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Case study of an urban heat island in London, UK: Comparison between observations and a high resolution numerical weather prediction model

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The ability to accurately forecast local conditions in cities is important for a wide variety of applications. For example, alerting local authorities of low temperatures so that roads can be gritted, or issuing health-related warnings to vulnerable residents. Until recently, a lack of urban meteorological observations above roof height has meant that verification of numerical weather prediction models in urban areas can be difficult.

Observations of the climate of Central London have been carried out at the BT Tower (190 m) and at rooftop height since summer 2010. A Doppler lidar has been used over the same period to obtain profiles of wind and turbulence, and to determine boundary layer height. 30/09/2011 was chosen for comparison with the Met Office 1.5 km resolution model (UKV). The conditions produced a strong urban heat island, and it is expected that in this situation the urban surface would have its greatest effect on the atmosphere. The observations were compared with versions of the UKV using a slab and a two-tile representation of the urban surface. The two-tile scheme provides a more realistic version of the physics of the urban surface, and changes the surface energy balance by using two surfaces with different characteristics.

This case study shows that the model qualitatively captures detailed jet-like structures, and the diurnal cycle in boundary layer depth. However, the boundary layer depth observed using the lidar in London is approximately twice that of the modeled depth. The temperature at the BT tower is underestimated throughout the day by 1 – 2 K. The sensible heat flux is underestimated by up to 150 Wm^{-2} during the day, and is negative during the night, instead of positive. Preliminary results from a longer comparison (Oct. 2011 – Oct. 2012) will also be presented to provide context for this case study.