THE APPLICATION OF REMOTE SENSING AND GIS TECHNIQUES FOR MONITORING URBAN HEAT ISLAND IN THE MALAYSIAN CITIES

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LAPORAN AKHIR PENYELIDIKAN "THE APPLICATION OF REMOTE SENSING AND GIS TECHNIQUES FOR MONITORING URBAN HEAT ISLAND IN THE MALAYSIAN CITIES

Perkara di atas adalah dengan hormatnya dirujuk. .

Bersama-sama surat ini disertakan tiga (3) naskah Laporan Akhir Penyelidikan bertajuk ***The Application of Remote Sensing and GIS Techniques For Monitoring Urban Heat Island In The Malaysian Cities.***

Sekian, terima kasih.

Yang benar,

Prof. Madya Dr. Wan Mohd Naim Wan Mohd
Ketua
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ABSTRACT

Urban Heat Island is a reflection of microclimate changes brought about by the man-made alterations to the urban surfaces. Recent studies have indicated that satellite remote sensing and Geographical Information System (GIS) technologies inherently suited to study the relationship between land cover changes and surface temperature. This study have three main objectives, that is, i) to identify the relationship between LANDSAT satellite Digital Number (DN) and the surface temperature, ii) to identify the surface temperature of different land cover types, and iii) to analyse the effect of vegetation and building properties to the surrounding surface temperature.

The Klang Valley Region has been selected as the study area. For a more detailed study, four smaller areas within this region have been selected as sub-study areas. These sub-study areas are located in the city of Kuala Lumpur (3 areas) and the other is located within the City of Shah Alam. LANDSAT 5 Thematic Mapper (TM) and LANDSAT 7 Enhance Thematic Mapper Plus (ETM+) images of four different dates i.e. the 11th of February 1999, 15th of July 2000, 31st of May 2001 and 20th of September 2001 acquired from the Malaysian Centre for Remote Sensing (MACRES) are used in the study. Surface temperature maps and land use/land cover maps are generated from these satellite images. For a more detailed study on the effect of the surrounding vegetation and building properties (different roof types), scanned aerial photo, QuickBird and SPOT 4 satellite images are used as image backdrop.

Findings from this research have shown that there is a strong correlation between the digital number of the thermal infrared band of LANDSAT satellite image of the 15th of July 2000. The correlations for the three other datasets are not so strong. The temperature derived from the model obtained from this research is almost similar to that of other established models such as Markham and Barker's Model, Quadratic Regression Model, and Cubic Regression Model. Temperature maps derived from satellite images have shown the differences in surface temperature for different land use, with forested or green areas and industrial areas exhibit the lowest and highest temperature respectively. The effect of different roof type, vegetation and water bodies on the surrounding surface temperature is clearly evident in this study.

CHAPTER 1

INTRODUCTION

1.1 Background

Today nearly half of the world's population is living in urban areas with cities in Developing Countries expanding rapidly over the last decades (Cohen, 1995 and Masek *et al.*, 2000). The expansion in the number of urban dwellers has significantly altered most of the natural landscape of the earth, with significant climatic and environmental implications across different scales. Results from various studies (examples Tso, 1996; Yamashita, 1996; and Comire, 2000) have shown that there are significant temperature differences between urban and surrounding rural areas, where urban areas are found to be generally warmer then the surrounding rural parts.

The Urban Heat Island (UHI) is a reflection of the totality of microclimatic changes brought about by manmade alterations to the urban surface (Landsberg, 1981). The process of urbanization has created the urban heat island. As a city expands, trees are cut down to accommodate commercial development, industrial areas, roads, and suburban growth. Trees or green areas normally reduce the amount of heat and smog generated by populated areas. Plants and water-retaining soils absorb heat during the day, and then carry the heat away through evaporation. Earlier study by Oak (1987) have identified micro topography, weather condition, city roughness, city density, city pattern, urban activity and thermal characteristics of the city surface as major factors which influence urban climate.

The higher temperatures not only creates uncomfortable atmosphere but also have serious implications on air pollution in our cities. Reports in many earlier studies have shown that the interaction between air pollution and heat is complex, but the result is clearly harmful. When gasses and particles interact with each other, pollution in the air produces smog. The heat island effect promotes the formation of smog by increasing the speed of particles in the air and the probability of chemical interaction when increased temperatures meet air pollutants, the results are the