

A large-eddy simulation study of thermal effects on urban flows

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The flow and dispersion around buildings in urban areas is governed by the atmospheric as well as the local stability. The latter can be a result of longer duration of solar incidence on the buildings. Therefore, to understand the changes in flow dynamics due to the heated surfaces of the buildings, a simple case study was undertaken for validation [*Richards et al, J Wind Eng Ind Aerodyn, 2006*], in which ‘only’ the leeward side of a building was strongly heated. The simulations showed that at high local Richardson number, $Ri = -2$, the heat transfer coefficient from the leeward surface exceeded that from the roof. This suggests that the buoyancy forces dominate the strong shear on the roof top. Quadrant analysis showed that buoyancy enhances the strength of sweeps in the shear layer behind the cube due to stronger downward fluctuations which is a result of in-rush of cold air from upstream. These mechanisms will certainly influence the pollutant transport in urban areas.

In another set of computations on flow past an array of buildings, the preliminary results showed that the momentum coefficient was gradually enhanced with increase in ground heating. This will affect the pollutant dispersion, especially at the street level. We will be simulating the heat transfer at the neighbourhood scale (~ 1 km), which then would provide better parameterisation, e.g. drag and heat transfer coefficients for the mesoscale models.

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