2nd International Electronic
Conference on Remote Sensing

ANADOLU UNIVERSITY

Urban Heat Island Analysis Using Landsat 8 A Case Study in Skopje, Macedonia

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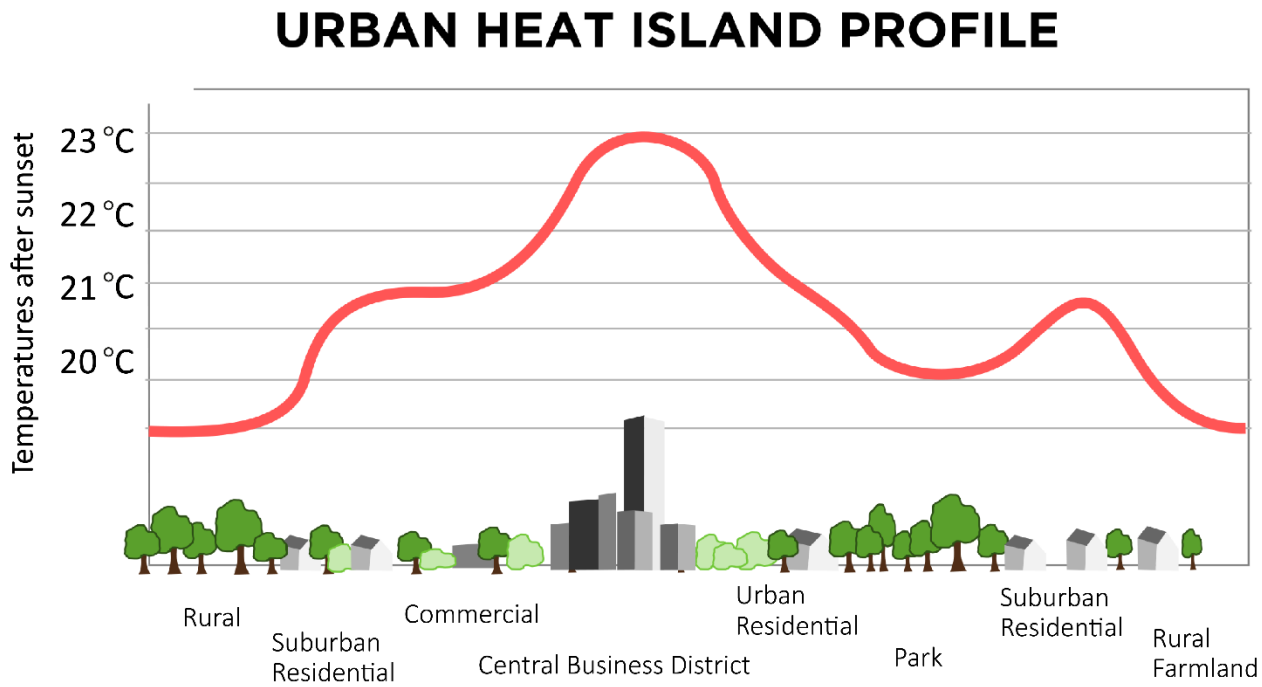
Overview

- ✓Introduction
- ✓Study Area
- ✓Methods
- ✓Results
- ✓Discussion and Conclusion

Introduction

Urbanization is one of the most significant contributors to **global warming.** The growth of population and urbanization has caused the phenomenon of Urban Heat Islands (UHI) which can be described *as the alteration of temperatures in urban areas compared to their rural surroundings.*

