

Geosci. Model Dev. Discuss., referee comment RC1
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Review Matsumoto et al.

Anonymous Referee #1

Referee comment on "MESMO 3: Flexible phytoplankton stoichiometry and refractory dissolved organic matter" by Katsumi Matsumoto et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-408-RC1>, 2021

Review of Matsumoto et al.: MESMO 3: Flexible phytoplankton stoichiometry and refractory DOM

The manuscript of Matsumoto et al. describes the third version of the MESMO model, a model of intermediate complexity dedicated to studies on ocean biogeochemistry. Major model developments include three phytoplankton functional types, a flexible phytoplankton stoichiometry based on ambient nutrient, temperature and light conditions, as well as an implementation of a refractory DOM pool, in addition to the existing semi-labile pool, also including stoichiometry of C, N, P and Fe. The model is well and comprehensively described and the substantial developments after version 2 fully justify a new version description. The paper is well structured by starting with the developments since version 1, the newly implemented processes and a discussion of the model results. It will be a useful and complete reference for the future use of this model version, and fits perfectly within the scope of the journal. Therefore, I recommend publication after the comments below are addressed:

General comments:

- I think the overall improvement resulting from the changes in the new model version could be made more clear in a quantitative way. This is qualitatively described in paragraph I. 484ff, and on a 'global-mean' basis in Table 3. Adding more parameters that are difficult to constrain (such as e.g. the partitioning between DOM_{sl} and DOM_r, or uptake stoichiometry) should somehow "pay off" in terms of better agreement with observations or a more flexible representation of processes needed to model biogeochemistry in a changing ocean scenario. It is described that e.g. the nutrient pattern is better in MESMO3 than MESMO2, can you quantify this (with e.g. an RMSE, or a scatter plot/taylor diagram)? Or in Tab. 3, export C:N:P ratio seems to be less close to observations for the new version – what is the cause? Is there a better representation of the spatial pattern instead?

i.e. the difference between a simulation with or without RNPG. Please either show an effect, or adjust the caption accordingly.

- Figure 4: Panel b would benefit from a latitudinal mean from observations for comparison, maybe from the dataset you already cite: Martiny, A. C., Pham, C. T., Primeau, F. W., Vrugt, J. A., Moore, J. K., Levin, S. A., & Lomas, M. W. (2013). Strong latitudinal patterns in the elemental ratios of marine plankton and organic matter. *Nature Geoscience*, 6(4), 279-283.
- Figure 7: Please define DOCT again in the caption