Testing Rainfall Rate Algorithms for CSU-CHILL X-Band Radar

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This paper examines four rainfall rate estimators using data from the CSU-CHILL X-band polarimateric radar, over a ground-instrumentation site, located 13 km south-southeast from the radar. The ground instruments included a Pluvio rain gauge housed inside a 2/3rd scaled double wind-fence, the same one used for the MASCRAD snow observation project (B. M. Notaroš, V. N. Bringi, C. Kleinkort, P. Kennedy, G-J Huang, M. Thurai, A. J. Newman, W. Bang, and G. Lee, "Accurate Characterization of Winter Precipitation Using Multi-Angle Snowflake Camera, Visual Hull, Advanced Scattering Methods and Polarimetric Radar," Atmosphere, 7(6), 81, 2016). The paper presents and discusses results from the analysis of an event which occurred on May 23, 2015 and lasted for 90 minutes, with the CHILL X-band radar performing regular scans over the Pluvio (MASCRAD) site.

Previous analysis (M. Thurai, P. Kennedy, V. Bringi, B. Notaroš, and S. Rutledge, "Propagation effects at X-band from the 2015 rain measurement campaign in Greeley, Colorado", Proceedings of the 10th European Conference on Antennas and Propagation, EuCAP 2016, DOI: 10.1109/EuCAP.2016.7481927) had utilized rain rate estimates derived from the CHILL X-band data directly over the Pluvio site. The four estimators were based on (i) attenuation-corrected reflectivity ($Z_{h,corr}$), (ii) specific differential propagation phase (K_{dp}), (iii) specific attenuation (A_h), and (iv) combined A_h and differential reflectivity (Z_{dr}), all at X-band. In this paper, we use the same four estimators to derive rain rates over radar pixels not only at the Pluvio location but also the pixels surrounding the site. A two-dimensional weighting function is used to improve the rain rates derived from the radar data. This has enabled us to test the performance of a recently-developed weighted-composite algorithm (using the outputs from all four estimates) by comparing against the Pluvio measurements, in terms of both rainfall rates and rain accumulations.