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Atmospheric Measurement Techniques Discussions

Interactive comment on "Particle sizing calibration with refractive index correction for light scattering optical particle counters and impacts upon PCASP and CDP data collected during the Fennec campaign" *by* P. D. Rosenberg et al.

Anonymous Referee #2

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General

The manuscript "Particle sizing calibration with refractive index correction for light scattering optical particle counters and impacts upon PCASP and CDP data collected during the Fennec campaign" by P. D. Rosenberg et al. describes a calibration method for OPCs which are in extensive use everywhere in the world. The technique that is described is for sure worth to be published in AMT after some corrections after having

clarified open questions.

1) The work that this manuscript is based on is for sure not to underestimate. Nevertheless it seems that it is incomplete. The authors describe a calibration method and apply this on a measured data set. The result they compare with the same data set treated according to the specifications of the instrument producer. Why do the authors provide no absolute comparison with a reference. Then it would be much clearer which technique is better. In this context it is not clear why the authors used a DMA for generating particles but they did not use a SMPS for checking the DMA generated aerosol size distribution. At least a CPC in parallel to the calibrated PCASP could provide something that can be compared with what is recorded by the PCASP – this would improve the described calibration procedure by additionally calibrating concerning OPC-measured particle number.

2) I'm wondering about the use of the expression "particle size distribution" in connection with Figures 3 and 5 and in according caption and text referring to the figures. What is shown here is anything but a particle size distribution. What is shown here is a pulse height in unspecified units versus a frequency of appearance (by the way, without any unit). So, I suggest that established termini are used more carefully. It would help, just to change into another expression.

3) The authors mention turbulences in an inlet, particle losses in tubes, the bandwidth of the DMA selecting certain particle-electromobility-diameter (which is not the true particle diameter). But it is not very clear how these uncertainties are considered in the calibration and particle sizing.

4) Some sentences are pretty long (e.g. page 109, 12-15; page 118,16-19 – more cases can be found throughout the text), additionally with quite complex constructions. The manuscript would improve if these constructions were "streamlined".

Specifics: Page 99, line 25: of which size, concretely, are the "largest particles"?

Page 100, line 6: I guess “though” should be “through”

Page 100, lines 9-10: why once writing 0.06μm and later “one-hundred micrometers”?

Page 100, line 12: What is meant with “Shadow OPC”, please provide an example and Reference(s), if available.

Page 100, line 19: In which sense is “particle is homogeneous” meant?

Page 100, line 21: In which sense is “homogeneous water” meant?

Page 101, lines 1-3: Please provide Instruments names and Reference(s), if available.

Page 101, lines 22-23: A word seems to be missing in this sentence.

Page101, line 27: please provide concrete values for the sample and sheath flow of the PCASP in the setup that is used here

Page 102, lines 12-13: knowing these digit values is pretty useless for a reader

Page 102, line 19-21: the description of the inlet is not very clear. It seems that the authors mean a diffusor-type inlet. Perhaps following references help to specify this specific inlet:

“Wilson et al., Stratospheric sulfate aerosol in and near the northern hemisphere polar vortex: The morphology of the sulfate layer, multimodal size distribution, and the effect of denitrification, J. Geophys. Res., 97, 7997–8013, 1992” or

“Hermann, et al., Sampling Characteristics of an Aircraft-Borne Aerosol Inlet System, J. Atmos. Ocean. Tech., 18, 7–19, 2001.”

Page 102, line 22: how does this needle valve impact particle losses?

Page 102, line 18-28: This will cause turbulences and thus additional particle losses

Page 102., lines 28-29: In which sense is the subsample maintained? For a reader that does not know the work of Belyaev and Levin it would help if the “range covered”

is provided explicitly.

Page 103, lines 2-9: Now a statement about the turbulence comes up - and a bunch of additional information is following. Seems not to be essential for understanding the calibration described later. Apart from this any conclusive statement at the end of this section is missing. Bottom line: these details about the aircraft operation, increased flow, turbulences, fluid-dynamics, etc. leaves more questions coming up than it answers.

Page 103, lines 20: “known as the Sizer and the Qualifier” is there a reference defining these expressions?

Page 104, line 2-3: This statement is seductive for asking the authors: Why not? This would even further upgrade the manuscript.

Page 106, line 16-22: I suggest to put all of this in a list placed underneath the equation.

Page 106, lines25-27: For the sake of clearness I suggest to put this in a table.

Page 108, line 13: Which type of DMA? Are there any references?

Page 109,line 1: how is the particle number controlled? Was any reference particle counter used?

Page 109, line 5: At which concrete particle concentration would coincidence be expected to cause problems for the CDP?

Page 109, lines 6-7: So how are described problems avoided in this work?

Page 109, lines 11-13: how long is the tube length, concretely, if talking about “directly connected”, or “a section of flexible tubing”.

Page 109, line 16: please specify “as short as possible”

Page 111, lines 4-5: Neither the expression in the Fig 3 caption is correct nor the text referring to Fig 3. This figure shows pulse height vs frequency and not “mode particle

scattering cross section". The Figure is not a particle size distribution. One is confused about the number in the graphs: what is the mode diameter

Page 113, lines 8-12: The particles-inertia based impactor technique is not the best way to "physically remove" multiply charged particles from a calibration aerosol.

Page 114, lines 12-14: This sentence makes obvious that particle number was measured somehow. And one would like to know with which instrument that is not shown in the calibration setup and how/where these measurements were used or why not used.

Page 119, lines 14-15: The argumentation of not well defined lower boundaries of the first bins should be discussed in more detail to make plausible that there is a rational to simply discard measurement data.

Page 121, lines 8-10: From this section one gets the impression that more "corrections" were applied to the data set which the new calibration technique is applied on. In contrast, it seems that one took less care of the data based on the manufacturer specifications. If so, the data sets cannot be compared that easy. If not, the procedure should be described more carefully and detailed.

Page 121, lines 15-16: Nevertheless the discontinuity is still present. Is one of aims of this new calibration procedure really to reduce this discontinuity? Where is the proof that the reduced discontinuity is closer to the true size distribution? On the other hand features like a mode between 1.5 and 4 μm are amplified. In the panel "c" one could misinterpret this as a mode in the particle size distribution – this risk would be minimized in the size distribution shown in panel "a".

Page 122, lines 1-3: A reader could ask why this work was not completed by the data from the shadow OPC.

Figures: Figure 1: Suggestion: Change the colors of the graphs such that one color is not used for two different substances.

Figure 3: The ordinate axis has no unit. It is not clear where the numbers (in units of

μm) in the graphics come from. Finally the question arises if these are single measurement runs or if the experiments were repeated several times. In later case, a statistic (error bars) would be nice.

Figure 8: The label "d" is missing in according graph. The comparison would improve if "c" and "d" were shown together with "a" and "b" in one plot, respectively.

Figure 5: The lines between the measurement points might cause misinterpretation. In fact the measured data point should be shown without any line in between. Furthermore the question arises where the 0.30μm in the graphic is connected to. If this value fits to the maximum that is locate exactly underneath the 0.28μm peak the question comes up how this can be?

Figure 6: The ordinate label "F" should be highlighted. Error bars are missing here.

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