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THE ANALYSES LAND SURFACE TEMPERATURE DERIVED FROM SATELLITE IMAGERY

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Abstract: This paper analyses the surface temperature profile using the remote sensing. LST data provides helps in understanding the spatial and temporal variations in surface temperatures, identifying heat islands in urban environments, monitoring changes in land use, and assessing the impacts of climate change. Another index using in this paper is NDBI stands for Normalized Difference Built-Up Index, it used to assess and analyze urban development and the extent of built-up areas within a region.

Keywords: remote sensing, NDVI, LST, temperature

1. INTRODUCTION

Landsat 7 (L7_ETM) images obtained from the United State Geological Survey (USGS) were used for this study (https://earthexplorer.usgs.gov).

The combination of remote sensing and Geographic Information Structures (GIS) is used in Land Surface Temperature (LST) assessment, which uses satellite imagery [3], [5]. The Normalized Difference Vegetation Index (NDVI) is a standardized vegetation index that generates information about relative biomass. The Normalized Difference Vegetation Index (NDVI) has values between -1 and +1, where values close to -1 highlight areas covered by soil, rock, built-up areas and values that tend to approach 1 mean area covered by vegetation (forests, parks, etc.) [4].

Monitoring land surface temperature (LST) through remote sensing imagery is one of the most important contributions to climatology. The LST (land surface temperature) results indicate the affected areas and the local thermal differences on different types of surfaces in the analyzed basin.

2. METHODOLOGY

The study area is the town of Timisoara located in western Romania, close to the borders with Hungary and Serbia, on the banks of the Bega River. The average annual temperature is approximately 10.6°C, and the annual average amount of precipitation is 592 mm. The surface temperature profile is analyzed to see which part of the city has the highest and lowest surface temperatures using ArcGIS software.

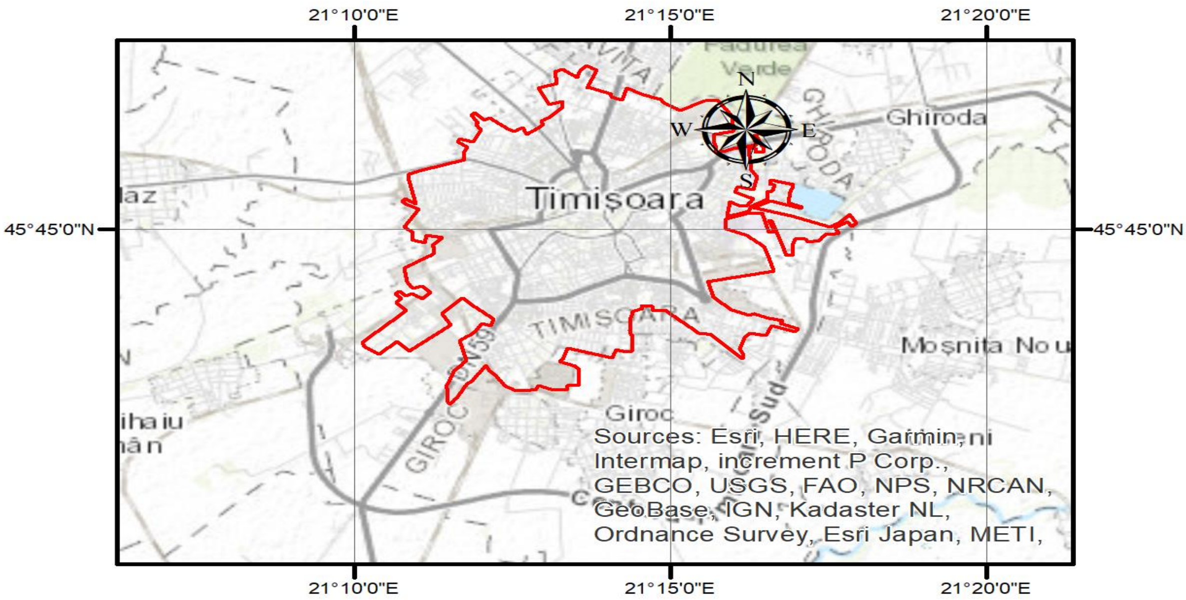

Figure1. Location map of the study area

NDVI is calculated by using the red and infrared bands of Landsat data based on Eq. 1 proposed by Gao [1]. The ratio of the NIR and red band is used for the calculation because absorption by chlorophyll of these two bands of the electromagnetic spectrum is highest [2].

