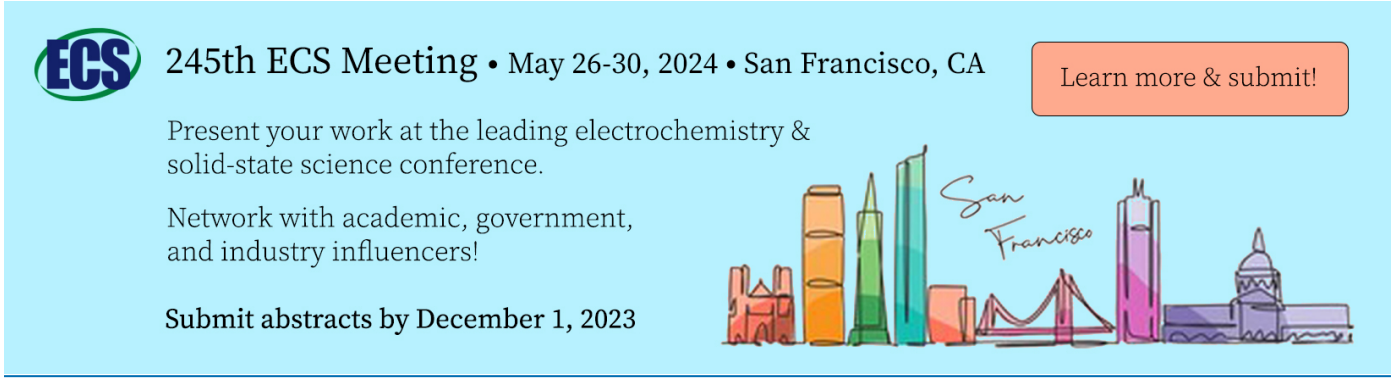
# Monitoring the Land surface temperature LST with different seasons for Babylon City using GIS and R.S techniques





# Monitoring the Land surface temperature LST with different seasons for Babylon City using GIS and R.S techniques

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**Abstract.** This paper is based on the Sentinel-2 satellite data: the thermal, red, and NIR bands. The Babylon city was chosen in this study for different reasons: its location in the middle of Iraq and it represents the largest capitals of the Mesopotamia civilization in the word. The Land Surface Temperature (LST) was determined using a method that incorporates remote sensing, geographic information systems, and statistics. This process has made it possible to monitor the relationship between land usage and the land surface temperature for four seasons in the year 2021. The mapswere processed and analyzed by using ArcGIS software. Five maps of the LST were constructed. Each map represents different season, however, two maps in summer was introduced because it represents the longest and more effective season in Iraq. In these maps, the lowest LST appears in the water bodies and vegetative area while the arid areas showhighest values. From the results,the mechanical, military, industrial, transport and road enterprises have a significant influence on the exterior of earth temperature particular in center city where the high temperatures in contrast to the areas that include water bodies or agricultural activity.

**Key words**: LST, GIS,Remote sensing , Babylon City

## 1. Introduction

Sentinel-2 satellite is a component of the European Copernicus initiative, which the European Space Agency established (ESA). Sentinel 2 is equipped with a multispectral sensor that has 13 spectral features, including six at 20 m, four at 10 m, and three at 60 m. The orbital route is 290 km wide [1, 2]. Two twin satellites, Sentinel-2A and Sentinel-2B, are part of the Sentinel-2 mission and provide visual data with a range from visible to near and mid-infrared at various spatial resolutions. The time between visits ranges from 5 to 10 days [3,4]. The Sun's electromagnetic energy is reflected, transmitted, or absorbed as it reaches the surface of the Earth. The principle the fact that various types of targets (such as soils, water, rocks, and plants) interact with incident radiation in unique and distinctive ways, each of which is defined by the target's spectral, which is used in remote sensing.
Several factors affect any target's spectral reaction. As an illustration, consider the topography of the ground surface, the direction and height of the sun in the sky (solar elevation angle), the direction the sensor is facing in reference to the peer, and the condition of the vegetation in case that it is the target, and the circumstance of the atmosphere [5,6].

## 2. THE RESEARCH AREA

Babylon located middle Iraq, surrounded by provinces Karbala, Baghdad, Al-Muthana, and the city of Wasit, and the great Euphrates River passes from its north to its south. It has an area of approximately 5119Km$^2$ , with population about 2,165,042[4].

