



Scenario-Based PALM-4U Simulations of Green Space Reduction in a Residential District of Šiauliai

Sinan Cetin and Kevin Sieck

Climate Service Center Germany (GERICS), Helmholtz-Zentrum Hereon, Hamburg, Germany

Rapid population growth and urban expansion are altering land surface characteristics in cities worldwide. At the same time, climate change is increasing the frequency and intensity of heatwaves, making urban areas more vulnerable to thermal stress, particularly where green and permeable surfaces are reduced or modified. In recent years, urban climate models have increasingly been used to examine these processes and to support climate adaptation at the local scale. In this study, the PALM-4U model system is applied to investigate the microclimatic effects of changes in green space within a residential district of Šiauliai (Lithuania). A scenario-based approach is used to compare current land-use conditions with alternative configurations in which existing green areas around residential buildings are replaced by hard surface materials, such as asphalt. Simulations are conducted for a representative heatwave period, and differences between scenarios are evaluated using PALM-4U model outputs, focusing on near-surface air temperature and surface thermal characteristics. The results illustrate the sensitivity of neighborhood-scale urban climate conditions to modifications in green space distribution and demonstrate the value of high-resolution urban climate modeling for assessing land-use scenarios relevant to climate adaptation and planning under increasing heat stress, and provide a consistent reference for the interpretation and validation of Earth Observation derived land surface temperature data in subsequent modeling applications.