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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of biomass burning aerosols in the HadGEM3 climate model with observations from the SAMBBA field campaign" *by* B. T. Johnson et al.

Anonymous Referee #1

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This well-written, scientifically sound paper uses observations from the South American Biomass Burning Analysis (SAMBBA) campaign to evaluate biomass burning aerosol properties in then HadGEM2 climate model. Two aerosol modules are considered: a simpler mass-based model (CLASSIC) and a more complex microphysical aerosol module (GLOMAP). The authors show that both schemes reasonably represent biomass burning aerosol properties once emissions are scaled up, and that scaling depends on the scheme considered. Overall, the microphysical representation of the aerosol produces a slightly superior biomass burning aerosol representation, particularly in the representation of optical property variability and size distribution.

I find this study acceptable for publication in ACP after the authors address a few minor

points, which I outline below.

1. Page 2, Line 19: Space between needed: "3km" -> "3 km" 2. Page 3, Line 3 (and thereafter): "Biomass Burning" -> "biomass burning" 3. Page 3, Line 5: Remove quotations around aerosol-radiation interactions. 4. Page 3, Line 7: I do not agree with the statement that aerosol absorption suppress the hydrological society. What about the Elevated Heat Pump effect of Lau et al., Randles et al. etc. and similar studies? In some cases absorption suppresses precipitation, in others it can enhance precipitation. Please reword to state it can have either impact, depending on environmental conditions. 5. Page 6, Line 14: This is unclear. Are then same exact oxidant fields (climatology) used for both the CLASSIC and GLOMAP runs? If not, why? Wouldn't this make a difference? 6. Page 7, Line 15: This seems odd. No sea salt transport over land? You just wash it out once it crosses the coastline? Is this realistic? 7. Page 7, Line 7: I'm a bit confused about how emissions are prescribed in CLASSIC. Doesn't the OC:BC ratio on emission come from the emissions inventory (GFED)? Please clarify. 8. Page 7, Line 25 (and thereafter): Put a space between number and unit (micrometer). 9. Page 7, Line 31: "Refractive Index" -> "refractive index" 10: Page 9, Line 14: "hygroscopic" -> "hydrophilic" 11. Page 9, Line 16: Do you get optical properties on the fly or from a pre-computed look-up table? 12. Page 9, Line 19: You don not consider UV absorption (brown carbon)? Why not? Can you indicate if this should be the case here? Does SAMBBA lend support for a representation of brown carbon? 13. Page 9, Line 29: You imply that QFED and FEER use global scaling. They do not. QFED, for example, uses biome-specific scaling. Please reword so that is clear while these inventories do scale their emissions, the scaling is more complex then multiplying by a single number globally as you do here. Considerable effort was made by these inventories in their scaling efforts. 14. Page 10, Line 1: Why did you choose to use GFED as opposed to QFED or FEER? Curious. 15. Page 10, Line 30: When calculating optical properties, do you use the POM or OC mass? 16. Page 14, Line 7: Why do you just consider Aqua? 17. Page 14, Line 16: Are you using the Level 3 product? Is this the best to be using? Do you do any sub-sampling of your model to only consider satellite

observation times? Would sub-sampling impact your comparison? You do say this on page 16 but I would comment here as well. 18. Page 16, Line 28: You say the model AOD is calculated on clear-sky RH. What does this mean? Does your model track 2 RH (clear- and cloudy- sky)? Or do you represent RH as a sub-grid PDF? Please explain. 19. Page 17, Line 28: Ilorin will also be impacted by dust aerosol; is it therefore correct to conclude that your under-representation is due to biomass burning aerosol alone? Or could your dust simulations also be off? 20. Page 17, Line 32: How are you attributing this to BB aerosol? Couldn't it also be anthropogenic? 21: Page 18: Line 15: OA = POM? 22. Page 19, Line 2: I still don't understand why both CLASSIC and GLOMAP do not have the BC:OA ratio coming from the emissions inventory (since that is built into the emissions). 23: Page 20, Line 9: Remove space before % 24: Page 22, Line 24: "Sampling issues (e.g. altitude) may be a large source of representativeness error in the ... " 25: Page 23, Line 25: Do you not also sub-sample the model at AERONET observation times? Why not? Would't that matter? 26: Page 24, Line 27: Comment on why it's expected that a microphysical model can achieve more realistic variability in optical properties than a mass-based model. This is an important point. 27. Page 25, Line 30: "Scattering Growth Factor" -> "scattering growth factor" 28. Page 30, Line 8: This is a very important point. Can you comment on why the growth factor is smaller in the observations? Do any of the chemical data suggest reasons for this? Do you think this is characteristic of all BB or just over south America?

29: Figure 3: Could remove repeated colorbars (since all are the same) and just have one large one. What is the white in the squares in (e)? Missing data? Maybe grey this out. 30: Figure 5: For AERONET, put the standard deviation on the month to indicate sub-monthly variability Could also do this for the model as shading. 31: Figure 8: The part labeled "dust-dominated" -> is there another measurement that confirms this? You see the same thing (almost) in SAFARI-2000 and there was not as much dust in southern Africa correct? 32. Figure 11: Again, one colorer for each 2 panels across. 33. Figure 12: Rather than all the grey spaghetti lines, why not just shade max-min? Would be easier to see

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