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***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.***

**Anonymous Referee #1**

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**Summary**

The manuscript by de Almeida Castanho et al. tests the IBIS dynamic global vegetation model for several improvements made for carbon fluxes and stocks simulated over Amazonia. One of the main findings in recent years is the occurrence of a strong carbon gradient as one moves from eastern (low-NPP and high biomass) to western Amazonia (high-NPP and low biomass). The presence of this gradient has been partly explained by soil nutrients (in particular, P is high in W Amazonia) and turnover, which is also higher in W Amazonia. Global carbon cycle models generally do not include

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soil nutrients, or biome-scale parameterizations for carbon allocation, and so this paper re-parameterizes IBIS based on tropical plot-level data to test the role of site-level and spatially varying modifications for (1) turnover, (2)  $V_{cmax}$ , and (3) NPP-woody allocation on simulated carbon fluxes and stocks.

The large improvements made by the model using the variable parameterization highlights several existing model deficiencies and suggests areas for future research where model development should be focused. It is likely that the results from this publication are applicable to other DGVM models and the paper makes a strong contribution to tropical ecosystem modeling.

#### 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.

#### Minor points

1. The phosphorous analysis and the estimation of  $V_{cmax}$  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

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to Vcmax to turnover modifications.

3. Typo in Fig 1 'sensu stricto'

4. Figure axis font needs to be larger

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**BGD**

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