

Interactive comment on “Investigating biomass burning aerosol morphology using a laser imaging nephelometer” by Katherine M. Manfred et al.

Anonymous Referee #2

Received and published: 21 October 2017

This is a very interesting manuscript that describes the performance of a fairly novel polar Nephelometer used of the characterization of fresh biomass burning aerosols and their morphology. This is a generally well-written manuscript but it will need major revisions due to the lack of fractal analysis of SEM images (comments 11, 12) and the selective use of literature values (comments 7, 9, 12). However, it is appropriate for ACP and should be published after the following comments are taken into account.

1. P. 4 LiNeph: As this commercial polar nephelometer has not previously been described in the literature, a more detailed description would be desirable with more information on choice of wavelengths, beam dump, flow rates, curvature of beam image, etc. being of interest.
2. P.4 Image Processing: This section would benefit from quantification and examples

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for background spectra, wall scattering, etc.

3. P.5, L.2: replace “aerosol-only” with “particle-only” as “aerosol” is defined as colloid of particles in air or other gases; i.e., aerosol includes the gaseous component.

4. P.4, L.12: “was found to be linear”; please quantify and show an example.

5. P. 7, L.8 and elsewhere “fractal-like particles; and P. 8, L. 4 and elsewhere “fractal aerosols”. Please decide if you want to call these particles “fractal-like” or “fractal” and use this consistently. Personally, I prefer “fractal-like” as the agglomerates are not purely fractal; the fractal nature breaks down below a certain length scale (monomer size).

6. P.7,L.18: “and $\text{Abs}(2ka(m-1)) \ll 1$ with wavenumber ($k=2\pi$) and a equal to the monomer radius.” Why not just use the definition of the size parameter x for the monomer and replace with “and $\text{Abs}(x(m-1)) \ll 1$, where x is the monomer size parameter.”?

7. P.8, L.4-6: “While fractal aerosols produced from fossil fuel combustion have been studied extensively, only one systematic measurement of the fractal parameterization of fresh biomass burning combustion products has been undertaken. Gwaze et al. (2006) measured $k=2.77$ and $D=1.85$ for biomass burning aerosol, although the authors note that 1.85 is a lower limit on D_f .”

What about the systematic analysis of fractal characteristics of particles emitted from the combustion of different biomass fuels given by Chakrabarty et al. (2006). Please cite and compare with Gwaze et al. (2006).

8. P. 8, L.17: “manufacturers specifications for a similar instrument”. Which instrument is this (please specify) and how similar are these instruments? Is the angular range identical?

9. P. 8, L. 21-23: “Spherical particles were assumed to be predominantly organic material, and a representative refractive index for humic-like substances was assumed at

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each wavelength ($m = 1.64 + 0.12i$ at 375 nm; $m = 1.64 + 0.11i$ at 405 nm) (Hoffer et al., 2005; Lang-Yona et al., 2009). “Why do you use refractive indices for humic-like substances when refractive indices for OC from biomass burning (with much smaller imaginary parts) are readily available (Chakrabarty et al., 2010) and much more appropriate? Please explain and compare results when using either refractive index.

10. P. 9, L.9: Replace “errors arising from the background signal is more systematic. . .” with “errors arising from the background signal are more systematic. . .”.

11. P.11, L. 6-8: “This implication from the phase function measurements is further supported by SEM images (Figure 7), which show that the non-volatile (denuded) components are mostly fractal-like particles.” A quantitative analysis of the SEM images for fractal-like parameters (dimension, pre-factor) is much needed to check applicability of literature values used for optical modeling.

12. P.11, L.17-19: “The phase function measured for the total aerosol population (Figure 8(a)) shows good agreement with the RDG model, assuming the parameterization ($k=2.77$; $D=1.85$) from Gwaze et al. (2006) for biomass burning products.” This needs to be compared with other literature values (Chakrabarty et al., 2006) and even better with SEM characterization of fractal-like parameters.

13. P.11, L. 32: “the measurements suggest”. Specify which measurements.

14. P.25, Fig. 6 and P.27, Fig. 8: The y-axis is labeled with “Scatter (au)”, however, the figure caption states “Phase functions are normalized to total scatter in spherical coordinates.” Which one is true? Also what do you mean by “scatter”; I’m not familiar with this term (differential scattering cross-section?), please change or explain and give reference.

References

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