Answers to the Reviewer#2

We thank the anonymous reviewer#2 for the detailed review. Including the suggestions by the referee has significantly enhanced the paper. In the following you will find our response to the reviewer directly marked in red.

REVIEW NOTES and comments:

Laboratory Validation and Field Deployment of a Compact Single-Scattering (SSA) Albedo Monitor

Journal: AMT
Title: Laboratory Validation and Field Deployment of a Compact Single-Scattering Albedo (SSA) Monitor
Author(s): Julia Perim de Faria et al.
MS No.: amt-2019-146
MS Type: Research article

Matrix Scores: Criteria:

Scientific Significance – Good 2

Scientific Quality – Fair 4

Presentation Quality - Fair

Over all English language presentation:

There is a general non-standard usage of comma separators, and a few general awkward English syntax constructions. However, it seems most intended meanings are clear. The paper could use revision of grammatical and syntactical usage to make the reading flow more smoothly.

Over all Scientific Presentation:

General lack of the definition and standard used for the terms accuracy and precision. There should be at least an equation presented for the calculation assumed in each measure. It is important as the system of closure for the complete instrumental experimental circuit depends not only upon the accuracy and precision of each individual instrument, but the data path through all of them.

The study could be enhanced by a true presentation of error propagation by classical form differential error analysis. The assumption of normally [Gaussian} distributed error seems perhaps unfounded in such a complicated closure strategy.

The work has merit and should be published conditional upon appropriate revisions and additions.
Specifics:

Table1: the mixture of AS+AD is assumed to have an SSA λ=630nm of 0.6 for the study case, but lacks details in discussion of how the mixture of the standard substances was to be controlled.

The SSA of the mixture containing AS and AD, was controlled by the online measured SSA measured by the CAPS $PM_{ssa.}$ See: Line 80-81 in the revised version.

…. The SSA of the mixture containing AS and AD, was controlled by the online measured SSA measured by the CAPS PMssa. …

We also added to the head of the table 1) that this is an expected/estimated value.

Lines 100 – 105:

Perhaps some calibration data could be presented, as well as plot of Scattering Channel signal vs. Extinction Channel signal. This could provide insight into baseline fluctuations and possible instrumental bias.

We have added Figure 4 (new) to the revised version.

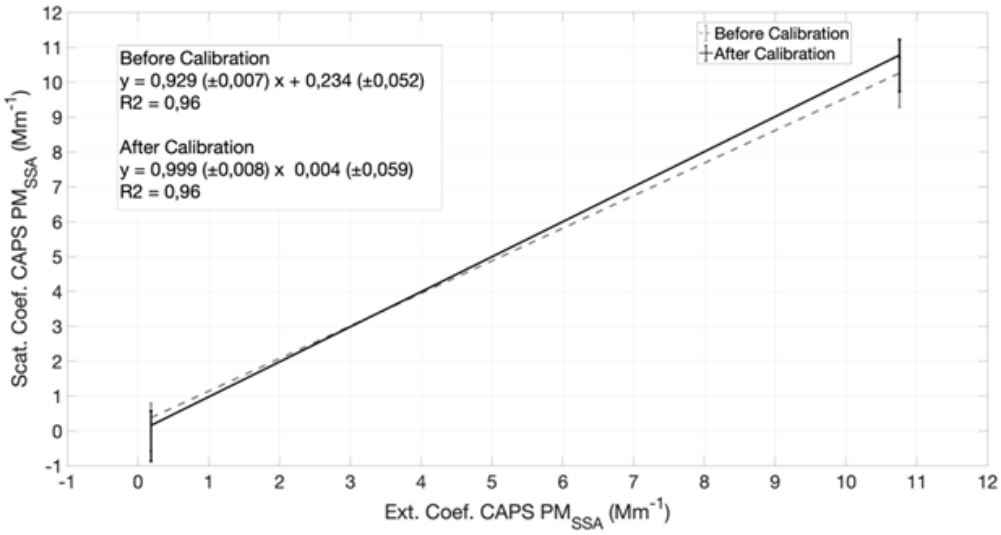

Figure 4. Scatterplot of the correlation of the extinction and scattering channel of the CAPS PMssa before and after the calibration using CO2.

Section 2.1.2

Lines 115 -120 “The instrument measures.....”

We have complemented the section.

Section 2.1.3 CAPS PMext configuration

It might be beneficial to include a figure as nicely detailed as that of Figure 2. For the CAPS PMssa configuration.

Figure 2 (new) has been added – although we still have to check the rights to publish a figure from another journal.

