ESTIMATION OF LAND SURFACE TEMPERATURE (LST) FROM THERMAL BAND OF LANDSAT 5 SATELLITE

MUDASIR
7755
“B”

IQRA NATIONAL UNIVERSITY PESHAWAR

INTRODUCTION:

Land Surface Temperature (LST):

The Land Surface Temperature (LST) is the radiative skin temperature of the land surface, as measured in the direction of the remote sensor.

Study Area:

Area selected for this study is **CHARSADDA.**

Objectives of the Study:

1. Extraction of Area of Interest (AOI).
2. NDVI estimation
3. TOA Spectral Radiance.
4. Brightness Temperature.
5. Land Surface Emissivity (LSE).
6. Land Surface Temperature.

Material:

- Landsat 5 Image
- ArcGIS Software

Tools:

- Clipping Tool
- Raster Calculator

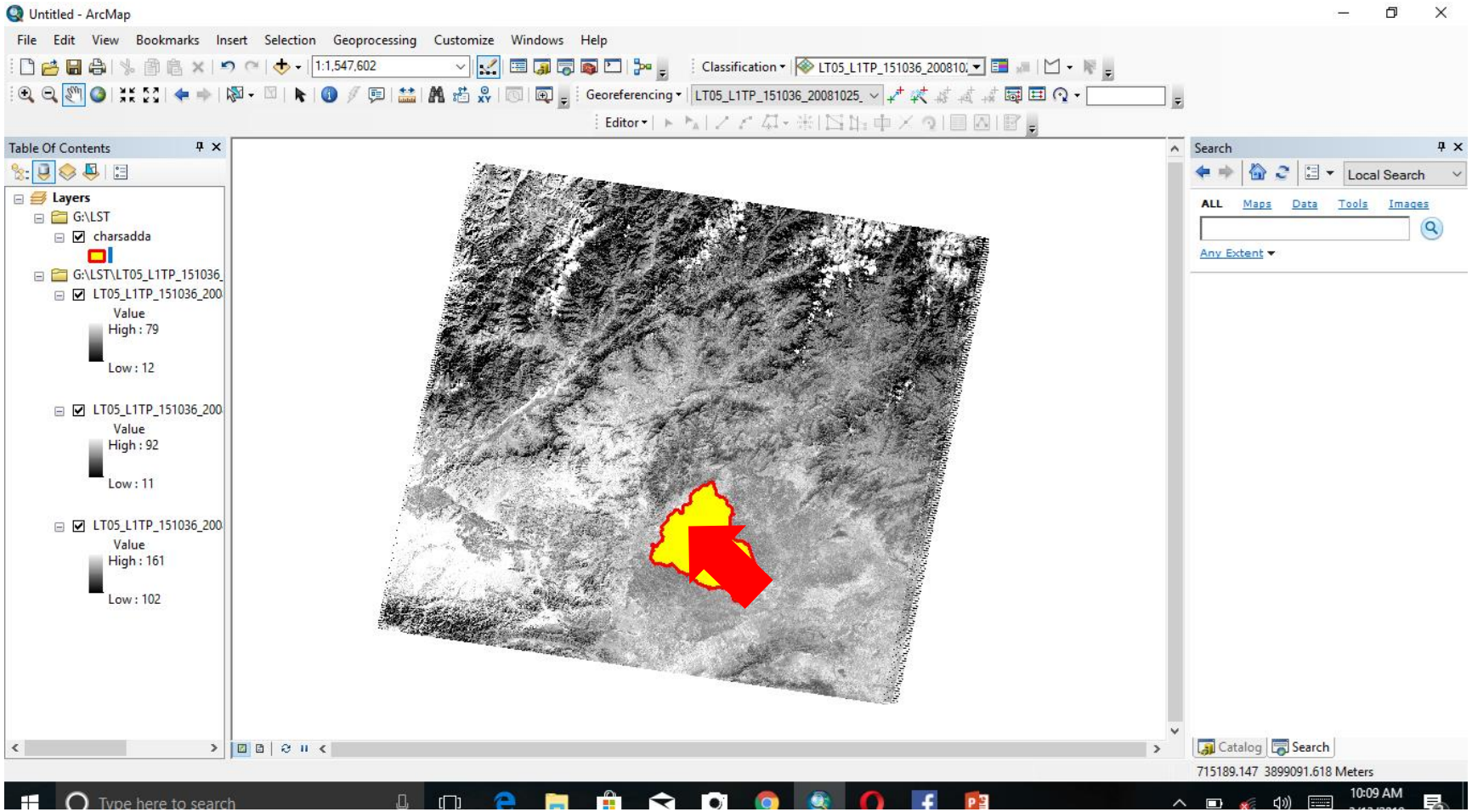
Formulas:

- NDVI = NIR – RED / NIR + RE
- (TOA) Lƛ =ML Qcal + AL
- T= k2 / ln (k1/Lƛ+1)
- PV= (NDVI + NDVI min / NDVI max – NDVI min)2
- Land Surface Emissivity (LSE) = 0.004 (PV) + 0.986 (values are constant)
- LST= (BT/1+W*(BT/P)*ln (e))

