



A Japanese validation project of a numerical model for simultaneous prediction of urban climate and building electricity demand

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The outline of the authors' ongoing research project concerning the interaction between energy demand and urban climate will be presented with its latest results. The goal is to substantiate the performance of the authors' numerical models of urban climate and building energy simulation with the spatial resolution of 1 km and the temporal resolution of 1 hour throughout a city and a year. For the verification, the original coupled system of a multilayer urban canopy model and a building energy model (CM-BEM) had been incorporated into the Weather Research and Forecasting (WRF) model. The developed system WRF-CM-BEM is being applied to a Japanese major city Osaka where yearlong and hourly electricity demand data have been obtained with a city-blocks-scale spatial resolution. Additionally, yearlong meteorological measurements have been conducted in FY 2013. 15 meteorological stations were installed in Osaka with a spatial resolution of one station per about 5 km X 5 km area. Those observations are being used for the validation of WRF-CM-BEM together with the electricity demand data. The solar radiation was also monitored at all stations for the analysis of the spatial inhomogeneity of the insolation, and its potential impact on the photovoltaic power generation is planned to be evaluated through simulations.

As a result of preliminary analyses of observed insolation, it was found that 8-month accumulated radiation had site-by-site differences up to 6% and instantaneous discrepancies of 40% at maximum among the stations in Osaka. Those spatial inhomogeneities of observed insolation were able to be roughly and statistically reproduced by WRF-CM-BEM, suggesting its promising performance in the projection of urban photovoltaic power generation. Also, WRF-CM-BEM was almost reasonably validated from the aspects of the reproducibility of urban surface air temperature and electricity demand in the observation areas in Osaka.