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Biogeosciences Discussions

Interactive comment on "The Jena Diversity-Dynamic Global Vegetation Model (JeDi-DGVM): a diverse approach to representing terrestrial biogeography and biogeochemistry based on plant functional trade-offs" *by* R. Pavlick et al.

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We thank the reviewer for their time and their constructive comments. We are happy to see that the reviewer is enthusiastic about the novelty of the JeDi-DGVM approach. However, we note that some suggestions go beyond the scope of this manuscript and may stimulate future modeling studies.

RC: Reviewer comment, AC: Author comment

RC: This paper summarizes the Jena Diversity DGVM model which takes a unique approach to defining the diversity of plant functional types. The authors describe the model itself followed by the performance of this model within the Carbon Land Model Intercomparison Project (C-LAMP) framework. The concept of self-adapting plant functional types which can trade off performance between traits to represent different plant growth strategies is compelling and should have many interesting applications. Though the authors describe why this approach should capture unique dynamics, I was disappointed to find that no new insight into the earth system or demonstrations of the application of this model to new problems are described in this manuscript. They do mention some possible applications, but do not show any applications here. This manuscript would be improved by a direct demonstration of the unique capability of this model or its improved performance relative to other common models.

The authors describe the model thus: "JeDi-DGVM is a prototype meant to explore the potential utility of a trait-based functional trade-off approach for transitioning the stateof-the-art of global vegetation modelling beyond the limitations of a set of fixed PFTs". Please explore the potential utility of this approach for the readers! The Biodiversity section (4.1) does show a unique capability of JeDi-DGVM, but it is lost in the C-LAMP metrics description. More examples like this would greatly improve this manuscript. Using the C-LAMP protocol the authors compare JeDi-DGVM to two other land models, both land surface models with non-dynamic vegetation. While using the C-LAMP framework shows the authors interest in validating the JeDi-DGVM against observations, the text of the manuscript is largely focused on the metric scores and the comparison of JeDi-DGVM with other land surface models. I suggest

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that the authors condense the description of C-LAMP results, or move some of it to supplementary material. Move the majority of the methods associated with the C-LAMP comparison to supplementary material. It is useful to include for validation, but not sufficient to demonstrate the ability of JeDi-DGVM.

I want to re-emphasize that I think the modeling approach described here is novel, unique, exciting and worth publishing. I hope that the authors can improve the manuscript to demonstrate the unique capabilities of this approach to clearly show it's merit.

We appreciate the reviewer's enthusiasm for the exciting possibilities that the JeDi-DGVM approach opens up. However, what we set out to do in this manuscript is to:

1. Introduce a new and more parsimonious approach to vegetation modelling based on simulating a large-number of randomly-assembled plant growth strategies that are constrained only through functional tradeoffs and environmental selection. Then, aggregating the fluxes and properties of those growth strategies using a simple but well-established 'biomass-ratio' hypothesis
2. Test whether the emergent vegetation properties from this new less-constrained approach are able to reproduce realistic large-scale patterns of terrestrial biogeochemistry and biogeography (e.g. richness).

The fact that JeDi-DGVM is able to reproduce these patterns despite using less input information than PFT-based models (i.e. the growth strategies are randomly assembled and a priori bioclimatic limits are not included) is both 'unique' and an 'improvement' over the state-of-the-art. We feel that this in itself is novel and substantial enough to standalone as a manuscript. We have revised the manuscript throughout to

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emphasize and clarify the specific goals mentioned above.

We have several JeDi-DGVM manuscripts in preparation, including one where we use JeDi-DGVM in its diverse mode and an aggregated PFT-like mode to explore the global patterns of biodiversity-ecosystem functioning relationships. In another, we highlight the differences between projected no-analog climates from GCM simulations and no-analog vegetation compositions that arise in JeDi simulations using the same climate forcings. These are great example of the potential utility of JeDi-DGVM, but we feel they deserve their own treatment in a separate manuscripts and would get lost in the this manuscript, which is already quite long.

To further demonstrate the strengths of the JeDi approach in this manuscript, we are currently preparing an ensemble set of sensitivity simulations in which we vary the numbers of starting growth strategies. Preliminary results show that simulated biogeochemical fluxes/properties generally converge with increasing allowed diversity and the associated C-LAMP scores generally increase. We will include these results in the revised version of the manuscript as soon as they are ready.

RC: The authors mix the description and comparison of dynamic and non-dynamic global vegetation models throughout the manuscript. Non-dynamic land surface models do not allow the distribution of PFTs to change across the land surface. Models in this category include CASA', CN (the two models compared with JeDi-DGVM using the C-LAMP protocol), and many of the models in Friedlingstein et. al. 2006 CMIP4 intercomparison. Clarification of distinction between the two types of models is needed in the text.

AC: We have added a few sentences to clarify this distinction between dynamic and

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non-dynamic models in the revised manuscript. We note, however, that this comparison is valid as the simulations considered in this manuscript are for present-day conditions. Thus, despite having fewer a priori inputs (e.g. no predefined PFT map) the JeDi-DGVM performs similarly to the other two models on nearly all metrics. This only serves to highlight a potential strength of the new approach.

RC: pg 4652, line 3-6: The authors mention that competition for light may be required to accurately represent biomass in the Amazon forest. Further discussion on how light competition is or is not captured by the plant growth strategy approach would be helpful here. The text points to further discussion in seciton 5.3, but light was not addressed directly in that section. In one location or the other, further discussion would be helpful.

pg. 6456-7, section 5.3: This manuscript would beneïňĄt from further discussion, or clarified discussion, of the similarities and differences between the plant growth strategies approach and an approach representing direct competition between plant types/strategies (i.e. Ecosystem Demography or DIVE). In what way are the two approaches redundant and how do they vary?

AC: In a revised version of this manuscript, we have added a paragraph in Sec 5.3 elaborating on the discussion of competition. We specifically attempted to clarify the issues of light competition and how the simple JeDi-DGVM 'biomass-ratio' approach to competition differs from more direct representations of competition (e.g. ED or DIVE).

RC: pg 4629, line 11: see also a review by Levis 2010, Wiley Interdisciplinary Reviews: Climate Change

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AC: We have included a reference to Levis (2010) in the revised manuscript.

RC: pg 4647 line 21, I would prefer if this line read "data-driven model estimates", as the Beer et al. global map of GPP estimates is derived from a statistical model and is not data.

AC: We have adapted the description as suggested.

RC: pg 4650, line 26-28: This is disputed by Angert et al. 2004 and may not point out a deficiency in JeDi-DGVM.

AC: We have pointed out the on-going controversy regarding the cause of the post-Pinatubo drawdown in the revised manuscript. We also note that regardless of the origin of the drawdown, this is a deficiency of JeDi-DGVM which requires further study.

RC: pg 4651, line 3: "yr" should be spelled out

AC: We have corrected this in our revised version of the manuscript.

RC: pg 4655, line 16: see also Loarie et al., 2009, Nature.

AC: We thank the reviewer for pointing out this paper and have added a reference to it in the revised manuscript.

Interactive comment on Biogeosciences Discuss., 9, 4627, 2012.