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Combining crowdsourced weather data and the numerical urban climate model PALM – potentials and limitations

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The increasing intensity and frequency of heat waves combined with the urban heat island can create thermal conditions which are hazardous for human health. Numerical urban climate modelling can deliver the necessary information to plan resilient adaptation measures for healthy living conditions in cities under a future climate. However, as a model is always a simplification of the real world, model evaluation with measurement data is important. Traditional measurement networks and campaigns are very often not suitable in active planning processes. Crowdsourcing the required weather data offers the potential to easily evaluate model results at any given time.

To identify the potentials and limitations of this approach, the microscale urban climate model PALM is applied to simulate a hot day (T_{max} > 30 °C) in a German city. The model results are evaluated with quality controlled crowdsourced air temperature data. The evaluation reveals a good model performance with a high coefficient of determination (R^2) of 0.86 to 0.88 and a root mean squared error (RMSE) around 2 K. A temporal pattern in model accuracy is detected with an underestimation of night-time air temperatures. Due to the high number of available stations and the resulting representation of intra-urban temperature variations, the crowdsourced air temperature data proved valuable for model evaluation. Limitations for this approach arise from radiation errors leading to a reduced data quality. Furthermore, measurements from a single station are influenced by microscale and localscale conditions and therefore only the information derived from several stations can be used for evaluation.