Characterizing the Urban Land Surface Temperature via an Innovative Multi-Platformed Suit of Satellite and Ground-Based Remote Sensing Technologies

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Motivation for this study arises from the escalating urban heat issue, characterized by rising temperatures in complex urban areas. However, a significant gap exists in comprehensive air temperature measurements within these environments. Therefore, this research endeavors to establish a vital connection between satellite measurements, which offer a superior spatial coverage across cities, and urban air temperatures. In this study, the relationship between air and land surface temperature (LST) is analyzed across various city sizes from 2003 to 2022 using three air temperature datasets. Air temperatures are obtained from Automated Surface Observing Systems (ASOS), the New York Urban Hydro-Meteorological Testbed (NY-uHMT), and data collected by high school students. 227 ASOS stations are provided to analyze the consistency of the discrepancies between air and surface temperature at different parts of the world via matching up with satellite retrievals. At the finest spatial scale, air and surface temperature measurements are taken by high school students at Baruch College Campus High School in the spring 2023 and NSF's Implementing Novel Solutions for Promoting Cultural Change In Geoscience Research & Education (INSPIRE) project during the summer 2023. At the largest scale, land surface temperatures are taken from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS). One-to-one plots comparing land surface temperature with air temperature are created. Surface temperature is furthest from air temperature in the summer and in urban locations (slope of 1.01 at Monmouth Executive Airport in eastern New Jersey instead of 0.792 at JFK airport in southern New York). Results from the field campaigns yield more or less uniform air temperatures, which leads to a relaxed surface vs. air temperature slope (values on the order of 0.1 instead of 0.9). Furthermore, using surface temperature data collected during the summer 2023 field campaign, a heat map of the Bedford Stuyvesant area is generated through Inverse Distance Weighted interpolation in ArcGIS Pro. This map is then compared to Environmental Justice Index (EJI) data for the same region, obtained from CDC. Notably, the

resulting map highlights a strong correlation between high environmental injustice scores and elevated temperatures in the area. In the context of future research, several crucial directions are planned. First, an expansion of the analysis is planned through a comparative examination of the EJI with various demographic datasets. This approach aims to uncover the multifaceted contributors to environmental justice disparities. In parallel, the scope of mapping efforts will be extended to encompass not only temperature variations but also an array of related environmental factors, including air quality, green spaces, and public health indicators. To refine the accuracy of spatial representations, experimentation with diverse Geographic Information Systems (GIS) interpolation methods is anticipated. These forthcoming initiatives underscore a commitment to advancing the comprehension of environmental disparities and their relevance to urban contexts, how climate continually impacts people and society, and how it can be more accurately predicted.