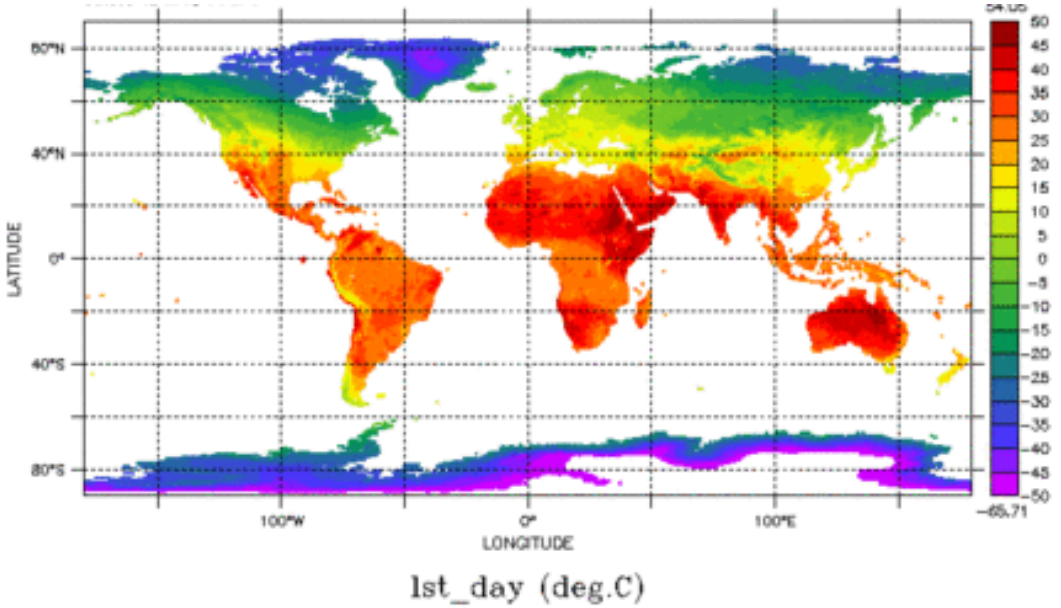


http://www.metlink.org/other-weather/urban-heat-islands/urban-heat-island-background/

