Quantitative Precipitation Estimation Using Dual-Polarization Radar Network Over the Dallas-Fort Worth (DFW) Metroplex

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The Distributed Collaborative Adaptive Sensing (DCAS) paradigm introduced by the National Science Foundation Engineering Research Center (NSF-ERC) for Collaborative Adaptive Sensing of the Atmosphere (CASA) has shown great advantages to observe and track low-level atmospheric conditions during the 5 years operation (2007-2011) in Southwestern Oklahoma. To demonstrate the DCAS concept and mitigate the increasing vulnerability to urban flash floods, CASA, in collaborative with the North Central Texas Council of Governments (NCTCOG), has been establishing its first urban radar network in Dallas-Fort Worth (DFW) metropolitan area. The eight-node X-band dual-polarization radar network is expected to provide improved hazardous weather forecasts, warnings and response in this densely populated metroplex.

Radar-based Quantitative Precipitation Estimation (QPE) is one of the major research activities in the development of this urban remote sensing network. In this study, we implement a K_{dp}-based rainfall algorithm for the CASA DFW X-band radars to estimate the rainfall intensity and accumulations. The spatiotemporal resolution of CASA QPE is about 500 meters and 1 minute. In addition, the local S-band NEXRAD site (i.e., KFWS radar), which has been upgraded to have dual-polarization capability since November 2012, is also used to generate the networked dual-polarization rainfall products. For this S-band radar, we use a combination of reflectivity (Z_h), differential reflectivity (Z_{dr}), and K_{dp} to retrieve the rainfall field. Composite rainfall products are then created using resampling techniques based on the CASA radar and NEXRAD rainfall measurements.

To validate and evaluate the dual-polarization radar rainfall products, 19 rain gauges operated by the City of Fort Worth and 21 by the City of Grand Prairie are used for cross comparison between the radar rainfall measurements and gauge rainfall observations. The evaluation results show excellent performance of the CASA DFW rainfall products with low bias and normalized standard error.