Estimation of Linear Depolarization Ratio at Attenuating Frequencies

Robert M. Beauchamp and V. Chandrasekar
Colorado State University, Fort Collins, CO, 80523

Linear depolarization ratio (LDR) is a dual-polarization weather radar observable of great interest for microphysical investigation of precipitation. In particular, LDR has long been used as a means of identifying ice contamination, such as hail in convective observations or the melting layer in stratiform systems. Accurate estimation of LDR requires accurate estimation of cross-polar echo power which can be many order of magnitude lower than that of copolar echoes. The cross-polar signals must often be estimated in low signal-to-noise ratio conditions where noise power biases are significant. Accurate estimation of the LDR is further complicated by system differential gain and differential path-integrated attenuation for observing precipitation with frequencies of X-band or higher. An robust estimator of LDR, LDR_e, has been recently developed which demonstrates reduced sensitivity to noise and is not affected by differential path-integrated attenuation. From theory, the LDR_e estimator is also shown to be insensitive to differential receiver gain and differential transmit power biases that adversely effect the conventional estimator. The LDR_e estimator is briefly discussed and compared to conventional LDR estimators.

Using the NASA dual-frequency, dual-polarization, Doppler radar (D3R), Ku-band observations of both stratiform rain and convection are used to demonstrate the enhanced LDR estimator's performance. For these cases, comparison to the conventional LDR estimator is considered to demonstrate the improved performance of the new estimator. This direct comparison of these estimators demonstrates the improved rejection of noise and immunity to bias from differential attenuation with the LDR_e estimator. This new enhanced LDR estimator is shown to be superior to conventional estimators for low and moderate signal-to-noise ratio observation. It is free from receiver and transmitter differential gain and attenuation bias effects that limit the accuracy of conventional LDR estimators, especially at X-band and higher frequencies.