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Urban Heat and Mitigation Potential in the Kansas City Metropolitan Area: Insights from Integrated Numerical Modeling and Heat Mapping

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Urban Heat Islands (UHIs) represent a climatic consequence of urbanization, leading to elevated temperatures within cities compared to surrounding rural and suburban areas. Addressing this human-induced phenomenon demands effective mitigation strategies. This study quantifies the UHI in the Kansas City Metropolitan Areas (KCMA) in the United States and investigates the potential of albedo modification, particularly through the cool roof implementation, as a means to mitigate UHI effects within the KCMA.

Utilizing the Weather Research and Forecasting (WRF) model, we first designed a suite of high-resolution simulations, examined UHI dynamics during a heatwave event across various scenarios within the KCMA, and determined the effectiveness of mitigation strategies in reducing temperatures within the KCMA. Specifically, we simulated two cool roof scenarios: one representing "newly installed" cool roofs with an albedo of 0.8 and another reflecting "aged" cool roofs with an albedo of 0.5. Our findings reveal that cool roof materials significantly mitigated surface UHI effects during evenings, delaying the onset of UHI effects until later in the day. Moreover, our study showcases the more profound impact of cool roofs on surface skin temperature, influencing the surface energy balance by altering sensible and ground storage heat fluxes and the planetary boundary layer.

Leveraging numerical modeling, we led and launched an Urban Heat Island Mapping Campaign in Kansas City. It is a volunteer-based community citizen science field campaign that builds upon local partnerships among academia, local government agencies, non-profits, and private sectors. This campaign engages Kansas City's local residents in a scientific study to map and understand how heat is distributed in the communities and the factors affecting the uneven distribution of heat. It raises awareness about the adverse impacts of extreme heat and excessive urban heat and presents actionable measures for urban planners and policymakers to address heat-related challenges in metropolitan areas.