Microscale Simulations for Urban Green Eye

Modelling the Effectiveness of Adaptation Measures for Thermal Stress in German Cities Under Climate Change

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In Short

- Simulations of German cities using the microscale climate model PALM-4U
- Estimation of improvements of thermal stress using adaptation measures
- Relationship between surface and air temperature

Within the framework of the project Urban Green Eye [1], satellite data will be established to determine climate adaptation-relevant parameters as means of action in municipal administration and planning processes. Municipalities will be able to access updated indicators for climate adaptation free of charge through a cloud-based data portal.

***Figure 1:** The Urban Green Eye project logo [1].*

The project will provide indices of thermal stress and relief and hydrological relief as a quantitative measure for inclusion and reuse in geographic information systems (GIS). These indices will be available nationwide for all municipalities, creating a nationally uniform data basis for the development of qualitative and quantitative indicators for municipal climate adaptation strategies.

To this end, the state-of-the-art meteorological modelling system PALM-4U [2,3] will be used to simulate the microclimate and outdoor thermal comfort of some selected neighbourhood of some German cities, such as Berlin, Leipzig, and Duisburg.

PALM-4U is a modern and highly efficient urban climate model allowing for simulations of the urban atmosphere with building-resolving spatial resolution over a neighbourhood and a city scale. This model is equipped with all the modules required for simulating urban areas, such as the plant canopy module, the urban surface module, the land surface module, the radiation module, the indoor climate module, the chemistry module, and the biometeorological module. The model has been successfully evaluated against field measurements, wind tunnel simulations, and previous LES studies. It shows also excellent scalability on massively parallel computer architectures.

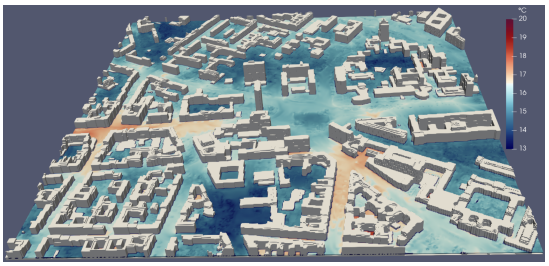

***Figure 2:** Near surface air temperature in the simulated domain (Ernst-Reuter-Platz in Charlottenburg, Berlin) during a summer night.*

The PALM-4U modelling system will be utilised to transfer remotely sensed data into ground-level meteorological and bio-meteorological variables in order to examine the impacts of uncertainties in satellite-based calculations of green volume and validate and expand the deficit analysis results. Additionally, the scenario calculation will demonstrate the effects of concrete adaptation measures on areas with high deficits.

Therefore, the project will involve simulations of current conditions and scenarios for German cities that include adaptation measures to address thermal relief. These measures will consider factors such as green space connectivity, biodiversity, and the availability of fresh air, as well as the quantity and quality of vegetation and its potential cooling capacity.

We will use simulations with PALM-4u to examine the relationship between surface temperature and air temperature under various meteorological conditions at the local meteorological scale, considering the influence of spatial scale and vegetation on this relationship. We will calculate the correlation coefficients between air and surface temperatures at this local scale, and also investigate the impact of spatial scale and vegetation density on air temperature. Additionally, we will use the simulated average surface temperature and normalized difference vegetation index to accurately estimate air temperature from satellite-derived surface temperature data.

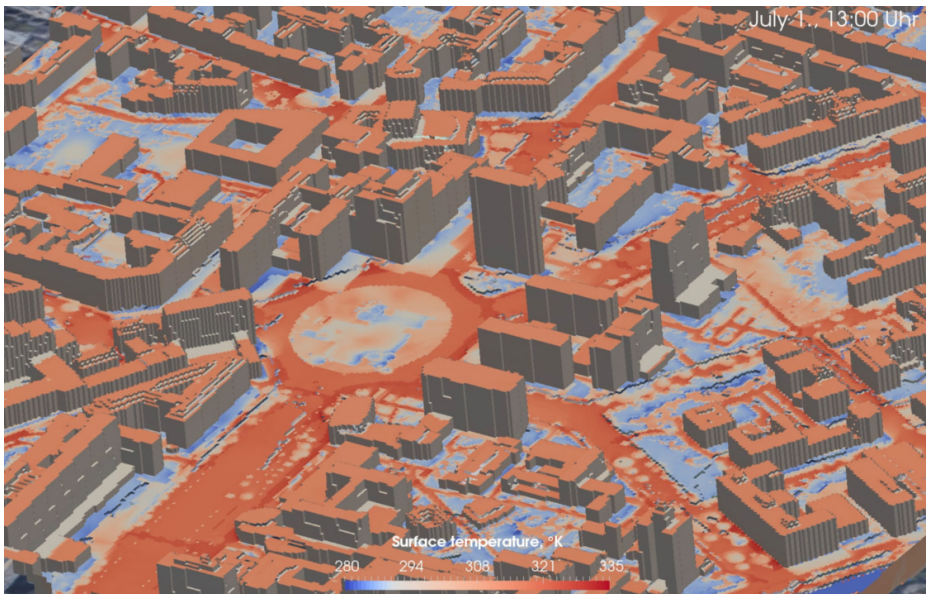

Figure 3: *Surface temperature of a focus domain in the simulated area (Ernst-Reuter-Platz in Charlottenburg, Berlin) during a summer day at 13:00.*

WWW

http://urbangreeneye.de/

More Information

[1] Urban Green Eye http://urbangreeneye.de/

[2] Maronga, B., et al.: Overview of the PALM model system 6.0, Geosci. Model Dev., 13, 1335–1372, https://doi.org/10.5194/gmd-13-1335-2020, 2020.

[3] Salim, H.S., Schubert, S., Maronga, B., Schneider, C., Cidek, M.F., 2020. Introducing the urban climate model palm system 6.0. International Journal of Applied Energy Systems Vol. 2, No. 1, 15–18.

Project Partners

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