

Land Surface Temperature Maps- Surat and Rajshahi

Land Surface Temperature

The Land Surface Temperature (LST) is the irradiative skin temperature of the land surface, as measured in the direction of the remote sensor. It is estimated from Top-of-Atmosphere brightness temperatures from the infrared spectral channels of a constellation of geostationary satellites. Its estimation further depends on the albedo, the vegetation cover and the soil moisture. LST is a mixture of vegetation and bare soil temperatures. Because both respond rapidly to changes in incoming solar radiation due to cloud cover and aerosol load modifications and diurnal variation of illumination, the LST displays quick variations too. In turn, the LST influences the partition of energy between ground and vegetation, and determines the surface air temperature.

$$LST = (BT / 1) + W * (BT / 14380) * \ln (E)$$

Where:

BT = Top of atmosphere brightness temperature (°C)

W = Wavelength of emitted radiance

E = Land Surface Emissivity

Method

- We have employed Landsat-8 and Landsat 9 satellite data to map the Land Surface Temperature (LST) of Surat. The mapping was done using ArcGIS software.
- The process of LST estimation using Landsat data involves computation of Land Surface Emissivity (LSE) and NDVI (Normalized Difference Vegetation Index).
- NDVI gives an idea of vegetation cover on the ground, whereas LSE is the intrinsic property of natural materials and determines the ability of the material to transform thermal energy to radiant energy, which is actually measured by the satellites.
- Cloud-free satellite images were used for retrieving LST distribution.
- To delineate the hotspots, we adopted the percentile method. In this approach, first, the areas experiencing temperatures above 95% of the highest LST observed on a particular date were extracted. These areas represent the thermal hotspots at temperatures in excess of 95% of the highest LST measured on the particular date. Then, this method of extraction of hotspots was repeated for 90%, 85%.....till we found hotspots in every ward of the city.

MAPPING METHODOLOGY)

‘Heat hot-spots’ are areas within the city which experience ambient temperature in excess of the average monthly maximum temperature.

Step 1: Data Identification

- Landsat 8 provides data with 11 spectral bands

Step 2: Conversion of DNs to Spectral Radiance values

- Band 10 of Landsat 8 data was used for retrieval of LST

Step 3: Computation of Land Surface emissivity (LSE)

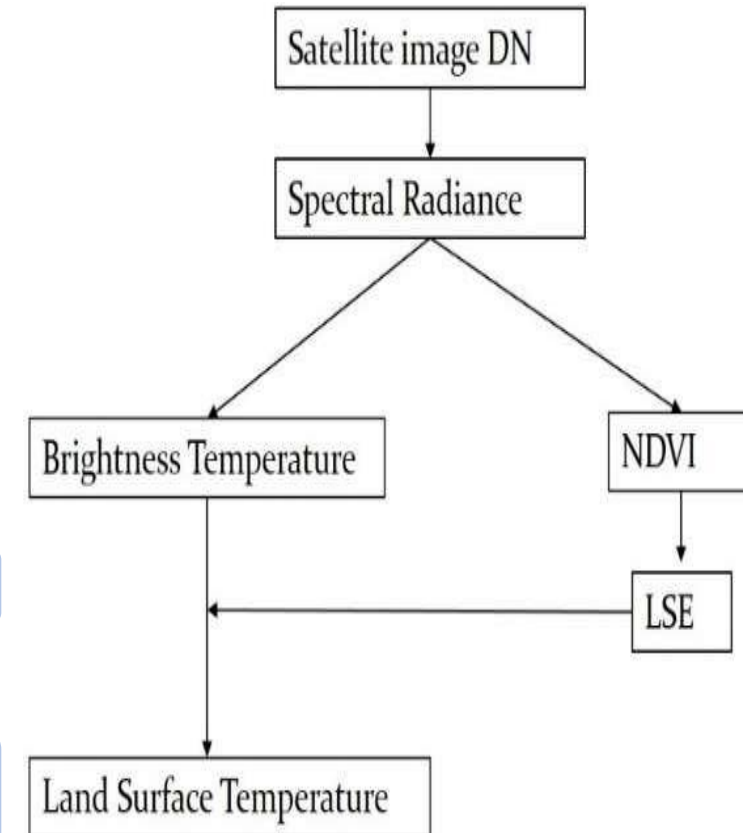
- NDVI (Normalized Difference Vegetation Index) based approach

Step 4: Converting .tiff file to shape file

- Convert the .tiff file to a .shp file in ArcGIS 10.1

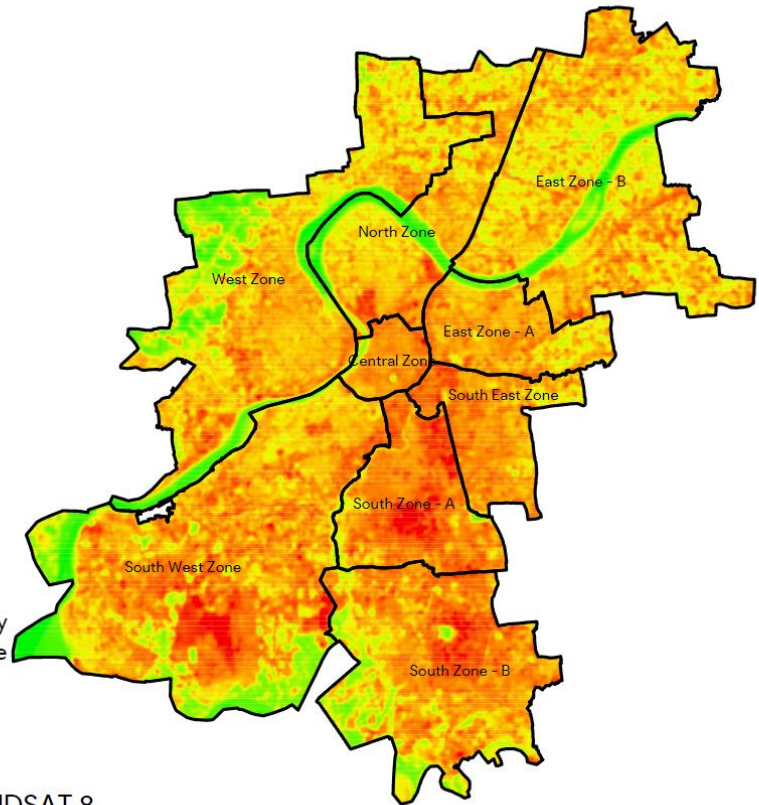
Step 5: Converting the data from the obtained shape-file in the Hotspots

- areas having the land Surface Temperature more than 40°C



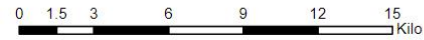
Flowchart depicting calculation of LS

LAND SURFACE TEMPERATURE MAP OF SURAT



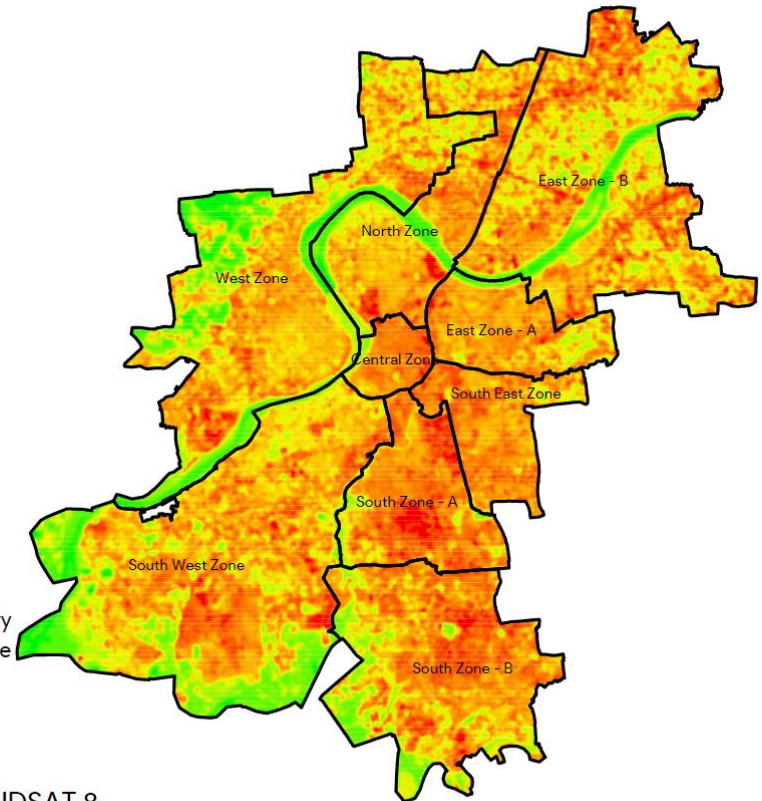
Legend
Surat Zonal Boundary
Land Surface Temperature
Value
High : 45.4475
Low : 26.2689

