MID-TERM ASSIGNMENT

PREPARED BY

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DUE DATE : 07/05/2023

COURSE NAME : REMOTE SENSING II

LECTURER : ASSOC.PROF. ESRA ERTEN

The purpose of this assignment is to make geometric and radiometric corrections on an uncorrected image using the methods taught, using the SNAP applications.

Data Set Attribute	***Attribute Value***	***Data Set Attribute***	***Attribute Value***
Satellite ID	Landast 5	Image acquisition date and time	2007/06/06
Sensor ID	TM	Image Path number	180
Image Scene ID	LT51800312005157MTI00	Image Row number	031
Image Product ID	LT05_L1TP_180031_20050606_20200902_02_T1	Image quality	9
Sun elevation	63.29149694	Sun azimuth	128.65785632
Land Cloud Cover	1.00	Scene Cloud Cover	1.00
Corner Upper Left Latitude	42.70394	Corner Upper Left Longitude	28.24930
Corner Upper Right Latitude	42.38177	Corner Upper Right Longitude	30.45888
Corner Lower Left Latitude	41.12716	Corner Lower Left Longitude	27.75566
Corner Lower Right Latitude	40.81262	Corner Lower Right Longitude	29.91411
Corner Upper Left Lat DMS	42°42'14.18"N	Corner Upper Left Long DMS	28°14'57.48"E
Corner Upper Right Lat DMS	42°22'54.37"N	Corner Upper Right Long DMS	30°27'31.97"E
Corner Lower Left Lat DMS	41°07'37.78"N	Corner Lower Left Long DMS	27°45'20.38"E
Corner Lower Right Lat DMS	40°48'45.43"N	Corner Lower Right Long DMS	29°54'50.80"E

Figure 1 Image of Landsat 5 TM Level 1 satellite with 180 Path and 31 Raw numbers dated May 11, 2007.

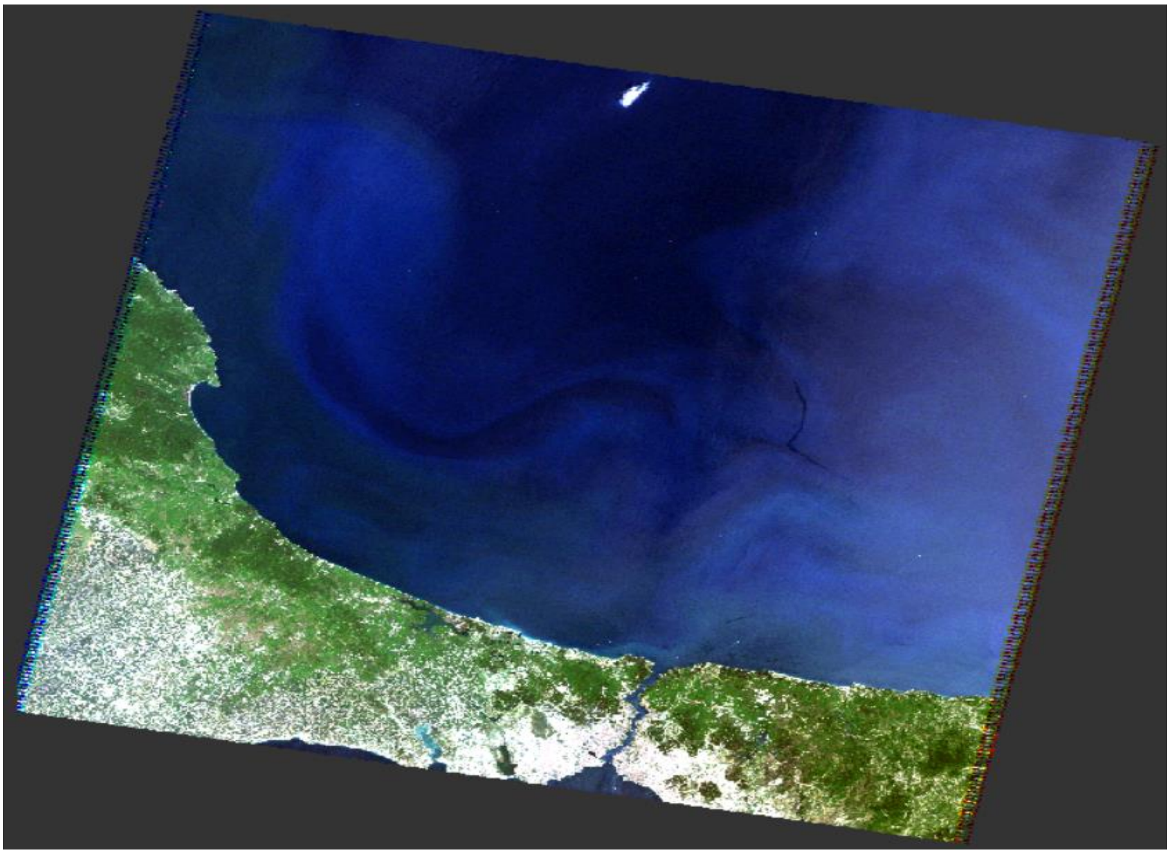

Figure 2 Image that opened with SNAP program.

Figure 3 Subset Area Image.

Part 1:Calculation of Land Surface Temperature (LST)

Landsat 5 TM K1 = 607.76

Landsat 5 TM K2 = 1260.56

LMAX λ = RADIANCE_MAXIMUM_BAND_6 = 15.303

LMIN λ = RADIANCE_MINIMUM_BAND_6 = 1.238

QCALMAX = QUANTIZE_CAL_MAX_BAND_6 = 255

QCALMIN = QUANTIZE_CAL_MIN_BAND_6 = 1

QCAL = "radience_6_CopyRaster1"

Lλ = (LMAX λ – LMIN λ)/(QCALMAX – QCALMIN)*(QCAL – QCALMIN) + LMIN λ

Lλ = (15.303 – 1,238) / (255 – 1) * ("radience_6_CopyRaster1"– 1) + 1.238

Radience to Kelvin Formula:

T = k2/Ln(k1/Lλ+1)

When calculating Land Surface Temperature (LST) in ArcGIS ArcMap, especially if you are using Landsat satellite images, a copy of Band 6 (thermal band) is created and the NoData value is set to 0.The reason for this is to ensure that the raster calculations and analyzes to be performed on the thermal band during the process have a suitable data structure so that they can work properly.

Setting the NoData value to 0 is usually done to facilitate the integration of the data into the analysis process and to prevent errors that can occur when working with incompatible values. This process also helps align the thermal band data with previous calculations.

