**Ocean Science**
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*Interactive comment on* "Extreme winter 2012 in the Adriatic: an example of climatic effect on the BiOS rhythm" *by* M. Gačić et al.

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This manuscript relates a reversal of the circulation in the northern Ionian Sea to an especially pronounced dense-water formation in the Adriatic in 2012, which the authors judge as showing a "remarkable sensitivity of Adriatic-Ionian BiOS" (which the authors have delt with in various previous papers) "on climate forcing". Absolute Dynamic Topography (ADT) and the related surface geostrophic velocities, Argo profiler and altimetry data, and air-sea heat fluxes were taken into account; subsurface geostrophic currents were obtained from CTD data using the float velocities for referencing. The manuscript is well organized, the figures are helpful to assist the argumentation, the results are convincing, and the literature is adequately covered. However, I note some items that the authors must address.

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Specific comment. 1 The introduction makes a lengthy comparison of the Mediterranean's overturning circulation with that of the global ocean. A more concise argumentation (e. g., Mediterranean first and then what is different from the global ocean) should be chosen. Besides the shallower (subsurface) westward return flow by the LIW, the separate western and eastern deep waters are mentioned. The text suggests that these waters are not involved in the westward return, whereas they are involved, partly directly, and partly by upwelling into the LIW.

(Authors reply – AR) The Introduction was partially re-written in order to address the reviewer's queries. In fact, the introductory chapter now starts with discussing firstly the Mediterranean and then similarities and differences with respect to the World Ocean.

2 The sentence beginning p. 429, line 19 (429-19) should be omitted, because the role of salinity has been specified a few lines before. In 429-21 f. the North Ionian Gyre inversions occur "at the same time scales". However they occur in direct relation to the salinity changes mentioned a few lines above, reword.

(AR) The sentence beginning at p. 429, line 19 was omitted as suggested. Also the sentence "This means that NIG inversions appear at the same time scales." is omitted from the revised ms.

3 430-12 ff.: I do not understand what the numbers mean. Are these depth intervals over which averaging is applied? Clarify.

(AR) The sentence was reformulated in order to make it more clear.

4 431-10 ff.: No uncertainties are given for the ADT values. The altimeter part will be ok, but I am pretty sure that the Synthetic Mean Dynamic Topography has a certain error. A hint on this is the fact that the subsurface geostrophic velocities use drifter rather than ADS data as reference.

(AR) In annex we present a short discussion on SMDT error not included, however, in the revised ms. In addition, in the Data and Methods chapter we add the sentence

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specifying that the error of the Synthetic Mean Dynamic Topography in the study area is on the order of 1 cm.

Inspecting Figs. 3 and 4 I have great problems to identify the features that are mentioned in the text (e. g., that the 2008 circulation is anticyclonic is fine, but I am uncertain how the 2011 circulation is judged cyclonic). This is all the more true in Fig. 4. Additional explanation is necessary. It might help to indicate the center trajectory with a pointer in Figs. 3 and 4.

(AR) The text was changed to make it more clear so in the revised version of the ms. we speak about the anticyclonic meander and its larger/smaller northward extension in either anticyclonic/cyclonic phase of BiOS.

How does the sentence in 431-25 f. assess the seasonal influence? Is there any disturbance from Ekman flow?

(AR) We omitt the part of the sentence mentioning the assessment of the seasonal influence since the reviewer is right, we cannot assess the seasonal influence but address it only qualitatively. The Ekman flow cannot introduce any disturbance since we are considering the surface geostrophic flow.

5 432-27 mentions Fig. 2 (which, in contrast to Figs. 3 and 4, gives me a clear view of cyclonic and anticyclonic circulation). Similar curves are shown later in Fig. 8b, but now positive values indicate cyclonic circulation, which in Fig. 2 is represented by negative values. Unify!

(AR) In Fig. 2 we present the spatially averaged zonal velocity component over the northern square and it is defined positive eastward. Thus anticyclonic pattern is associated with the eastward/positive flow while the cyclonic phase coincides with the westward/negative flow. In Fig. 8b on the other hand, we simply showed the sea level differences between the two areas which is now defined as the difference between the northern and southern square.

Furthermore Fig. 2 ends in about Sept. 2012 whereas Fig. 8b extends up to March 3013. Similar extension in Fig. 2 is desirable. And by the way, taking Fig. 2 literally, the flow in 2012 does not definitely become anticylonic, but rather far less cyclonic; such a signal is however evident in Fig. 8b, please explain.

