Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-161-RC2, 2018

Atmospheric Chemistry and Physics Discussions
Open Access

Interactive comment on "Light absorption by polar and non-polar aerosol compounds from laboratory biomass combustion" *by* Deep Sengupta et al.

Anonymous Referee #2

Received and published: 19 April 2018

This manuscript describes the study of the absorption spectra of water- and hexane-soluble components of biomass burning aerosols. Aerosols were generated from selected fuels under both flaming and smoldering conditions and these were studied nascently and after chemical aging in an oxidation flow reactor. The authors found that the solar-weighted hexane-soluble fraction was 2-3 times more absorbing (per mass of fuel consumed) than the water-soluble fraction. They also found that absorbance of the hexane-soluble fraction of all samples decreased after aging while the aged water-soluble fractions of two of the samples increased. Futhermore, the shape of the spectrum, as indicated by the absorption Ångström exponent, was found to change upon aging. Higher NOx levels were observed from the flaming combustion, and the high-resolution mass spectra show evidence for organic-nitrogen species that may be

Printer-friendly version

Discussion paper

formed during aging in the presence of NOx.

Overall, this manuscript provides an interesting comparison between polar and non-polar light-absorbing components of model biomass burning aerosols. The data and results are presented clearly, though some of the interpretations are confusing or not consistent with the figures. For example, it is stated that the hexane-soluble extracts were more absorbing than the water-soluble extracts for all samples except for the Siberian peat; yet, Figure 3 clearly shows that this is true for all four samples, including the Siberian peat. Such an inconsistency makes it confusing for the reader and undermines his/her confidence in the interpretation of the data, especially since this is one of the primary conclusions from the study.

Given that relatively few studies have explored the differences in optical properties of polar and non-polar aerosol extracts, this work serves to advance the understanding of brown carbon in biomass burning aerosols. However, despite the plethora of data presented, including high-resolution mass spectra and pH dependence of the absorption measurements, there are very few insights or general conclusions drawn from this work. Additionally, the absorbance data are presented as solar-weighted, i.e. weighted by the actinic solar spectrum, which makes interpretation difficult. For example, Figure 3 shows that the (solar-weighted) hexane-soluble fraction has a larger absorbance than the (solar-weighted) water-soluble fraction for all four fuels studied, but is this true for all wavelengths, or is the difference larger at some (e.g. UV) wavelengths than at others? While Figure 2 does compare the spectra from the two fractions, it is not clear how the spectral dependencies differ. Perhaps a plot of the ratio of the two spectra would be helpful.

In summary, the work presented here might be worthy of publication in ACP but only if the conclusions drawn were more clearly stated. As it stands now, it is a jumble of results riddled with typos and mistakes making it difficult for the reader to appreciate what has been learned from these experiments. The conclusions need to be generalized to provide some more fundamental insight into the nature of the differences in absorption between the polar and non-polar fractions.

Specific comments:

1. Page 1, line 24: It should be clearly stated that the non-polar fraction is “2-3 times more absorbing” when weighted by the solar spectrum and normalized to mass of fuel consumed. 2. Page 1, lines 25-26: It is stated that “an increased absorbance was observed for water extracts of oxidized/aged emissions,” but that appears to be true only for two of the four samples, FASMEE and Hawken Fire; the other two, Florida Peat and Siberian Peak, show a decrease upon aging (Figure 3). 3. Page 1, lines 27-28: The statement “Comparing the absorption Ångström Exponent (AAE) values, we observed changes in the light absorption properties of BB aerosols with aging that was dependent on the fuel types.” is vague. What is meant by “light absorption properties”? The only observed difference was in the AAE values themselves. 4. Page 3, line 11: “Just a decade ago . . .” is followed by a citation to a paper from 2001, 17 years ago. That’s not a decade. 5. Page 4, line 22: “muck” is not a very scientifically specific word and should be replaced. 6. Page 10, line 7: “700 to 900 nm and” should read “700 to 900 nm”. 7. Page 10, line 8: The use of the term “AbSλ” is confusing; why not use “Absλ”? Why use a capital S? 8. Page 11, line 2: remove “was calculated”. 9. Page 16, line 11: The results don’t “suggest”, they show/indicate/demonstrate. There is no inference in this statement. 10. Page 16, line 11-12: Figure 3 clearly shows that there is more absorbance in the hexane-soluble fraction than the water-soluble fraction for all four samples, including the Siberian peat. 11. Page 16, lines 12-14: It should be made clear here that the “total absorbance” referred to is the solar-weighted total absorbance. 12. Page 19, lines 20-23: First, the authors refer to Fig. 1, but the absorption spectra appear in Fig. 2. Second, “FAASME” should be “FASMEE.” Third, the FASMEE and Florida Peat absorption spectra are shown in Fig. 2, not FASMEE and Hawken Fire samples as stated. Fourth, the increase in absorption observed occurred over a wider range of wavelengths than just 380-500 nm. Fifth, are the authors referring to an increase in absorbance for the water-soluble fraction or the hexane-soluble fraction?

Sixth, an increase in absorbance over a wide range of wavelengths such as observed here most certainly does not suggest that the “primary precursors for secondary emissions . . . are mostly aromatic in nature”; this statement is highly speculative and should be removed. 13. Page 24, lines 14-16: how does the decrease in absorbance with decreasing pH compare to the results of (Phillips et al., 2017) mentioned? Is it similar or not, and if not why not? 14. Page 25, lines 1-2: how does the protonation of functional groups explain the decrease in absorption with lower pH? This statement needs to be clarified.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-161, 2018.

Printer-friendly version

Discussion paper