AN ANALYSIS ON THE COUPLING RELATIONSHIP BETWEEN URBAN VEGETATION AND LAND SURFACE TEMPERATURE IN HANGZHOU BASED ON ASTER IMAGERY

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Both urban vegetation and urban land surface thermal environment (ULSTE) are vital factors to the health of citizens, city image and the further development. Urban vegetation is greatly influenced as the development of social economy and the urban expansion, and the ULSTE is significantly changed as well. Therefore, they have both been the most important components in urban ecological environment research. On the other hand, land surface temperature (LST) is the main factor of ULSTE. The coupling relationship between urban vegetation and LST is therefore of great interest to a variety of environmental studies [1,2]. As the development of remote sensing techniques, urban vegetation and LST research has been supported with data and techniques.

Hangzhou, the provincial capital of Zhejiang Province in China, is also well known as the tourism city in and out of China. The ecological environment plays an important role in the influence of city image and further development. This paper chooses Hangzhou as the study area, and the urban vegetation and LST is monitored and analyzed utilizing Terra ASTER imagery in the year 2007. The coupling relationship is studied accordingly, so as to provide the basis for decision making of ecological planning and environment protection.

The research consists of 3 steps:

1) Retrieval of urban vegetation and urban forest from ASTER image. Urban forest plays a much more important role in most of the ecosystem subjects, so it is chosen as a special part of urban vegetation for the analysis; and both urban vegetation abundance (UVA) and urban forest abundance (UFA) are estimated in each pixel of ASTER image. UVA is calculated utilizing the dimidiate pixel model, while the LST is calculated using a classification and regression tree algorithm.

2) Retrieval and analysis of LST in the urban area of Hangzhou. LST is calculated introducing a split-window algorithm [3], which makes use of Band 13 and Band 14 of ASTER images. And the ULSTE of the study area is subsequently analyzed.

3) Coupling relationship research between urban vegetation and LST. This is the main part of this paper. Firstly, the relationships between NDVI and LST are studied in the following 3 parts: 1, the

characteristics of NDVI-Ts (surface temperature) Space [4] and the significance of its edges; 2, assisted by a scatter plot of interval mean value of NDVI and LST, NDVI is divided into 4 sections by 3 threshold values, 2 sections of which that are correlative with vegetation are emphasized; 3, the coupling relationship between NDVI and LST is learned according to the results of linear fitting and quadratic polynomial fitting, as well as the Pearson Correlation Coefficient in the overall study area.

The main research results and conclusions are as follows:

1) NDVI, urban vegetation abundance (UVA) and urban forest abundance (UFA) are all in negative correlation with land surface temperature (LST). Urban vegetation and urban forest are both capable in decreasing LST. Urban forest is in more complex coupling relationship with ULSTE, and is more capable in improving ULSTE.

2) The negative correlation between urban vegetation information (NDVI, UVA, and UFA) and LST decreases as the research scale increases; the influence of urban vegetation and urban forest increases initially and then decreases with pixel aggregation, which peaked around 90m ~ 120m resolution; the correlation coefficient increases till it is near 0.

3) Compared with the results analyzed utilizing Landsat ETM+ imagery in another city, the correlation shows some differences. The possible reasons are: (1) the remote sensing data used are different, both in thermal infrared bands and resolutions; (2) the climate, vegetation are quite different between Northern and Southern China.

At the end of this paper, some disadvantages of the analysis are discussed. And future efforts will mainly focus on: (1) improving the methods for retrieving the information of vegetation, and analyzing the coupling relationship between various types of vegetation and LST; (2) comparing the different results in different cities or using different remote sensing imagery, as well as the main reasons of the differences.

Keywords: Hangzhou, urban vegetation abundance (UVA), urban forest abundance (UFA), land surface temperature (LST), coupling relationship

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