

Isolating the impacts of urban form and fabric from geography on urban heat and human thermal comfort

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Public health risks resulting from urban heat in cities are increasing due to rapid urbanisation and climate change, motivating closer attention to urban heat mitigation and adaptation strategies that enable climate-sensitive urban design and development. When evaluating the effectiveness of urban heat mitigation strategies in observational or traditional modelling studies, it can be difficult to separate the impacts of modifications to the built and natural forms from the interactions of the geographic influences, limiting the universality of results

To address this, we introduce a new methodology to determine the influence of urban form and fabric on thermal comfort, by utilising a comprehensive combination of possible urban forms, an urban morphology data source, and micro-climate modelling. We perform 9814 simulations covering a wide range of realistic built and natural forms (building, roads, grass, and tree densities as well as building and tree heights) to determine their importance and influence on thermal environments in urban canyons without geographical influences.

We show that higher daytime air temperatures and thermal comfort indices are strongly driven by increased street fractions, with maximum air temperatures increases of up to 10 and 15C as street fractions increase from 10% (very narrow street canyons and/or extensive vegetation cover) to 80 and 90% (wide street canyons). Up to 5C reductions in daytime air temperatures are seen with increasing grass and tree fractions from zero (fully urban) to complete (fully natural) coverage. Similar patterns are seen with the Universal Thermal Climate Index (UTCI), with increasing street fractions of 80% and 90% driving increases of 6 and 12C, respectively. The resulting method allows mitigation strategies to be tested on modifiable urban form factors isolated from geography, topography, and local weather conditions, factors that cannot easily be modified.

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