SATELLITE - LANDSAT 8
IMAGE CAPTURED - 17/03/2022



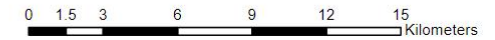
17 March 2022

LAND SURFACE TEMPERATURE MAP OF SURAT



Legend
Surat Zonal Boundary
Land Surface Temperature
Value
High : 42.1673
Low : 25.8582

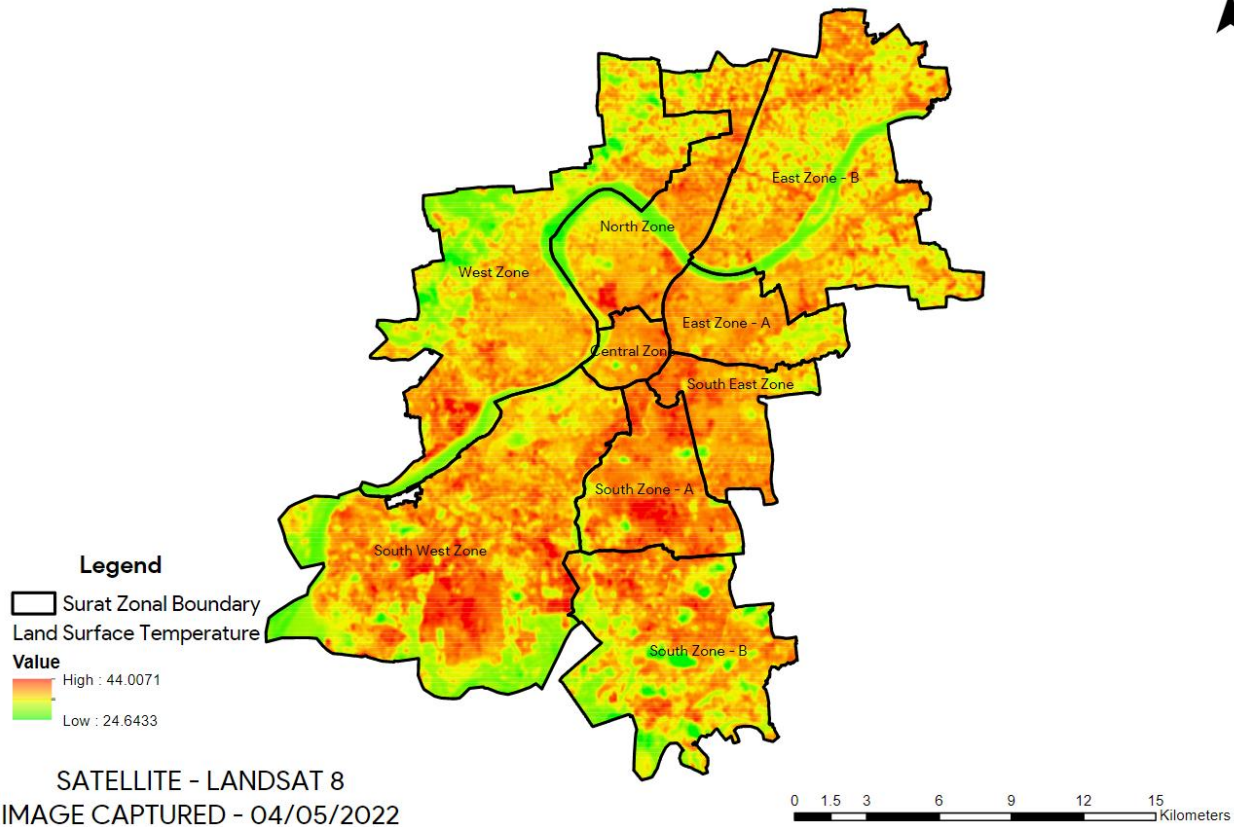
SATELLITE - LANDSAT 8
IMAGE CAPTURED - 18/04/2022