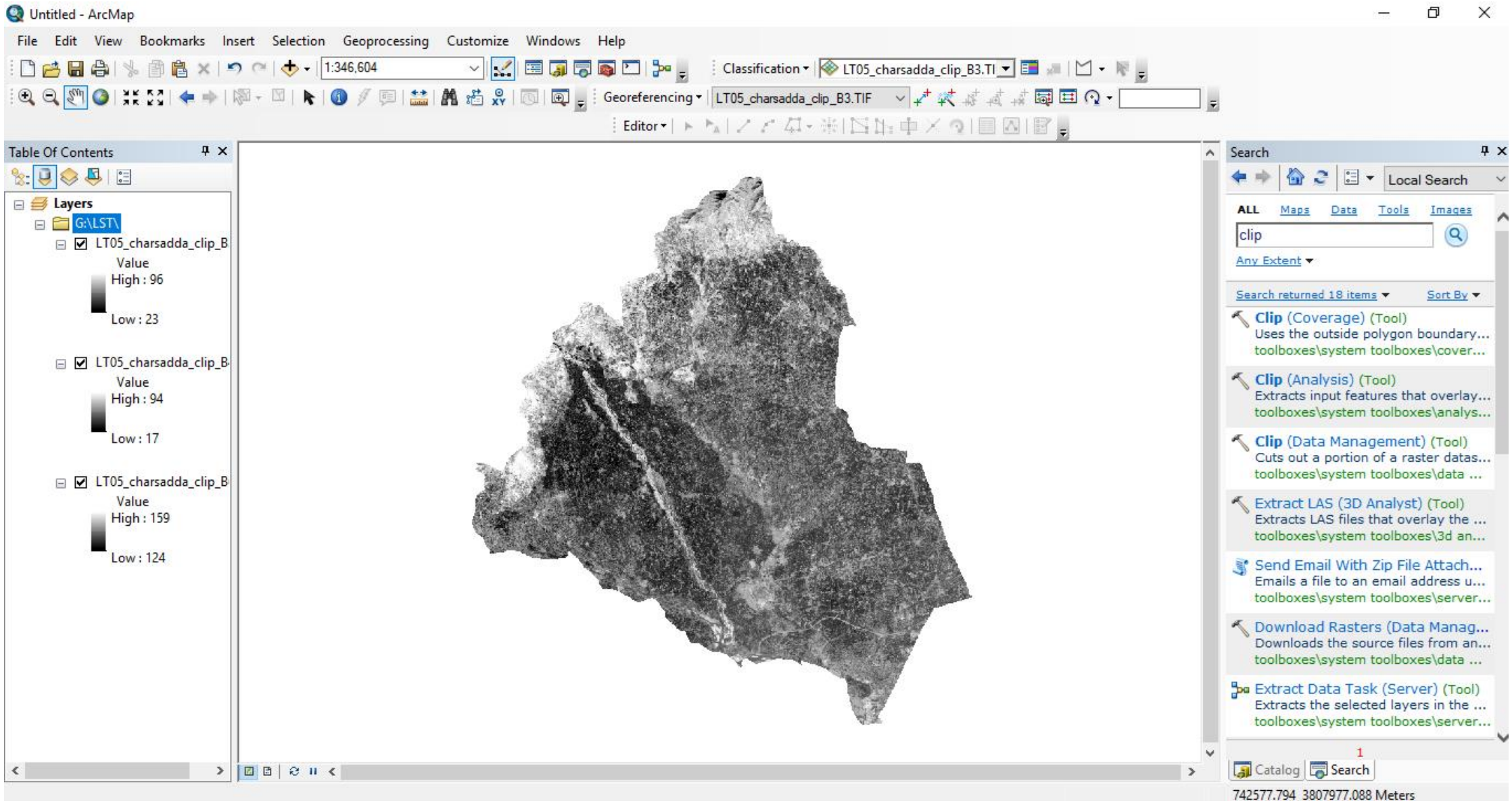
PROBLEM STATEMENT

- To over come the difficulty of LAND SURFACE TEMPERATURE (LST)