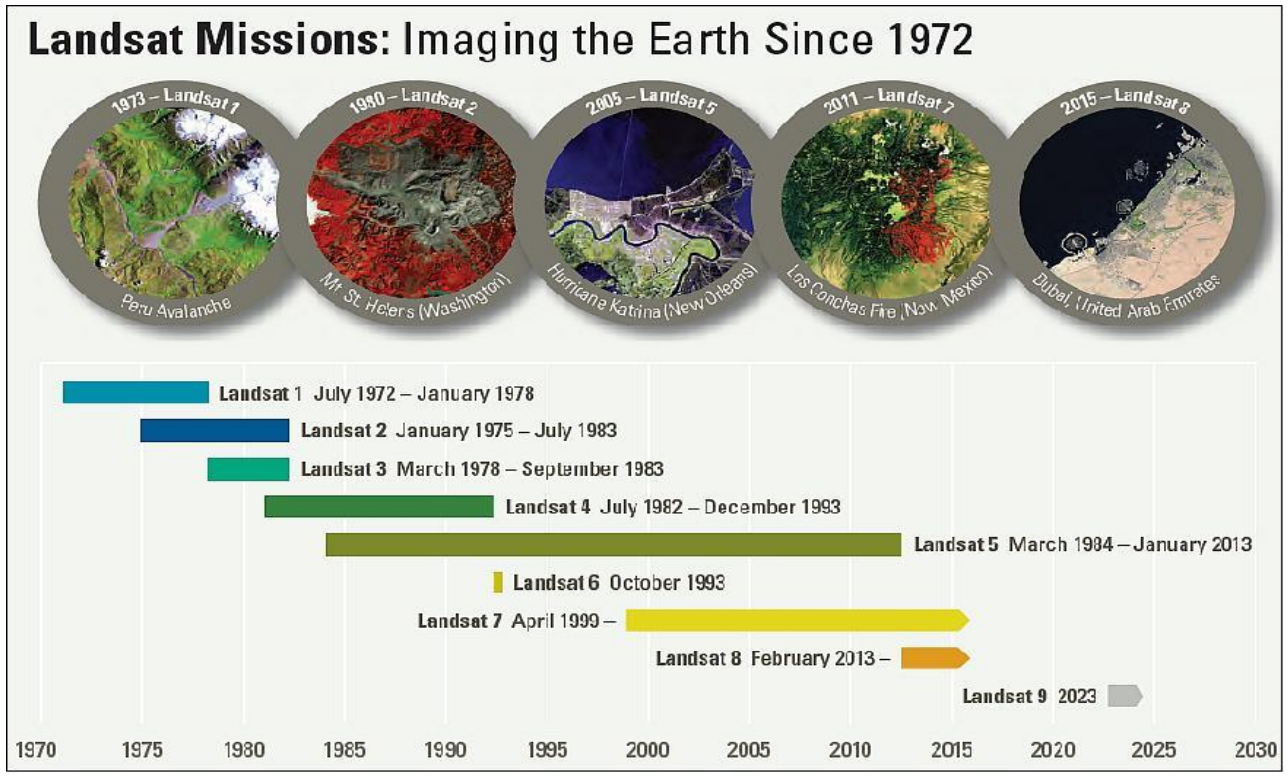
Remote Sensing and UHI

Different Remote Sensing instruments have been used in UHI studies as:

The Moderate Resolution Imaging Spectroradiometer – MODIS, Landsat Thematic Mapper, Landsat ETM+, Landsat OLI/TIRS, ASTER , as well as their combined use.

