Turbulent Scalar Dispersion in the wake of an Individual Tall Building

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Understanding dispersion within urban arrays, in particular vertical concentration fluxes of pollutants out of the street level, is important to predict and minimise the impact of air pollution on the population of cities. Previous studies have shown that tall buildings significantly influence the vertical scalar fluxes within urban arrays (1)(2).

In order to examine the effect of a tall building without the effect of the city around it, an experiment was carried out on a 1:2400 isolated building model in the UoS Recirculating Water Tunnel. The incoming flow conditioning simulated an approaching atmospheric boundary layer with the height of the building within the log-law region. A ground level, point source was located 5 building heights upstream. The use of synchronised planar laser induced fluorescence (PLIF) and particle image velocimetry (PIV) allowed for full fields of velocity and species concentration to be captured.

Full maps of the mean scalar concentration and scalar fluxes will be presented alongside the advective flux fields, which represent transport by mean flow, and turbulent flux fields, which represent transport by turbulent fluctuations (e.g. Fig. 1). Analysis of the data shows the same turbulent rooftop shear layer as observed by Lim et al (1), but lower vertical scalar flux in this region. Instead, the scalar is horizontally transported close to the ground after the plume impinges on the lower section of the building. It is hypothesized that the difference in this case is that without the array of surrounding buildings, the scalar plume is mostly impinging on the tall building below its stagnation point, as opposed to the opposite when the building exists in an urban array.

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(1) Lim, H. D et al, *Experiments in Fluids*, *63*(6) 2022

(2) Fuka, V et al, *Boundary Layer Meteorology* *167*(1), 53–76 2018

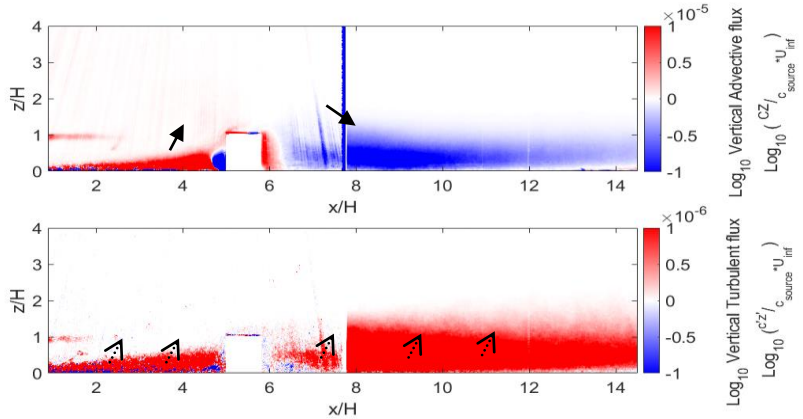

Fig 1: Vertical advective (top) and turbulent (bottom) flux fields around the individual building.