

Referee comment: Development and characterization of the Portable Ice Nucleation Chamber 2 (PINCii), Castarède et al., 2023

The manuscript presents a new instrument to measure ice-nucleating particle concentrations, both in the laboratory and the field. Even though there is already a high number of instruments of the same type, PINCii is a further improvement of the measurement technique. Furthermore, the authors discuss a new approach to analyze the data of a CFDC. To validate the instrument, multiple experiments including deliquescence, homogeneous freezing and heterogeneous freezing were performed and the results are compared to literature values from different studies.

Overall, the manuscript is well written and structured and gives detailed explanations of the work that has been done. However, there are some points, listed below, that would further improve the quality of the paper. My comments are structured in first more general comments and second minor comments.

General comments

- Given the length of the text, there is a quite high number of figures, such as e.g. in section 2.4. I would recommend to reduce the number of figures and instead explain the outcome of the measurements in more detail in the text. The figures can then be either deleted or moved to the appendix.
- Figure 8, 9 and A1 are very complex and hard to understand. They should be simplified to a 2D plot, with AF as a color scale. If the change in AF is the important parameter for defining the onset, then the color code can also be presented as ΔAF .
- How much does a potential underestimation of the number of ice crystals due to the binning of the OPC and the set ice threshold contribute to the total uncertainty of the INP concentration? The authors provide a calculation of the ice crystal growth, however, this assumes a spherical ice crystal and a constant mass accommodation coefficient of 0.3. Based on this calculation, the threshold for ice crystal detection in the OPC was set. However, since the binning of the OPC is quite broad, some particles might not be counted as ice (or droplets), because they are not detected in the respective channel of the OPC. This could be especially relevant when measuring INPs in low concentrations.

Minor comments

- L6: The phrase “very low concentrations” should be supported with numbers of the range of the limit of detection
- L21-22: In line 21 you are writing “heterogeneous nucleation”, however, in the following sentence in L22 you call it “heterogeneous ice nucleation”. You should stick to one term, preferably the second one.
- L39: Mention that the CFDC-IAS has a cylindrical shape
- Figure 1: A list inside the figure explaining the letters (a) to (k) would help for an easier understanding. The color of (f) (refrigerant cooling coil pipes) should be changed, because it is difficult to differentiate it from the other items.
- L89: Briefly explain what ETH-IODE is and what it is used for
- L101: Explain the abbreviation R23
- L117: How much longer is the main chamber of PINCii compared to other CFDCs? You should give at least a range of numbers

- Figure 5: The symbols of the first and second experiment are very hard to distinguish in the plot. As it is written in the text, the data are presented as normalized values, so it might not be needed to present them in different symbols. If the authors think, that it gives the reader some value to know which data points were recorded on which day, they should divide the figure in two sub plots. It might be also beneficial to mark the range in which the data points represent either an activated cloud droplet or an ice crystal.
- L234-239: The authors should elaborate a bit more the outcome of figure 8(a) by giving numbers e.g. at which RH_{lam} activation happens for different temperatures and how much it differs from the Koop line.
- L247-248: How is it seen that some ice crystals did not grow to 5µm. I guess it can be seen by the ice threshold that is shifting to a lower RH_{lam} from Fig. 8(a) to 8(b). However, a short note on that might be helpful for the reader.
- L274-276: Replace one of the “significantly”
- Figure 9: In the caption, replace “triangles” by “squares”
- L329: Add a short note why the rapid cooling should be avoided
- L237: “exceptionally” and “mediocre” need to be defined in terms of values
- L341: Remove “exceptionally”
- L343: A short discussion about the background concentration after 3 ramps is missing
- Figure 11: Was the droplet break through only measured for four of the scans?
- L465: Rephrase to “sampling from sources with INP concentrations as low as ...”
- Figure A1: This figure is mentioned quite often in the text. Therefore, I suggest to move it from the appendix to the main text.