Comparison of model-derived distribution of sensible heat flux over an urban area with radar-derived rainfall fields

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Fig. 1 - Top: Surface elements height, $z_H$ (m). Bottom: Frontal area index, $?_F$.
Note the large values of frontal area index in the city centre.

Fig. 2 - Air temperature, $T$ (top), and wind, $u$ (bottom) observations on the 14th (left) and 21st June (right) 2004 from different sources over Greater Manchester: MetOffice &Manchester University of Manchester Atmospheric Science Research Group, central Manchester_SalfordUni field experiment at Salford University; Salford AWS situated in Salford [www.wunderground.com].

Fig. 3 - Radiometric surface temperature, $T_{\text{sat}}$ (K), over the Greater Manchester study area, from satellite imagery around 13 UTC, on the study days of (left) 14th and (right) 21st June 2004. Grey areas are cloud or missing data. (MODIS/Terra and MODIS/Aqua Land Surface Temperature [modisland.gsfc.nasa.gov])

Fig. 4 - Modelled surface sensible heat flux, $Q_H$ (W/m$^2$), over the Greater Manchester study area, around 13 UTC, on the study days of (left) 14th and (right) 21st June 2004. Grey areas are cloud or missing data. The dotted lines delineate the 9 km wide swath through the city centre.

Fig. 5 - Rainfall rate (mm h$^{-1}$) on 21st June 2004, around 10 UTC, given by the Hameldon Hill C-band radar located some 24 km north of the centre of Manchester, North West England. This image is an example of the radar data used in this work (10 min image, with 2x2 km$^2$ spatial resolution).

Fig. 6 - Hovmöller diagrams of rainfall rate (mm h$^{-1}$) on 21st June 2004 derived from the Hameldon Hill radar (a) 06:00-12:00 UTC and (b) 12:00-18:00 UTC. The coordinates represent distance along a 7 km wide swath running through the city centre in the direction of the westerly cell movement and the absissa represents time. Some small spurious areas of rain remain where the removal of radar ground clutter echoes has been incomplete. Note that in the morning a cell forms about 5 km downwind of the city centre. This is consistent with the time it takes for the thermal forcing associated with the large buildings in the city centre of Manchester. In the afternoon a cell is generated about the same distance upwind of the city centre over Salford consistent with the large values of $Q_H$ here.

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