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Size spectra of ice & drops in mixed phase clouds: measurements at the AIDA Cloud Chamber

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The novel cloud particle spectrometer NIXE-CAPS consists of two different instruments, the CAS-Depol and the CIP greyscale. It can not only record particle number size distributions between 0.6 and 900 μm diameter, but also provides information on the particles phase -water or ice- for every cloud particle. NIXE-CAPS is deployed at the cloud chamber AIDA during three campaigns where ice formation in mixed phase clouds was investigated in the wide range of 220 - 275 K.

We found that in case of drop and ice coexistence conditions (relative humidity RH $\gtrsim$RH$_{\mathrm{w,sat}}$ and $>$RH$_{\mathrm{ice,sat}}$; RH$_{\mathrm{w,sat}}$, RH$_{\mathrm{ice,sat}}$ refer to saturation over water and ice), the freezing of the drops is size dependent, i.e. the larger drops are frozen, the smaller drops remain liquid and in between there is a size range where both drops and ice crystals coexits. This size range of drop and ice coexistance is found to decrease together with the from 20-30 μm to 8-20 μm diameter. In the case of Bergeron-Findeisen conditions (RH $<$RH$_{\mathrm{w,sat}}$ and $\gtrsim$RH$_{\mathrm{ice,sat}}$), the freezing of the drops is still size dependent as long as RH$\sim$RH$_{\mathrm{ice,sat}}$. Then, larger drops are frozen and the smaller the cloud particles are the more remain liquid. Only if RH$>$RH$_{\mathrm{ice,sat}}$ the larger ice crystals ($\gtrsim$ 20 μm) grow while all small liquid drops as well as ice crystals evaporate.

In the AIDA chamber, ice crystals are not shattered during sampling like it is most often the case when sampled in the atmosphere from high speed aircraft. Thus, the AIDA ice crystal size distributions are not contaminated by small ice fragments originating from crystal shattering. Under drop and ice coexistence conditions, the ice size distributions contain crystals down to 3 μm in high concentrations, which free of doubt are not produced by ice crystal shattering.