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# Unstably stratified atmospheric flows and pollutant dispersion over idealized urban roughness by large-eddy simulation (LES)

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In addition to urban morphology, thermal stratification is another factor dominating the flows and dispersion in the urban boundary layer (UBL) above built areas. Many field campaigns have showed that, due to incoming solar radiation and heat storage in urban fabrics, unstable stratification often lasts more than half a day, demonstrating its importance in atmospheric studies.

Large-eddy simulation (LES) equipped with the one-equation subgrid scale (SGS) model is adopted to study the behaviours of flows and pollutant dispersion over idealized urban roughness in different intensities of unstable thermal stratification. The computational domain consists of a free-stream layer and a series of idealized street canyons, which are separated by square building blocks, at the bottom. Three building-height-to-street-width (aspect) ratios are considered, namely, 0.5, 1 and 2. Incompressible flows are assumed and Boussinesq approximation is adopted in buoyant flows. The prevailing wind is driven by a background pressure gradient in the free-stream layer. Periodic boundary conditions (BCs) are assigned to the spanwise domain and domain inlet-outlet so that infinitely long street canyons and pseudo-steady flows over urban roughness are simulated. Different values of (constant) temperature are assigned to the domain top and the urban surfaces in which the intensity of (unstable) stratification is controlled by the gravitational acceleration constant. Passive pollutant is released continuously from the ground of the first street canyon and is removed from the domain outlet.

Turbulence intensities and Reynolds stresses are enhanced in unstable stratification compared with the neutral one. The turbulent mixing is also enhanced, leading to the more uniform mean wind (vertical) profile and the increased drag on urban areas. In the lower UBL, the mean wind profile deviates from the conventional logarithmic law-of-the-wall due to the increased drag. Besides, the increased turbulence helps pollutant dispersion that reduces the street-level pollutant concentrations. The characteristics of mean wind profile, turbulence, and plume dispersion in unstable stratification will be reported in the conference in details.