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The extent of urban-modified cloud-to-ground lightning characteristics for Atlanta, Georgia (USA), 1992-2003

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Changes in land cover can modify local weather and climate. We describe the patterns of cloud-to-ground (CG) lightning flashes around Atlanta, Georgia (USA), a region that has undergone an intense conversion from natural to anthropogenic land uses. For the twelve year interval spanning 1992 to 2003, annual average CG flash densities on the order of 6-8 flashes per square kilometer per year emerged around Atlanta. These values are 50-75% higher than the surrounding rural areas, and comparable to flash densities along the Atlantic coast of Georgia. Urban flash density enhancement extended over a large swath of Atlanta, and into Gwinnett County, a heavily suburbanized, rapidly growing county to the northeast. The number of days in which a flash was observed reached a maximum several kilometers north of downtown Atlanta. Urban production peaked during the summer (May through June) and exhibited more night (1800 to 2400 hrs LST) and early morning activity (2400 to 0600 hrs LST) than the surrounding rural areas. GIS-based analyses of flash day counts and strike production indicated that Atlanta's higher flash densities develop when the broader atmospheric setting favors widespread lightning. Mapping of flashes by interval classes also revealed how flash density maxima differentially emerge among three zones of enhancement in Atlanta. In addition, a large area of reduced positive polarity flashes developed along the western edge of Atlanta's loop highway, Interstate 285, and extended 200 km or more downwind (east). This area also trended south along the Interstate 75 corridor into central Georgia. These patterns suggest that automobiles may be a source for the aerosols that lower the percentage of positive lightning flashes.