Dynamical Downscaling for the Urban Climate Projection in Tokyo under the RCP4.5 Scenario

Hiroyuki Kusaka [1], Sachiho A. Adachi [2], Suzuki-Parker Asuka [1],
Keiko Fujita [3], Masayuki Hara [2], Yoshiki Yamagata [4]
1: Center for Computational Sciences, University of Tsukuba, Tsukuba, Japan
kusaka@ccs.tsukuba.ac.jp
1-1-1 Tennodai, Tsukuba, Ibaraki 305-8577, Japan
2: Research Institute for Global Change, JAMSTEC, Yokohama, Japan
3: Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan
4: Center for Global Environmental Research, National Institute for Environmental Sciences, Tsukuba, Japan

This study presents the projected urban climate of Tokyo for the 2050's August under the RCP4.5 scenario. To accurately evaluate the urban climate, the simulations use the improved WRF model with 4-km grid increment coupled to the single-layer urban canopy model (UCM). Dynamical downscaling approach is used with a CMIP-5 GCM (MIROC5) in future projection. The projected 10-year mean temperature increase in the Tokyo metropolitan is 2~3°C for the 2050's August compared the 1990s (Fig.1). This temperature difference is comparable to the mean temperature anomaly for abnormally hot summer in current climate. The result provides an estimate of heat stress for the Tokyo residents in warming climate. Additional experiments indicate that the compact city urban planning scenario can reduce the August mean temperature of surrounding residential areas by 0.2°C, whereas the distributed city scenario can increase the temperature of surrounding residential areas by 0.5°C. Uncertainty due to urban planning scenario is much smaller than that due to emission scenario or GCM and urbanization has less impact on the temperature increase due to global climate change in the future, but the urban planning in the future should be not ignored in the dynamical downscaling for the future-climate projection.

Acknowledgements

This study was supported by the Global Environment Research Fund (S-5) of the Ministry of the Environment in Japan, and the Research program on Climate Change Adaptation (RECCA) of Ministry of Education, Culture, Sports, Science and Technology in Japan. Numerical simulations for the present work were done under the "Interdisciplinary Computational Science Program" in the Center for Computational Sciences, University of Tsukuba.

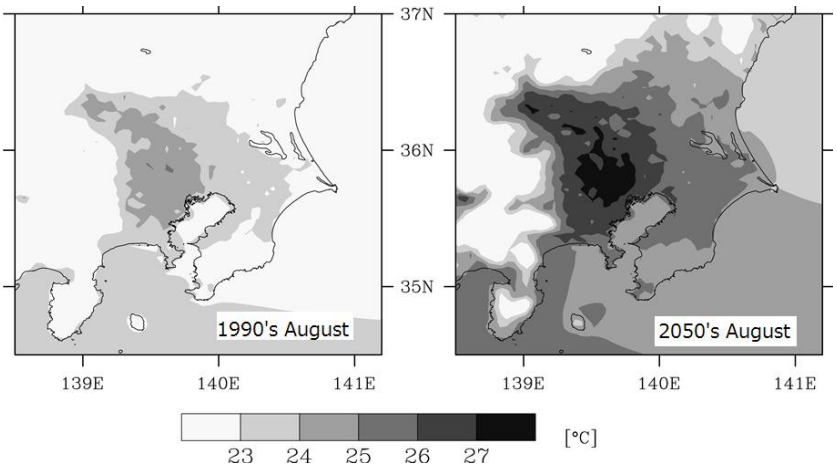

Figure 1: Projected surface air temperature in 1990's and 2050's August. The results are from the dynamical downscaling with the WRF model from a CMIP5-GCM (MIROC5).