Geophysical Research Abstracts,
Vol. 11, EGU2009-3720-1, 2009
EGU General Assembly 2009

HALO ice crystal spectrometer intercomparison at the AIDA - chamber: first results from the novel ice experiment NIXE-CAPS

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Discrimination of water from ice in mixed phase clouds and identification of the shape of crystals smaller than 50 um is one of the most difficult challenges in understanding cloud microphysical processes. For many years the LIDAR community has used depolarization of backscattered light to identify aspherical particles and separate water from ice. This same technique has now been implemented as a modification to the Cloud Aerosol Spectrometer (CAS), an instrument that has been been widely used for airborne, in situ measurements of cloud properties since 2002. The standard CAS collects light scattered from individual particles at near forward (4-12 degrees) and near backward angles (168-176) to size and estimate the refractive index of aerosol and cloud particles. Comparison of the forward and backward intensities is also used to separate spherical from non-spherical particles, but at very selected sizes. An additional backscattering detector has been added with a polarized filter rotated 90 degrees relative to the incident light. The signal from this detector is proportional to the amount of depolarization caused by individual particles passing through the laser. The addition of this detector greatly increases the sensitivity of the CAS to changes from spherical to aspherical shapes and over a much broader range of sizes.

This new instrument, called the NIXE-CAPS, has just completed tests in the AIDA cloud chamber where it took part in a series of experiments to nucleate ice on soot and other aerosols. The ratios of the depolarized backscatter to forward scattering to and the deoplarized to non-polarized backscatter were used as indicators of particle shape. During a number of experiments when CCN were activated as water drops that then froze homogeneously at temperatures below -35C, the depolarization ratios indicated a clear transition from water to ice. Furthermore, by stratifying these ratios by size range, it could be clearly seen that the trends were quite different. The larger particles, i.e. 20-50 um, transitioned to ice much more rapidly than did the 2-20 um size ranges.

This presentation will describe the implementation of the depolarization detector, summarize some of the most significant preliminary results, and discuss the implications of this new measurement technique for future cloud studies.