Geophysical Research Abstracts
Vol. 20, EGU2018-3538, 2018
EGU General Assembly 2018

Structure and evolution of flood-producing storms in small urban watersheds: implications for urban flood modeling

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In this presentation, we synthesize findings from previous empirical and modeling analyses that are principally motivated by two objectives: (1) to characterize the structure and evolution of storms that produce severe urban flooding and (2) to investigate roles of interactions between storm properties and basin characteristics in determining scale-dependent flood response in urban watersheds. Our analyses focus on a diverse sample of “small” urban watersheds (basin scales ranging from 1 to 200 km2) over a collection of U.S. cities, including Princeton, New Jersey; Charlotte, North Carolina and Phoenix, Arizona. These urban watersheds are equipped with long-term, high-resolution stream gaging observations (more than 15 years, 1 to 15 min) and high-resolution, bias-corrected radar rainfall fields (1 km2, 15-min). We examine structure and evolution of flood-producing storms based on storm tracking procedures utilizing 3-D radar reflectivity fields from the Weather Surveillance Radar 1988 Doppler (WSR-88D). We identify key storm properties of urban flood response based on metrics characterizing interactions of spatiotemporal rainfall variability and flow path networks, as well as through numerical experiments using high-resolution hydrologic modeling tools (e.g., GSSHA, KINEROS). Our results highlight the important roles of storm structure and evolution in determining the spatiotemporal rainfall variability and flood response in small urban watersheds. Higher temporal resolutions of rainfall fields that characterize critical storm evolution features are required for improved flood modeling in small urban watersheds.