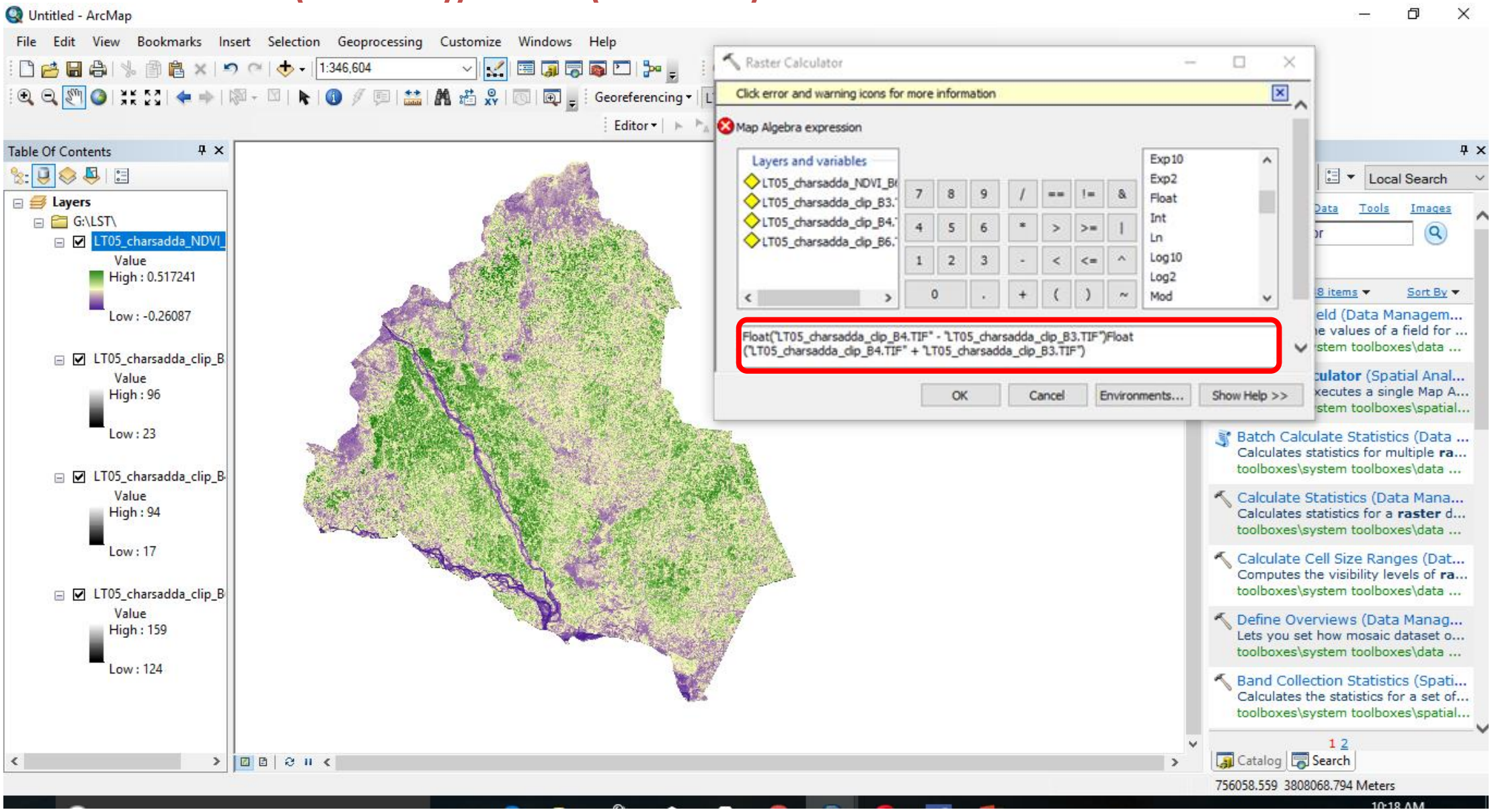
METHODOLOGY


Untitled - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:1,547,602
Classification
LT05_L1TP_151036_200810
Georeferencing
LT05_L1TP_151036_20081025_
Editor
Table Of Contents
Layers
G:\LST
charsadda
G:\LST\LT05_L1TP_151036_
LT05_L1TP_151036_200
Value
High : 79
Low : 12
LT05_L1TP_151036_200
Value
High : 92
Low : 11
LT05_L1TP_151036_200
Value
High : 161
Low : 102
Search
Local Search
ALL Maps Data Tools Images
Any Extent
Catalog
Search
715189.147 3899091.618 Meters
Type here to search
10:09 AM

Clipping of AOI



NDVI = float(NIR-R)/float(NIR+R)

