Attenuation Correction for Reflectivity Observations from a Dual-frequency Dual-polarization Doppler Radar

V. Chandrasekar and Haonan Chen*
1373 Campus Delivery, Colorado State University, Fort Collins, USA.
*chandra@engr.colostate.edu, haonan.chen@colostate.edu

In recent years, monitoring of precipitation using higher frequency radar systems, such as X-band, Ku-band, and Ka-band, has gained increasing interest because of the cost efficiency and portability. However, at such frequencies, the electromagnetic waves will suffer from attenuation due to propagation in precipitation, and the attenuation is determined by the extinction cross section of precipitation particles. Therefore, radar measurements of reflectivity (Z) must be corrected for attenuation before it can be used for quantitative precipitation estimation (QPE). Since the introduction of dual-polarization concept, a number of attenuation correction procedures have been proposal based on dual-polarization observations. Among which, the differential phase based methodology was shown to have less effect on radar calibration and system errors. It is extensively used for correcting C-band and X-band observations.

In this paper, we presents a specific differential propagation phase (Kdp) based attenuation correction method for the NASA Dual-frequency Dual-polarization Doppler Radar (D3R). D3R is a ground system designed to support the Ground Validation (GV) activities of NASA's Global Precipitation Measurement (GPM) satellite mission. It is operating at the nominal frequencies of 13.91GHz (Ku-band) and 35.56GHz (Ka-band) covering a maximum range of about 40 km (M. A. Vega et al., *Radio Science*, **49**, 2014, pp. 1087-1105). For Ku-band, the specific attenuation (AH_{Ku}) is estimated as a linear relation to Kdp as:

$$AH_{Ku} = \alpha_{Ku} Kdp_{Ku} \tag{1}$$

For Ka-band, the specific attenuation (AH_{Ka}) is estimated as a linear relation to AH_{Ku}, as shown in equation 2(a), where the coefficient is determined by Kdp_{Ku} shown in equation 2(b):

$$AH_{Ka} = \alpha_{Ka} AH_{Ku} \tag{2a}$$

$$\alpha_{Ka} = f(Kdp_{Ku}) \tag{2b}$$

In order to get the specific values for coefficients in equation (1) and (2), simulation is performed based on the drop size distribution (DSD) observations during the NASA Iowa Flood Studies (IFloodS) field experiment conducted in May-June, 2013. In this paper, the simulation process will be described. The attenuation correction methodology will be implemented for D3R observations during the IFloodS field campaign. In addition, the attenuation corrected results will be evaluated by comparing with observations from a collocated S-band radar and surrounding disdrometers.