

Land Surface Temperature Downscaling for High-Resolution Urban Heat Monitoring

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The Urban Heat Island (UHI) effect is often difficult to characterize due to the low spatial resolution of satellite thermal infrared (TIR) sensors compared to visible and near-infrared (VNIR) instruments. This study introduces a two-stage hyper-sharpening protocol developed for the Italian Space Agency's MUSTER project, enhancing Landsat 8/9 TIRS data from 100 m to 15 m resolution. The method uses a multimodal fusion approach, exploiting the correlation between thermal emission and reflected solar radiation. The first stage, assimilation, involves synthesizing sharpening images for each thermal band through pixel-by-pixel multivariate linear regression of higher-resolution optical bands. This process creates "synthetic Pan" images at 15 m resolution to enhance spatial details. The second stage uses a projection-based fusion algorithm to inject high-pass spatial frequency components into the interpolated TIRS bands, ensuring balanced spatial detail enhancement. Validated in Poznań, Poland, the 15 m sharpened Land Surface Temperature (LST) maps capture fine-grained thermal variability, with quality assessments showing high physical consistency and improved correlation coefficients compared to original thermal bands. This enhances urban heat intensity measurements.

References

[1] Alparone, L., Garzelli, A., "Downscaling Land Surface Temperature via Assimilation of LandSat 8/9 OLI and TIRS Data and Hypersharpener", *Remote Sensing*, 16(24), 4694, 2024.

Preferred mode of presentation: Oral preferred, poster ok