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Large-area heat fluxes from two-wavelength scintillometry in the suburban environment

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The scintillometry technique provides turbulent heat fluxes over a scale of a few hundred metres to kilometres. The measurements are spatially-integrated, which makes this technique particularly valuable over areas with moderate heterogeneity. A unique millimetre-wave scintillometer was deployed alongside an infrared scintillometer over Swindon, UK. Pairing these wavelengths enables direct determination of the latent heat flux in addition to the sensible heat flux. The fluxes obtained are representative of the suburban surface at a scale of approximately 5 km2. To evaluate hydro-meteorological models and satellite data products, fluxes at this scale are extremely useful. The Swindon results show clear differences between the large-area scintillometer and smaller scale eddy covariance fluxes.

The behaviour of the surface at these two different scales is investigated. The key role of vegetation in determining suburban evaporation is evident. Whilst the source area of the scintillometers contains a higher relative proportion of vegetation, for some wind directions the eddy covariance source area comprises mainly impervious surfaces and buildings. The scintillometers suggest a representative evaporation rate for the study area is around 2-3 mm day-1 in summer, significantly larger than the eddy covariance results (1-2 mm day-1). The impact of limited water availability is explored at the two scales and across the seasons. Whilst vegetation is usually able to access sub-surface moisture and continue transpiring, impervious surfaces dry out over several days following rain and the Bowen ratio is seen to rapidly increase. These findings have important implications for data assimilation, energy and water balance modelling and quantifying fluxes over mixed land cover.