

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2020-396

Anonymous Referee #2

Referee comment on "FABM-NflexPD 1.0: assessing an instantaneous acclimation approach for modeling phytoplankton growth" by Onur Kerimoglu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-396-RC2>, 2021

Review of "FABM-NflexPD 1.0: Assessing an Instantaneous Acclimation Approach for Modelling Phytoplankton Growth" by Kerimoglu, Anugerahanti and Smith

General comments

The article presents the first spatially-resolved implementation of an "Instant Acclimation" approach to modelling plankton ecosystem. The authors found that the Instant Acclimation model performance was very close to that of a more computationally expensive Dynamic Acclimation version. Both of these models were markedly different from a physiologically less realistic Fixed Stoichiometry model. This is an important contribution that will allow biogeochemically and ecologically important stoichiometric variation to be efficiently included in computationally expensive global ecosystem and biogeochemistry models.

The objectives of the article were clearly communicated, and the approach accurately described. From my perspective the main weakness of the article was the 'Model Description' section, which I felt could be made a lot more coherent. As it stands, the article attempts to describe three versions of the general model in parallel. As the model contains a number of subsections, each subsection needs to be described in multiple different ways before we can move on to the next subcomponent. I found that this made it hard to understand how each version of the model works as an integrated whole. My recommendation would therefore be to first describe the Dynamic Acclimation model in full, before going on to describe how the Instant Acclimation and Fixed Stoichiometry models deviate from this. This makes more sense to me, as both of the latter models are effectively simplified versions of the former.

My other main comment is that I did not see the benefit of varying the way photoacclimation is handled in the three models. This mechanism is included in many

"fixed stoichiometry" models, so it is not a unique benefit of the two more sophisticated approaches. Given the not insubstantial level of complexity in the rest of this article, I wondered if it might not make more sense to fix this part of the model across the three cases, and focus on the more novel developments in the C:N ratios.

Specific comments

Line 34: "Models that account for variations in cellular composition are indeed more likely to provide more realistic estimates" - Suggest "Models that account for variations in cellular composition are in principal more likely to provide more realistic estimates"

Line 68: "The key assumption is that growth and nutrient uptake are at all times strictly balanced [w.r.t. the internal C:N stoichiometry of the cell]"

Line 76: "the inclusion of transport terms may lead to additional complications". Please could you explain how/why this leads to extra complications?

Line 96: "the trivial flux terms". I do not see how these terms are trivial?

Eqns: 1-3. I found this notation a bit confusing. I wonder if simple word equations might be the most straightforward here? (e.g. $d\text{PhyN}/dt = \text{phytoplankton uptake} - \text{linear mortality}$). Failing that, I think substituting in the terms from Table 1 would be a lot clearer.

Line 153: "(equivalently, relative size of the chloroplast, following Pahlow and Oschlies (2013)), f_C ". I found this hard to understand. Have we switched to an entirely new idea here (f_V to f_C)? If so wouldn't it be better to separate out, instead of adding it on parenthetically?

Equation 30: Which state variables are actually transported? Presumably not C for the IA or FS models. It is noted in the Discussion that C biomass is not conserved - I expect due to issues with advecting C in IA model. This should perhaps be discussed in a bit more detail.

Figure 4: The third row of panels (g-i) are cited out of order in the legend, which is slightly confusing.

Results section: I think it would be worth noting any differences in system level functional parameters such as overall primary production and C export.