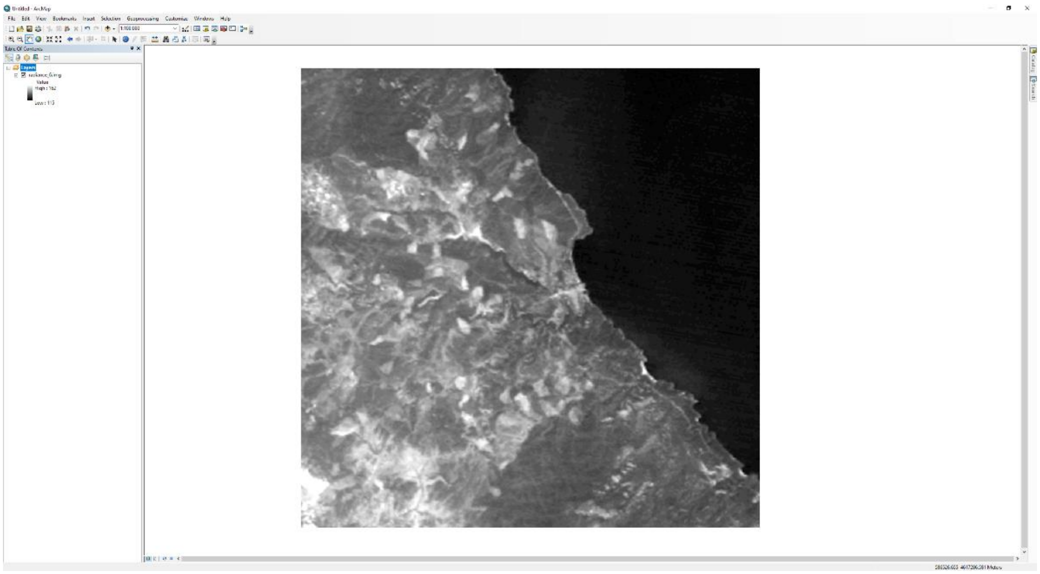

Figure 4 Radiance 6 opened in ArcMap of ArcGIS Desktop.

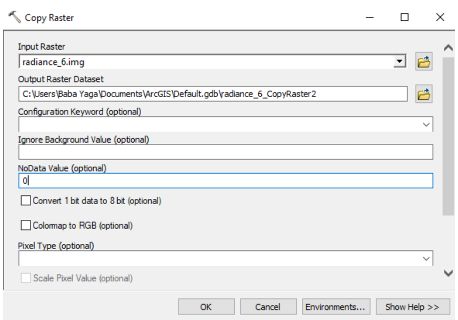

Figure 5 Setting Radiance 6's NoData Value.

After setting No data Value, Arcmap model builder opens (Figure 6). This model is dragged into the Raster Calculator from the builder tools section and dropped into the model builder (Figure 7). The Raster Calculator that comes here is opened by double-clicking. Here, the Band 6 radiance value is calculated with the formulas shown above (Figure 8).

The data we use in these formulas are used by finding the text document with the "MTL.txt" extension in the Landsat 5 files. After that, the raster calculator process is repeated and this time the Radiance value is converted to Brightness Temperature (Figure 10).

As a result of this operation, the result is in Kelvin type. To convert this result in kelvin to degrees Celsius, another raster calculator is added to the model builder and the result is converted from Kelvin to Celcius via this caculator (Figure 12). Finally, the calculation and transformation model we created in this step is run and the newly created image in the catalog section of the application is opened by double-clicking (Figure 16).

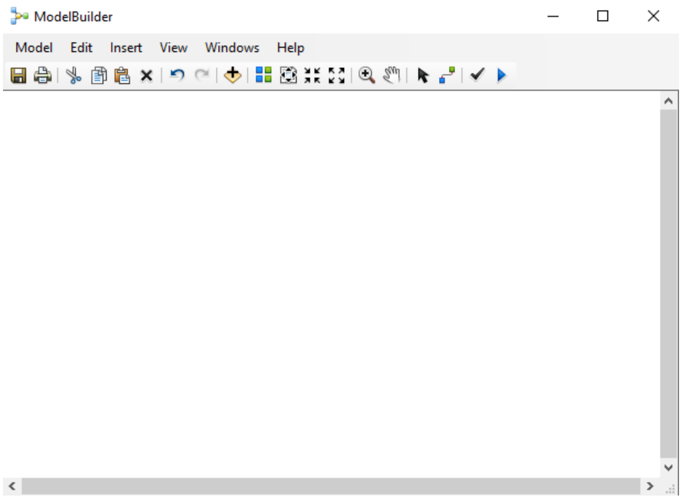

Figure 6 Opening ModelBuilder via ArcMap.

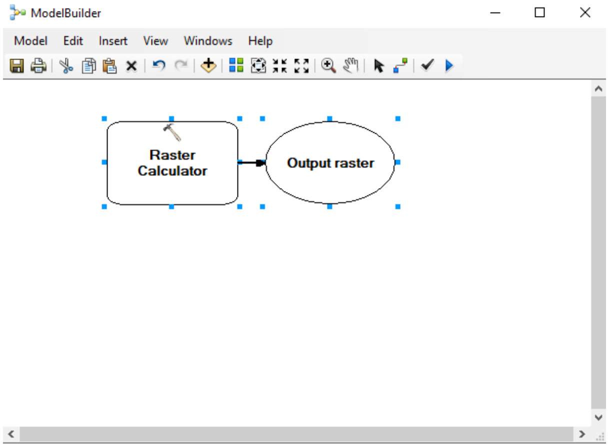

Figure 7 Opening Raster Calculator in Model Builder.

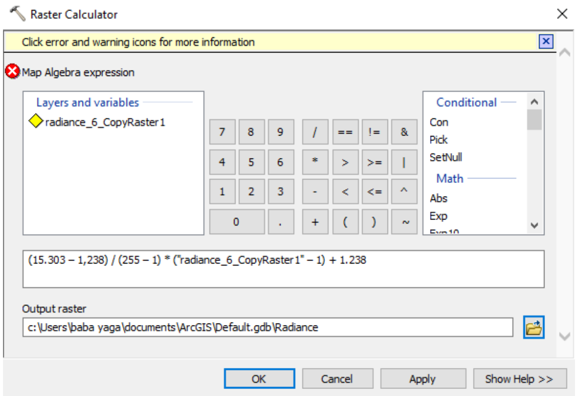

Figure 8 Calculation for New Radiance.

