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Urban heat island intensity change over Tokyo metropolitan area during winter

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During the recent 100 years, mean surface air temperature (SAT) increased about 3 C in Tokyo, Japan, while the world mean SAT increased only 0.66 C. The major reason of the difference of the warming is the effect of urban heat island (UHI), whose intensity also increased during the period and often largest during winter. This study investigates the change in UHI intensity (UHII) of Tokyo metropolitan area by the effects of global climate change. Present climate simulation is conducted using a high-resolution numerical climate model (WRF) including an urban canopy sub-model. Future climate run is also conducted using Pseudo-Global-Warming method assuming the boundary conditions in 2070s estimated by a GCM under the SRES A2 scenario. We calculate UHI intensity (UHII) using the results of four experiments as follows, $UHII_{CTL} = T_{CTL} - T_{CTLNU}, UHII_{PGW} = T_{PGW} - T_{PGWNU}$. The difference between $UHII_{PGW}$ and $UHII_{CTL}$ ($UHII_{PGW} - UHII_{CTL}$) shows UHII change due to the future climate change. The UHII is 2 to 3 C during night, while it is almost zero at noon in the CTL and PGW. Change in UHII due to the global climate change reaches more than 20% of the UHII (about 0.5 C) during night. SAT in the urban area is more slowly increase during daytime due to the larger heat capacity than the rural area. Heat release from the buildings in urban area is larger than that in rural area at night, when the dispersion of the released heat tends to be restricted in the lower atmosphere because of weak turbulence. These processes are sensitive on cloud fraction and the atmospheric stability in the lower atmosphere.