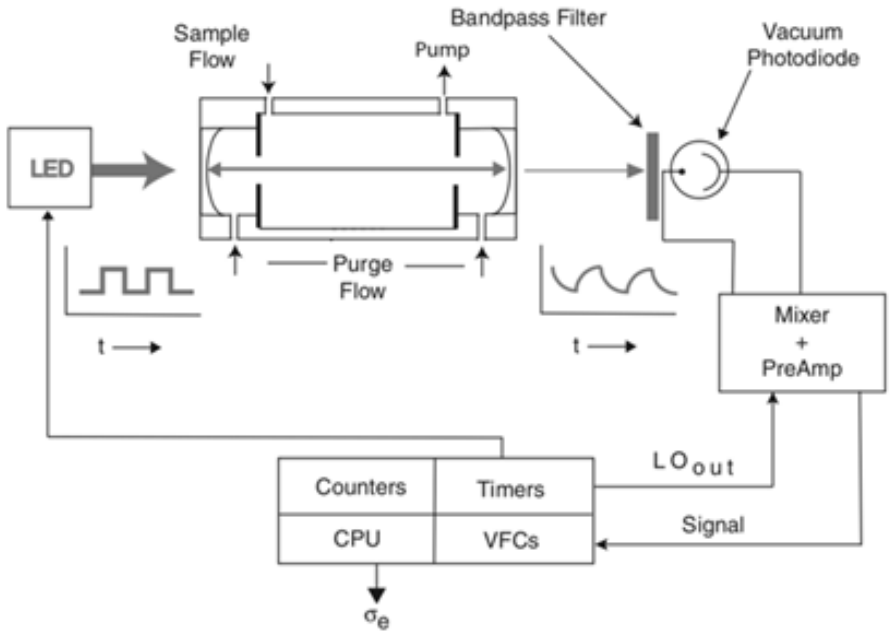

Figure 2. Overview of the main components and operation principle of the CAPS PMex instrument (Massoli et al., 2010)

Lines 140-145

One of the unique features of the CAPS PMssa set-up is the integrating sphere. The glass tube that passes through the sphere needs a bit more detailed information as it is inside the integrator. Some specifics as to the thickness of the wall, any coating it may have, it's optical properties should be characterized or listed somewhere from the manufacturer or supplier - if not determined during calibration of the instrument itself.

We have added more information in the lines 185 – 193

Petzold at al. (2013) showed that this purge flow shortens the measurement path and dilutes the sample and requires a correction factor. As done for the CAPS PM_{ex}, a new correction factor was developed, by using monodisperse polystyrene spheres (PSL) of know size, for the CAPS PM_{ssa}. Due to the cell geometry, the new correction factor was slightly larger than the one found for the extinction monitor, 1.37 and 1.27, respectively (Onasch et al., 2015). The noise of the instrument, trunction angle and instrument uncertainty have also been studied by Onasch et al. (2015). The values found were all below 1 Mm^{-1} for the noise levels (1σ, 1s) for all wavelengths. For the case of this particular instrument (630 nm), the truncation correction was determined

below 4% for typical ambient conditions. The uncertainty was estimated at ±0.03 for SSA equal to 1 (PSL and ammonium sulphate) and decreases to ±0.01 as the SSA goes down. (630 nm), the truncation correction was determined below 4% for typical ambient conditions. The uncertainty was estimated at ±0.03 for SSA equal to 1 (PSL and ammonium sulphate) and decreases to ±0.01 as the SSA goes down.

For more details we have to reference Onasch et al. (2013).

[A general Question: Were any other wavelengths considered or tested for the calibration standard? - No]

Section 3 discussion:
Some of the sentences could be divided into shorter more clear constructions Lines 210 – 215:

1) I think these critical figures could be sized up a bit

We have improved the resolution of the figures, but the final aspects will be determined by the layout from AMT, thus we will wait until the final version (format wise) is done to work on this issue.

2) There seems to be a general assumption that the standard deviation is the most reliable measure of experimental uncertainty. This reviewer is not sure this is a completely valid assumption.

The Reviewer is right, as long as the standard deviation relays on the assumption that the statistical population follow a Gausian distribution. We have not proven the assumption by applying a Chi square fitting test, but the assumption is not too bad considering the frequency of occurrence diagram (Figure 8 in the revised version) . We have chosen the standard deviation and not a quartile distance (used as distribution free measure) because most readers are used to- and will ask for it.

3) The reference to PSAP-NEPH extinction measurements being similar to those of Petzold 2013: this unfortunately requires the reader to find the other paper to validate this statement of event or know what the expected result was. A simple sentence could clarify this. [Yes, as one of the contributing authors it is perfectly acceptable to cite their own previous research articles, but perhaps a bit much to expect the reader of this article to be familiar with the result of that work.]

