterranean saline water in the North Atlantic) in the ms are overestimated. There are many- many other papers dealing with the Meddies characteristics, their dynamics in the N Atlantic. The authors to search for those papers in order to improve this part of the ms.

2nd paragraph (regarding the Specifics issues) There are already exist new data sets from SeaDataNet and EMODNET, which passed screening, quality control procedures.

Section 3.4 4th paragraph (regarding the Specifics issues) Already exist high quality controlled db for the Med sea as a results of the SeaDataNet, EMODNET as well MyOcean. Page 27 Section 4.1 3rd paragraph: add that in the E. Med are also available multi-parametric sensors.

Page 28 5th paragraph Missing information about the recent studies of the flow features and their variability in the Eastern Mediterranean and Levantine Basin, based on thousands of new in-situ data, including data from gliders.

Page 31 Section 4.2 1st and 2nd paragraphs: The last 5-8 years in the Med exist high frequency surface forcing with 5 -10 km resolution, used to force the daily high resolution (1km, even in some case 500 m) circulation models of the MONGOOS community . Re-write these two paragraphs to reflect the today real situation on modeling in the Med. Page 32 2nd paragraph: Again and again the same story about the eddies gen-

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eration in the E. Med is repeatedly mentioned in several sections throughout the ms. To correct it based on the comments done for page 16. Delete the last sentence of the 2nd paragraph, see the comments for the page 31. 5th paragraph (regarding the Specifics issues): already exist what is proposing here to develop!!!

Page 33 1st paragraph Correct MONGOOS (former (MOON). The QC procedures applied to the data before the assimilation in the operational models.

Conclusions 2nd paragraph: 2nd sentence. Clarify if the inversion of the circulation concerns the Ionian Sea, its not clear. 3rd paragraph: Include in the 1st sentence that not only historical but recent observations prove that the Med sea is getting saltier. Add references. Add the role of the operational oceanography in the increase of our knowledge for the Med sea.

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