$$NDVI = \frac{NIR-RED}{NIR+RED} \quad (1)$$

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Based on the maximum and minimum values from the NDVI Images, the proportion of vegetation was determined. Next, Land surface temperature maps are generated in ArcGIS using Landsat 7.

$$L\lambda = min + (max - min) * \frac{DN}{255} \quad (2)$$

Where: Lλ spectral radiance; min spectral radiance of DN value 1; max spectral radiance of DN value 255; DN digital number.

For the NDBI index in the modeling of urban areas by means of satellite images, the two bands were used. Remote sensing data are primary sources used to detect changes in recent decades.

$$\text{NDBI} = \frac{(\text{SWIR} - \text{NIR}))}{(\text{SWIR} + \text{NIR})} \quad (4)$$

The Normalize Difference Build-up Index value is between -1 and +1. The negative value of NDBI represents water bodies, while the higher value represents urban areas.

Table 1. Landsat image characteristics used.

Characteristics	Landsat 7 ETM+
Band number	**30 m:** Band 1 - Blue Band 2 - Red Band 3 - Green Band 4 - NIR Band 5 - SWIR-1 Band 7 - SWIR-2 **15 m:** Band 8 - Pan **60 m:** Band 6 - TIR
Thermal band spectral range	Band 6 (10,31-12,36 nm)
Acquisition dates	- 01 October 2002 - 11 November 2002 - 14 January 2003

Source: NASA 2003, USGS 2015

3. RESULTS AND DISCUSSIONS

Landsat visible and near-infrared bands were used to calculate the normalized difference vegetation index (NDVI) (Eq. 1).

It is essential to estimate the NDVI because the amount of vegetation present is an important factor for LST estimation [6].

Then is calculated the proportion of the vegetation (Pv) using NDVI (figure 2).

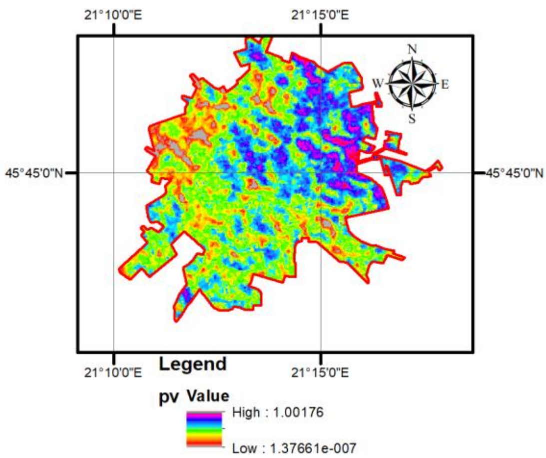


Figure 2. Proportion of the vegetation map

Regions covered with grass or buildings generally express very low NDVI standards such as 0.1 or below. Areas with meadows and shrubs will contribute modest NDVI values, around 0.2 to 0.5. The NDVI values for the study area start to increase in the period 2015-2022 (Figure 4).

Next, to determine the LST index, the emissivity and spectral radiance were determined (figure 3 and figure 5).

