

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

Anna T. Trugman et al.

a.trugman@utah.edu

Received and published: 11 October 2017

→ We thank Referee 2 for the helpful feedback and suggestions on our manuscript. Our responses are listed below along with corresponding changes that we will make to the text once the discussion period ends. We invite further dialogue if anything is unclear or if more explanation is required.

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

C1

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 an 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.

→ We will experiment with plotting model evaluations as histograms and quantify the skew of distributions for each bark and no bark simulations to illustrate the differences in model performance.

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 (resprouting 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?

→ First, as a clarification, the minimum tree size in all figures should read

C2

2cm<dbh<8cm, as we excluded trees smaller than 2cm dbh in our modeling results because trees smaller than 2cm were not surveyed in our observational comparisons. We apologize for not making this clear and will do so in the revision. The biomass fraction of small trees is not illustrative of the number frequency of small trees, as small tree biomass comprises a very small fraction compared to the large trees, so it is not necessarily the case that small trees are not present in the bark simulations. We will add additional figures showing the number count of trees by size class to better illustrate the demographic processes based on this confusion and a suggestion from Reviewer 1.

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.

→ We include variable fire intensity/probability of mortality dependent on grass biomass (line 131) in the model simulations. We will further experiment with including results for how variable fire intensity affects tree mortality.

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.

→ We will update the manuscript to include in the discussion about capturing savanna extent on larger spatial scales.

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

C3

might be more important. Bark thickness is mainly important for tall trees that managed to escape flame height.

→ Bark thickness could be relevant to smaller trees in that it could slow growth and prolonged the period during which trees are more susceptible to fire, depending on environmental conditions. Additionally, bark thickness might influence the threshold at which a tree could be considered large enough to no longer be susceptible to fire.

l. 62: suggest to reword to "carbon storage in the tropics" l. 106:

→ We will reword according to your suggestion.

Please check table, I can't find definition of beta in Table 1. → We will remove the reference to Table 1, as beta is defined in the main text in line 106-110. We apologize for this stray reference from a previous draft.

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

→ We will clarify this in the main text.

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

→ We will update the reference to 2a.

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

→ We will update 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.

→ We will consistently use fire frequency in the text.

C4

