



Climatic effects of urban expansion over the three largest urban agglomerations of China

Qian Cao (1), Deyong Yu (1), Matei Georgescu (2), Jianguo Wu (1,3)

(1) Center for Human-Environment System Sustainability (CHESS), Beijing Normal University, Beijing, China, (2) School of Geographical Sciences and Urban Planning, Arizona State University, Tempe AZ, USA, (3) School of Life Sciences and School of Sustainability, Arizona State University, Tempe AZ, USA

Urbanization has long been known to affect local, regional, and global climate. China is urbanizing at an unprecedented rate, and modification of land surface to urban areas has raised climate concerns for its citizens. Using the Weather Research and Forecasting (WRF) model, we examine how urbanization under different intensities and climate regimes affects regional climate of the three largest urban agglomerations across China – the Beijing-Tianjin-Hebei (BTH), the Yangtze River Delta (YRD), and the Pearl River Delta (PRD). We simulated three urban expansion scenarios corresponding to 1988, 2000, and 2010 conditions into the WRF model, with each scenario simulated by three separate summers (i.e. 2001, 2003, and 2005). Urban extent of the three regions indicates stable growth during 1988 – 2000, followed by a phase of rapid expansion during 2000 – 2010. Our simulations show that urban environment-induced near-surface warming, mainly rising temperatures during nighttime, is greatest over the BTH with local maximum warming approaching 1.5 °C, followed by the YRD with peak warming reaching 1 °C and the PRD 0.8 °C. Due to the initial moisture conditions, the YRD and the PRD suffer more humidity deficit, particularly during daytime, with maximum reductions in water vapor mixing ratio reaching 0.8 g/kg. Our findings demonstrate that urban expansion has warmed and dried the urbanized regions in eastern China. The spatial pattern and magnitude of temperature and humidity differences quantified by our simulations provide useful information for understanding the impacts of urbanization on regional climate and for developing mitigation and adaptation strategies that can alleviate the deleterious impacts induced by urban expansion.