

Review of “Using depolarization to quantify ice nucleating particle concentrations: a new method” by Zenker et al.

General Comment

This manuscript introduces a new method to distinguish between ice particles, aerosol particles, and liquid water droplets at the water droplet breakthrough (WDBT) line in a continuous flow diffusion chamber. The traditional method to determine the concentration of ice nucleating particles (i.e., particle size) is not accurate at the WDBT and therefore, the proposed method can be of high importance. The new proposed method agrees well with the traditional method before the WDBT and it improves the detection of INPs at and above this line. However, this new method cannot be applied to field measurements given that the uncertainty is very high when low concentrations of INPs are present. Therefore, this new method is only valid for laboratory experiments where high concentrations of INPs are usually achieved.

Although the scientific goals are interesting and the experiments/analysis were carefully performed, the presentation of the manuscript is not the best. There are too many typos, some parts are repeated along the manuscript, and there are key references missing. It would be nice if a senior researcher from the team can proof-read the revised version. The reviewer did not find a major point; however, the following minor comments need to be addressed before its publication in AMT.

Minor Comments

P2 L6: “depositional freezing” is incorrect given that “freezing” refers to the transition from liquid to solid. In deposition ice nucleation the liquid phase is not present.

P2 L9-10: In all clouds or Mixed-phase clouds only?

P2 L17: Why Mixed-phase clouds exclusively? Heterogeneous ice nucleation can also take place in cirrus clouds, for example.

P2 L18: Add references after “GCMs”.

P2 L20: There are many studies showing this. I will rather cite a review paper instead.

P2 L22: Atkinson et al. (2013) and Yakobi-Hancock et al. (2013) are not field studies.

P2 L24-25: Other groups working on ice nucleation (besides the two cited here) have done a significant contribution as well. It would be better to divide the references by aerosol type. The recent reviews by Coluzzi et al. (2017) and Kanji et al. (2017) nicely fit here.

P3 L8: Add references after “crystals”.

P3 L16: The Cziczo et al. (2017) review could be cited here.

P6 L13: What do the authors mean with “processing chamber”?

P6 L14: Remove “TAMU”. It was previously mentioned that CFDC will refer to the CFDC TAMU.

P7 L4: Why were the flows changed? Should it not be constant?

P7 L4: Please add the uncertainty for 2 L min^{-1} .

P7 L4: I found the 1.5°C value quite high. Other CFDC report much lower values. What is the reason for this?

P7 L10: Remove “and” after “pressure”.

P7 L15-16: “The concentration of particles measured while the filter is in place is subtracted from the total concentration measured by the CASPOL”. Both are measured by the CASPOL. I think it would be better to say: Total concentration measured during the supersaturation scan.

P7 L18: Add references after “crystals”.

P7 L28: “Any droplets that remain larger than the $2 \mu\text{m}$ size cut will be miscounted as ice”. This is based on who?

P8 L7: "discern". Between what?

P8 L8: What do the authors mean with positive and negative artifacts?

P8 L11: This sound a bit awkward.

P8 L15: Add references after "signal".

P8 L15: This is the fourth time the word "new" is used.

P8 L16: What is "high" and "low"?

P8 L16: Replace "our" with "the".

P9 L4: Add reference after "infinite"

P9 L11: Delete "Using" after "...droplets."

P9 L15: Add references for the 1.33 value.

P9 L16: Add the uncertainty for the droplet sizes.

P9 L18: Remove "and" after "frequency".

P9 L22: "sample flow is split between flow to the the CASPOL" sound a bit awkward. Remove one "the".

P9 L22: Remove "and" after "controller".

P9 L24: Replacer "are" with "were".

P10 L4: "in aerosols"?

P10 L12-23: "in the absence of activated liquid droplets". Do the authors mean in the absence of INPs?

P10 L15: " -11 ± 1.5 % SSW"? Something is wrong here.

P10 L26: Remove "TAMU". See comment on P6 L14

P11 L16: "Fig.s 1" should be "Fig. 1".

P12 L17 and P13 L6-8: Why did the authors choose dust-like as the model for aerosol particles? How about biological particles? Soot?

P13 L27: Please indicate to what Figure the authors are referring to.

P14 L23-24 and along the manuscript: Please use "WDBT" instead of "water droplet breakthrough". This was defined in P8 L1.

P15 L5: Please indicate to what Figure the authors are referring to.

P16 L24-26: Replace "um" with " μm " to be consistent.

P17 L8: I think the year of the Pruppacher and Klett book is incorrect.

P17 L23-24: "the geometry of the ice crystal can be modified leading to drastic differences in the observed depolarization ratio." Can the authors report the time scale under which this is valid? i.e., how many seconds/minutes are needed for an ice crystal to change its geometry?

P17 L24 and 27: Add the year of the Smith et al. paper.

P17 L28: "(2016)" is out of place.

P18 L2: Add "field" before "campaign".

P19 L25: Please indicate to what Figure the authors are referring to.

P22 L3-4: How about to include kanji et al. (2017)?

P22 L8: "the Colorado State University (CSU) CFDC". This was defined already in P3 L18.

P23 L19: Add "only" after "experiments".

P25-30: Be consistent with the journal names in the references. Either add the full name or their abbreviation.

P25-30: The page numbers in several references are missing (e.g., DeMott et al. (2017), Levin et al. (2016), McCluskey et al. (2016), McFarquhar et al. (2011)).

P25-30: References need to be up to date.

Figure 2: Given that there is no extra-charge for colored-figures in AMT, I suggest to add color to this figure to improve its readability.

Figure 3: Blue circles in panel's b and c should be blue squares.

Figure 11: "TAMU CFDC versus CSU CFDC comparison." Is written twice in the figure caption.

Table 1: Add ":" after "1" for consistency with the Figures.

References

- Coluzzi, I., Creamean, J., Rossi, M. J., Wex, H., Alpert, P. A., Bianco, V., Y. Boose, C. Dellago, L. Felgitsch, J. Fröhlich-Nowoisky, H. Herrmann, S. Jungblut, Z.A. Kanji, G. Menzl, B. Moffett, C. Moritz, A. Mutzel, U. Pöschl, M. Schauperl, J. Scheel, E. Stopelli, F. Stratmann, H. Grothe, and D. Schmale III (2017). Perspectives on the Future of Ice Nucleation Research: Research Needs and Unanswered Questions Identified from Two International Workshops. *Atmosphere*, 8(8), 138.
- Cziczo, D. J., Ladino, L., Boose, Y., Kanji, Z. A., Kupiszewski, P., Lance, S., Mertes, S., and Wex, H. (2017). Measurements of Ice Nucleating Particles and Ice Residuals. *Meteorological Monographs*, 58, 8.1-8.13.
- Kanji, Z.A., Ladino, L., Wex, H., Boose, Y., Burkert-Kohn, M., Cziczo, D.J., and Krämer, M. (2017). Overview of Ice Nucleating Particles. *Meteorological Monographs*, 58, 1.1-1.33