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Comment on egusphere-2022-1244

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Referee comment on "Characterisation of a self-sustained, water-based condensation particle counter for aircraft cruising pressure level operation" by Patrick Weber et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-1244-RC1, 2022

Review of "Characterization of a self-sustained, water-based condensation particle counter for aircraft cruising pressure level operation" by Weber et al.

The present manuscript deals with the performance of a new commercial condensation particle counter aimed for the automated operation onboard passenger aircraft. In a laboratory simulation of the flight conditions, the performance was characterized. The thorough characterization of such an instrument for standard operational use is an important task, and it may serve as reference for the deployment of this instrument at other locations. The manuscript shows the results of these calibration measurements and discusses deviates as function of thermodynamic conditions. It generally shows the suitability of the instrument for the intended use, onboard the IAGOS container.

The manuscript is suitable for the publication in AMT, but requires some clarification and corrections. A grammar check for punctuation is suggested.

Remarks/Questions

Abstract: It should be mentioned in the abstract that the instrument was modified after this investigation. Also, maybe a recognizable instrument version of MAGIC should be given to avoid misunderstandings of the applicability.

Figure 1: Many arrows are not straight, which is inadequate for a scheme. What is the difference between the line from the top labeled 'flow control' and the line from the left without label above the humidifier? If the butterfly symbolizes a MFC, why is the additional 'flow control' needed? G-CPC should be explained in the caption. Flow rate ranges (and pressure ranges) should be given for all flows, not only for one. Also the pump symbol should be in the legend for sake of completeness. A better match to 'Humidifier' would be 'Dryer' instead of 'Dehydration'. The caption has an unmatched parenthesis.

110-125: I can't make much sense of this section. It is too short to give a real explanation of what was done in this previous work of Bundke et al. 2015. And it doesn't make sense showing a curve from the previous work and then stating, that another curve has ben used. Or is there a different physical meaning between xi and eta?

This section should be thoroughly reworked. Either extend it to give a short explanation what was actually done in which step, or remove it, refer to the literature (and in case, state what was different to the previous approach).

148-163: This seems to be one of the key achievements. But we learn here for the first time, that MAGIC is actually not specified for < 300 hPa, which might be on of the motivations of that study. Therefore, the problem should mentioned in the introduction. Also, some more information on the optimization procedure would therefore be useful (plots). E.g., at which laser voltages and which sensor thresholds / offsets the system operated with what efficiency?
From 155-157 we learn that detector offset and threshold are different properties, but the expressions are used before. Maybe a sketch of the instrument and its logic would help here following the explanation. Are offset and threshold applied to the same reference potential or do they apply to different part of the electronics?

165: Without further explanation, Fig. 5 should be in the method section describing the aerosol generation. What means 'the particle mobility sizes were measured to 138 nm'? There is a size distribution displayed – the maximum of the soot distribution? Why is the size resolution as a result suitable for the cut-off characterization? Y axis: In Fig. 3, the symbol was used, but here a description instead of N_FCE. Unify (Applies also to other plots).

179: Fig. 6: The D50 apparently doesn't match the fit curve. Which data does D50 refer to? Is the fit curve in this case then suitable? Same applies to Fig. 8

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Minor remarks/Corrections

39: Reference format

42: Reference format

44: ‘limited’: Chose another wording. Being a greenhouse gas might be unfavorable, but it not really a limitation (compared to a flammable material onboard aircraft). And water vapor is a greenhouse gas, too, though of course weaker.

46: Doesn’t the reference belong to the second statement after it?

70: Reference format

75: Remove ‘as well’?

101: What happened to 2.1 and 2.2?

102: Multiply charged?

103: It is not an error of the DMA, as it simply selects according to charge-to-size ratios (or effective mobility). It’s an error of the data interpretation by assuming a unique effective-mobility/size relationship. The effect of course is correctly described, but I suggest a more careful wording.

104: ‘This effect…’ These different sizes?

109: Figure 2 is not referenced (or referenced as Figure 3). Figure 2 doesn’t add much information over the text. Remove.

112: While for N_FCE is quite clear, what it should be, the symbol is not explained above. This equation has no number, but the next one ha. Why?

121: '_' before Xi

122: Reference format

130: 'pressure detection': barometer / pressure sensor is measuring

131: 'until only the detector threshold is the only limit of signal detection': unclear. Reword.
And why is the threshold decreased, if the laser power increases? One would expect that also the 'background' light intensity would increase, and therefore the threshold should be increased.

143: 'optimised' should be explained in the caption

144: 'droplets, which need to be counted.' ?

146: If there is a 1-sec average, what is the actually reading frequency?

146: 1-sec averaged à 1 s average or one-second average

146: It seems that [standard] laboratory ?

171-173: Quirky. Rephrase.

173: corrected -> multiple-charge-corrected

174: concerning -> with respect to

174:remove multi-charged

175: FEC -> FCE

179: different

181: The material ammonium sulfate should be mentioned in the text before the curves are discussed.

198: dryer

200: Fig. 8: The pressure levels should be sorted ascendingly. D50 is one time after, one time before fits.

210: Fig. 9: The pressure levels should be sorted ascendingly.

218: ‘square of the Pearson correlation coefficient’ or ‘coefficient of determination’ – but where is it?

234: affinity -> disinclination / repugnance

240: Table 2: Bb -> B ?

250-252: As long as there is not bypass sampling in used.

253: Bundke et al. 2015

257: Header has no number

260: ‘We recommend, testing’ remove comma

263: “It is noted that since this study, the manufacturer has modified…” That should maybe be noted with a remark at the according plots, otherwise a reader might overlook that the plots are no longer applicable to the current instrument generation.

265: So are the manufacturer setting acceptable now for this pressure range?

267: “Its well-engineered water recycling mechanism…” That information is new. Its relevance for the section is unclear.

266: “operates without loss in performance” The manuscript dealt with the details of exactly this performance loss, so this general statement doesn’t seem to be suitable for the conclusion section.

269: “To evaluate …” from here a summary start, which should be at the beginning of the last section.

276: Solubility is probably not a directly relevant property here.

277-278: “… Its well-engineered water recycling mechanism.” Unclear. Rephrase

278: “For pressures below 200 hPa, the efficiency of the MAGIC 210-LP can reach 100% linearity…” No data for this pressure range were shown in the manuscript, so the conclusion is a bit surprising. Or is this referring to pressure altitudes? Avoid ‘can’.

296: Some of the references don’t seem to be managed by a citation system, what would berecommended. Some dois are given as http-reference, some only numerically. Unify.

300: Details of publication missing?

303: doi is missing a ‘w’