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Retrieving the Size Distribution of Laboratory Ice Clouds from Broadband Infrared Extinction Measurements: Case Studies from Experiments at the Aerosol and Cloud Chamber AIDA

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As part of the extensive instrumentation of the AIDA aerosol and cloud chamber at Forschungszentrum Karlsruhe (Aerosol Interactions and Dynamics in the Atmosphere), broadband infrared extinction measurements are one powerful tool to study the formation and growth of ice crystals in nucleation experiments which use the AIDA aerosol vessel as cloud expansion chamber. Based on reliable infrared complex refractive indices for ice, details of the size distribution of the ice crystals as well as the ice water content of a cloud may be retrieved from the measured infrared spectra. The retrieval results, however, are notably influenced by different assumptions on the shape of the ice crystals.

Although recent publications already offer a wealth of information on this subject, the experiments at the AIDA cloud chamber may be a valuable complement, benefiting from the excellent diagnostic techniques for the characterisation of ice clouds. Thus, the retrieval results from the infrared extinction spectra can be directly compared to those measured by independent techniques, e.g.: optical particle counters for counting and sizing of ice crystals; a CCD camera with microscope optics for direct imaging of the ice crystals; separate measurements of the total water (interstitial water vapour plus ice crystal water) and the gas phase water mixing ratios, their difference directly yielding the ice water content.

We will present selected case studies from AIDA expansion experiments in the 235 - 200 K temperature range. Ice clouds were generated both by homogeneous freezing

of supercooled solution droplets and by heterogeneous ice nucleation on mineral dust or soot particles. Focussing on ice clouds composed of small (1 - 15 micrometer) ice crystals, we want to elucidate to which extent reliable information on the size distribution of the ice particles can be inferred from their corresponding infrared spectra.