



Investigating urban heat islands in relation to land use (case study: Sanandaj)

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Abstract

Increasing population growth (including natural increase and migration) and rapid industrial growth is one of the main causes of climate change in the world. Today, the most important problem in urban areas is the increase in the temperature of the earth's surface due to changes in natural levels. In urban areas, depending on the type of land use and vegetation, there are areas with different temperatures from other areas. In this research, in order to answer how the types of urban uses affect the creation of high temperature areas and with the aim of knowing the temperature difference of different areas of the city and the surrounding suburbs in order to prepare a map of the heat island area in Sanandaj city, the amount of emissivity and the temperature of the ground surface in the city. Sanandaj was estimated using Landsat 8 satellite data using the Jenks method in summer and autumn.

For this purpose, Arc GIS and Envi software were used, and finally, the surface temperature changes obtained were evaluated according to the types of land uses, and the role of each land use in creating the land surface temperature was determined. The results of the research showed that barren, industrial and urban facilities have the highest temperature and commercial uses and green spaces have the lowest temperature, as a result, it determined the effect of urban uses on the emergence of the current thermal conditions of Sanandaj city, which shows the relationship between the type of use and the level of surface temperature.

Keywords: thermal island, Sanandaj, land use, Google Earth Engine

1.Introduction

With the development of urbanization, large amounts of agricultural and forest areas have been replaced by urban areas, industrial areas and other infrastructures. The increase in population, the increase in pollution caused by industries and the increase in car traffic causes the temperature of some urban areas to increase compared to other

areas, so in urban areas, depending on the land cover, there are areas with higher temperatures than other areas, which is called Urban Thermal Island has been named. Investigating the dispersion of thermal radiation and its relationship with the types of uses is very important in understanding the microclimate of urban areas. During the last two decades, the great need for earth surface temperature information has turned remote sensing into one of the most important scientific topics. Studies show that the role of thermal remote sensing is very important for studying the effects of urban heat islands. Thermal remote sensing data has provided the possibility to dynamically monitor and evaluate urban heat islands.

Until recently, urban areas occupied only 2% of the earth's surface area, but today, urban areas constitute the most dominant human landscapes and have significant effects on local and global ecosystems. In today's era, urbanization has become very prosperous and this has caused the earth to be affected by various issues and to lose its natural state to a great extent, one of the consequences of which is the increase in temperature. With the expansion of the city and urbanization, especially after the Second World War, local climate changes appeared in urbanization. In the 20th century, urbanization happened at a high speed on a global scale. According to United Nations estimates, almost half of the world's people live in cities. In western societies, this figure reaches more than 57% (United Nations), the most important problem in urban areas is the increase in the temperature of the earth's surface due to the changes in natural levels, the unbridled and unplanned growth of cities. Especially the big cities of the country, which is caused by the natural growth of the urban population, the increase in rural migration, etc., has led to an increase in the destruction of the environment and an increasing number of types of pollution. Urbanization has changed the types of land cover in urban areas, which has caused the formation of a distinct climate, which is called urban climate. Urban warming is one of the most well-known forms of local climate manipulation by humans, so that the changes the use of land cover in urban areas can lead to an increase in temperature in urban areas compared to the air temperature in surrounding rural areas. The temperature of the earth's surface can provide useful information regarding the physical characteristics of the earth's surface and climate, which play a significant role in environmental processes. The heat island effect was first observed in London and other European cities, followed by it was seen in cities like New York and Chicago. The mentioned phenomenon is now considered an important environmental phenomenon and wherever there are large cities, the heat island effect can also be seen. Urban areas are hotter than the surrounding rural areas for two reasons:

- 1) First, the structure and morphology of the city has the capacity to absorb and store significant net solar radiation, especially in calm and clear summer weather conditions. This leads to the creation of nighttime heat on the city center (commercial area) and the formation of a heat island in the summer season. The commercial center of big cities can be 6 to 8 degrees Celsius warmer than their suburbs.

- 2) Second, large heat islands are created due to the release of heat by human activities ca...

