OPTIMAL COMBINATION OF TWO INDEPENDENT ALGORITHMS FOR RETRIEVING PROFILES OF THE THERMODYNAMICAL STATE

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Within the framework of COST720, two ground-based algorithm techniques for retrieving profiles of the cloud liquid water content (LWC) have been combined. Both of the methods described below rely on the target categorization scheme developed within the European CloudNET project. By using this scheme, regions of liquid water in the vertical column can be identified.

The first method, the Integrated Profiling Technique (IPT), uses measurements of a microwave profiler, a cloud radar, a lidar-ceilometer and the closest operational radiosonde to retrieve profiles of temperature, humidity and LWC for non-precipitating clouds applying the "Optimal Estimation" (OE) equations. Within IPT, LWC is transformed into radar reflectivity (Z) using a standard LWC-Z power-law relation derived from a microphysical model. This relationship is part of the so-called forward model. When applying the OE equations to measured data, it is crucial to have information about the errors of the measurements and also of the forward model. The errors associated with the LWC-Z relation have up to now been estimated from the microphysical model output.

The second method is based on a large number of in-situ measurements of cloud drop-size distributions (DSD). Since it is possible to calculate Z and LWC from cloud DSD, LWC-Z relations have been derived from this data set. Using the so-called radar-lidar ratio (defined as radar reflectivity divided by lidar extinction), a classification w.r.t. to cloud effective radius has been derived. The in-situ data base clearly shows three regimes – a pure cloud regime with smaller cloud droplets, a drizzle regime with larger drizzle droplets and a transition region in between. The classification implies that if the radar-lidar ratio is known, a regime-specific LWC-Z relation can be applied. If, due to lidar attenuation, no radar-lidar ratio can be derived, the classification into the three classes is carried out using a simple Z threshold.

The LWC-Z relations derived from the lidar-radar ratio have been inserted into the IPT, now making application to drizzling and non-drizzling clouds possible. The error assumptions needed have been derived from the in-situ data base, from which the uncertainty for deriving LWC from Z for one of the three regimes can be calculated. This combined algorithm has been applied to the LAUNCH 2005 data set. Typical cases will be shown and statistical differences between the old algorithm versions and the newly derived version will be shown.