Enhancing Specific Attenuation Rainfall Estimates in Stratiform and Convective Rain Regimes

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A new multi-radar multi-sensor (MRMS) Q3 Dual Pol (“Q3DP”) quantitative precipitation estimate (QPE) algorithm has been developed that utilizes specific attenuation (*A*) to estimate precipitation rate below, reflectivity (Z) within and above the melting layer, and specific differential phase (Kdp) where hail is likely. Extensive verification over a 13-month period showed Q3DP performed significantly better than the current operational MRMS QPE utilizing multiple R(Z) relationships to estimate rainfall. A critical component of Q3DP is the calculation of the path integrated attenuation which utilizes a parameter α defined as the ratio *A*/Kdp. This parameter is quite sensitive to drop size distribution (DSD) changes and has larger (smaller) values in stratiform and tropical (convective) rainfall. The parameter α is estimated by calculating the slope of the differential reflectivity (Zdr) –Z dependence in pure rain.

Although overall successful, Q3DP exhibited a dry bias in light to moderate stratiform rainfall and an occasionally wet bias in some convective rainfall events. Subsequent analyses indicated that one major contributing factor was the use of a single α for a whole radar domain that did not capture large spatial variations of rainfall regimes. To address this challenge, the specific attenuation QPE was refined to better capture spatial variations of precipitation regimes. Test results utilizing 29 predominantly stratiform, 12 predominantly convective, and 34 mixed regime rainfall events indicated the enhanced QPE algorithm utilizing the new technique significantly reduced variability and exhibited over 20% reduction in the Mean Absolute Errors for stratiform and convective events. While the error reduction for mixed regime events was smaller, ~5%, there was a significant reduction in the variability resulting in more robust estimates.

Keywords: Specific Attenuation, R(A), MRMS