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Mapping Urban Heat Islands Using Calibrated ENVI-met Model : Application to Sense-City Data

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Urban heat islands (UHI) occur in urban areas with higher temperatures than in surrounding zones, exhibiting an average increase of 2°C. During summer heatwaves, this difference can even reach up to even 12°C. This intense heat phenomenon in urban areas leads to thermal stress, potentially causing health issues such as increased risks of dehydration, heat strokes, and other heat-related health problems. To evaluate the impact of thermal variations on health in urban environments, ENVI-met is used. This work focuses on two main points: sensitivity analysis and parameter calibration.

Numerical sensitivity analysis allows to study the influence of urban area model parameters on quantities of interest (e.g. thermal confort indices). These parameters include notably surface albedo and emissivity. Hence, it gives information of their impact on heat islands. This step prioritizes the influence of each parameter, providing crucial insights for the subsequent stages of the study.

To better understand these urban phenomena and design efficient mitigation solutions, the calibration of the ENVI-met model stands as a promising approach. It aims to establish a digital twin based on experimental data. This calibrated model will enable a detailed mapping of urban temperature and other environmental parameters, thereby enhancing our understanding of the mechanisms behind urban heat islands.

This approach will facilitate an evaluation and comparison between the outcomes of the numerical model and the experimental data collected in Sense-City urban area. Sense-City is a climate chamber that can cover two $400m^{2}$ areas. These urban areas can be studied in natural conditions or in controlled climatic conditions. This comparison will strengthen the credibility and trust in the accuracy of the established digital twin. Thanks to simulations and experimental observations, we will have the opportunity to deepen our knowledge about the formation and the evolution of urban heat islands in this specific environment and to select efficient cooling strategies at the block-scale.