An Overview:
Special Issue on “Urban Climate”

Takehiko MIKAMI¹, Yasushi SAKAKIBARA², Takashi HAMADA³, Jun MATSUMOTO⁴, Rikie SUZUKI⁵ and Yohta KUMAKI⁶

This special issue brings together the latest scientific papers on the urban climate including urban heat islands (UHI), which have been researched by urban climatologists in Japan. However, a large number of papers have been published mainly by urban technology researchers in the fields of architecture and civil engineering for the purpose of contributing to the mitigation strategies for urban heat islands promoted by central and local governments. The reason for this is explained by differences in research motivations and methodologies between scientists and technologists.

Most urban climatologists are interested in the phenomena themselves and in the mechanisms of urban climates, such as observed and simulated temperature patterns in large cities and their formation mechanisms in terms of surface energy balance systems. On the other hand, urban technology researchers are mostly interested in technological developments and innovations that can be applied in mitigation strategies such as roof-top gardens and water retainable road materials, which could efficiently decrease surface temperatures on hot summer days. Both approaches are required to mitigate urban heat islands in large cities, where heat stress patients due to extremely high temperatures in summer are increasing and local torrential rainfalls triggered by summer heat islands are occurring more frequently than before.

The papers included in this special issue are summarized as follows:

Nakagawa (2011) reviews trends in studies on the formation mechanism of the urban heat island in Japan with special emphasis on the relationships between urban heat island intensity (UHI) and boundary layers of urban areas. Kusaka (2011) reviews urban climate studies using the Weather Research and Forecasting (WRF) model with a brief description of WRF and three urban parameterization schemes in WRF. Watarai et al. (2011) present a numerical simulation of the rapid rise of the surface air temperature in the Northwestern Kanto Plain on 20 February, 2009 using the WRF model. The results show that the temperature rise was mainly brought about by a downward wind with adiabatic heating over the area.

Akasaka et al. (2011) describe a high-spatial density meteorological observation system in Tokyo named METROS, and clarify temporal and spatial characteristics of the thermal environment of Tokyo based on METROS. Mikami et al. (2011) briefly introduce high-resolution temperature ob-

---
¹ Faculty of Liberal Arts, Teikyo University, Hachioji, 192-0395, Japan
² Faculty of Education, Shinshu University, Nagano, 380-8544, Japan
³ Natural Environment Division, Nagano Environmental Conservation Research Institute, Nagano, 381-0075, Japan
⁴ Graduate School of Urban Environmental Sciences, Tokyo Metropolitan University, Hachioji, 192-0397, Japan
⁵ Research Institute for Global Change, Japan Agency for Marine-Earth Science and Technology, Yokohama, 236-0001, Japan
⁶ Department of Geography, Senshu University, Kawasaki, 214-8580, Japan
servations using Extended-METROS in the Tokyo Metropolitan Area, and analyze some climatological mean temperature charts using Extended-METROS data. Yamato et al. (2011) analyze the influence of sea breezes on daytime urban heat islands in summer in the Tokyo Metropolitan Area using Extended-METROS data. The results indicate that temporal and spatial variations in high-temperature areas in the Kanto Plain are closely related to the movements of sea breezes. Takahashi, K. et al. (2011) analyze the influence of sea breezes on daytime urban heat islands in summer in the Tokyo Metropolitan Area using Extended-METROS data. The results indicate that a calm zone, which might be caused by a wind convergence due to UHI, was detected. Takahashi, H. et al. (2011) discuss the minute spatial structure of both the frequency of intense summer rainfall in Tokyo on the basis of hourly rainfall data from a dense rain-gauge network. The results suggest that the large surface roughness due to high-rise buildings in the western part of central Tokyo increases the frequency of intense rainfall.

Sakaida et al. (2011) present vertical observations of wind and air temperature made at the Miyagi Prefectural headquarters in the urban center of Sendai, Northeastern Japan. The cooling effect of sea breezes appeared to be more remarkable in the urban center than in the suburban residential area, both of which are the same distance from the sea, probably due to downward cool air currents produced by the windward walls of buildings. Sakakibara and Nakagawa (2011) describe the vertical structure of the nocturnal heat island in a small town (Obuse in Nagano prefecture) based on mobile observations from tethered balloon soundings. It became clear that surface inversions developed quickly after sunset at the rural site, whereas development was slower at the urban site.

Hamada and Ichinose (2011) attempt to clarify the effects of mountain winds on urban temperatures from meteorological observations conducted in the summer of 2008 and 2009 in Nagano City, central Japan. Nighttime air temperature drops due to the direct effects of mountain winds were detected at the center of Nagano City and compared to data from a suburban Local Meteorological Observatory that was not affected by mountain winds. Narita and Sugawara (2011) review observational studies on the mitigation effects of green spaces in urban areas focusing on “cold-air seeping phenomena” in urban green spaces during clear calm nights. The results suggest that the cooling effect of green parks is not related to cool island intensity, because sensible heat flux was almost zero during the seeping-out of cold air in contrast with the increase of cool island intensity. Sugawara et al. (2011) discussed the vertical structure of the cool island in an urban green park based on synchronized kite-balloon measurements. The results indicate that the maximum height of the cold air layer reached is 71 m, and that the estimated cooling energy for cold air formation over the park was 5 W/m².

References


