Geoscientific
Model Development
Discussions

# Interactive comment on "Metos3D: a marine ecosystem toolkit for optimization and simulation in 3-D – Simulation Package v0.2" *by* J. Piwonski and T. Slawig

**Anonymous Referee #1**

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General comments

In this paper the authors present a newly assembled toolkit (Metos3D) for the implementation of two solvers based on PETSc library. I understand Metos3D is meant to generalize the coupling of transport matrices and source/sink models with the possibility to use a Newton solver as well as a fixed point iteration (spin-up). This should save the user the effort to develop a coding interface every time a new source/sink model is introduced.

However, my understanding outlined above (if at all correct) comes from a lot of guesswork. The authors do not explain clearly what the objective of the work is. There is a

paragraph that was meant for this (page 4404, lines 18-26) but it should be improved. I think the Introduction before that paragraph did a fair job in introducing the problem, outlining the three components put together here to tackle it but then from line 10 of page 4404 it gets a bit confused and the first sentence of the objective paragraph (Lines 18-19) sounds oddly out of place to me.

In general, I think the paper requires a better structural organization in order to improve its readability. Furthermore, it needs to highlight better what is the novelty here and why should a user use this toolkit and what for. What is the contribution with respect to the work of Khatiwala (Ocean Modelling 23 (2008) 121–129) where a matrix-free Newton–Krylov solver was applied to a similar framework?

In its present form I'm afraid the manuscript wouldn't be able to encourage a model user to download and get acquainted with Metos3D.

Specific comments

Sections 2 and 3 could be shortened or maybe moved to supplement material or to an appendix.

Section 4 seems to get to the core of the novel contribution of this work and I think it could be merged with Section 6. This merged section would benefit from schematics or a flowcharts to help the reader to better understand how Metos3D works. The description of the implementation of the toolkit in layers (section 6.1) is an example of something that would probably be better explained in a schematic.

In Section 5 it would help to give 5.3.2 the same title as 5.2 (aren't they the same thing?).

Section 6.2: I know PETSc has its own load balancing algorithm. How is your procedure different?

In Section 7 results are presented. In Section 7.1.1 (Model) at lines 2-3 of page 4420, it is said that a model wrapper of the original source code is implemented. Is this

something that the user of Metos3D will have to do for every source/sink model? Is some sort of guidance or template provided?

Figure 3 compares the initial state of the converged annual cycle with WOA. I don't see the point of this comparison. Your solution should be compared with the solution coming from the spinup of the MITgcm coupled with the same biogeochemical model, if available, of course. I don't believe the skill of the model in reproducing real-world observations is the point here. It does not say anything about Metos3D.

Technical corrections

page 4403, line 12: ...is often TOO high, even at LOW resolutions,...

page 4410, line 2: "With those two building blocks". It does not hurt to remind which two blocks you mean.

Page 4411, line 5: k=1,....?

Page 4414, line 5: "The latter includes (?)"

Page 4414, line 23: "The next TWO layers"

Page 4415, lines 6-7: this last sentence is confusing. Consider reformulating it.

Page 4418, line 1-2: "We compare the simulation results with others" others what?

Page 4424, lines 11-12: consider rephrasing this one.

Page 4426, lines 5-6: consider explaining why it is so interesting.

Page 4428, lines 2: what was the "intended purpose"? Remind it here.

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