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Biogeosciences Discussions

Interactive comment on "Sensitivity of woody carbon stocks to bark investment strategy in Neotropical savannas and forests" *by* Anna T. Trugman et al.

Anonymous Referee #2

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Bark thickness can protect trees against fire damage and mortality. This feature is particularly important for survival in fire driven ecosystems such as savannas. Most dynamic vegetation models do, however, not consider tree plant functional types with variable bark thickness and hence with different levels of resistance against fire. In this study, bark thickness is considered in the ED2 vegetation model to describe fire survivorship and it is explored how the introduction of more fire tolerant trees influences vegetation dynamics in neotropical forests and savannas. The authors argue that including fire tolerant trees improves agreement with empirical data and that it can increase the areas where savannas can occur.

The manuscript investigates and interesting and important question and it may contribute to our understanding of the distribution of savannas and how we can better model savannas. The manuscript is generally well written and formulates hypotheses that are then tested by model simulations.

I have some comments concerning the results. Generally I think that statistical test should be conducted to quantify agreement with data and differences between model runs. I am for example not convinced that in Fig 2a, the "Bark" simulations are better than the "No Bark" simulations. Maximum dbh of with bark simulations is higher than in the no bark simulations but differences in means are not visible in the panel. Histograms for the dbh or height distribution might be more illustrative than box plots.

Fig. 4 suggests that there are more or less no small trees in with bark simulations while we often find many small trees in savannas due to the high re-sprouting rates. This biomass distribution suggests that re-sprouting and recruitment are not possible (re-sprouting is not included in the model and is identified as a limitation in the discussion) but I assume that it would strongly influence small tree numbers. I wonder how stable this vegetation state is: if simulations were continued and all tall trees die, would the simulated vegetation converge to a grassland without any trees because regrowth is not possible?

Most analyses investigate vegetation in response to variable frequency while timing or intensity are not considered. Yet, these variables strongly influence vegetation responses to fire.

It is stated in l. 60 that "DGVMs are still unable to fully capture global savanna extent". It would be very interesting to see how the updated model version influences the savanna distribution at larger spatial scales both in comparison to the original model version and to other DGVMs. I think this is not the scope of this study, nonetheless this point could be mentioned in the discussion.

Further comments:

l. 53: "Slower growth rates result in a population of smaller trees with relatively thinner bark“ I would argue that bark thickness is not relevant for small trees anyway because they are in the flame zone and damaged by each fire. The capacity to regrow after fire might be more important. Bark thickness is mainly important for tall trees that managed to escape flame height.

l. 62: suggest to reword to "carbon storage in the tropics“

l. 106: Please check table, I can’t find definition of beta in Table 1.

l. 195: I suggest to make clear that the tree MAP levels are sites along the rainfall gradient.

l. 217: Fig 2a instead of 1a?

l. 521: Fig 3 shows biomass but the caption says "woody carbon“. Please check text for consistency.

Fig 5: I suggest to replace the current color legend with a legend showing color and the associated fire return interval. Also I suggest to use a consistent notation: fire interval or fire frequency.

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