Response Letter

Editor:

Public justification (visible to the public if the article is accepted and published):

Thank you for your revisions so far. I have a few more requests that I can review myself before acceptance:

- My question about land use areas was specifically about land *use*. Did your spinup include cropland or no?

>> Yes, the spinup included the cropland. We have added this in the revised manuscript.

L148: *Because starting a new simulation at a different spatial resolution could introduce model artifacts, we ran CLM5-BGC at a 0.5°× 0.5 °spatial resolution from the initial state, including the land use, such as cropland, for 200 years for the equilibration with repeatedly using Climate Research Unit (CRU) – National Centers for Environmental Prediction (NCEP) reanalysis climate data for 1980-2000.*

- Please replace citations of equations in CLM Technical Description with their equivalent citations from Li et al. (2012, Biogeosciences: https://bg.copernicus.org/articles/9/2761/2012/)

>> As per editor's suggestion, we have replaced the citation in the revised manuscript.

L93: *The PFT-level carbon emission from the fire is calculated as follows (Li et al., 2012):*

L102: *In CLM5-BGC, the amount of leaf carbon to litter (**Ψ**) caused by fire is calculated as follows (Li et al., 2012):*

L149-154, "spinup" section:

- It's confusing to refer to this as a "spinup", as you saw with one of the reviewers. Maybe "equilibration" would be better? It would help to mention that the year-2000 initial conditions

are the result of a complete spinup.

- "was repeatedly run for 200 years" implies some number of 200-year runs. I think "repeatedly" refers to the repetition of the 1980-2000 climate forcing (which is actually 21 years, not 20).

>> As per editor's suggestion, we have used "equilibration" and clarified the data period in the revised manuscript.

L148: *Because starting a new simulation at a different spatial resolution could introduce model artifacts, we ran CLM5-BGC at a 0.5°× 0.5 °spatial resolution from the initial state, including the land use, such as cropland, for 200 years for the equilibration with repeatedly using Climate Research Unit (CRU) – National Centers for Environmental Prediction (NCEP) reanalysis climate data for 1980-2000.*

- Despite the text in this paragraph, Figure 2 doesn't appear to have anything to do with the spinup. In fact, Figure 2 is generally confusing. Why are arrows leading from atmospheric forcing and surface condition to GFED4 burned area, implying those are somehow inputs in your workflow to GFED4?

>> We have revised the Figure 2 to clearly describe the different experiments of this study.

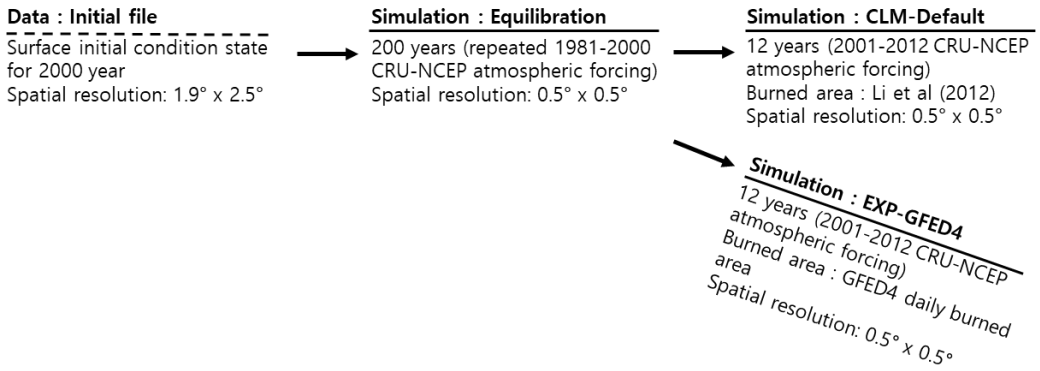

Figure 1. Flow diagram for CLM-Default and EXP-GFED4.

- This paragraph should mention the time period of your experimental runs.

- Suggested rewrite of this part of the text: "Our simulations started with a pre-existing initial

condition state for 2000 at XXX resolution. Because starting a new run at our 0.5° resolution could introduce model artifacts, we ran CLM-Default from this state for 200 years using repeated YYYY–ZZZZ CRU-NCEP forcing data before starting our experiments with transient 2000-2012 climate."