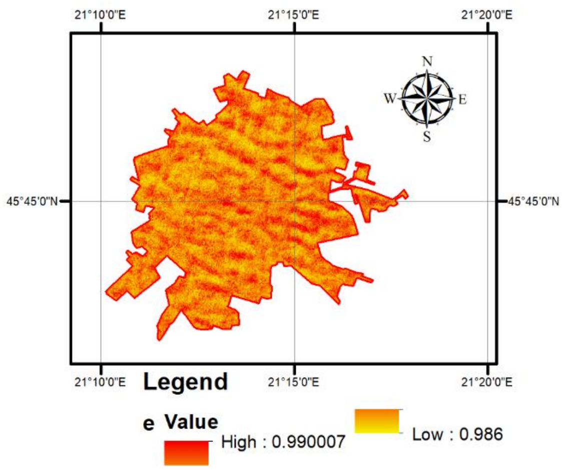
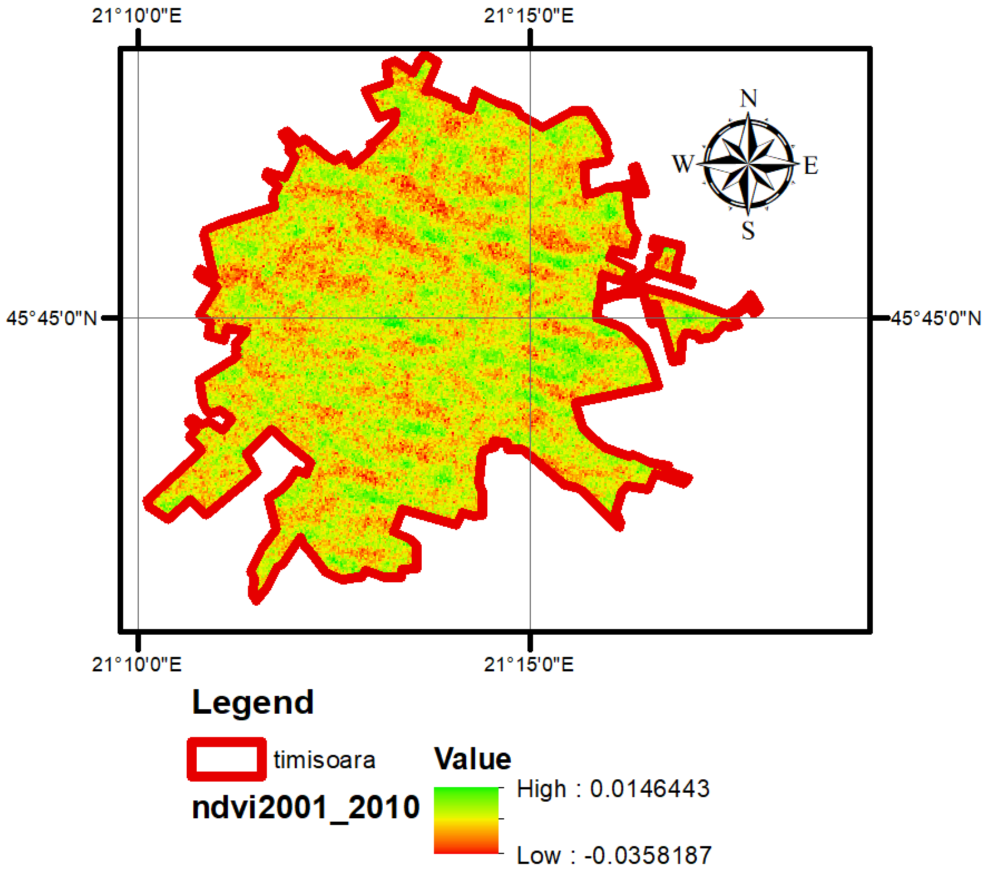


