13.9 A DUAL-POL RADAR SYNTHETIC QPE FOR OPERATIONS

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The dual-polarization (DP) upgrade of the United States NEXRAD network was completed in 2013. As a result, a near surface hydrometeor classification and a DP radar quantitative precipitation estimation (QPE) were implemented at each radar site. The hydrometeor classification provided a much improved identification of non-hydrometeor echoes over the single-polarization (SP) radar techniques, and the DP QPE had much less contamination from anomalous propagation clutter and biological scatterers. The DP QPE, based on reflectivity (Z), differential reflectivity (Zdr) and specific differential phase (Kdp), provided improved precipitation estimates over the previous SP QPE in some warm season events where the freezing level was high. However, it had relatively large random errors due to its sensitivity to errors in Zdr observations, which can be significant at times. The DP QPE also suffered from discontinuities and some biases near the melting layer. Based on these initial assessments, a new DP radar synthetic QPE was developed within the Multi-Radar Multi-Sensor (MRMS) system.

The MRMS DP QPE calculates precipitation rates (R) based on a combination of specific attenuation (A), Kdp, and Z. The R(A) relationship was based on Ryzhkov et al. (2014) with some modifications based on a large number of case studies and real-time evaluations. The R(A) relationship has advantages of being immune to calibration errors in Z and Zdr and is insensitive to partial beam blockages. It is more linearly related to the liquid water content in the radar beam path than other radar variables. However, there are no well defined R(A) relationships in areas containing ice due to complex properties of hydrometeors in the mixed and ice phases. Therefore, the MRMS DP QPE applies R(A) relationship in areas where radar is observing pure rain, R(Kdp) in regions potentially containing hail. A vertical profile corrected R(Z) is applied elsewhere. The vertical profile correction is to account for the vertical reflectivity variations in and above the melting layer.

The MRMS DP QPE has been tested in real-time over CONUS since April 2017. It′s performance during the warm season of 2017 will be presented at the conference.

References

Ryzhkov et al. 2014: Potential Utilization of Specific Attenuation for Rainfall Estimation, Mitigation of Partial Beam Blockage, and Radar Networking. JTECH, 599-619.