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Determining Heat Waves from Observations and COSMO-CLM Simulations in Istanbul

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Climate change has crucial effects on cities and especially for informal settlements, urban poor and other vulnerable groups by influencing human health, assets and livelihoods. These impacts directly result from the variations in temperature and precipitation, and emergence of heat waves, droughts, floods and fires (IPCC, 2014). Summertime episodes with extremely high air temperatures which last for several days or longer are addressed to as heat waves and affect the weather and climate in the globe.
The aim of this study is to analyze the occurrence of heat waves in terms of quantity, duration and frequency and also to evaluate the accuracy of the COSMO-CLM (CCLM) model coupled with MPI-ESM-LR in reproducing the characteristics of heat waves in Istanbul. The summer maximum temperatures of six Turkish State Meteorological Service (TSMS) stations are selected between 1960 and 2013 to estimate the characteristics of heat waves in Istanbul. We define the heat wave if the maximum temperatures exceed a threshold value for at least three consecutive days. The threshold value is determined as 30.5 °C from the 90th percentile of all six station's observations. Then it is used in the detection of the hot days, heat waves and their durations. The results show that not only the number of heat waves but also duration of heat waves increase towards the end of the study period. Especially, a significant increase in heat wave events is evident after 1990s. An example of this situation is observed in a Kilyos station located northern part of the city. Kilyos experiences only one heat wave in the beginning of 1970s whereas the number of heat waves increases in years and reaches to the maximum value of 5 in 2000. Furthermore, Kartal as an urban area in the Asian side of the city, exhibits highest heat wave duration with 18 consecutive days in 1998. In addition to station data analyses, the local climate of Istanbul and its vicinity is simulated by CCLM model with approximately 3 km resolution between 1970 and 2005 and the verifications of the heat waves are carried out in terms of the intensity, duration and spatial extent. It is found that urban heat island increases the frequency of hot-days at the urbanized areas of Istanbul. This work is supported by TUBITAK project, number 114Y047.

Keywords: Heat waves, Istanbul, local climate, COSMO-CLM, urban heat island