URBAN THERMAL ENVIRONMENT SIMULATION AND PREDICTION BASED ON REMOTE SENSING AND GIS

Du Peijun*, Liu Pei , Luo Yan and Zhang Huapeng
Department of Remote Sensing and Geographical Information Science,
China University of Mining and Technology, Xuzhou City, Jiangsu Province, 221116, P.R. China
Email: dupjrs@cumt.edu.cn, dupjrs@gmail.com

Abstract: With the change of land use/cover change (LUCC) in urban areas, urban heat island (UHI) has become one of the most serious environmental damages in urban areas. Urban thermal environment is dramatically changed as a result of urban heat island impacts; and that further result in great temperature difference between urban and suburban areas, lead to pollutant concentration in urban areas and degradation of human settlement. In order to monitor the pattern, distribution and trend of urban thermal environment and predict its influences to urban ecological environment and human settlement, it is necessary to adopt thermal remote sensing data and geographical information system to visualize, analyze, simulate and predict the spatial pattern and evolution trend of urban thermal environment. In this paper, the thermal infrared data of ASTER are used to estimate land surface temperature (LST), and the multi-spectral data of ASTER are used to land cover classification. GIS is used to simulate the evolution of thermal environment and predict its trends under the specific land cover scenarios.

Firstly, ASTER images are processed from two aspects: land cover classification and land surface temperature (LST) estimation. After a comprehensive comparison to three classifiers: Maximum Likelihood Classifier (MLC), Back Propagation Neural Network (BPNN) and Support Vector Machine (SVM), SVM classifier is chosen to classify land cover owing to its superiority to other classifiers in terms of efficiency, accuracy and generalization ability. Based on a comparison to some LST inversion methods from ASTER thermal infrared data, split-window algorithm is used to estimate LST, therefore the spatial distribution of urban thermal environment is determined.

Based on the statistics to the LST of urban area and its corresponding land cover on ASTER data, some reliable samples are obtained to estimate the average temperature of the specific land cover from ASTER images in different seasons, so the average temperature of each land cover can be derived as references for estimating the temperature of related land cover in the land planning scenarios.

Finally, some typical scenarios of urban land planning are input to GIS and converted into raster data with the same cell size as pixel size of ASTER visible and near infrared image, that is, 15m, and the identical land

* Corresponding author: dupjrs@cumt.edu.cn, dupjrs@gmail.com

cover categories to land cover classification of ASTER image is used to depict different land uses in the planning scenario, so the temperature of each land cover can be used to predict and simulate the spatial distribution of urban thermal environment under the given land use scenario. That is helpful to analyze the land use planning schemes from the specific aspect: urban thermal environment view, so that the land use planning can be optimized by improving the thermal environment and avoiding the negative impacts resulted from urban heat island.

This paper consists of 7 parts. Section 1 is a brief introduction to the background and related studies. The case study area, data and tools are introduced in Section 2. Land cover classification is conducted in Section 3, and LST is estimated in Section 4. The relationship between land cover and LST is analyzed in Section 5, and then it is used for LST estimation of the specific land use scenarios in Section 6. Finally, some conclusions and suggestions are given in Section 7.

Keywords: Urban Heat Island (UHI), urban thermal environment, Remote Sensing; Geographical Information System; land surface temperature (LST)