Geophysical Research Abstracts, Vol. 8, 05844, 2006
SRef-ID: 1607-7962/gra/EGU06-A-05844

Performance of algorithms for rainfall retrieval from polarimetric X-band radar measurements

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The use of radar polarization parameters in the recent years has shown considerable potential for improvement of quantitative estimate of rainfall rate. In this paper different estimators for rainfall rate retrieval from recent (autumn 2005-winter 2006) polarimetric radar measurements at X-band are validated against in-situ measurements from a 2D video disdrometer and tipping bucket rain gauges in the Athens urban area. The disdrometer was deployed at a distance 10 km away from the radar and the rain gauges at distances ranging up to 35 km. The disdrometer was used for the analysis of drop size distributions (DSD), shape and orientation of rain droplets, as well as the theoretical estimation of polarimetric products in the radar measurement. Radar measurements include PPI scans at low elevation angle ($<$ 1.5 deg) and RHI scans above the in-situ sensors in order to estimate an altitude correction for the radar rainfall estimates. The observed rain intensities range from light stratiform events to heavy convective storms. The polarimetric estimators of rainfall rate, R, include different multi-parameter relationships used in the literature, which are based on horizontal polarization radar reflectivity, Zh, differential reflectivity, Zdr, and specific differential phase shift, Kdp after correcting power measurements for rain-path signal attenuation. A new estimator is also examined which uses a variable exponent dependent on Kdp in the Zh-R relation. This estimator takes advantage of the fact that Kdp is more readily detectable at X-band, is estimated by spatially filtered data and, thus, is characterized by less noise compared to the usually low Zdr values. The performance of the algorithms is analyzed for different accumulation periods ranging from 1 min to 1 hour, and different classes of the rain microphysical parameters (on the basis of Gamma DSD model parameters).