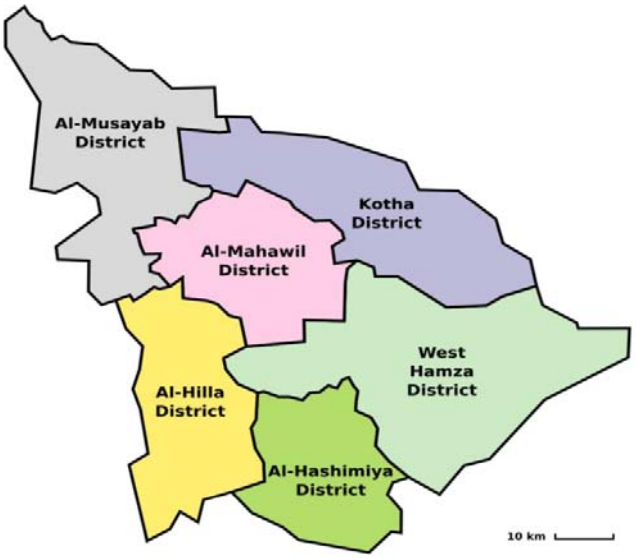


**Figure (1):**The Map of Babylon city with important districts.

## 3. THECONCEPTS

The flow chart in The research's method is displayed in Figure (2). The infrared wavelength that has been detected is roughly between (0.70 and 100) m [7], which is a hundred times more than the obvious component. To study the properties of the infrared radiation, both of the reflected infrared, emitted and thermal infrared regions have to be focused on. One application of the reflected infrared radiation range (0.7 – 3.0) μm is in the remote detecting, as can be used to determine the radiation from the route in the obvious segment. Although the warm infrared region shows different altitude from the obvious local and the reflected one, as this vitality is fundamental to transmitted radiation from the warmer regions of the earth surfaces, and this spans range (3.0 – 100) μm [8].

## 4. NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI)

The vegetation cover can be investigated in many vegetation procedures by the remote sensing images. A number is represented by an vegetation record that is created by combining various remote sensing sets. The Normalized Difference Vegetation Index is the standard measure of plant cover used around the world (NDVI). Two bands (Red close infrared (NIR)) were used to determine the( NDVI)[9].

### 4.1 CALCULATE OF EMISSIVITY

The surface ofthe emissivity represents the essential parameter todetermine the long wave radioactive budget[10].

i. The assumed dominant land cover for each pixel is known.
ii.The emissivity of each pixel in the image can be determined.

### 4.2 THERMAL ESTIMATION OF THE LAND SURFACES (LST)

Pictures from the Sentinel 2 satellite were used to estimate the Earth surface temperature (LST) for different seasons in 2021, to evaluate the mud surface temperature (LST). All processesweredone with the ArcGIS 10.3.

LST = T/1 + E (T./p) In(e)) ————————- (1)
When:
T.= The satellite's temperature.
E=The emitted radiance of the (11.5 m) wavelength.
P equals (1.438*10-2m.k)h*C/S.
Where:
h =Planck’s Constant
S = The Boltzmann Constant
C = light velocity

e = 0.004 * PV + 0.986--------- (2)
When:
e = the land's surface emissivity.

The following equation was used to calculate the percentage of vegetation:
PV = (NDVI - NDVI min / NDVI max – NDVI min)2 --------- (3)
Where:

Equation 4s NDVI (Normalized Difference Vegetation Index) calculation
NDVI = NIR – R/ NIR + R ---------- (4)[1,10]

## 5. OBSERVATION AND RESULTS

The latter equations were depended to construct maps to the research area's land surface temperature (LST) for locating the necessary characteristics that were previously discussed in the paper. TheArcMap10.3 program based on the mentioned equations, and used the choice of raster calculator for each equation alone. The following flow chart illustrates the research steps (Figure 2).

