Extraction the urban thermal features in satellite sensed thermal images with Raster-Patch-Cluster Scheme

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The thermal textures in a satellite sensed image show the heterogeneity and homogeneity of urban canopy layers. They express the objective existing of local urban heat islands or cool islands in a city. Extracting and analyzing such textures could help us to identify the local thermal environment of cities and consider the countermeasures against urban heat islands in residential community scale. The conventional research with satellite thermal images have paid most of their attentions on the energy exchanges between canopy layer and the above atmosphere in pixel-based ways but missing the features in thermal textures of images and the mechanism they are formed.

Instead of statistical comparison of brightness temperature and environmental conditions pixel by pixel, this paper extracts the thermal features from satellite sensed images by a Rater-Patch-Cluster scheme and discusses the thermal characteristics of features extracted. This scheme is applied to the Yokohama City with ASTER/TIR observed on the 30th of October, 2003 for verifying the spatial structure of urban heat islands and the characteristics of local thermal features in late autumn. As the results, the following knowledge is obtained.

1) The Rater-Patch-Cluster scheme is an efficient method for abstracting the spatial structure of urban heat islands city-widely and assessing the intensities of heat islands or cool islands locally.

2) There exist a significant logarithmic relationship between feature areas and local heat island intensities and significant linear relationship between feature areas and local cool island intensities. That is to say, the bigger the area of heat islands (cool islands) the larger the intensity of heat islands (cool islands) even within a city.

3) The differential of brightness temperatures in the city was complicatedly affected by land uses and topographical characteristics which are two main dominating factors of urban canopy layer. It is verified through the thermal image that the cool air generated by grasslands and bare lands after sunset might go down along valleys or slopes of hills so that the spatial extent of cool islands would be expanded.

The above conclusions show that the thermal features are important elements of local environment and thermal images like ASTER/TIR is useful as thermal information resource for land use planning or natural land conservation.