



Clear-sky upwelling thermal infrared emissions of UK cities scale sub-linearly with population

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ABSTRACT

Human health and infrastructure resilience can both deteriorate quickly during hot weather. Cities contain high densities of people and complicated infrastructure networks. Because of differences in heat absorption and release between urban and rural landscapes, cities develop thermal climates different from their surroundings. The rise in global temperature due to an increasing Greenhouse Effect, and high rates of urbanization, make it important to understand the energy balance of cities, including the extent to which the energy balance is modified by the city's urban form (i.e. arrangement of work and residential buildings, road layout, and so forth). In this study, satellite data of UK overpasses of the Moderate Resolution Imaging Spectroradiometer (MODIS), covering the period between 2000 and 2017, were sampled to examine the seasonal (winter and summer) variability in night-time surface thermal climate for 35 UK cities. Total (area-integrated) emitted energy was also calculated, and interpreted by looking for 'allometric' scaling against the total population of the urban areas. Total night-time emitted energy is found to scale linearly with population on both summer and winter nights. This indicates that UK Cities, although often appearing superficially very different, are similar in their 'thermal make-up', i.e. in terms of the components of urban form which dictate thermal properties.