

Interactive comment on “Transformation of Levantine Intermediate Water tracked by MedArgo floats in Western Mediterranean” by M. Emelianov et al.

M. Emelianov et al.

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Dear Claude,

Please find enclosed the response to your comments.

The first general comment concerning the criterion used to select the LIW layer was answered on 29.06.2006. We re-calculated the clusters using pressure range to determine the LIW layer avoiding the presence of non-LIW in our analysis.

We introduced changes in the text according to the second general comment following the idea that LIW itself creates and maintains the circulation in the intermediate depth (“LIW spreads and circulates”). We also eliminated the sentence about LIW en-

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trainment by the Algerian current. We agree with the referee that the surface Algerian current can not capture the intermediate LIW.

We improved figures 2(b) and 5(b) changing the symbols and numbering of clusters according to the LIW transformation degree. Now “cold” colours and higher cluster numbers correspond to more transformed LIW, and clusters with less transformed LIW have smaller cluster number and “warm” colours. We add figures with representative profiles enveloped in all T,S profiles of the same cluster, providing the differences between profiles within each cluster and differences between “neighbouring” profiles belonging to different clusters.

As we changed the determination of LIW layer from “density range” to “pressure range” we “automatically” resolved the specific problem of the bathymetry and of the location of the MWs veins, which is the objective of the last major comment. Now the clustering tool searches the absolute maximum of salinity in the pressure range between 200 and 600 decibars. It must be the extremum point in the salinity profile. If it is not the extremum point, it means that the lower salinity values do not exist below the found salinity maximum (the case of profile “cut” by the bathymetry), and the profile will be eliminated from the clustering analysis. As we explained in our first author comments, the pressure of LIW core is determined as the average pressure between that of the absolute maximum of salinity and that of the closest relatively maximum of potential temperature. The range of +/- 200 db around LIW core was considered as LIW layer. If the LIW core lies close to 600 db and the distance between it and the lower limit of the analysed layer (600 db) is less than 200 db, the clustering tool takes in the analysis the distance (in db) between LIW core and 600 db.

Specific comments:

- P.570, l.24: “westward path”. If the authors agree with my diagram, what I suppose, they should avoid using westwardĚ.

Response: We changed “westward path” to “displacement”.

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- P.570, l.25: “more to the west than the most transformed one” is unclear. First, it must be specified that the sentence concerns LIW along the slope of Sardinia in the Algerian subbasin. Second it should be more convenient to say “that LIW as unmixed as the LIW generally found alongslope can be found nearby in the interior of a subbasin”.

Response: We don't fully understand your comment. We should discuss this more in depth.

- P.571, l.12: the authors must specify what are the different areas of LIW formation in the eastern basin and provide adequate references. I do not want to influence them but in our reference I gave above, the authors can find hypotheses about why LIW has been found away from the northern Levantine subbasin (that we assume is the sole place where it is formed). Basically, we assume processes similar to those already demonstrated for the Algerian subbasin: LIW forms roughly south of Rhodes then spreads and circulates alongslope, in particular south of Crete where it can be entrained by Ierapetra and transported, eventually till Egypt, and/or south of the Peloponnese where it can be entrained by Pelops in general toward the interior of the Ionian subbasin.

Response: In the new version of the paper we will specify only one well-known area of LIW formation, which is Rhodes area.

- P.571, l.16: I do not understand the notion of “suspended”. Any water lies, away from the zones of dense water formation, at a level corresponding to its own density: it floats and circulates above (denser) water below and below (lighter) water above.

Response: We changed the term “suspension” for “emulsion”. From our opinion the new term describes better what we want to say about the LIW thermohaline structure. In all cases we use this term only to illustrate our hypothesis and not to approximate it to the real situation.

- P.571, l.20: “sink up” down?

Response: It is corrected.

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- P.571, l.21: I am not sure that evaporation is larger in summer everywhere in the sea; in particular, dry continental air masses entrained over the sea by violent northerly winds in winter probably induce a non-negligible evaporation; seemingly, cooling can also be induced in summer due to the northerlies.

Response: You may be right, but this is another issue, beyond the scope of this paper. We only wanted to point out the main process for LIW generation, without further details.

- P.571, l.25: This is again a personal opinion that the authors might not share but I do not think that “the picture becomes even more complicated in the western basin”. Processes driving the functioning of each basin and the circulation in it are, according to me, relatively similar and there are, in both basins, eddies either wind-induced or “current-instability induced” that can entrain the alongslope veins towards the interior of the basin.