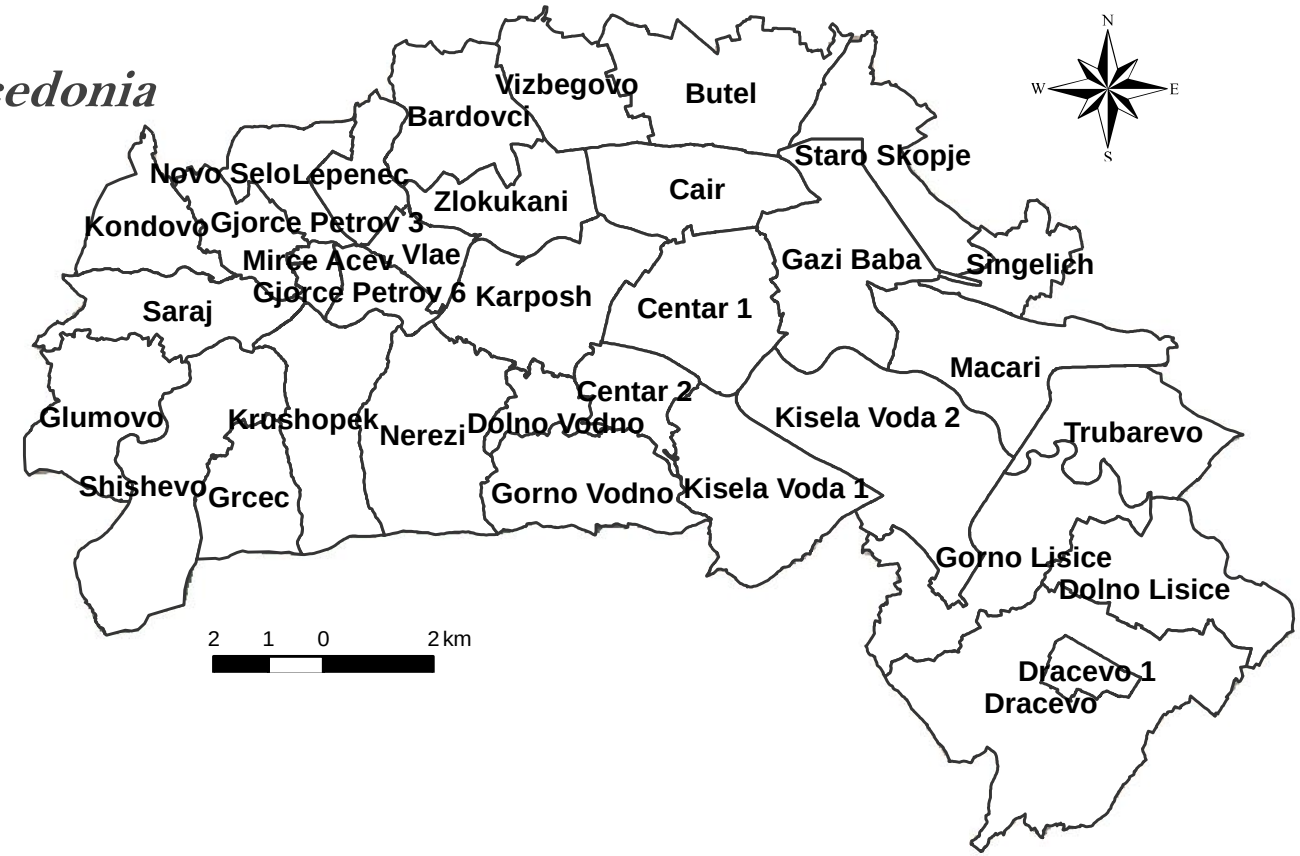


Using remote sensing techniques, various vegetation indices can be obtained and used in the assessment of vegetation cover. Land Surface Temperature (LST) is defined as the temperature felt when the land surface is touched with the hands or the skin temperature of the ground. The Normalized Difference Vegetation Index (NDVI) has been widely used for vegetation extraction. Higher NDVI values indicate higher vegetation area in a pixel. For extraction of urban areas, Normalized Difference Built-up Index has been widely used. Building a connection between the land cover and LST can be valuable for urban climate studies.



Study Area

- ***Skopje*** is the capital of the ***Republic of Macedonia*** located in the center of the Balkan Peninsula.
