EGU2020-1352
https://doi.org/10.5194/egusphere-egu2020-1352
EGU General Assembly 2020

Representing the Urban Heat Island Effect in Future Climates

Annkatrin Burgstall[1], Ana Casanueva[2], Elke Hertig[3], Erich Fischer[4], Reto Knutti[4], and Sven Kotlarski[1]

[1]Federal Office of Meteorology and Climatology MeteoSwiss, Zurich, Switzerland (annkatrin.burgstall@meteoswiss.ch)
[2]Department of Applied Mathematics and Computer Science, University of Cantabria, Santander, Spain
[3]Faculty of Medicine, University of Augsburg, Augsburg, Germany
[4]Institute of Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland

An increasing fraction of people living in urban areas and the expected increase in long lasting heat waves highlight the important role of urban climates in terms of future climate change impacts, especially with relation to the heat-health sector. Due to the urban heat island (UHI) effect and its (generally) increased intensity particularly during nighttime, people living in urban areas happen to be more affected by heat-related discomfort and health risks than those in non-urban regions. In this contribution, temperatures of both rural and urban sites (station couples) in Switzerland and Southern Germany are analyzed, using (i) observed as well as (ii) bias-corrected and downscaled climate model data for daily minimum (tmin) and daily maximum temperature (tmax) to account for the UHI in future climates. As meteorological data are often restricted to locations of long-term measurements at rural sites only, they need to be transferred to urban sites first. For this purpose, the well-established quantile mapping technique (QM) is tested in a two-step manner. The resulting products are urban time series at daily resolution for tmin and tmax. By analyzing the temperature differences of the observed climate at rural sites and their respective urban counterparts and by assuming a stationary relationship between both, we can represent the UHI in future climates, which is quantified in terms of heat indices based on tmin and tmax (tropical nights, summer days, hot days).

The QM performance is evaluated using long-term weather station data of a Zurich station couple in a comprehensive cross-validation framework. Results reveal a promising performance in the present-day climate, given very low biases in the validation.

Applying the proposed method to the employed station couples, projections indicate distinct urban-rural temperature differences (UHI) during nighttime (considering the frequency of tropical nights based on tmin) compared to weak differences during the day (considering the frequency of summer days and hot days based on tmax). Moreover, scenarios suggest the frequency of all indices to dramatically rise at the urban site by the end of the century under a strong emission scenario (RCP8.5): compared to the rural site, the number of tropical nights almost doubles while the number of summer days reveals about 15% more days at the urban site when focusing on the station couple in Zurich and the late scenario period. The lack of nighttime relief, indicated by tmin not falling below 20°C (i.e. a tropical night), is especially problematic in terms of human health and

makes the study of the urban climate in general and the UHI effect in particular indispensable.