



High-resolution Rainfall Mapping in Dallas-Fort Worth (DFW) Urban Network of Radars at Multiple Frequencies

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Urban flash flood is one of the most commonly encountered hazardous weather phenomena. Unfortunately, the rapid urbanization has made the densely populated areas even more vulnerable to flood risks. Hence, accurate and timely monitoring of rainfall at high spatiotemporal resolution is critical to severe weather warning and civil defense, especially in urban areas.

However, it is still challenging to produce high-resolution products based on the large S-band National Weather Service (NWS) Next-Generation Weather Radar (NEXRAD), due to the sampling limitations and Earth curvature effect. Since 2012, the U.S. National Science Foundation Engineering Research Center (NSF-ERC) for Collaborative Adaptive Sensing of the Atmosphere (CASA) has initiated the development of Dallas-Fort Worth (DFW) radar remote sensing network for urban weather hazards mitigation. The DFW urban radar network consists of a combination of high-resolution X-band radars and a standard NWS NEXRAD radar operating at S-band frequency. High-resolution quantitative precipitation estimation (QPE) is one of the major research goals in the deployment of this urban radar network.

It has been shown in the literature that the dual-polarization radar techniques can improve the QPE accuracy over traditional single-polarization radars by rendering more measurements to enhance the data quality, providing more information about rain drop size distribution (DSD), and implying more characteristics of different hydrometeor types. This paper will present the real-time dual-polarization CASA DFW QPE system, which is developed via fusion of observations from both the high-resolution X band radar network and the S-band NWS radar. The specific dual-polarization rainfall algorithms at different frequencies (i.e. S- and X-band) will be described in details. In addition, the fusion methodology combining observations at different temporal resolution will be presented. In order to demonstrate the capability of rainfall estimation of the CASA DFW QPE system, rainfall measurements from ground rain gauges will be used for evaluation purposes. This high-resolution QPE system is used for urban flash flood forecasting when coupled with hydrological models.