2. Materials and method

Sanandaj, the center of the border province of Kurdistan and the center of the city of the same name, located in the west of the city of Sanandaj, with the geographical coordinates of 45,59,46 east longitude and 35,00,19 north latitude, and an altitude of 1480 meters, with a moderate climate that tends to be cold and semi-arid and with the average rainfall is 480 mm, confined to the heights that almost surround the city. The highest of these mountains are: Kochksar (2946 meters), Abider Bozor (2550 meters), Sheikh Maruf (2895 meters) and Youssef Siah Mountain (2550 meters). These heights have become the origin and bed of many streams and rivers that flow around the city, including Qeshlaq, Qezl-Ozen, Ab Sirvan and Gaveh Rood. 3 The distance between Sanandaj and Tehran is 501 km by land and 391 km by air. 5 This city is connected with other cities of the province as well as neighboring provinces by paved roads, and it is about 80 km away from the border of Iraq in a straight line on the map, Siyarem, Kurd Kook is mentioned.

Sanandaj city is bordered by Divandere city from the north, Qorveh city from the east, Kamiyaran city from the south, Marivan and Sarovabad cities from the west, and based on the latest country divisions, this city has 2 divisions, 2 cities and 10 villages.

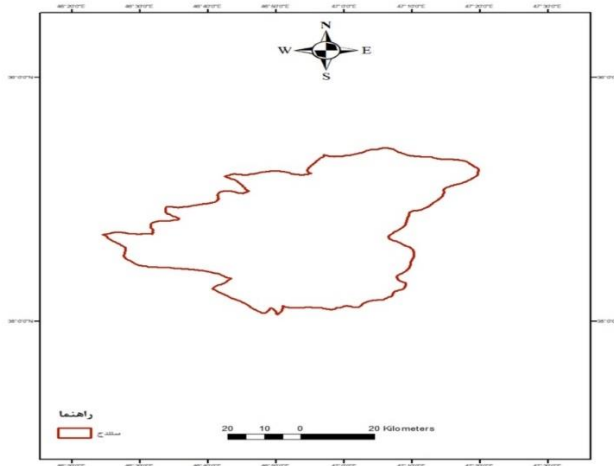


Figure 1- Geographical location of Sanandaj city

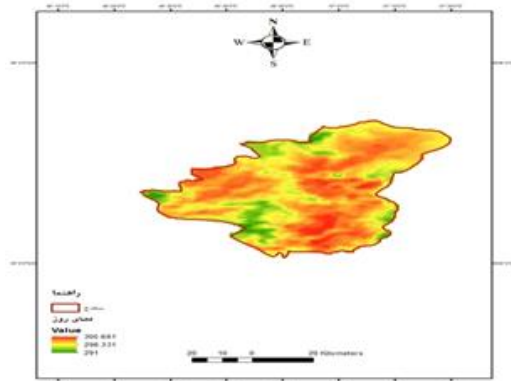


Figure 2- Day temperature map

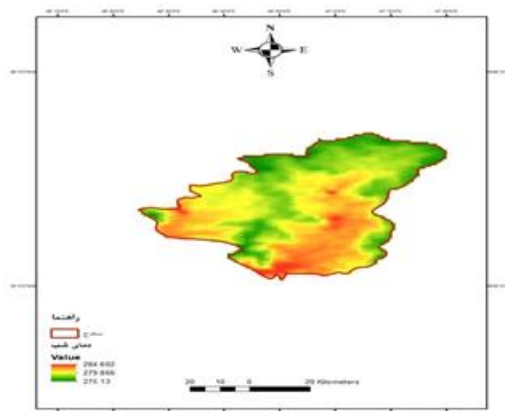


Figure 3- Night temperature map

Then night and day temperatures were compared. Finally, the monitoring map of Sanandaj thermal island was prepared

