EXPLORING SPATIAL VARIATION OF THE URBAN HEAT ISLAND IN RELATION TO URBAN STRUCTURE USING MACHINE LEARNING

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With the growth of urban populations and increasing heat emissions, the Urban Heat Island (UHI) effect has become an increasingly severe issue, contributing to higher energy consumption, more frequent extreme weather events, worsening air pollution, and public health risks [1, 2]. Understanding the factors influencing UHI is critical for improving the urban thermal environment. Previous studies have shown that the spatial pattern of artificial impervious surfaces plays a significant role; however, the effects of the morphological spatial patterns of impervious surfaces on UHI intensity remain underexplored. This study quantified four built-up landscape pattern metrics, including Edge Density (ED), Largest Patch Index (LPI), Percentage of Landscape (PLAND), and Mean Patch Area (MREA-MN), along with built-up volume, built-up surface area, and greenery, to investigate their effects on UHI intensity at scale 500 m in Vilnius, Lithuania. Using an explanatory machine learning approach, non-linear relationships between these factors and UHI intensity were identified. Spatial Random Forest model was applied to quantitatively assess their relationships with UHI. Results indicate that LPI is strongly associated with UHI intensity. Interactions among key variables show that high values of LPI or PLAND combined with high built-up volume are associated with elevated UHI levels.

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