Does urban climate follow urban form? Analysing intraurban LST trajectories versus urban form trends in 3 cities with different background climates

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Abstract

The current climate change trend urges the application of efficient spatial planning to mitigate the effects of urbanization on local urban warming. Nevertheless, how urban temperatures respond to urban form changes inside cities is still insufficiently understood. In this paper, we explored the relationship between urban form and diurnal space-time land surface temperature (LST) trends (2003–2019) in Beijing (continental climate), Cairo (arid) and Santiago (temperate). We analysed changes in land cover, white sky albedo (WSA), night-time lights (NL) and the enhanced vegetation index (EVI) inside areas representing clustered thermal performance (steady cold and hot spots and warming cold and hot spots). The structure of local climate zones (LCZs) was assessed for each LST trend. To test the relevance of other urban form dimensions, we analysed the hierarchical influence of the employed 2D metrics (i.e., built-up cover, WSA, NL and EVI) and additional 3D indicators (i.e., height and volume) on LST, applying machine learning classification and regression trees (CARTs) to Beijing's data. Despite diverse patterns of urban form change, cities in our sample present common LST trends, with thermal differences as a consequence of local climate. LCZs are composed of highly heterogeneous built-up areas inside LST trend categories. In the case of Beijing, LST is hierarchically driven by footprint, WSA and EVI. Moreover, by adding height and volume, urban form differences between LST trend classes that are not evident with 2D data were found. Our findings suggest that a compact green urban tissue is necessary to cope with the current trends of urban warming, taking into account city-specific measures based on the local background climate. © 2022 Elsevier B.V.

Author keywords

Spatial heterogeneity; Urban change; Urban composition; Urban warming