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Role of Vegetation in mitigating urban heat risk in Twelve American Cities - Applying the ARIES Modelling Approach

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The anthropogenic urban realm exacerbates surface urban heat island (UHI) effects, triggering health hazards, such as mortality attributable to heat exposure in cities. The study makes a concerted effort to unravel the complex interplay between various spatial, quantitative, and qualitative attributes of vegetation, aiming to comprehend its pivotal role in mitigating urban heat risks within urban environments. The UHI risk is related to land surface temperature (LST). The study models UHI risk in twelve American cities in diverse Köppen-Geiger Climate zones spanning the contiguous USA. To address this, the Integrated Modelling approach by the ARtificial Intelligence for Environment & Sustainability (ARIES) initiative has been adopted in the study. This approach based on FAIR (Findable, Accessible, Interoperable, and Reusable) principles is accessible at https://aries.integratedmodelling.org/. Utilizing the k.LAB software with semantic reasoning our modeling approach assesses the UHI risk. It maps the spatial distribution of UHI considering hotspots of anthropogenic heat, vegetation, land cover, and land surface temperature. UHI risk is assessed at a resolution of 30 meters alongside census tract-level data using an ordered weighted approach. The study found variations in the relationship between greenness, as indicated by the Normalized Difference Vegetation Index (NDVI), and Land Surface Temperature (LST) across 12 different cities. The findings highlight the cooling effect of the water bodies, especially in areas near the port and green spaces. Linear parks such as roadside tree plantations typically feature uniform tree species and often lack smaller trees and shrubs, making them susceptible to heat infiltration from surrounding areas and resulting in a lesser overall temperature reduction. It identifies at least 30 percent of census tracts across 12 cities necessitate urban greening intervention. The study provides scientific insight into the cooling effects of urban parks, offering valuable guidance for urban planning and aiding decision-makers in addressing the UHI effect and enhancing overall urban sustainability. The study also underscores the significance of open science in developing environmental models addressing global sustainability challenges concerning the pressing issue of assessing urban climate risks. Models and scientific artifacts often face challenges in reusability, transferability, and sharing across diverse programming languages or modeling systems, revealing a significant lack of interoperability. By delving into the factors of LAI, NDVI, and Landscape Shape Index (LSI), the study aims to enhance understanding of the role of vegetation in ameliorating the adverse effects associated with UHI, thus paving the way for more effective urban heat management strategies.