A Comparative Study of Urban Influence on Precipitation in the South-Central United States

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As many studies have shown that urban areas can influence local and regional rainfall (Changnon 1969, Shepherd et al. 2002, Diem & Brown 2003, Diem & Mote 2005, Shepherd 2006, Nordfelt 2008), it is important to further examine the relationship between urbanization and climate as urban areas grow larger in population.

While there are urban influences on precipitation through all times of the year, I will concentrate on convective and frontal precipitation. Convective rainfall is affected in that there is an area of increased precipitation received downwind of the main urban center. This is caused by many factors such as the urban heat island, the urban canyon, increased surface roughness and lifting due to building density and height, and changes in pollution. These factors also influence frontal precipitation in the form of storm splitting and bifurcation. Bornstein and Lin (2000) defined storm bifurcation as "a single initial storm splits into two separated supercells, given appropriate vertical wind shear conditions". It is stated that this is different from storm splitting in that splitting is a storm that moves in two directions around a city. These concepts have not been widely studied at this time. One existing study of storm bifurcation was conducted in the Baltimore Metropolitan region (Ntelekos et al. 2008). It was found that the urban area did influence rainfall and that aerosols were one of the biggest factors. In addition to storm bifurcation and splitting, it is known that propagation, enhancement, and evolution of a storm have all been affected by urban areas.

The main focus of this study is to analyze how warm-season rainfall is influenced in and around multiple urban areas throughout the south-central United States. There are three proposed objectives for this study. The first objective is to determine which urban areas experience an urban influence on precipitation. This objective will involve using PRISM data for the entire south-central United States. I will use this data to analyze the spatial pattern exhibited by rainfall received in and around urban areas. This includes performing a linear regression of rainfall for each city to see where anomalies exist.

The second objective includes using radar data to study how rainfall received by frontal and convective systems is spatially distributed around an urban area. Stations within the study areas will be compared to this radar data for ground-truthing purposes. Storm movement will be classified into various categories (storm splitting, bifurcation) and its propagation and regeneration will be studied. This will allow me to develop standardized definitions of storm splitting and bifurcation. This data will then be compared to rainfall at other cities.

The third objective involves a synoptic analysis to analyze the frequency of splitting and bifurcation events and how they vary for each precipitation type. It will then be possible to determine what type of synoptic conditions storm splitting and bifurcation are most commonly found with and how these synoptic controls vary over time.

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