Reply to Anonymous Referee #1

Response to the reviewer comments

The Authors thank the reviewer for their comments that have helped to improve our manuscript. We hope that the reviewer finds our manuscript now suitable for publication in Ocean Science. Hereinafter, the reviewer's comments are in black and the authors' answers in blue.

Thank the authors for the detailed reply to my comments, the reply and revision give convincing answers, and I have no further major comments.

Minor comments:

Line 6: typo, should be 'strength'.

Mistake corrected (line 7).

Line 85: The structure or content of the article should be introduced at the end of the Introduction section.

Suggestion accepted (lines 86-88).

"In this study, we first describe the proposed method to calculate the MLD and MTD, then we compare the results with other methods found in the literature, finally we calculate the thickness and strength of the thermocline, to obtain the climatologies of the mixed layer depth, the maximum thermocline depth, the thermocline thickness, and the thermocline strength index."

Line 250-251: The sentence 'Finally, the climatology … |TSI<0.1|' is confusing, what does 'seen previously' refer to?

We removed the phrase "seen previously", hoping to be clearer in this sentence (lines 261-262).

"Finally, the climatology of the thermocline strength (Fig. 8) maintains the seasonality in subtropical and subpolar latitudes with a |TSI < 0.1|."

Line 280: 'exampled' should be examples.

Mistake corrected (line 291).

Line 281: typo, 'Tin' should be 'In'.

Mistake corrected (line 292).

Line 283: typo, 'therocline' should be 'thermocline'.

Mistake corrected (line 295).

Figure 1: The location of figures 1(e) and (g) are in the equatorial and subtropical regions, respectively, but their surface temperatures are low, please clarify it.

The order of the coordinates in the caption was wrong. Mistake corrected (Fig. 1 and lines 170-172).

Reply to Anonymous Referee #2

Response to the reviewer comments

The Authors thank the reviewer for their comments that have helped to improve our manuscript. We hope that the reviewer finds our manuscript now suitable for publication in Ocean Science. Hereinafter, the reviewer's comments are in black, the authors' answers in blue and changes to the manuscript are shown in italics.

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Review of the manuscript “Revised submission”:

"Improving the thermocline calculation over the global ocean"

Submitted for publication in “Ocean Science”

2nd Review, 19th April 2023

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After revision of the paper it appears to me that this work is more solid and precise when presenting its new methodology and approaches. It also encompasses nice discussions about the role of salinity on MLD estimations, which are necessary in a context of diagnosing MLD from temperature profiles. Main issues that were raised in the first review were correctly adressed and the reviewer thanks the authors for their detailled answers. This work is then quite ready to be published in Ocean Science according to me.

I have still a few comments below and also suggestions for minor/technical corrections, especially about figure 1 and S1 that, for me, could be better described and be coherent with each others :

l.6 : instead of “the maximum depth of the thermocline” what you compute more exactly is “the maximum thermocline depth” or identically “the depth of the maximum thermocline”

Mistake corrected (line 6).

l. 102-103: I find the formulation here a bit unclear. (i) I would suggest instead something like : “To locate the MTD, we computed the vertical maximum of the contribution of temperature to the squared brunt-Vaisala frequency (i.e. maximum of N_T^2) to locate the most stratified point from the temperature profile.” (ii) Also, it is quite obvious what is N_T^2 but still there is no explicit routine to compute it in TEOS10 as far as I have checked, so it could be nice to recall the formulation of N_T^2 = -g2 * rho * alpha * d(Cons.Temp.)/d(press).

(i) Suggestion accepted (lines 105-107).

(ii) Suggestion accepted (lines 108-110 and Eq. (1)).

“N_T^2 is given by Eq. (1), where g is the gravitational acceleration, ρ is the density, α^Θ is the coefficient of thermal expansion, $\Delta\Theta$ is the vertical conservative temperature gradient, and ΔP is the pressure gradient.

$N_T^2 = g^2 \rho \frac{-\alpha^\Theta \Delta\Theta}{\Delta P}$ *(1)"*

l.214-215 : this sentence is not clear grammatically I think, and should be rephrased

We modified this paragraph, hoping to be clearer (lines 188-190).

l.338 : "Tin" à "In"

Mistake corrected (line 292).

l.340 : "thermocline"

Mistake corrected (line 295).

(i) Figure 1 : when comparing figure 1 with figure S1 (which is a plus to have it), I do not find the two corresponding upper/lower thermocline limits sometimes and also the colour code is not the same it seems (upper/lower is resp. black/red in fig1 and in figS1, it looks to be the opposite, so you should arrange this to be same). For exemple, on fig S1b, there is only one black dotted line which seems to be the one around 40m but the 400m one is not there, why ? better to have it in both figures , same for figS1c (missing red line) ; same for fig1g which has only the black line while figS1g has also one red one close to surface ; same for figS1f which has very different lines that on fig1f …. (ii) Also the legend of fig1 and figS1 should describe further what are those lines. You write about thermocline and mld or barrier limits on fig S1 but you never say to what they correspond on the figure. This should be corrected as for now it is unclear and misleading to me.

(i) Figures 1 and S1 did not have the same color code. We have corrected Fig. S1 from the supplementary information to avoid confusion.

(ii) Suggestion accepted. Now, in addition to the box in panel (a) of Fig. 1 and S1, we indicate in the caption what each of the lines and points of the figures are.

Figure 8 : missing unit of the variable above the colorbar, can be e.g. "Thermocline Strength Index (TSI) [degC/m]"

Suggestion accepted (line 162 and Fig. 8).

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