

## Helicopter-borne thermocamera measurements of surface temperatures in downtown Tokyo -Comparison of 2013 with 2007-

TSUNEMATSU, Nobumitsu<sup>1\*</sup> ; YOKOYAMA, Hitoshi<sup>1</sup> ; HONJO, Tsuyoshi<sup>2</sup> ; ICHIHASHI, Arata<sup>1</sup> ; ANDO, Haruo<sup>1</sup> ; MATSUMOTO, Futoshi<sup>1</sup> ; SETO, Yoshihito<sup>3</sup>

<sup>1</sup>Tokyo Metropolitan Research Institute for Environmental Protection, <sup>2</sup>Chiba University, <sup>3</sup>Tokyo Metropolitan Research Institute for Environmental Protection/Tokyo Metropolitan University

Annual mean air temperatures in downtown Tokyo have increased about 3 degrees Celsius in the past 100 years due to global warming and urban heat island. The frequency of heat stroke outbreaks in Tokyo tends to increase in recent years. The Tokyo metropolitan research institute for Environmental Protection has therefore investigated the current situation of the temperature rises in Tokyo through the monitoring of urban heat island. This can contribute to verification of measure effects on urban heat island.

As part of the investigations, we performed helicopter-borne infrared thermocamera measurements of surface temperatures in downtown Tokyo (mainly an Otemachi-Marunouchi-Yurakucho area) on two different extremely hot days, Aug. 19, 2013 (hereafter, HTM13) and Aug. 7, 2007 (HTM07). The measurements were carried out in the daytime (12-13 local time) and the nighttime (20-22 local time), using a Robinson R22 helicopter with a longwave (8-14um) infrared thermocamera (TS7302) developed at NEC Avio Infrared Technologies Co., Ltd. An altitude of the helicopter flight was 610 m. The daytime air temperatures on those days reached 32-33 degrees Celsius although southerly sea breezes prevailed in the area. Compared with the HTM07 case, a higher air temperature condition was predominant prior to HTM13.

Results of analyses of data from the thermocamera-derived images (a 2 m ground resolution) show that surface temperatures obtained from HTM13 are relatively large in the greater part of the area, compared with HTM07 (refer to a figure shown below), whereas, smaller surface temperatures can be recognized in redevelopment areas where new buildings have been constructed after 2007. (Note that the emissivity of each surface material can influence it.) Also, the thermocamera-derived images projected on Google Earth show higher surface temperatures on intersections.

In addition, we would like to show geographical distributions of the observed surface temperatures in the nighttime, differences between the daytime and nighttime surface temperatures, and a relationship between surface temperatures and sky view factors.

Keywords: Helicopter-borne measurements, thermocamera, surface temperature, downtown Tokyo, verification of measure effects on urban heat island, extremely hot days

