

Interactive comment on “Humidity effects on the detection of soluble and insoluble nanoparticles in butanol operated condensation particle counters” by Christian Tauber et al.

Anonymous Referee #2

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Summary: The paper demonstrates a humidity dependence on NaCl activation using a butanol CPC, where increasing humidity decreases the activation cut-size, while showing no such dependence with Ag particles. The measurement was performed with both continuous flow CPCs and the SANC. Due to the strong humidity-dependence of some particles, it is believed that ambient measurements could be activated at smaller sizes than their laboratory-controlled equivalent and care should be taken in assuming constant cut-sizes for butanol-based CPCs in ambient measurements of unknown composition.

These results seem significant and interesting, but I think it could be reorganized to

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better integrate, introduce, and motivate each experiment's contribution to the objective. Some experiments are not fully motivated of their potential significance until the results section.

The abstract/intro is missing a significant section of the paper regarding charge effect. Poor humidity sensor selection for a paper on targeting humidity effects. Sensor uncertainties need to propagate through to resulting figures (e.g. Figure 4).

Would a working fluid such as Fluorinert counteract the humidity dependence of NaCl activation, or would the NaCl still uptake water and nucleate more easily with humidity? Practical solutions and guidelines for scientists would be helpful.

Major Comments: The citations provided, on nucleation for example (P2 L5), should credit the work from previous authors. Also, heterogeneous nucleation mechanisms needs to include more sources than Wang et al. 2013. In general, the sources need to be expanded to include the major pioneers of the subjects. If the experiments were already performed with propanol in Schosbesberger et al., why would a different behavior with butanol be expected? The difference between the papers, aside from changing the working fluid, should be highlighted.

Figure 1 does not include control system mechanism for RH. The paper focuses on humidity as a primary variable, but not much detail was provided on how it was varied and controlled. Is RH controlled with a feedback loop to account for transients throughout the experiment? If RH is the main variable of interest, its introduction to the system and control should not be glossed over.

Honeywell sensors mentioned are crude (accuracy +/- 3.5%, hysteresis 3%, repeatability +/- 0.5%, etc.). These uncertainties need to be reflected in the figures.

Regarding the counting efficiency experiment (P4), each TSI CPC can have a unique counting efficiency based on laser age, optics cleanliness, alignment, etc. Characterizing the effect of CPC ΔT on nucleation effectiveness using 3 different CPCs does

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not seem substantial enough, as each CPC could have a different counting efficiency at the same temperature. It would have been preferable to compare one CPC and repeat the experiment 3 times, so the additional factors mentioned above are constrained. Otherwise, it would need to be stated that the 3 CPCs have been normalized to one another for each of the deltaTs (or proven operation is identical).

The charge effect isn't addressed in the abstract or introduction/background and seems significant to the NaCl activation. The inclusion of this experiment is good, but it feels like it came only at the result of Section 3.1, and didn't have its own proper introduction to motivate why it's included.

Minor Comments: P1 L14-22: This paragraph seems irrelevant to the focus of the paper goals and losing it would not detract from the message. The overview seems a little vague, when it would benefit with a background more targeted to the objective.

Commas must be added in sentences using passive voice. This is done with some, but not all sentences and must be corrected throughout.

Simplify wordy sentences throughout: e.g. P2 L4: "This process is called nucleation and arises. . ." could simplify to "This process of nucleation arises. . ."; and P2 L18.

P2 L7: Remove "a" to make CCN plural to agree with your verb and that you used "nuclei" instead of "nucleus", i.e. "...nanometer-sized particles contribute as cloud condensation nuclei (CCN)."

P2 L15-17: You describe deliquescence and efflorescence without using the term for the mechanism.

P2 L 20: Subject-verb agreement; "One technique. . . is CPCs", not "are".

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