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城市化进程中城市热岛景观格局演变的时空特征——以厦门市为例

Analysis on spatiotemporal changes of urban thermal landscape pattern in the context of urbanisation: a case study of Xiamen City

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中文摘要:

热岛效应作为城市化过程中产生的特有环境问题,对其形成和演变规律的研究有助于人们提出有效的应对措施。以厦门市为研究对象,利用1987-2007年等时间间隔、同时相的5景Landsat TM/ETM+遥感影像数据进行地表温度反演,在此基础上使用景观格局指数分析厦门城市热岛景观格局随城市化进程演变的趋势。结果表明:随着厦门城市化进程加深,整个热岛景观在逐渐变得更加破碎化,高等级热岛景观斑块个数、类型面积和个体面积都增大;新的高等级热岛景观斑块都出现在原有高等级斑块附近,致使高等级类型的邻近度增加而各类型之间相互接触的程度也增加;景观总体的聚合度逐渐下降,而高等级热岛景观类型的聚合度则呈上升趋势;景观水平的蔓延度总体呈下降趋势,优势度高的低等级热岛景观所占的比重下降,优势度逐渐降低;多样性指数、均匀度指数总体呈上升趋势,各热岛景观面积在各类型间的分配逐渐趋于均匀;热岛景观斑块的转化方面,在20 a间低等级斑块类型(1、2、3级)向高等级斑块类型(4、5、6级)转化的面积总体上呈增加趋势,而高等级斑块类型向低等级斑块类型转化的面积总体上呈减小趋势,且等级升高的面积明显大于同期等级降低的面积;就高等级热岛景观斑块而言,他们与3级热岛景观斑块间的相互转化最容易发生,远比高等级斑块内部各类型之间的相互转化来得容易,尤其6类和5类的转化是最为困难的热岛景观变化之一;从空间上看,各高等级热岛景观斑块都经历了数量增加、面积扩大、等级升高三个方面的变化,形成了海沧、新阳、杏林、厦门岛西北港口区和机场5个高温组团。利用景观指数分析城市热环境,可探明热岛景观随城市化演变的趋势,并为有效的热岛效应减缓措施提供直接的理论依据。

English Summary:

Cities are centers of political, economic, cultural and social life. It is a symbol of human civilization and development, and urbanization is a common trend in many countries. Nowadays, world urbanization accelerates greatly, especially in developing countries. While providing great economic and social benefits, urbanization has also created some environmental problems, including the Urban Heat Island (UHI) effect. UHI has deep impacts on material cycles and energy transfers within urban ecosystems, and has become an important issue in urban climate and environmental research. Xiamen is one of the special economic zones, and its rapid urbanization induced the UHI becoming much more intense and extensive. To study UHI from a viewpoint of landscape is a new method in urban thermal environment research. Analyzing the dynamics of the urban thermal landscape in the context of urbanization will provide support for environmental protection, energy use policy making, and urban planning and management.

This study analyzed the spatiotemporal changes of urban thermal landscape pattern in the main area of Xiamen City. Firstly, Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) thermal images, which were acquired on similar dates in the winter of 1987, 1992, 1997, 2002 and 2007, were used to retrieve brightness temperature. Then a relative brightness temperature (R) was calculated and the thermal patches were classified into 6 grades by temperature difference. Landscape metrics were used here at both landscape and class level to quantify changes in the urban thermal landscape pattern. And they can describe the changes of thermal landscape pattern in 3 aspects, including quantity, shape and structure. Finally, we investigated the distribution of thermal pollution sources in Xiamen.

The results showed that: 1) In terms of quantity, with the rapid urbanization of Xiamen City between 1987 and 2007, the thermal landscape became more fragmented, and was more and more dominated by high-grade thermal landscape patches. 2) The shape of high-grade thermal patches even the whole landscape tends to complex. 3) For structure, each grade of thermal landscape became well-distributed and even. The new high-grade thermal patches were found close to the old ones that induced the proximity index (PROX_MN) of high-grade thermal patches increased; the aggregation index (AI) of the whole landscape decreased while the high-grade thermal patches increased; the contagion index (CONTAG) of the whole landscape also decreased so that dominance of high-grade thermal patches gradually increased. 4) The area of thermal patches which converted from low-grade to high-grade is bigger than the area converted from high-grade to low-grade. According to statistical analysis, we found that it is much easier that the high-grade thermal landscape patches converted into the middle-grade thermal landscape than converted among high grades. 5) The high-grade thermal patches mainly distributed in the industry area, and they were increased remarkably. All the high-grade thermal patches experienced three kinds of changes (increasing number, expanding area and increasing grade), and grouped into five high temperature zones (Haicang, Xinyang, Xinglin, seaport of Xiamen island and airport), especially in the industrial districts of Xinyang and Xinglin.

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