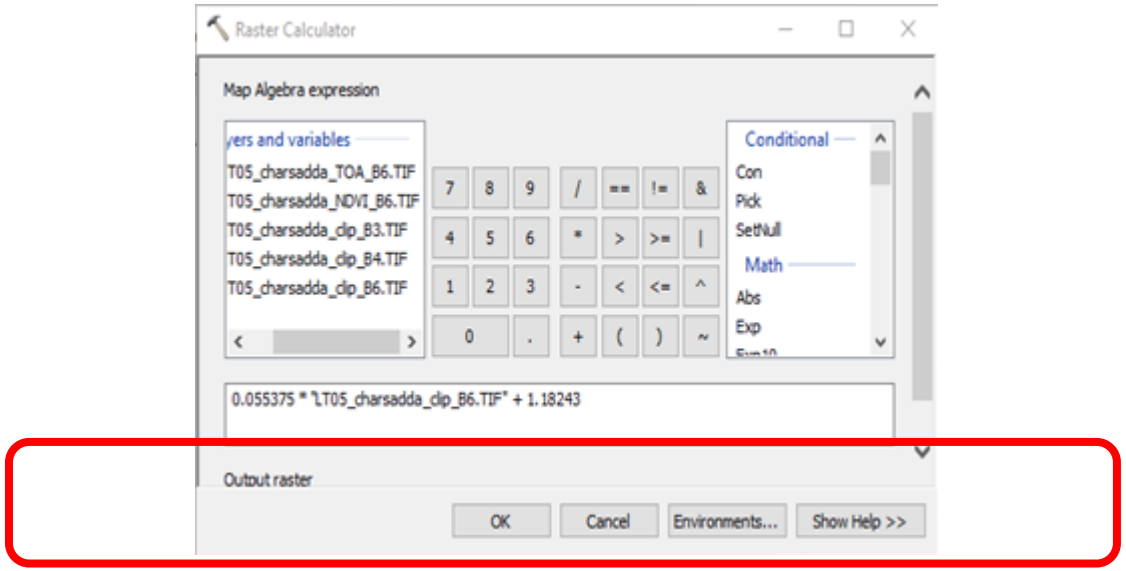


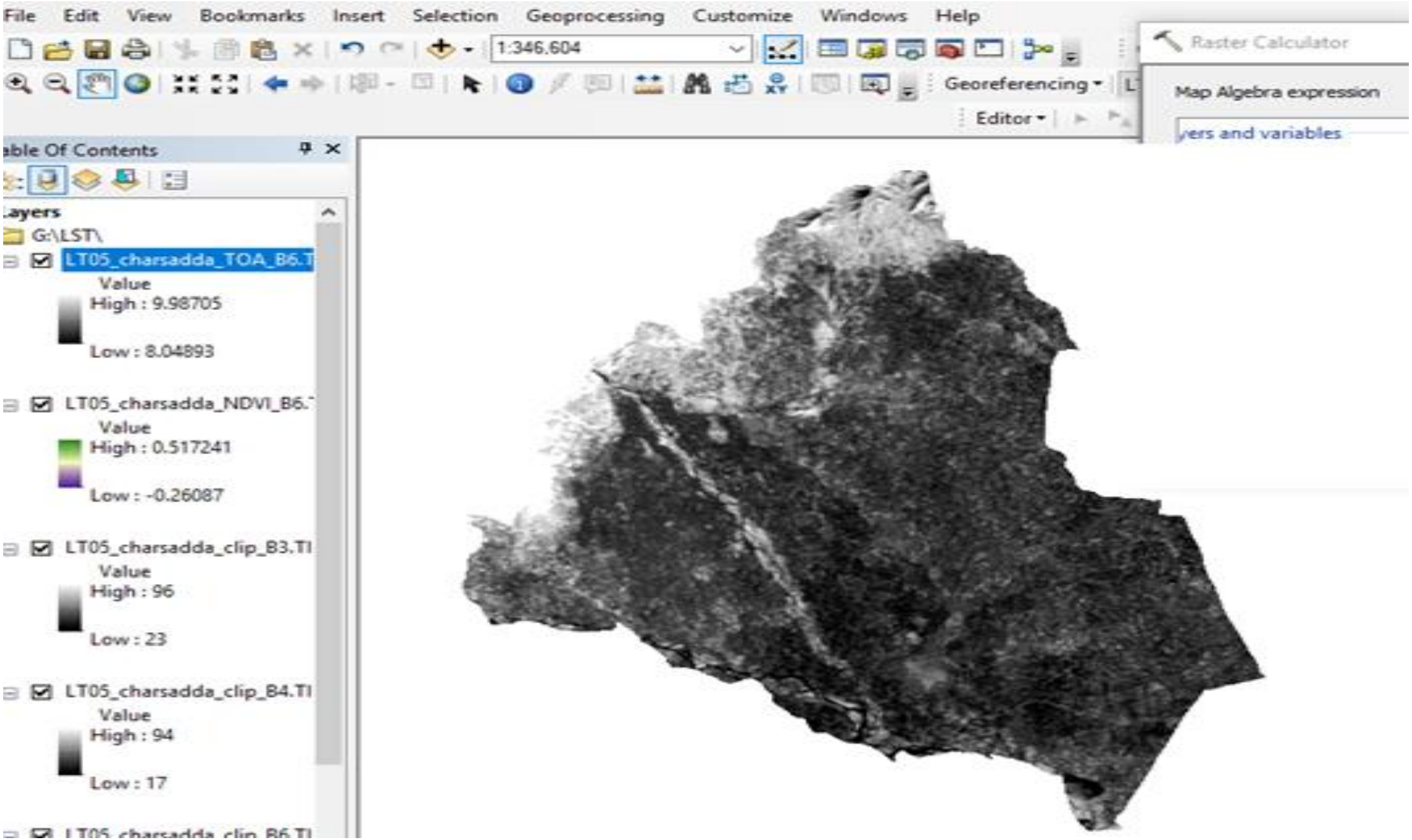
Top of the Atmosphere (TOA):

Formula TOA Radiance is:

$$L\lambda = ML\ Qcal + AL$$

- Lλ = TOA spectral radiance.
- ML=RADIANCE_MULTI_BAND_6.
- AL= RADIANCE_ADD_BAND_6
- Qcal=is the specific thermal band
- The output of this formula is TOA




File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:346.604
Georeferencing
Editor
Raster Calculator
Map Algebra expression
yers and variables
able Of Contents
Layers
G:\LST\
LT05_charsadda_TOA_B6.T
Value
High : 9.98705
Low : 8.04893
LT05_charsadda_NDVI_B6.
Value
High : 0.517241
Low : -0.26087
LT05_charsadda_clip_B3.TI
Value
High : 96
Low : 23
LT05_charsadda_clip_B4.TI
Value
High : 94
Low : 17

Brightness Temperature (BT):

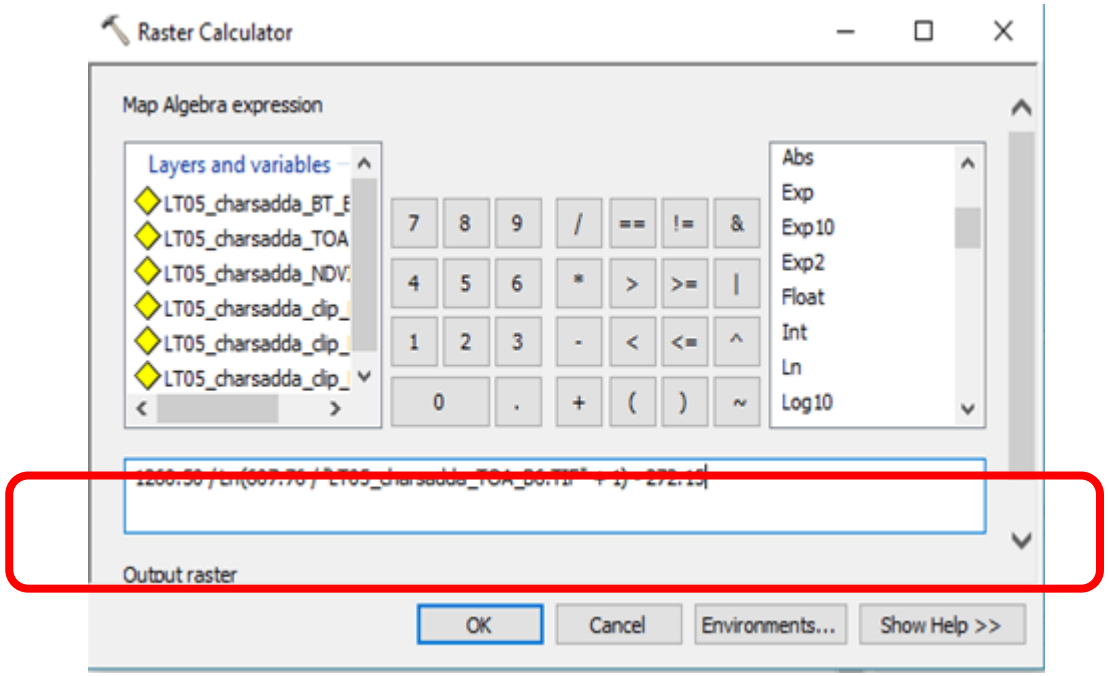
Formula for Brightness Temperature:

