Assessing Vulnerabilities to Regional Climate Change:
A Case Study of Tokyo, Japan

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Recently, local governments have an increasing need to take extensive and effective local measures to adapt to regional climate change, but have difficulty knowing how and when to adapt to such change. This study aims: 1) to characterize an efficient and cost-effective database management tool (DMT) for developing a Geographic Information System (GIS) based approach to using observed and projected data, for decision-making by non-expert government authorities, and 2) to document how to adjust the bias using observed data to provide specialized yet understandable climate change information to assist local decision-makers in clarifying regional priorities within a wide array of adaptation options. The DMT combines climate change mapping, statistical GIS, and a vulnerability assessment.

To take into account local priorities and issues, projections were from a 5 km-mesh, non-hydrostatic, cloud system-resolving regional climate model (NHRCM-5 km, 5 km resolution), following the Special Report on Emissions Scenarios (SRES) A1B scenario. Those were dynamically downscaled results from the MRI-AGCM3.2S. The MRI-AGCM3.2S is an Atmospheric General Circulation Model for AMIP (Atmospheric Model Intercomparison Project) conducted under Coupled Model Intercomparison Project—Phase 5 (CMIP5). Tokyo, Japan, was chosen for this pilot study.

Tokyo is a megacity with a population of 13.22 million as of 1 January 2013, and covers an area of 2,188.67 km2. The number of people aged 65 or older in Tokyo is 2.63 million, or 20.76 % of the total population, which includes 9.0 % of the total population of the elderly in Japan (as of 1 January 2012). Similar to megacities in other developed countries, the continuing increase in size of the elderly population is an urgent issue for metropolitan governments. Meanwhile, in Tokyo, the population has continued to increase in the inner city. From 1 January 2003 to 1 January 2013, the population grew by 697,255 people, with a growth rate 7.75 %.

In this paper, results illustrate qualitative agreement in projection of summer daily mean temperatures; the mean temperature increase at Okutama-machi is the greatest of any area in Tokyo. Okutama-machi is a sparsely populated mountainous region (area 225.63 km2; population 5,830 as of 1 January 2013) to the northwest of the city of Tokyo, with the highest peak (2,017 m) in the Tokyo metropolitan area. In comparing near future (2015–2039) and future (2075–2099) periods, August monthly mean temperature will increase more than 0.7–0.9 °C and 2.6–2.9 °C, and monthly precipitation by 43–70 % and 25–41 %, respectively. However, the root mean square (RMS) errors and bias of percentage change for monthly precipitation in summertime are 26.8 % and 4.3 %, respectively. These data provide an early warning and have implications for local climate policy response. Additionally, the bias adjustment using observations (daily mean temperature) during 1979-2013 is discussed.