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Modeling of the Urban Heat Island (UHI) using WRF – Assessment of adaptation and mitigation strategies for the city of Stuttgart.

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Cities are warmer than their surroundings (called urban heat island, UHI). UHI influence urban atmospheric circulation, air quality, and ecological conditions. UHI leads to upward motion and compensating near-surface inflow from the surroundings which import rural trace substances. Chemical and aerosol formation processes are modified due to increased temperature, reduced humidity and modified urban-rural trace substance mixtures. UHIs produce enhanced heat stress for humans, animals and plants, less water availability and modified air quality. Growing cities and Climate Change will aggravate the UHI and its effects and urgently require adaptation and mitigation strategies.
Prior to this, UHI properties must be assessed by surface observations, ground- and satellite-based vertical remote sensing and numerical modelling. The Weather Research and Forecasting Model (WRF) is an instrument to simulate and assess this phenomenon based on boundary conditions from observations and global climate models. Three urbanization schemes are available with WRF, which are tested during this study for different weather conditions in central Europe and will be enhanced if necessary. High resolution land use maps are used for this modeling effort. In situ measurements and Landsat thermal images are employed for validation of the results.
The study will focus on the city of Stuttgart located in the south western part of Germany that is situated in a caldera-like orographic feature. This municipality has a long tradition in urban climate research and thus is well equipped with climatologic measurement stations.
By using Geographical Information Systems (GIS), it is possible to simulate several scenarios for different surface properties. By increasing the albedo of roof and wall layers in the urban canopy model or by replacing urban land use by natural vegetation, simple urban planning strategies can be tested and the effect on urban heat island formation and air quality can be investigated. These numerical simulations will then be used to assess effectiveness and impact of planned adaptation and mitigation actions for the UHI under present and future climate conditions. Urban air quality is in the focus of these studies.
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