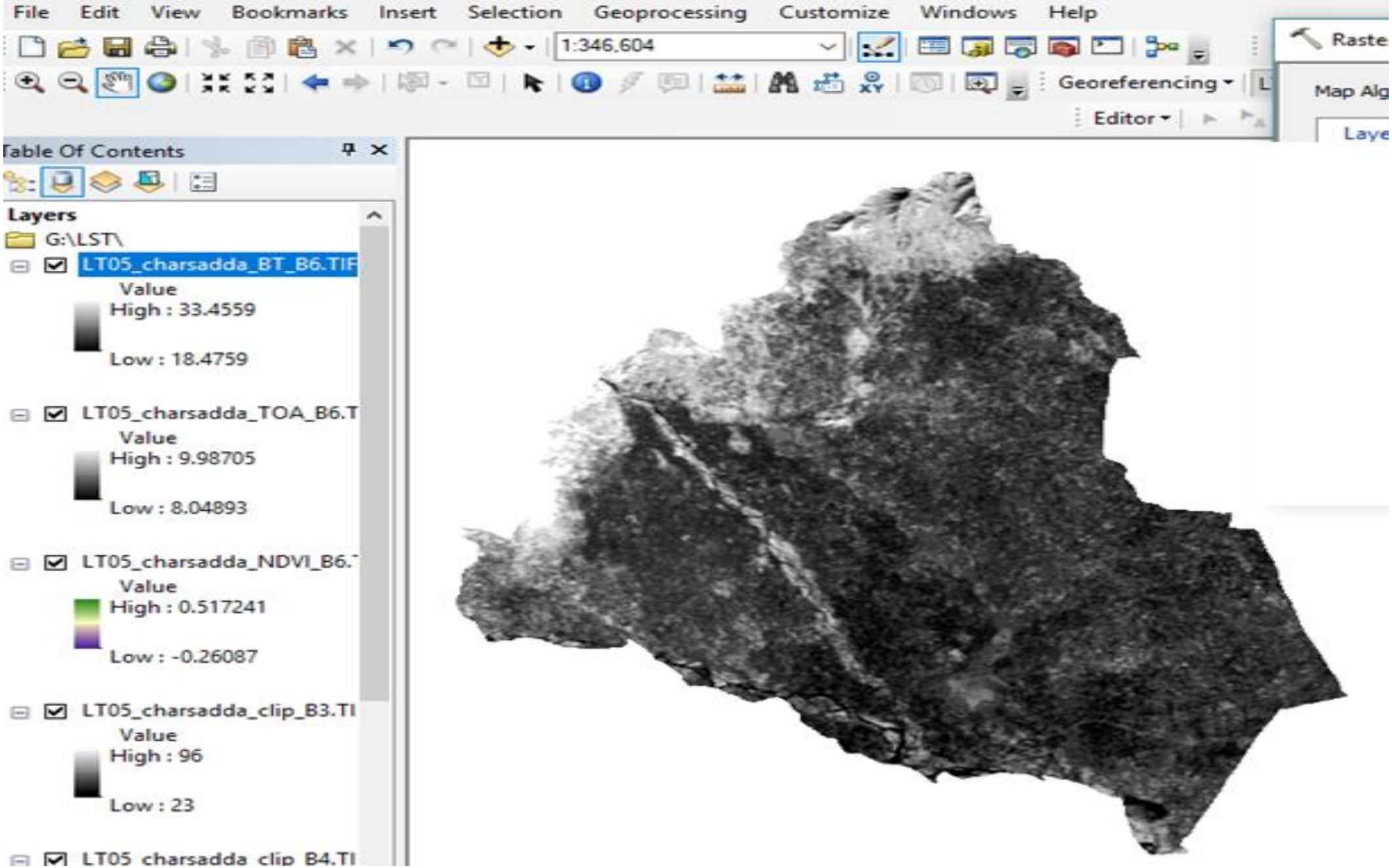
$$T = k2 / Ln. (k1/L\lambda+1)$$

- K1= Thermal constant values present in meta data
- K2= Thermal constant values present in metadata

