Extended Validation of Composite-Weighted Rain Rate Algorithm using Iowa XPOL-5 Radar Scans over a Twin-Bucket Rain Gauge Network

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In our recent work (Thurai et al., 2017), we had proposed a new composite-weighted rainfall estimator for the Iowa XPOL-5 radar. The XPOL-5 is part of a mobile radar network that participated in NASA’s Iowa Flood Studies (IFloodS) field campaign and made measurements over watersheds at high spatiotemporal resolutions (75 m range resolution and 5°/sec scan rate). We used data from six two-dimensional video disdrometers (2DVDs) to derive four X-band rain-rate estimators based on (i) attenuation-corrected radar reflectivity ($Z_h$), (ii) specific differential propagation phase ($K_{dp}$), (iii) specific attenuation for horizontal polarization ($A_h$), and (iv) both differential reflectivity ($Z_{dr}$) and specific attenuation algorithm ($A_h$) jointly. These estimators were then weighted as per the measurement and algorithm errors using a piecewise constant functions over reflectivity values. Subsequently, the weights were turned into continuous functions using smoothing splines. Thereafter, we derived our composite-weighted algorithm and tested it against measurements from 12 rain gauges deployed within XPOL-5 coverage for an 8-hour event. The rain gauge network comprised both twin and triple tipping buckets.

In this paper, we expand the evaluation of our algorithm to a network of 25 gauges. As an illustration, Fig. 1 shows the normalized bias (NB) values in terms of event accumulation with respect to one (namely, the first) of the gauges in a twin-bucket instrument. The blue dots show total accumulation in the second gauge assuming the first gauge is the “truth”. The orange and green dots denote the NB values for $R(A_h)$ and $R(K_{dp})$, respectively.

We will demonstrate how our composite-weighted algorithm improves the normalized bias. We further fine-tune our methodology to include the drizzle-component of the drop-size distributions.

Reference:


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Figure 1: The NB values of event accumulation using $R(A_h)$ and $R(K_d)$ algorithms compared against Gauge #1 (‘truth’). Also shown are the NB values for Gauge #2.