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Radiative Response of Impervious Urban Materials - Spectral Reflectance, Broadband Albedo and Surface Emissivity

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The urban surface provides a complex interface for surface-atmosphere interactions, with heterogeneous materials and three-dimensional structure. Improved understanding of the radiative response of the various materials forming urban canopy elements, such as roads, buildings, and parks, offers advances at two fronts of environmental research in cities. Firstly, given radiation is a key component of the surface energy balance, detailed information on albedo and emissivity is required to interpret micrometeorological observations and to model boundary layer climates. Secondly, spectral radiative response in the short-wave and thermal infrared regions of the electromagnetic spectrum can be used to obtain information about the surface composition and properties at different spatial resolutions.
While differences between natural and artificial materials are fairly well understood, only a few studies have been concerned with the diversity of spectral properties for classes of anthropogenic materials. This study presents a new spectral library of impervious urban surface materials, covering short-wave and thermal infrared wavelengths.

Using two field spectroscopy methods (Visible/Near/Short-Wave InfraRed, VNIR/SWIR, reflectance and Fourier Transform InfraRed, FTIR, Spectroscopy), spectral reflectance and emissivity are measured and presented here, along with spectrally integrated estimates of their respective broadband values. Considerations of the applicability of bi-conical reflectance observations of non-Lambertian surfaces are discussed, and an attempt is made to quantify the uncertainties of the applied emissivity retrieval method. Material samples are classified into different groups based on their IR absorption and reststrahlen features. How the radiative response in the VNIR/SWIR region relates to that in the thermal IR is also considered. The work suggests that hyperspectral thermal remote sensing offers great potential for advances in urban environment research.