Session: B2 Oral presentation

Contrasting urban and rural response of heat stress associated with temperature extremes to climate change

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Extremely hot temperatures in combination with high humidity cause human discomfort and may locally increase morbidity and mortality. A global climate model with an embedded urban model is used to explore the urban-rural contrast in the wet-bulb globe temperature, a thermal comfort index. Wet-bulb globe temperatures are calculated at each time step in order to resolve the whole diurnal cycle. The model simulates substantially higher wet-bulb globe temperatures in urban areas compared to neighboring rural areas even though the large night-time urban heat island is somewhat alleviated by an urban humidity deficit. The urban-rural contrast in wet-bulb globe temperature is most pronounced at night and over mid-latitudes. Wet-bulb globe temperatures strongly increase with doubled atmospheric CO2 concentrations over both urban and rural surfaces. According to the model experiment, the tropics are impacted most by the increase in heat stress, despite the weakest warming of around 2^{o}C. Due to the high relative humidity and low present-day variability, the comparatively weak tropical warming leads to an exceedance of the present-day 99th percentile wet-bulb globe temperature threshold for more than half of the days in a year under doubled CO2 conditions, which means that heat stress levels exceeds present-day levels on a regular basis. The increase in wet-bulb globe temperatures in the tropics is similar in urban and rural environments, whereas in midlatitudes the increase in high-heat stress nights is substantially stronger over urban areas.