

CITIES 2015 International Conference, Intelligent Planning Towards Smart Cities, CITIES 2015,  
3-4 November 2015, Surabaya, Indonesia

## Spatio temporal analysis trend of land use and land cover change against temperature based on remote sensing data in Malang City

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### Abstract

The purpose of this study is to assess the land use / land cover change (LULC) against Temperature Based on Remote Sensing Data in 2003-2013. This study uses a spatio temporal approach by using digital remote sensing data. The image data are used Landsat 7 ETM + and Landsat 8. Analysis of LULC change used supervised classification. The temperature data obtained by digital conversion number (DN). The results showed the spatial effect of LULC with the increase of temperature in Malang City. The LULC occurred on constructed land. The change are proven by the decrease of uncovered land and vegetation. The increase of temperature was proved by temperature data in 2013 were dominated by hot temperature class, while in 2003 was dominated by cold temperature class. The spatial distribution of hot temperature followed the pattern of main road including Part of City Region (PCR) Central Malang and Northeast Malang.

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Peer-review under responsibility of the organizing committee of CITIES 2015

*Keywords:* Spatio Temporal, Land use / land cover (LULC) change, temperature, remote sensing data.

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## 1. Introduction

The temperature increase trend is affected by natural and anthropogenic factors; especially CO<sub>2</sub> which produced from human activities that cause greenhouse gas concentrations. Land use has a very important role in controlling the temperature change. Some studies show (Fall, Et al. 2009) that land use / land cover change (LULC) have a significant impact on change in air temperature in the urban areas.

According to Effendy (2007), increasing temperatures in urban areas causes the difference in surface temperature distribution between the suburbs with the area of green open space that is still quite extensive. The phenomenon of differences distribution temperature in urban with the suburban areas is commonly called "Pulau Panas" or "Heat Island". According to Wisnu, 2003 Heat island is a phenomenon of temperature in areas with high concentrations of the building is higher than the temperature of the surrounding open land. The temperature in an area also shows the quality of the air in the area. High tend temperatures contain greenhouse gases such as CO and CO<sub>2</sub> with high concentrations that are harmful to human health. Hajji (in Fauzi, 2010: 40) said that generally for normal activities. The limits of the parameters as comfortable condition. The air temperature in range 20°C - 26°C and 45-60% relative humidity. The land use for the building can affect temperature in the area. This is because of each land cover material has a different ability to absorb and release heat. Temperature balancing can be done by increasing the area of green open space and increase the number of plants in the area.

Malang City as one of the cities in East Java is located at an elevation of 400-500 meters above sea level has a pressure point in the development of education, tourism, and industry. Based on research Hutabarat and Taufiq (2009) from 2005 to 2009 there was an increase in residential area of 14.19 Ha (10.63%). Besides, a small increase in trades and services area of 2,037 ha (1.53%) and public facilities covering an area of 0.824 ha (0.62%). While the green open space (GOS) is reduced 10.078 hectares from the beginning area 90.472 ha.

In recent years there has been increased temperature in Malang City. Based on research Utomo (2000) temperature differences on various land use in Malang City with daily average temperature of agricultural land is 23.83° C, settlement of 25.21° C and 26.77° C industrial land. This condition caused by the material of land use/land cover has a different of absorption and heat storage so it will influence the temperature around it. In 2010, Malang City have increased temperature recorded that the average of temperature ranges from 23 °C – 27 °C, with a maximum temperature of 33 °C, and the minimum temperature reaches 22°C. The same condition is also studied by Hamdani (2011), that during the year 2006 the average of temperature ranges between 22.2 °C - 24.5 °C, the maximum temperature reached 32.3 °C and a minimum temperature of 17.8 °C.

The utilization of remote sensing data allows to get spatial data in a relatively short and vast areas with quite high accuracy and low cost compared with the conventional way. Moreover, remote sensing also be multitemporal which means that the data in previous years can be easily obtained briefly in the form of images or aerial photographs. This allows analysis of land use/land cover change and temperature distribution pattern for a few years with more efficient. Based on these ideas, this research needs to be done with the aim of assessing land use/land cover change against Temperature Based on Remote Sensing Data in 2003-2013.

## 2. Methods

This is a survey research, which means that the study sought to collect large number of data at the same time. This study aimed to find out the effect of land use/land cover change against surface temperature in Malang City. Parameters of land use / land cover were used that constructed land, an open land and vegetation. To find out land use/land cover change using image data of Landsat 7 ETM+ in 2003 and Landsat 8 in 2013. The parameter of land use/land cover are using constructed land, open land, dan vegetation. While the classification of land use/land cover were using maximum likelihood classification method. Temperature data obtained by Digital Number (DN) value by using band 6 for Landsat ETM+ image and band 10 and 11 for Landsat 8 image. According to USGS (2003) conversion of image data into temperature data using two stages, i.e:

1) Conversion of Digital Number (DN) into Spectral Radiance ( $L\lambda$ )

$$\text{Radiance } (L\lambda) = (\text{gain} \times \text{DN}) + \text{offset} \quad (1)$$

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