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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Laboratory studies of fresh and aged biomass burning aerosols emitted from east African biomass fuels – Part 1 – Optical properties" *by* Damon M. Smith et al.

Anonymous Referee #1

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The paper summarizes results on optical properties of aerosols generated by burning of 3 common fuels in Africa. Some measurements were carried out on fresh BBOA, some on BBOA aged in the dark, some on photooxidized BBOA in the presence or absence of additional VOCs (typical urban aromatics). Fuels were burned at low (500 C) and high (800 C) temperatures. Non-refractory chemical composition of the aerosol was also measured, although not really discussed here. Single scattering albedo data, determined on size-selected aerosols, at mid-visible confirmed production of more absorbing aerosols under high temperatures. There was not a strong wavelength dependence to SSA between 500-570 nm. Dark aging of the BBOA resulted in increase in SSA possibly due to condensation of SOA and increase in the scattering cross sec-

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tion. The novelty of the experiment is in the selection of the fuels. However, I see some flaws in the approach (contribution of multiply charged particles was not corrected for in Mie calculations); the paper does not seem complete without the description of the compositional measurements (some conclusions are drawn on the composition of SOA without providing any support; there were no measurements of BC, yet overall refractive indices were estimated to use in Mie calculations); last the chamber oxidation experiments in the presence of additional VOCs don't seem to have worked. There were also several sentences that were confusing and need to be rephrased/clarified. Overall I don't find the quality of this paper appropriate for ACP and cannot support any revisions. Other specific comments are listed below: - L 20-21: Bad grammar - L 23-24: bad grammar - L32: "injecting" and not "ejecting" - L33: it's unclear why measurements after 12 hrs of injecting VOCs and BB aerosol in the chamber were not useful. - L 43: "measuring the. . ." - L47: "partial evaporation. . ." - L85: "authors'. . ." - L112: The sentence related to drying of the fuels should be moved earlier, before the weighing discussion. - L115: the EF mentioned is for tropical forests, which is not really representative of the African fuels studies here. Please provide your justification for using this value. - L164-165: It's unclear what is actually meant here "SSA and AAE were derived from these relationships using observations of CO, CO2, OA, and BC." - L187: Temperature change even if very small should be included since it can impact gas-aerosol partitioning and evaporation of BB-POA. - L216-217: Consider indicating what the aerosol number concentrations, and absorption and scattering coefficients typically were after 24-hr flushing and before start of a new expt. - L221: what does it mean that "The experiments were repeated after keeping the BB aerosol in the chamber overnight (24 hours) without the UV lights"? - L231: indicate manufacturer and level of purity - L245-251: Typically urban concentrations of VOCs are expressed as volumetric mixing ratios (ppmv or ppbv, etc). Is that not the case for the aromatics indicated here? If not, to clarify, you need to include ppmm or ppm by mass. If indeed the mixing ratios of 5:14:6 was ppmv based, then one expects different volumes (and also different masses of them based on their density) of each to be injected and the

calculation here is not correct. - L254-256: what VOC mixing ratios were achieved in the bag so readers can compare them with the typical urban mixing ratios of these VOCs in Africa? - L267: what does “710 μm impactor inlet” mean? It seems 710 um is not related to the size cut. - L269- 270: how was the concentration of multiply charged particles accounted for? Those can significantly impact the measured optical coefficients given their larger physical size, even if their number concentration is not high. This is mentioned in lines 318-320, but still no consideration is given for correcting 200 nm particle concentrations. - Equation 2: need to define tau and tau0, sigma_ext and N(CRD). - L294: Since the CPC is placed after the optical instrument, what is the fractionall loss of particles in the CRD and nephelometer? - L316: it is worth indicating what each of these uncertainties are. - L330-331: It’s unclear what the CE value was and how it was determined for this one species. What assumptions need to be made to justify using the same CE for all the species? - L340: this sentence needs to be rephrased “The optical properties were also measured as a function of different forms of aging: dark aged, photochemically and photochemically aged with added VOC’s lights on in the presence of VOCs injected into the chamber before particles were introduced at both temperatures.” - L351 and 363: section 2.3.1 is not in the paper - L357: How was concentration of BC taken into account to calculate the SSA? And how were the aerosols treated? Internal or external mixtures? These details need to be fully explained. - L361-362: why would the impact of multiply charged particles not be present in lower combustion temperature samples? How different were the chamber size distributions under these conditions? The geometric mean for all fresh aerosols seems to be the same and 50 nm (Fig 1). - Figure 3. The legend needs to include the imaginary number indicator “i” - L380: Do the dashed lines show the uncertainties in SSA or the variability of the measurements, e.g., standard deviation of the average? Please be specific. - L391-392: Unlike what’s mentioned here, SSA for eucalyptus aerosol is not uniformly higher or lower than other fuels; please correct this statement. This needs to be corrected in the conclusions as well. - L382-400: The discussion on burn temperature and BC vs BrC emissions gets repeated; consider describing this

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dependence more concisely and to the point only once. - Figure 5: why is the SSA for 400 nm included here whereas in other plots 300 nm observations were included? What is the reason for having much larger error bar on one of the data points? - L414: The sentence related to the higher uncertainty needs to be rephrased. - L419-421: I don't think the example with actual values of SSA are needed. Also the last sentence is stating something that has been known in the community for a long time; therefore ,it's not worth reiterating or at least provide proper literature reference. - L431: Why is particle dynamic expected to be different at night compared to daytime such that it would influence nighttime oxidation differently? Please clarify. - L461: there's no basis for suggesting nitrogen-containing OA as opposed to other types of SOA were formed under these dark aging conditions since no information on composition was provided. Please rephrase/remove this in the Conclusions as well. - L487: Section 2.2.1 includes description of photooxidation without additional VOCs - L505-507: the explanation doesn't seem to be valid. Why can't it be that the SOA form these VOCs has the same optical characteristic as the SOA formed in the absence of the VOCs? L539: it actually appears that there was insignificant additional SOA formed from oxidation of aromatics that were added to the chamber. What was the NOx level in the experiments? Perhaps the high NOx conditions of the burns lead to low SOA yield from these precursors and therefore no significant SOA is observed. If results from aging in the presence of additional VOC were not conclusive, I suggest removing all the discussion related to it throughout the paper. - L 516-517: I'm not following why continuous size-selection was not possible during these aging experiments.

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