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Geoscientific Model Development Discussions

Interactive comment on "Verification of the mixed layer depth in the OceanMAPS operational forecast model" *by* Daniel Boettger et al.

Daniel Boettger et al.

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1 Scientific comments

On a spatially dependent MLD definition. The reviewer questions our suggestion that the suitability of the MLD criteria thresholds may vary spatially. We adopted de Boyer Montegut et al., (2004) as a well performing and widely cited scheme. However, there are a number of clear points that would not support this as an optimal definition. As we discuss in section 3, the calculation of the MLD is complicated by the wide variety of temperature and density profiles observed in the ocean, making any MLD criteria susceptible to errors in certain circumstances. The temperature criterion is not set to be optimal in every global location or season but a single criterion that is "fairly successful"

at estimating the MLD. The principal justification for the threshold is based on the representation of the spring re-stratification of observations in Arabian Sea and Subpolar North Pacific. This is well demonstrated in their Figure 4b and 4d. Furthermore, the 0.2 degC threshold was compared with 0.5 and 0.8 degC as previously cited values. However, by making use of the 10 m reference temperature a smaller threshold is made possible as clearly shown. However refinement of the criterion in the range 0.1 to 0.3 degC is not made. Figure 4c in their paper shows the criterion underestimates the MLD in Sub-tropical North Pacific and a value between 0.2 and 0.5 degC is likely best for this region. How this impacts the other two regions would need to be investigated. We argue that the method as described has an uncertainty of at least +/- 50%. A similar range of uncertainty for the density thresholds is to be found in de Boyer Montegut et al., (2004). In addition, our study examines a period of Austral autumn and the subtleties of spring re-stratification are absent. The MLD estimates from the observations should be robust to this change in threshold, though we find a nonlinear response. More important; however, is that we are using the observed sensitivity as a reference to interpret the response of the model. In any event, we have modified this paragraph to more clearly outline our argument.

On MLD statistics. The reviewer has suggested that it would be more advantageous to compare instantaneous OceanMAPS profiles to the Argo observations. While we agree with this suggestion, the standard OceanMAPS forecast output only provides 24 hr mean fields for sub-surface variables. As we do not have the resources to reproduce the OceanMAPS operational forecasts, higher resolution time steps are not available. In addition, the 0.1 deg resolution of the model fields introduces spatial averaging errors that are not present in the Argo observations. However, given the randomness of the float location within a cell and the time relative to the centre of the time-average we do not expect this to lead to systematic errors. To remove the influence of diurnal variation that may be present in the near-surface Argo observations, we have defined our MLD criteria in terms of a reference depth of 10 m; below this depth negligible diurnal variation can be expected and the model mean profiles can be considered represen-

tative of the instantaneous fields. While this method does limit our MLD estimates to depths below 10 m, the vertical resolution of the model (only two levels above 10 m) would preclude any accurate estimate of such a shallow MLD. A more detailed explanation of the available OceanMAPS data has now been included in Section 2.2 of the dataset.

2 Technical comments

Section 4.3 line 16-17. 'Skilful' is the UK spelling, while 'skillful' is common in the USA and Canada (see https://en.oxforddictionaries.com/definition/skilful). We have retained the UK standard. The reviewer also identified a typographic error ("that"); we have adopted their recommended change.

Figure 4(a). On the absence of a mean (black) line. The reviewer noted that the observed mean line (in black) was not evident in this figure, despite being identified in the caption. This was a typographical error in the caption, and the mean line (from figure 2) was not intended to be included.

Figure 5. A label has been added to the y-axis legend

Figure 6. The contrast between the light and dark bars has been increased

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