EGU24-16420, updated on 16 Jan 2025
https://doi.org/10.5194/egusphere-egu24-16420
EGU General Assembly 2024

Representing mean wind speed profile over urban canopy with building height variability

Keisuke Nakao[1], Hideki Kikumoto[2], Hiroshi Takimoto[1], Jia Hongyuan[2], and Wang Xiang[3]
[1]Sustainable System Research Laboratory, Central Research Institute of Electric Power Industry
[2]Insitute of Industrial Science, The University of Tokyo
[3]Graduate school of Engineering, The University of Tokyo

The horizontal mean wind speed profile in vertical direction within and above urban canopy (UC) is an essential information to drive the exchange of momentum, heat, moisture and pollutants in atmosphere. Well-known profiles in logarithmic and exponential layers, which express upper and lower wind over UC, respectively, are efficient assumptions used to express UC wind profile.

This study attempted to add the intermediate layer (IL) between those two-layers to include the effect of building height variability on the mean wind speed profile. Large-eddy simulations (LESs) of UC with building height variability were conducted using a wide range of morphology parameters, that is, plan area index, aspect ratio, and the standard deviation of building height.

A tendency of the bulk drag coefficient of the IL was expressed by the plan area index and the frontal area index at the intermediate layer. The wind speed at IL was modeled linearly by the length- and velocity-scale analysis. By parameterizing the coefficients of these three layers, we attempted to analytically represent an entire wind speed profile by the three-layer wind profiles. The results indicated reasonable consistency in the wind speeds at mean building height and the momentum flux with LES data. Effect of the thermal stratification was investigated by the correction of the length-scale in IL.