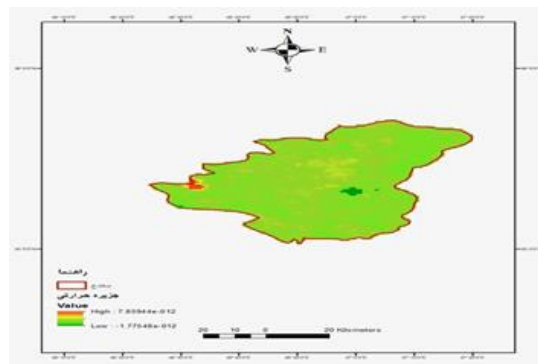


Figure 4- Monitoring map of heat islands

3. Conclusion

Figure 1 Studies show that the role of thermal remote sensing is very important in studying and estimating the temperature of the earth's surface. Earth's surface heat is an important indicator in the study of energy balance models on the earth's surface on a regional and global scale. Due to the limitation of meteorological stations, remote sensing can be a suitable alternative for estimating the temperature of the earth's surface. The main purpose of this research was to monitor the temperature of the earth's surface and investigate the land use relationship. The increase in the temperature of the earth's surface and the formation of thermal islands in the areas that have become cities or metropolises without prior planning is one of the basic environmental problems. Among the methods of studying the temperature of the earth's surface are modern remote sensing methods. Studies show that the role of thermal remote sensing is very important in studying and estimating the temperature of the earth's surface. Thermal remote sensing data provides the possibility to check and estimate the temperature of the earth's surface as well as heat islands. Among the remote sensing thermal data, satellite images have a special place, and images such as Landsat, Esther, Madis, etc. can be useful in estimating the temperature of the earth's surface due to having thermal bands. But in general, it should be stated that there is a strong relationship between vegetation and the temperature of the earth's surface, such that the areas with vegetation have the minimum temperature and the areas without vegetation have the maximum temperature, which shows the role and importance of vegetation in the region.

Heat island is the result of urban climate and one of the important environmental challenges in the 21st century. Increasing population growth (including natural increase and migration) and rapid industrial growth is one of the main causes of climate change in the world. Today, the most important problem in urban areas is the increase in the temperature of the earth's surface due to changes in natural surfaces. In urban areas, depending on the type of land use and vegetation, there are areas with different temperatures from other areas. In this research, in order to answer the effect of various types of urban uses in creating areas with high temperature and with the aim of knowing the temperature difference of different areas of the city and the surrounding suburbs in order to prepare a map of the heat island area in Sanandaj city, the surface temperature of the ground in Sanandaj city using Satellite data was estimated. Finally, the surface temperature changes obtained will be evaluated according to the types of land uses and the role of each land use in creating the land surface temperature will be determined. So far, an attempt has been made to explain and investigate the interaction of land use and thermal island with a preliminary statement. In this context, in the first three chapters, the assumptions, objectives, background and basics of the research were stated. In this chapter, the necessary data were prepared and processed in order to analyze the results of these data in the next chapter.

Based on maps of temperature classes and land use, as well as spatial and temporal temperature changes according to land use changes in the city of Sanandaj, here to improve the temperature distribution in the city, as well as reduce and adjust the surface temperature in critical areas and islands. Thermal suggestions are provided as follows:

Due to the fact that vegetation has a reducing effect on the temperature of the surrounding environment. green roofs; that use natural vegetation on the roofs will reduce heat accumulation in buildings. As a result, the creation of green spaces such as parks can help reduce the temperature of the urban environment and the creation of green spaces throughout the city can moderate the urban atmosphere and help purify the city's air. Narrow and narrow streets in some densely populated areas of Kerman city. It has prevented the easy flow of wind to circulate and moderate the air, so to solve this problem, it is better to add fog to the width of the sidewalks. It is better to divide green spaces according to the quality of vegetation and trees in order to approach the real standard of green spaces in the urban environment.

Water cover, like vegetation, moderates the temperature in the city, so measures must be taken to create water levels in Sanandaj city.

Using more meteorological stations in the city of Sanandaj for more accurate monitoring of temperature. Studying other effective parameters in creating heat islands in Sanandaj such as population, type of urban structures, height of buildings and urban traffic

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