

Using higher radar moments to study ice clouds

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There are still gaps in the understanding of microphysical properties and processes of ice clouds. In-situ observations with aircraft are costly and cannot provide any long term observations which are needed for a deeper understanding of the processes. Ground based remote sensing observations have the potential to fill this gap, but uncertainties of current retrievals of cloud properties are high, because only a fraction of the required degrees of freedom can be measured. For cloud radars, usually only reflectivity and Doppler velocity are used for retrievals, few studies use spectral width as well. The measured Doppler spectrum, however, contains more information than that. To exploit this additional information, the presented study uses additional, higher moments of the Doppler spectrum such as skewness and kurtosis together with the slope of the peaks. First, these higher moments are used to test various parametrisations of size distribution, area, mass and shape of ice particles. For this, ISDAC in-situ aircraft observations of ice clouds are modelled with the Pamtra forward operator using the various parametrisations. The higher moments of the modelled Doppler spectra are statistically compared with the observations of the MMCR radar of the NSA ARM site in Barrow to ensure that the simulated radar measurements correspond to reality. Eventually, the information content of the higher moments is evaluated and their potential for retrieving ice cloud properties is estimated.