- The population of ***Skopje*** is estimated to be more than 700.000.
- In the last few decades, the urban area of ***Skopje*** has been significantly expanding.



Study Area

- ***Skopje*** has been built in the ***Skopje Valley***

along the riverbed of ***Vardar***.

- ***Skopje*** covers an area of 1818km2, 23km in

longitude and 9km in latitude and is situated on a height of 245 meters above the sea level.

http://www.dronestagr.am/urban-city-skopje-macedonia/

Data and Methods

Two Landsat 8 satellite images (Path 185 and Row 31) from July 2013 and July 2017 have been downloaded from the USGS webpage.

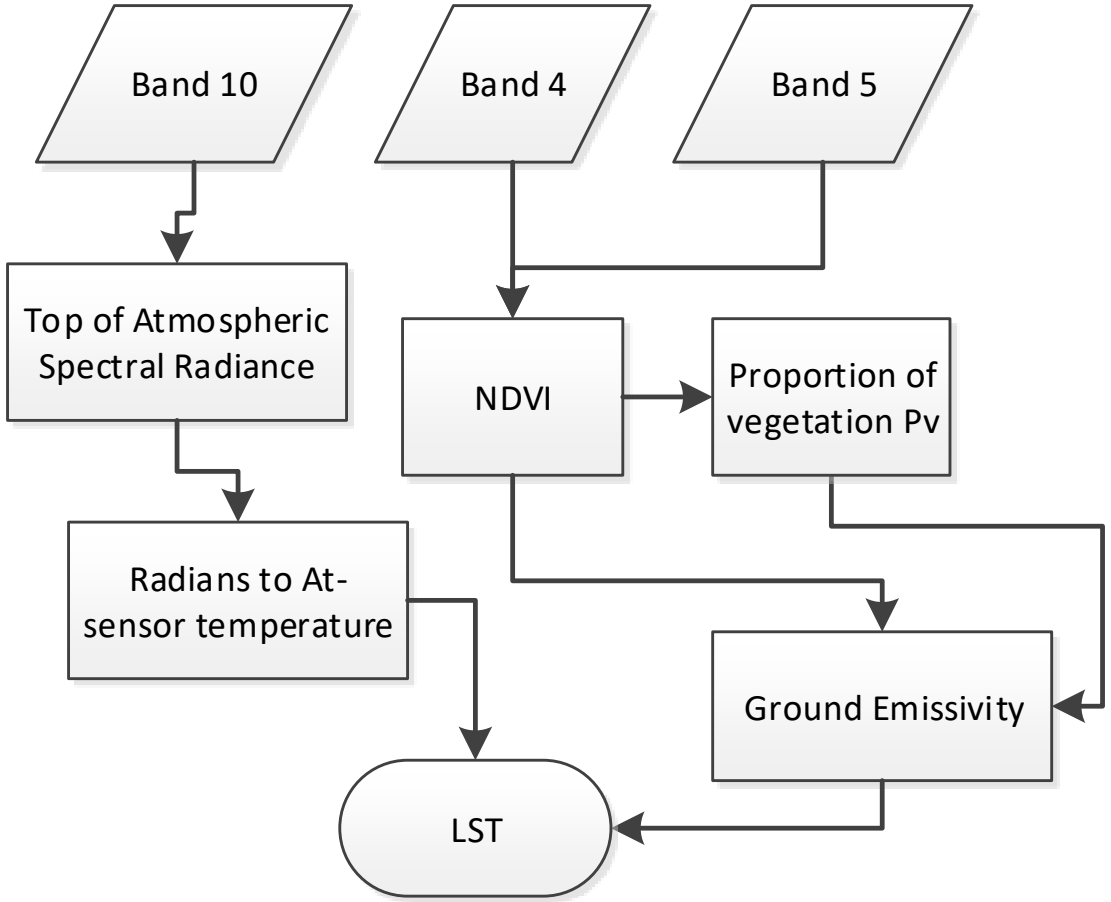
The UHI were extracted with the following formula:

