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A Micro-scale Model for Urban Wind Field and Air Pollutant Dispersion Simulation

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A micro-scale air pollutant dispersion model system is developed for the emergency response purposes; it includes a diagnostic wind field model to simulate the wind filed around blocks by dividing the space around a block into several key zones (e.g. the up-wind cavity zone, the lee-wind cavity zone, the roof-top zone). The wind fields then used as input into a random-walk air pollutant dispersion model to simulate the pollutant concentration with considering the influence of urban buildings. Numerical experiments are designed to evaluate the model performance with the CEDVAL (Compilation of Experimental Data for Validation of Micro-scale Dispersion Models,https://www.mi.uni-hamburg.de/en/arbeitsgruppen/windkanallabor.html) and FZ (carried out in Nanjing University) wind tunnel experiments data for the simulations for wind fields and air pollutant dispersion around a single building and in a real neighborhood as well. The results show that the wind model can reproduces the vortexes trigger by urban buildings and the dispersion model simulates pollutant concentration around buildings well. The model can represent the wind fields and tracer concentration well. Due to the complex shapes of buildings and their distributions, the simulation errors are usually caused by the simplification of the building shapes and the determination of the key zone sizes. The computational efficiencies of different cases are also discussed and the model can produce very high-resolution ($\sim$m) wind fields on the neighborhood scale ($\sim$km) in just minutes. This model has the potential for multiple applications: the predictions of air pollutant dispersion and evaluate environmental impact under urgent disasters; urban planning scenarios and assess for micro-scale air quality in urban area and so on.