Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-142-RC1, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Intercomparison of biomass burning aerosol optical properties from in-situ and remote-sensing instruments in ORACLES-2016" *by* Kristina Pistone et al.

Anonymous Referee #1

Received and published: 21 March 2019

This manuscript presents the comparison of biomass burning aerosol optical properties namely single scattering albedo and Ångström exponents measured from in-situ and remote sensing instruments during ORACLES-2016 campaign. They presented two different case studies and found that SSA agrees within measurement uncertainties between multiple instruments. Furthermore, they found that instruments agreement in more robust if AOD400 > 0.4. Even though two case studies show agreement between instruments, campaign-wide average and range show values are highly variable between instruments.

Overall, this manuscript is well written. This work is an important contributor to connect

in-situ and remote sensing measurement of biomass burning aerosol optical properties. I have some comments for improving the manuscript and that should be considered before the publication.

Major Comments:

Even in 30s average data, PSAP shows variation in absorption by the factor of almost 6 while PTI shows about only 2. Even though, authors conclude this is due to the higher noise level in PTI but still they used PTI data to compare with remote sensing measurements. I don't get the whole point of doing that. Authors keep talking about the improvement in the PTI measurements for 2018 deployment given improved PTI data is not included in this study. I would recommend either using the data from 2018 PTI deployment or don't repeat the statement. Increase in SSA at longer wavelengths in two 80m scan is concluded due to sea salt in the boundary layer. This fact is not evident in the AAOD plot (Figure 6a). AAOD for 4STAR (80 m) scan is larger than 1 km scan indicating there were absorbing aerosol on boundary layer too. Why RSP is different than 4STAR 80 m? As expected, SSA from in situ may not exactly be correlated with remote sensing given an impact of RH, why two remote sensing method does not correlate at all (Figure 9c)? Authors should explore that in more depth than just present the result. I am not much worried about the inconsistency between in situ vs remote sensing but why AirMSPI vs 4STAR does not show correlation with any of the optical properties discussed in this study? For example, AAE measured by 4STAR shows variations between 0.8 to 1.8 while AirMSPI AAE lies between 1.2 to 1.4. Since their conclusion for this variation is higher uncertainty in derived AAE, it is better to do in-depth uncertainty analysis than just to mention. Given the fact that tow remote sensing method has more inconsistency than the remote sensing and in situ, I recommend the author to explore similar relationship (as shown in figure 10) between remote sensing methods. What is the whole point of choosing remote sensing and in situ? Given in situ have unclear bias from the RH as discuss later by the authors. In addition, the difference should be mention in relative not in absolute.

Minor Comments:

Page 2 Line 12: Mixing state is also an important factor.

Page 2 Line 18: Absorbing aerosol also shown to impact the global circulation patterns (Brown et al., 2018) in addition to the facts included in line 16-20.

Page 2 Line 23: SSA is defined already.

Page 2 Line 24: "Typically between 0.7 and 0.95" this statement is not always true for BB smoke. There are lots of laboratory and ambient studies which shows a huge range of SSA from BB emissions (Liu et al., 2014; Pokhrel et al., 2016; Vakkari et al., 2014).

Page 11 Line 29: Is there a specific reason to calculate SSA by extinction weighted? What is the benefit of it over SSA calculated from vertically integrated absorption and scattering coefficients?

Page 12 Line 10: What was the noise level of 30s averages PTI?

Page 17 Figure 4: What is the slope of the fitting line?

Page 18 Line 23-24: Since bars on the figure represent 10-90th percentile ranges. Which factor (instrument uncertainty or variations in data) contribute more at a longer wavelength.

Page 19 Line 33: 4STAR 1km plume only or sky scan?

Page 21 Figure 5: Please use the same legend in Figure 5 & 6.

Page 23 Line 24-26: More explanation for possible reasons.

Page 23 Line 31: How aerosol loading impact the spectral dependence of SSA?

Page 23 Line 32: Do PTI and PSAP SSA's comparable at higher altitude cases only?

Page 24 Line 3: Why AirMSPI uncertainty increase by a huge amount from about 450 to 470 nm?

Page 25 Figure 7: Be consistent between graph and legend.

Page 31 Line 9: Please express difference in relative.

References Brown, H., Liu, X., Feng, Y., Jiang, Y., Wu, M., Lu, Z., Wu, C., Murphy, S. and Pokhrel, R.: Radiative Effect and Climate Impacts of Brown Carbon with the Community Atmosphere Model (CAM5), Atmos. Chem. Phys. Discuss., 18, 17745–17768, doi:10.5194/acp-18-17745-2018, 2018.

Liu, S., Aiken, A. C., Arata, C., Dubey, M. K., Stockwell, C. E., Yokelson, R. J., Stone, E. a, Jayarathne, T., Robinson, A. L., Demott, P. J. and Kreidenweis, S. M.: Aerosol single scattering albedo dependence on biomass combustion efficiency: Laboratory and field studies, Geophys. Res. Lett., 41, 742–748, doi:10.1002/2013GL058392, 2014.

Pokhrel, R. P., Wagner, N. L., Langridge, J. M., Lack, D. A., Jayarathne, T., Stone, E. A., Stockwell, C. E., Yokelson, R. J. and Murphy, S. M.: Parameterization of single-scattering albedo (SSA) and absorption Ångström exponent (AAE) with EC/OC for aerosol emissions from biomass burning, Atmos. Chem. Phys., 16(15), 9549–9561, doi:10.5194/acp-16-9549-2016, 2016.

Vakkari, V., Kerminen, V.-M., Beukes, J. P., Titta, P., Zyl, P. G. van, Josipovic, M., Wnter, A. D., Jaars, K., Worsnop, D. R., Kulmala, M. and Laakso, L.: Rapid change in biomass burning aerosols by atmospheric oxidation, Geophys. Res. Lett., 2644–2651, doi:10.1002/2014GL059396, 2014.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-142, 2019.