Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
https://doi.org/10.5194/gmd-2021-154-RC2, 2021

Comment on gmd-2021-154

Anonymous Referee #2

Referee comment on "Testing stomatal models at the stand level in deciduous angiosperm and evergreen gymnosperm forests using CliMA Land (v0.1)" by Yujie Wang et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-154-RC2, 2021

In the study "Testing stomatal models at stand level in deciduous angiosperm and evergreen gymnosperm forests using CliMA Land (v0.1)" by Wang et al., the authors implement and compare three different stomatal models within the CliMA land model. While one model is optimization-based, the other two are empirical. The comparison at two flux-tower locations shows that all models predict site-level carbon fluxes well, while the optimization-based model performs best for water fluxes. Vegetation and Earth system models could benefit from the results of this study by implementing stomatal optimization models. Because of the importance of stomatal conductance for vegetation-climate feedbacks in Earth system models, this paper is an important contribution to the community. The paper is interesting to read and mostly well-written. There are, however, a few unclear passages and the structure of the method Section could be improved. My individual comments are the following:

- An overview figure about the various applied model components and their main inputs would greatly support the understanding of the model framework.
- The model description could be generally a bit more streamlined. For example, the authors could give some more background information about used model compartments (e.g. mSCOPE) and describe their changes to the models (especially the land model) in comparison to the original implementation (which is sometimes done, but not always, see minor comments).
- The authors suggest that the optimization-based model could be used for land models within Earth system models. Can the method be applied globally? In L58-66 the problem of global inputs is discussed with a possible solution but from this paragraph, it was not entirely clear to me. It is one of the main motivations of this paper that this method previously was not used in models of larger scale due to a too large number of traits. The paper potentially aims to solve this problem at least partially. It would be nice if the authors could come back to this point in the Discussion.

- In relation to my previous comment, I was wondering why the authors only compared the three models for 2 sites. To evaluate whether the optimization based model could benefit global Earth system modeling, results from different climate zones are required, because stomatal processes could have different properties there. It would be good, if the authors could give a reason, why they only choose 2 flux tower sites and/or why this is sufficient to judge the method on a larger scale.
- The 4th. Chapter, Solar-induced chlorophyll fluorescence, does not state exactly which model setup has been used here. Before, three different setups have been compared, but Chapter 4 only uses one of the variants? Generally the aim of this Chapter could be explained a bit more. The authors could also think about restructuring the Chapters to one method Chapter (model description, site description, model protocol etc.) and one Chapter for all the results (comparison of the models and SIF).

Minor comments:

- L67: Please give a short description, why stomatal optimization models need a RT scheme (maybe add this to a possible overview figure).
- L74/75: Please state here again in which model the stomatal optimization model and the mSCOPE RT concept are implemented.
- L74-78: Please also describe here the comparison of the different models, since it is a key result of this paper.
- L82: Could the canopy radiative transfer be also used instead of mSCOPE? Or is this not possible for the reasons stated in the introduction?
- L87: Please replace "here" by the model name.
- L87-97: Are these the changes implemented in the land model of CliMA? Which of these points has been part of the model before, and what was newly implemented? What is the difference to the original implementation?
- 98-104: Also here, please better highlight the actual changes, compared to the original model.
- L114: Here the changes to mSCOPE are better introduced, but it would be nice to know how exactly the carotenoid light absorption was implemented in the model.
- L129: The SLUSPECT-B model should be better introduced. Why is this procedure necessary?
- L160: Why was E_crit defined as the transpiration rate at which leaf xylem hydraulic conductance decreases to 0.1% of the minimum value? Is there a literature example or any clear reason for doing this?
- L166/167: Please revise sentence structure.
- L208: Could soil moisture, leaf temperature and LAI be modeled by the land model?
- L209: Please describe the "offline simulations" a bit more. E.g. how many simulations under which conditions.
- L214: What uncertainty is reduced here? Of the evaluation data or of the model?
- L225-234: It is not clear for several of these points, which steps are newly implemented by the authors and which were already part of the land model.
- L245: Is the root:stem:leaf resistance ratio of 2:1:1 a widely accepted ratio? Is there a

literature example for this choice?

- 249: thoughtout -> throughout
- L304: Here would be a good place to discuss the problems to implement stomatal optimization in vegetation models. The authors stated before, that this is problematic due to missing trait data. How exactly does the described approach help here and what is missing for a global application possibly in Earth system models?
- L315: This sounds as if the underperformance of the empirical models were based on an arbitrary decision of the authors. Please rephrase.
- L325/327: Rephrase; the alternation of g1 *within the empirical models* shows potential...
- L322-331: A good solution for this problem would be to do model simulations at other sites or even potentially global. A short reason, why this has not been done in this paper, would be good here.