Comment on acp-2022-96

Anonymous Referee #1

Referee comment on "Satellite-based evaluation of AeroCom model bias in biomass burning regions" by Qirui Zhong et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-96-RC1, 2022

Review of Zhong et al, Satellite-based evaluation of AeroCom model bias in biomass

burning regions

This paper present an evaluation of AeroCom model aerosol optical properties in regions strongly influenced by biomass burning. In line with previous research, large biases are found. Diverse satellite products are used and a valuable comparison of satellite products is included. Furthermore, a useful disentangling of the biases associated with emissions and with lifetime is presented. The paper is well written and has potential to be an important contribution to ACP. I have a number of minor comments which should be addressed before the paper is published.

Minor comments

Models and variables section: More historical context on when the simulations were run and what the differences in model versions are between the experiments would be useful here. Were the model versions the same, or did the models change between the BBE, 2016 and 2019 experiments? I don't think you can expect your readers to be familiar with AeroCom protocols or to go through other AeroCom papers or the Excel sheet supplement, though of course all the details of specific changes from one experiment to the next do not need to be repeated here.

Even though the size distribution of the model output is not available, the size distributions of the simulated BB emissions inputs are mentioned in the Appendix Table, so it should be possible to infer the impact of these size distributions on lifetime and AOD to some extent. It would be useful to try to do this, and it seems odd to have such a long discussion on hygroscopicity when size is probably more important.

Why does the NMB for BBE5 reach up to 19? Isn't it a bit surprising that it ever exceeds 7.5, given BBE1 has a maximum NMB of 1.5? Is this a linear increase (line 372)?

Figure 5: I find this figure hard to extract much meaning from – a great deal of the information is lost by just showing charts of the correlations. I did not understand the value of a correlation between spatial correlation and temporal correlation. I think it would be better to have AOD vs time line plots for POLDER and for all of the models, with one subfigure for each region (or similar). Then we could see which part of the season the biases are most apparent in, and where the biases are in the regions. It is surprising the spatial correlation can be so low for some models (GISS and INCA) – perhaps a scatter plot would be useful here of simulated AOD vs POLDER AOD for these models?

Also, why are the results in subfigures a, b and c so different? What differed between the three experiments to cause this? You comment in the text that the figures are pretty similar, but they look quite different to me.

L381-390 this is a nice analysis, should be very useful.

What is the real distinction between section 4 and section 5, before section 5.1? The sections may need more thought.

L450-465: The interesting part here is not so much the negative correlation, which is presumably coded into the models by their parameterizations of Mie theory, but why the models deviate from the Mie curve- presumably due to the mixing of several broad size distributions.

L541 I did not see a discussion of the clear-sky assumption in the appendix, and the references given there are mostly generic model description papers, so it would take the reader unfeasibly long to reconstruct what difference the authors are referring to, so please clarify.

Technical corrections

Abstract: "comprise" at line 60 is the wrong word

L240 "proposed" is an odd word here.

L240-270 the paragraph is much too long and should be split up, with clearly defined topics introduced in the first sentence of each paragraph. That said, the paragraph from 271 to 274 does not have its own topic and seems to belong with the previous text.

L256 improve sentence

L520 not clear what 'thoroughly' means