Atmos. Chem. Phys. Discuss., 12, C11770–C11773, 2013
www.atmos-chem-phys-discuss.net/12/C11770/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Brown carbon absorption linked to organic mass tracers in biomass burning particles" *by* D. A. Lack et al.

G R McMeeking (Referee)

gavin@dropletmeasurement.com

Received and published: 18 January 2013

The manuscript presents recent measurements of light absorption made using a photo-acoustic system and aerosol composition made using an aerosol mass spectrometer in a biomass burning plume from a wildfire near Boulder, Colorado. The work builds on a detailed analysis of the aerosol optical properties in the same plume carried out by many of the same authors by linking the optical observations to measurements of the aerosol organic composition. The authors show relationships between indications of absorption by brown carbon to changes in organic mass spectra, specifically the ratios of the mz60 and mz44 fractions of total organic aerosol. They suggest that a robust relationship between these markers could allow for the prediction of brown carbon absorption from AMS-type measurements.

The manuscript is well written, concise and the methods employed are described in reasonable detail with a few minor exceptions. I recommend it be published in ACP once the following minor comments have been addressed.

General comments

In places, the text in the abstract and main body of the manuscript suggests that POM absorption (at 405 nm) is related to levoglucosan emissions. The text should clarify that this does not necessarily mean levoglucosan itself is absorbing. I could not find any measurements of light absorption by pure levoglucosan with a quick literature search, but I have sampled atomized pure levoglucosan using a photoacoustic instrument in the past and have not observed any light absorption signal at 405 or 532 nm over a range of sizes and concentrations. These data are available at the authors' request.

I would be interested to see the authors explore the MAE observations in a little more detail. First, how does their observed range of MAE at 404 nm compare to other recently reported/estimated values for brown carbon absorption efficiencies (e.g, Kirchstetter et al., 2004; Hoffer et al. 2006; Clarke et al., 2007; Yang et al., 2009). I admit these studies use different methods, but I think a short discussion could be valuable. Second, it would also be useful to include an MAE at 404 nm based on the mz60 mass concentrations from the AMS for comparison with future studies that have similar measurements.

Please state the upper size cutoff used by the PAS system as well as the method used to determine the collection efficiency applied to the AMS data.

The section describing the PMF work as well as the details of the analysis given in the supplement can be omitted since the results are not used in the analysis. A short statement that separation of the HOA and BBOA factors using a PMF analysis was not obtained and therefore the analysis focuses on the f60 and f44 results.

A rough description of the age of the emissions measured would aid future compar-

ACPD
12, C11770–C11773, 2013

isons by other studies? Additional parameters such as emission ratios of various emitted species to CO (e.g., OA/CO), could also help link results from this study to others carried out examining biomass burning emissions in the future, given the large variability in fire behavior and its impacts on emissions.

Specific comments (page, line)

29131, 5: Please consider adding reference to Simoneit et al. (1999) here. Also, what is meant exactly by "backbone"? Is there a specific functional group that leads to the mz60 fragment common to levoglucosan and other related species? A little extra information here would be helpful.

29131, 8: could mention method of ionization (EI) here.

29131, 18: of BC → by BC; also should add some earlier references (e.g., Kirchstetter et al., 2004, Reid et al., 2005) should be added to those already cited.

29132, 22: figures should be re-ordered to match text

29133, 2: suggest deleting "to" and change "produce" to "to produce"

29135, 21: what is meant by "levoglucosan-based products of BB combustion"? Are the authors referring to other sugars? I wouldn't say these were "based" on levoglucosan. Perhaps "products of BB combustion associated with levoglucosan" is more accurate. Last sentence of the paragraph missing a period. I noticed one or two others missing following references that should also be checked prior to final publication.

References

Clarke et al., Size distributions and mixtures of dust and black carbon in Asian outflow: Physiochemical and optical properties, Journal of Geophysicla Research, 109, D15S09, doi:10.1029/2003JD004378, 2004.

Hoffer et al., Optical properties of humic-like substances (HULIS) in biomass-burning aerosols, Atmospheric Chemistry and Physics, 6, 3563-3570, 2009.

ACPD

12, C11770–C11773, 2013

Kirchstetter et al., Evidence that the spectral dependence of light absorption by aerosols is affected by organic carbon, Journal of Geophysical Research, 109, D21208, doi:10.1029/2004JD004999, 2004.

Reid et al., A review of biomass burning emissions part III: intensive optical properties of biomass burning particles, Atmospheric Chemistry and Physics, 5, 827-849, 2005.

Simoneit et al., Levoglucosan, a tracer for cellulose in biomass burning and atmospheric particles, Atmospheric Environment, 33, 173-182, 1999.

Yang et al., Attribution of aerosol light absorption to black carbon, brown carbon and dust in China-interpretations of atmospheric measurements during EAST-AIRE, Atmospheric Chemistry and Physics, 9, 2035-2050, 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 29129, 2012.