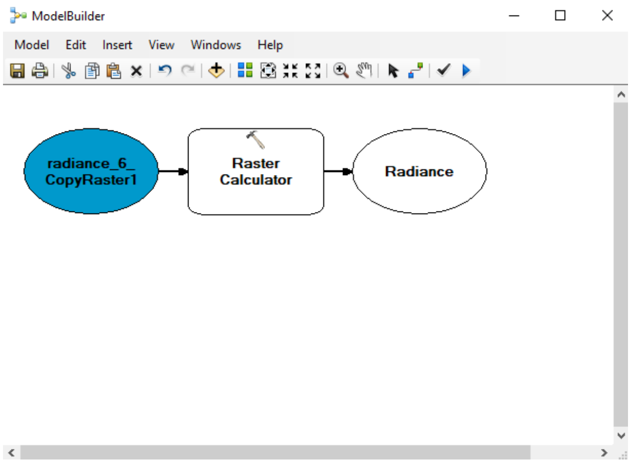

Figure 9 View of Calculation in Model Builder.

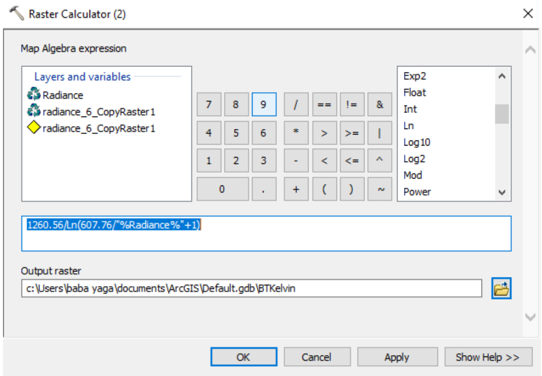

Figure 10 Calculation for Radience to Kelvin.

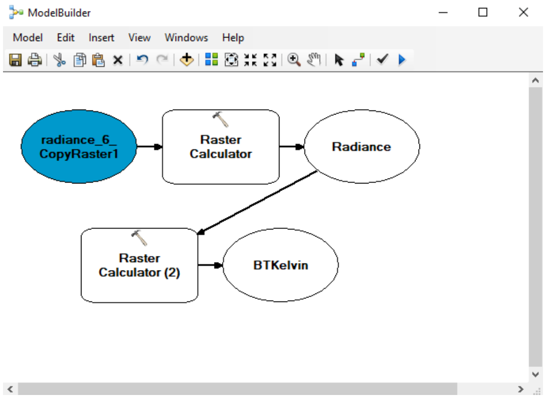

Figure 11 View of Calculation in Model Builder.

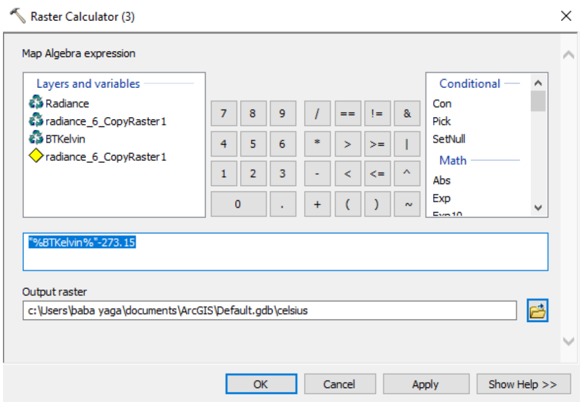

Figure 12 Calculation for Kelvin to Celsius.

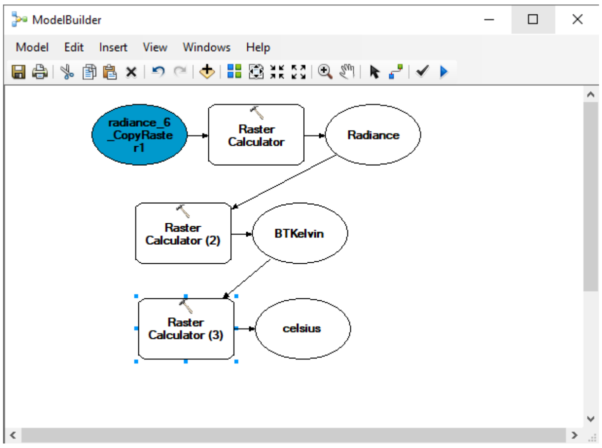

Figure 13 View of Calculation in Model Builder.

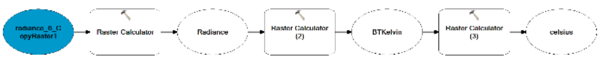

Figure 14 Edited Model Builder View.

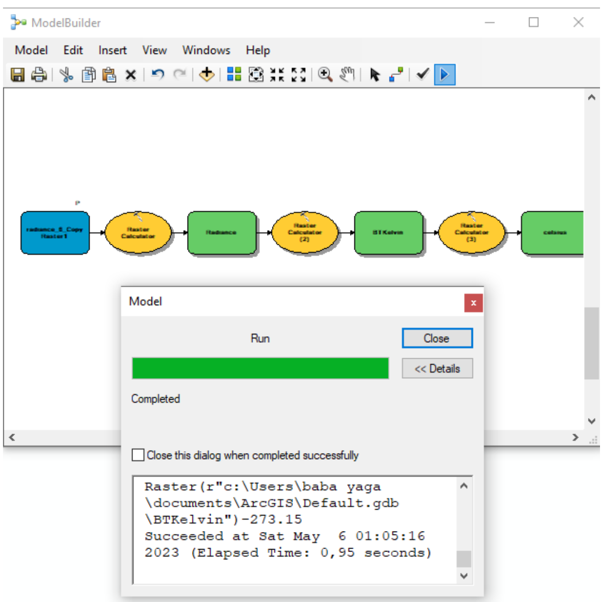

Figure 15 Running the Prepared Model.

