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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterisation of the filter inlet system on the BAE-146 research aircraft and its use for size resolved aerosol composition measurements" *by* Alberto Sanchez-Marroquin et al.

Anonymous Referee #2

Received and published: 10 July 2019

This paper presents a characterization of the filter inlet system of the research aircraft BAe146. It includes calculated inlet sampling and transmission efficiency, a description of the analysis of the filter samples by scanning electron microscopy (SEM), and a comparison of the size distributions obtained by SEM with underwing aerosol and cloud probes.

Unfortunately, the manuscript suffers from being vague at important points. Especially for a technical journal, a comparison between calculations and measurements needs to discussed in more detail. Also, expressions like "in agreement" are used frequently

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Discussion paper

where a precise numbers (with error limits) would have been necessary. Thus, I can not recommend publication in the current stage and suggest some major revision before publication:

Major points:

As said above, the manuscript lacks precise numbers. Many statements are vague, like "in agreement" or "minor fraction" etc. This is not sufficient for a technical journal.

Furthermore, the SEM part is a description of the classification, but no further validation is done. Additional aircraft-based gas (e.g. CO) and particle measurements (mass spectrometers?) may help to characterize the air mass origin and the particle properties and thereby validate the composition. The comparison of SEM size distribution with the PMS probes is not very conclusive, because only qualitative statements ("in good agreement") are made.

Furthermore, the size distributions of the PCASP (Fig. 5) seem to have a problem at 300 nm and above 2 μm. The PCASP shows decreasing number concentrations above 2 μm while the CDP starts at 5 μm with much higher number concentrations. Does the PCASP underestimate particle number above 2 μm? If so, would it be better to omit these points and use a lognormal fit to the reliable CDP and PCASP data to obtain realistic fine and coarse mode distributions? To what extend can such size distributions validate the inlet efficiency if the uncertainties are so high?

Figure 8-10: Have the SEM data been corrected for the calculated inlet transmission and aspiration efficiency? I could not find a statement on this in the text. If not, then an overestimation of about a factor 3 - 4 around 10 μm should be observed (from Fig 3b). Is that the case? By bare eye, the factor seems to be larger than three, but there is no discussion in the text, except for a "good agreement" statement.

Minor

I was a bit confused by the mixture of sampling efficiency study and chemical compo-

sition study. I see that both needs to be done, but I needed some time to realize that the manuscript focuses on these two topics. Mabye a change of the title would help the reader.

Specific comments

Line 353: "This happens more frequently for smaller particles, but it can also happen with some larger particles..." What is "smaller" and "larger" here? Please be more precise and give a size range.

Line 366-368: "The number of particles is very low, typically about the order of magnitude of one particle per 100 by 100 μm square, which is well below the typical particle loading on a filter exposed to the atmosphere" Please give numbers for typical particle loading. "Well below" is not quantitative.

Line 373: "...from the analysis of atmospheric aerosol (it was only ever a very minor component)." Please specify "very minor"

Line 374: "By doing this, we make sure that we excluded more than half of the artefacts of the analysis" I don't understand. Before that, you said that >90% contained Cr, so you would remove >90 of the artifact, isn't it?

Section 7 Did you observe any signs of meteoric material (see Murphy et al., 2014)? Particles dominated by Fe, Mg, Si and S ?

Line 501: "sodium chlorine" -> sodium chloride

Fig 4, caption: "FAAM core datasets" have not been explained before

Fig 5 + lines 257-264: As already written above, the size distributions of the PCASP (Fig. 5) seem to have a problem at 300 nm and above 2 μm. The PCASP shows decreasing number concentrations above 2 μm while the CDP starts at 5 μm with much higher number concentrations. Does the PCASP underestimate particle number above 2 μm? If so, would it be better to omit these points and use a lognormal fit to the

reliable CDP and PCASP data to obtain realistic fine and coarse mode distributions? What happens at 10 μm with the CDP?

Figs 8 and 9: I suggest combining Figs 8 and 9 into one figure with 4 graphs

Fig 8, 9, 10 and line 415: "The results of these comparisons are in agreement with the theoretical calculations in Sect. 2.2." Did you correct the SEM size distribution with the calculated sampling efficiency? Can you divide SEM dN / PMS dN and derive an "experimental" sampling efficiency and compare that to the calculated curves in Sect. 2.2? One of the above should be done, otherwise your statement "are in agreement" is too weak.

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