



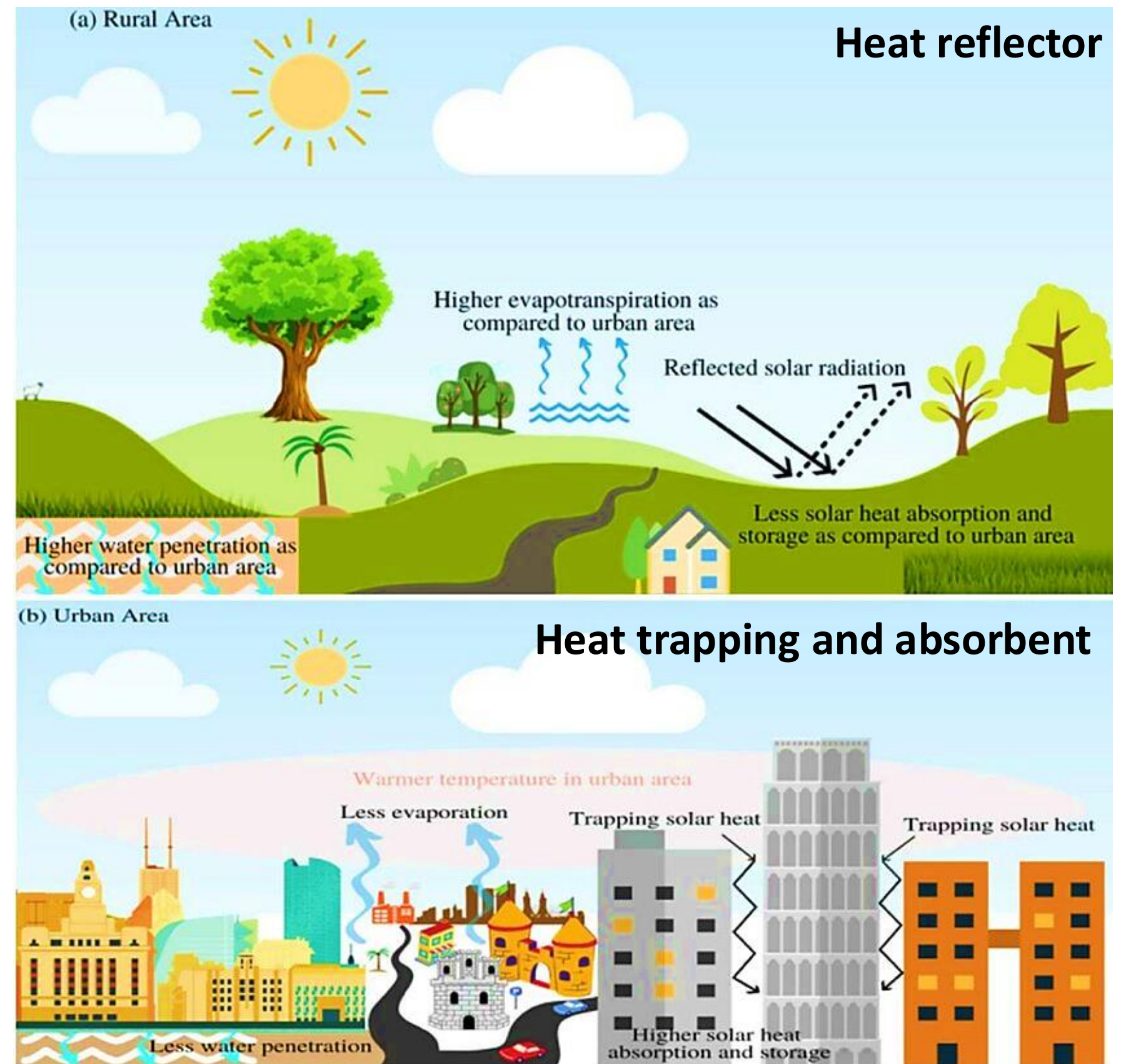
Evaluating the Impact of **Landcover** Changes on **Urban Heat Islands**

A Case Study of Houston

Romina Tafazzoli

Urban Heat Island (UHI) is the result of replacing natural landcovers with build ones in urban areas.

- Buildings
- Streets
- Impervious pavements...



https://www.researchgate.net/figure/An-illustration-of-rural-pervious-and-urban-impervious-areas-lmran-et-al-2021_fig1_369663101

UHI Effect is hazardous for vulnerable communities.