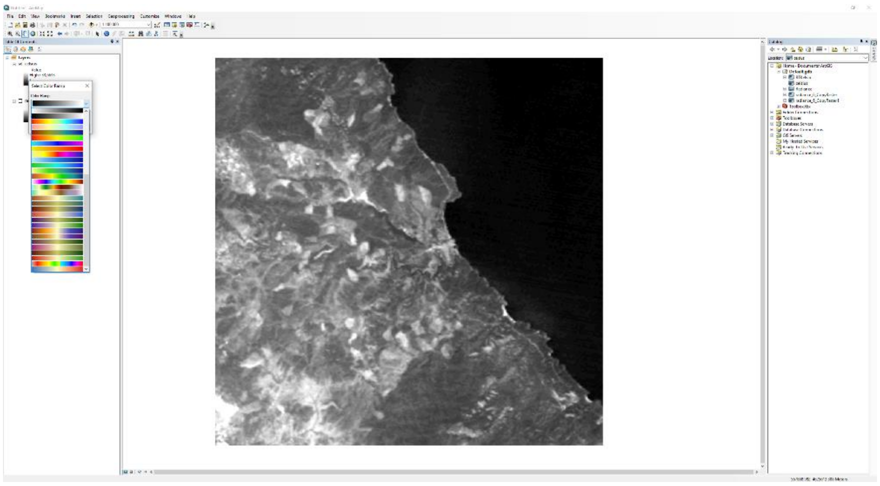

Figure 16 Editing Color Ramp After Model Run.

After completing these steps, the most appropriate and understandable color combination is selected from the Color Ramp section of the image we opened. As seen in Figure 20, the rightmost Blue-Green-Yellow-Red color combination is the most prominent among the images opened in 3 different color scales.

The calculations made in the previous stages are indicated in the color scale in Maximum-Minimum Degree Celsius under the Layer at this stage (Figure 18). Looking at these data, the maximum temperature of our area is 33.6633°C, and the minimum temperature is 13.3087°C.

