

Interactive
Comment

***Interactive comment on* “On the relationship among the Adriatic–Ionian Bimodal Oscillating System (BIOS), the Eastern Mediterranean salinity variations and the Western Mediterranean thermohaline cell” by M. Gačić et al.**

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Received and published: 5 November 2012

The authors relate salinity changes in the Levantine Sea and the Sicily Channel to water mass formation in the Western Mediterranean, especially in relation to the Western Mediterranean Transition (WMT), which was apparent as increased salinity in the Western Mediterranean Deep Water (WM DW), beginning in the winter of 2004–2005. The changes in the Levantine are documented using data of the MEDATLAS collection, 1945–2002, and they are shown to be anti-correlated to salinity changes in the northern Ionian Sea obtained from the same source, which is attributed to reversals in the lo-

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nian upper circulation (the so-called BiOS mechanism, see Gacic et al., 2010). Salinity variations in the Sicily Channel, 1985–2001, are based on results of several cruises in that area. Periods of minimum and maximum salinity values are clearly apparent. Using these data, the authors deduce mean transport times from the Levantine up to the Sicily Channel and from there into the WMDW at a location in about 38 N. They estimate that 40% of the extra salt now present in the WMDW, originate from the Eastern Mediterranean. The arguments are convincing and important, which definitely warrants publication in OS. A general remark is that the text might be somewhat more concentrated, avoiding any repetition of arguments. Use of the English language is fine.

We are grateful to the referee for his careful reading of the paper and very detailed and encouraging comments which certainly help us in eliminating some shortcomings in the manuscript .

Major comment: The authors find a transfer time LIW formation area to Sicily Channel (17 years) which exceeds a previous tracer-based value (Roether et al., 1997; 9 years, not 8). A difference is that the tracer-based value was determined along the 29.05 potential density horizon, while the new value starts from values 50 – 150 m, i.e. prior to the reaching the LIW layer; the formation will furthermore drag in waters somewhat off the formation center, which takes extra time. This implies a bias between the tracer based and the new value, in effect reducing the difference. A related point is that the transfer time Sicily Channel to WMDW refers to the onsets of changes at both locations (i.e., 1995 – 2004). If one did the same for the transfer time LIW formation area to Sicily Channel, one would find a lower value, i.e., about 14 years (1981 – 2005), or similar. In Fig. 2, the salinity maximum in fact occurs in 2009, but possibly the LIW waters of 1992 arrived in the Sicily Channel already in 2005 and the further salinity increase is due to addition of waters in which salinity grew more gradually. This would reduce the delay by about four years. Even if sticking with the maximum salinity (Fig. 3), one could interpret the relevant maximum to be bounded by 11 and 20 years,

i.e., when R changes sign. In view of the uncertainties of the yearly values, it may be safer to use the median time, leading to a slightly lower value, 15.5 years. These points should be clarified by the authors.

Very good point. In fact as a response to this comment in a revised version of the manuscript we calculated the cross correlation between the Medar gridded average salinities at the level of the LIW in the Levantine (mean value between 150 and 300 m) and over the 150-500 m depth interval in the Sicily Channel. Apart from the fact that the phase-lag obtained this way becomes more reliable, we end up with a shorter travel time (10-13 years) which indeed reduced the difference between the estimated travel time from transient tracers and from our calculations.

Technical items: 1. P. 2563, line 15, “especially in the Ionian Sea”: The largest variations were present in the Levantine Basin, reword.

Reworded.

2. Line 18, “after the EMT”: Many people use EMT in this fashion, but in fact only the Aegean dense-water input had ended, the changes in the deeper waters are still now apparent. Reword.

Instead of “After the EMT ...” we put “After the recent discovery of the EMT ...”

3. 2564 line 13, “previous situation”: Reword to anticyclonic situation

Done

4. 2565, line 25, salting: salting in this sense has been used also previously, but the word means putting salt on something, such as for curing meat, reword

Instead of “salting” we put “salinity increase”

5. 2566 line 6: You might add a citation of Roether and Lupton, OS 7, 2011, who confirmed EMT-induced enhanced convection in the Tyrrhenian during 1987 – 1997 and appreciable output of enhanced-salinity waters into the WMDW depth range.

Done.

6. 2568 line 1 - 2 “an area representative of the presence of AW was chosen”: In my view this does hold for the southern part of the area, but less so further north. Reword?

The northern part of the Ionian is under the rather strong influence of the AW during the anticyclonic BIOS phase and indeed there the differential impact of the cyclonic and anticyclonic circulation on the surface salinity is clearly seen.

7. 2569 line 2: refer here to Fig. 2

Done.

8. 2570 line 6 and 2571 line 23: The amount of extra salt that the authors deduced should also be given as an absolute number not only as a percentage.

Done

9. References: Robinson et al. must precede Roether et al., same for Schroeder et al., 2006; 2008; CIESM 2009 and Roether et al. 1996 are missing; Roether et al. LIW JMS is 1998 not 1997 (correct in the text); I cannot find in the text Ovchinnikov 1983 and Schroeder et al. 2008.

Corrected. Ovchinnikov is mentioned in the new version of the paper at the page 8. We eliminate the Schroeder et al. (2008) reference.

10. Fig. 3: I strongly recommend choosing a common salinity scale, because that would give an intuitive understanding of the salinity situation. As far as I can see, the curves would hardly overlap.

Done.

Does the 3-year low pass filtering not smear out the extrema noticeably?

Comparing non-filtered and filtered data we did not notice appreciable smearing of extremes.

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Numbering in the figure should be chosen somewhat larger.

Done

Interactive comment on Ocean Sci. Discuss., 9, 2561, 2012.

OSD

9, C1240–C1244, 2012

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C1244

