Reviewer 2 comments – JK (author) replies in red

In this manuscript (MS), the authors utilize novel field data to reveal the characteristics of bottom mixed layer (BML) thickness in the central and eastern Pacific and identify key controls on BML variability (ocean depth, total internal tide dissipation, slope). The RF analysis in the MS is first application of machine learning to BML thickness, identifies physically intuitive predictors, which is a notable strength. Several issues related to the RF regression and result interpretation need refinement to enhance the manuscript's scientific rigor and impact. The detailed comments are provided below.
Thank you for the positive comments on the novelty of this study.

1. The authors use GMM to predict practical salinity for TPT profiles using nearby GO-SHIP data, but no quantitative comparison is provided between predicted salinity and independent measurements (e.g., discrete water samples from TPT, or collocated GO-SHIP profiles not used for model training).

Thank you for this insightful comment. As this was not the primary purpose of the paper the details were placed in the Appendix, more detail on the GMM is provided there. Alongside the comments made by the other reviewer, an example figure has been added for one of the sites T-S plot showing the profiles. In addition, the average difference and standard deviation between the salinometer value and modelled SP value has been added to Section 2.2.

2. In the MS, the authors tried to characterize and explain the BML patterns in the central and eastern Pacific that covers the fracture zones, but the data used are mainly located in the central Pacific. In the RF regression, the input GO-SHIP data are selected within 10° of the TPT measurements, which could create a data imbalance that risks biasing the model toward GO-SHIP's spatial characteristics.

The datasets used within the RF regression are not within 10° of the TPT measurements. The 10° limit was the data used to correct the TPT salinity measurements are within those bounds for the GMM for predicting practical salinity and multiple occupations and additional GO-SHIP lines of P21 were included within these 10° bounds. This has been added to the Appendix. It is possible that there could be a data imbalance, but the spatial characteristics are within the same region and therefore applicable in this case.
This sentence has been added to line 233 at the end of the methods where the TPT and GO-SHIP sites are being identified "Because TPT salinities were corrected using nearby GO-SHIP profiles, the combined dataset may inherit some spatial imbalance toward the more regularly sampled GO-SHIP sections; however, both datasets occupy the same hydrographic regime and spatial scale, making them appropriate for joint analysis while acknowledging that this imbalance could introduce minor bias in the RF feature relationships."
The extension of the data to the west coast of the US was the reason for including eastern in the title of the manuscript.

3. In the RF regression, stratification and shear (or the state of stability) are important factors for determining the BML thickness, but are not considered as potential influencing parameters.

Thank you for this comment. In original versions of this paper, we included the mean buoyancy frequency within the BML thickness as previously explored by Liu et al. 2023 (Frontiers in Marine Science). However, we chose to exclude this as the goal was to predict the BML thickness with the RF regression spatially using available datasets over the area spatially, therefore having the stratification would imply already having the CTD profiles, from which you could find the BML already.

4. The relationship between BML thickness and depth, total dissipation, slope, etc., may be more intuitively displayed using scatter plots or similar methods.

Scatter plots and basic regression were our first point of call for this analysis and has been completed at other locations. We found it to be unclear to identify the spatial variability, therefore the RF regression was used.

5. Line 119, the authors mentioned Appendix A1, however in the Appendix A, it is about GMM, the information for TPT profiles can not be found.

This was a mistake, it is Table A1.

6. The MS reports key spatial patterns but provides limited physical explanation for these differences. For example, the authors note cooler, saltier AABW near Hawaii vs. fresher NPDW at the equator, but do not explicitly connect this to stratification (a key control on BML mixing). Stronger stratification in AABW regions should suppress mixing and thin the BML—consistent with thinner BML south of Hawaii.

Thank you for this detail. We draw attention to this in lines 368 to 373 where stratification is mentioned several times. We have now made this more explicit in the final line of the paragraph (line 373). "Therefore, the buoyancy gradient remains difficult to overcome, resulting in a thinner BML in AABW regions compared to regions of NPDW at the equator (Weatherly and Martin (1978))."

7. Figure 2: the locations of each profiles are not shown, making it difficult to link BML thickness to regional features. The "visual interpretation" line in Figure 2c is helpful but should be standardized across all subplots for consistency. The x-axis ranges of some subplots are too large to visually identify the BML thickness. Also the solid dots showing BML results of different methods could cover some critical features of the profiles.

The locations are identified in third column of the figure. The annotations of Figure 2(c) were explicitly only included in only one of the figures as with all annotations included, the figure was very cluttered with all annotations included. Where possible to have all BML thickness results still within the x-axis figure range the x-axis will be changed.

8. Equation 1: The variable h_1 is not defined. It likely represents the seafloor depth, but this should be explicitly stated.

Yes, correct. This has been added to the sentence below the equation.

9. The first mention of "σ_4" (Section 2.3) does not explain it is potential density referenced to 4000 dbar.

Line 145 this distinction has been added. "The threshold method (TH) uses the depth at which the difference in either Θ or potential density referenced to 4000 dbar, σ4, is less than a defined threshold value."

10. Line 146: The citation of Hogg et al. (19821) contains a typo.

Changed, this is 1982.

11. Line 149 and 167: Appendix A2 should be Appendix B.

Changed to Appendix B in both instances.

12. Line 159: The authors refer to "Douglas-Peuchker" is a typo.

Changed to Peucker

13. In appendix B, the authors justify the 0.003°C threshold for BML derivation using "highest mean QI" but do not show some example profiles with BML results regarding different thresholds. QI might be high when the mixed layer results are shallower than the actual ones.

Yes, this is possible, however in order to make a more informed decision than most papers on BML thickness reflect, we opted to include the average for all the profiles to remove any visual identification factor and focus only on this method, therefore getting the mean value as highlighted by Figure A2 and A3 and explained in point 14. The histograms for the TPT profiles threshold values were mistakenly excluded and only the two highest performing threshold values for the GO-SHIP datasets were included. This will be rectified in the revision.

14. In Figure A2, there are no subplots (c-e).

Thank you for pointing this out, mistakenly, an appendix plot was not uploaded as explained above. This was for the GO-SHIP profiles only, the results for the TPT profiles have been added.