

Interactive comment on “One size fits all? – Calibrating an ocean biogeochemistry model for different circulations” by Iris Kriest et al.

Anonymous Referee #1

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Kriest et al., calibrate a single ocean biogeochemical model with five different ocean circulation models (in the form of transport matrices) and explore how the model-observation misfit varies as a function of the suite of calibrated biogeochemical parameters and of various metrics of ocean circulation. The authors find consistent relationships between metrics, parameter values and model-observation misfits despite differences in calibrated parameter values. The authors then explore how each calibrated parameter set performs with an alternative circulation model finding that calibration in other models, such as coarse-resolution models, can still reduce the misfit.

Overall, this is a very well-designed set of model experiments and a very thorough analysis. The authors have done an impressive job of analysing and communicating a very complex set of results! The study raises a lot of interesting and important scientific

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questions about the calibration and complexity of biogeochemical models that are significant to the wider biogeochemical modelling community. Some of the results could be specific to the biogeochemical model used but the authors openly discuss this. The study itself is sufficiently self-contained that I think this is not a problem (and is a necessity given the complexity of the results). I recommend very minor revisions, mainly to improve the quality of the figures which otherwise hinder the visual interpretation.

General Comments:

Some of the figures were a little hard to interpret due to the large number of model set-ups. Figures 6, 8, 9, 10 and 12 would really benefit from a legend or key to more quickly pick out which model set-up is which (a legend on the first relevant plot that is referenced for subsequent plots for example). Interpreting the plots with reference to the text was difficult because of this.

Specific Comments:

Section 2.7: I found this section a little unclear due to the discussion about the previous optimisations. It would help to focus on the parameters varied in this study based on the second 2017 optimisation and mention more briefly that the plankton parameters were the same as the first 2017 optimisation.

Line 347: “MOPS coupled to UVic circulation is more robust with respect to changes in parameters.” : the sentence meaning is unclear, does this mean that the calibrated parameters are similar across the three UVic circulation used? (In comparison to ECCO or MIT28).

Line 349: “. . .the large impact of oxygen on the misfit function. . .”: could you elaborate briefly why this is the case here.

Lines 399 – 413: this analysis assumes that the interactions between circulation, biogeochemistry parameters and the misfit are linear and additive? Figure 11 suggests that this might not be the case as the Δ_{par} and Δ_{circ} bars do not sum to the

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delta_all bar. The analysis in this form is fine (and considering non-linear interactions would not be easy!) but I think this assumption should be mentioned.

Lines 453 – 454: “. . .it prevents fast settling of organic particles out the euphotic zone” is a little unclear. Does this mean there is effectively an increased residence time of particles in the euphotic zone which equates to a larger fraction of particles being remineralised before reaching the ocean interior? Is there also an impact of the plankton model in this instance, e.g., changes in zooplankton grazing?

Lines 459 – 461: “long term storage of nutrients and carbon will, to a large extent, depend on the prescribed particle flux profile” – the air-sea balance of CO₂ might depend on circulation more than nutrients to the gas exchange component, similarly to the arguments made about O₂ previously.

Line 469 - 474: There should be a caveat that these findings are for MOPS specifically.

Figure 4D is very hard to interpret due to the colour contrasts and placement/combination of lines. The panel is not explicitly mentioned in the text so I would suggest to move the figure to supplementary or separate into more panels to make it clearer.

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