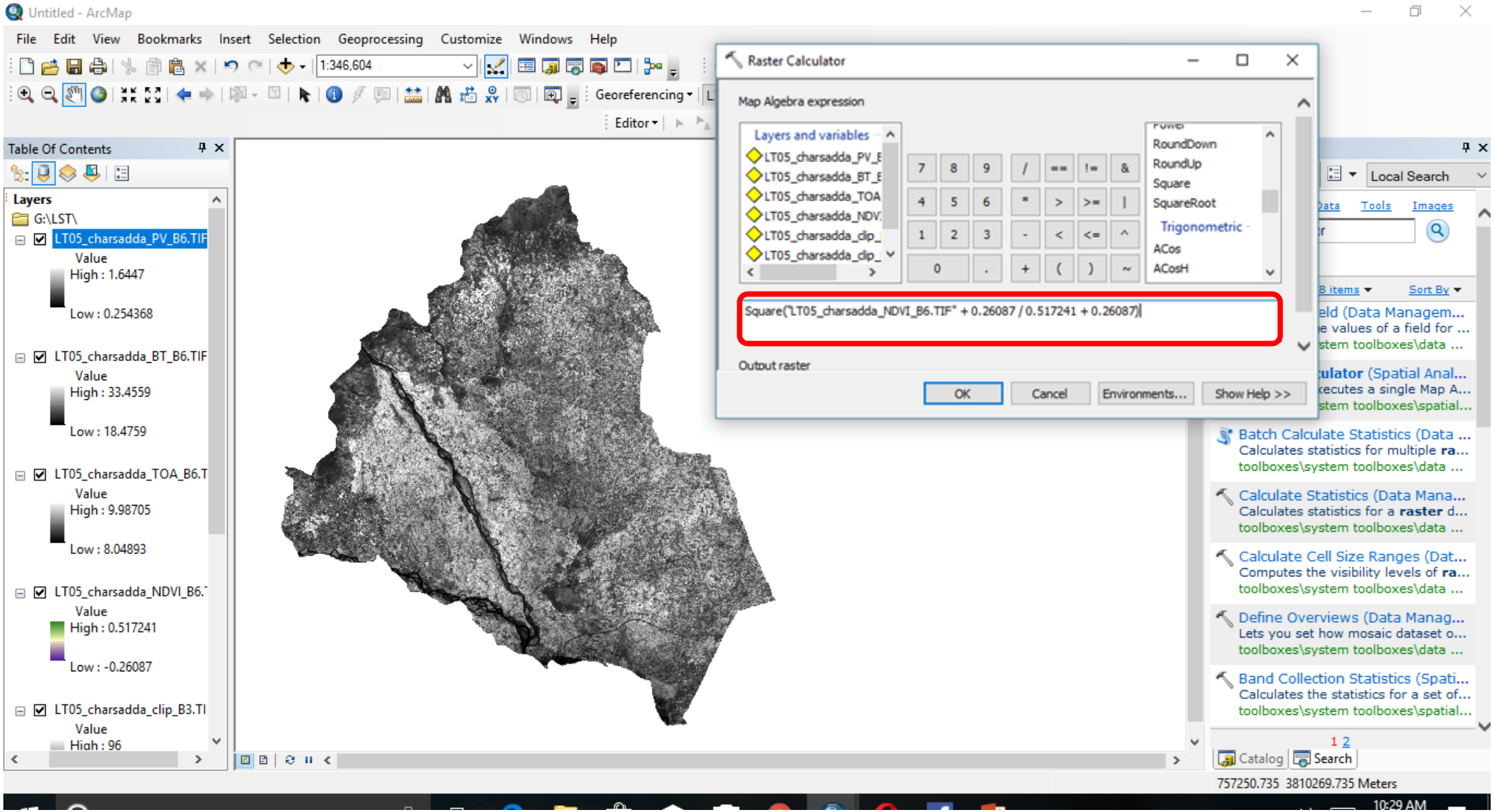
For converting the kelvin temperature to degree centigrade, subtract -272.15 from the formula.

$$T = k2 / Ln. (k1/L\lambda+1)-272.15$$




File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:346,604
Georeferencing
Editor
Table Of Contents
Layers
G:\LST\
LT05_charsadda_BT_B6.TIF
Value
High : 33.4559
Low : 18.4759
LT05_charsadda_TOA_B6.T
Value
High : 9.98705
Low : 8.04893
LT05_charsadda_NDVI_B6.
Value
High : 0.517241
Low : -0.26087
LT05_charsadda_clip_B3.TI
Value
High : 96
Low : 23
LT05_charsadda_clip_B4.TI

(Proportion of Vegetation) PV=square(NDVI-



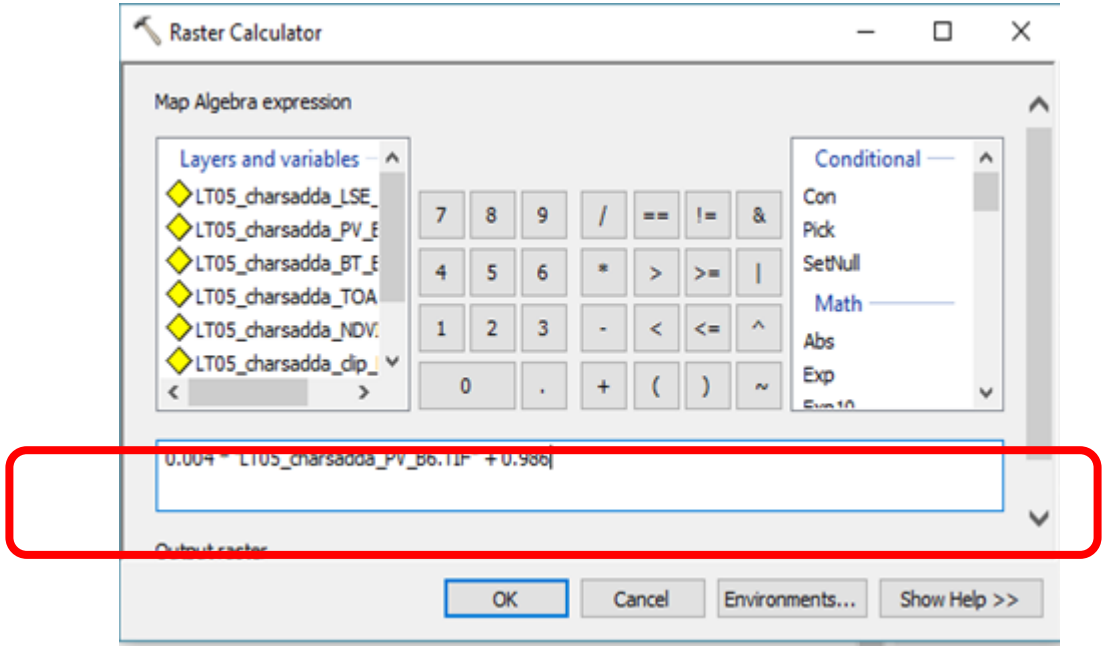
Land Surface Emissivity (LSE):

