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Sub-daily Land Surface Temperature data for urban heat monitoring from spaceenhanced by machine learning

Christian Mollière, **Lukas Kondmann**, Julia Gottfriedsen, and Martin Langer
OroraTech GmbH, München, Germany (christian.molliere@ororatech.com)

Urban heat islands are becoming a major health factor for cities in the eye of a warming planet. Fueled by impervious surfaces and rising temperatures, extreme heat may lead to 235,000 emergency room visits and 56,000 hospital admissions annually in the US alone in 2023 [1]. Beyond its economic impact, urban heat therefore puts a strain on wellbeing and health across the globe with visible effects on mortality.

Urban planning aims to mitigate extreme heat in cities, a challenge intensified by urban densification and climate change. However, accurately predicting and managing urban heat is complex due to the difficulty in measuring local physical processes, particularly in dynamically changing environments. The scarcity of granular measurements of land surface temperature compounds this issue. While satellite imagery from thermal instruments offers some assistance, traditional data sources often lack the necessary temporal density of observations. Rapid diurnal temperature fluctuations necessitate near-real-time monitoring for effective decision-making and a comprehensive understanding of urban temperature dynamics.

New Space constellations with higher temporal cadence are starting to close this data gap with enormous potential for urban development as well as extreme heat event anticipation. For example, OroraTech's Forest constellation allows frequent observation of urban areas. With 2 satellites operating in orbit and 9 more planned to launch in 2024, we aim to provide Land Surface Temperature (LST) every 12 hours globally. Once our full constellation is operational in 2027, the update frequency will again improve to sub-hourly.

The native spatial resolution of Forest data at 200m is, however, a challenge for urban applications. We are currently exploring enhancing our imagery with artificial intelligence approaches to 70m to get from city quarter to building block level. These super-resolution techniques are the result of recent advancement in AI and image processing with promising results on our thermal data. Yet, the usability of super-resolved data for urban policy is underexplored. We aim to present preliminary findings of the accuracy of our super-resolution method compared with higher resolution Ecostress data and investigate the applicability of the

results for urban planning as well as extreme heat event analysis. With this, we aim to help cities to mitigate and adapt to the new public health challenges as a result of extreme heat.

[1]: Yale Program on Climate Change Communication, 2023 https://yaleclimateconnections.org/2023/07/extreme-heat-will-cost-the-u-s-1-billion-in-health-care-costs-this-summer-alone/