Multiple Regression Analysis for Unmixing of Surface Temperature Data in an Urban Environment

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Global climate change and increasing urbanization worldwide intensify the need for a better understanding of human heat stress dynamics in urban systems. During heat waves, which are expected to increase in number and intensity, the development of urban cool islands could be a lifesaver for many elderly and vulnerable people. The use of remote sensing data offers the unique possibility to study these dynamics with spatially distributed large datasets during all seasons of the year and including day and night-time analysis. For the city of Basel 32 high-quality Landsat 8 (L8) scenes are available since 2013, enabling comprehensive statistical analysis. Therefore, land surface temperature (LST) is calculated using L8 thermal infrared (TIR) imagery (stray light corrected) applying improved emissivity and atmospheric corrections. The data are combined with a land use/land cover (LULC) map and evaluated using administrative residential units. The observed dependence of LST on LULC is analyzed using a thermal unmixing approach based on a multiple linear regression (MLR) model, which allows for quantifying the gradual influence of different LULC types on the LST precisely. Seasonal variations due to different solar irradiance and vegetation cover indicate a higher dependence of LST on the LULC during the warmer summer months and an increasing influence of the topography and albedo during the colder seasons. Furthermore, the MLR analysis allows creating predicted LST images, which can be used to fill data gaps like in SLC-off Landsat 7 ETM+ data.

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