Future urban climate projection for a mega city in Asia: Greater Ho Chi Minh City metropolitan area, Vietnam

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Abstract

General Circulation Models (GCMs) are used to predict the global climate change in the future due to increasing of greenhouse gas. However, the spatial resolution of GCMs is still low and not enough to depict the climate change at regional scale such as cities. In addition, the local climate of cities is not only affected by global climate change, but also modified by local factors, e.g. the expansion of urban areas.

This study examines climatic responses to the coupled effects of greenhouse gas-induced global warming and the future urban expansion over one of mega cities in Southeast Asia countries, the Greater Ho Chi Minh City metropolitan area (GHCM) in the mid of 21th century. A dynamical downscaling approach using a high-resolution regional climate model coupled to an urban canopy model (WRF/UCM) was adopted. The boundary condition for future climate were generated by pseudo-global-warming method using 2050s output data from five GCMs of CMIP5 experiments scenario RCP8.5.

The main findings of this study are as follows: First, agreement between simulated (for the case of current urban) and observed values demonstrates that the WRF/UCM is able to reproduce the urban climate of GHCM. Second, the simulated results show that, in the absence of any adaptive urban design, the urbanization, alone and separate from greenhouse gas-induced forcing, can be expected to raise near surface air temperature about 0.2 ° C in the pre-existing urbanized areas and about 0.4 ° C in newly urbanized areas of the GHCM. On the other hand, greenhouse gas-induced global warming is estimated to raise surface air temperature about 1.6 ° C over the region. This implied that the future urbanization will contribute about 20% of the total urban warming in the mid of the 21th century over GHCM, and appropriate adaptive urban design is needed to reduce the urban warming.

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