18 April 2022

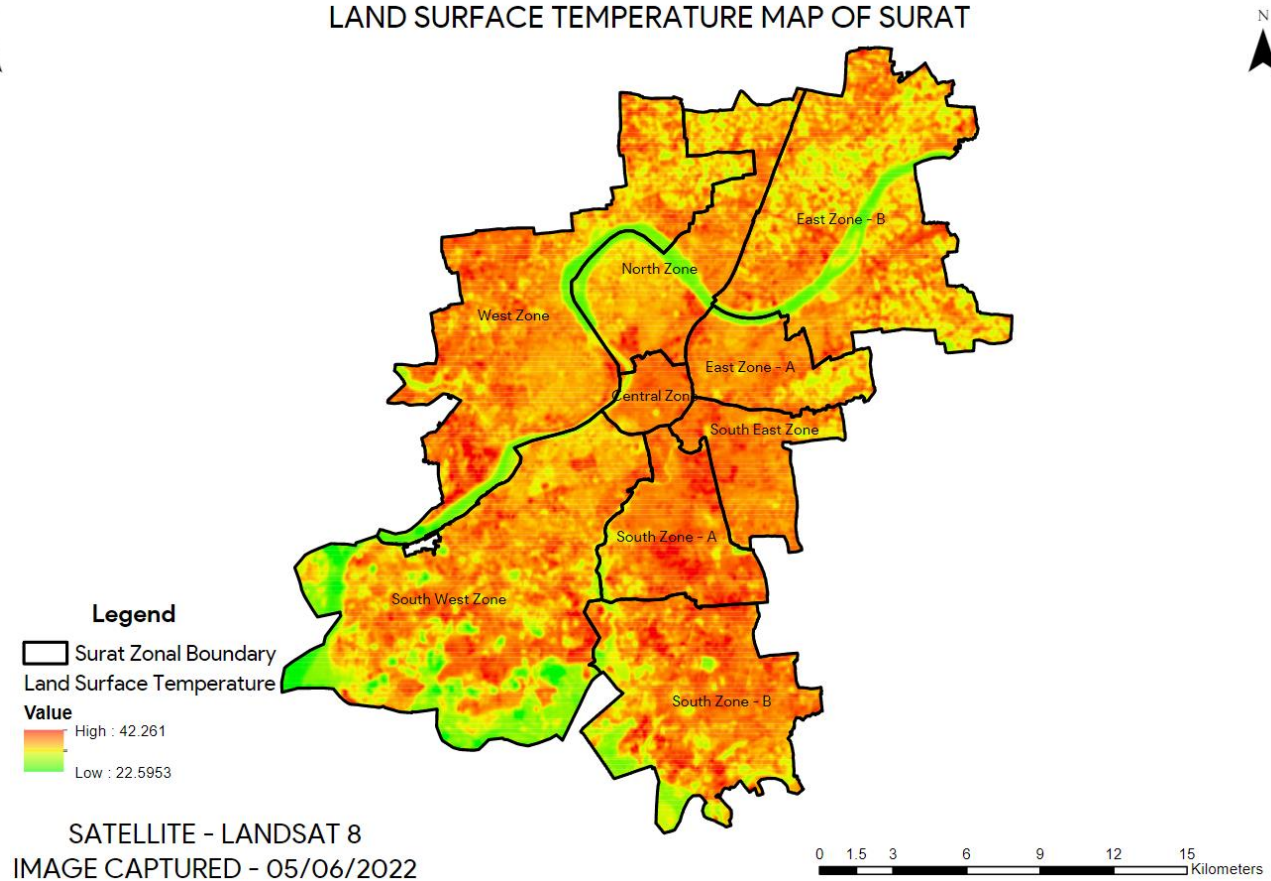


LAND SURFACE TEMPERATURE MAP OF SURAT



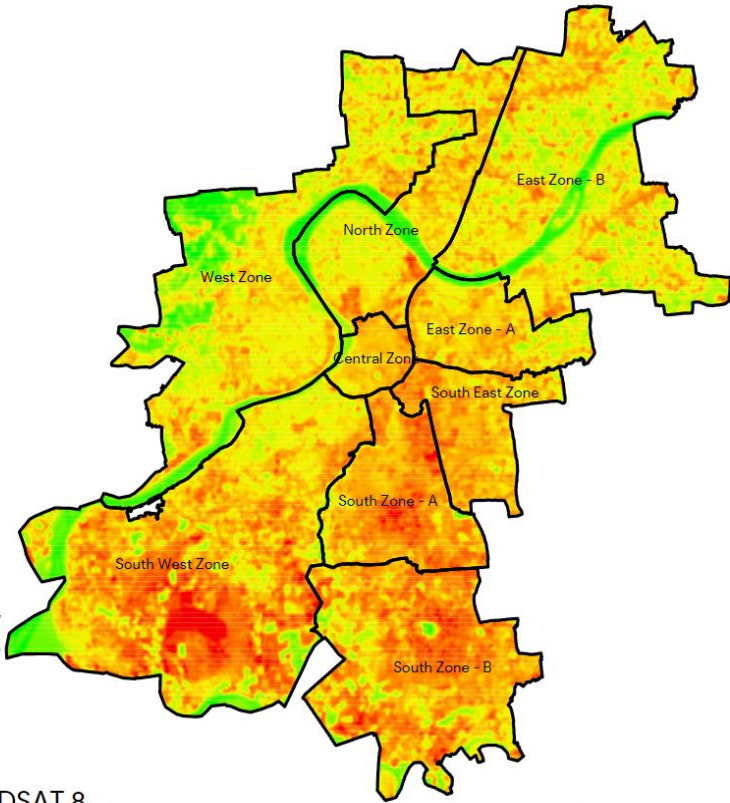
4 May 2022

LAND SURFACE TEMPERATURE MAP OF SURAT



5 June 2022

LAND SURFACE TEMPERATURE MAP OF SURAT

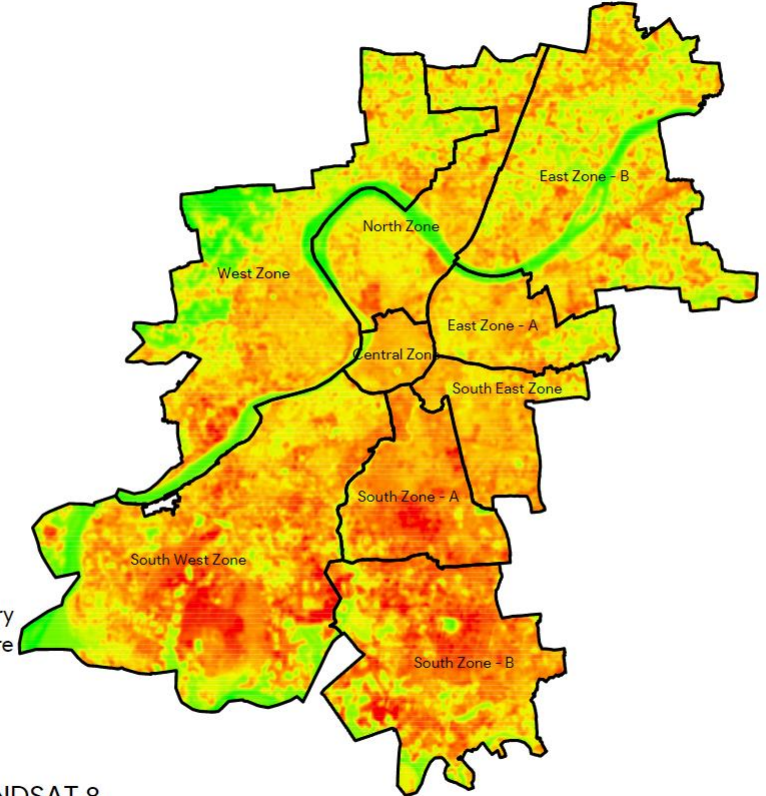


SATELLITE - LANDSAT 8
IMAGE CAPTURED - 14/03/2021

14 March 2021



LAND SURFACE TEMPERATURE MAP OF SURAT



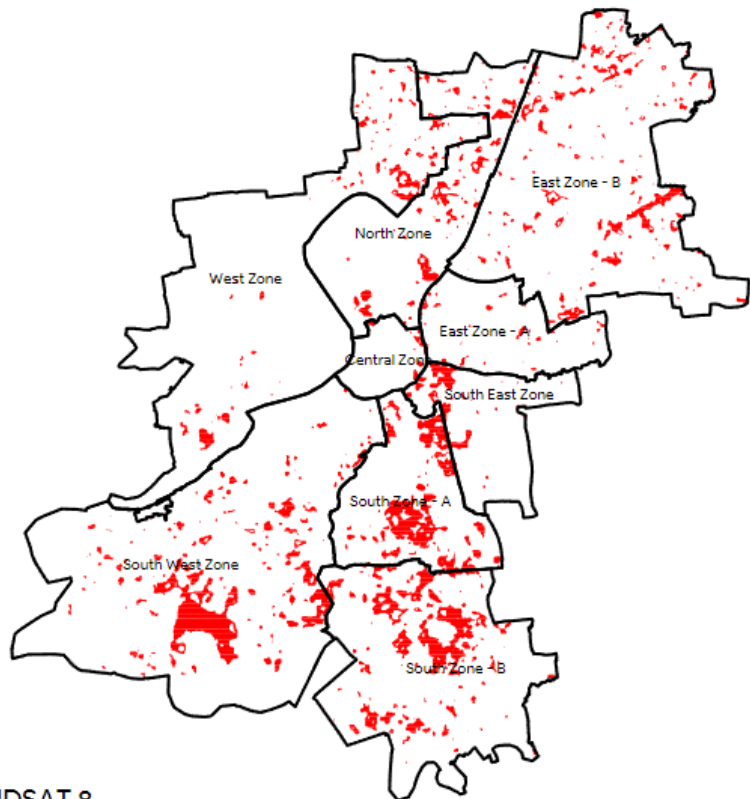
SATELLITE - LANDSAT 8
IMAGE CAPTURED - 15/04/2021

15 April 2021



30 March 2021

LST MAP OF SURAT SHOWING HIGHEST 90 PERCENTILE TEMPERATURE



Legend

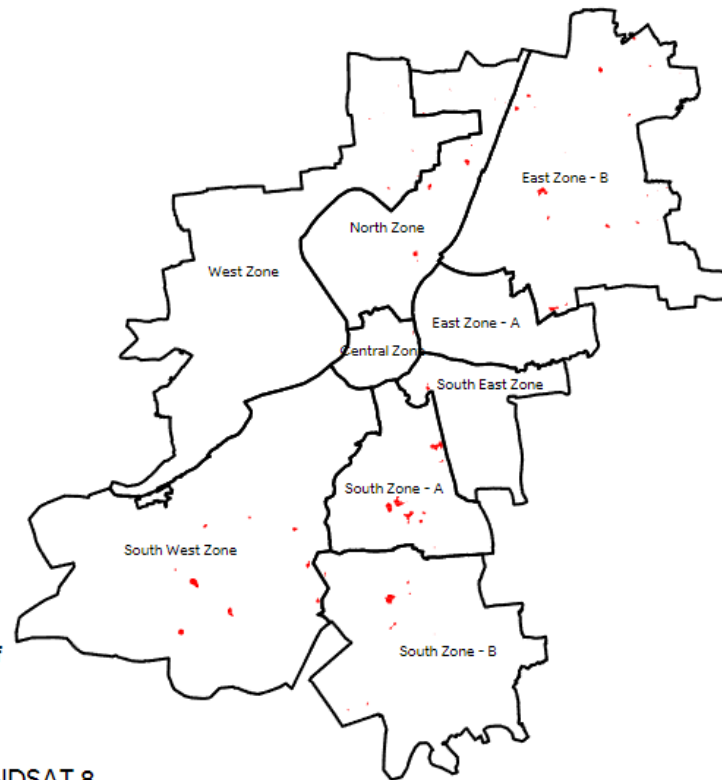
- Zone_boundary Drawing
- LST_30_03_2021_L8.tif
- <VALUE>
- 27.75117493 - 40.98465
- 40.98465001 - 43.261575
- 43.26157501 - 45.5385

SATELLITE - LANDSAT 8

IMAGE CAPTURED - 30/03/2021

0 1.5 3 6 9 12 15 Kilometers

LST MAP OF SURAT SHOWING HIGHEST 95 PERCENTILE TEMPERATURE



Legend

- Zone_boundary Drawing
- LST_30_03_2021_L8.tif
- <VALUE>
- 27.75117493 - 43.261575
- 43.26157501 - 45.53852844

