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COMBINING CROWDSOURCED WEATHER DATA AND THE NUMERICAL URBAN CLIMATE MODEL PALM – POTENTIALS AND LIMITATIONS

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Motivation



Fig. 1: Examples of climate sensitive buildings (Oke et al. 2017)

Climate adaptation in urban areas

Detailed information on
microscale thermal conditions

Numerical urban climate
modelling

Model evaluation?



Fig. 2: Logo of the PALM model and PALM-4U model components (Leibniz-Universität Hannover)

Methods

- Study area: Bochum
- Study period: hot episode in August 2020 ($T_{\max} = 36\text{ °C}$)
- Quality controlled, crowdsourced air temperature data for evaluation
- PALM model system
 - Atmospheric boundary conditions from COSMO-D2
 - Offline & online nesting
 - PALM-4U modules

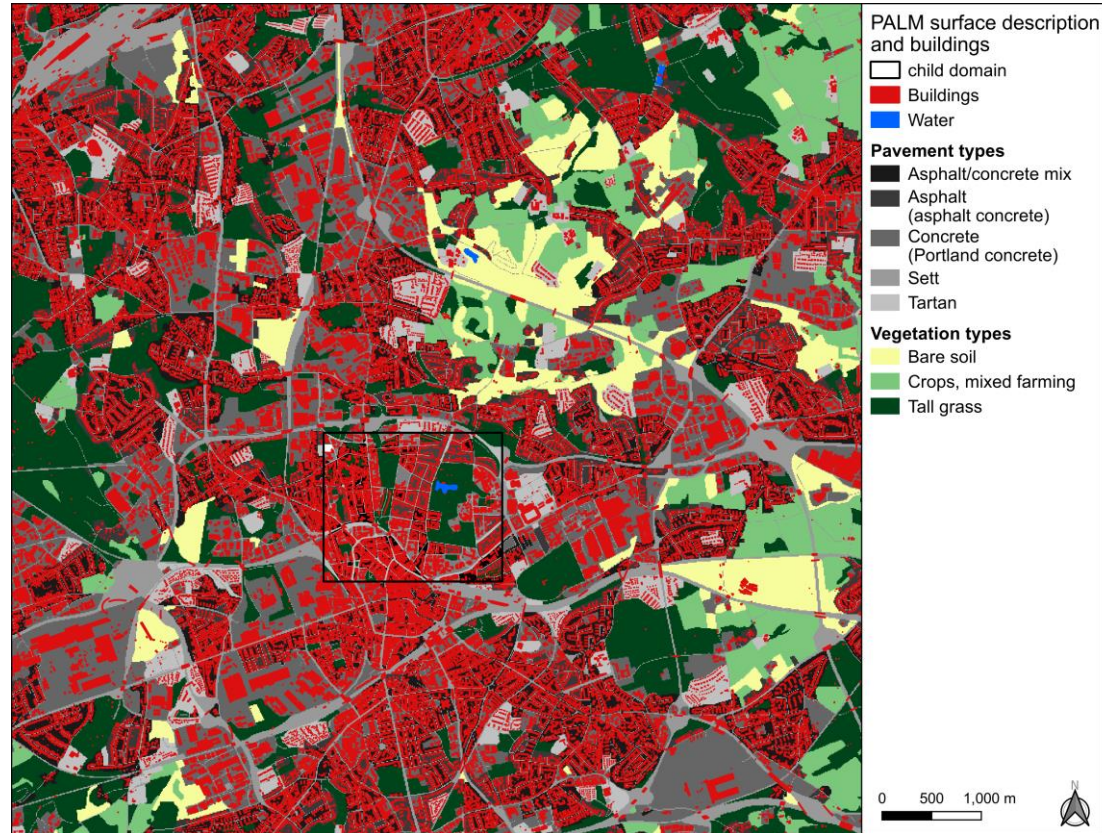


Fig. 3: Surface description and building positions as input for the PALM simulation

Results

Model results

- Clear daily cycle
- Expected maximum air temperatures reached
- Temporal pattern in urban rural air temperature differences
 - „Rural reference“: Local Climate Zone D (low plants)

