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Atmospheric Measurement Techniques Discussions

Interactive comment on "Performance of diethylene glycol based particle counters in the sub 3 nm size range" *by* D. Wimmer et al.

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We thank Referee #1 for thoughtful comments and address the questions and comments in the following.

RC: In the introduction on lines 23-25, page 2153, three different methods for the genera- tion of supersaturated vapors are mentioned. As this is an instrument and technology related journal I recommend adding representative references for each method. Simi- larly, in section "General considerations" the authors correctly point out the problem of signal interference from homogeneously nucleated droplets at high saturation

ratios. In this context it may be worth noting that apart from the proper selection of working fluid also the time-resolved monitoring of particle number concentration allows extension of the lower detection limit to sizes well below 2 nm (e.g., Winkler P., et al., Atmos. Res. 90, 125-131 (2008)).

AC: The references to the methods described in the introduction are now included as suggested by the referee. A description and reference of the time-resolved monitoring of particles around 2nm as described by Winkler et. al., 2008 is now included.

RC: Section 3.3 discusses methods and procedures for the generation of aerosol particles. On lines 1 and 2, page 2159, the authors say that particle free air from the laboratory was used as carrier gas. Was the removal of particles the only conditioning of the lab air? How about organic trace gases that are likely present in the air they were using? In fact, on lines 14 and 15 (page 2159) the authors even note that contaminant levels were considerably higher when using filtered lab air compared to pure nitrogen carrier gas. In view of the finding that organic contaminations play a crucial role in the counting efficiency, this should be discussed in more detail. An assessment of the sources for organic contaminations in such presumably clean laboratory surroundings would clearly enhance the impact of this paper. Furthermore, some emphasis is put on the operation of the high-resolution DMA in open and closed loop. I think it would be worth including a brief statement about the benefits/drawbacks of each method and why it has been done this way

AC: In the case when particle-free air is used as carrier gas this was the only conditioning of the lab air. It is very likely that organic traces are present in the lab air, therefore we decided to switch to using nitrogen as carrier gas in the later experiments. We do not know where the contaminations in the lab air are coming from, but since we are not working in a clean room environment, they can have various sources. A description of using the DMA in different ways is described in more detail in Kangasluoma et al. and we added a short comment about the issue in the revised manuscript.

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RC: In section 4.1 the authors discuss possible reasons for the observed differences in detection efficiency. Apparently, positively charged particles showed lower detection efficiencies than others which is in agreement with available literature data. However, in Figure 5 positively charged WOx particles show significantly (on the basis of illustrated error bars) higher detection efficiencies in the range of the cut-off diameter and below (red triangles). Some Figure interpretation would be desirable. This figure (and others as well) raise the question whether the shown error bars are reasonably determined. Why are the error bars smallest when one would expect highest measurement uncertainty? It even seems that the scatter of the mean values at full detection efficiency is larger han the uncertainty shown for the negative WOx particles below 2 nm. This certainly needs some explanation. Also the discussion on possible reasons for the charge sign effect on page 2162 is not clear to me. What do the authors mean when saying that working fluids are positively charged? How would the working fluid become charged? Are there arguments supporting this assumption? If so, what are those arguments? For instance, what is the influence of cosmic radiation on working fluid charging? I assume this could be quantitatively estimated.

AC: The determination of the error bars have been re-calculated thoroughly, and the new figures are included in the revised manuscript. To address the issue of the charge sign, apparently we agree that the text needed to be worded more clearly. Of course the working fluids are not charged. We clarified this point in the revised manuscript. Certainly the possible influence of charging the working fluid (i.e. via cosmic radiation)is an interesting issue but a discussion of this issue is beyond the scope of this paper.

RC: Regarding section 4.3 I am not sure what it adds to the message of this paper. It is vaguely formulated and basically shows that in the absence of nanoparticles the CPCs agree nicely. Maybe a change in the section header would help directing the reader to what can be expected from this section. I would suggest something like “Instrument comparison in ambient conditions”

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AC: the title of section 4.3 was changed in the revised manuscript

RC: Section 5 “Conclusions” largely sounds like a motivating section. I would also recom- mend putting the obtained results into context with other similar studies on DEG CPCs (e.g. Kuang C., et al., Aerosol Sci. Technol. 46, 309-315 (2012); Iida K., et al., Aerosol Sci. Technol. 43, 81-96 (2009); Jiang J., et al., Aerosol Sci. Technol. 45, 510-521 (2011)). How do the Frankfurt DEG CPCs perform in comparison to the Brookhaven or Minnesota DEG CPCs?

AC: We added a brief comparison of the DEG CPC results to the mentioned literature, showing that our results compare well with the findings from the previous literature.

RC: Figure 1: In my printout I did not find any labels, however, the electronic file did show them.

AC: ok,corrected

Figure 3: Please enlarge figures. Shouldn’t the NaCl generator be added in Figure 3a? See text in section 3.3, page 2158.

AC: Figure 3a: the NaCl generator is a relict from a previuos version and the paragraph about the setup will be re-written in the manuscript. Figures are enlarged in the revised manuscript.

Figure 7: Please enlarge figures

AC: Figures are enlarged in the revised manuscript.

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