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SMART-TWIN: Transforming urban climate science into planning practice using a geospatial digital twin

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Adaptation to climate change in urban areas is increasingly based on integrated models that combine high-resolution geospatial data, urban morphology and physically based climate simulations. However, in practice, the application of advanced urban climate models is often limited by complex user interfaces and workflows, incomplete data structures and high computational requirements.

As part of the EU-funded project 'SMART-TWIN – AI-supported planning tool for climate-friendly green urban development in Bavaria' the existing digital twin for the City of Würzburg (Germany) is further developed to fill the gap between urban climate science and operational planning practice. The digital twin acts as a central platform, integrating geodata sets such as 2D and 3D city models, land use, building characteristics, green and blue infrastructure, and environmental observations, and presenting them to the user in a visual and interactive way.

The innovation of SMART-TWIN is the close coupling of the digital twin with the high-resolution urban climate model PALM-4U. This model provides a spatially explicit scenario parametrisation layer that allows local authorities and planning offices to create real or hypothetical planning measures such as new buildings, demolition, unsealing or greening strategies directly within the digital twin. The base geospatial data of the digital twin as well as the modified scenario inputs are automatically harmonised, pre-processed and transferred to PALM-4U via standardised data pipelines. Simulation results such as air temperature, wind fields or heat stress metrics are post-processed automatically and transferred back to the digital twin where these thematic layers are visualised. This enables a comparison between alternative planning scenarios and between different current or feature climate scenarios.

For the initial test runs, five public locations within Würzburg were selected, for which modelling was simulated under typical climatic conditions at a resolution of 1 m. Subsequently, individual changes, such as the creation of additional green spaces, were simulated. The automatic data processing worked to a high degree, and the results of the urban climate model also show promising results regarding the effects of infrastructure modification.