Project: **1511**

Project title: **URBANLINE: Assessing future urban heat vulnerability and adaptation by integrating micro scale modelling and participatory approaches.**

Principal investigator: **Leonie Grau**

Report period: **2025-05-01 to 2026-04-30**

The project URBANLINE researches co-produced vulnerability assessments for future urban heat events through the integration of micro-scale climate modelling and participatory approaches. Vulnerabilities will be investigated from two perspectives: On the one hand, micro-scale climate modelling, tailored to the specific urban area under study, will provide detailed insights into localized climate impacts and city hot spots of urban heat islands.

As part of the project, this research explores the effect of different adaptation measures on the distribution of heat in a neighbourhood for a hot day in the present and in the future.

During the previous allocation period, the focus was on establishing a robust and efficient modelling framework with the large-eddy simulation model PALM in order to enable the planned scenario-based analyses. Major progress was achieved in setting up the model configuration and preparing the basis for systematic sensitivity experiments.

A key milestone was the development and evaluation of a suitable model domain. Initial efforts explored a nested domain configuration to combine larger-scale forcing with high-resolution neighbourhood simulations. However, repeated technical limitations and stability issues led to a reassessment of this approach. As a result, the research focus was refined and a revised modelling strategy was successfully implemented using a single, elongated domain optimised for the investigation of neighbourhood-scale heat advection. This solution reduced technical complexity while remaining well aligned with the scientific objectives.

Building on the stabilised model configuration, first scenario simulations focusing on overheating conditions were conducted. These runs demonstrate the model’s capability to resolve spatial temperature patterns, flow structures, and their interaction within the neighbourhood-scale domain. First results illustrate horizontal gradients in air temperature and wind fields (Figure 1), as well as a consistent temporal evolution of overheating over the diurnal cycle (Figure 2). Figure 2 also shows the problem of cyclic boundary conditions re-introducing heat into the system when implementing a strong heat source.

Selected simulations were re-run using improved and more accurate static input data, particularly for surface characteristics. These refinements enhanced the physical consistency and quality of the results and established a solid foundation for the systematic experiments planned for the next project phase.

Overall, the previous allocation period resulted in a functional and well-tested modelling setup, allowing the project to transition from model development to focused scientific analysis in the upcoming allocation period.

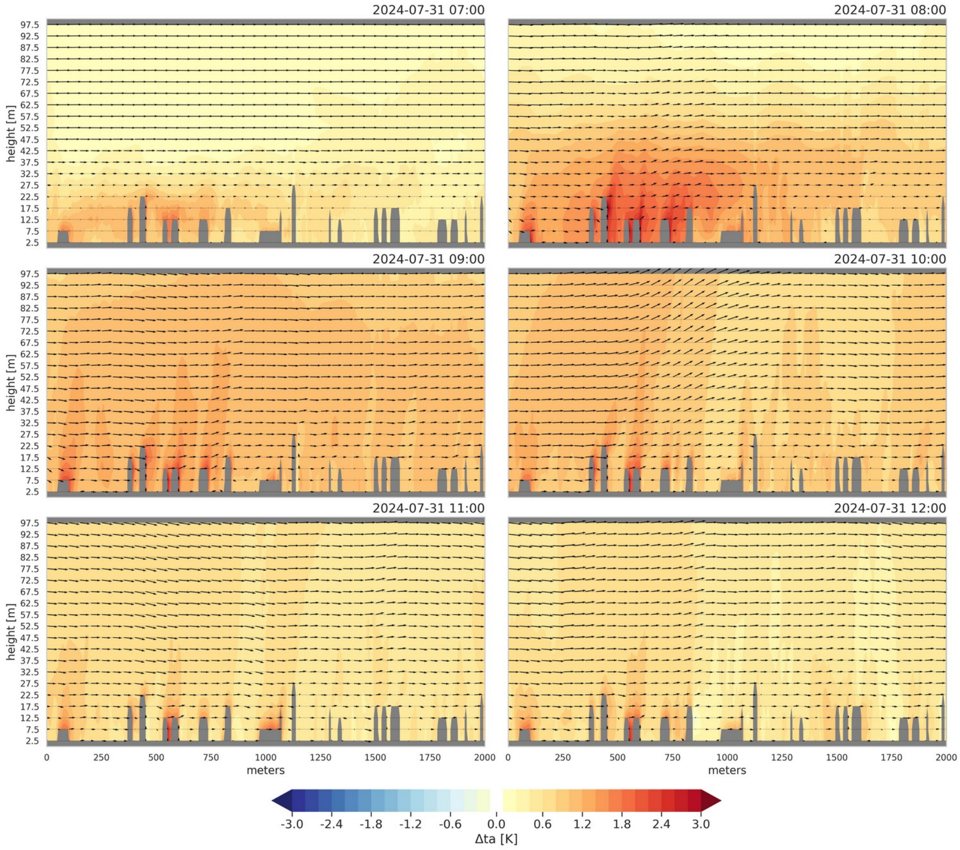

Figure 1: Wind field and difference in air temperature between the base run and the run with multiple heat sources for the morning hours.

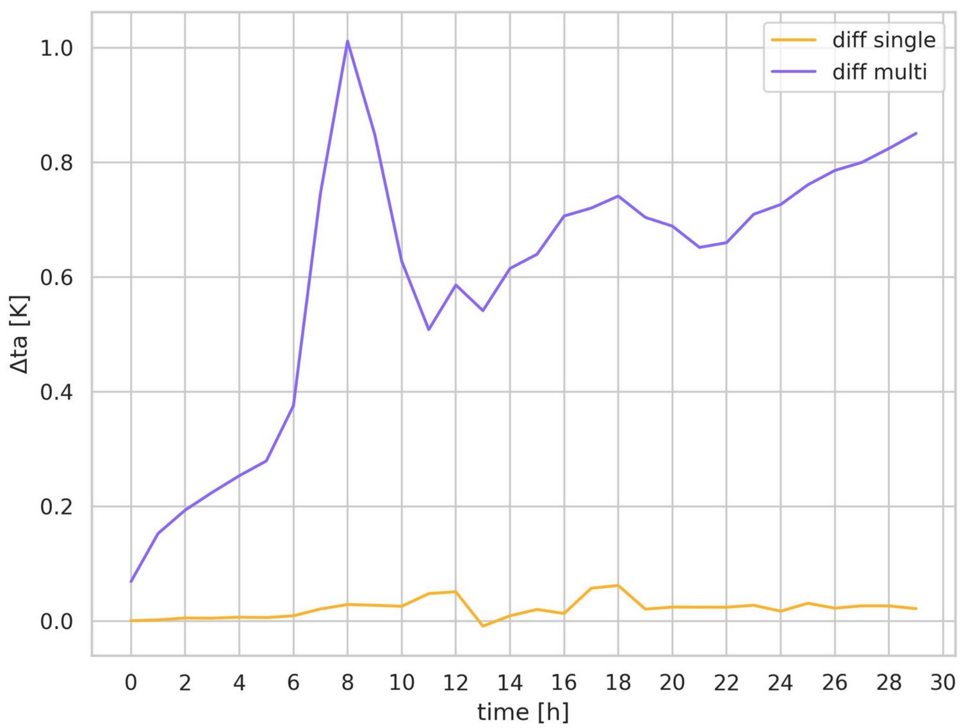

Figure 2: Difference in instream air temperature over time for the run with a single heat source (diff single) and the run with multiple heat sources (diff multi).