$$UHI = \mu + \frac{\sigma}{2}$$

Where μ is the mean Land Surface Temperature LST value of the study area, and σ is the standard deviation of the LST. For analyzing the UHI changes in the study area, Normalized Difference Vegetation Index NDVI and Normalized Difference Built-up Index NDBI were applied in order to determinate the correlation with the LST results.

$$NDBI = \frac{MIR-NIR}{MIR+NIR} \qquad NDVI = \frac{NIR-Red}{NIR+Red}$$

Land Surface Temperature



Flowchart of the Land Surface Temperature Algorithm

Results

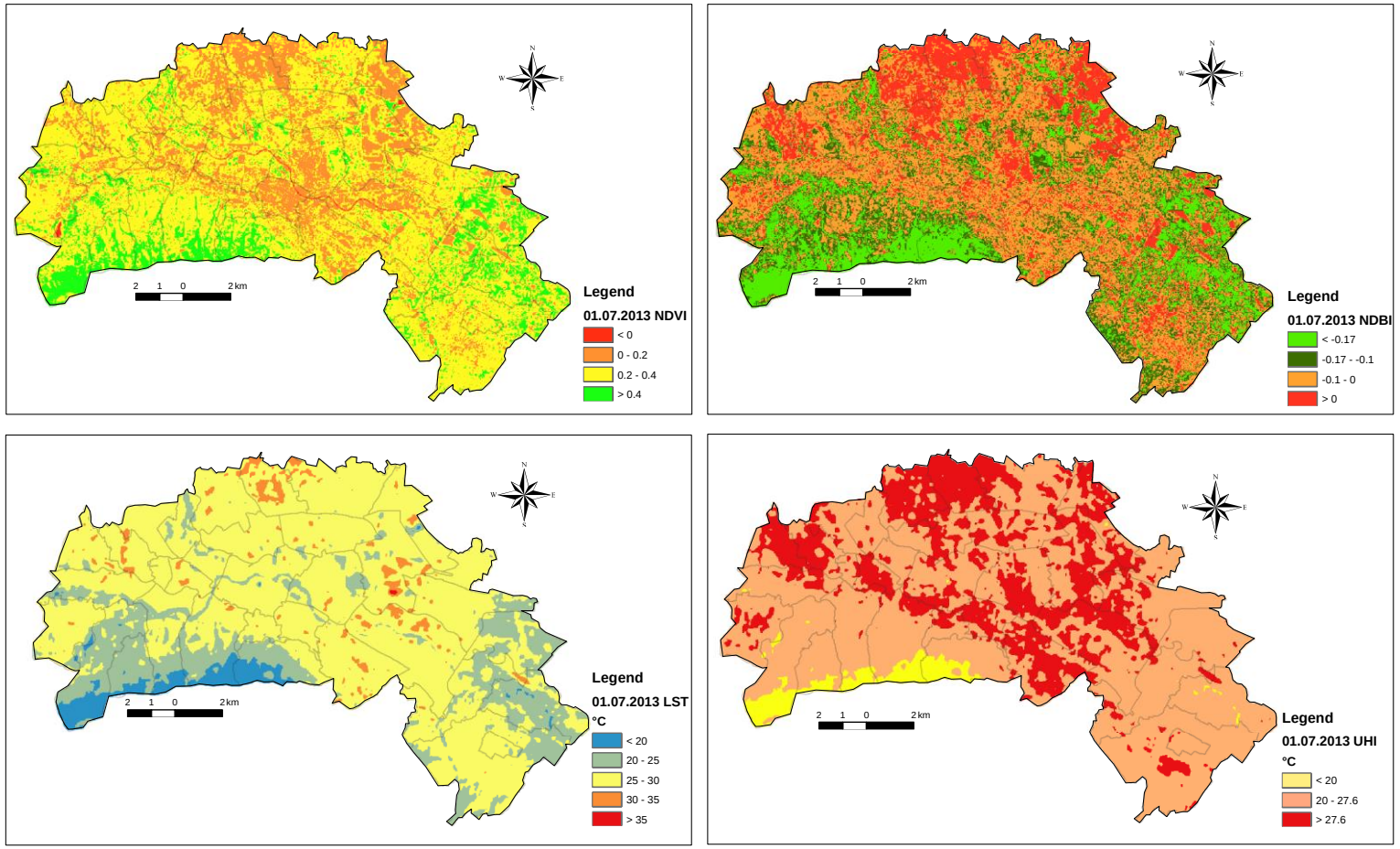


Figure 1. Results for 01 July 2013

Results

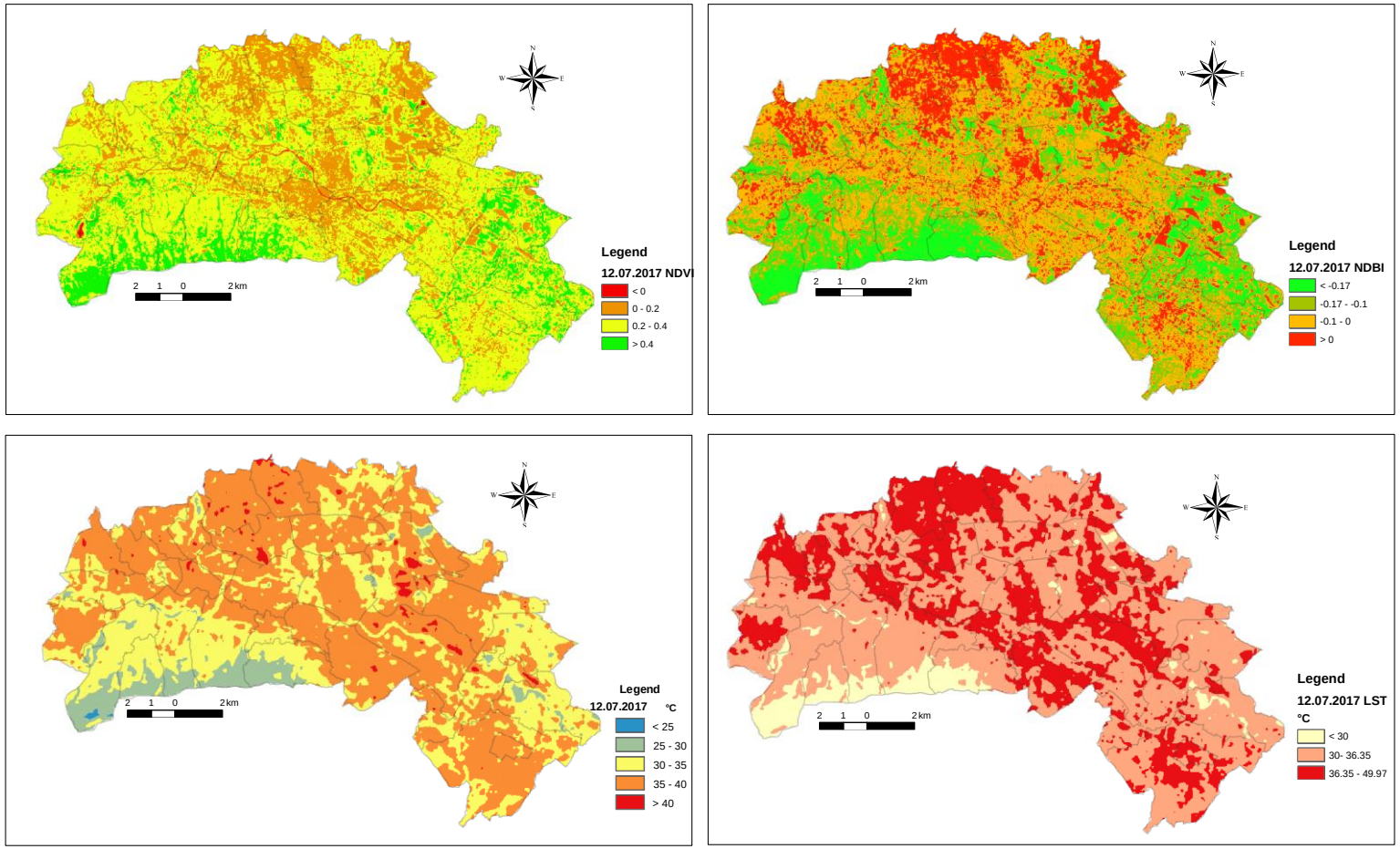


