

Author comments

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Manuscript title: Investigating biomass burning aerosol morphology using a laser imaging nephelometer

The discussion below includes explanations of changes made to the manuscript by the authors (excluding those in response to reviewers' comments). All page and line numbers refer to the original manuscript. Added text is indicated by italics, and deleted text is struck through.

1. Recently, the authors became aware of an article on the development of an imaging nephelometer similar to that shown by Dolgos et al. The following has been changed to include this instrument in the discussion of aerosol phase function measurements:

P.3 L.10-12: “The fourth category is the newest and features a *single* pixel array detector *or pair of detectors* with either an elliptical mirror (Curtis et al., 2007) or a wide-angle lens (Bian et al., 2017; Dolgos and Martins, 2014) used to image nearly all angles onto the array(s). This type of instrument uses ~~a single detector~~ *one or two detector(s)* with a simple...”

The full reference is:

Bian, Y., Zhao, C., Xu, W., Zhao, G., Tao, J. and Kuang, Y.: Development and validation of a CCD-laser aerosol detective system for measuring the ambient aerosol phase function, Atmos. Meas. Tech., 10(6), 2313–2322, doi:10.5194/amt-10-2313-2017, 2017.

2. We added an additional reference for a new publication to the following:

P.3 L.17: “...visible spectral region (Dolgos and Martins, 2014; *Espinosa et al, 2017*).”

The full reference is:

Espinosa, W. R., Remer, L. A., Dubovik, O., Ziemba, L., Beyersdorf, A., Orozco, D., Schuster, G., Lapyonok, T., Fuertes, D. and Martins, J. V.: Retrievals of aerosol optical and microphysical properties from Imaging Polar Nephelometer scattering measurements, Atmos. Meas. Tech., 10(3), 811–824, doi:10.5194/amt-10-811-2017, 2017.

3. To emphasize that the instrument measures the bulk sample (rather than single particles), we have added the following:

P.4 L.16: “...1 s integration time. *The combination of a wide-angle lens and CCD array allow imaging of the phase function for aerosol particles and gas molecules within the volume of the beam, as discussed in Dolgos and Martins (2014).* The CCD combined...”

4. The  $D_f$  value from Gwaze et al. used to model biomass burning fractal-like particles was misreported in our original manuscript as 1.85. The correct value (the average value in Gwaze et al.) is 1.83.

5. The MCE value for Fire A was corrected from 0.946 to 0.949 (P.9 L.20).

6. In the discussion of the importance of fractal morphology for biomass burning aerosol in general, we have now added a sentence acknowledging that past studies indicate coatings condense on BC particles quite quickly in the atmosphere.

P.12 L.9: “...aging in the atmosphere. *Studies have shown that biomass burning aerosol are coated with organic material within hours in the atmosphere (e.g. Akagi et al., 2012; Vakkari et al., 2014).* However, ~~if~~ fractal-like aerosol do not immediately collapse or accumulate sufficient organic coatings to become

spherical, then remote sensing retrievals of wildfire plumes from dry brush or grasses may significantly underestimate the forward scatter from the aerosol. Cheng et al. (2013) showed recently...”

7. The subject heading “Summary and Conclusions” has been moved forward one paragraph, as the discussion of the potential impacts of this study seem to fit better as a summary.

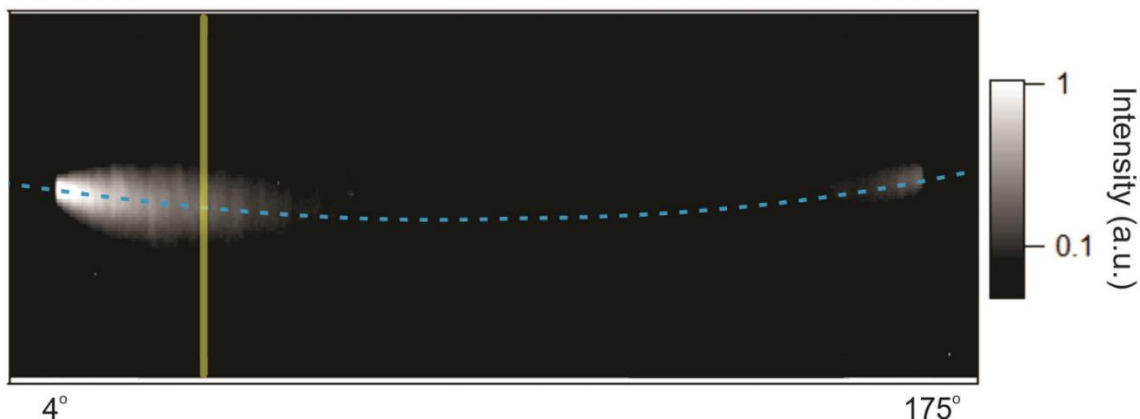
8. We have added the following text regarding the potential importance of accurate phase function algorithms for fresh biomass burning emissions:

P.12 L.14: “...for remote sensing platforms that use reflectance. *This error would likely have been unimportant for past retrievals from MODIS, for example, since cloud masking algorithms often misclassified thick smoke (typically fresh plumes) as clouds (Giglio et al., 2016). However, with improved biomass burning cloud masking algorithms, it will be interesting to see if MODIS retrievals of thick, fresh smoke plumes will be accurate with a spherical morphology algorithm. This will affect...*”

The full reference is:

Giglio, L., Shroeder, W. and Justice, C. O.: The collection of 6 MODIS active fire detection algorithm and fire products, Remote Sens. Environ., 178, 31-41, doi:10.1016/j.rse.2016.02.054, 2016.

9. Figure 2 was changed slightly to make the image more clear:



10. The following reference was changed:

Selimovic, V., Yokelson, R. J., Warneke, C., Roberts, J. M., de Gouw, J., Reardon, J. and Griffith, D. W. T.: Aerosol optical properties and trace gas emissions by PAX and OP-FTIR for ~~from~~ laboratory-simulated western US wildfires during FIREX, Atmos. Chem. Phys., In review ~~preparation~~, doi:<https://doi.org/10.5194/acp-2017-859>, 2017.