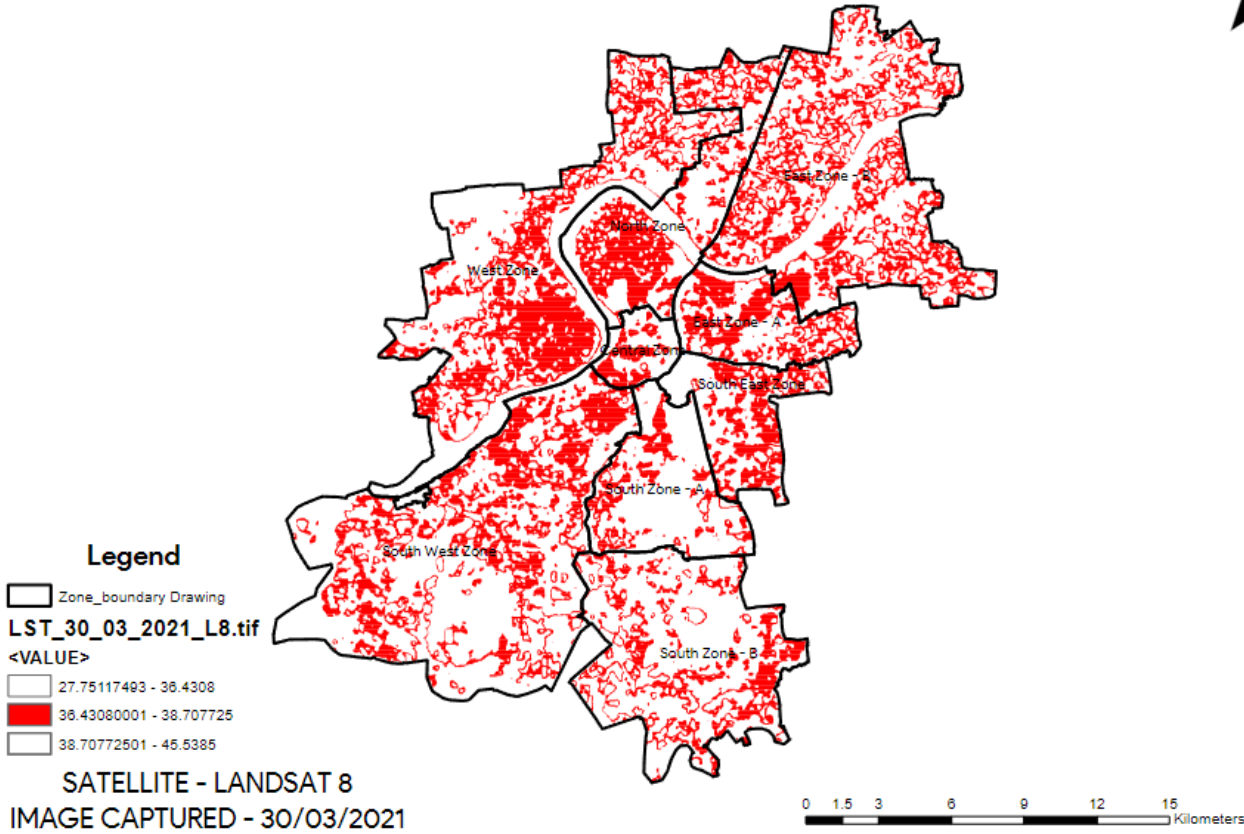
SATELLITE - LANDSAT 8

IMAGE CAPTURED - 30/03/2021

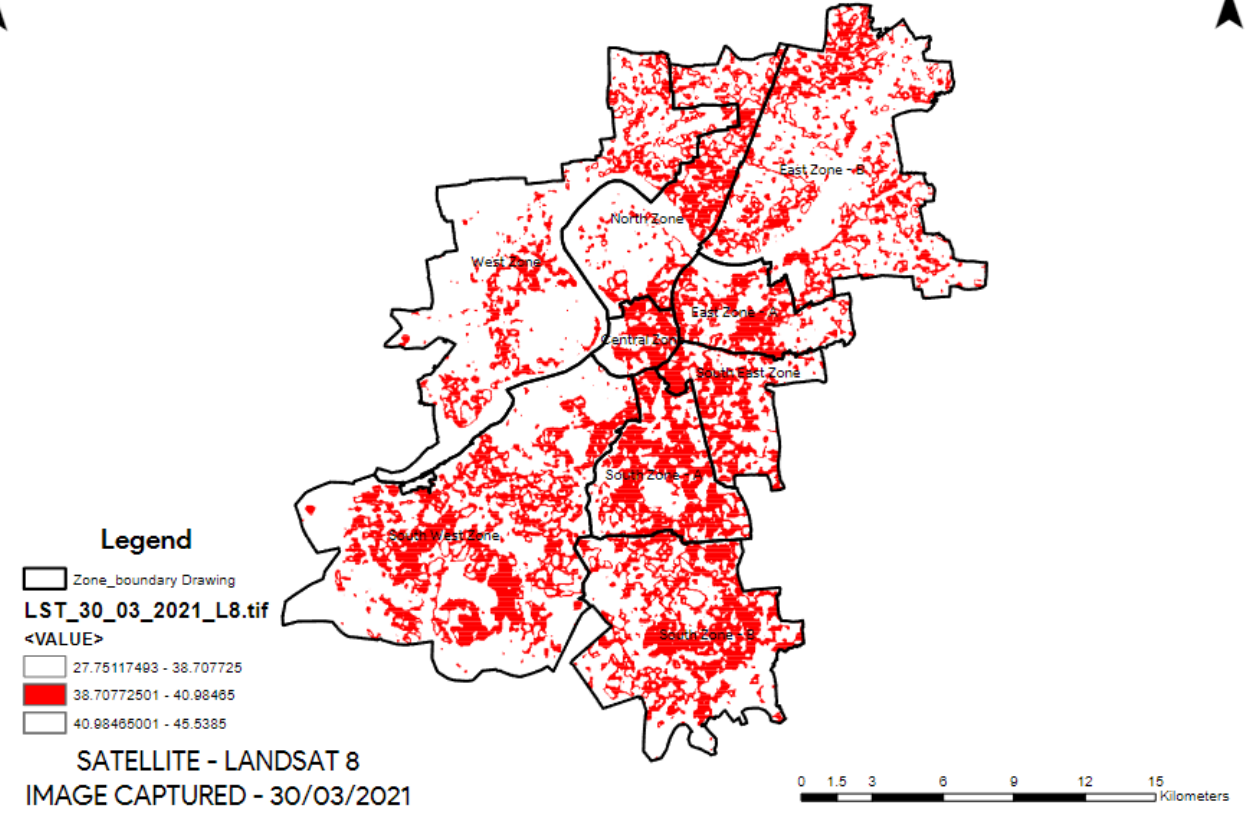
0 1.5 3 6 9 12 15 Kilometers

30 March 2021

LST MAP OF SURAT SHOWING HIGHEST 80 PERCENTILE TEMPERATURE

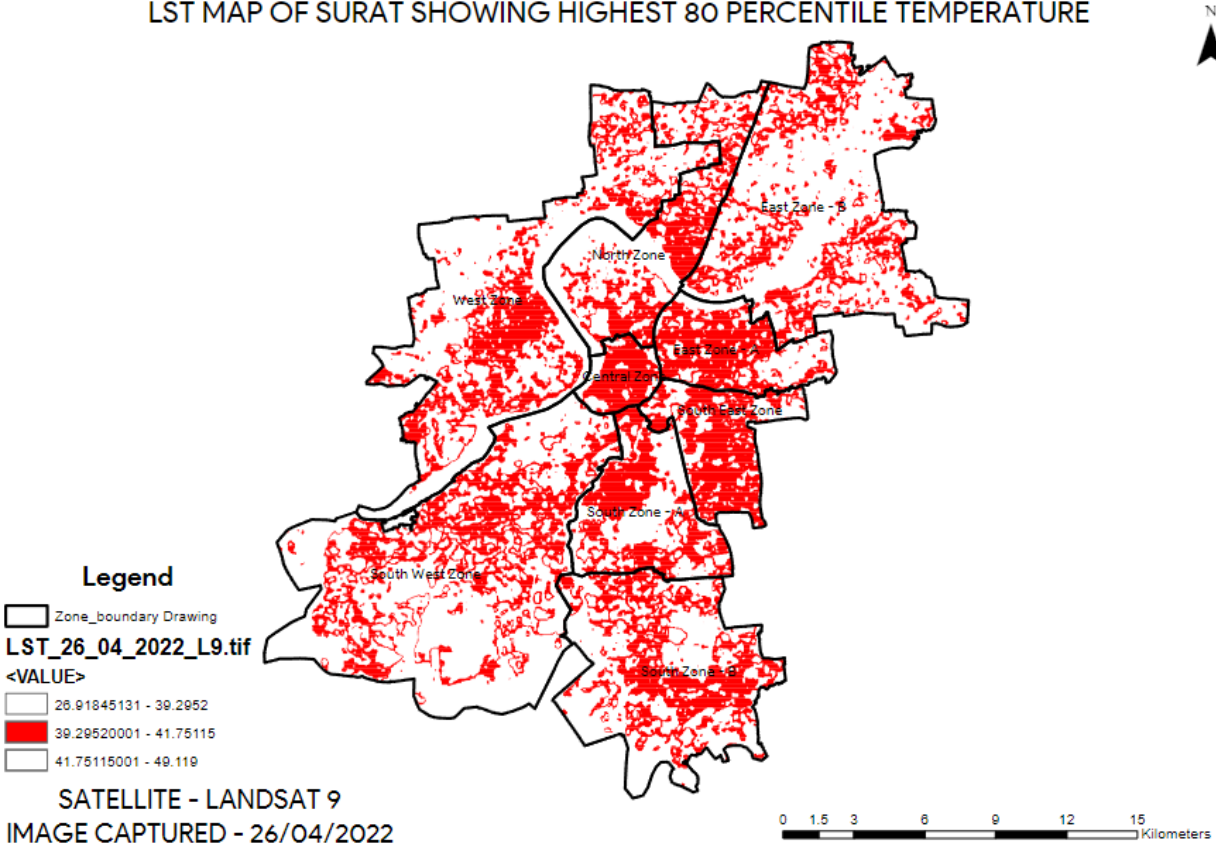


LST MAP OF SURAT SHOWING HIGHEST 85 PERCENTILE TEMPERATURE

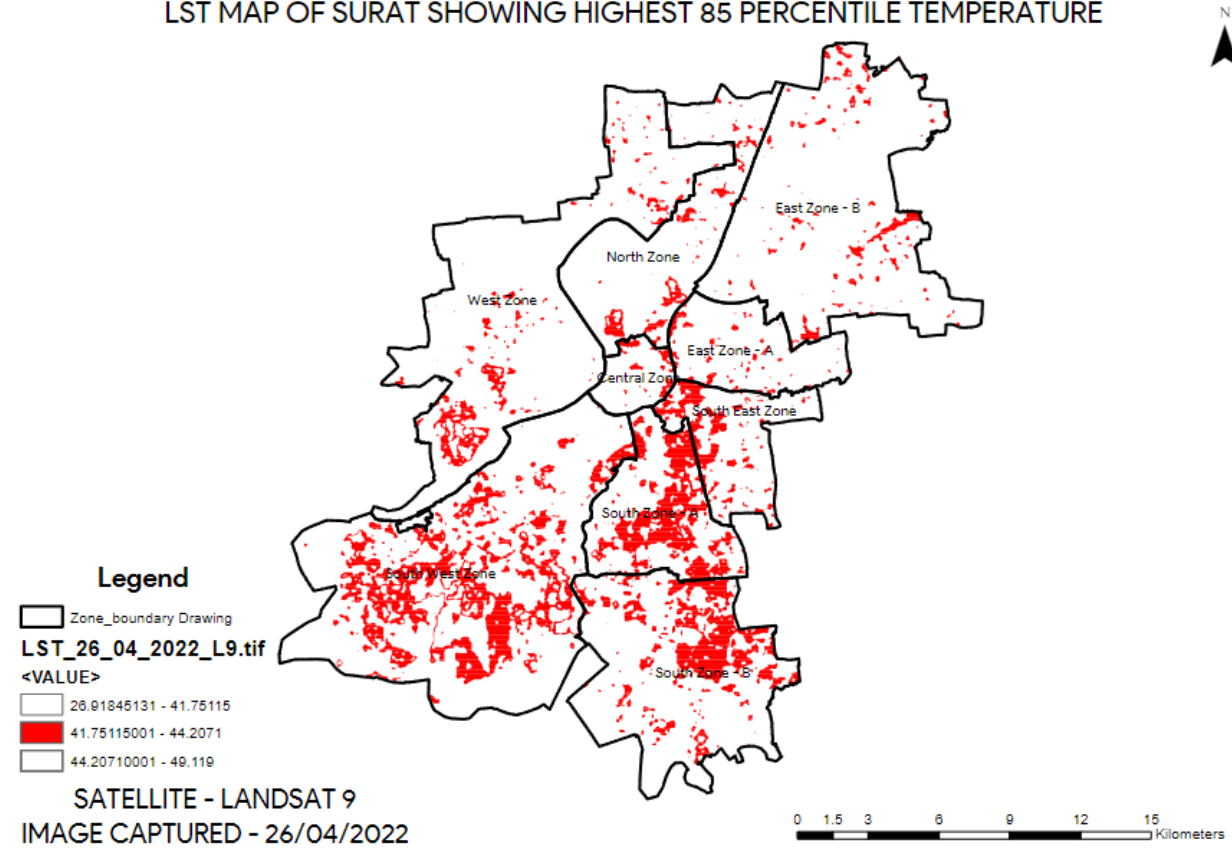


26 April 2022

