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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The radiative impact of out-of-cloud aerosol hygroscopic growth during the summer monsoon in southernWest Africa" *by* Sophie L. Haslett et al.

Anonymous Referee #2

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This manuscript describes measurements and estimates of particle water during a field campaign (DACCIWA) in West Africa in June and July 2016. The investigators present measurements of particle mass from an AMS aboard aircraft platforms and RH measurements from balloon launches. The authors identify an important open question in atmospheric chemistry, that is, what is the concentration of particle water and how can that be used to understand the radiative impacts of atmospheric particulate matter. There is literature that relates particle water to AOD, and it is not cited here. I find the manuscript tries to make broad statements beyond their analysis. As case studies this manuscript could be very good. I cannot recommend the article for publication in its current form.

Specific comments

Abstract: Line 1: atmospheric water can also exist in the solid phase The authors state: "at high humidities more water vapor condenses onto particles.." This is true for a constant particle concentration and unchanging chemical composition. A main conclusion in the abstract is "Therefore, …. AOD … can be described by relative humidity alone." The evidence presented here does not support that conclusion and contradicts other published manuscripts from the same campaign.

Page 2, starting at Line 29: the extent to which particles take on water is also dependent on the particle concentration in addition to chemical composition.

Page 3, Line 58: I find a lack of support that ZSR calculations are more reliable than HGF calculations for nitrate-containing particles. Hennigan et al., ACP, 2015 (doi:10.5194/acp-15-2775-2015) and Guo et al., ACP, 2015 (doi:10.5194/acp-15-5211-2015) find closure when considering nitrate. Perhaps the calculations here may be more accurate, but the "likely more reliable" statement is not well supported.

Page 3, Line 65: The authors should back up their statement that organic compounds contribute less to particle water than inorganic species. There are several examples. Since the investigators used an AMS: Nguyen et al., ES&TL, 2016 (DOI: 10.1021/acs.estlett.6b00167).

Page 3, Line 82: The basic premise of this manuscript is that HGF is dependent on RH not particle concentration or chemical composition, which directly contradicts the argument the authors make here, that b/c anthropogenic emissions are expected to increase, hygroscopic growth will be impacted. They could argue RH might change … but they should not contradict themselves.

Page 4, sentence beginning at line 107: The authors state mineral dust contributes little to aerosol volume. This assertion is not well defended and is contradicted in a recent manuscript: "Potential climate effect of mineral aerosols over West Africa:

Part IIâĂŤcontribution of dust and land cover to future climate change: by Ji et al. https://link.springer.com/article/10.1007/s00382-015-2792-x. Would the authors resolve this statement in the context of the existing literature?

Page 8, Starting at line175: The authors could not discern a diurnal profile due to insufficient sampling and then 'therefore' assume constant chemical composition throughout the day is not well defended. Figure 7 from the campaign's overview paper "THE DYNAMICS–AEROSOL–CHEMISTRY–CLOUD INTERACTIONS IN WEST AFRICA FIELD CAMPAIGN" Flamant et al., BAMS, 2018 shows a time-of-day change in aerosol backscatter (related to HGF). It is rises during the day and is not lowest when RH is lowest. Likely this observation is due to changing aerosol concentration and chemistry, and subsequently kappa and properties that change particle growth factors are changing. If RH is the predominant controlling factor, why does the timing of Flamant's Figure 7 of backscatter not match the time profiles of RH here? I cannot accept the stated assumption as a 'therefore'.

Figure 7: how are data extrapolated above $\sim$2500 asl specifically? Is it a linear extrapolation? Typically these profiles are assymptotic to zero. Instead of plotting an example profile, it's my opinion that a distribution about the mean or median would be better. I think it unlikely the vertical profiles all match the average so well, but acknowledge there may be little variability and I may be wrong. As presented it is difficult to tell. Also, is this aerosol mass as measured by the AMS or do the estimates include particle water?

Figure 1: The authors consider data from only a small fraction of this map. The excluded areas should be masked in some way to highlight they are using a subset of data that is not representative of this entire map.

Page 7, Line 154: Can the authors back up how they know the aerosol was “acidically neutral” in all studied cases.

Figure 2: It seems the authors flew to $\sim$3000 a.s.l .but only present data to 2000 a.s.l.

Why? The nitrate-to-carbon ratio changes from a factor of $\sim$5 to 2.5. Would the authors explain what they mean precisely by “stable chemical distribution” *line 170.

Page 8, Line 175: The authors state that because they could not attain a sufficient sample size ... “therefore” the aerosol concentration and distribution is ... constant throughout the day. This does not logically follow and contradicts data presented in manuscripts from this campaign, and I would argue data presented here.

Figure 10: At first I thought this distributions were over-layed and then after seeing Figure 11 it seems they are stacked. This is not clear. What is the physical meaning of AOD>1? It seems the authors use a qualitative visual inspection of a) and b) (which have different y-axis limits) to state definitively similarity. I do not think this conclusion is well-founded.

Editorial I find the introduction disjointed and in many way disconnected from the manuscript's science. It seems sections were written by different people in different styles and the manuscript does not read as a coherent document.

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