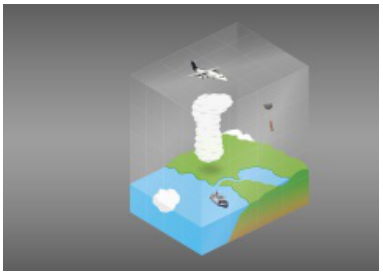

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A new criterion to detect drizzle from ground-based: a potential new tool for model evaluation.

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Liquid clouds substantially contribute to Earth's radiation budget but are still poorly represented in global circulation models (GCMs), i.e. due to uncertainties in the description of the cloud-scale microphysical processes such as drizzle production. Drizzle production in pure liquid clouds is the main mechanism of liquid water removal and it affects the dynamics and lifetime of clouds as well as the boundary layer dynamics and thermodynamics. In models like The high-resolution (150 - 300 m) Icosahedral non-hydrostatic model (ICON-LEM), developed by the Max Planck Institute for Meteorology (MPI-M) and the German Weather Service (DWD), this process is described by the autoconversion parametrization, that characterizes the mass transfer rate from cloud droplets to embryonic drizzle particles. Various parametrizations of autoconversion have been proposed in recent years for numerical models but their evaluation is still controversial because direct observations of drizzle development in the cloud are missing.
In this work, the new criteria "CLAssification of Drizzle Status"(CLADS) to detect drizzle development in the cloud is presented. We base the new criteria on the skewness of the Doppler spectra obtained from the Ka-band radars operating at JOYCE (Juelich Observatory for Cloud Evolution) and at the Barbados Cloud Observatory. CLADS has been tested on a statistical ensemble of liquid cloud case studies collected at JOYCE as well as on a number of shallow cumulus cloud cases observed at the Barbados Cloud Observatory. After algorithm application, the different drizzle classes are characterized in terms of standard Doppler spectra moments reflectivity, mean Doppler velocity, spectral width and microwave-radiometer-derived LWP. These are compared to the different categories identifying drizzle in the common Cloudnet target classification. The new criterion improves compared to Cloudnet the possibilities of detecting drizzle from the ground and is currently being implemented as an extension to the Cloudnet target categorization algorithm.
ICON-LEM is an LES model with characteristics that makes is especially interesting to be compared to ground-based observations. We used the radar forward simulator PAMTRA to evaluate the process of drizzle formation in the measurement space by deriving radar Doppler moments: we apply CLADS to ICON-LEM output as well as to observations and we develop an analysis of clouds in a multivariable space including liquid water path, center of gravity and radar Doppler moments aimed at providing constraints for autoconversion parametrizations.

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