We have added lines 268-269 :

…similar to the one found by Petzold et al. (2013), in which an excellent correlation (slope of 0.99) was found for the laboratory comparison between the same instruments using highly absorbing aerosol, exclusive scattering aerosol and mixtures of both"

Section 3.2

Line 217: " There is no systematic error found neither in the average nor in the standard deviation of the measured values." Although the internal reference is to a table included in the supplemental material, it

is a mathematically unsupported assertion. A calculation or insight into how this statement is evidenced might make a stronger case for its inclusion.

The reviewer is right. We have changed the sentence

Within the error bars of the two instruments we could not observe a systematic deviation of both either in the average or in the standard deviation of the measured values.

Section 3.3

Figure10: is problematic on multiple levels: although the notion of overlying *timeseries* into a single track representing the CAPS PMssa and PSAP for the three type of aerosol particles testing is a good idea, the diagram has flaws. [same comments apply to Figure 7 on the scattering channel;]

1) The figures do not expand into full size charts and are presented TOO SMALL to intuit any scientific sense from their visual examination. [This may be a display result after the Copernicus online system was revamped for their paper display] But the authors could simple make a much larger figure.

We have improved the resolution of the figures, but the final aspects will be determined by the layout from AMT, thus we will wait until the final version (format wise) is done to work on this issue.

2) The horizontal axis has numbers on a scale with no mention or label as to their units. Are they "seconds" after the calibration sequence has finished? Are they minutes?

The Unit (seconds) has been added to the axis label.

3) Even if the individual axis numbers align, there is not a mention to assure the reader they were simultaneously measured.

We have clarified this in the Figure caption.

4) These figures as a set need to be amplified in the vertical scale so as to make visible Any regions in time where the CAPS PMssa signal fluctuations and spikes might not be synchronous to those of the supposed time coincident signal of the PSAP.

Same answer about the figures.

5) Expanding the horizontal time axes will allow the reader to view regions where the signals might not be precisely time correlated and any instrumental fluctuations as "noise."

This would require an interactive zooming option. Unfortunately this is not supported by AMT.

Discussion of this diagram is not complete. No mention is made to the significance of the regions where the traces converge over time to a common point in the AD and BC examples. No mention of the significance, if any, of time intervals where the signals step down, or step-up in sigma (σ).

This increase/decrease is seen in figure 12 for the absorption. The explanation is added:

"The increase in the absorption coefficient observed in Figure 12 for the higher levels of AD and BC, is related to the transmission decay of the filter in the PSAP and the correction algorithm chosen for this study."

NOTE: as mentioned prior it is not sufficient to cite a method "data correction" (Ogren 2010) without explaining why it is appropriate in this situation and how it fundamentally treats the data. Forcing the reader to find another paper to understand what is going on in this paper is not exercising good scientific communication skill. There is nothing wrong with the citation of Ogren 2010, simply the authors here should explain how and why is it used, as well as it's importance to the data collected in this research.

We have added all correction functions to the text for completeness. But we did not motivate them in all the details.

I would like to state that it is good practice to reference a data correction algorithms used to the paper without explaining them in all detail as long as they are commonly rated as best practice. If we would have chosen a new/or exotic algorithm then the referee is right. Scientific papers relay on the referencing system. Otherwise the wheel has to be invented again and again- and articles would be more like textbooks. It is no argument that it is some work for a reader to search for a paper. This is part of our job! On the other hand, reading the original literature gives the original authors the credit they should get.

It should also be noted that without a time series analysis proper [lag correlation, etc. as an example] there is not a reliable method to indicate how the static correlation coefficients presented in the table evolve over time as the instruments run. Correlation coefficients are important as measures, but should state clearly they might not reveal complex interrelationships between data signals as the instruments run over time.

In particular the lag correlation (auto- and cross-correlation) does not help for this kind of lab studies. We did not test the instruments dynamically for transfer- response- or relaxation-times. This would be part of an extra paper. A detailed time series analysis is needed for field measurements. The way we address this is to do the test for several runs repeatedly. Thus the reported correlation is not just a snapshot.

Section 3.4
This is the key portion of the research and should be strongly emphasized. Generally well done.

Line 281: does the statement "....expected values for each aerosol type" directly refer to table 1? If so, reiterate that. If not, please summarize the expected values directly here.

We have added the internal reference (Table 7).

THIS IS ENOUGH TO WORK ON FOR now