Response: We agree with you that the mechanisms of water mass formation and circulation are relatively similar in the eastern and western Mediterranean basins. Thus we eliminate “in the western basin” from line 25, P. 571.

- P. 572, l.14, fig. 1: Obvious errors on Theta and/or S should be corrected and erroneous points on the Theta-S diagram eliminated.

Response: It is corrected.

- P. 574, section 3: Basic information about the MedArgo characteristics are given only in the last lines of the Conclusion. I think that they should be given just at the beginning of section 3, furthermore it is essential to know which kind of information these floats can provide us with.

Response: We add basic information about the MedArgo floats in section 2, “Materials and methods”. We also include in this section a brief description of data quality as recommended Dr. Gould.

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- P. 574, l. 6, fig. 2: Erroneous locations (over land; why are locations in fig. 2 not similar to those in fig. 1?) should be corrected.

Response: It is corrected.

- P. 574, l. 6: I think that differentiating “three main groups of clusters” is not obvious and not essential for the remainder.

Response: This sentence is eliminated.

- P. 574, l.10: I think it is not correct to deal with clusters located “west of islands” instead of specifying “in the interior of the Provençal and Algerian subbasins” since the specificity of these clusters is mainly to be away from the slope.

Response: The new version of this sentence is: “Less saline cluster representatives 4, 5 and 6 include the profiles placed in the interior of the Provençal and Algerian subbasins, mainly away from the shelf slope of Corsica and Sardinia islands.”

- P. 575, l. 9: names that need to be specified and are not well known need to be mentioned in a figure

Response: The not well known names are eliminated from the text.

- P. 575, l. 10: I did not understand what is “the thermohaline inversion often observed”. Please detail and comment.

Response: The new version of this sentence is: “The Theta,S curve from this cast is relatively uniform and does not have the thermohaline inhomogeneities often observed above and below LIW core in other areas of the basin. These peculiarities are mainly formed by the processes of mixing and stirring of LIW with surrounded water masses.”

- P. 575, l. 15: I understand and agree that circulation and mixing are intensified in narrow passages, which should lead to homogenisation. But I am not sure that this will lead to the complete destruction of lenses, which is not what the authors consider for the distribution of LIW in the western basin, i.e. after LIW crossed the channel of

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Sicily. The authors must be careful in describing the various processes concerning homogeneity and properly describe their feeling.

Response: We only wanted to point out the important role of the Mediterranean straits in the modification of water thermohaline structure. May be this is another issue, beyond the scope of this paper. We should discuss this more in depth.

- P.575, l. 17-18: one understands that the process invoked is double diffusion but this is not explicitly said; in addition, it is not explained why this process would lead to heterogeneities in the horizontal. This needs to be explained more carefully.

Response: The new version of this sentence is: “After crossing the channel area, as current velocities decrease, the “emulsion of LIW” returns to be separated into continuous (background layer) and dispersed (saltier and warmer lenses) phases. The thermohaline inhomogeneities begin to appear on Theta,S profiles due to double-diffusive mixing, which tends to diminish the remaining excesses of salt and heat (Kelley, 2001).”

- P. 576, l. 2: my own understanding of “patchiness” is “juxtaposition side by side” of classes. My own analysis of fig. 5 is “superposition” of classes that are “partly crossing each others”, which is normal since the analysis is spread over a relatively large time interval and, especially in the basin interior (i.e. away from the continental slopes), characteristics are dependent on mesoscale phenomena that are moving. Concerning fig. 5, let me emphasise that sub-cluster 1.3 is clearly considering deep features that are far from being related to LIW (hence demonstrating that the 29.0-29.1 criterion is not a good one).

Response: We changed “patchiness” to “spotty character” and with the change of LIW layer definition from density range to pressure range, we avoid the presence of non LIW water in the analysis.

- P. 576, l. 6-7: I think that the overall description of the “background transformation” could be improved. I personally think about LIW (and other water masses as well)

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continuously changing roughly anywhere, due to continuous mixing under normal conditions, and encountering, in a discontinuously manner, changes here and there: in the narrow passages (always), when de-structured by mesoscale eddies (from time to time and during any season), when involved in the process of dense water formation (in some specific places during winter only).

Response: We don't see any contradiction between your point of view and our description. We don't fully understand your comment and we should discuss this more in detail.

- P.577, l. 8: I do not think that profiling floats suffer some “drag” (horizontally in the authors' mind). They are entrained horizontally by the water in which they are ascending or descending (and do not “feel” these horizontal motions; they only feel as a drag their vertical displacement).

Response: We changed “drag” to “drift”.

Interactive comment on Ocean Sci. Discuss., 3, 569, 2006.

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