Quantifying the microclimatic effects of urban green infrastructure for climate change mitigation and adaptation

Teresa Zölch[1], Johannes Maderspacher[1], Stephan Pauleit[2], Werner Lang[3]

[1] TU München, Centre for Urban Ecology and Climate Adaptation, Munich, Germany
[2] TU München, Chair for Strategic Landscape Planning and Management, Freising, Germany
[3] TU München, Institute of Energy Efficient and Sustainable Design and Building

Rising temperatures and the intensification of the urban heat island (UHI) effect due to climate change are major challenges for cities. Adaptation via green infrastructure (GI) can significantly reduce the UHI effect. Our study aims at quantifying GI measures at urban micro-scale with benefits for outdoor as well as indoor thermal comfort and buildings' energy demand by coupling microclimate modelling with thermal building simulation. We use the microclimate model ENVI-met to analyse outdoor thermal comfort conditions in different urban greening scenarios. In order to evaluate the effect of these scenarios on indoor thermal comfort and buildings' energy demand, we employ IDA-ICE, a building performance simulation tool. As ENVI-met operates at a temporal resolution of single extreme weather days while analyses of energy demand and thus CO_2 emissions are based on yearly records, yearly weather files are clustered into typical-day categories. For each of the typical-days an ENVI-met simulation is realized. The results of these calculations are the input for the building simulation. The input files can be measured data as well as climate change scenarios to study the effects in a projected future climate. The methodological approach is tested for an urban block in Munich, Germany, representing a typical urban fabric of residential buildings with a high degree of compactness and surface sealing. The study allows a detailed analysis of how GI measures at building level (green roofs and facades) as well as in the public space (street trees) are reducing the potential for indoor and outdoor heat stress for the typical-days of a year. The results are expected to serve as decision support for urban planners and city administrations when implementing GI measures.

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TOPIC 3: GI for climate regulation and climate change resilience