Figure 3. Emissivity map of TIMISORA


21°10'0"E
21°15'0"E
45°45'0"N
N
W
E
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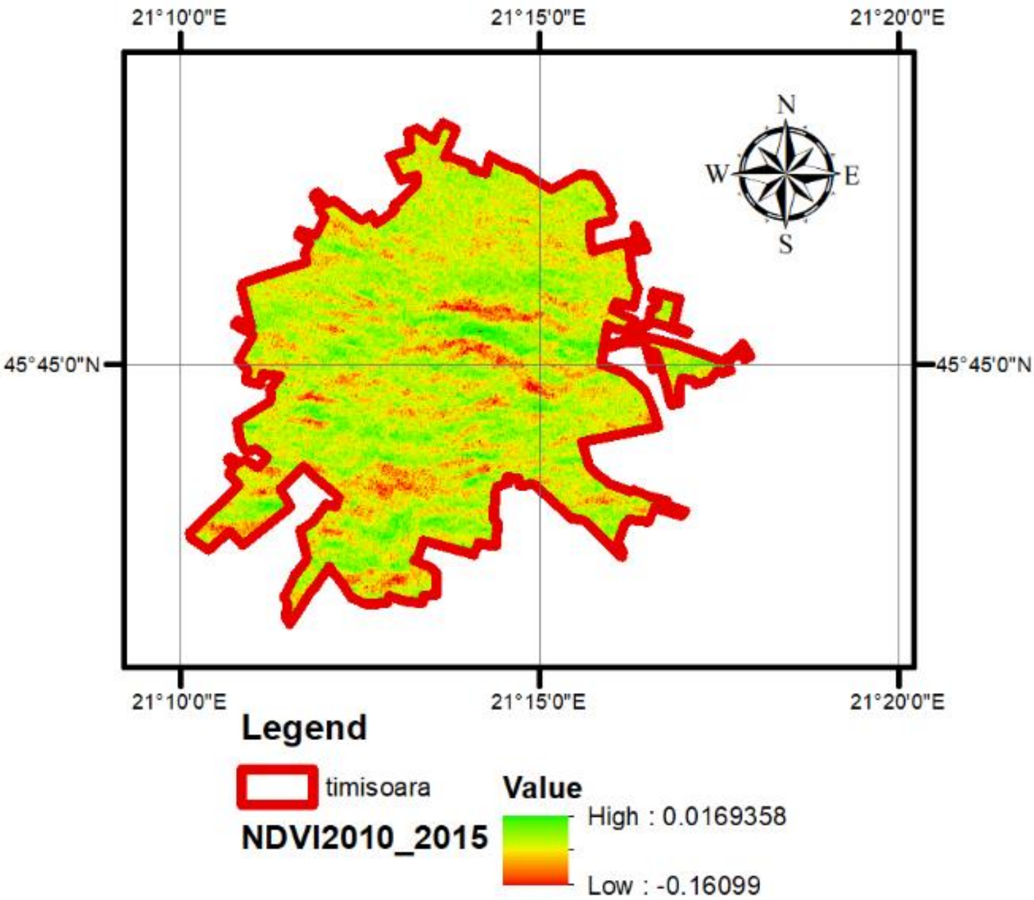
Legend
timisoara
Value
ndvi2001_2010
High : 0.0146443
Low : -0.0358187


21°10'0"E
21°15'0"E
21°20'0"E
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timisoara
Value
NDVI2010_2015
High : 0.0169358
Low : -0.16099

