

## ***Interactive comment on “The Effect of South American Biomass Burning Aerosol Emissions on the Regional Climate” by Gillian D. Thornhill et al.***

**Anonymous Referee #1**

Received and published: 13 December 2017

General comments:

I find the paper by Thornhill et al. interesting, clear and well-written, and it should fit into the scope of ACP. Biomass burning aerosol emissions are high in South America, and information on how these emissions may impact the regional climate is of value. However, I have some comments and questions that need to be addressed before I could recommend the paper for publication. My main comments concern methodological choices and model evaluation. Please see specific comments below.

Specific comments:

Page 1, lines 15-18: It would be good to include uncertainties to the numbers given.

Page 2, line 25: Feingold et al. (2005) is also a relevant reference here. Feingold,

C1

G., Jiang, H. L., and Harrington, J. Y.: On smoke suppression of clouds in Amazonia, *Geophys. Res. Lett.*, 32, 2, L02804, 10.1029/2004gl021369, 2005.

Page 5, line 9: What levels of CO<sub>2</sub> and other greenhouse gases were used? Representative of the 2000s?

Page 5, line 16: Isn't it a rather strong assumption to have BC and OC lumped into one species, given their very different properties (e.g., hygroscopic growth, radiative properties)?

Page 5, lines 29-32: How are the high level emissions distributed among the different model levels 3 to 20? Is the vertical information given by GFED, or is it done online in the model, e.g., by a plume rise routine? I would expect your results to be very dependent on how the emissions are distributed vertically, e.g., to what fraction of emissions occur within or above the boundary layer.

Page 6, line 1: Have the monthly, daily or 3-hourly GFED data been used?

Page 6, lines 4-7: Scaling the emissions by a factor of 2 is a rather extreme measure that needs to be justified. Is this factor solely based on the previous literature cited, or have you done any experiments in this study to reach a conclusion that a factor of 2 gives more realistic results?

Page 6, lines 31-33: Any idea why the hygroscopic scattering growth is so different between southern African and Amazonian BBA? Is it likely due to some regional-specific properties (e.g., climatological differences), or is it more related to how the measurements were conducted?

Page 6, line 33: Are these values for fresh and aged BBA, respectively?

Page 7, line 2: Looks like you have taken the lower value (1.05 for 80% RH) from Kotchenruther and Hobbs (1998) when drawing the green dashed line in Fig. 3. What is the reason for that? Also, did Kotchenruther and Hobbs (1998) find any difference in the optical properties between fresh and aged BBA, or did they conclude that these

C2

were similar as in SAMBBA?

Page 9, lines 4-7: Doesn't this show that BB BC and OC should be treated separately?

Page 10, line 13-14: "see figures" is very unspecific. I suggest referring to Fig. 5 (i.e., "see Fig. 5"). Similarly for Table 1 caption ("which is outlined in each figure").

Figure 5 caption: Suggest changing to "used to calculate the mean values in Table 1".

Figure 5 caption: "Stippling represents 95% confidence limit". I presume this is based on the interannual variability, i.e., a Student's t-test on the yearly time series? This comment also applies to the other map figures.

Table 1: It would be good to include some uncertainties here, to be able to assess whether or not the changes are significant. E.g., I expect the AOD change to be significant, but I am not convinced that this is the case for the change in cloud fraction. Changes that are significant (e.g., based on a Student's t-test on the yearly time series) could be indicated in bold.

Table 1: I would show the % change either as (H-L)/L or (L-H)/H.

Page 12, line 4: Table 1 shows 70.6% reduction.

Figure 6: I find the colour scale a bit confusing because I normally associate brown colour with drying. I suggest using blue colour for high cloud fraction and brown for low cloud fraction.

Figures 10-11: Stippling is not mentioned in the captions.

Page 17, lines 1-2: Any reason why it is negative?

Page 19, lines 3-4: Do you mean "we can see the semi-direct effect through cloud burn-off, but the ..."?

Page 20, line 2: As mentioned earlier, it would be good to include uncertainties to the mean numbers. E.g., 0.14+/-X.XX degrees C.

C3

Page 20, lines 3-4: Should mention that the increase is not significant.

Page 21, line 3: The precipitation increase is also not significant.

Page 21, line 4: Table 1 shows 15.2%.

Figure 16: The caption has a lot of unnecessary repetition. Please rewrite (e.g., "September mean wind circulation at 850 mb for (a) high emissions case, (b) low emissions case, and (c) the difference between high and low emission cases..."). Also, the common unit for atmospheric pressure is Pascal and not millibar. I would replace "mb" with "hPa".

Page 21, line 16: Please correct Figure numbers.

Page 21, lines 16-17: Good to see that the model compares relatively well with ERA-Interim for surface pressure and wind. How does the model compare for other important variables, such as cloud cover and precipitation, in the South America region? Has this been published before, or could you extract more variables from ERA-Interim to expand the comparison?

Figure 17: The figure quality is not good. The titles and axis labels are small and not readable. Please improve. The same comment applies to Figs. 18-19.

Page 25, line 5: Insert "(Fig. 19)" after "S. America".

Page 27, lines 18-22: In general I find the discussion in Section 4 a bit too detailed and inconclusive. Given that no conclusion on the BB impacts on the monsoon can be reached, due to missing daily output in the experiments, I think the paper would benefit from a substantial shortening of Section 4. For instance, you could keep Fig. 19 and part of the Fig. 19 discussion, and move Figs. 17-18 and most of the associated discussion to the Supplementary Material.

Page 31-34: The reference list needs a lot of cleaning up to comply with the format used in the ACP journal.

C4

Technical corrections:

Page 9, line 7: Fig 4 -> Fig. 4

Figure 7: Please remove or change "Cloud Amt" -> "Cloud Amount" in legend.

Figure 7 caption: "mass mixing ratio" -> "mass mixing ratio (MMR)"

Figure 8 caption: "Deep" -> "deep"

Page 14, line 26: "Fig.9" -> "Fig. 9"

Page 15, line 1: "reduces" -> "reduce"?

Page 15, line 13: "CS" -> "clear sky"

Page 18, line 7: ", illustrates" -> "illustrate"

Page 20, line 4: "Fig.15(a))" -> "Fig. 15(a)"

Page 22, line 3: "Fig. 15(c)" -> "Fig. 16(c)"

Page 22, line 11: "patters" -> "patterns"

Page 22, line 14: "suggestuing" -> "suggesting"

Page 23, line 28: "(18(a-d-g))" -> "(Fig. 18(a-d-g))"

Page 25, line 6 and 7: "dryer" -> "drier"

Page 25, line 31: "andout" -> "and out"

Page 27, line 22: "a results" -> "a result"

---

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-953>, 2017.