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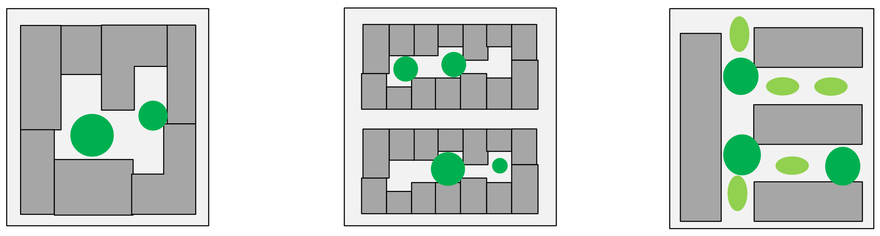
Identifying synergies for climate change mitigation and adaptation at the district level

Introduction

Strategies and measures for climate change mitigation and adaptation are often conceived as separate issues by municipal administrations, although they are actually closely interrelated. Rising temperatures and the further intensification of the urban heat island (UHI) effect are major challenges for cities (EEA 2012). They lead to an increase in energy demand for cooling which counteracts mitigation efforts (Fahmy and Sharples 2011, Akbari 2002). Adaptation via urban greening can significantly reduce the UHI effect. Our study aims at identifying optimal urban planning measures for synergetic adaptation and mitigation by coupling microclimate modelling with thermal building simulation.

Research Approach

The microclimate modelling software ENVI-met simulates the surface-plant-air interaction in an urban quarter (Bruse et al. 2014). We use it to analyse outdoor thermal comfort conditions in different urban planning scenarios for adaptation. 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 (Equa Simulation AB 2014). Coupling the microclimate and building simulations incorporates the ENVI-met output parameters air temperature, relative humidity, wind speed and solar radiation as input values for IDA-ICE. 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, an approach to coupling needs to be developed. In our approach yearly weather files are clustered into typical-day categories (VDI 2012). Mean values of these categories are edited by the meteorological values produced by ENVI-met and subsequently interpolated over the whole year. The input of yearly weather files can be measured data as well as climate change scenarios to study the effects in a projected future climate.



Types of city districts selected for analysis (own draft)

The methodological approach is tested in three different case studies in Bavarian cities with more than 100,000 inhabitants. The case studies represent three different urban district types (see above). All three are highly exposed to urban overheating due to their degree of compactness and surface sealing but require differing sets of adaptation measures.

Conclusion and Outlook

Coupled modelling allows us to assess the effects of adapting urban planning on outdoor thermal comfort, on buildings' energy demand and CO_2 emissions at the district level as well as to identify synergetic measures. These are expected to serve as decision support for urban planners and city administrations when implementing new measures. Through stakeholder integration we will develop assessment criteria for two additional dimensions to be included in the decision-making process: quality of life and biodiversity.

References

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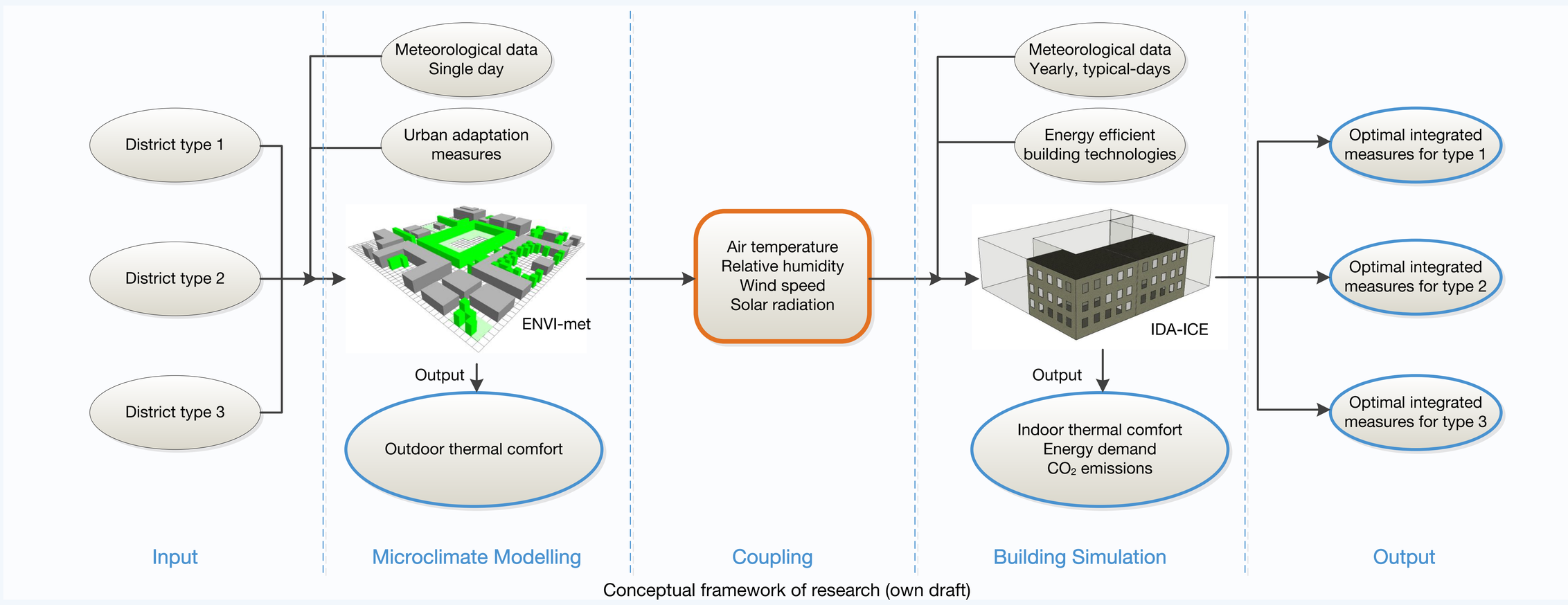

Conceptual framework of research (own draft)

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