LST MAP OF SURAT SHOWING HIGHEST 80 PERCENTILE TEMPERATURE

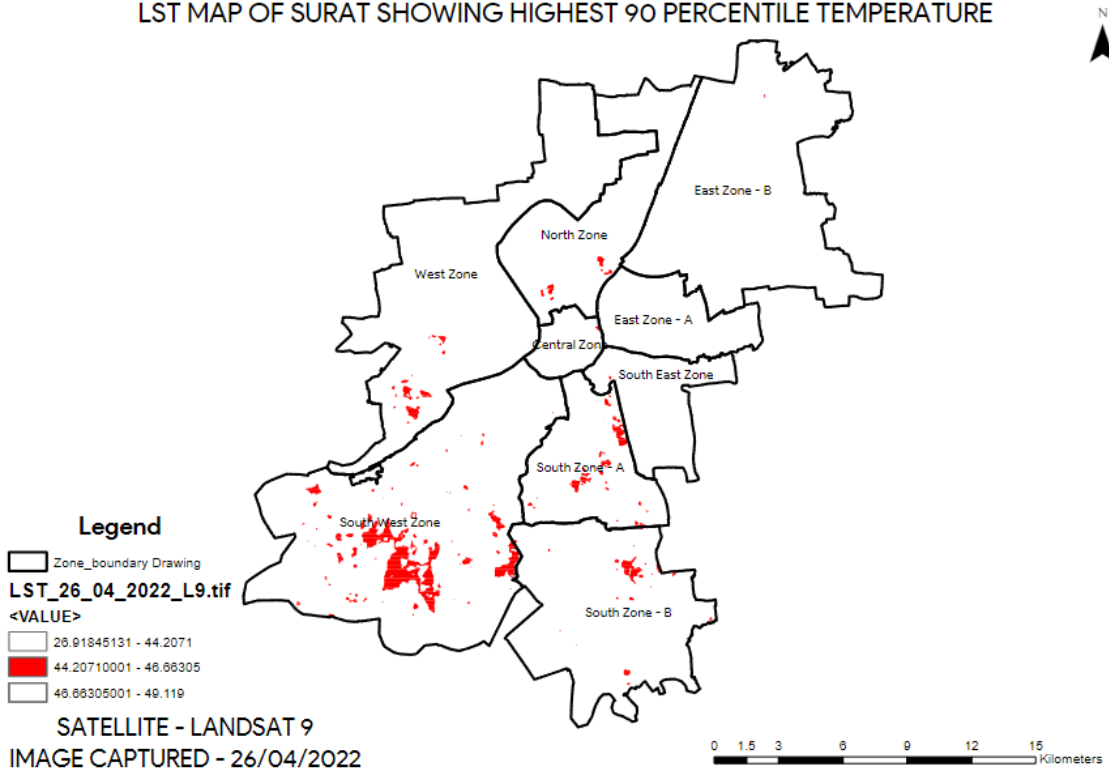


LST MAP OF SURAT SHOWING HIGHEST 85 PERCENTILE TEMPERATURE



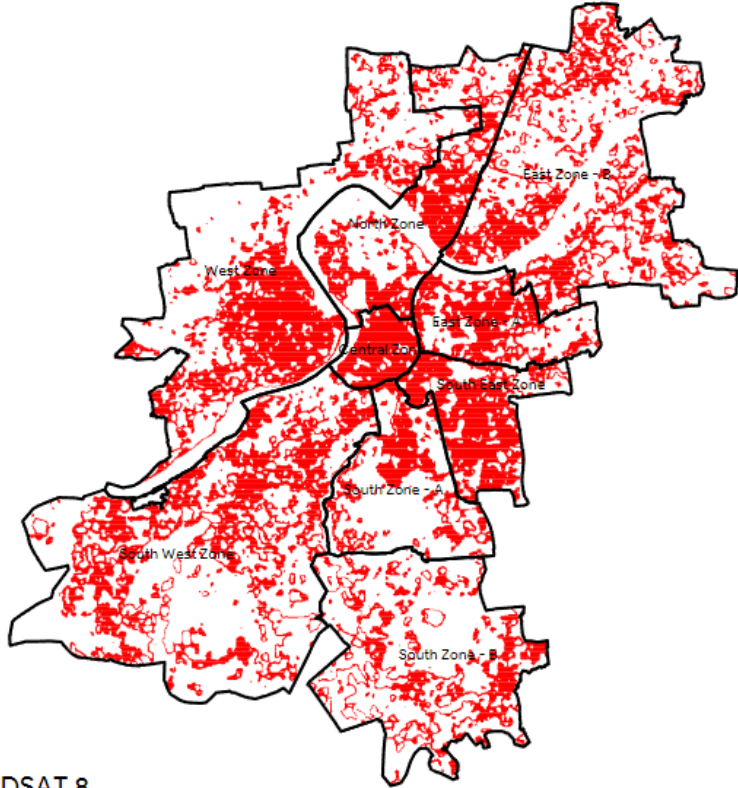
26 April 2022

LST MAP OF SURAT SHOWING HIGHEST 90 PERCENTILE TEMPERATURE



15 April 2021

LST MAP OF SURAT SHOWING HIGHEST 80 PERCENTILE TEMPERATURE



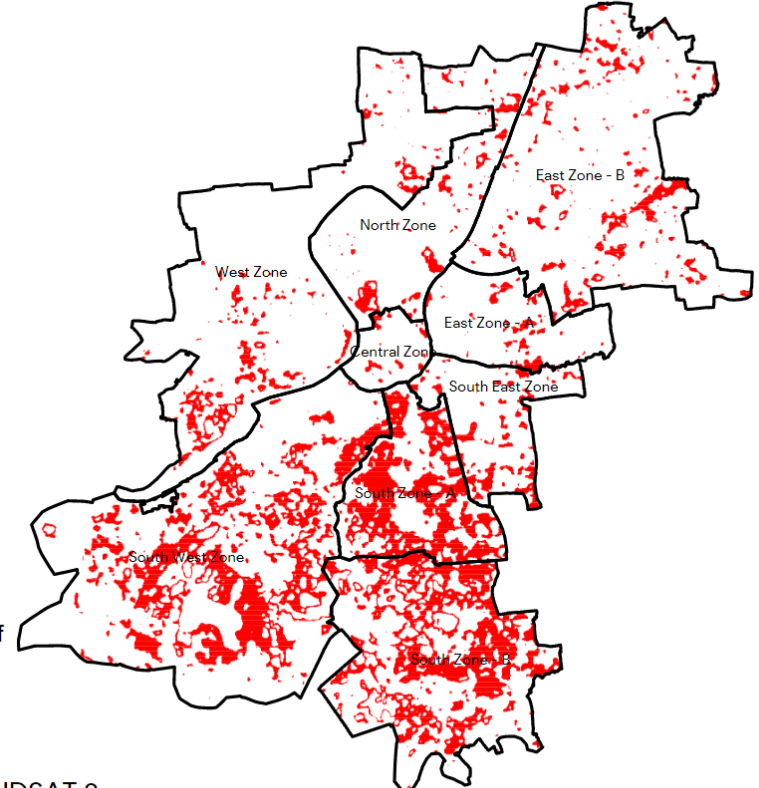
Legend

- Zone_boundary Drawing
- LST_15_04_2021_L8.tif