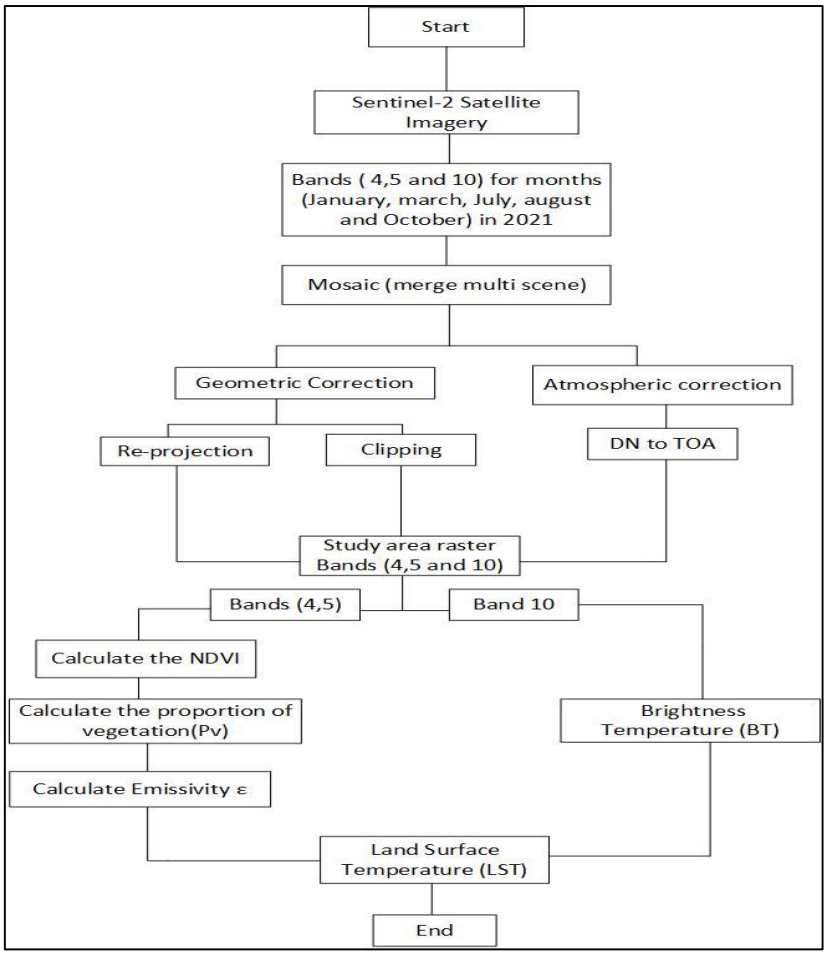


**Figure (2) the flowchart of steps to calculate the LST for Babylon city.**

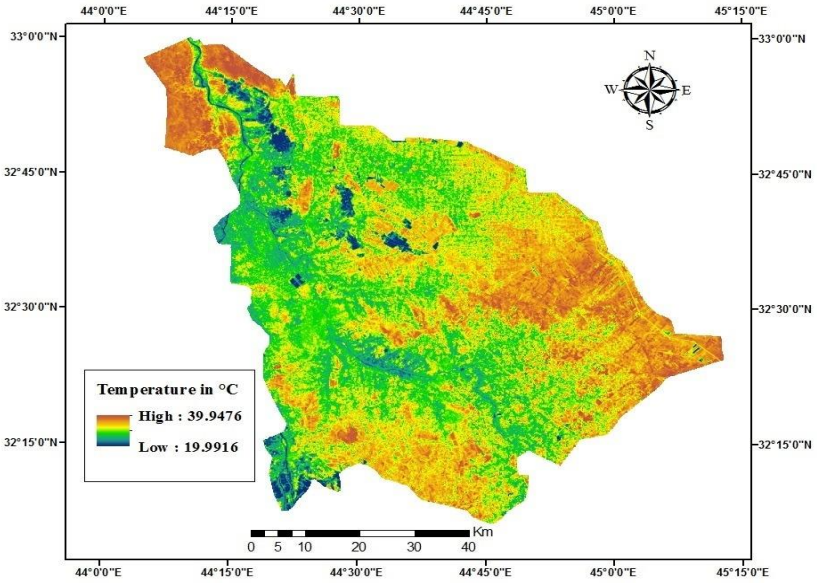


Figure (3) the LST distribution of Babylon city at 15\10\2021

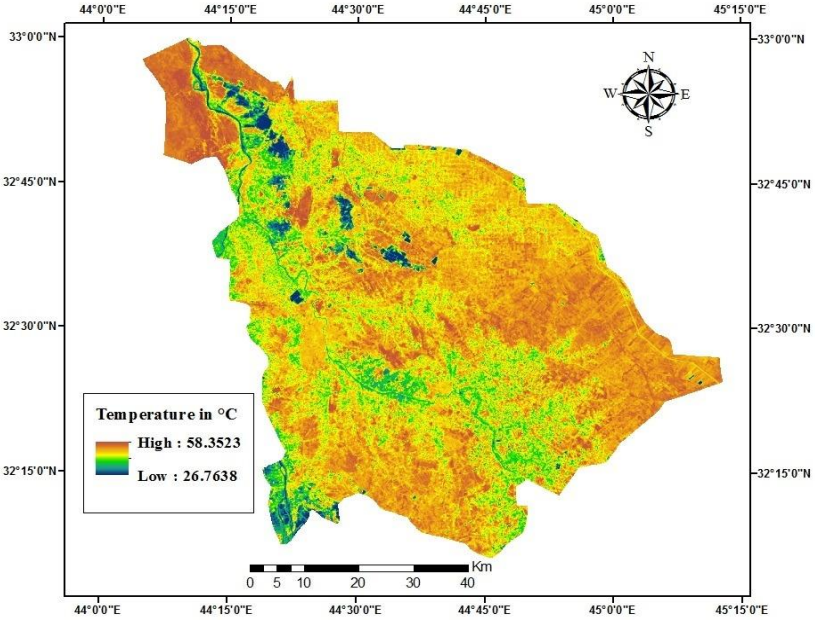


