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Comment on acp-2021-173

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Community comment on "Ambient aerosol properties in the remote atmosphere from global-scale in-situ measurements" by Charles A. Brock et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-173-CC1, 2021

Some Comments on Brock et al. paper by line numbers.

L49 Please specify the exact "…database commonly used in global models…"

L98 Please specify that "….an inlet.." is actually the " shrouded solid diffusor inlet designed by Clarke (University of Hawaii) and evaluated by McNaughton et al., 2007."

L184 Can authors clarify what is understood as "significant concentrations" criteria for cloud free air as stated "..absence of significant concentrations of droplet or precipitation size particles."

L220 The treatment of all components as externally mixed sizes would benefit from additional discussion of when this may or may not be a representative approach.

L232 "We substitute negative AMS values with zeros when calculating optical or hygroscopic properties." Does this have the effect of reducing uncertainties in these calculations or other consequences?

L273-275 Provide reference for "few percent" under typical aged plume conditions as seen by ATom and common coating thickness..

L473-479 Perhaps an examples of such profile should be included that illustrates application of these requirements. Some additional information would be useful

Approximately what fraction of profiles are excluded by imposing these conditions?

Are there some regions that meet these criteria more commonly than others?

There is also an implicit assumption that any layering in AOD is constant over the horizontal extent of a profile (not very common) but there is no lidar data etc. to confirm that. For example even in clean Southern Hemisphere regions and AOD dominated by sea-salt and water there is appreciable variability in meso-scale AOD (Shinozuka et al., JGR, 2004) and wind speed (and fetch) driving the sea-salt and water component.

L510+ Comparison with AERONET if profile is within 300 km is generally not going to be accurate due to commonly observed atmospheric variability over these scales. Needs more discussion regarding strategy here in the section labeled "Limitations of the Atoms Data Set."

L522 Far more robust comparisons with ambient extinction and AOD exist in the literature. Given the numerous and sometimes subtle considerations (Fig 2) for calculated extinction discussed here, I do not see how the agreement or lack thereof in Fig. 6 actually "……..indicates the methodology to calculate ambient aerosol optical properties is sound." It may be sound but better agreements with simpler assumptions exist. This data set is not designed to get AOD closure or even challenge many sources of uncertainty. One worthwhile objective would be to determine what are the most important measurements needed to characterize AOD within a specified uncertainty. Or how well do we need to know all properties to reduce uncertainties to an acceptable level. Assessing the global role of intensive aerosol properties measured would appear better suited to the ATom measurement strategy.

L523+ and Fig. 6

Fig. 6 Regression line should not be forced through zero (or at least include and discuss both forced and non forced regressions) and the few high AOD cases here are "the tail that wags the dog". For the majority of cases (AOD < 0.1) there are large disagreements with some greater than a factor of two. Aircraft uncertainty bars seem larger than expected.

Prior careful Southern Hemisphere clean region profile comparisons to AOD (and AERONET) highlight importance of meso-scale variability and windspeed etc. (see Shinozuka et al, JGR, 2004).

Fig 7. These data points need uncertainty whiskers added. Given uncertainty in Fig. 6 it is hard to know what to make of the variability in this data shown on a log scale. Some discussion and comparisons to other references appear warranted here.

L635+ and Fig. 12. Please note the actual number of profiles used (and excluded) that were used to generate each of the panels shown in Fig. 12.

It should be noted that a single 30min profile flying at 450m/s covers about 800km on the ground. The tropics are not a closed system. Hence, horizontal advection in multiple layers below the aircraft is the norm on such scales and usually varies with altitude while advecting at rates far greater than subsidence. Hence, it is problematic to interpret subtle changes in mean values for multiple profiles as an indication growth without other data that can support it.

L665+ I am not clear on what argument or process is being claimed here. "This decrease……..with increasing altitude."

L682+ Yes, it would be difficult in this paper to try and compare ATom data to "the extensive literature on global aerosol microphysics….". A comparison to OPAC makes some sense since it is widely used. However, a comparison to shipboard data does not seem particularly useful.

Admittedly there are a large number of comparisons to other data sets that might be made for various purposes. However, there is the extensive aerosol profile data by Clarke and Kapustin (Science, 2010) for many similar regions sampled by ATom. Much of this is flown on the same DC-8 platform, using the same inlet system and with similar instrumentation. That paper synthesizes eleven global campaigns and about 1000 vertical profiles to address issues of aerosol size, nucleation, optical properties, CCN etc. and include the objective of providing input for modelers etc. (see supplementary material). Some reference to this work should be made and possible selected comparisons could be considered.

L726 I think the heading "Limitations of the ATom dataset" sounds more prejudicial then necessary. The data is what it is. Perhaps something like "Use and Application of the ATom data set" would work with a lot more effort spent in the text on guiding modelers and others in its effective use.

L770-775 I recognize that detailed uncertainty analysis is beyond the scope of this paper. I assume it will be a part of other papers analyzing the data. However, Figures 6 and 7 raise some concerns noted above. Here it is claimed that Fig. 6 suggests that that accumulated errors in ambient extinction are <30% but it appears that a significant number of points would fall outside a 30% deviation from the regressed line. More discussion of this is warranted.

L796++ The initial findings described here are a disappointment given the potential capabilities described for the instrumentation. These are all basic observations that have

been well established in numerous global measurements and will be common knowledge for most readers interested in this paper. These "findings" are not a justification for a program of this scale and a greater focus on the characterization of the intensive aerosol properties seems warranted and of interest.

L800-803 "To our knowledge this is the first….."----- This claim is not correct! The Clarke and Kapustin 2010 Science paper mentioned above synthesizes eleven airborne campaigns of very self-consistent global airborne profile data for use by scientific community (see supplementary data.) Moreover, in addition to the synthesis in that paper, the archived NASA and NSF data sets it references are all available and merged with gas, aerosol size and composition, radiative properties, meteorological and aircraft data etc.. Many also include continuous lidar (up/down) that allows visualization of the 2-D atmospheric curtain (eg. aerosol, ozone) that the plane is sampling.

L803-806 I do not think "Snapshots" really describes the nature of the data and no aircraft campaign can really provide a climatology. Only the synthesis of model and satellite data can do that. Aircraft measurements can help ensure the interpretation of these products is consistent with observations. Greater effort describing how to use ATom data for that objective is warranted.

Concluding comments:

This provides a good overview of ATom data. Suggesting and discussing strategies for using the ATom data would be helpful for modelers and others. The authors do suggest modelers "nudge times" to coincide with the data sets and suggest "….the model domain be sampled along the flight track". This is probably essential for any direct comparison of aerosol "extensive" data to models but is far more demanding than summarizing mean profile values etc. An example on the scale of ATom data is the comparison of DC-8 NASA PEMT mission aerosol data over the Pacific (Clarke et al., JGR, 2001) with the MATCH assimilation chemical transport model (Collins et al., 2001).