

Interactive comment on “Observations of new western Mediterranean deep water formation using ARGO floats 2004–2006” by R. O. Smith and H. L. Bryden

J. Font (Referee)

jfont@icm.csic.es

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This manuscript presents a detailed analysis of ARGO floats CTD data in the western Mediterranean that helps understanding the changes occurred during winters 2004–2005 and 2005–2006 in the intermediate and deep water masses of the region. Several authors had pointed out an “anomalous” situation found in the deep layers of the NW Mediterranean after the extreme 2005 winter conditions, and also after the 2006 winter in the Ligurian Sea. Now Smith and Bryden confirm that not only the deep waters warming and salinification trends have increased in the last years, but the dense water formation was extended to unusual (or at least not previously studied) areas, and

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provide hypotheses to explain the facts through the evolution of the vertical structures as revealed by ARGO floats and information on atmospheric and climatic characteristics than trigger this dense water formation. Specially interesting is the analysis of the mixed layer depth evolution that has to face the additional problem of data collected by drifting platforms. The special care given to the pre-conditioning phase is also a good contribution.

Although there are some aspects considered by other authors and not deeply discussed here, as the possible role of water cascading from the continental shelf in the definition of new Western Mediterranean Deep Water characteristics or the interannual variability in climatic conditions, my opinion is that this is a valuable and extended contribution that deserves being published and rapidly distributed to the scientific community that is trying to fully understand the processes that have originated the changes occurred in the last years. I have no major concerns about the structure and contents of the manuscript, and give here below several detailed comments to be considered for the final version:

734, 22 and others. Following the consensus reached after two round tables organised by the International Mediterranean Commission (CIESM) in 1998 and 2001, the surface water of Atlantic origin present in the Mediterranean should be labeled as Atlantic Water (AW) instead of Modified Atlantic Water (MAW) as it was referred to for many years. Please see details in <https://www.ciesm.org/catalog/WaterMassAcronyms.pdf>

738, 21-27. The paper by Emelianov et al. that the authors cite in other parts of this manuscript is also a study that has presented data from ARGO in the Mediterranean

740, 4-8. Maybe it would be better to explain here why these two cells are selected, although it is made evident later throughout the manuscript

742, 16-28. **IMPORTANT.** There is a general mismatch between the descriptions in the text and the colour-coded trajectories in Fig. 2. The authors should carefully check the figure as some coordinates given in the text are not coincident with the trajectories,

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float numbers seem to be exchanged, etc. This makes difficult a correct understanding of several parts of the manuscript

743, 8-9. Refer to Fig. 4 for the Smax, as it is not a "well established" feature in Fig. 3b

743, 12. Correct homogeneous, not homogenous

745, 10. WIW is Western, not Winter, Intermediate Water (CIESM, 2001)

745, 18. The inset in Fig. 7 only shows the 12 March data, not the two signals stated in the text

745, 23. According to Fig. 2, float 6900293 was never in the Ligurian subbasin

747, 6. The 2 January 2006 profile is not included in Fig. 10

749, 9-11. It is shown, from this and other authors analysis, that in 2004-2005 nWMDW was formed in the Catalan subbasin and probably also in a large area around the Gulf of Lyons. After the sinking and spreading phase, this nWMDW should be present in the deep layer of the western Mediterranean. Is there a clear explanation for this not including the Ligurian, as it is evidenced by the deep casts before March 2006?

749, 19. According to Fig. 14 it should be 23 January instead of 21

749, 24-27. I would say that from the data of the 14 March profile it is not possible to infer that the detected nWMDW was formed in 2006 probably outside the MEDOC area rather than it is just the signature of the nWMDW formed there the previous winter

750, Air-sea fluxes. A better general picture of the situation would appear if NCEP/NCAR heat fluxes were provided for both regions for the two winters. It would help understanding not only the differences between the nWMDW formed in both areas but also why there was or not dense water formation in a specific area in a specific winter

753, 5 and 9 + 757, 9. Provençal, not Provencal

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754, 25. Caston, not Castson

755, 19-25. Dating the violent mixing phase in March is not so unusual, and for the 2005 winter in the Catalan subbasin this is coherent with the time series presented by Font et al. (2007, *Scientia Marina*, 71: 339-346)

757, 15-16. I don't understand why the authors conclude that "else the Catalan subbasin could not have undergone the pre-conditioning required for deep convection" in 2004-2005. This appears to be contradictory with the rest of the paper

757, 23. regimes or regions?

758, 21-. The authors should clarify whether they indicate by nWMDW the newly formed deep water in every winter, or a distinguishable water mass formed in 2005 and 2006 that had markedly different characteristics than the "usual" deep water, the latter being indicated by oWMDW, as supported by other authors (Salat et al., 2007, *Rapp. Comm. int. Mer Médit.*, 38: 197)

760, 3. Marty and Chiaverini 2007 is not included in the reference list

760, 17-20. The doubt on previous ship surveys having neglected the regions where WMDW formation was documented in this paper by ARGO floats can be solved by looking at other available data sources, e.g. the DYFAMED time series or some campaigns mentioned by other authors. There are evidences of the 2005 convection in the Catalan subbasin being part of an unusually wider dense water formation area, both from in situ data (Salat et al., 2007) or numerical simulations (Béranger et al., 2007, *Rapp. Comm. int. Mer Médit.*, 38: 127)

762, 25. Lavender and Davis and Owens erroneous reference? Not matching 754, 26

767, Fig.2 horizontal axis. 2, 6, 1 missing in label

774, Fig. 9. A missing profile in January 2006 could be indicated in the figure to help the reader

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776, Fig. 11 caption. ascent, not accent

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