>> As editor's suggestion, we have revised the paragraph for the experimental design with correcting the data period.

L144: *Figure 2 shows the experimental process of this study. Our simulations started with a pre-existing initial condition state for the year 2000 at a 1.9° × 2.5° spatial resolution provided by NCAR. Because starting a new simulation at a different spatial resolution could introduce model artifacts, we ran CLM5-BGC at a 0.5°× 0.5° spatial resolution from the initial state, including the land use, such as cropland, for 200 years for the equilibration with repeatedly using Climate Research Unit (CRU) – National Centers for Environmental Prediction (NCEP) reanalysis climate data for 1980-2000. Then, CLM-Default and EXP-GFED4 were simulated for 12 years (2001-2012) at the 0.5° × 0.5° spatial resolution using CRU-NCEP atmospheric forcing, which include precipitation, temperature, wind speed, surface pressure, specific humidity, longwave radiation, and solar radiation.*

L205-9 and the related Fig. 4 still need some rework:

- "The number of grid cells... in CLM-Default where the burned areas exceeded 0.1 ha in 2004 was more than 50." This should be GFED4 instead of CLM Default.

>> We have corrected the number from 0.1 to 0.01 Mha and replaced "CLM Default" with "GFED4" in the revised manuscript.

- "In contrast to the GFED4 burned areas" should just be "In contrast"

>> We have corrected it in the revised manuscript.

Fig. 4:

- It seems like some gridcells exceed the highest value in the colorbars. This should be indicated on the colorbars with a dark triangle at the top and/or a ≥ symbol in front of 0.01.

- Yellow on white is very hard to see. Please use a different color scale, or consider a gray background to this figure.

>>As editor's suggestion, we have added the ≥ symbol and changed the background color to gray in Figure 4.

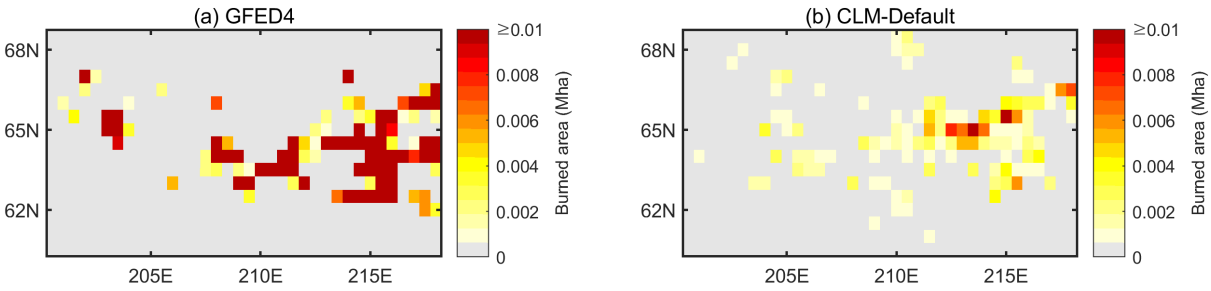

Figure 2. Spatial distribution of burned area of (a) GFED4 (b) and CLM-Default in 2004 over Alaska.

GFED4, global fire emission database (version 4); CLM-Default, default CLM5-BGC simulation

Minor comments:

- Throughout: Replace "leaf size" with "leaf area"

>> We have corrected them in the revised manuscript.

- Figures:

- "OL" still in Fig. 4 and captions of Figs. 3 and 9. Replace with CLM Default.

>> We have corrected them in the revised manuscript.

- Please consider adding

- L13: Rename "open-loop" to match rest of manuscript

>> We have corrected them in the revised manuscript.

L12: *The results showed that the simulated carbon emissions with burned areas from GFED4 (i.e., experimental run) were significantly improved in comparison to the default CLM5-BGC simulation, which resulted in opposite signs of the net ecosystem exchange for 2004, 2005, and 2009 over Alaska between the default and experimental runs.*

- L281: Negative sign needed in parenthetical at "–9.19 mm (28%)".

>> We have added the negative sign in the revised manuscript.

- L293: Delete "f"

>> We have deleted it.