

# The relationship between urban volume and land surface temperature using ALOS PRISM and Landsat images: A case study of Tsukuba and Tsuchiura, Japan

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Estimating urban green volume (UGV) and urban built volume (UBV) is essential for city planning and sustainable development of the cities. UGV and UBV can be used as a proxy indicator for measuring the spatial pattern of urban development. UGV and UBV have a strong relationship with land surface temperature (LST) to occurring urban heat island phenomena in urban areas. To calculate the UGV and UBA needs two primary input data such as built footprint, green footprint, and heights of the features. This study examines the relationship among UGV, UBV, and LST by using geographical information systems and remote sensing to identify the spatial distribution of UGV and UBV in traditional and planned cities in Japan. Several methods such as urban-rural gradient, grid-based analysis and statistical analysis were used to identify the relationship. Landsat TM data were used to extract urban built footprint and green footprint in selected two cities and Landsat TM thermal band data were used to extract LST. ALOS PRISM DSM was used to derive the surface feature heights (SFH) of the built and green footprint. The result indicates that built-up area in grid-based analysis has positive relation with LST in both cities while the green area has negative relation with LST. The built-up volume also positively correlates, and green volume negatively correlates with LST in both cities. Landscape pattern of two cities directly relates with LST. Urban-rural gradient analysis was used to identify the landscape pattern of the two selected cities. The result of urban-rural gradient analysis shows that heights in Tsukuba mean that LST value was recorded in in 1.1 km distance from the city center, while heights in Tsuchiura mean that LST value was recorded near the city center. Built-up area and green area scattered in Tsukuba were compared with those of Tsuchiura. More green space can be seen near the city area in Tsukuba in comparison with Tsuchiura. In addition, mean LST showed a positive relationship with built-up density and was negatively related with green density along the urban-rural gradient analysis in both cities. Findings of this study can be a useful tool for policymakers in the context of future urban and landscape planning activities.

Keywords: ALOS PRISM, LST, urban built volume, urban green volume, Tsuchiura, Tsukuba