A NEW CRITERION TO IMPROVE DRIZZLE DETECTION FROM GROUND BASED §

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Stratocumulus clouds are a key contributor to Earth's radiation budget, however their representation in global climate models (GCMs) remains an open challenge due to the uncertainty in the description of cloud-scale microphysical processes including drizzle production. Drizzle formation is one of the main liquid water removal mechanisms and strongly affects cloud dynamics and lifetime of stratocumulus clouds all over the globe.

In models, this process is described using the concept of autoconversion, a microphysical process that characterizes the mass transfer rate from cloud droplets to embryonic drizzle particles. Since autoconversion is a sub-grid-scale process, several parameterizations have been proposed for numerical models but the evaluation of such schemes remains difficult due to the lack of direct observations.

Here, we focus on a novel statistical criterion to detect drizzle onset within clouds based on higher Doppler spectra moments, as opposed to the commonly used "standard" moments reflectivity, mean Doppler velocity and Doppler spectrum width. We analyze Doppler spectra measured by the MIRA cloud radar at JOYCE (Jülich Observatory for Cloud Evolution) and measurements from the synergy of various other available instruments.

Among the higher moments, the skewness is sensitive to early drizzle production and drizzle growth throughout thin cloud layers: 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. in the convention in which downwards motions are defined positive, this means positive skewness at first and negative when drizzle starts to dominate the spectrum).

In our methodology, first de-noising filtering techniques are applied to the data in order to identify coherent skewness structures and to indicate microphysical signatures of drizzle onset. Non-drizzle, early drizzle and mature drizzle regions are identified on the basis of the filtering technique and are then characterized in terms of reflectivity, mean Doppler velocity, spectral width, liquid water path (LWP) and geometrical thickness. Based on this, an algorithm based on a chi2 test is applied to each pixel to derive a probability for belonging to certain drizzle class.

The new method has been tested on individual cases at JOYCE and areas of drizzle formation within the cloud have been retrieved. We propose that this new method can provide additional observational constraints for autoconversion parametrization in numerical models. In order to fulfill this purpose, the methodology is currently being implemented as an extension of the Cloudnet target categorization algorithm, which is currently operating at many different sites across the world and has often been used for model evaluation.