

Interactive comment on “Tropical climate-vegetation-fire relationships: multivariate evaluation of the land surface model JSBACH” by Gitta Lasslop et al.

Anonymous Referee #1

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General Comments:

Reviewer summary: The manuscript presents results from multi-variate comparisons between a simple fire model and complex fire model within JSBACH against those of remote sensing datasets for tree cover, grass cover, and burned fraction for regions within the tropics. The work finds that the resolution of the remote sensing datasets is important for setting precipitation limits on tree cover and burned fraction classifications. The fire models capture broad spatial patterns, but overall the complex fire model has improved performance. The analysis was completed for continental subsets and with and without preindustrial land use. Given the results the authors suggest

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improving the drought response of vegetation, including more complex bark thickness for trees, and a representation of size-structure. The multi-variate analysis used here better identifies model-data mismatches to model processes.

Article contribution and overall impact: This study highlights the challenges of simulation of vegetation-fire interactions across the tropics. Strong climate vegetation relationships and a closely interacting fire regime make the vegetation state of this region difficult to simulate. The manuscript does a good job of presenting the challenges of capturing vegetation and fire in the tropics with simulation and with remote sensing datasets. The discussion would benefit from a more detailed description of the connections between recommended improvements and deficiencies of the simulations, as well as inclusion of more references. Please update the discussion to include a reference back to the figure or table being discussed (some of these are highlighted in detail comments). Specifically, more detailed discussion of size-structure and its importance as a mechanism for tree survival in fire prone regions should be included. A key component of the mortality of woody vegetation to fire is its size at the time of fire and the ability to accumulate size between fires. This is central to the work of many of W. Hoffman's papers in the region (Hoffman et al 2003, Hoffman et al 2009, Hoffman et al 2012). This type of work should be referenced as well as important differences between the continents in terms of vegetation survival from fire.

Detailed comments:

Page 6 line 15: Are burned area and burned fraction the same?

Page 7 line 12: "stronger relationship between low tree cover and high fire occurrence than observations" Explain this in more detail. By what measure and for which figure/table?

Page 9 line 6: Why use the preindustrial land use? The observation datasets are for the period of 1996-2005.

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Page 10 line 4: Update “We here discuss. . .” to “Here we discuss. . .”

Page 10 line 7: Clarify that improvements in the SPITFIRE version cannot improve this mismatch. The standard version does not capture the observations as shown in figure 3.

Page 11 line 3: update “too high tree cover” to “excessive tree cover”

Page 11 line 5: update “too high dominance” to “excessive dominance”

Page 11 line 6-7: Explain how saplings being inferior to grasses would improve the representation of tree-grass competition? How would these saplings alter the resulting tree cover in areas where grasses exist? Are there processes in the model that would need to be added to include grass suppression of saplings?

Page 11 line 8-9: Include the figure that this relationship is referring to “higher burned fraction and lower tree cover for open canopies, however it is not found in the observations.” Is this for figure 4? Also specify for what regions, as they are not consistent.

Page 12 line 1: Explain how increased bark thickness would be implemented in the model. Include discussion of the relationship between bark thickness and size-structure of trees, and species or regional variability in bark thickness characteristics, and how this might be accounted for in the model.

Page 12 line 4: “This feedback is included. . .but might be too weak.” Support this statement with more detail. What information indicates that the feedback is too weak? Is this true for all regions? Which figures lead to this assertion?

Page 12 line 5-6: “. . .long-lived adult tree state could increase the survival of trees.” How long do trees live in JSBACH? Provide some background on existing parameterization of tree life span and mortality mechanisms to support this statement. Include discussion of Hoffman’s work on the ‘fire-trap’ within savanna systems.

Page 12 line 7: “For Australia. . .for both fire models is strong.” Include the figure this is

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referencing. Figure 4?

Page 13 line 3: Update to “The rank correlation...compared to model outputs (Table 1).” Include the reference to Table 1.

Page 13 -14 line 1: “adapts to changes in climate with usually PFT specific time scales.” What does this mean? Are there variable PFT longevity within simulation?

Page 14 line 1-2: Include references to examples of DGVMs which include human dimensions.

Page 14 line 2: “. . .population density is a commonly used driver.” Driver of what? Ignitions? Land use change? Please clarify.

Page 14 line 3: Start a new paragraph with the sentence beginning “Our model simulations. . .” and update this sentence to “Our model simulations also show that the modelled climate. . .”

Page 14 line 6: Update sentence to “. . .not affected by land use or by the type of fire model. . .”

Page 14 line 7: “. . .seasonality that is not resolved by the mean annual precipitation.” The model has no seasonal variation in precipitation and is only using MAP? Please clarify.

Page 14 line 8-13: Include discussion of how the results differ due to the use of only preindustrial land use. Qualify the text in this section to clarify that the JSBACH simulations use preindustrial land use and these products use recent land use (Andela et al 2017 uses the past 18 years). Explain why the comparison is still valid.

Page 14 line 12: “The mechanism behind the reduction due to croplands. . .” Reduction of what? Fire occurrence? Please clarify.

Page 14 line 13: “. . .fragmentation of the landscape, which is not explicitly accounted for in the model.” Include discussion of how fragmentation affects forests in reality, and

how this may be a challenge for models such as JSBACH. Is this an area for potential improvement?

Page 14 line 17: "...spatially varying ignitions." Do ignitions vary temporally?

Page 14 line 18: "...these differences in ignitions..." Differences between what? One is not spatially varied ignitions? Please clarify.

Page 14 line 32-33: Add at the end of the sentence what the values are for the satellite datasets. It is not possible to read them from the figures to compare to this measure of 100 mm and >650 mm per year.

Page 15 line 6-7: "...spatial scale needs to be considered..." Add discussion on how increased spatial scale (finer resolution) might improve the model results. Why not perform simulation at 1km similar to the Hirota dataset? Should simulation be finer than 1km? How small of a resolution can you achieve before you see compromised results for simulation?

Page 15 line 11-12: Are there plans to compare to biomass datasets? Identify potential datasets.

Page 15 line 26-28: "The multivariate comparison helped to..." Re-word this sentence. It is not clear what is meant by "too strong effect of fire on tree cover". Split into two sentences to identify problems, and then another to suggest improvements. Clarify where and how increased bark thickness can be included.

Page 15 -16 line 1: "although known variations in vegetation characteristics are not represented in models..." Provide a brief description of what is not represented? Bark thickness variability, size-structure? Consider adding a stronger concluding sentence to identify how these improvements will be helpful to models.

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