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Radar Analyses of Space-Time Variability of Extreme Flood-Producing Rainfall in Urban Drainage Basins

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The Charlotte, North Carolina metropolitan area has experienced extensive urban and suburban growth during the past 40 years, resulting in increasing flood hazards in the region. Record flooding in the urban core of Charlotte occurred on 23 July 1997 from a storm that produced rainfall accumulations of more than 250 mm during an 18 hour period, more than doubling the 24 hour rainfall maximum in Charlotte, and causing $60 million in property damage and three fatalities. Analyses of the 23 July 1997 storm and flood are based on rainfall and discharge observations from dense networks of rain gages and stream gages maintained by the U.S. Geological Survey and rainfall estimates from two WSR-88D weather radars, both located approximately 100 km from the urban core of Charlotte. This wealth of observations provides an opportunity to address hydrometeorological questions concerning: (1) the accuracy of radar rainfall estimates for extreme, flood-producing rainfall; (2) the space-time variability of extreme, flood-producing rainfall in urban environments; and (3) the effects of urbanization on extreme flood response in urban environments. It is shown that bias-corrected radar rainfall estimates for the 23 July 1997 storm are quite accurate and provide the capability for resolving the fundamental rainfall forcing associated with regional variation in extreme flood response. This study shows how the spatial and temporal variability of rainfall combines with the land surface properties to determine extreme flood response in urban drainage basins.