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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Results from the University of Toronto continuous flow diffusion chamber (UT-CFDC) at the international workshop for comparing ice nucleation measuring systems (ICIS 2007)" *by* Z. A. Kanji et al.

Anonymous Referee #2

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General comment:

The paper presents results from an intercomparison of ice nucleation measurement techniques, especially those from the University of Toronto continuous flow diffusion chamber (UT-CFDC). For that pupose, heterogeneous ice nucleation of biological aerosol particles, various mineral dust samples as well as soot was investigated at the

AIDA cloud chamber during the International Workshop on Comparing Ice Nucleation Measuring Systems (ICIS 2007).

In the paper the importance of reliable measurements of heterogeneously freezing Ice Nuclei (IN) is described as well as the difficulty to intercompare the various IN counters, and a state of the art of laboratory measuremenst is given. The experiments at the AIDA chamber and the results of the UT-CFDC and other instruments are efficiently summarized. But, the paper presents not only an instrument intercomaprison but also contributes a perspective of the freezing properties of the most important ice nuclei in the atmosphere. Overall the paper is well structured and fluently to read.

I suggest the paper for publication in ACP after adressing some points listed in the Specific Comments.

Specific comments:

- **P 20862, line 4**: Please indicate if the size is diameter or radius.
- **P 20863, title and first sentence of Section 2.2**:

  I suggest as title

  'Experimental overview of AIDA expansions and CSU experiments at ICIS-2007'

  and for the first sentence

  'The AIDA cloud expansion experiments ...'
- **P 20863, line 12**: What is the ice threshold size of the Welas OPC and how it is determined?
- **P 20863, line 18**: Please give the special issue references for the CSU and the AIDA.

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- **P 20863-64, CSU**: As far as I understood, the CSU can also discriminate between water and ice at temperatures > 250K, yes? Can you please mention this.
- **P 20866, line 8**: '.. the RH's for 0.1% of particles activating.'

  To be clear, I would suggest here and **throughout the text** to always say '0.1% of particles activating ice'.
- **P 20866, lines 10-11**: 'To infer modes of ice formation we assume that activation below water saturation proceeded by deposition nucleation and activation at or above water saturation proceeded by condensation freezing.'

  This classification of freezing modes should be explained. And, why you think that the drop freezing process is condensation and not immersion freezing? This needs to be discussed.
- **P 20866, line 24**: '.. , it is possible that large particles were lost while sampling from AIDA.'

  Only a comment: a pity that you didn't connect a size resolving particle counter (for example an APS system) to the sampling lines from AIDA and APC. Even a rough estimate of the size dependence of heterogeneous freezing would have further improved the study.
- **P 20867, line 1**: 'The bacteria samples mostly activated *ice* around water saturation, ...'
- **P 20867, line 14**: 'to deduce 0.1% activated *ice* fractions, ...'
- **P 20867, line 25 - P 20868, line 6**: I read this paragraph several time but didn't get the message ... could you rephrase it?
- **P 20871, line 8-10**: '... suggest a transition from condensation to deposition freezing for GSG at about 234 K which is lower than the transition temperature for dusts ...'

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Doesn't that mean that GSG does not nucleate ice at all, because the temperature for homogeneous drop freezing is 235K? Please explain.

- **P 20871, title section 4**: I suggest

  'Inter-comparison of UT-CFDC, CSU-CFDC and AIDA expansion techniques'

- **P 20871, line 18-21**: 'UT-CFDC gave higher onset RHs of ice formation for 0.1% of particles freezing than did the *AIDA* expansion chamber. This could partly be an issue of differences in the "residence time" of particles in each of the chambers. For the CFDC techniques, particles pass through the chamber within seconds whereas in the expansion chamber, particles remain in the chamber throughout the experimental run that can last for a few minutes, albeit with continued cooling.'

  I have a comment and a question to this discussion:

  1) Comment: If the particles in the AIDA chamber stay longer until ice formation while continuous cooling, they will grow further, yes? Could this explain the higher onset RHs of ice formation? Please discuss.

  2) Question: for the same experiment, the ice activation temperatures of AIDA, UT-CFDC and CSU-CFDC are different, yes? How the activation temperatures for the IN counters were choosen? What are the differences? Is it possible in the figures to see which experiments were the same ? This question popped up several times when reading the article so I think it would be good to discuss this in the beginning of the paper, maybe in section 2.

Comments on the Figures:

Though the Figures are quite nice, I have several suggestions which I think can further improve them to be more easy to understand:

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Interactive Comment

- **Figure 2-7 general**: Some more information could be given in the Figures:

  1) it would be nice to have: the water-saturation line, the ice-saturation line and the line of homogeneous freezing of solution particles in each Figure. Also, a vertical line could be drawn at 235K, the point of homogeneous drop freezing.

  2) Further, it should be noted in the Figure captions that for UT-CFDC above 250K it is not possible to distinguish between water and ice.

  3) '... onset RHw for 0.1% activated *ice* fraction ...'

- **Figure 2**: You could add a legend to the figure showing a black triangel (AIDA), square (APC) and star (AIDA 2nd cycle). This would help the reader.

- **Figure 3**:

  1) Print 'ATD' above the legend.

  2) Please adjust the blue CSU symbols to those of AIDA (filled triangles –> sqaures, open triangels –> dots).

  3) Indicate that UT/CSU(APC) and UT/CSU(AIDA) means smaller and larger particles.

- **Figures 3-7**: indicate *condesation/immersion freezing* above the water saturation line and *deposition freezing* below.

- **Figures 4-7**:

  1) Print the aerosol type above the legend.

  2) Use the same scaling for x- and y-axis for the Figures.

  3) Figure captions 5-7: don't repeat the complete caption for each Figure, just say 'Same as Figure 4, but ....'

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 20857, 2010.