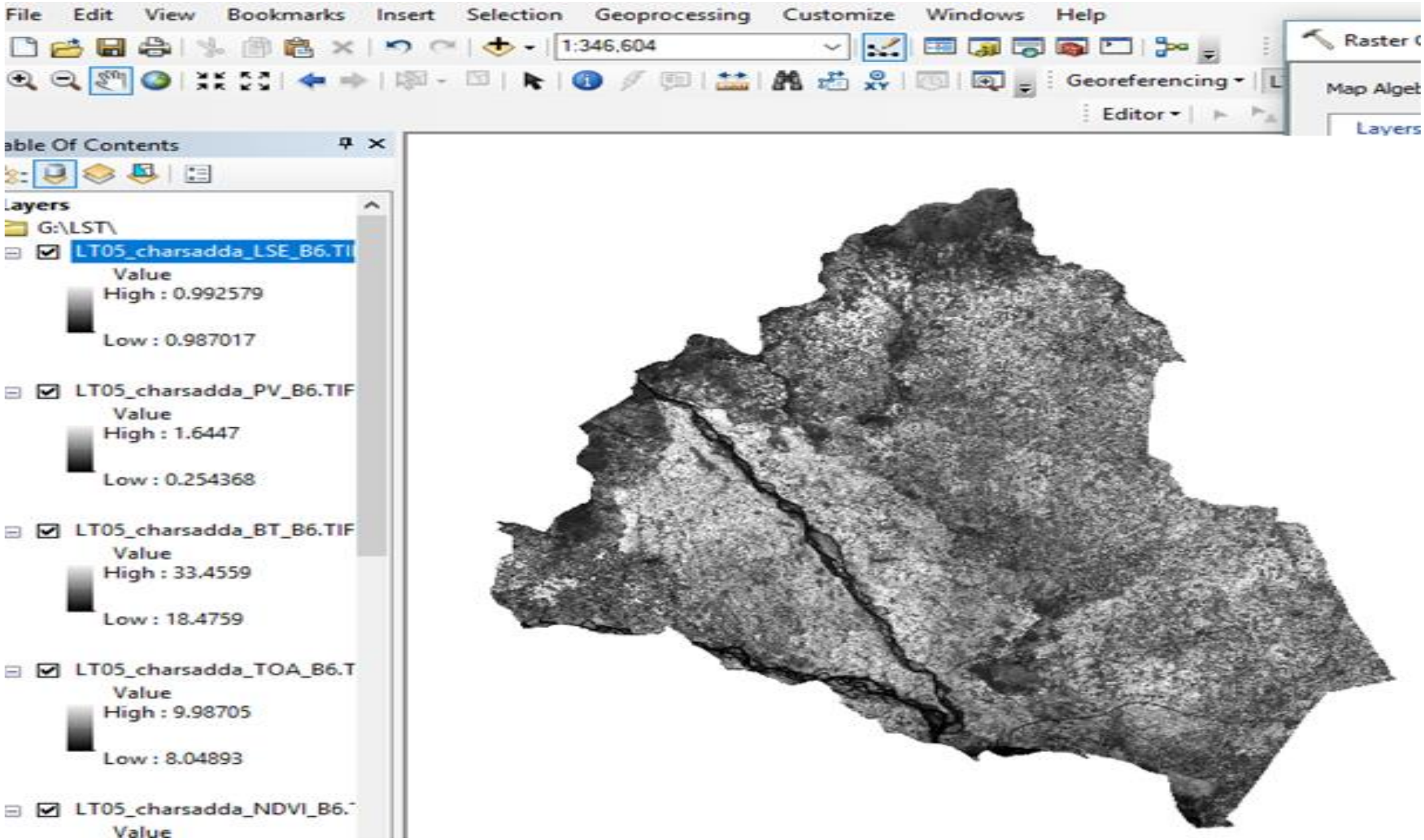
Formula for LSE:

LSE = 0.004*PV+0.986

where the 0.004 and 0.986 is the constant values

While PV is the Proportion Vegetation calculated earlier.




File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:346,604
Georeferencing
Editor
Raster
Map Algeb
Layers
able Of Contents
Layers
G:\LST\
LT05_charsadda_LSE_B6.TI
Value
High : 0.992579
Low : 0.987017
LT05_charsadda_PV_B6.TIF
Value
High : 1.6447
Low : 0.254368
LT05_charsadda_BT_B6.TIF
Value
High : 33.4559
Low : 18.4759
LT05_charsadda_TOA_B6.T
Value
High : 9.98705
Low : 8.04893
LT05_charsadda_NDVI_B6.
Value

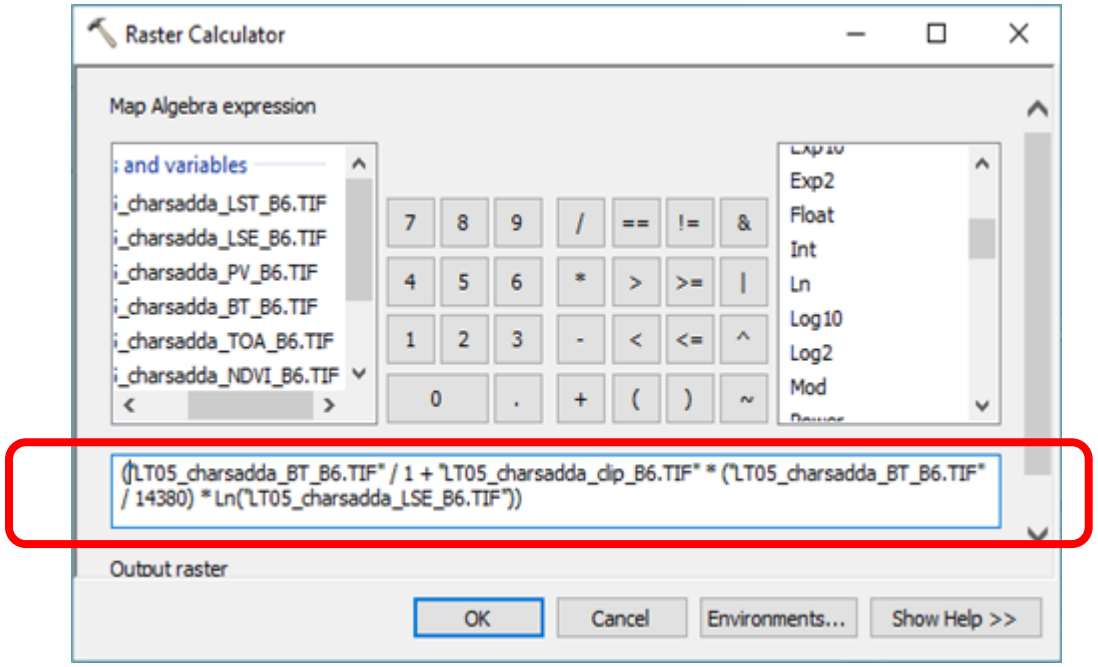
Land Surface Temperature (LST):