- <VALUE>
- 27.73206329 - 36.70336
- 36.70336001 - 38.99732
- 38.99732001 - 45.8792

SATELLITE - LANDSAT 8
IMAGE CAPTURED - 15/04/2021



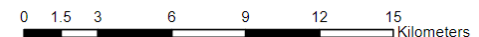
LST MAP OF SURAT SHOWING HIGHEST 85 PERCENTILE TEMPERATURE



Legend

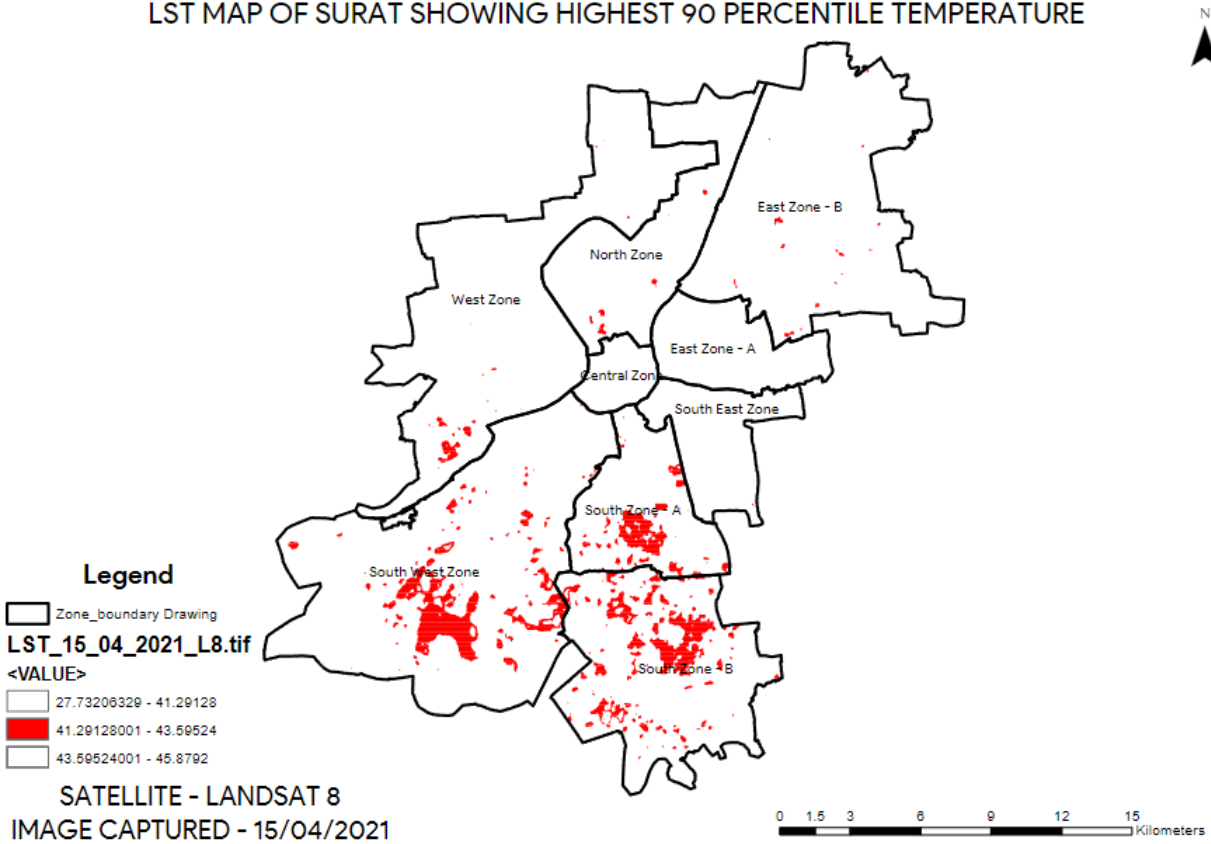
- Zone_boundary Drawing
- ST_15_04_2021_L8.tif
- <VALUE>
- 27.73206329 - 38.99732
- 38.99732001 - 41.29128
- 41.29128001 - 45.8792

