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Dynamic Modeling of Urban Heat Island Effect and Mitigation Strategies Based on Green Infrastructure

Urban Heat Island (UHI) effect refers to the phenomenon where urban areas experience higher temperatures than their surrounding rural areas due to human activities, buildings, and infrastructure. This temperature difference is mainly caused by the absorption and retention of heat by impervious surfaces such as asphalt and concrete, along with the release of heat from air conditioning systems, industrial processes, and vehicular traffic. The UHI effect has become increasingly prominent in rapidly urbanizing areas, contributing to various environmental and health challenges, including increased energy consumption, poor air quality, and the exacerbation of heat-related illnesses.

To mitigate the adverse impacts of UHI, green infrastructure has emerged as a promising solution. Green infrastructure involves the integration of natural systems such as vegetation, water bodies, and permeable surfaces into urban planning and design. This approach helps to reduce the heat absorption of impervious surfaces, enhances the cooling effect through evapotranspiration, and promotes natural air circulation. Green infrastructure includes practices such as urban forestry, green roofs, green walls, parks, and rainwater harvesting systems, all of which contribute to reducing urban heat and improving the overall quality of life in cities.

In order to effectively address UHI, dynamic modeling tools are essential for understanding the complex interactions between urban environments, climate factors, and human activities. These models can simulate the spatial and temporal variations of heat distribution in urban areas, providing valuable insights into the factors that influence the UHI effect and the potential impacts of different mitigation strategies. By incorporating green infrastructure elements into dynamic models, it is possible to evaluate the effectiveness of various interventions in real-time, allowing for the optimization of urban planning decisions.

This paper explores the dynamic modeling of the UHI effect, focusing on the factors that contribute to heat accumulation in urban areas and the role of green infrastructure in mitigating these effects. The study will examine different green infrastructure strategies and assess their impact on reducing the UHI effect under various urban conditions. Through the use of dynamic modeling, the paper aims to

provide a framework for the development of sustainable and climate-resilient cities that can effectively combat the urban heat island effect.