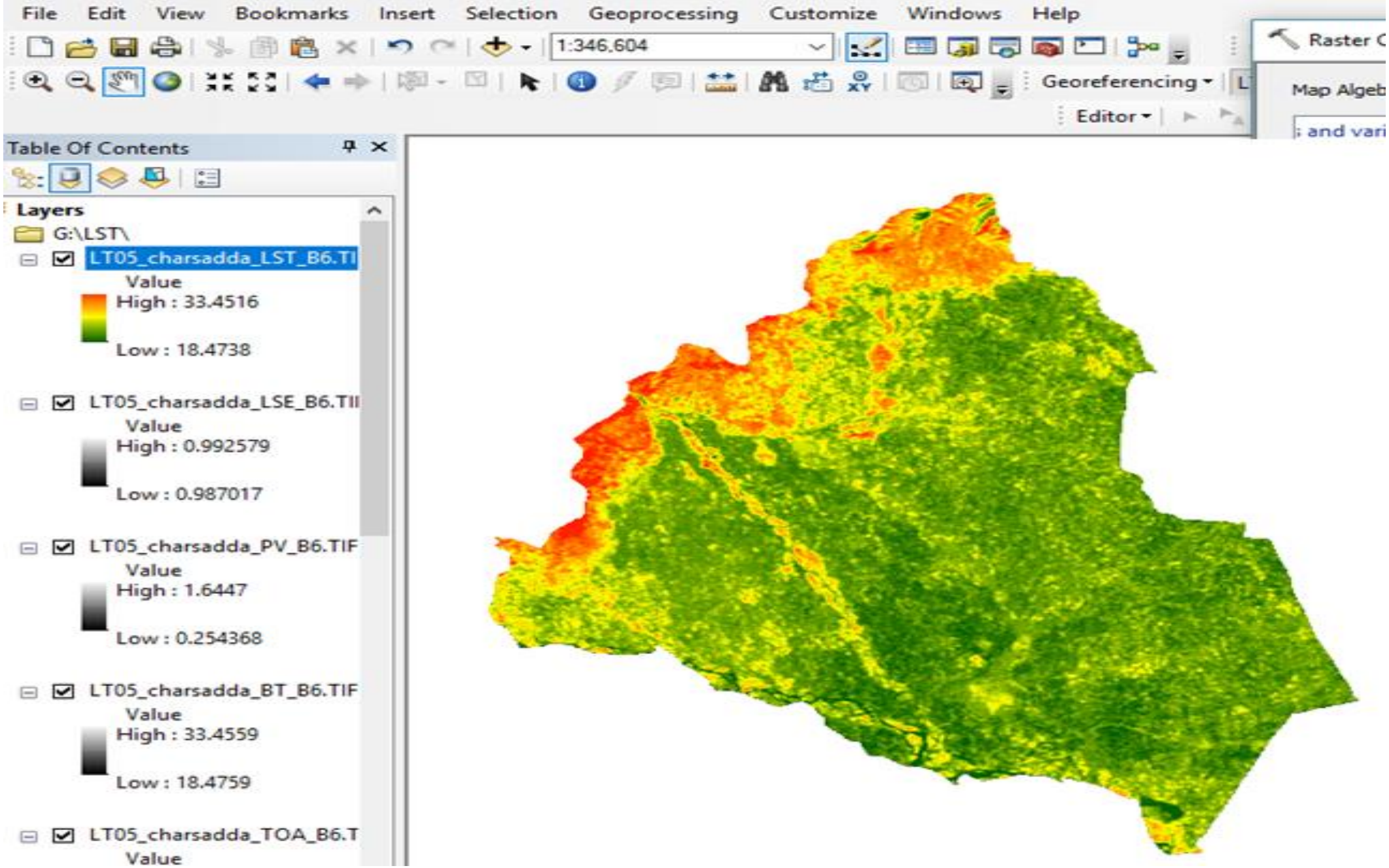
LST= (BT/1+W*(BT/P)*Ln. (e))

- BT= Satellite brightness temperature
- W= Wavelength of emitted radiance
- P= h*c/s ---- equation (1)
- h= Planck's constant having value (6.626*10^-23 joule)
- S= Boltzmann constant (1.38*10^8 m/s)
- C= velocity of light (2.998*10^8 m/s)
- Putting the values in Eq. 1, we get:

  P = 14380

- e= 0.004 (PV) + 0.986




File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:346,604
Georeferencing
Editor
Table Of Contents
Layers
G:\LST\
LT05_charsadda_LST_B6.TI
Value
High : 33.4516
Low : 18.4738
LT05_charsadda_LSE_B6.TI
Value
High : 0.992579
Low : 0.987017
LT05_charsadda_PV_B6.TIF
Value
High : 1.6447
Low : 0.254368
LT05_charsadda_BT_B6.TIF
Value
High : 33.4559
Low : 18.4759
LT05_charsadda_TOA_B6.T
Value

Thanks for your Attention