SATELLITE - LANDSAT 8
IMAGE CAPTURED - 15/04/2021

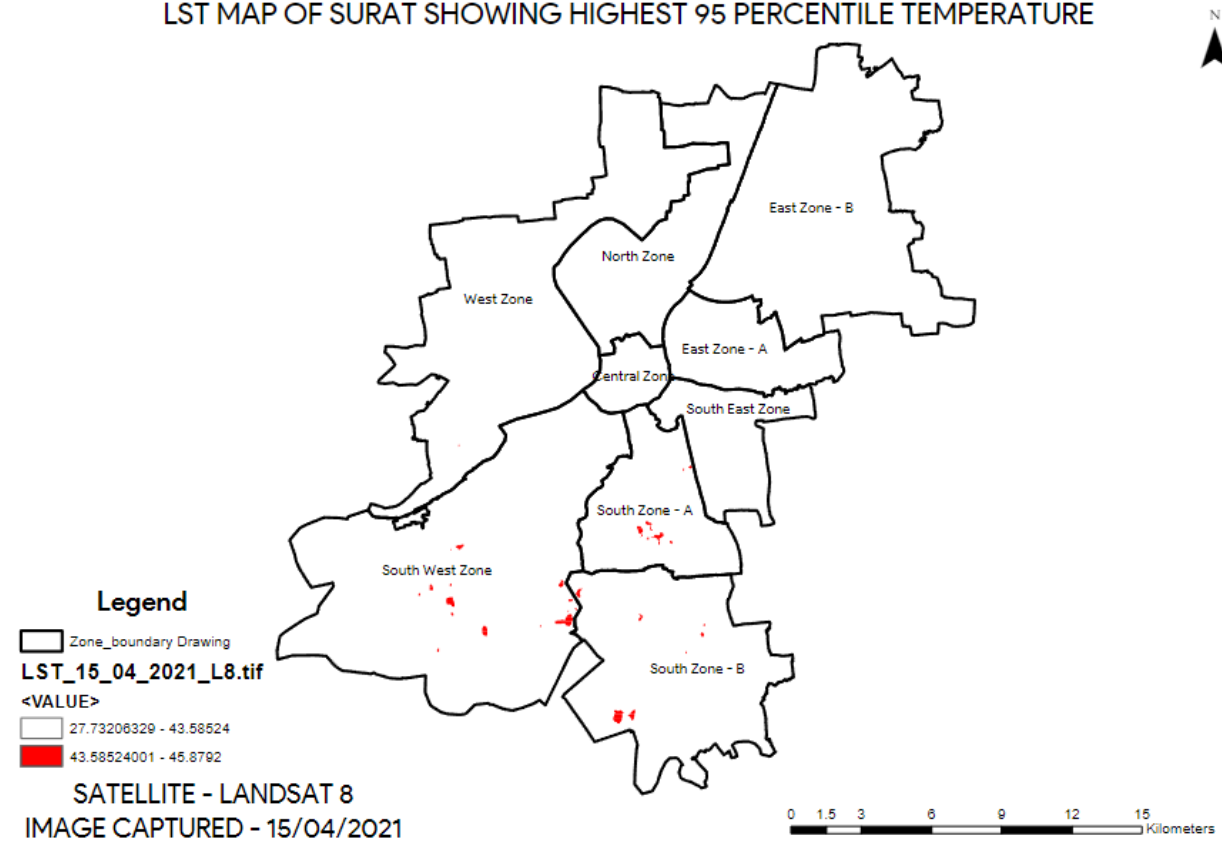


15 April 2021

LST MAP OF SURAT SHOWING HIGHEST 90 PERCENTILE TEMPERATURE

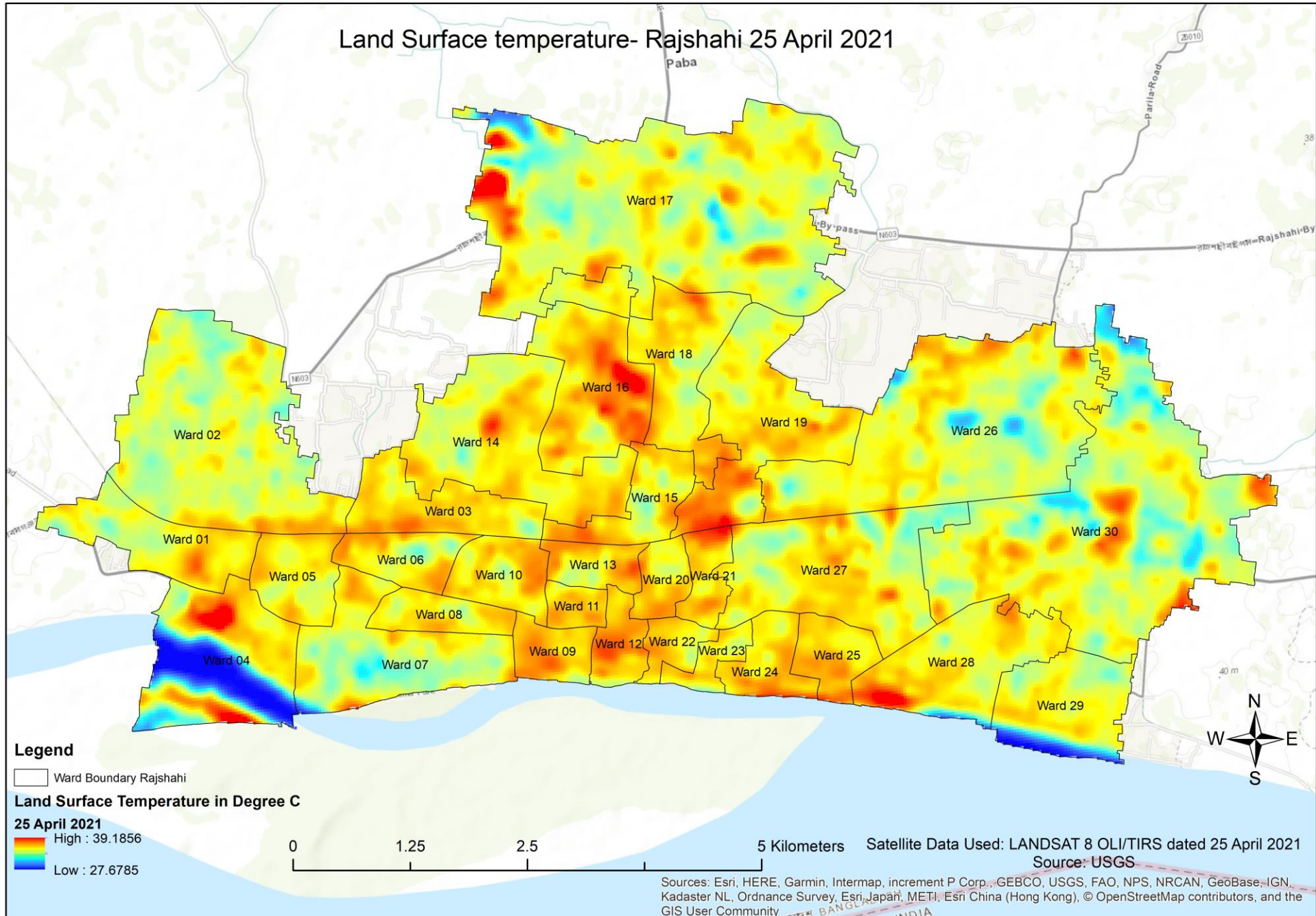


LST MAP OF SURAT SHOWING HIGHEST 95 PERCENTILE TEMPERATURE

