Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Modelling the radiative effects of smoke aerosols on carbon fluxes in Amazon" *by* Demerval S. Moreira et al.

Anonymous Referee #2

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This study uses a modelling approach to quantify the impact of biomass burning aerosol on CO_2 fluxes through changes in direct and diffuse surface solar radiation in the Amazon region. Assessing and improving the ability of atmospheric models to simulate such effects is important and this study can potentially contribute to this effort, therefore being in principle well-suited for ACP. The manuscript is reasonably well written and easy to follow in its logic. I have several (mainly) minor recommendations that I would like to see addressed before publication.

Specific comments:

- p 4, l 15: not clear what you mean by the two-way mode coupling, could you please describe in more detail how this coupling is implemented and how it works

- p 5, l 1-3: did I understand correctly that all other aerosol emissions, except biomass

burning, were ignored in the model? If this is the case, I would like the authors to add a few words here on why this assumption is needed from a technical point of view and what inaccuracies is likely to introduce (e.g. neglecting masking effects and interactions from other aerosol types etc.). I think that rather than doing a "no aerosol" vs. "biomass burning only" comparison, it would be preferable to do a "all aerosol" vs. "no biomass burning" comparison.

- p 5, l 28: please explain in a bit more detail how the cloud filtering was done. Also need to say how ignoring the effect from clouds is likely to affect results presented in this study, preferably also attempting the quantify this.

- p 7, l 8-9: I struggle to understand why you did not run all 3 simulations for the whole 2-year period (as you did for the DIR+DIF experiment) and I would strongly recommend to do so. The ability to make annual estimations would substantially increase the significance of the paper.

- p 10, l 11-12: Fig 3b shows in fact that the model values are outside the standard deviation range of the observed temperatures for all night and late afternoon hours

- p 11, l 31: here and in other parts throughout the paper where you compare modelled vs. observed values, please quantify these comparisons by giving some relevant stats (e.g. mean bias, correlation etc.)

- p 12, l 20: can you add a reference to these sensitivity studies?

- p 12, l 31,34: why are these results not shown as they seem to be important here?

- p 13, l 18: "CO_2 mixing ratio peaking about 1 hour later" – this is actually not apparent from Fig 9b

- p 14, l 18-20: here you should discuss in more detail what these columns b-c actually show and what it means. Also, can you evaluate the results presented in Fig 13 against some observed values?

- p 15, l 4: here and throughout the manuscript, please revise the way you calculated all percentage changes. If GPP increased by 293 Tg C month-1, from 913 to 1206, this means an increase of 32%, not 24%.

- p 15, l 9-10: I don't quite understand how you derived the 13% increase in NPP. If A=B-C and B increases by 22% and C increases by 9%, this does not imply that A increases by 13%. Please clarify.

- p 15, l 10-12: I don't think you can make such extrapolations (one peak season month is by no means representative of the entire season). Also, here you say that the biomass burning season lasts for 3 months (and thus divide by a factor of 4), while later (p 20, l 6) you say that it lasts 4 months (and use that for other estimates). These comparisons really needs to be addressed properly and in addition to correcting the current mistakes, it is very apparent that the paper would benefit a lot from performing annual simulations for all 3 experiments.

- p 19, l 28-30: can you include a direct comparison of your model results with these Yamasoe et al conclusions, i.e. do you also see the same behaviour for these AOD intervals?

- p 39, Fig 9a: should explain in the text why is the effect (difference between the red and pink line) stronger during the night?

In addition, I think the readability of the paper could be substantially improved by getting editing help from someone with full professional proficiency in English.

Technical corrections:

- title: I suggest a slight change of title, replacing "Amazon" with "Amazonia" or "the Amazon region"

- use the present tense in the abstract when presenting your results, e.g. "our results indicate…" etc

- p 2, l 4: "to be a sink" -> "to being a sink"

- p 2, l 8: "cerrado" -> "cerrado areas"

- p 2, l 14: "areas of about several" -> "areas of several"

- p 2, l 14: "out of the biomass burning season" -> "outside the biomass burning season"

- p 2, l 18: "Angstrom exponent" -> "The Angstrom exponent"

- p 2, l 23-26: please rephrase, possibly removing the first phrase which is unnecessary

- p 3, l 6: "deplete" -> "achieve"

- p 3, l 10: not clear what you mean by "net radiation"; do you mean "total radiation"?

- p 5, l 23: define D (from eq 1) somewhere in the text

- p 7, l 21: ":" -> "." (or rephrase using small letter after the colon, as it implies that a list of things is following)

- p 8, l 6-7: not clear if you want ratios or percentages here

- p 8, l 21 & p11, l 22: "observation" -> "observations"

- p 9, l 35: best to use consistently throughout the manuscript either "biomass burning" or "smoke"

- p 10, l 12: please rephrase "diurnal cycle early in 1-hour"

- p 13, l 27: "oC" -> degree C

- p 14, l 1: here and throughout the manuscript, PAR already includes "radiation", so no need to say "PAR radiation"

- p 14, l 35: "GPP jumps" – please rephrase, e.g. "GPP increases"

- p 15, l 1: "Table 2 resumes" —> "Table 2 summarises"

- p 16, l 24: "punctual" –> "point"

- p 17, l 1: do you mean "lower fraction of diffuse radiation"?

- p 17, l 18: "weighting" –> "weighted"

- p 17, l 25-28: not clear what you mean here, please rephrase

- p 18, l 2: please replace "it is fair to say" with a more scientific wording

- p 18, l 12-14: not sure what you mean here, please rephrase this last sentence of the paragraph

- p 19, l 19: remove "all" from "all together"

- p 27, Table 1 caption: "three-degree" –> "third-degree"

- p 33, Fig 3b caption: please clarify what standard deviations are shown for the black and red lines (e.g. what values were used to derive them)

- p 34, Fig 4: since this shows precipitation, I suggest to reverse the colour scale (as you did for Fig 5)

- p 36, Fig 6 caption: please clarify what exactly you mean by "fire product"

- p 37, Fig 7: please include some stats (here or in the text) for the scatter plots on the right. Also, the standard deviations are missing from the top scatter plots. I would also suggest to use a better colour scale for altitude to help visualising the results (at the moment the purple and pink are too similar – a more intuitive transition from low to high altitudes is preferable)

- p 39, Fig 9: please use different colours for the model results (the light pink is almost invisible). Since you use UTC, it might help to show with dashed vertical lines where the local sunrise/sunset times are on the X-axis.

- p 40, Fig 10: why not showing the effect of the best simulation (DIR+DIF)?

- p 44, Fig 14: please add a legend

- p 45, Fig 15: please clarify what values are shown here (spatially and temporally)

- p 47, Fig 17: please add a legend