Figure 4. Results for 12 July 2017

Results

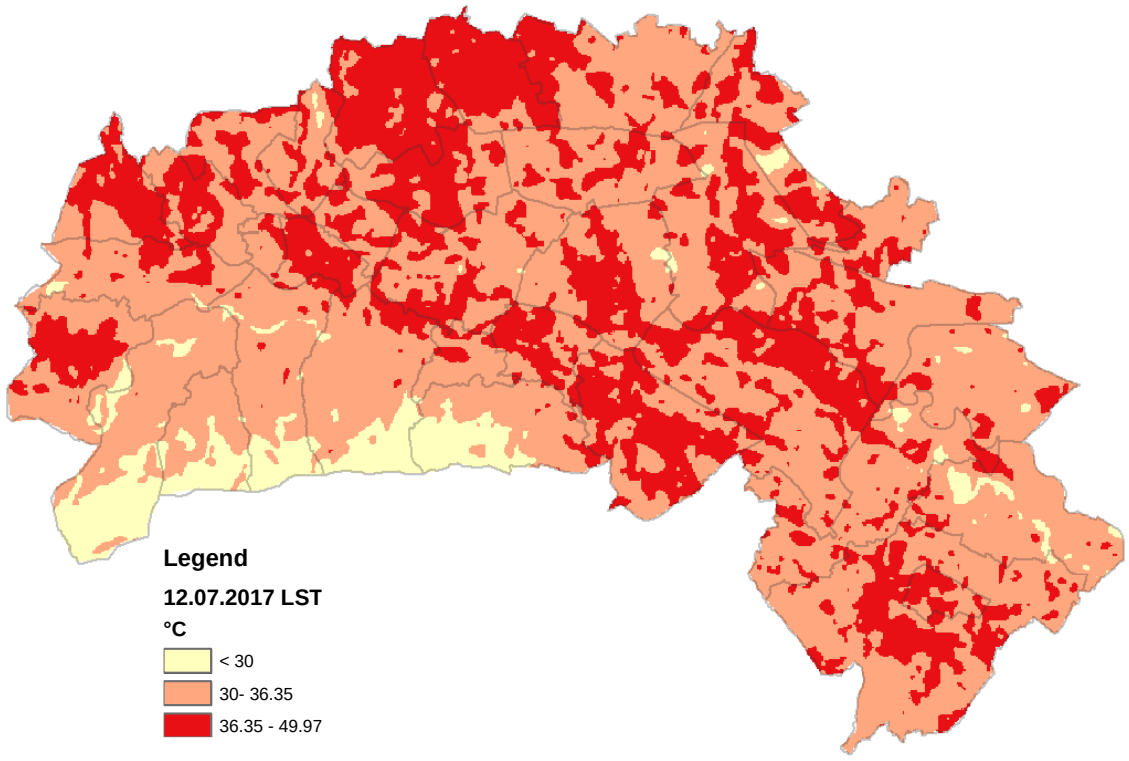


Table 2. Results of the correlation coefficient between LST, NDVI, and NDWI

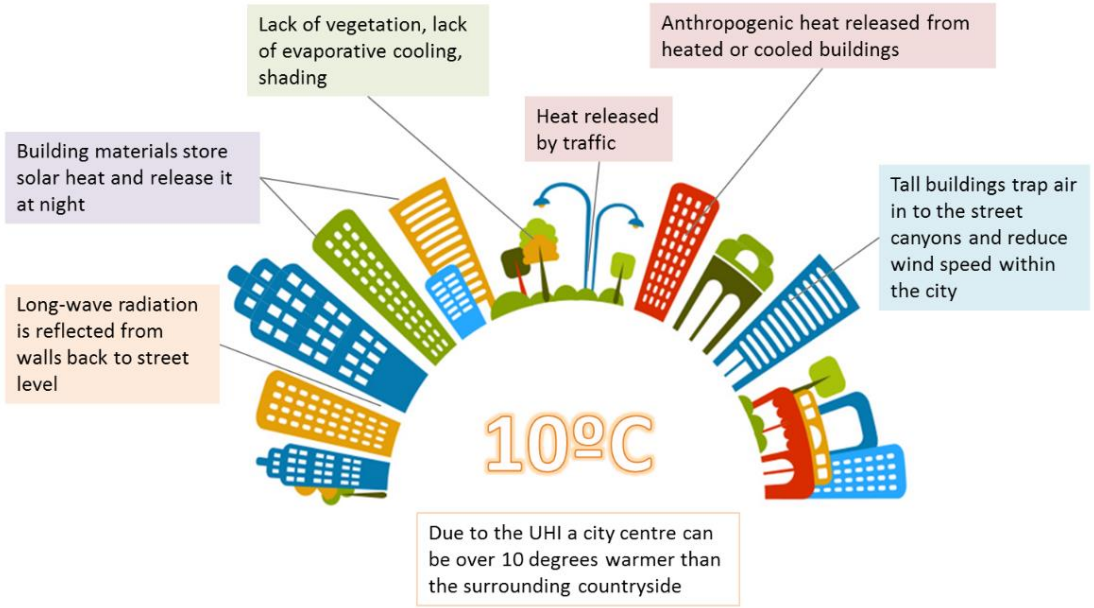
Year	LST-NDVI	LST-NDBI
2013	-0.63	0.67
2017	-0.59	0.64

Table 3. 2013 – 2017 UHI comparison

Year	Study Area (km²)	UHI area (km²)
2013	130	51
2017	130	55

Discussion

Negative correlation between LST and NDVI indicates that the green areas can weaken the effect on urban heat island, while the positive correlation between LST and NDBI means that the built-up land can strengthen the effect of urban heat island in the study area.



http://blog.nus.edu.sg/e0014690/2016/09/16/an-insight-into-the-urban-heat-island-effect/

Conclusion

- Global climate change is expected to raise the occurrence of urban heat island effects;
- Land use/cover has relationship with LST that can help in land use planning;
- Lower LSTs usually are found in areas with high NDVI;
- In order to reduce UHI effects, local governments should increase the green areas in the intensive populated urban areas.

http://www.eurosense.com/documents/your-application/energy-environment-agriculture/urban-green-monitoring.xml?lang=en-gb

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Thank you for your attention!

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