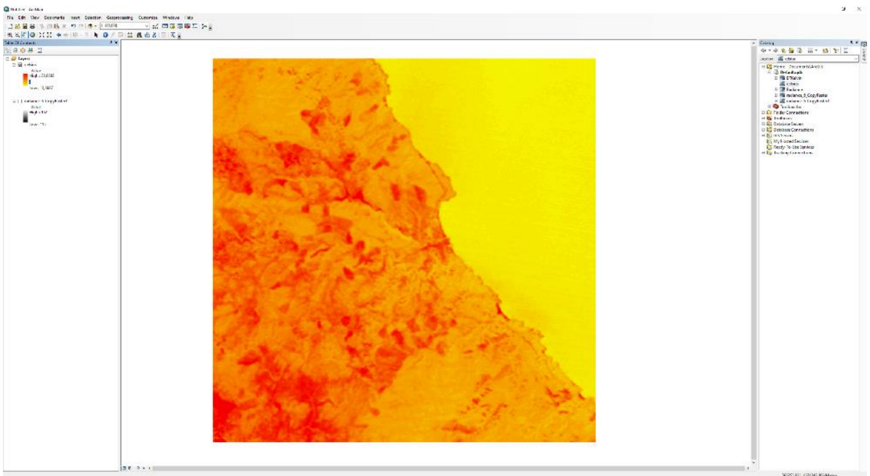

Figure 17 Yellow-Red Colour View

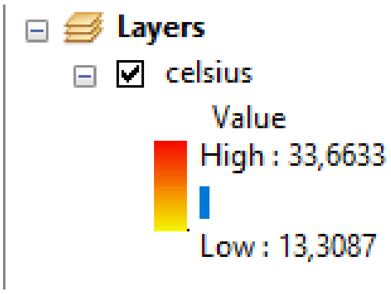

Figure 18 Temperature Values

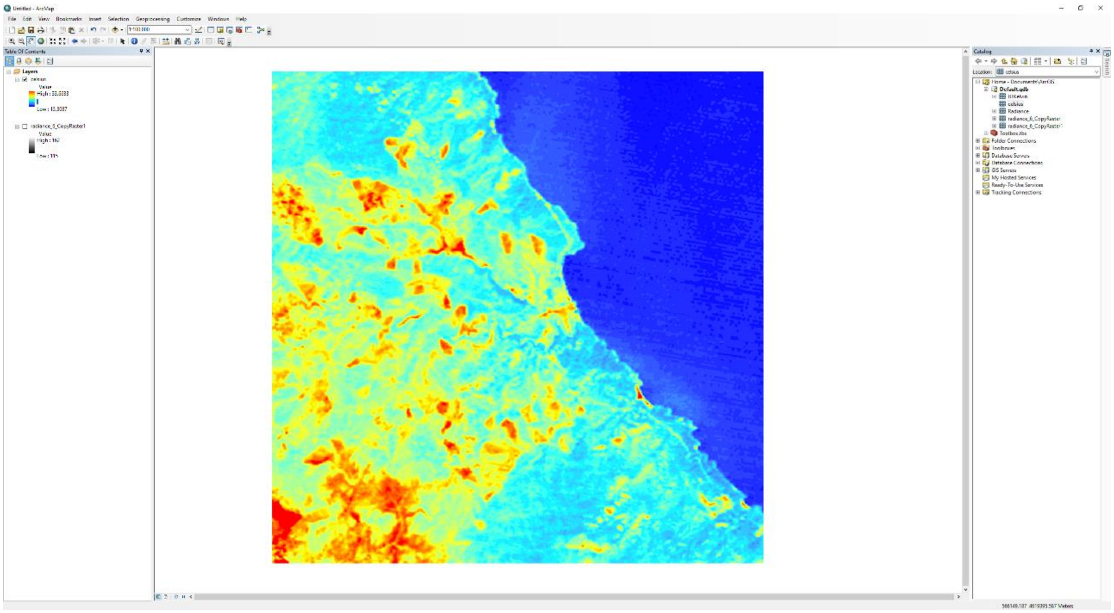

Figure 19 Green-Yellow-Red Colour View

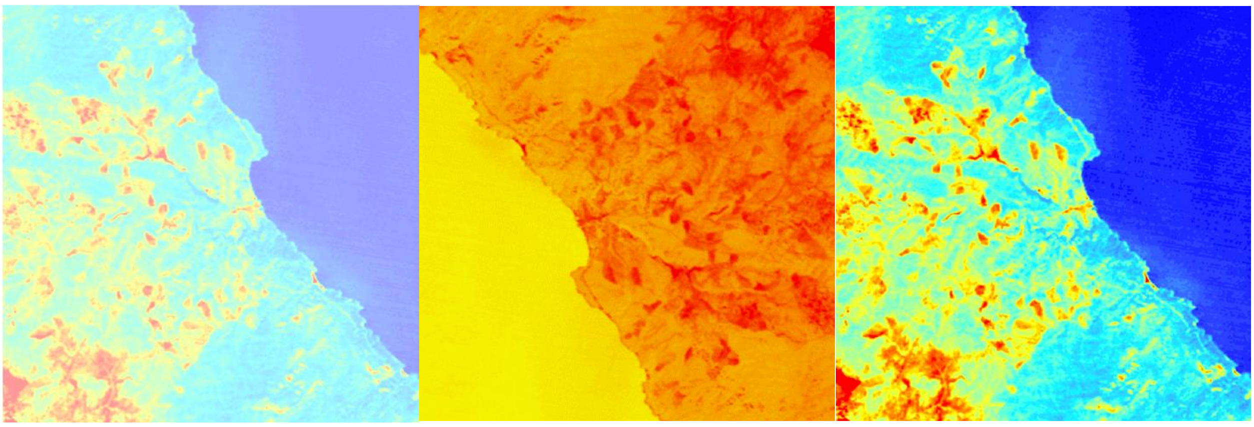

Figure 20 Pale Green-Yellow-Red / Yellow-Red / Green-Yellow-Red

PART 2

It was decided that the RGB map was the most suitable map for comparison. The reason for this is that this map shows the hot places in red and the relatively cold places in blue, which will make it easier for us to distinguish the hottest and coldest points.

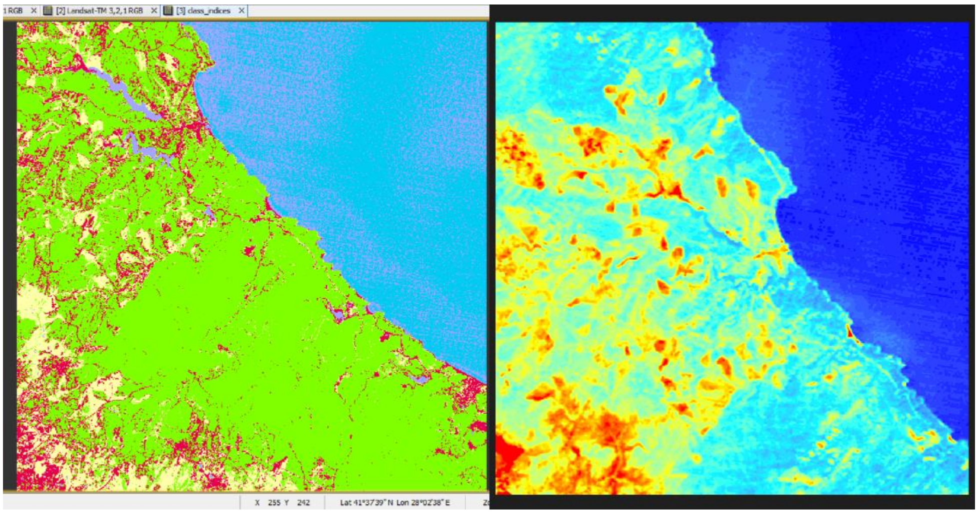

Figure 21 LULC and LST Full View.

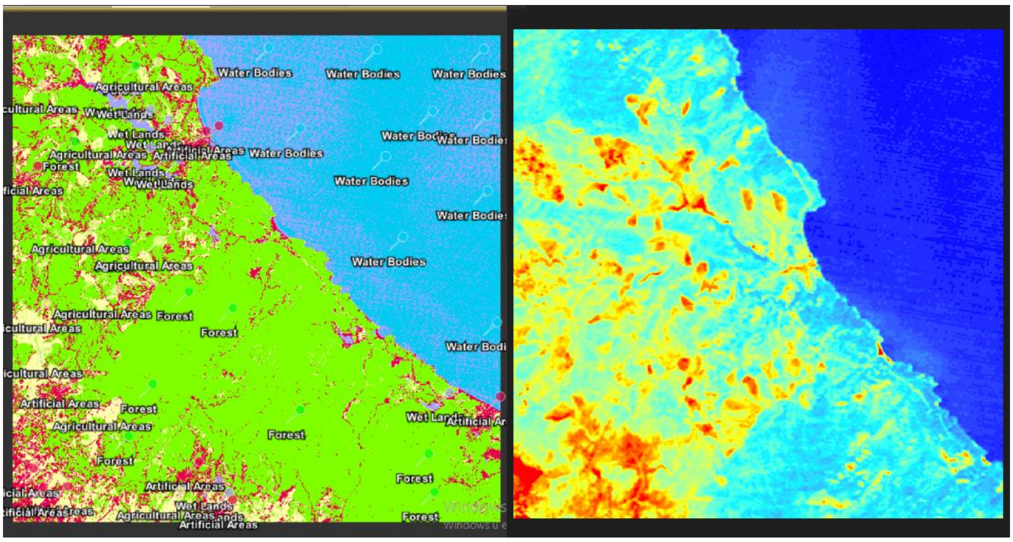

Figure 22 LULC and LST images with poi points.

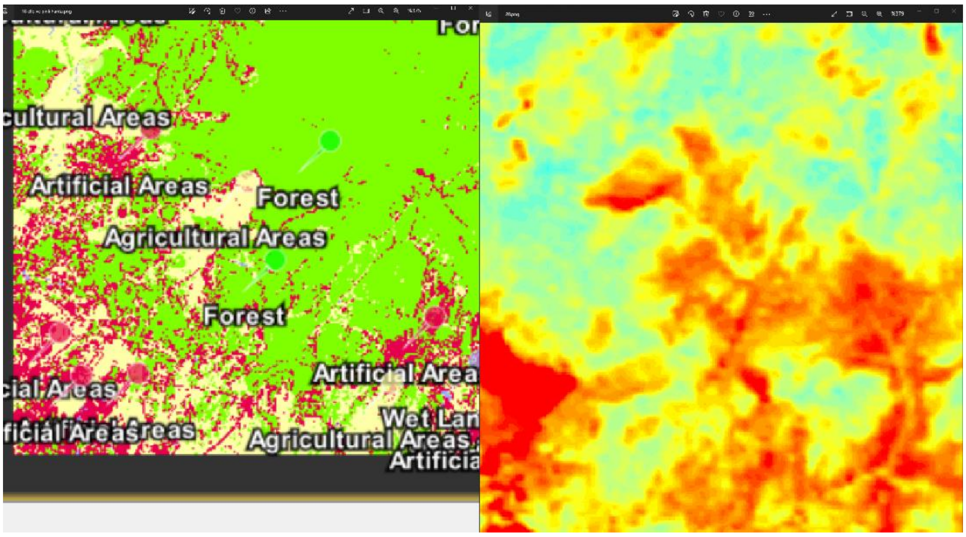

Figure 23 LULC and LST images high temperature zone.

