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Biogeosciences
Discussions

Interactive comment on "Accounting for spatial variation in vegetation properties improves simulations of Amazon forest biomass and productivity in a global vegetation model" *by* A. D. de Almeida Castanho et al.

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Authors Reply to Anonymous Referee #1

We thank the referee for the motivating words in stressing the strong contribution of this paper for the tropical ecosystem modeling. The major concern of the referee regarding the maintenance of the prognostic nature of DGVMs is of great importance and a discussion about it is included in the final section of the paper. We also thank the referee for the minor points raised and overall contribution and time spent on reviewing this

work.

Anonymous Referee #1 Main concern. With such an approach a concern is on how to retain the 'prognostic' nature of DGVMs while making regional improvements that depend on field-based parameterization? Arguably, the improvement to the model shown here constrains the model's application to the contemporary time period (i.e., soil phosphorous concentrations will change over time), and to regions where detailed information on allometry exists from intensively measured field plots. However, the authors address these concerns with a call for more specific research in the tropics and by identifying future tasks for ecophysiological research to improve models using first-order processes rather than diagnostic inputs.

Authors Reply: Yes the referee's concern is relevant and a paragraph discussing this issue is included in the revised manuscript in the Discussion section. The model still retains its prognostic ability to simulate plant functional type (PFT) composition within Amazonia and everywhere else outside the basin. The model predicts within the Amazonia region one dominant PFT (Tropical Broadleaf Evergreen Trees). We introduce a spatially varying parameterization of forest dynamics (e.g. turnover time) and physiology (e.g. Vcmax) for this dominant PFT instead of a fixed one, as in the original version. Remembering that for outside the basing the model works exactly as it was originally with PFT with fixed properties. But we agree with the referee that even this second step on prescribing the spatial variability of the Amazonian forest heterogeneity or any other Tropical forest should be dynamic, and predicted by the model, and not prescribed as we did. But this step would only be defensible if the processes that drive the variability were well known and could so be implemented in the model. Unfortunately, this is not the case yet.

(P. 11793, L. 24): "The result of this work is to incrementally improve the numerical modeling of tropical forest. It identifies the most important and relevant parameters for the simulation of C fluxes and stocks by a DGVM. It also shows the importance of good spatial and temporal representation of these parameters for tropical ecosystem

modeling. It is to be expected that field-based spatial parameterization gives a higher present-day accuracy of carbon simulation variability across the Amazon Basin. We also hope to motivate future work that advances knowledge of the processes that drive the spatial and or temporal variability of biophysical parameters. The next step is to make the model more dynamic and to improve PFT description so that they better characterize the functional diversity of tropical forests. Fyllas et al., (2012) numerically derive different PFTs for Amazonia by jointly analyzing an Amazon-wide dataset of (409) species abundance, species functional traits (10) and site edaphic and climatic conditions across 53 plots. We propose that the Amazonian tropical forest can still be represented by a single PFT however it can no longer be static as in the past but a new concept of Dynamic Plant Functional Type has to be defined. We propose that the PFT parameters should be dynamic and defined as a function of climate and/or edaphic properties. This way the prognostic ability of the model is improved in its spatial and temporal scale, once climate and edaphic properties are given. The first question that has to be answered is: How do climate and/or edaphic properties modulate the observed spatial variability for Vcmax, residence time, and carbon allocation? Some work has already been done in this way. For example, Mercado et al., 2011 used an ecosystem canopy-scale photosynthesis model equation (Domingues et al., 2010) where they implemented P limitation into the main photosynthetic parameters. There is not a straightforward way to represent the spatial variation of residence time or carbon allocation but new insights into these processes have recently been gleaned and may form the basis of further model development (Quesada et al. 2012, Aragao et al. 2009)."

Anonymous Referee #1 Minor points 1. The phosphorous analysis and the estimation of Vcmax should point out the difference between total soil P and the labile P pool. In Quesada et al 2012, the authors find the highest correlation with total P and woody NPP despite a large fraction of total P not being available for plant uptake. There is large uncertainty with tropical P cycling that should be commented within this study by clarifying the different P pools in the soil.

2. Subtitles in the Methods would be helpful for the reader to transition from the NPPw to Vcmax to turnover modifications.

3. Typo in Fig 1 'sensu stricto'

4. Figure axis font needs to be larger

Authors Reply 1. We agree that there is a large uncertainty in our knowledge of tropical P cycling and that there are clear differences between the total P and the labile P pools in soil. The relationship between total P and the Labile P pools is not linear and could depend on external factors as soil texture for example and it still not well defined. However the estimate we present in the paper is focused on a large scale variability of P in soil where total P varies from 50 -500 mg/Kg. We argue that the P components correlate to P in leaves, that would be the P related to the Vcmax. We agree that a detailed relationship would be important for more specific analyses however not for the resolution of the P map we are suggesting this work. We thank the reviewer for bringing up this important issue and we included the following paragraph to better address this concern:

(P. 11775, L. 23): "The relationship between total P and the Labile P pools is not linear and could depend on external factors as soil texture for example and it still not well defined. However the P map estimate we present in the paper is focused on a large scale variability of P in soil where total P varies from 50 -500 mg/Kg. The total soil P correlate significantly (r2 0.65, $p<0.005$) to P in leaves that is P related to the Vcmax. "

2. Subtitle is included in the Methods section in the final version for a better comprehension for the readers.

3. Thanks for noticing the typo – that was corrected.

4. Figure axis font was increased for figures Fig 2,3,7,9

Interactive comment on Biogeosciences Discuss., 9, 11767, 2012.