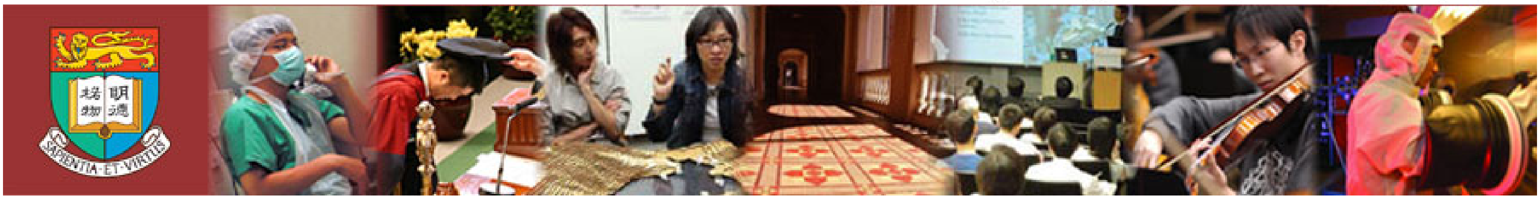

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Laboratory Measurements of Local Mass Transfer Coefficients Over Idealized Two-Dimensional Urban Street Canyon Models

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One of the major sources of anthropogenic releases in the atmospheric boundary layer (ABL) is due to human activities in urban areas. Therefore, how urban morphology affects the heat and mass transfer in built environment is always a popular research problem in the urban climate community. In this paper, a series of laboratory experiments is conducted to elucidate the mass transfer from idealized urban surfaces constructed by repeating idealized two-dimensional (2D) street canyons. The experiments are carried out in the wind tunnel in the University of Hong Kong. The urban ABL in the wind tunnel, which is controlled by the incoming wind profile and turbulence levels, is developed using small cubic Styrofoam blocks placed upstream of the test section. The street canopies are fabricated by movable rectangular acrylic blocks so that different building-height-to-street-width (aspect) ratios can be examined. The height of the building blocks is kept at constant to assure that the vertical extent of the urban canopy layer (UCL) over the street canyons is high enough for fully developed turbulent flows. The building blocks are repeated and aligned in the streamwise direction so the street axis is normal to the flow. Water evaporation is used to construct surfaces having uniform mass concentrations on the building facades and ground surfaces. The surfaces of the sampling street canyons are covered by soaked filter papers. To ensure saturated moisture layers, the wet bulb temperature is continuously monitored. The weight difference of the filter papers before and after the experiment is measured to determine the amount of water evaporated. Initial trials have been performed investigating the general behaviors of water evaporation over a flat plate under convection. The wind speed of the wind tunnel is maintained at around 2.5 m sec-1 so that the Reynolds number is large enough for flows independent from molecular viscosity. Our preliminary results show that scaling effect occurred in the experiment. The local convective mass transfer coefficient is proportional to the stream wise distance approximately to the power of 4/5. The relationship between the flows and the convective mass transfer can be described in a dimensionless form using the Sherwood number. Besides, the profile of the airflow in the street canyon of aspect ratio 1 and 1/2 is also investigated in order to examine the mass transfer characteristics in the skimming flow (d-type) regime.