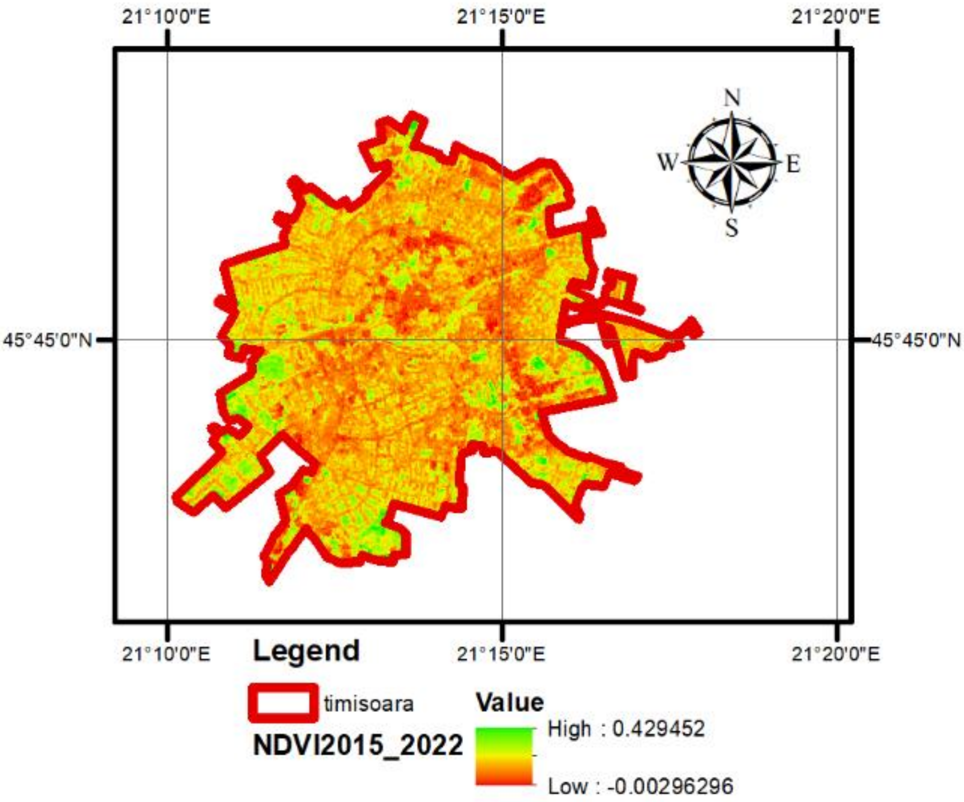


Figure 4. NDVI of TIMISORA county. NDVI for 2001 – 2010; NDVI for 2010 -2015; NDVI for 2015 -2022

