Quantifying the impacts of built environment and surface properties on temperature extremes

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Urbanization has created an increase in urban heat island (UHI) effect. UHI reflects an elevated temperature in cities as compared with nearby rural areas which is due to the change in landscape from grass covered and vegetative to concrete and asphalt with three-dimensional structures. Our on-site study revealed that mixed environments (grass, water, and concrete) result in different temperature profiles within specific ranges. Grass shows the coolest environment, water is the most temperate, and concrete has the highest peak temperatures during the day for the duration of the study. To further understand temperature extremes at fine temporal and spatial scales in complex urban settings and to minimize the thermal impact of structures on the surrounding environment, we plan on quantifying the impacts of built environment and surface properties on surrounding temperature through three specific tasks: 1) downscaling satellite infrared radiation brightness temperatures to identify hot spots within urban environments and introduction of a localized offset table concept to quantify the impact of various surface type on thermal anomalies, 2) understanding the behavior of common surface materials in the built environment in interaction with solar radiation and quantification of the vertical association between skin temperature and near surface air temperature for thermal mapping within urban microclimates, and 3) development of a conceptual framework for assessing environmental risk and vulnerability to temperature extremes by modeling the near surface air temperature profile of complex urban systems based on land surface properties and field measured data.