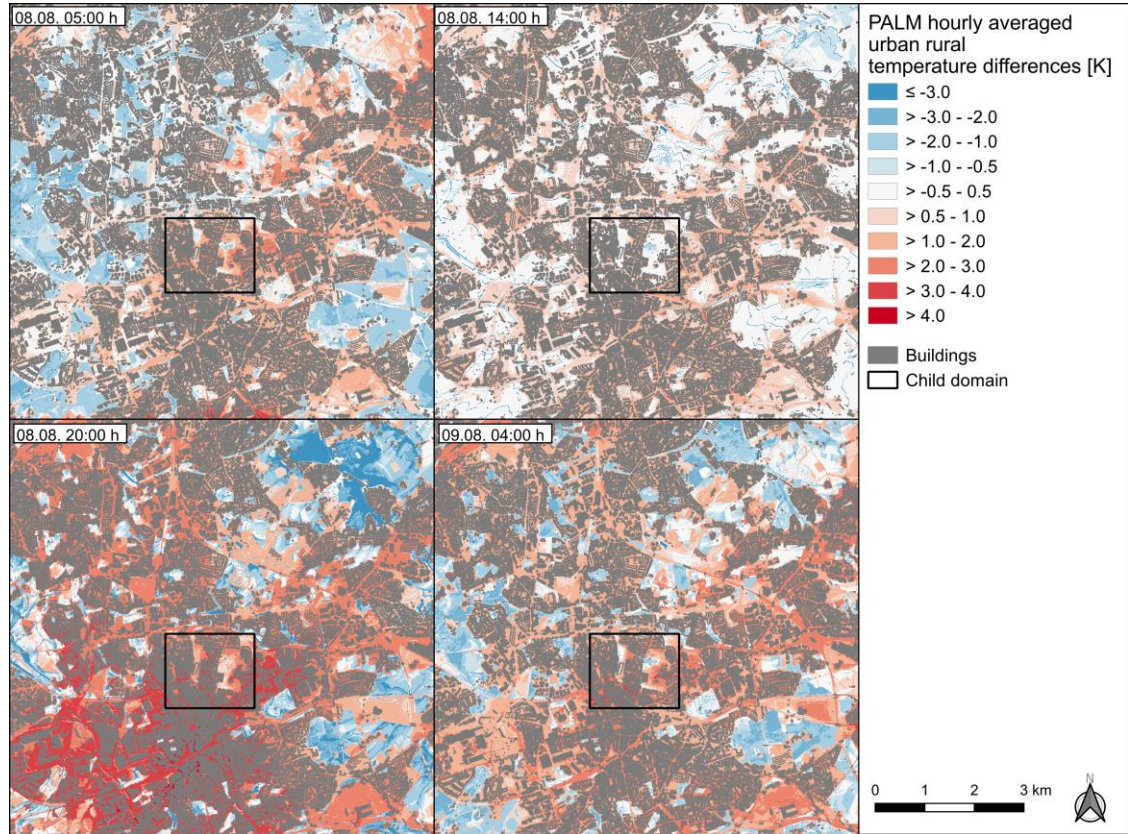


Fig. 4: PALM urban rural air temperature differences [K] at four selected timesteps

Results

Evaluation

Parent domain

- Pearson r: 0.93
- R²: 0.88
- RMSE: 1.89

Child domain

- Pearson r: 0.93
- R²: 0.86
- RMSE: 1.98

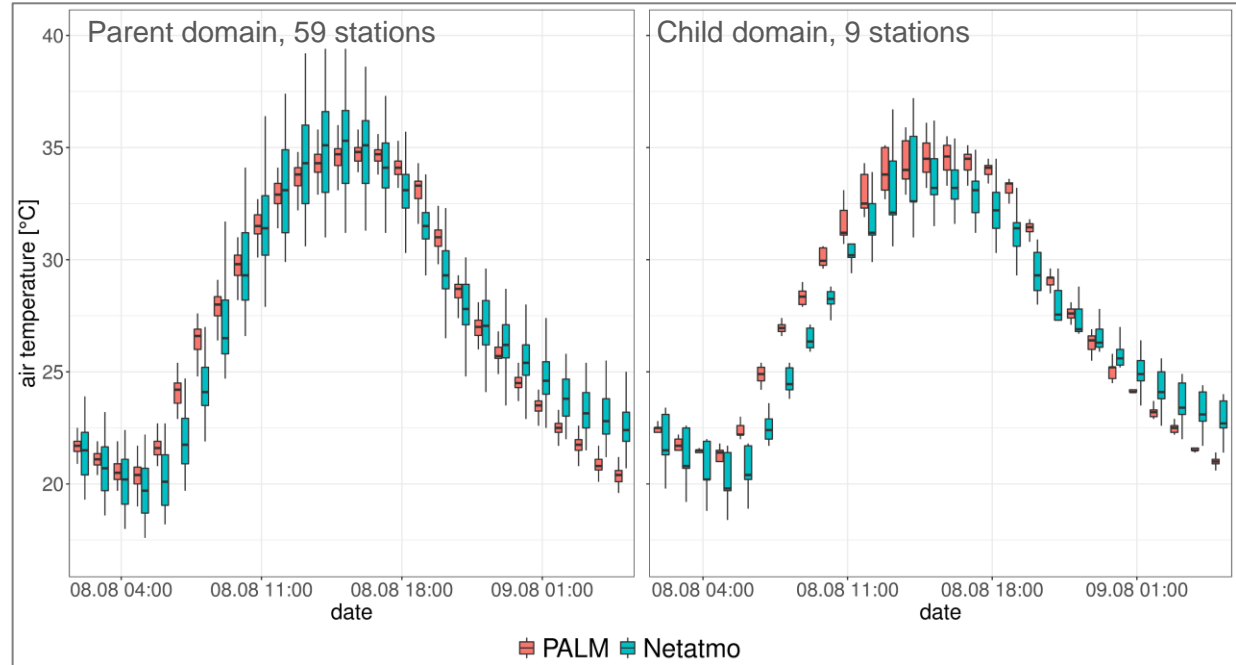


Fig. 5: Boxplot timeseries of the PALM 2 m air temperature [°C] and Netatmo air temperature [°C] for parent and child domain

Discussion

Potentials

- Statistical values indicate high agreement
- High spatial resolution
- Same type of station
- Placement within urban areas:
representation of thermal conditions in
different urban environments

Limitations

- Low data quality and remaining radiation errors
- Uncertainty of exact location of each station
- Influenced by micro and local scale phenomena
- Low number of stations in child domains

Outlook & further information

- Application to different cities
- Further investigation into causes for differences between modelled and measured data
- Compare evaluation with crowdsourced data to evaluation with professional data or data from measurement campaign

Further information:

van der Linden L, Hogan P, Maronga B, Hagemann R, Bechtel B (2023): Crowdsourcing air temperature data for the evaluation of the urban microscale model PALM—A case study in central Europe. PLOS Clim 2(8): e0000197. <https://doi.org/10.1371/journal.pclm.0000197>