Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-646-RC2, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Understanding Climate-Fire-Ecosystem Interactions Using CESM-RESFire and Implications for Decadal Climate Variability" *by* Yufei Zou et al.

Anonymous Referee #1

Received and published: 2 October 2019

General comments: In the manuscript 'Understanding Climate-Fire-Ecosystem Interactions Using CESM-RESFire and Implications for Decadal Climate Variability', Zou et al. explored complex interactions between climate change, fire, and ecosystem using a global Earth System Model equipped with a coupled fire module. They estimated the global net radiative effects and NEE changes due to fire aerosols and fire-induced land cover changes under present-day and future scenarios. The topic is interesting and relevant to the scope of ACP. Overall, this is a nicely written manuscript with a clear description of data, model design and results. I recommend it to be published after some minor modifications suggested below.

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Discussion paper

Specific comments: My only major concern is the present manuscript lacks a detailed discussion about the uncertainty of the simulations and calculations. Specifically, although most current state-of-art fire models (including RESFire used in this study) may be able to reproduce the main spatial variability of fire emissions (and fire pollutants) under current climate condition, their ability to simulate temporal variability, as well as the changes under a changing climate has not been validated. As mentioned by the authors, some important processes (such as the lightning changes in the warming future) are also ignored in this study. It will be interesting to know how does it lead to changes in the simulated fire impacts in the future scenario. I believe this paper will be benefited from adding some discussions on this topic.

Minor and technical comments: Page 1, Line 17: “The complex climate-fire-ecosystem interactions were not included in previous climate model studies”. I suggest softening the tune here. Some components of the interactions between climate, fire, and ecosystem have been considered in previous studies (although they were not necessarily incorporated into, or might not be represented thoroughly in a fully coupled online model).

Page 2, Line 58: “These processes were not included in previous climate model studies”. Similar to the above, this sentence is way too assertive.

Page 3, Line 102-103: Since the new scheme is not implemented in this study (and the readers don’t know the strength of the new approach), you don’t have to mention it here. Removing this sentence won’t affect the integrity of this paper.

Page 7, Line 218-220: In addition to biogenic organic aerosols, can an underestimation of fire emissions be another reason for low simulated aerosols?

Page 7, Line 246-247: Any physical explanation for the differences between the signs of aerosol-cloud interactions and aerosol-radiation interactions?

Page 8, Line 279: It would be good to briefly introduce this plume rise parameterization

(e.g., based on what measurements? Global universal or regional-based?)

Page 11, Line 376-379: The terms ‘fire combustion factors’, ‘fire spread distribution’, and ‘fire spread factors’ are probably not familiar to many readers. Please consider a short explanation on these parameters (i.e., what do they mean physically).

Page 11, Line 388-389: I don’t quite understand the causal relationship stated in this sentence. The changes in wind speed are higher over the ocean than that over land, but this could be simply due to the larger magnitude of wind speed over the ocean. Relatively smaller changes in land wind speed could still have large impacts on fire spread and burned area.

Page 25, Figure 2: Please align tick label ‘0.1’ with other tick labels in panels b, c, d.

Page 27, Line 817: Should the unit of CDNUMC ‘10^9 # /m2’ (as correctly shown in panel d)?

Page 30, Figure 7: The colors in panel c don’t have enough separation. Please use another scale.

Page 32, Figure 9: If my understanding is correct, the data in this figure show the differences of fire modifications on weather variables between the future and present ((CTRL2-SENS2B)-(CTRL1-SENS1B)), not the differences of weather variables (in CTRL model) between the future and present (CTRL2-CTRL1). The current form of figure caption is a bit confusing.

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