

Dear two anonymous reviewers,

We greatly appreciate your constructive comments to improve our manuscript. A point-by-point reply to the comments is as follows.

[Reviewer 1]

- 1) Mention in the abstract that the simulations are performed without dynamic vegetation response and are uncoupled from the climate.

Reply: We have added “with prescribed vegetation cover and uncoupled from atmospheric model” in the abstract.

- 2) In the methods, explicitly state that the vegetation is not dynamic. Presently one has to read almost until the end to be made aware that the simulations use prescribed vegetation cover.

Reply: In the first paragraph of sect. 2.2.1, “with prescribed vegetation cover and uncoupled from atmospheric model” has been added.

- 3) Abstract - Confusing at times, it could use some smoothing out, as could other parts of the manuscript.

Reply: Done.

- 4) Section 2.1 - More information is needed to help the reader understand how fire affects vegetation mortality, transfer to litter and soil C pools, etc. Give numbers to how these processes are parameterized. The description of the fire model is almost absent. I do realize that this is a companion paper, but some information is warranted. I also understand that much of the model is described in previous publications of Li and coworkers, but it would helpful to have some parameters given here that are important for determination of the fire direct vs. indirect effect. Readers should not have to sift through a dozen CLM publications to piece together how model parameterizations could influence the reported results.

Reply: We have added a paragraph (para. 3 in Sect. 2.1) to describe the fire model. In addition, a table of the PFT-dependent parameters related to biomass burning, vegetation mortality, and fire-induced C transfer has been added in the supplement (Table S1).

- 5) p. 17314 l.23 - The description on maintenance respiration is too vague. Please add in more detail.

Reply: “...maintenance respiration of live vegetation tissues” has been changed to “...metabolic costs for live leaves, stems, and roots (i.e. maintenance respiration).”

6) p. 17315 l. 18 paragraph - This might be useful to CLM users, but it is rather opaque otherwise, consider revising for clarity for people who do not use the model.

Reply: this paragraph is about the debugging of CLM4.5 fire code and just useful for CLM4.5 users. We put it here to make the description of model platform more strictly. We have added “The revised fire code can be obtained from us for free” at the end of this paragraph. Readers without CLM4.5 background may be difficult to understand the paragraph and can skip it.

7) p. 17317 l. 18 - This makes it seem like they use the model generated CO₂ and not observed, is that correct?

Reply: This sentence has been changed to “The prescribed 1850–2004 annual CO₂ and monthly 1.9° (lat) × 2.5° (lon) nitrogen and aerosol deposition are provided with CESM1.2, where the CO₂ comes from observations, and the nitrogen and aerosol deposition come from simulations with the CESM atmospheric chemistry and transport model (Hurrel et al., 2013).” to avoid confusion. The new ref (Hurrel et al., 2013) has also been added in the reference list.

8) p. 17323 l. 15 - Was NBP defined earlier?

Reply: The “NBP” has been changed to “net biomass productivity”.

9) p. 17324 l. 5 - Keep in mind that GFED emissions are a modeled result too.

Reply: We have changed the sentence to “Ward et al. (2012) pointed out that they underestimated the global fire carbon emissions mainly due to the simulation bias in Northern Hemisphere tropical fires. Mouillet et al. (2006) estimated ~3.0 Pg C yr⁻¹ of global fire carbon emissions at the end of the 20th century, which was much higher than GFED3 (~2.0 Pg C yr⁻¹).”

10) p. 17324 l. 15 - Why is CLM4 relevant? All model results presented here are for CLM4.5 are they not?

Reply: this sentence has been removed.

12) p. 17324 l. 17 - 23 - Confusing. Missing a closing parenthesis?

Reply: we have broken this sentence into two sentences: “The weak long-term trend ...from Mouillet et al. (2006). It is also in the range of....2013).” to

improve readability.

13) p. 17324 l. 21 - Prentice et al. 2010 is not in references, what paper is this referring to?

Reply: this reference has been added.

14) Fig 2 - Can the Fire-on - Fire-off label be changed? I found myself looking for a narrow black line before realizing that it was meant to be minus symbol.

Reply: all “Fire-on – Fire-off” in figures and Tables, their captions, and text have been changed to “Fire-on minus Fire-off”.

[Reviewer 2]

1) I agree with referee #1 that the changing land-use/land cover imposed to the model is partly the result of historical fires, so that the model has some indirect effect of fires even in fire-off simulations. There is no good solution to that problem but the authors should mention it.

Reply: we have added “In the present study, the prescribed changing land-use/land cover used in both simulations is partly the result of historical fires, so that the effect of fires is not totally excluded in the fire-off simulation.” In para.3 of the last section.

2) Discussion of Fig 1. (a) and 4. (a). Both figures show 2 oscillations between 1900 and 1970. I assume these are the result of the cycling of the 1948-1972 atmospheric forcing. Am I right? This should be explained in discussing both figures. In Fig 4.(a).the trend after 1970 does not seem larger than the previous 2 cycles. It seems mainly the result of 2 years before the last. Is this trend significant?

Reply: Yes, you are right. We have added “The 25-year cycles shown in the simulated global burned area before ~1970 are due to the cycling of the 1948-1972 atmospheric forcing.” and “The 25-year cycles shown in the simulated global fire carbon emissions before ~1970 are due to the cycling of the 1948-1972 atmospheric forcing.” in the description of Fig 1. (a) (i.e. sect. 2.4) and Fig. 4. (a) (Sect. 3.2.1).

Yes, the trend after 1970 in Fig. 4a is significant at the 0.05 level. In the description of Fig. 4a (Para. 2 of Sect. 3.2.1), we have added “(at the 0.05 level)” after the word “significant” to make it clearer.

3) p17321 l 25: I believe it should be “followed by” instead of “following”

Reply: It has been changed to “followed by”

3) The authors should replace "Fire-on - Fire-off" by "Fire-on minus Fire-off" or another name in the captions of all the figures and in the Tables. This was very confusing to me, especially in the figures.

Reply: all "Fire-on – Fire-off" in figures and Tables, their captions, and text have been changed to "Fire-on minus Fire-off".