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Temporal and spatial patterns of sensible heat flux measured by scintillometers in central London

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Spatially-integrated measurements of sensible heat flux (QH) are needed in urban areas to evaluate urban climate models and satellite observations. Scintillometers allow observations of QH over much larger areas than techniques such as eddy covariance (EC), however there remain challenges with interpreting results over heterogeneous urban surfaces. This work presents a full year of observations from a unique configuration of three scintillometers in central London with path lengths ranging from 1.1-3.2 km. Results are compared with simultaneous EC measurements from a flux tower operating in the long-term scintillometer source area. Scintillometer measurements are within 10% of EC observations, though scintillometer calculations are sensitive to estimates of the effective measurement height and displacement of the urban canopy.

Results show expected diurnal courses and seasonal trends in QH magnitude related to solar radiation input. Observations also reveal a clear anthropogenic component to QH when weekday and weekend values are compared. Spatially, vegetation and building land cover fraction in the measurement source areas are correlated with normalized QH after data are conditionally sampled to control for synoptic conditions and anthropogenic activity. This spatial analysis provides additional evidence of anthropogenic influence on QH with highest weekday/weekend ratios from a commercial/financial district of the city. Spatial differences are used to estimate horizontal advection and develop a novel method to estimate monthly latent heat flux. Using an energy balance residual approach, annual anthropogenic heat emissions are estimated and compared to heating degree days and carbon dioxide emissions.