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A sensibity study on the role of the urban land surface scheme for a regional climate model, NHRCM

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The conditions of land surfaces give large impacts on surface air temperature, via the dynamical and thermal energy exchanging. In order to forecast the physical quantities, such as momentum, heat, and vapor fluxes from the land surface, we have selected a sophisticated vegetation scheme of the SiB (Simple Biosphere) as the land surface scheme of the MRI's NHRCM (Non-Hydrostatic Regional Climate Model). Recently, as model-resolution became higher up to several kilo-meter, non-vegetation but urbanized grids had appeared, and these grids were treated as dried bare ground on the SiB to express the so-called urban deserts. But, in these grids, reproducibility of the climatology seemed to be insufficient. Therefore, we need to apply the new scheme to improve the representation of radiation and heat budgets in such urban area. For that purpose, we developed a new scheme for urban land surface to applied to a regional climate model. This new scheme is called SPUC (Square Prism Urban Canopy, Aoyagi and Seino 2011).

In this study, we applied SiB and SPUC scheme to the 4km-resolution NHRCM, executed present climate simulations, and compared outputs with observational data of JMA(Japan Meteorological Agency). The target area was Kanto-Koshin region including Tokyo metropolitan area. As initial and boundary condition, we used the JMA's RANAL (Regional analysis) dataset (20km resolution), which was downscaled once by NHRCM10km with SiB scheme for all grid. The 10km resolution dataset was also downscaled by NHRCM4km. We executed the 4km experiments, using SiB scheme for all land grids (NHRCM-SiB), and using both SiB for natural surface grids and SPUC for urban surface grids (NHRCM-SPUC).Time integration was continuously executed for about 5 years from August 1st, 2001 to September 1st, 2006.

The result of the experiment using SiB scheme had negative bias(about -1.3 ^{o}C) in the surface temperature in the Tokyo metropolitan area. By using SPUC scheme, this negative bias changed to positive(+1.55 ^{o}C). Although the bias remains, the correlation factor between the simulation and observation was improved from 0.73 (NHRCM-SiB) to 0.86 (NHRCM-SPUC). This improvement implies that NHRCM-SPUC had the better reproducibility on horizontal distribution of air temperature. On the other hand, the difference was hardly seen in total amount of precipitation in five years.

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