

Interactive comment on “Fire-regime variability impacts forest carbon dynamics for centuries to millennia” by Tara W. Hudiburg et al.

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Response to Rev. 3 General comments. . . Globally, the text is clearly written, the scientific context and knowledge gaps are clearly exposed as the problematic and the general hypothesis. Also, the questions addressed here are very pertinent. That said, I advise the authors to follow previous comments and advises from SC1, RC1 and RC2. Moreover, a more deeper review of fire ecology with respect to carbon cycling could: i) help to better understand the choice of DayCent for this study; ii) bring a more critical interpretation/discussion of the processes you mentioned (line 99-100) linked in DayCent model and improve the interpretation and discussion of the results.

Response: We thank you for the careful review and suggestions. Please see our specific comments below for our planned improvements.

C1

I also noted several improvement possibilities (see also Technical corrections): 1/ Structure: Mixing results and discussion is sometimes confusing (especially for section 3.4). Because section 3.1 to 3.3 are not full discussions but rather descriptions and comparisons between your model estimates with values of other studies, it should not will be difficult to separate results and discussion. For example, discussion could contain a section on the limits, a section with the implications for projecting future ecosystem states and another for research development needs.

Response: We will consider revising the structure to separate the results and discussion based on the final revised manuscript. Because of what we address from the first 3 reviewer comments, the structure and text has changed enough that doing these structural improvements may no longer be straight forward.

2/Hypotheses: Based on Kelly et al. (2016), the general hypothesis assuming forest carbon budget modeling would be different between equilibrium runs and paleo-informed runs is explicit. Nevertheless, the alternative hypotheses that you mentioned (line 103) and results that were “expected” (line 301) are not explicitly described. You could add these hypotheses in the introduction.

Response: Thank you for pointing this out. We will add hypotheses (explicitly) to the introduction.

3/ Model parameterization: According to SC1, DayCent is quite well described. Unfortunately, I was not able to access the model input and parameterization file. While it is clear that you informed the model with paleo-fire reconstruction from Dunette et al. (2014), it is less clear what you do with the vegetation data. You wrote that you “pair a paleoecological record of vegetation and wildfire activity” (line 98) and that DayCent requires input of vegetation cover (line 145), but no information is provided on vegetation in section 2.3. It would be important to get more details.

Response: The comments here are in agreement with Rev 2, and we realize details need to be expanded regarding the simulations. We will add the details (note that the

C2

'vegetation' did not change at this site per the record). We plan to post the DayCent input files on Dryad, however, this is not allowed until publication.

Specific comments 10. Is the overall presentation well structured and clear? Yes, but could be improved (see General comments). 11. Is the language fluent and precise? Yes. 12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes, but see SC1 comments for [date] CE.

Response: We will clarify this.

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Yes. Values for equilibrium scenario should appear in Figure 3 or equilibrium scenario should be removed in lines 301-305. As the Chickaree Lake watershed is the object of this study, some characteristics such as the watershed size and topography (slope characteristics) could be mentioned. Moreover, you defined 8 partial paleo-informed scenarios but only 4 are represented in Figure 1. To facilitate the reading, I suggest to represent all partial paleo-informed scenarios in Figure 1 or you can specify that you show only 4 on the 8 scenarios in the figure caption.

Response: We will improve the figures and text as suggested, especially the watershed description.

Technical corrections Line48: should read "greater than simulated under an equilibrium and climate warming scenarios"? Response: We will fix this.

Line 71: NECB appears for the first time here but is defined at lines 162 163. Response: This will be addressed.

Line 103: the "alternative hypotheses" are not clearly exposed and should appear here. Response: As noted above, we will add the hypotheses.

Line 112-114: should be in the Discussion or Conclusion section. Response: We agree.

C3

Line 117: same comment as SC1 Line 125: should read "Dunette et al. (2014)" Line 125-127: the sample resolution of the core results from the chronology based on 14C dates. I suggest to reorder the sentence. Line 129: should read "Dunette et al. (2014)" Line 160: autotrophic respiration is accounting in NPP yet. Response: We will revise based on the suggestions above.

Line163: how are emissions are calculated in the model? Response: We will add text to clarify this. Basically, the fire is parameterized by pool (woody, litter, coarse wood, live or dead C) to combust a fraction of each pool based on the fire 'severity'.

Line234: what is STATSGO?

Response: The definition and a general description of the database will be added (USDA soils database from the Natural Resource Conservation Service).

Line252: should read "Figure2" instead of "Figure1". Line275: should read "Kelly et al. (2016)". Line275: should read "Together, this work and ours". Line 280: it is not clear what the equilibrium scenario is doing here. Line 286: can you justify the threshold of 1 Mg C ha⁻¹? Response: Again, thank you for the careful reading! We'll address the corrections, clarify what equilibrium is doing and, yes, we can justify the threshold based on previous work and what we consider to be stable soil C.

Line 296: should read "stand-replacing". Line 303: "lower" compared with equilibrium or paleo-informed scenario? Line 301: "As expected" refers to a hypothesis? I think you should present this hypothesis in the introduction. Line 301-305: you mention the equilibrium scenario in your comparison and refer to the Figure 3, but values for the equilibrium scenario don't appear in this figure. Response: As noted above, we will add/change the hypotheses in the introduction as suggested and address the equilibrium missing values.

Finally, I recognize the great potential of this paper and the important gap it helps to fill in the carbon cycling-related fire history knowledge. I am happy to see that

C4

such research is unfolding and I advise the authors to consider previous comments to improve their manuscript.

Response: Thank you!

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