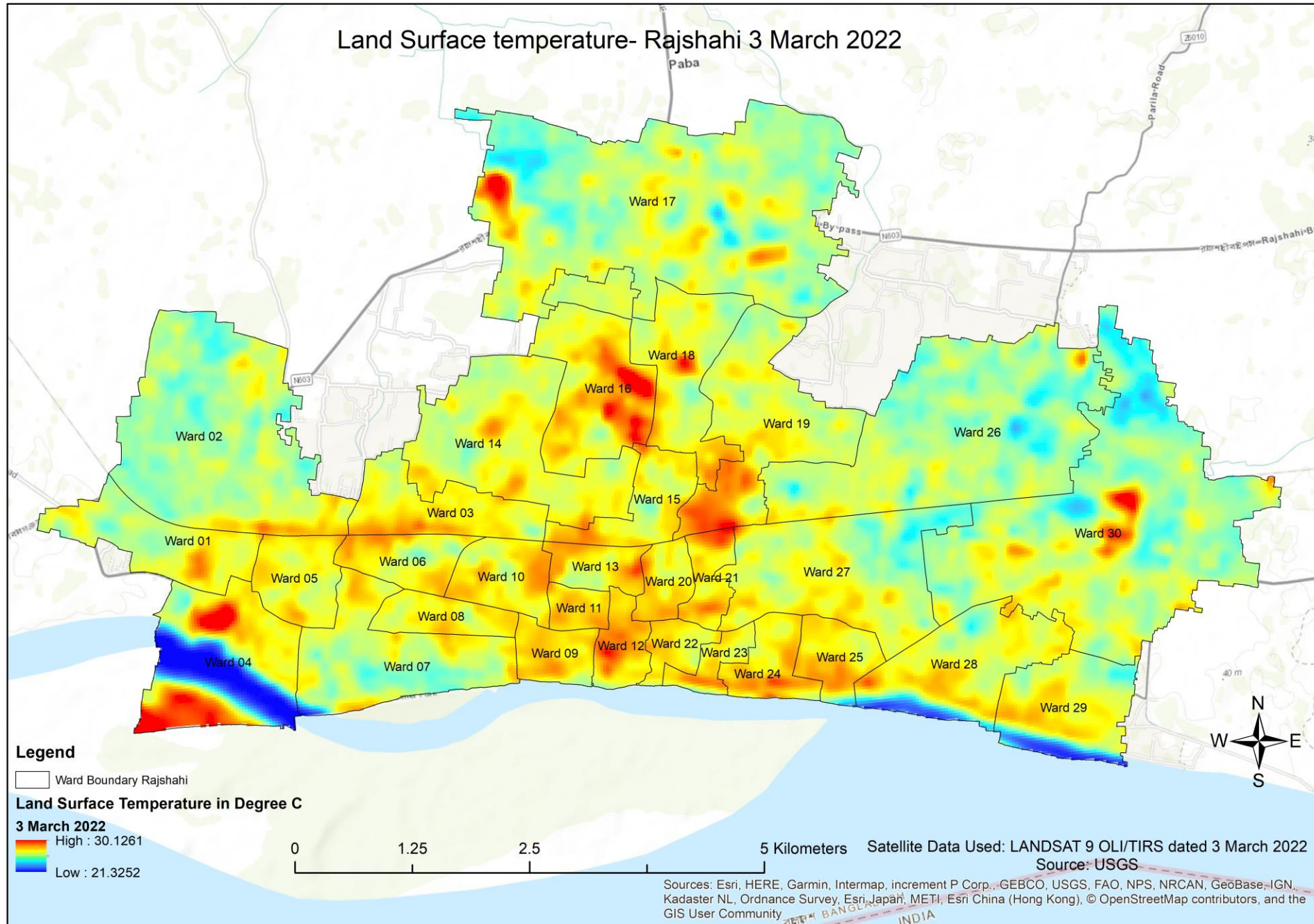


25 April 2021

Land Surface temperature- Rajshahi 25 April 2021

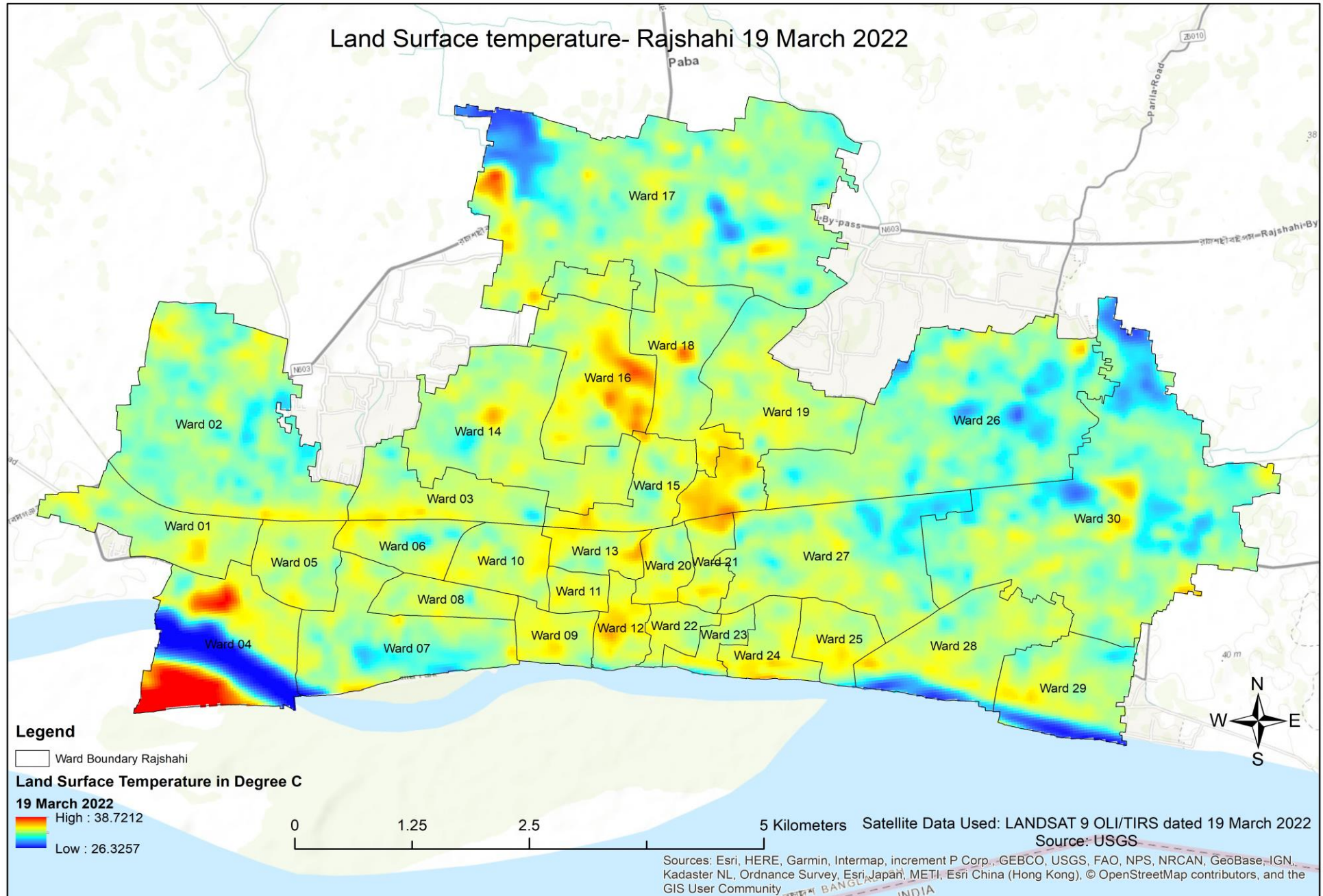


3 March 2022

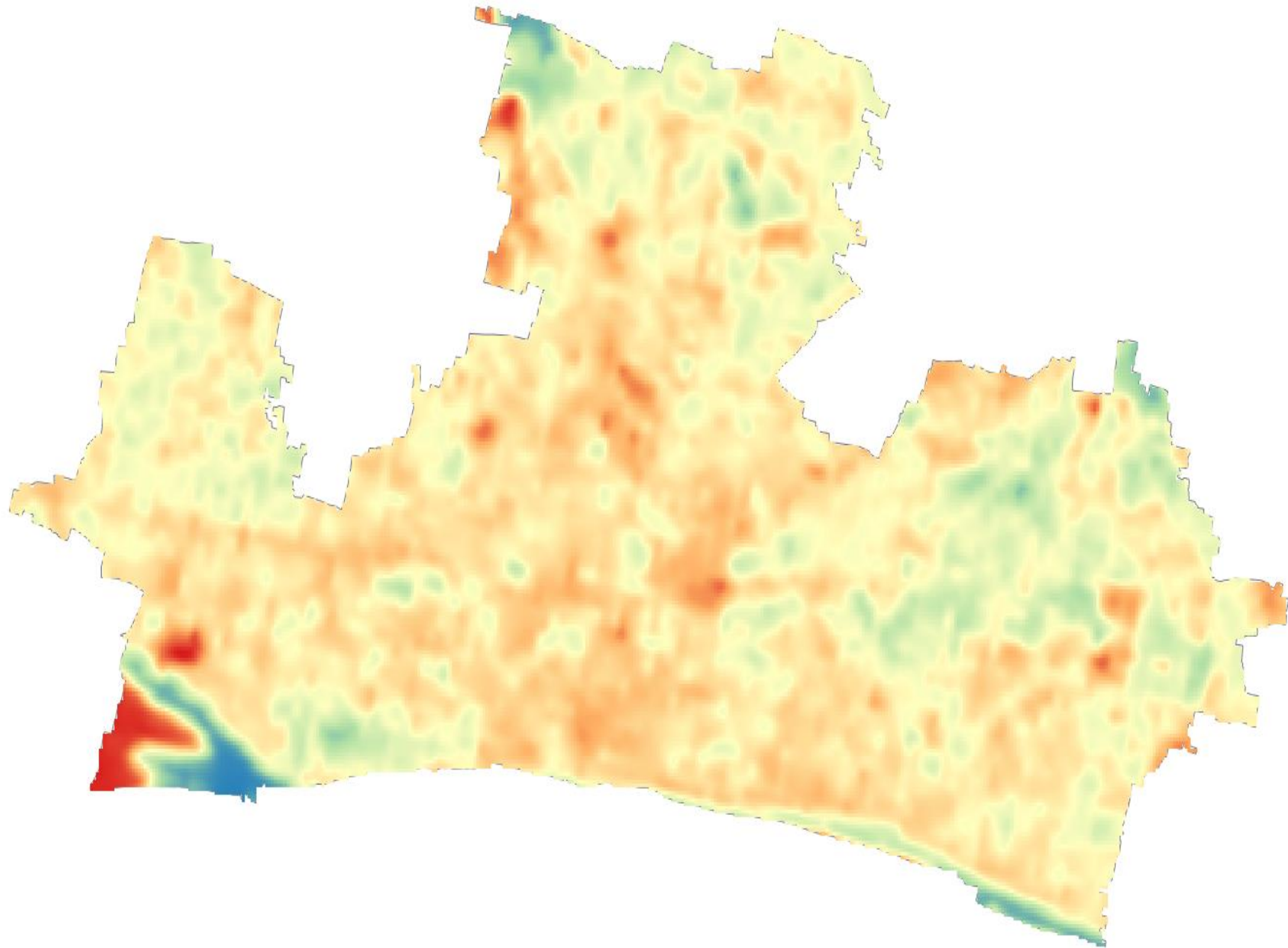


19 March 2022

Land Surface temperature- Rajshahi 19 March 2022



6 April 2020



19 March 2022