P-33 | Integrating high-resolution simulations and transformer network predictions for mitigating human heat stress: A digital twin of a Texas campus

COA SHOWCASE

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Extreme heat events intensified by climate change pose a severe threat to public health. Yet, there has been limited exploration of high-resolution spatial-temporal simulations and advanced data-driven deep learning predictions for human outdoor heat stress using urban digital models. Additionally, developing dynamic digital twins that integrate physical systems with virtual worlds for bi-directional information flow and decision-making support remains underexplored in this field. Here we conducted a case study of a campus in Texas, utilizing the physical microclimate model, high-resolution urban 3D model, and meteorological data to simulate the Universal Thermal Climate Index (UTCI) during a heatwave period in 2022 with 1-meter spatial and 1-hour temporal resolution. We further developed a Transformer network model that integrates spatial and temporal data to rapidly predict UTCI and created a digital twin to provide stakeholders and the public with a platform for effective neighborhood-level heat exposure responses. This study contributes to a deeper understanding of the fine-scale spatial-temporal variation of human outdoor heat stress, offering insights to mitigate the negative impacts of extreme heat and make informed decisions for enhancing thermal comfort and building more climate-resilient cities.