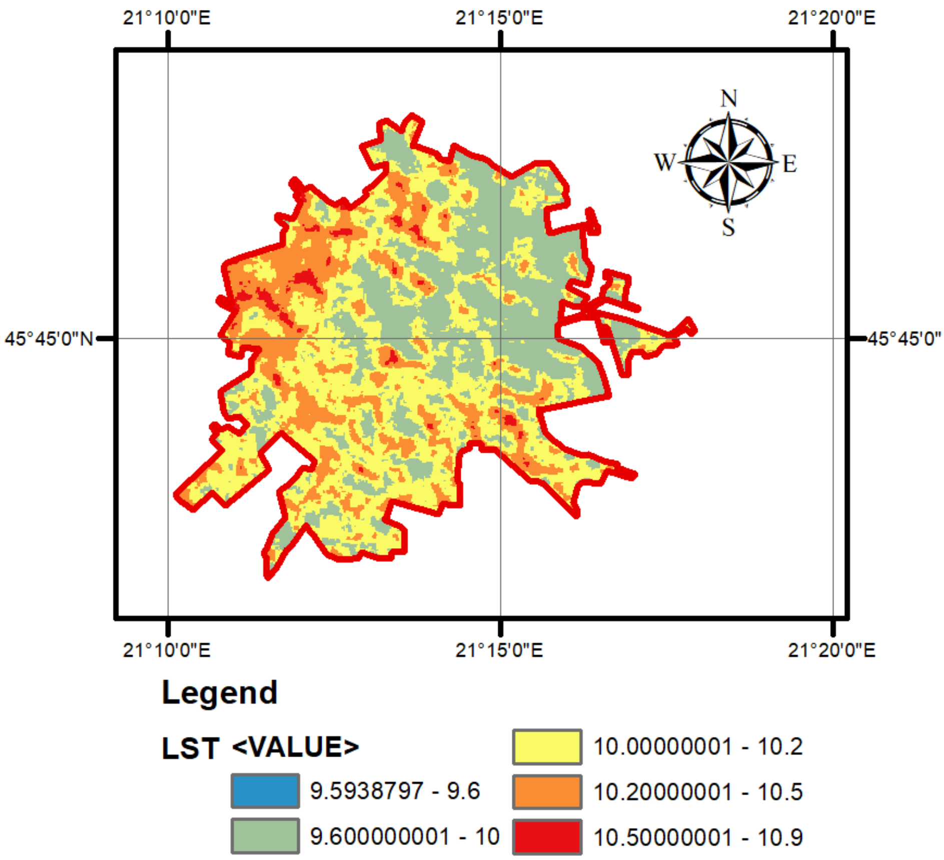


Figure 5. LST map of TIMISORA

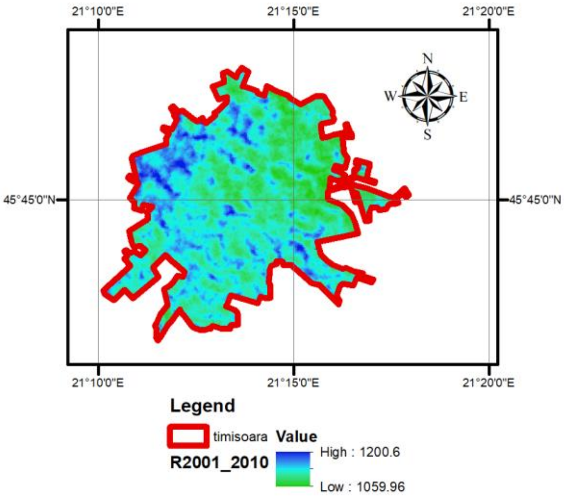


Figure 6. The spectral radiance map

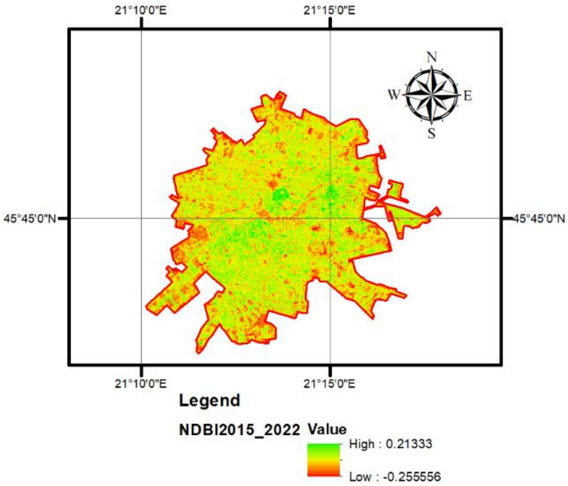
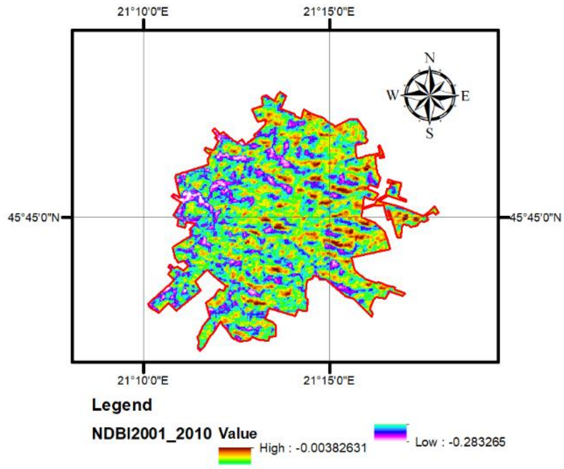
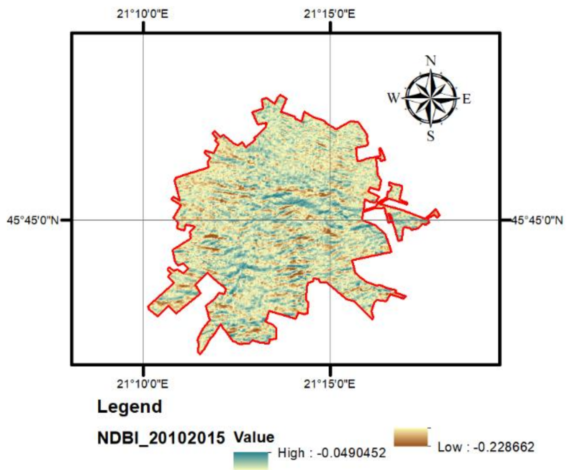


Figure 7. NDBI of TIMISORA county. NDBI for 2001 – 2010; NDBI for 2010 -2015; NDBI for 2015 -2022





The main objective of this study was to determine the LST trend in the period 2001-2022 1999 for the city of Timisoara. Recently, there has been an interest in understanding the dynamics of land cover change and its relationship to several environmental parameters. Therefore, the analysis of these LST, NDVI and NDBI parameters (Figures 5, 6 and7) in this study shows a connection with the land uses in the analyzed area. The study observed that the pattern and values of the three parameters varied accordingly with changes in land cover. The increasing of LST in the study area is associated with the declining of vegetation cover and increasing of bare land. Due to the existence of substantial vegetation cover, is obtained a low LST.

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