(AR) We extended Fig. 2 until March 2013. The presence of the anticyclonic signal is the most prominent in the northern portion of the Ionian where the strongest signal associated with the AdDW occurs and thus there the flow inversion is clearly identified. However, indication of a possible inversion of the flow depends strongly on the position of the averaging area.

The text says unexpected reversal in 433-17, but a more careful wording may be in order.

(AR) Instead of "unexpected" we used as in other part of the ms. "premature".

6 433-4: The "complete signal" presumably is the weekly average signal and should be denoted that way.

(AR) We changed the wording introducing "unfiltered time-series" instead of the "complete signal".

7 In the paragraph beginning 435-8 it is stated that there is a two-layer regime but I cannot find evidence of that in the text. The scatter plots of Fig. 6 indicate that the isopynals in question all have the same slope relative to the ADT, which in my view means that these isopycnals belong to the same layer. Further down, newly incoming AdDW may enforce a different flow field (more cyclonic, probably). A clarification is needed. Similar in 439-21.

(AR) Please see the Author Response published during the discussion period.

8 438-7: what is the time scale of averaging here?

The filtering procedure is described in details in the legend of the Fig. 8.

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9 I do not understand the meaning of the sentence beginning in 439-12.

(AR) The sentence: "This passage made part of the "regular" decadal inversions of the Ionian basin-wide circulation." was omitted in the revised ms since it does not add any information to the text.

10 Caption Fig. 1: Reference should be made in the caption to the (a), (b), (c) in the figure, and to Fig. 2 when the surface geostrophic flow is mentioned. An indication is needed where the float tracks begin or end.

(AR) Done.

11 Caption Fig. 5: The time period of the density data should be given in the caption for easier comprehension

(AR) Done.

12 Fig. 9: I have problems to get a feel for the velocities presented in view of all the scatter.

(AR) Indeed the velocities are pretty much scattered especially in the northeastern portion of the Ionian where the horizontal pressure gradients are not so prominent. In the northernmost portion and along the western flank the dispersion is not so strong due to stronger horizontal pressure gradients.

Technical corrections.

1. 426-2: The Adriatic and Ionian Sea .. . -5: anticyclonic... . -6: to the extremely .. . -15: level was lowered ...

(AR) Done.

2. 428-9: replace manifested by is manifest

(AR) Done.

3. 429-9 change to: of Levantine. -16 into consideration

(AR) Done.

4. 430-1: an unexpected reversal

(AR) Done.

5. 431-2: replace detected by found. -8 satelites

(AR) Done.

6. 432-19 f.: diminish to All profiles used a CTD ..

(AR) Done.

7. 434-4: add 2012 after December. -6: add (Fig. 8) after March 3013. -10: in terms of an effect. -15 change to: a values reached. -17 change to: a value that was approximately half the average ...-27: move (Fig. 5) two lines up after 2012. -28: replace spread by spreading south.

(AR) Done.

8. 436-21: independently of. -23: detail not details. -24: evidence not evidences.

(AR) Done.

9. 437-13: remove period

(AR) Done.

10. 438-22: ff has wrong font; same in 439-25 and 440-1

(?) Did not understand the comment! Maybe the wrong font appeared in the word version of the ms.

11. Reference Bensi et al.: I believe the doi should be 10.1029, please check.

(AR) Checked.

Annex:

The Synthetic Mean Dynamic Topography (SMDT) of Rio et al. (2007) was computed combining in-situ drifter velocities and altimetric measurements; these estimates were used to correct a first guess of the Mediterranean MDT, derived from the outputs of the MFSTEP model. The error map associated with the SMDT accounts for the errors of the altimetric and drifter datasets as well as for their different sampling capabilities. The accuracy of SMDT field obtained in areas covered by drifter data is also linked to the number of observations: the smallest errors are found in the best sampled regions (Ionian and Adriatic Seas), while where very few or no observations are available (northern Levantine and Aegean Sea) the accuracy is linked to the MFSTEP model errors. Indeed in our study area, the Ionain Sea the accuracy is of $\sim 1$ cm which is one order of magnitude smaller than the spatial and temporal variability.

Interactive comment on Ocean Sci. Discuss., 11, 425, 2014.

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