Comparison of Eddy Dissipation Rate Retrievals using Vertically Pointing ARM Cloud Radar Observations

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Small-scale turbulence plays an important role in cloud evolution. A proper understanding of shallow cumulus clouds cannot be achieved without the knowledge of in-cloud turbulence. Quantitative information on turbulence, e.g. eddy dissipation rate, can be retrieved from the Doppler moments, velocity and spectral width, from radar measurements. Here we propose the use of the Vertically Pointing ARM Cloud Radar to study the structure and evolution of eddy dissipation rate. Its high spatial and temporal resolution allows the observation of the kinematic cloud field in great detail. Eddy dissipation rate (ε) is an important parameter to estimate since it affects the collisional rate of cloud droplets, determines the time scales of turbulent mixing, and it can provide insight in the deconvolution of microphysical and dynamical effects in radar Doppler spectra. There are different techniques to estimate ε from a single cloud radar, using time-series of Doppler velocity measurements, Doppler spectrum width measurements, and from the variance of measurements of mean Doppler velocity. In this work, the validity of these different techniques under different cloud scenarios will be explored. It will also be shown that there is good coherency in the structure of the diurnal variation of the different ε retrievals techniques. Finally, a comparison between the estimates from cloud radar at cloud base and Doppler Lidar will be shown where at a first look it appears that sedimentation does not necessarily contaminate the outcome of the results from the cloud radar retrieval.