Autoconversion describes the mass transfer rate from cloud droplets to embryonic drizzle particles. This process plays a key role in the atmospheric water cycle and for the short and long wave cloud radiative forcing in our climate system.
Several parameterizations for autoconversion have been proposed for numerical models of varying scales. However, verification of the proposed schemes and their details (e.g., what is the typical size range of the embryo drizzle particles) remains not , well understood, primarily due to the fact that it cannot be identified with any direct observations.
The use of ground-based remote sensors provides information on the vertical structure of clouds. However, the early detection of drizzle in clouds remains challenging for commonly used target classification schemes (e.g, Cloudnet).
Here, we focus on a novel, more advanced approach based on higher Doppler spectra moments (as opposed to the "standard" moments reflectivity, mean Doppler velocity and Doppler spectrum width) obtained from the MIRA cloud radar at JOYCE (Jülich Observatory for Cloud Evolution) and from the synergy of a variety of instruments present.
One of these higher moments is the skewness of the radar Doppler spectrum. Normally, cloud droplets without any significant fall velocity but under the influence of turbulence will lead to a Gaussian Doppler spectrum (i.e. skewness is zero), whereas the onset of drizzle will lead to a deviation from the ideal Gaussian form (i.e. positive skewness at first).
This basic idea is exploited to develop new criteria to detect drizzle onset within clouds. The criteria is based on the statistical distributions of unambiguously determined drizzling and non-drizzling clouds. A statistical probability for belonging to the non-drizzling, respectively the drizzling population is calculated based on the moments of the Doppler spectrum. In order to minimize instrument and skewness estimator noise, a prefiltering skewness mask is applied first, which selects adjacent radar pixels with positive skewness values. The new method has been tested on individual cases at JOYCE and has shown to identify potential areas of drizzle formation within the cloud. We project, that our new method can provide new observational constraints for autoconversion parametrizations in numerical models.
Additional sensitivity studies on IQ raw cloud radar data have also been performed to evaluate the accuracy of higher moments estimates and their sensitivity to basic radar parameters, like the number of FFT points in the radar Doppler spectrum and number of spectral averages. By this, the optimum radar settings are identified for highest sensitivity in the specific context of applications concerning drizzle detection in warm clouds.