

Associate Editor Decision: Publish subject to minor revisions (review by editor) (12 Aug 2020) by [Andrew Sayer](#)

Comments to the Author:

Dear authors,

Thank you for your revised manuscript; I have received one review of it from a referee of the previous version. The referee and I appreciate the additional work put in here, particularly in the estimation of uncertainties. The referee has a number of minor comments on this version (mostly language issues), which I have reproduced below with some notes of my own.

I would be grateful if you could further revise the manuscript to address the below comments. I expect that, after this, I will accept the manuscript for publication in AMT without going out for another round of review. I know that this paper has been in review/revision for somewhat longer than normal and appreciate your patience. These comments are as follows:

I'd like to thank the authors for including a thorough analysis of the uncertainty propagation of the various combinations of instruments, and for making other improvements in the manuscript. I strongly recommend that they incorporate the uncertainties into their discussion and conclusions, focusing on whether agreements between the different instrument combinations agree within these carefully calculated uncertainties. This would be facilitated by plotting these uncertainties, rather than standard deviations, on the x-y plots. With these changes, the manuscript should be acceptable for publication following a substantial number of technical and minor edits. [Editor's note: a few additional sentences, and the plot modifications, would be good here. If the goal is to assess the agreement then in general I think uncertainty is more helpful to show than standard deviation.]

Minor changes and technical edits:

1) Line 23: change "lowest" to "best". "Lowest" is ambiguous; is low accuracy good or bad?

Done , ok

2) Line 29: change "measurement" to "determination". SSA is not directly measured.

Done , ok

3) Line 40: define σ_{ep} , σ_{sp} , and σ_{ap} here; they are not defined in Eq. 1.

Done , ok

4) Lines 45-65, and elsewhere in the manuscript: consistently use the mathematical notation for σ_{ep} etc. rather than writing out the variable name each time.

Done , ok

5) Lines 53 and 59: Change "measure" to "determine"

Done , ok

6) Lines 71 and 72: Change "aerosol" to "material"--it's not an aerosol until it's nebulized

Done , ok

7) Lines 113 and 114: Move this sentence to just before Eq. 5.

Done , ok

8) Line 116: Move Eqs. 8 and 9 to just after Eq. 4. You are using Angstrom exponent here; you need to go ahead and define it here.

9) Table 4: The column labels "Blue", "Green" and "Red" make no sense. The row label "Angstrom Exponent" makes no sense. The row label should be "Wavelength Pairs", and the column headings a(B/G) etc. should be replaced with "450 nm/550 nm", "450 nm/700 nm", and "550 nm/700 nm". Get rid of the first row with the unneeded column labels "Blue" etc.

Done , ok

10) Eq. 6: Define σ_{PSAP} here, not after Eq. 7.

Already defined there, definition after EQ7 deleted..

11) Eq. 7: Why use ω_{naught} for SSA when you've been using SSA throughout the text?

These is the original equation.

12) Table 5: Explain what the values in parentheses on the last row are.

done

13) Line 151: Remove "change in". When particles are introduced into the cavity, there is a phase shift, not a change in the phase shift. (I think?)

The change of the phase shift relative to the particle free case (Baseline) is the relevant signal.. Clarified in the text

14) Fig. 2: Make larger. Define LO_{out} . Use σ_{ep} instead of σ_{e} , for consistency with the text.

Size will be scaled during production process. Changed to σ_{ep} .

15) Line 172: Negligible differences between what and what?

..clarified in the text

16) Line 181: Change to, "The noise levels were $< 1\text{Mm}^{-1}$"

Done

17) Line 182: Replace "lower than" with " $<$ ". Also, won't the truncation uncertainty vary with the size of the particles generated? For ambient conditions the uncertainty may be $<4\%$, but maybe not for these lab tests.

Indeed, the truncation error depends on the size distribution. We know the size distribution of the dispersed particles- The truncation corrections is comparable to "ambient" case.

