Measurements and Modeling of the Urban Heat Island Effect - the Role of Anthropogenic Emissions

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The Urban Heat Island (UHI) effect is due in part to differences in surface morphology and surface characteristics—most notably—albedo, and moisture availability. Additionally, the emission of waste heat and moisture from energy consuming activities in the urban environment can significantly impact both the UHI and humidity levels throughout the city. While the various causes of the UHI are relatively easy to list, assessing the relative contribution of each cause is a more difficult task - and more important with respect to providing guidance for UHI mitigation measures.

This presentation will focus on two related aspects of our research that seek to address this need. The first component of this work is the development and implementation of a UHI measurement traverse platform for assessing the spatial variability of the near-surface air temperature UHI. This platform consists of high accuracy fast-response temperature and humidity sensors mounted in a radiation shield on a mast secured to a standard passenger car window frame. The sensor system is aspirated by the vehicle motion and is complemented by a data-logging GPS unit, with all sensors acquiring data every 5 seconds.

The second aspect of the research is the development of a spatially-detailed model for anthropogenic heat and moisture emissions. In this presentation we will focus on the building sector emissions model which links building energy simulations of prototypical buildings with parcel-level information regarding building types and sizes. The result is a parcel-level estimate of hourly emissions of heat and moisture. These data can be combined with a Geographical Information System (GIS) data resource containing information on land use, vegetation, albedo, impervious surface and related parameters. When the traverse data are added to this GIS data resource we are able to develop predictive equations quantifying the relationship between the UHI magnitude and its causes.