

Anonymous Referee #2, 22 Oct 2025

The manuscript by Brabson et al. describes the implementation of a temperature-dependence of the remineralisation of particulate organic carbon in the CESM1 model. The authors conclude that the new temperature dependence results in an improvement of the transfer efficiency in different temperature regimes of the ocean. The study is interesting and overall clearly presented, with some details missing (see comments below). I recommend it for publication after the following points are addressed:

Dear RC2,

Thank you for the positive feedback! All comments are addressed below sequentially.

Best Regards,

Liz, on behalf of all co-authors

I recommend to add a description of the actual values of newly introduced parameters, e.g. the tuning result, for the Tdep parameters (e.g. in a table), and ideally also show a plot of the temperature influence on the remineralisation rate.

** We can certainly add a table of values, which would be primarily for the adjusted scalelength depths (both base scalelength and depth bands). The other value for the temperature parameter was newly added, so it is only the referenced value from the text. For our formulation, we do not calculate remineralization rate directly, but it is instead determined using mass balance as in Equation 2.

Methods: More information on the simulations performed, including information on the tuning process, would be informative in this section.

** Additional details on the specific details will be added to Section 2.2.

l 179ff: it would be good to list the number of data points used for comparison somewhere, along with an exact computation of the error metrics used.

** Individual data points are shown as triangles in Figure 7. Cite-specific citations for error handling are listed in Table 1. Here, data from each location were normalized to flux at 150 meters for equivalent comparison across the compilation.

l. 5: The figure size should be enlarged to enhance readability of the figure inlet.

** Good point. We will adjust accordingly for easier readability.

l. 250: “negative biases of 0 to 1.0” – please provide the unit.

** We will add the units here.

l. 255: Why does the Indian and Arctic Ocean perform almost identical with respect to the phosphate concentration, when they have the highest differences in the basin-scale efficiency (Fig. 6)? A sentence addressing this would be helpful.

** This is a great point, and we will include additional discussion of these results.

Also l 255.: I don't agree with the statement that Fig. 9 shows a decrease in cRMSE and an increase in R2 for most of the simulations. If the filled symbols indicate indeed the PI simulations, they are all higher for R2 and lower for cRMSE, except for the Indian Ocean and the Arctic. Please doublecheck the symbol description in Fig. 9 (also in comparison to Fig. 11, see comment below), and if it is correct, adjust the statement in l.255 accordingly. (Same for supplementary figures). For now, I assume this is a plotting mistake, otherwise, some of the conclusions need to be revised.

**** You are correct, this is a labeling error. Many apologies. This will be corrected, and all figures double-checked.**

Fig. 8: The model performance with respect to the WOA2023 phosphate concentration looks slightly worse in the Tdep simulations in the low latitudes when comparing the PI simulations. This should be addressed in the discussion – why is that the case? Could other processes or controlling factors be missing? Have other parameter values overcompensated the temperature effect before, and require adjusting now that the temperature dependence is included?

**** There are definitely other factors at play, specifically in high-productivity regions. We will add further discussion of this, as well as proposed recommendations for next steps to address these challenges.**

Figs. 11 and 9: For consistency, I would advise to use filled symbols for either the PI or the Tdep simulation, and not change between the meaning in different figures. At the moment, Fig. 11 has filled symbols for Tdep, and Fig. 9 has filled symbols for PI.

**** This will be revised and made consistent.**

I could not access the data sets provided in the accompanying link for the review process, perhaps due to an embargo before publication. I can therefore not make any statement on the supplementary datasets.

****We have been able to access on our end. Please let us know if this persists.**