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A dynamic aerodynamic resistance approach to calculate high resolution sensible heat fluxes in urban areas

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Remotely sensed data from satellites have potential to enable high-resolution, automated calculation of urban surface energy balance terms and inform decisions about urban adaptations to environmental change. However, aerodynamic resistance methods to estimate sensible heat flux (QH) in cities using satellite-derived observations of surface temperature are difficult in part due to spatial and temporal variability of the thermal aerodynamic resistance term (rah). In this work, we extend an empirical function to estimate rah using observational data from several cities with a broad range of surface vegetation land cover properties. We then use this function to calculate spatially and temporally variable rah in London based on high-resolution (100 m) land cover datasets and in situ meteorological observations. In order to calculate high-resolution QH based on satellite-observed land surface temperatures, we also develop and employ novel methods to i) apply source area-weighted averaging of surface and meteorological variables across the study spatial domain, ii) calculate spatially variable, high-resolution meteorological variables (wind speed, friction velocity, and Obukhov length), iii) incorporate spatially interpolated urban air temperatures from a distributed sensor network, and iv) apply a modified Monte Carlo approach to assess uncertainties with our results, methods, and input variables. Modeled QH using the aerodynamic resistance method is then compared to in situ observations in central London from a unique network of scintillometers and eddy-covariance measurements.