As seen in figure 23, the lower left part of our LULC map is seen as the urban area (artificial area), and it is possible that the temperature is high in places where the temperature is high in our LST map, as well.

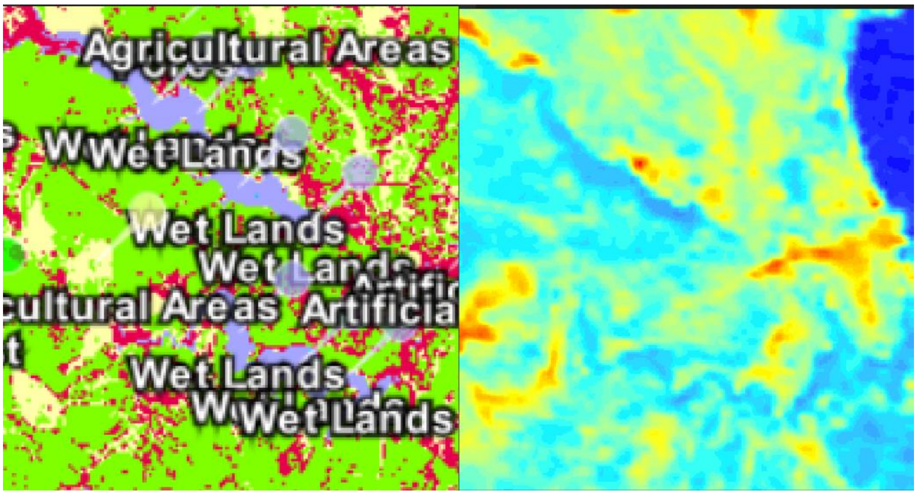

Figure 24 LULC and LST images low temperature zone (Wetlands).

As seen in Figure 24, the area seen as lilac on the LULC is wetlands, and in the same way, that area is shown in a darker blue on the LST map. This indicates that that region is colder, and water regions can be expected to be warmer from the surface.

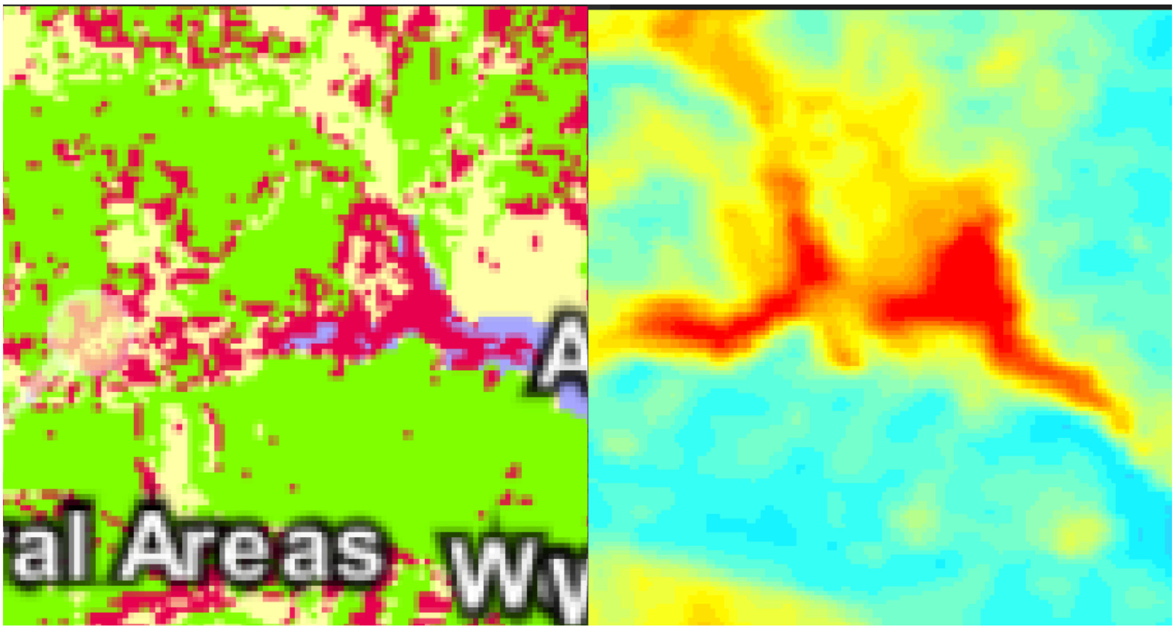

Figure 25 LULC and LST images high temperature zone.

As seen in figure 25, LULC map is seen as the urban area (artificial area), and it is possible that the temperature is high in urban areas where the temperature is high in our LST map, as well.

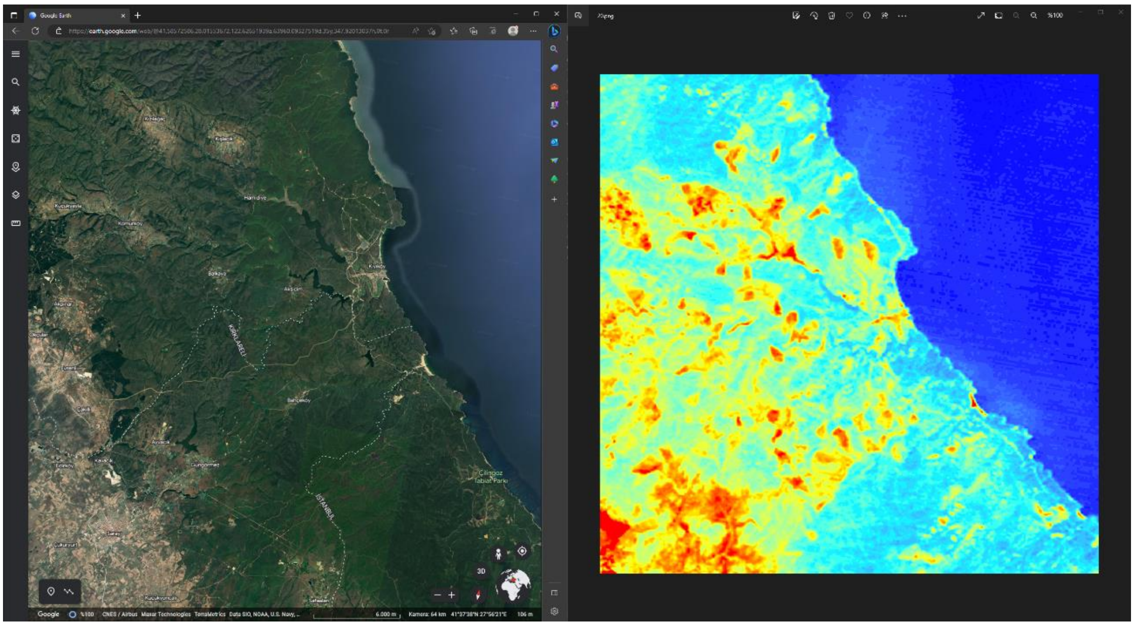

Figure 26 maps full view.

