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Quantifying Adaptation Measures for Thermal Stress in German Cities using the Microscale Urban Climate Model PALM-4U: Insights from the UrbanGreenEye Project

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The UrbanGreenEye project is a collaborative research initiative focusing on monitoring urban areas for climate change adaptation using remotely sensed indicators. The project addresses the critical need for comprehensive and accessible data to support sustainable urban development. In the context of climate change adaptation, the project recognizes the challenges faced by local civil services in obtaining timely and cost-effective information about urban structures. This study presents the crucial role of the microscale building-resolving urban climate mode PALM-4U in quantifying the effectiveness of vital indicators derived from Earth Observation, such as land surface temperature (LST), urban green volume, vegetation vitality, and imperviousness. For instance, the implementation of PALM-4U enables a detailed deficit analysis of urban green volume, allowing for the identification of areas experiencing thermal and hydrological stress. The model PALM-4U is used in validating greening scenarios, providing valuable insights for urban planners and decision-makers in formulating effective adaptation measures. Recognizing the inherent uncertainties in satellite-based calculations of indicators, the model PALM-4U investigates the impact of these uncertainties on the accuracy of PALM-4U simulations. By employing artificial intelligence algorithms, including Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) models, the UrbanGreenEye project aims to enhance the reliability of satellite-derived data for improved urban climate modeling. Through collaboration with nine partner municipalities, this research contributes to bridging the gap between remote sensing capabilities and local authorities' needs. The outcomes of this study will facilitate the creation of a robust model for urban green volume deficiency, identifying hotspots for adaptation measures and supporting evidence-based urban planning strategies. Additionally, urban areas, influenced by the urban heat island effect, experience elevated surface and air temperatures due to factors such as increased solar absorption, lack of vegetation, and human activities. The model PALM-4U is used to explor the relationship between surface and air temperatures. Understanding this correlation is crucial for informing decisions by city planners and policymakers to mitigate the urban heat island effect. The insights gained also aid meteorologists in accurate temperature predictions for urban areas and contribute to scientific understanding of temperature dynamics, providing valuable perspectives on the potential impacts of climate change on future cities. Ultimately, the

assessment of remotely sensed indicators using the model PALM-4U within the UrbanGreenEye project is considered a considerable step towards enhancing the resilience of urban areas to climate change.