CRITICAL EVALUATION OF DUAL-POLARIZATION RADAR MEASUREMENTS IN HYBRID MODE FOR MEASURING PRECIPITATION

Wang, Y, Chandrasekar, V.
Colorado State University, Fort Collins, CO 80523-1373

Polarimetric radar measurement in hybrid mode is realized by simultaneously transmitting and receiving horizontally (H) and vertically (V) polarized waves. When the eigen-polarization of precipitation aligns along the Horizontal and Vertical linear states, the co-polar polarimetric covariance variables of precipitation , defined in the linear H/V basis can be obtained. The standard variables in the H/V polarization basis under consideration are reflectivity (Z), differential reflectivity (Z_{dr}), Differential propagation phase (Φ_{dp}), linear depolarization ratio (L_{DR}) and copolar correlation coefficient. In contrast to the operation in the eigen-polarization mode of operation (H/V mode) the benefit of the hybrid mode is the simplification of transmission chain, though some of the variables are not measured, specifically the cross polar measurements namely LDR and cross polar correlation. However, if the eigen-polarization drifts away from H/V polarization, inherent biases will be introduced to the radar parameter estimates. In this paper, the hybrid polarization mode is evaluated in the context of precipitation measurement. A theoretical model for the scattering and propagation through precipitation medium will be used to analyze the inherent polarimetric errors specially at X band.

The cross polar components of backscattering is studied in a variety of precipitation types, as well as antenna polarization errors. The errors are evaluated for both quantitative applications such as rainfall estimation and qualitative applications such as hydrometeor classification. Extensive data from CSU-CHILL radar is analyzed to evaluate the performance of hybrid mode. For radar observation of rain, it is shown that, the antenna polarization purity and alignment are critical. Data collected from convective rain showers using both alternate mode (or eigen polarization state) and hybrid polarization mode are compared.

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1. (a)
Yanting Wang
Department of Electrical and Computer Engineering
Colorado State University
Fort Collins, CO
80523 US
ytwang@engr.colostate.edu

(b) (970)491-6758

(c)

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3. (a)

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