Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-300-RC2, 2020

Geoscientific Model Development Discussions

Interactive comment on "Robust Ecosystem Demography (RED): a parsimonious approach to modelling vegetation dynamics in Earth System Models" *by* Arthur P. K. Argles et al.

Anonymous Referee #2

Received and published: 23 January 2020

The authors present a model development work on vegetation demography, and seek to incorporate it into an earth system model. The framework provides a simplified solution to model the global vegetation distribution based on the "Metabolic Scaling theory". Both the topic and the model concept are very interesting. However, there are numerous errors and ambiguous expressions throughout the current manuscript. The model descriptions are not clear enough, especially for the equations and units. At some points, I have to stop to calculate the units of each term. I'm also not fully convinced by the model outputs and validations. Extra information are necessary to be provided for a proper judgement, e.g., how the NPP data was created, which climate forcing and vegetation map were used. I suggest an overall revision and reorgnization of the

manuscript. My major question about this approach is how it can be used in transit-time simulations, especially for the future projections. From a modelling aspect, the model simply ignored many factors that can be modfied due to climate change. Nevertheless, it would be very exciting if enough evidences support that some important emergent properties from land ecosystems would remain constant in a fast changing world.

Specific comments:
P1
Abstract L7:cohort-based models?
..L8:These models
..L14:I feel it should not be the major reason to argue that RED would be a great contribution. Only mentioning the computing cost is not convincible enough.
..L15:pdf?
..L19:solvable?
..L26:Why only compared to this dataset.
Introduction:
..L41:2K? not clear enough, references needed
..L47:keep update with the new results?
..L44-51: The logic here is unclear. I assume that the authors want to stress the large uncertainties in modeling land C budget. But the topic of the study is model development, rather than uncertainty analysis. So I suggest to use 1-2 sentences to describe the uncertainty topic, and go to the model development faster.
..L53: According to my knowledge, LUC prediction is from another sector, which is not from DGVM.
Provide the LUC examples here seems irrelevant to the modeling of this study. Also, why the authors only picked examples from RCP8.5.
P2
..Line 2: Rewrite the sentence and focus on the topic of this study. Generally, DGVM includes biochemical, biogeographical, biophysical processes and other factors influencing vegetation.

..Line 5: How to define complex. What about the other “complex” models.
..Line 10: Why non-individual based models cannot do that?
..Line 13: What is top-down models? Area based?
..Line 15: are significantly simpler and more computationally efficient(reference?).
..Line 17: over-estimated(reference?)
..Line 34: The previous paragragh only explain one benefit of RED: reduce computational cost. To me, it is at least not the major reason for the RED development. I feel it is necessary to mention the theoretical foundations for RED development, e.g., the scaling theory. Although this study is mainly about model development, the explanation of the underlying mechanisms is necessary to facilitate the understanding of the model concept.

Description of the model
Overall, the equations should be carefully checked and the units need to be added in an appropriate way.
..Line 47-49: Check the symbol consistency between equ.1 and the corresponding descriptions. I suppose the equation has been simplified – it is assumed that gamma is independent from mass level already.
..Line 50: Any form of what?
..Line 53: follows a power..
..Line 59: Correct the reference format
..Line 70: Is that a basic requirement to build a vegetation model?
..Line 86: keep unit unified throughout the MS. why using per plant per unit area previously but using explicit unit here?
..Line 88: why it is a concern? To keep mass and energy balance is basic to develop a model.
..Line 66 the area term “a” does not appear before.

P3:
..Line 8: P has been defined before. Again, units miss

..Line 17: This part is mainly derived from PPA and TRIFFID, or new for RED? If it is former, I suggest to provide main equations and introduce them briefly.

P4:
..Line 1: I’m concerned about the “coupling” here. Based on the description, I feel RED has not been actually coupled with the ESM. Using prescribed NPP means an implicit vegetation distribution in itself. From equ.16, higher NPP would mean higher baseline growth-rate.
..Line 53-54: What is the loss of vegetation C due to plants growing beyond the modelled mass classes.
P7:
For the first paragraph of “Modelling results”, Should it be part of the method section?
..Line 1: What tests?
..Line 2: Again, I’m concerned about the use of prescribed NPP. How you get NPP? Using which climate forcing? What period of NPP you used. And most importantly, how the NPP data from JULES defines the vegetation distribution? A predefined data or from a model? All the info needs to be added for a proper judgement. If fed a similar pattern from the data:ESA LC CCI to RED, then it is not surprising that they would have the similar output as showed in Figure 7.
..Line 10: Why choose this grid-box.
P16:
..Line 1: Discussion. The comparisons between RED and the other similar models are needed. But before that, I think the method description needs to be greatly improved, and the corresponding results should be further clarified.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-300, 2019.