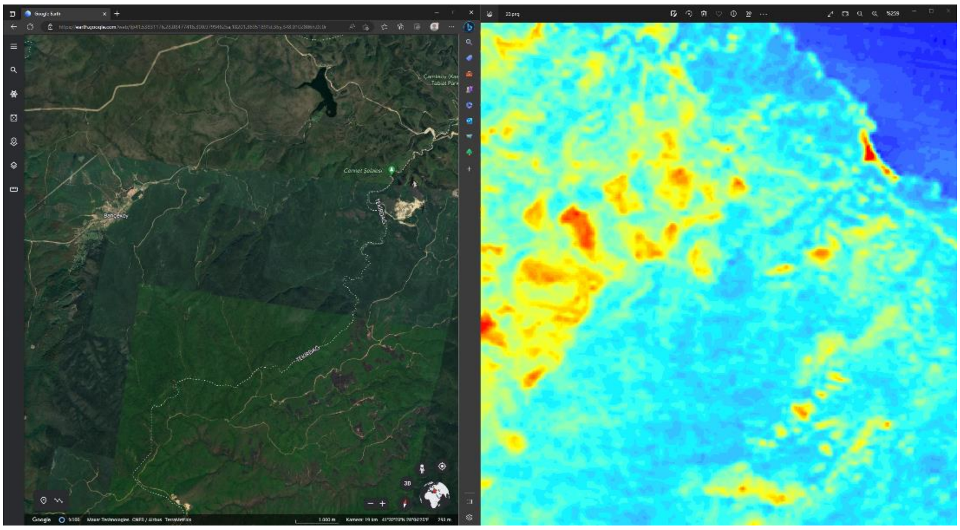

Figure 27 UHI and LST images of the low temperature zone (Bahçeköy).

As seen in Figure 27, the part that appears as a forest in the middle of our UHI image is also shown as cold in blue on our LST map, because forested areas remain cooler than urban or agricultural lands.

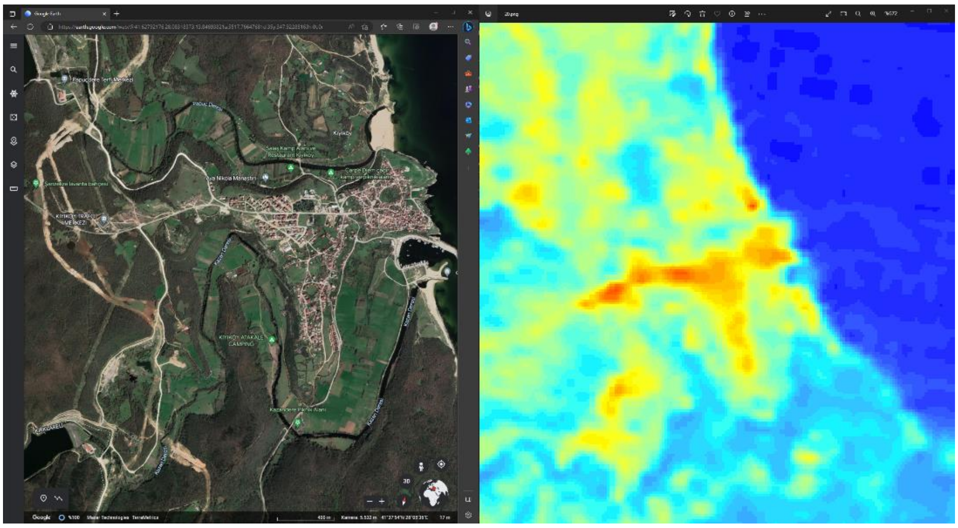

Figure 28 UHI and LST images of the high temperature zone (Kıyıköy).

As seen in Figure 28, the part that appears as the urban area (Kıyıköy) in our UHI image is also shown as high temperature in red on our LST map, because the urban area produces and retains more heat than forest and wetlands.

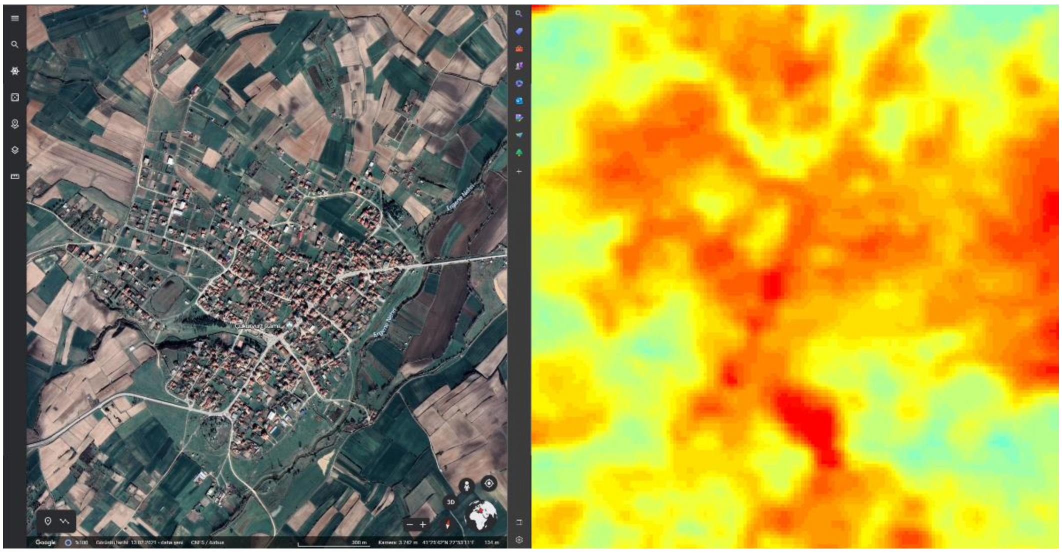

Figure 29 UHI and LST images of the high temperature zone (Çukuryurt).

As seen in Figure 29, the part that appears as the urban area (Çukuryurt) in our UHI image is also shown as high temperature in red on our LST map, because the urban area produces and retains more heat than forest and wetlands. also, the roads passing through the city clearly revealed the shape of the city.

