Urban Influences on Convection and Lightning Over Houston

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Abstract: The research presented in this dissertation addresses a fundamental question regarding urban, ultimately anthropogenic, influences on convection as it relates to lightning **production** and precipitation structure. In general, inadvertent weather modification hypotheses offered to explain lightning and rainfall anomalies rely on either or both perturbations in the spatial distribution and intensity of convection (from whence warm-season rainfall and lightning emanate), or modification to convective **cloud** microphysics through aerosol loading over and downwind of polluted cities such as Houston. Using eight independent datasets, causative mechanisms to explain enhancements in summer season **cloud**-to-ground (CG) lightning over the Houston area were examined in an attempt to isolate the primary contributor. We quantify a three-step process by which thunderstorm electrification may become enhanced over the Houston area relative to its surroundings. Findings indicate that the spatial extent of the flash density features are primarily the result of "typical" convective activity tied to the presence of a persistent thermal anomaly situated over the city center. Coupled with the land surface heterogeneity of the surrounding area, this urban heat island (UHI) gives rise to a preferential location of low-level convergence and convective initiation and enhancement. We find the primary causative mechanisms responsible for the intensity of the Houston CG lightning anomaly to be those associated with a mixture of urban and natural influences, specifically that UHI thermodynamics provide a more favorable environment for convective initiation and thunderstorm intensification as well as contributing to an area of preferred convergence over, downwind of the city, with associated mesoscale enhancements in sea breeze convergence.

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