Figure (4) the LST distribution of Babylon city at 15\8\2021

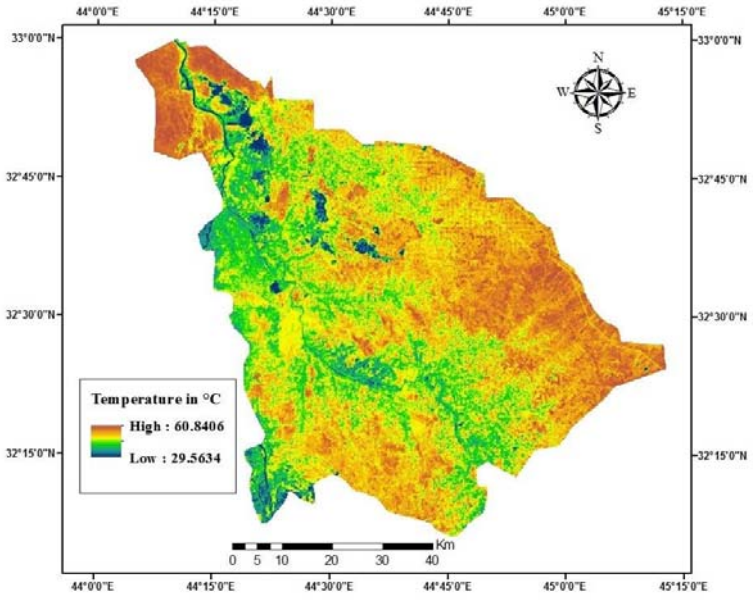


Figure (5) the LST distribution of Babylon city at 15\7\2021.

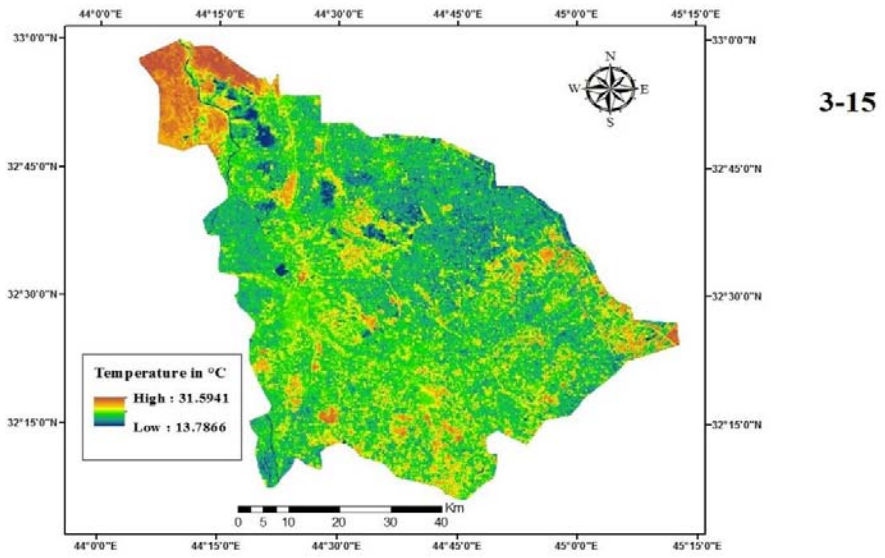


Figure (6) the LST distribution of Babylon city at 15\3\2021.

