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A study on optical and thermal signatures of the tree canopy-urban surface systems

Christos Halios[1], Owen Branthwaite[2], Samuele Lo Piano[3], Stefan Smith[1], Brian Pickles[4], and Li Shao[1]

[1]University of Reading, School of Built Environment, Reading, United Kingdom of Great Britain – England, Scotland, Wales (c.halios@reading.ac.uk)

[2]Jesus College, University of Cambridge, CB5 8BL

[3]Faculty of Management and Economics, Gdańsk University of Technology, Gdańsk, Poland

[4]School of Biological Sciences, University of Reading, Whiteknights Reading RG6 6AS, UK

Remotely sensed spectral and thermal measurements are used to address how the mix of built-up and green urban surfaces influence microclimates: thermal infrared sensors measure the emission of longwave radiation from surfaces, which is closely related to their temperature and can be used to explore how urban surfaces store and release heat. Visible to shortwave infrared sensors on the other hand capture how surfaces absorb and reflect incoming solar radiation at different wavelengths, which helps identify materials (like vegetation, asphalt, metal roofs) based on their reflectance signatures. Currently, issues like spatial variation and spectral mixing reduce accuracy in urban heat studies: when multiple surface types (e.g., vegetation, concrete, soil) coexist in satellite pixels, temperature assessments become more complex.

In this study measurements were obtained using a ground-based experimental layout consisting of a spectrometer and a thermal camera mounted on a portable crane. This layout was deployed to study the physical system that consisted of the tree canopy of containerised *Acer platanoides* trees placed on a paved surface and the background area. Numerical experiments involving the 4SAIL and PROSAIL optical radiative transfer models were used in an inverse mode to disentangle the contribution of the thermal signatures of the tree canopy and the underlying urban surface to the spectral reflectance variation. The sensitivity of the physical system was explored using the delta global sensitivity analysis metric. Strong correlations between the canopy-background temperatures and the fractional vegetation cover indicate that synergies between thermal and spectral measurements in the fine scale is a promising method for disentangling the combined signal components.