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Urban climate model simulations and low-cost air temperature measurements for heat load assessment in Vienna

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Extreme hot conditions are very likely to occur more frequently and with higher intensity in the future. Combining urban climate model simulations and local air temperature measurements may help identify hot spots in urban areas and bring added value in heat warning systems. We investigate what accuracy can be expected from the data collected through low-cost mobile measurements and whether the achieved quality of the data is sufficient for validation of the state-of-the-art local-scale climate model.
We use the dynamical urban climate model MUKLIMO_3 (horizontal resolution of 100 m) to simulate the urban heat load during day-time conditions in the area of Vienna. The model is initiated with the operational weather forecast model ALARO-ALADIN of the ZAMG (horizontal resolution of 4.8 km). We used the archived daily forecast data for vertical profile of temperature, relative humidity and wind for the summer period in 2011-2013 (April – October) as input data. The model output has been evaluated against the monitoring data at 9 weather stations and the data collected during the mobile measuring campaigns in 2011 and 2013 as alternative meteorological data. The measuring campaigns took place on a clear-sky, dry and hot days and several low-cost devices were used (Maxim iButton, OnsetHOBO UX100-003 and self-designed solar powered Arduino-based data loggers combined with the Sensirion SHT21 temperature and humidity sensor). The collected data were aggregated on a 100 m horizontal resolution grid and compared with the simulations initialized with the atmospheric conditions for a given day.
Both measurement and modelling results show similar features for distinct local climate zones (built-up area, near water environment, forest, parks, agricultural area, etc). The spatial gradients in temperature can be assigned to different orographical and land use characteristics and show a good agreement on a district scale. Even if many ambiguities remain in both modelling and the measurement approach, the collected data provide useful information for local-scale heat assessment and can serve as a base to increase the model reliability, especially in areas with low data coverage.