

ACP Paper Review

Manuscript Number: 769

Manuscript Title: A multi-year study of lower tropospheric aerosol variability and systematic relationships from four North American regions

Comments

Abstract: Line 32-33: States that AOP from 1996-2009 at BND and 1997-2009 at SGP are presented. Table 4 presents data on the trend but not the AOP measurements. One of the most important conclusions of the abstract is “Statistically-significant trends in σ_{sp} (decreasing), PM1 scattering fraction (decreasing), and b (increasing) are found at BND from 1996-2013 and at SGP from 1997-2013.” However, there is not plot in the paper, nor the supplement showing this result. The paper needs such a plot to support this important conclusion, please add.

Measurement Uncertainties – It is great that the authors incorporate uncertainties in their analysis; however, their presentation of uncertainty is confusing in several places.

Line 357-358: “uncertainties can hence be neglected when comparing measurements made at different sites and times” “Neglected”??? There are no uncertainties? Seems that the authors want to say that the measurement uncertainty at one site is the same as the uncertainty at another site. Is this correct? The uncertainty is still there, it is just the same, hence can be “neglected”

I would suggest the authors use the terms precision and accuracy in their discussion. From https://en.wikipedia.org/wiki/Accuracy_and_precision#Common_definition

In the fields of [science](#), [engineering](#),], and [statistics](#), the accuracy of a [measurement](#) system is the degree of closeness of measurements of a [quantity](#) to that quantity's true [value](#).^[1] The precision of a measurement system, related to [reproducibility](#) and [repeatability](#), is the degree to which repeated measurements under unchanged conditions show the same [results](#).

Using these definitions, precision is uncertainty with an instrument and itself; while accuracy is between instruments. Hence, it seems that the author are saying that the uncertainty is the same an instrument with itself and between instruments. Can this be made clear?

When the author talk about “unit-to-unit variability” (Line 363), it is accuracy and for one unit it is precision. I would suggest using “accuracy” uncertainties instead of total as is done in Table 3. Also, may want to add a sentence defining these terms.

Additionally, I do not believe that all the sites have the same instrument for the full duration of the measurement period even at a single site and hence instrument variability may be important even at a single site. Maybe the absorption measurements were conducted with the same instrument for the 2010-2013 period but was this the case at SGP for 1996-2013 period? Either it should be explicitly stated what serial number instrument was used at a single site or the accuracy uncertainty should be used.

I have a large issue with using an annual-mean value to determine an uncertainty of a measured parameter as is done with the scattering and absorption values. The article supplement provides

uncertainty calculations in terms of percentages of the value measured; however, an mean value is then used to determine the uncertainty. This can be very confusing as the scattering has a larger uncertain (1.9 Mm⁻¹) than the absorption (0.52), while in fact the percentage uncertainty is larger for absorption. For scattering and absorption, percentages should be used and given in the tables and plots. Uncertainty in a measurements should not be given in term of an annual mean when a percentage could just as easily be given, such as for the scattering and absorption in Table 3. This could be very miss leading to other scientist that would just take the uncertainty and apply it to their measurements. Percentage uncertainties need to be calculated for each parameter in table 3 and then applied. The calculations are straight forwards and easy to apply but does take a little time. I feel this is very important to understanding the results of the paper. While applying this methodology is unlikely to change any of the conclusions, I feel it is important to maintain this standard as an example to other researchers where it could affect conclusions.

It is not clear why the annual averaged AOP in Figure 2 have lower uncertainties than the monthly averaged AOP. These uncertainties should be given as a percentage of the value not as a fixed value that depend on the annual mean.

Details

Article – The ACP style is to indent at the start of paragraphs, why are the article's paragraph's not indented? This make things difficult to read.

Line 304-307 – Why is the font different on these lines?

Line 349 – Two commas in a row.

Line 345 – Additional spaces in sentence.

Line 361 – Space between Fig. And 2g. There are a number of other examples of this, for example Fig.2 on page 1 of Supplemental Materials. Why where these simple things not fixed?

Table 1: Change to not take so much space vertically.

Table 2: Why double space, fix so does not take so much space vertically.

Table 3 Caption: Need space between numbers and units. I don't understand why this has not been corrected.

Figure 2 and all other figures: Y-axis values should have label with the same number of figures, 2.0 and not 2

Figure 3: Figures should be able to be understand independent of the text; hence, APP, BND and EGB need to be defined. The time period of the data presented need to be given. LST needs to be defined. Like “Day of Week” is the x-axis on the left, “Hour of Day” should be label on x-axis on right. Also, Week need to be capitalized.

Figure 9 and 10: Caption needs to give time periods and define acronyms.

Supplemental Materials: Why are the paragraphs not right justified like the main article?

Supplemental Materials – Page 2: Space between value and unit, i.e. 450 nm, 550 nm, and 700

Supplemental Materials – Page 3: Space between value and unit, i.e. 4 Mm⁻¹ etc.