Biogeosciences Discussions

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Comment on bg-2022-87

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Referee comment on "Modelling the impact of wood density dependent tree mortality on the spatial distribution of Amazonian vegetation carbon" by Mathilda Hancock et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-87-RC1, 2022

This is a very well-written paper on a topic that should be of wide-interest across biogeosciences discussions. The authors included the tree mortality rate through the wood density-mortality relationship as a predictor of the carbon distribution of vegetation in the Amazon. Different dynamic global vegetation models (DGVMs) and four different mortality equations were used to compare with the standard models, which assume homogeneous mortality rates throughout the Amazon basin. This approach brought important improvements in the representation of the spatial dynamics of Carbon in the vegetation of the Amazon, showing a greater correlation between the model with variable mortality and the observed biomass.

Wood density is an important trait in the determination of mortality, and it is relatively easy to obtain, but even so, it does not fully represent the mortality patterns of trees. This is demonstrated by the low variation of the mortality data estimated in this paper, in relation to the actual values â□□â□□observed. Although there is a well-known relationship between wood density and mortality rate, we know that tree mortality results from the interaction between extrinsic environmental conditions, such as climate and other tree ecological traits. Local soil conditions, topography, occurrence of lightning, drought, fire and other environmental and climatic factors also affect mortality patterns, making prediction for such a heterogeneous Amazon basin difficult (e.g. New Phytologist (2019) doi: 10.1111/nph. 16260). As well as extrinsic conditions affect mortality rates, other functional traits also play a key role in determining mortality rates across the basin, such as the phenological behavior of species (e.g. Nat. Clim. Chang. (2019) https: //doi.org/10.1038/s41558-019-0458-0). These factors add even more complexity to the modeling of mortality, making this variable difficult to represent in DGVMs.

Likewise, mortality is an important process that determines the stock of biomass in Amazonian forests, but it is not sufficient by itself to explain the distribution of vegetation along the basin.

Despite these challenges, the authors did a great job of testing different mortality models and equations, carefully explaining the effects that each variable had on biomass estimates. It is an important advance that can be very useful when applied to the science of climate change and effects on Amazonian biomass. The methodology used opens the way for the use of other traits (such as phenology) in mortality estimates, as well as the use of processes other than mortality in modeling the spatial distribution of Amazon Carbon.

The article brings a detailed and very rich discussion about the main points of interest of the scientific community, increasing even more the importance of this manuscript. The methods are presented very clearly, despite the complexity of the subject. It also shows where there are some data gaps where researchers should focus efforts to increase our ability to understand the carbon dynamics of this important Amazon forest ecosystem.

Combining mortality variations as a result of wood density is a path that proved to be very useful and easy to implement to improve biomass stock estimates, although it needs special care in obtaining data and equations used.