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Comment on os-2021-120

Anonymous Referee #1

Referee comment on "The Levantine Intermediate Water in the western Mediterranean and its interactions with the Algerian Gyres: insights from 60 years of observation" by Katia Mallil et al., Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-120-RC1>, 2022

Review of "**The Levantine Intermediate Water in the western Mediterranean and its interactions with the Algerian Gyres: insights from 60 years of observation** "

By Katia Mallil, P. Testor, A. Bosse, F. Margirier, L. Houpert, H. Le Goff, L. Mortier, and F. Louanchi.

The authors describe the Levantine Intermediate Water (LIW) in the western Mediterranean using in-situ data gathered over more than 50 years with a particular interest given to the Algerian Gyres region. The mean and variability of the LIW temperature and salinity are assessed. Regarding the variability of the LIW, the data suggests a significant cooling of the LIW in the late 70s early 80s and a rapid warming after 2012. Salinity trends are also described here (although in-situ are sparse). I found this work interesting, well-organized, and well-written. The amount of available in-situ data itself deserves publication.

While the analyses/trends would deserve more statistical significance (in particular with respect to the number of in-situ data), I would recommend this article for publication after a careful revision of the following comments.

I wish the manuscript had included the origin and physical mechanisms of the cooling and warming. I hope it could be part of an additional study combining the large in-situ dataset presented here and some non-assimilated ocean model experiments.

Comments:

Line 10: This does not seem to be a statistically significant trend for the period 1960-2017. In fact, you say warming for the period 1960-2017, but if you choose the period 1965-2012, it looks like a cooling trend. See below for more comments.

Line 15: What does "active" mean in "active thermohaline circulation" ?

Line 24-25: Could you move these lines a couple of lines after? This paragraph is well-written but you mention successively the MOW, then the LIW, then the MOW, and back to the LIW.

Line 29: "Levantine Intermediate Water " -> LIW

Line 37: If it does not make Figure 1 too busy and unreadable, could you show these Algerian gyres in Figure 1? Or perhaps having a new figure that shows the mean circulation of the region, including the Algerian gyres, Sardinia Eddies, bathymetry In particular for readers (like me) who are not familiar with this region.

Line 50: further

Line 53: What are the findings of "Testor et al. (2005a)" ?

Line 60: 0.005°C/year. Can it be called "warming"? I'm guessing that number is not statistically significant. Same for the salinity "trend". If the references listed here found these values to be significant, please add the information to the text.

Line 70-71: Sect. -> Section

Figure 1 caption: "total number of data" -> "total number of profiles"

L100: any references for the "WMDW having small natural variability within a year (0.01)". What is the percentage of data going through the correction of salinity offset?

L119: Reference for choosing the range "28.95-29.115 kg.m-3"?

L136: Do you mean "western" Algerian Gyre?

L133-145: Except for EAIg and WAIg, how do you choose the other regions ? Are they related to bathymetry?

Line 154: Can you indicate the LIW in Figure 3?

Line 155-161: It would be clearer to plot the 2010-2008 and 2014-2008 differences (with a red-white-blue colorbar) to visualize the "trends".

Line 169: You might want to overlap SSH contours from altimetry to clearly see the anticyclone in Figure 5

Line 172-174: Does the LIW exhibit seasonal variability? If so, how did you compute the climatological values?

Figure 6: That would be interesting (not for this manuscript, just a thought) to add to Figure 6 the thickness of the LIW.

Line 180-182: How do you compute the climatology. Did you just compute the mean of all your data? If so, and as you mentioned, the mean value will strongly depend on the number of data per year. Why not do the mean of monthly mean data? (Or if there is little climatology do the mean of yearly mean data).

Line 188: Are the cyclonic Algerian Gyres some types of mode water eddies ?

Line 190: from table 1, the "overall increase" is true only for Albo and AlgC

Line 193 and 202: Does your analysis start from 1969 or from 1960?

Line 194: Θ -> Θ & S

Line 195: By "error" you mean standard deviation?

Table 1 and 2: Rather than using grey values for $R^2 < 0.5$, you should use grey values for **non statistical** significant values.

Line 197: "... different phases best fitted ...". I am not sure I understand. Why do you change the time period in each phase? For e.g. Why do you choose 2009-2017 for SSar? This is twice as long as the 2014-2017 period.

General comment: The number of points used in this analysis is very small, in particular for salinity for the period 1960-2010 or for temperature for the periods 1960-1970 and 2000-2010. In most years between 1960-2010 you have less than 5 data points per year for the 8 regions, meaning that most of the regions do not have data and the rest have 2-5 data points. This would be even more problematic if there is a seasonal cycle. How do you take this lack of in-situ data into consideration in your calculations?

Line 202-203: Only half of the region shows that "increase". Also, Table 2 shows some misleading values. For e.g, the salinity increase for SaMi for the period 1967-1977 ($R^2=0.8$). It seems however that there is no data between 1970-1997 from Figure 8b.

Line 207: Only 3 out of the 8 regions show a "significant" freshening. Yet, the conclusion is that there is a freshening.

Line 209: "propagates". How do you arrive at that conclusion? You look at yearly averaged, does it take several years for the signal to propagate from SSar to the other regions?

Line 211: If we assume that $R^2 < 0.5$ is not significant (I recommend using grey values for statistical significance), then only 2 out of the 8 regions have significant temperature trends (one warming and one colling). Yet, the conclusion here is "tending towards

increase for most areas (6 regions over 8)”

Line 215: “WAIg between 2013 and 2014 “. This is only a 2 year long period (i.e. 2 points).

Figure 8: This figure is great and clean. The separation between bars (and points) which represent each year is however not consistent. It would be also easier to read if the vertical dotted lines also correspond to 1 year.

Line 225: “monthly averaged data”. I felt already that there were very few data points for the yearly averaged time series (bars on Figure 8a). This section now uses monthly averaged data. Do you have enough data for that?

Line 226-229: Need to be rephrased.

Section 3.4: This is an interesting section. Are the “advection times” observed in other studies (could be during different periods of time). Can the 15months lag between MAIg and WAIg be explained physically? Is the surface circulation similar to the one at the LIW depth?

Line 266: “have” -> “has”.

Line 266: Is “Millot (1999)” support the “slow accumulation over time of LIW in the interior of the Algerian basin”? If so, move the reference up in the sentence.

Line 283: Add the period of time of the cooling discussed here.

Line 292: “the” -> “The”

Line 292-295: What are the propagation speed of those eddies. Is it consistent with the lag correlations in Figure 9?.

Line 296: Again, is the 47 lag realistic from the circulation of the region?

Line 354: Why is it alarming? Impact of biology, ecosystem, ...?

Acknowledgments: Do not forget to add the funding agencies, if applicable.