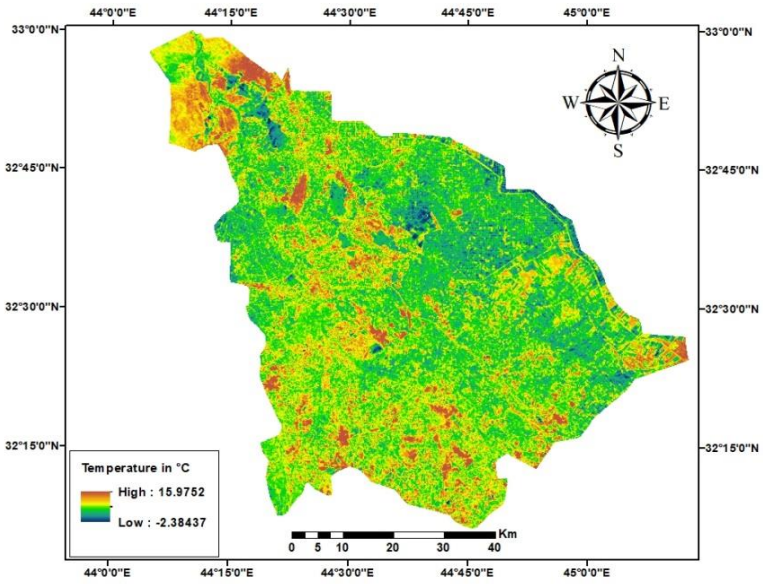


Figure (7) the LST distribution of Babylon city at 15\1\2021.

## 6. The Results and Discussions

The results were concluded in five maps which show the distribution the LST in the Babylon city. These maps represent the LST distribution in autumn (Figure (3)), summer (Figure (4) and Figure (5)), spring (Figure (6)), and winter (Figure (7)). The values of the lower and upper LST in the latter maps were listed in Table (1).

**Table (1): presents the values of the lower and upper LST in Babylon city in four seasons in 2021.**

| Date | Lower value of the LST (C°) | Higher value of the LST (C°) |
|---|---|---|
| 15/10/2021 | 19.9 | 39.9 |
| 15/8/2021 | 26.7 | 58.3 |
| 15/7/2021 | 29.5 | 60.8 |
| 15/3/2021 | 13.7 | 31.5 |
| 15/1/2021 | -2.3 | 15.9 |

The north and north-east areas of the city (Al-Musayab) show the highest LST in autumn, summer and spring, as shown in Figures (3) to (6) respectively. The regions to the east and west-south of the Babylon city in the summer shows a distinctive highin the LST (40 -60) C°, which represent ≈ 80 % of the total area of the city. July showed the highest value of the LST which was about 61 C° in 2021, as shown in Table (1). While in winter, the LST decreased to about – 2 C° in some areas, that represent bodies of water, as shown in Figure (7). Some prominentfacts will be discussed in the followingpoints:

1. In Figures (3) to (6), the lowest LST are observed on the water bodies and vegetative area in each season for Babylon city.
2. Figure (3) as mentioned before that represents the autumn season, we notice from the distribution map of the LST that the highest degree is 39.94 and it is in the residential areas and the arid areas and, while the lowest degree appears in the green and watery areas. Figure (6)shows the map distribution of the LST is similar to the figure (3) which was observed in the third month of 2021 at spring but the LST value shows the lower values.
3. Figures (4) and (5) represent the month 8 and 7 (summer season), that recorded the highest values of the LST.It is clearly that mostof the area with high temperature, accepted to beurban areas.
4.Figure (7) represents the first month in winter seasonthat shows the lowest in maximum and minimum LST recorded.

## 7. Conclusions

1. The environmental indicators the Earth's surface are having an impact the (LST),a temperature urban areas shows greater values than the agriculture regions. The major reason of rise in urban surface land cover temperature is the variation in the composition of the Earth's crust or the transformation in these areas' land usage and cover.
2. The a rise in temperature over time trips causes much harm to urban conditions and also to the occupants. Determine land use efficiency at LST, spatial immobility and spatial autocorrelation to solve the problem.
3. From the Figures (3) to (7), the LST of Babylon city had the greatest value in the seventh month(60.8 $C^{\circ}$) and then the night of the eighth month .As for the lowest value of the temperature, it was in the first month of the year 2021, and it was (-2.38$C^{\circ}$).
4. The results show that mechanical, military, industrial, transport and road enterprises have a significant influence on the earth's surface temperature. This is evident in the central areas of Babylon (the city center), where high temperatures contrast with areas that include water bodies and agricultural areas.

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