Urban Surface Temperatures and Remote Sensing

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Through the process of urbanization, cities develop a complex assemblage of surface types of varying heights, orientations, and material properties. Consequently, the urban surface temperature exhibits significant spatial and temporal variability due to the large variations in the local energy budget of individual surfaces.

Urban surface temperatures are of prime importance to the study of urban climatology. The surface temperature modulates the air temperature of the lowest layers of the urban atmosphere, is central to the energy balance of the surface, helps to determine the internal climates of buildings, and affects the energy exchanges that affect the comfort of city residents. Modification of urban surface temperature through surface property manipulation forms the basis for many current and proposed “heat island mitigation” strategies.

The variability of urban surface temperature lends itself well to observation using thermal remote sensing, which allows the identification of the spatial variability of urban surface temperatures at a range of scales, and, depending on the sensor platform combination used, to the assessment of the temporal variability. However, the application of thermal remote sensing over the three-dimensionally rough urban surface is complicated by the nature of the urban surface. The coupling of the three-dimensionally rough urban surface with a biased view of this rough surface by the remote sensor results in directional variations (anisotropy) of the thermal radiation arriving at the sensor. This is of particular concern when spatial resolution is such that individual surface structures are no longer resolved.

The large magnitudes of observed urban thermal anisotropy suggest that it can be a significant factor in the interpretation of the surface urban heat island and application of urban surface temperatures to modelling urban surface heat fluxes. The presentation will provide results of observational and modelling studies that have been undertaken to describe urban thermal anisotropy and describe work currently underway that may help to generalize those results, with particular reference to the impact on remote sensing of the urban heat island.