What is an urban heat island?

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Urban heat islands (UHIs) have been extensively studied in cities of different sizes and climates. However, defining and quantifying the magnitude of a UHI and the primary mechanism responsible for this type of phenomenon are still debated. This study investigated a UHI using hourly air temperature (Ta) collected at 263 stations and land surface temperature (Ts) collected four times daily in Beijing in 2013. Five typical urban area types were studied: parking lots, building roofs, warning towers (on streets), city grasslands, and city parks. The daytime UHI quantified by Ta was substantially less than that at night, and the highest UHI quantified by Ta was during nighttime in winter. The dominating factor of the diurnal and seasonal cycles of the nighttime UHI by Ta is the storage of energy by urban materials in the morning and the release of this energy later, dependent on urban structure and solar elevation. The amplitude and seasonal cycle of the nighttime UHI by Ts were similar to that quantified by Ta, and the largest values were in winter. The daytime UHI by Ts had a significantly different seasonal cycle, with the largest values in summer. The urban-rural contrast in evapotranspiration resulted in greater energy being absorbed by urban floors, the dictating factor for the daytime UHI by Ts and its seasonal cycle. These results have important implications for the impact of UHIs on the homogeneity of Ta observations and mitigating the impact of UHIs on extremely hot events in urban areas.