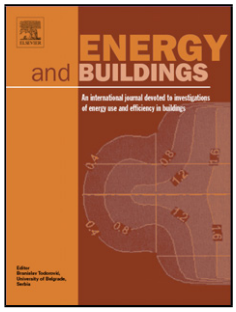

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Multi-scale Urban System Modeling for Sustainable Planning and Design

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Highlights

- Developing Integrated Multi-scale Environmental Urban Model (IMEUM).
- The IMEUM is a coupled dynamical and statistical model.
- IMEUM can be employed to assess the combined impacts of the UHI phenomenon.
- IMEUM output can be converted into a weather data file for simulation.
- Highlights the importance localized microclimate condition for energy simulation.

Abstract

The urban heat island (UHI) phenomenon has become a concern in many major cities worldwide, as high summer temperatures and poor wind flow can have negative impacts on city dwellers, particularly increasing energy demand for artificial cooling. This paper showcases how an Integrated Multi-scale Environmental Urban Model (IMEUM) can be employed to support planners, architects and engineers to assess the combined impacts of the UHI phenomenon and rising global temperatures due to climate change. IMEUM concept derives from downscaling environmental models from global scale (25km) to mesoscale (1km) and city scale (100m). Hence, this paper showcases a computationally efficient method which couples multi-scale atmospheric models with statistical model to estimate weather parameters. Developed under Singapore context, IMEUM can be utilized to incorporate appropriate UHI mitigation measures upfront in design process, consecutively bridging the gap between global and building scale. This paper also includes calibration of the IMEUM output using observations from ground sensors. Furthermore, by using case study of a hypothetical office building, this paper showcases how the IMEUM output can be fully converted into a localized weather data file for cooling load simulation. IMEUM is currently being developed further into integrated quantitative urban environment simulation tool (QUEST), which can be used to test the immediate microclimatic impact of development plans and assess their long term impacts under future climate change scenarios.

1. Abbreviations

BEM	=	Building energy model
BEP	=	Building effect parameterization
CUM	=	City-urban model
DMO	=	Direct model output