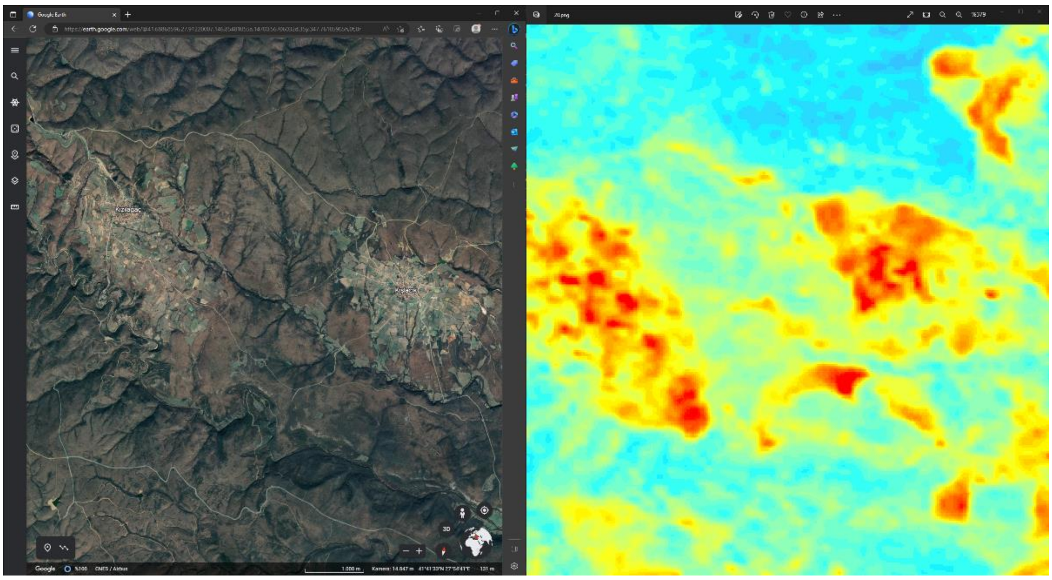

Figure 30 UHI and LST images of the high temperature zone (Kızılağaç-Kışlacık).

In Figure 30, the two city centers are more clearly distinguished in the LST image.

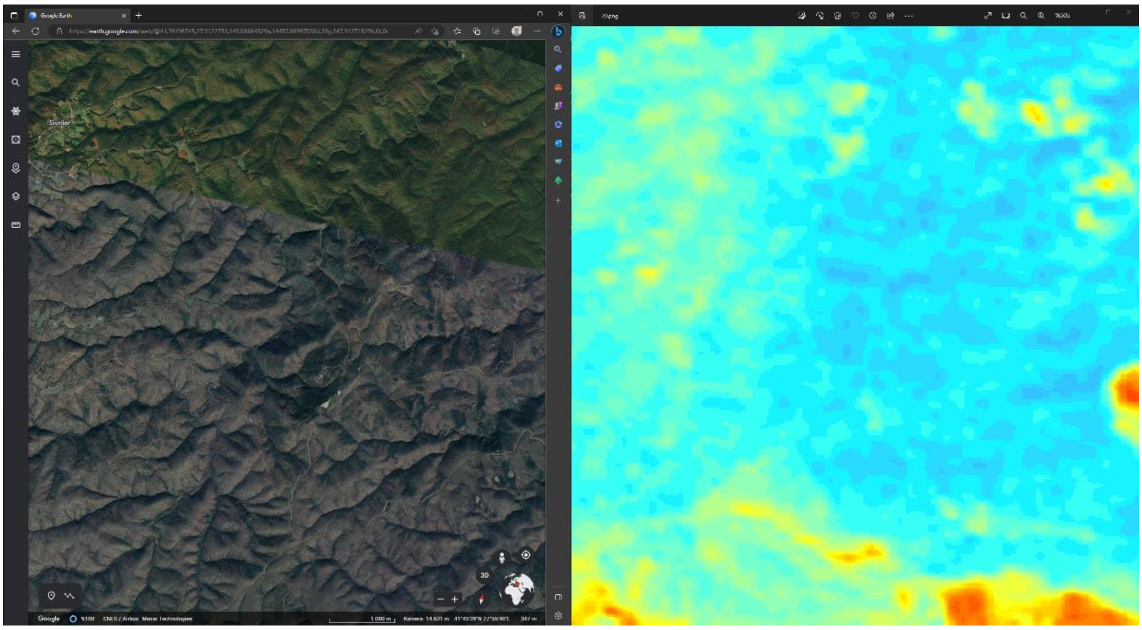

Figure 31 UHI and LST images of the low temperature zone (Forest).

The forest area, which is clearly visible in Figure 31 UHI image, is also identified with a dark color in the LST image.

In conclusion, it can be claimed that the impact of the Urban Heat Island (UHI) on Land Surface Temperature (LST) is significant. Urban surfaces become warmer as a result of the UHI effect, and urban regions' LST also rises as a result. Urban locations have a high concentration of heat-absorbing surfaces, such as buildings, roads, and other types of infrastructure, which increases solar radiation absorption and decreases cooling impact. Due to this, urban areas have greater LSTs than nearby green spaces. Remote sensing images show the UHI effect, which makes urban areas look as "hot spots" with higher LSTs than the nearby green areas. Urban planning and management must take the UHI effect into account since it has the potential to significantly affect urban areas' social, economic, and environmental conditions.

It is important to anticipate how the LST in the region may change in the future. Factors such as climate change, land use and land cover changes, coastal erosion and urbanization can have a significant impact on the LST.

Climate change and global warming can have an impact on the LST in the region by causing changes in temperature and precipitation regimes. For example, increasing heat waves in the region and rising temperature averages may cause LST values to rise. The growth and expansion of the small city center can lead to the formation of urban heat islands and increase in LST values. Urbanization changes surface emissivity and heat holding capacity, which raises temperatures by replacing natural surfaces with concrete and asphalt. Destruction and reduction of forest areas can affect surface temperatures. Trees and vegetation lower the temperature by releasing moisture into the atmosphere and providing shade. Decreased forest areas may cause an increase in LST values. Coastal erosion and sea level rise can affect surface temperatures in coastal areas. In addition, the arrangements made in coastal areas and the increase in touristic facilities on the coast may affect the LST values in the region. Expansion or shrinkage of farmland can affect surface temperatures in the region. In particular, water-intensive farming practices and irrigation systems can have a significant impact on surface temperatures.

As a result, if we consider that a large part of our region consists of water and forest, changes in forests and waters may lead our region to the direction of change, but if there is no change in water and forested areas, there will not be a big change in our LST map.