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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Probing ice clouds by broadband mid-infrared extinction spectroscopy: case studies from ice nucleation experiments in the AIDA aerosol and cloud chamber" *by* R. Wagner et al.

**Anonymous Referee #1**

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Comments on the manuscript " Probing ice clouds by broadband Ĕ" by R. Wagner, S. Benz, O. Mohler, H. Saathoff, and U. Schurath

The present work aims to test the accuracy of aerosol particles size distributions obtained from the mid-IR measurements in the large aerosol and cloud chamber AIDA apparatus. To do so the authors compare the size distributions retrieved from IR spectra with those obtained by several different methods, which causes feeling that the result presented here are reliable. The inversion procedure is standard and is based on the size /shape dependent extinction calculations (transition matrix) using the re-



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fractive indices for pure substances (ice in the present case). The authors present the cases where the ice particles nucleate on dust and sulfuric acid aqueous solution particles (used as seeds) at several different thermodynamic conditions. The article includes some potentially interesting and valuable material. The experiment and the fitting procedure are described in detail; furthermore, at times too detailed descriptions make it somewhat difficult to understand what the actual results are. I believe that the study is well executed and the paper contains some interesting and potentially valuable information. My comments are as follows:

1) General comment: While the thermodynamics tells us what state is more probable - the growth and consequently the shape of ice particles are controlled by kinetics that is very sensitive to variations in the temperature and water vapor density. Thus, it might be kinetically preferable to build elongated (needles) or squashed (plates) particles in certain temperature / saturation ratio ranges. Here is my general comment - It seems that the authors have potential ability to probe how the shape of particles (or at least asphericity parameter ) depend on temperature and water vapor pressure with the technique described in this work. I think that this would be much more valuable to do that sort of study with, say, diluted H2SO4/ H2O solution and to examine what kind of shape is more probable at such and such temperature and saturation ratio values.

2) It is seen From Fig.2 that - authors are welcome to correct me if I am wrong - the nucleation rates for ice freezing events in aerosol particles can be obtained directly. Has this very valuable information been published or is planned for publication?

3) It is generally agreed that size distributions retrieved from mid-infrared spectra are rather effective - in the sense that they effectively reproduce the aerosol/cloud's contribution to the atmospheric extinction -than absolute; and the authors confirm that accurate retrievals of size distributions are notoriously difficult, with each retrieval scenario to be considered independently. This calls for the following question - Are the efforts to obtain the absolute size distribution worth doing it?



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4) Section 3 (20). The author state that " Ĕ Note that the retrieved volume concentrations of ice are virtually un affected by these distortions in the size distributions, the percentage deviations being less than 3%.". This means that a volume size distribution can be retrieved more accurately than a number density size distribution. If the authors originally retrieve the volume distributions then the errors in the values of dispersion, asymmetry, and so on - those are the higher moments of the distribution function and for that reason are obtained lesser and lesser accurately - translate into much larger errors in the number density distribution function. Therefore I am puzzled with why the authors use the number density size distributions as a measure of accuracy in place where the volume distributions would be more appropriate?

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Interactive comment on Atmos. Chem. Phys. Discuss., 6, 5711, 2006.