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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Composition and mixing state of atmospheric aerosols determined by electron microscopy: method development and application to aged Saharan dust deposition in the Caribbean boundary layer" *by* Konrad Kandler et al.

Anonymous Referee #1

Received and published: 4 June 2018

General comments The authors have provided a very nice manuscript of measurements and associated modelling of aerosols in the Caribbean boundary layer which is suitable for publishing in ACP. The composition and mixing state of dust, sea salt and sulphate are analysed and they have been detailed in their efforts and provide a good analysis of uncertainty in the results. The general flow of the paper could be improved by condensing the methods and some small additions to the discussions. Of note I feel is the dry deposition discussion – a parameter which hinders aerosol modelling in

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general and, as shown here, needs further work in constraining.

Specific comments
Methods:
The methods section is highly detailed, particularly in its use of equations. While it is commendable to be thorough in an analysis I feel the manuscript would greatly benefit from condensing the main methods to the core equations and text. Following each one through in detail to its final derivation is not necessary for the discussion and instead detracts the reader from getting to said results. The SI is the ideal place for much of this text, and some could even be removed totally.

For example,
Section 2.3.5: It is good to be thorough and test other statistics, but this is not necessary in the main text and somewhat disturbs the flow. It is sufficient to briefly state you performed the bootstrap analysis with 10,000 replications and move on.
Section 2.4.1: The Petters manuscript and hygroscopicity term is well known within the atmospheric community. Small statements about assumed values and uncertainties would be sufficient I feel.
Results:

Section 3.2.1: In Figure 5, model d (Aluko) looks like it would perhaps give closer agreement to results in Table 2 than it does. By comparing results of model e (Piskunov) and d (and others if appropriate, e.g. from the tuning exercise) could the Authors also comment on impacts that uncertainty in differences in the deposition velocity for fine (<2.5 um) or coarse (>2.5 um) mode aerosol has on the results? - which are significant for fine mode between models d and e, but more similar in coarse mode.
Section 3.3.2: This is a great section but would befit from a bit more explanation I

feel. How do the airmass providences link to the trajectories? Fig 15 looks similar to the trajectories, but Fig 16 (particularly the iron) has a very difference providence – how was this reached? This is important as the air mass trajectories suggest there is a difference in 2016 in that it has a much stronger European component to it than 2013. Which makes sense with the SO4 sources analysis. However, the southern African source the Authors state for the combustion iron is less obvious I feel from the trajectories themselves, although apparent in Fig 16. Furthermore, the total iron to dust correlation is unfortunately not shown but, as the authors point out, combustion iron has become a topic of much discussion recently and so it would therefore be good to see this result and then put in the context of whether a combustion iron source is visible in 2016 vs 2013. For a south American source can the Authors identify if this likely to be anthropogenic or biomass burning dominated?
Section 3.3.4: Small additional discussions about

1) Iron solubility: interstitial and cloud-borne changes with sulphate in particular.
2)Relative concentration of feldspar in the ice nucleation discussion.
3)Wet deposition as a loss process when activated to be CDNC. Would be interesting.

Technical corrections

Figures
Please add legends to all figures where missing and check the use of colours is appropriate (see below for some examples).
Fig 2: The use of a log scale and a continuous colour bar is not intuitive. Please change to a discrete colour bar (10 or 5 colours).
Fig 4: colours do not match numbers using this scale, e.g. green is 2.5-4.5, but blue is 1.2-1.8?

Fig 12: The empty box plot for high volume sampler concentration looks odd. I suggest replacing with a simple horizonal line or a shape (e.g. a star).
Fig 13: the x-axis is logscale, but the bars are a fixed width. This does not make sense. Either alter to scalar plot (preferred) or alter the width of the bars to match the scale.
Figs 15, 16: Again, the use of continuous colours would probably be better as discreet.
Fig 16: 2013 small Fe-rich particles looks like it missing the data?
Fig S4, S5. Increase legend size to a single bar and add numbers to it.
Fig S9 : see Fig 12 note above
Supplementary tables and figures can be grouped together (currently tables are interspersed throughout figures)

Text
Italics are suggested additions to text.
L35: Largest by mass only, not number.
L36-37: Expand this by a sentence, too brief.
L40: Define the Central American Dust Barrier causes.
L42: What processes are not fully understood? Use of 'these' is too vague here.
L44: Change to: '. . .by *physical and* chemical processing, . . .'
L46-47: This is quite obvious. Best to either expand or remove sentence.
L47-48: Link with expanded L36-37 as to why this happens.
L49: While could start a new paragraph.
L49-51: Brief summary of these studies/anything of importance to note?
L55 an on: change methodical to *methods*
L62: 'Offline' can mean many things. Define it here to avoid ambiguity.
L111: remove space before comma
L198: '. . .mentioned correction methods as*a* function . . .'
L199: 'a higher accuracy *in* . . .. can be achieved'
L246: '. . .not *the* focus ..'

L255: '. . .separately an important. . .'
L260: without seeing the dust:iron ratio it is not possible to say that Fe is safely assumed to be from dust and not combustion.
L540: 'conclude'
L722-723. Deposition velocities are described in section 2.4.2.
L792-793: 2016 listed twice. However, I can see no obvious difference in the air masses coming from South America in Fig.S6 anyhow?
L801-803: Nitrate as well as sulphate associated with dust sources is likely to be from Europe (e.g., anthropogenic in origin).

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