

Geosci. Model Dev. Discuss., author comment AC4
<https://doi.org/10.5194/gmd-2021-392-AC4>, 2022
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Reply on RC1

Markus Pfeil and Thomas Slawig

Author comment on "Adaptive time step algorithms for the simulation of marine ecosystem models using the transport matrix method implementation Metos3D (v0.5.0)" by Markus Pfeil and Thomas Slawig, Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-392-AC4>, 2022

**** First of all and although you reject the paper, we would like to thank you for your report. It shows us that at least parts of the manuscript are not well understandable. And since you write you are a modeler, we would of course also would like that also modelers understand our presentations. We provide our answers to your commenst in italics.*

General Comments:

I went through the manuscript from the beginning to the end twice carefully. As an ocean biogeochemistry modeler, I found the manuscript is very hard to understand and follow. It was not like a model technique paper, but more like a bunch of model testing results report. I reject the paper and provide my comments below for authors to improve in the future.

**** Our paper is an algorithm development and evaluation paper. But we think that this can be alos regarded as "model technique".*

Specific Comments:

The model technique that was intend to address

The prepared manuscript tried to improve the time step selection in the transport matrix method (TMM). It argued the used time step affects both the

computational effort and accuracy of the steady annual cycle computation.

I think both the "computational effort" and "steady annual cycle" should be well explained in the introduction part. What are they? Are they being recognized as a common problem in previous research? How that impact the follow modelling results? It was very hard to feel the importance of the technique problem presents in so far writing.

**** We have to clarify the term "computational effort" as already mentioned by the other reviewer. We will also clarify the term steady annual cycle, we thought this was clear by equation (11) and the text before.*

Experiment design and way to present results

"The experiments are designed to shorten the running time of the computed steady annual cycle. The accuracy and cost save the calculated approximation.

It was very hard to understand the present results from so far figures and tables." Why not have a figure to show what is the non-steady state annual cycle globally look like and what a steady state annual cycle looks like?

Why not have comparisons between on- and off- line methods to show how they impact the steady annual cycle and the accuracy. It was also very hard to tell how much accuracy has been improved and cost saving was necessary from so far results.

**** It was not our aim to compare off- and online methods, and we did not want to argue against any of the two. We also do not see what benefit it would be for the reader to show a non-steady solution. We are trying to reduce the runtime necessary to compute a steady annual cycle. This is one form of the process usually called spin-up of a model. We thought that we made clear in the introduction that runtime reduction is of importance in these kind of simulations. We will try to emphasize this point even more.*

It will be good to read and learn the cited manuscript "Accelerated simulation of passive tracers in ocean circulation models" carefully and

learn how to present results like this to guide the reader. Another good example is "Performance of offline passive tracer advection in the Regional Ocean Modelling System" by Thyng et al. on GMD

**** Thank you for the recommendation. We will look into the second paper you mentioned as well.*

Mathematical forms

I felt there was too much details about how to get A from B, which are very annoying to follow the final results. It should be provided in the supplementary material. It should also provide some math in matrix form, which will be easier to follow

**** Here, it would be nice to have more details. We are aware of the fact that there is some mathematics in the paper that may be a little bit lengthy.*

We will try to reduce some of the formulas in a revised version.

Technical Corrections:

L68-L71:

"Due to the fully coupling of the ocean circulation with the tracers,, the tracer concentrations affect the circulation, the simulation of a fully coupled model ... to single model evaluations."

It was not correct to say this. Commons like this for online and offline methods should be careful. Online coupling is a mature technique and widely used. With the development of the computational source, the computational cost is not that high. It was true the offline model will be more efficient, but it was also difficulty in accurately representing vertical fluxes due to deep convection.

**** We agree, this statement was definitely too strict. It will be reformulated and the last part "to single model evaluation" will be skipped in a revised version.*

L83:

"No fluxes on the boundary"

Need to state all experiments are for global run.

**** This is correct, we will add this point.*