18) Eqs. 8 and 9: There is no need to introduce the variable "w" in Eq. 9; just use "x" and then the two equations make sense with each other (but move both to just after Eq. 4/5).

We think to move these EQs before Eq4/5 would interrupt the "reading" – We have added a link to these Eqs at EQ4/5 instead. (if the definition is needed for the reader)

19) Line 206: Again, this statement is non-sensical. Correlation is not useful and is not a goal; two measurements could be highly correlated yet disagree quantitatively. This study examines if the instrument combinations agree within uncertainties for a range of laboratory aerosols.

OK Agreed I adapted your formulation!

20) Table 6: Undefined parameters SEP, SSP, and SAP are introduced. Please use consistent nomenclature.

Done

21) Line 215: I suggest making the Appendix a Supplemental Materials section instead. [Editor's note: I leave this up to you. Practically, the main difference is that an Appendix will be part of the final journal pdf file while a Supplement will be a separate file also available for download from the final article webpage.]

I think the error propagation section should be part of the paper and of a separate document. Thus we would leave it like it is.

22) Line 226: "is principle"

Corrected

23) Fig. 4: In the caption explicitly state the time resolution of the data.

Done

24) Line 254: Replace "bellow" with "<".

Done

25) Line 256: Here is a place to clearly state, "These differences are within the combined uncertainties in measurements." Great!

Done!

26) Table 7: Are the values "Std m" and "std b" really standard deviations, or uncertainties in the slope and intercept, respectively?

Reputed is the standard error of the estimate, essentially the expected standard deviation of the calculated value.

27) Line 279: Replace "exclusive" with "purely".

Done!

28) Line 316: Here you refer to Table A3 as a "supplemental table". I agree the appendix should be a "Supplemental Materials".

Changed to "Appendix Table"

29) Line 326: Replace "below" with "<".

Done!

30) Lines 330-337: You may wish to say that the PM_ssa technique measures absorption with uncertainties comparable to that of the PSAP for absorption values greater than some minimum value. Done!

31) Section 3.4: In Fig. 12, the SSA value measured by PM_ssa for the purely scattering aerosol is far outside of the uncertainty value of 3% shown in Table 6. However, the expected uncertainty for a low scattering value is probably worse than 3% (Fig. 13 in the Appendix). In fact, it's hard to reconcile the broad-ranging uncertainties in the SSA values shown in Figs. 13 and 14 with the values in Table 6. Would it not be better to give a range of uncertainties and refer to the figures?

In this figure in particular the standard deviation (variability) is shown by the bars- not the errors of the average itself. The error of the single measurement is in the order +- 8% -9% (Fig. 13) which covers the out layer for low extinction.

32) Generally, I suggest you focus on the level of agreement in Fig. 12 and state if they are within expected uncertainty in the discussion and conclusions. Throughout the manuscript, it would be much better to plot the uncertainty bars (derived from the analysis in the Appendix/Supplemental Materials) in Figs. 5, 9, and 11, rather than the standard deviation of each measurement, to show the level of agreement between the various methods.

I disagree with the latter statement. As long as the instruments show a different time response (e.g. flushtime of the nephelometer > CAPS) it is not only the "numerical error" of the measurement which governs the inter comparison result. Here also the stability of the experimental conditions (e.g. production) is also needed and represented in the standard deviation to rate the result. Thus, we decided to leave the plots as they are.

33) There are numerous typographical and formatting errors in the references. For example, some references capitalize the title (e.g., Corbin et al.); sometimes the journal name is fully spelled out (e.g. Haywood et al.) and sometimes it's abbreviated (e.g., Heintzenberg et al.). There is an extra carriage return on line 409. These types of errors are characteristic of EndNote-type software; they format irregularly and must always be hand-corrected. [Editor's note: the journal typesetters will give specific queries related to these and apply consistent formatting at the page proofs stage, but it may be worth checking through yourselves as well first.]

Checked..

Please let me know if you have any questions.

Best wishes,

Andrew