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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 #2

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The paper presents results from several instruments to measure or retrieve aerosol optical properties, especially aerosol absorption, single scattering albedo, and their wavelength dependency during the NASA ORACLES campaign in September 2016. The paper is well written, it is definitely worth publishing in ACP. Actually, I did not find any errors but some points I don't understand, see below. I also have some suggestions for improving the paper.

I tried to find basic info of the flights:

- Approximate flight altitude range of the two aircraft

- Thickness of plumes, flight time in plume

- Estimated age of the aerosol at the measurement location since emission from the fires

- Distance from coast and fires

- Range of scattering and absorption coefficients, RH, and AOD in the plumes

The info is within the text but very scattered. Consider giving these in a table where you present descriptive statistics of these properties. And combined to your Fig. 3.

There is the section " 4.2 Impacts of humidification on aerosols". The discussion concentrates on SSA, that discussion is ok. However, you used the in situ instruments also for calculating AOD. It is definitely underestimated by using dry in situ data. Actually, when I look at Figs. 6 and 8 it also looks like that. Discuss this. And I expected to see some figures on data collected with the RH-nephelometer. Why don't you use that? Some figure? How does the scattering enhancement vary in the plumes? Effects on AOD?

Detailed comments

P10L24, "... operational modes: step-and-stare view mode and sweep mode, " explain with a couple of sentences, not every reader knows these

P11L22-23 "SSA was calculated using the measured PSAP absorption combined with dried (RH<40%) TSI nephelometer scattering interpolated to PSAP wavelengths." Shouldn't you use ambient RH scattering when comparing with the remote-sensing instruments? The same applies to calculating AOD from the in situ data.

P12L12 "... and absorption (AAE) are calculated from PTI absorption for data within ... " How can you calculate AAE from a one-wavelength instrument? I must be missing something.

P13L19 " ... AOD, and absorption is then derived as the change in net irradiance over the AOD differential ... " Don't understand. Isn't the change of net irradiance due to

both scattering and absorption? If I am wrong, please add a short explanation.

Fig 3. Name the aircraft in the Fig. Draw approximate vertical and horizontal scales in km: plume and flight altitudes, plume thickness.

P17L9 "... The generally lower PTI absorption could be due to several factors..." How do you know which instrument to trust?

In section "3.2.1 Case study: 12 September 2016" the in-situ-derived AOD is clearly lower than that derived from the remote sensing methods (Fig. 6). It is explained by the inlet cutoff on P19. Then in section "3.2.2 Case study: 20 September 2016" the AODs are essentially the same (Fig. 8). Why is that? Why couldn't the explanation for 9/12 be an aerosol layer above the plume measured with the in situ instruments? Have you considered comparing differential AODs of the in situ and remote-sensing methods? That would help in eliminating possible error due to high-level aerosol not observed with the in situ instruments.

P27L28 "..due to the small range in AAE values retrieved from AirMSPI" Any explanations or hypotheses?

P28L4-5 " ... values of AAE for a mixed aerosol (smoke) that are less than 1 (for the wavelength range 440-675nm) are suspect in that they run counter to theory ... " This is not true, it is easy to show with a Mie code that AAE can be < 1 both for uncoated and coated BC particles. Have a look at Figs. 7-9 of Gyawali et al. (2009) and Fig 8 of Lack and Cappa (2010) and the related discussions in these papers.

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