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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Parameterization of Single Scattering Albedo (SSA) and Absorption Angstrom Exponent (AAE) with EC/OC for Aerosol Emissions from Biomass Burning" *by* Rudra P. Pokhrel et al.

Anonymous Referee #2

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Review of Pokhrel et al.

The authors present measurements of aerosol optical properties for particles produced from biomass combustion. The confirm that there is a relationship between the SSA and AAE and the MCE, as has been shown before. But they importantly extend this to think about the relationship with the EC/OC ratio (and the EC/(EC+OC) ratio), finding a stronger relationship with these variables. These results may be useful for global modeling (although it should be noted that global models tend to calculate optical properties based on particle size distribution and composition and do not simply specify SSA as

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Discussion paper

an a priori parameter). I think that this paper should be publishable after the below comments are addressed. My main question at this point relates to their choice of r as the figure of merit in their (non-linear) fitting.

P1,L17: Suggest replacing "significant" with "substantial" or "important" so as not to imply statistical significance.

P1,L18: Suggest replacing "inferred" with "predicted".

P1,L20: I find ". . .emission factors for the MCE. . ." to be unclear. EFs of what?

P1,L27 and General Question: Pearson's r is a parameter that describes the linear correlation between two variables. Here, it seems to be applied to one data set that is linearly related (SSA vs. EC/(EC+OC)) and two that are not (SSA vs. MCE and SSA vs. EC/OC). Thus, are the r values really comparable? What does an r value mean for a non-linear relationship? Might a different statistical test be applied? Perhaps Spearman's or Kendall's rank correlation coefficients or a Pearson's Chi Square test?

P2,L9: The authors cite Stier (2007) as evidence that "most climate models treat organic carbon as purely scattering." However, it is clear from Fig. 1 in Stier (2007) that the OC is somewhat absorbing throughout the visible. In fact, most models treat OC as slightly absorbing (see e.g. the OPAC database).

P2,L13: The inclusion of the reference to Washenfelder here seems quite selective, as there are many regions where biomass burning has been implicated as a source of BrC. Not that it is not a nice study, but is there a reason why this study is being highlighted?

P2,L17: I suggest that the Saleh reference is removed and only the Feng (global model result) reference is retained.

P2,L23: What is meant by SSA and AAE are "commonly implemented in models"? Models don't specify SSA. Similarly, what is meant by "SSA and AAE are also critical for satellite retrievals"? Critical for or are important retrieved information from?

P3,L9: No reference to Salako et al. is provided. Also, I would contend that this really remains to be demonstrated as “charring” is known to be a particularly important for biomass burning. Also, the authors might compare their longest wavelength denuded-particle absorption measurements to the EC measurements to argue that there is a reasonable relationship between BC and EC for this data set.

P7,L3: The sentence starting “At high MCE” is a fragment.

Fig. 1: It seems odd that the least squares fit (red line) doesn’t match the data at smaller MCE values at 660 nm (most notably). Is there a reason for this? The functional form used (which should be given in the main text as well) should allow for better agreement at these low MCE values. Also, it is unclear if the fits were performed with/without accounting for the uncertainties in the individual points.

Fig. 3: The fits the authors retrieve allow for unphysical SSA values > 1. I suggest that they redo their fits, constraining the maximum retrievable SSA to be <= 1. This amounts to constraining the k0 in their fit equation to be <= 1. This links to P8,L14, where the authors note that this fitting does lead to SSA values > 1. But this is a solvable problem. Physical realism can be imposed on the fits.

P8,L1: the authors might indicate what they consider the EC/OC value at which composition is “dominated” by EC.

P8,L5: horizontal should be vertical.

P8,L12: Are the data truly more “bunched” or is the difference that Fig. 4 uses a linear scale and Fig. 3 a log scale for the x-axis? I think the latter.

P8,General: The authors discuss the robustness of their fits and the ability of EC/(EC+OC) to be used as a predictor. Although I generally agree, a few thoughts: (i) I think that the authors are overstating the case for AAE, as the correlation coefficient is only 0.79. (ii) Regarding the 405 nm measurements, yes, the fit gets a <1 SSA value when EC/(EC+OC) = 0. But it is also clear that the zero intercept here differs

substantially from the data points. In other words, the fit is certainly "good" but the model fit and observed SSA values differ by ∼0.03 or more, which is small yet non negligible. (iii) Can the authors include confidence bands?

Table 5 and discussion: Do the MCE and EC/OC from the literature for biomass burning emissions generally agree with the observations here in terms of functional form?

P9,L19: I find the meaning of the following sentence to be unclear: "While climate models may not directly parameterize optical properties based on EC/OC, the parameterization provides a good sanity check of model schemes to predict optical properties." Can the authors clarify how this table and discussion provides a "sanity check"?

P10,L4: What is meant by "reasonably good?" As good as the case that is shown? Can this just be shown?

P10,L12: If the peat burning was unintentional and a result of e.g. drought, I suggest the authors say "through unintentional peat burning."

P7,L5: To set things up for later in the paper, the authors might report the mean value for peat here in addition to the maximum. Some discussion of the variability would also be helpful (later in section 3.4).

P10,L21: this is a sentence fragment.

General: I suggest that the authors adopt the terminology "aerosol particles" throughout much of the particle, to indicate that they are looking at the particulate matter and not the associated gaseous material.

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