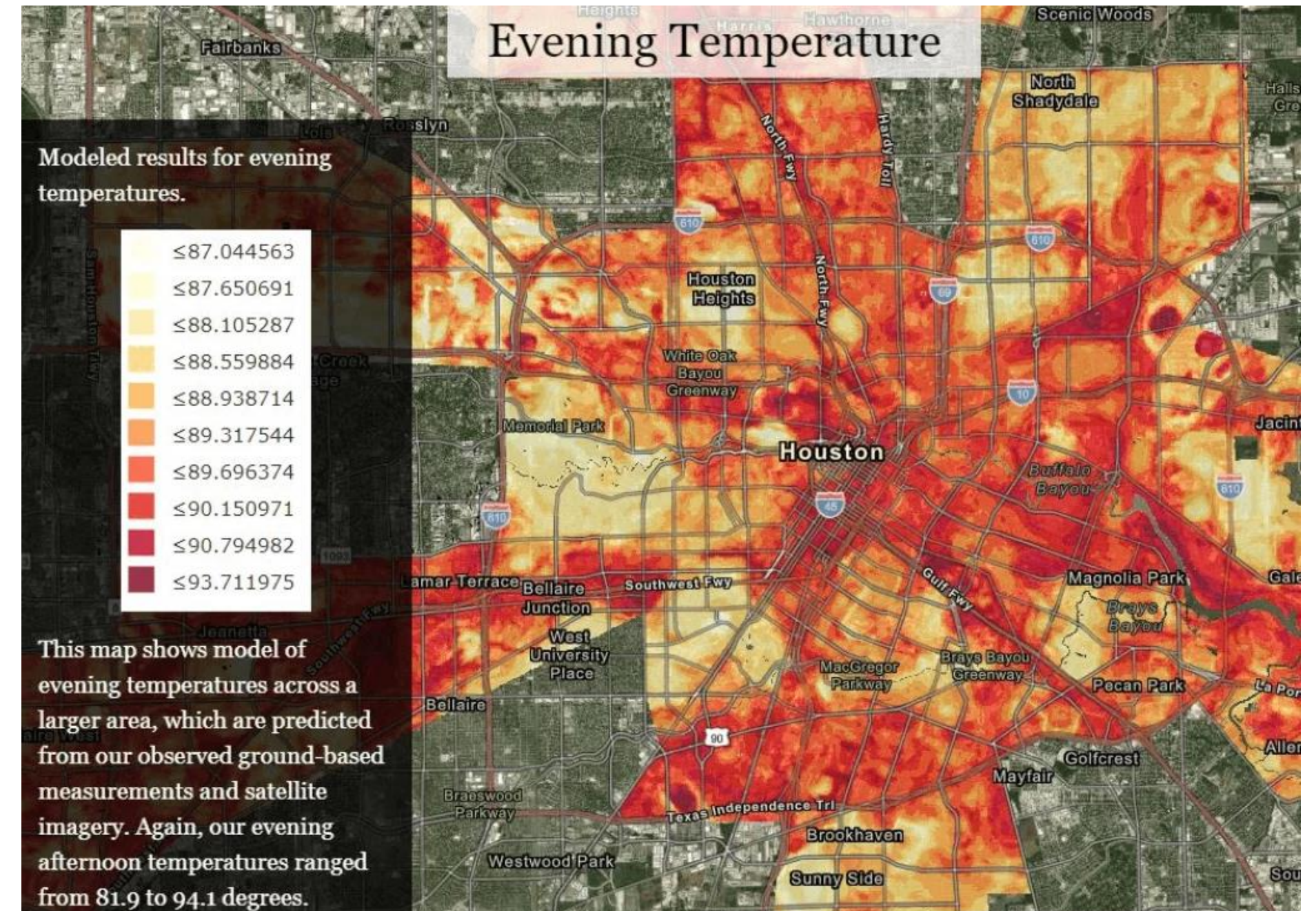
- Older population
- Children
- People with disabilities
- Low-income households living in cities' central parts...



<https://www.dreamstime.com/illustration/vulnerable-groups.html>

Houston

- Over 7.1 millions metropolitan population
- 2.3 millions in 640.4 square miles
- Fourth largest city
- Ninth-most expansive city
- Fourth hottest UHI in the nation (Climate Central 2021)
- 4,254,195 (73%) experience at least 8°F more heat (Climate Central 2023)

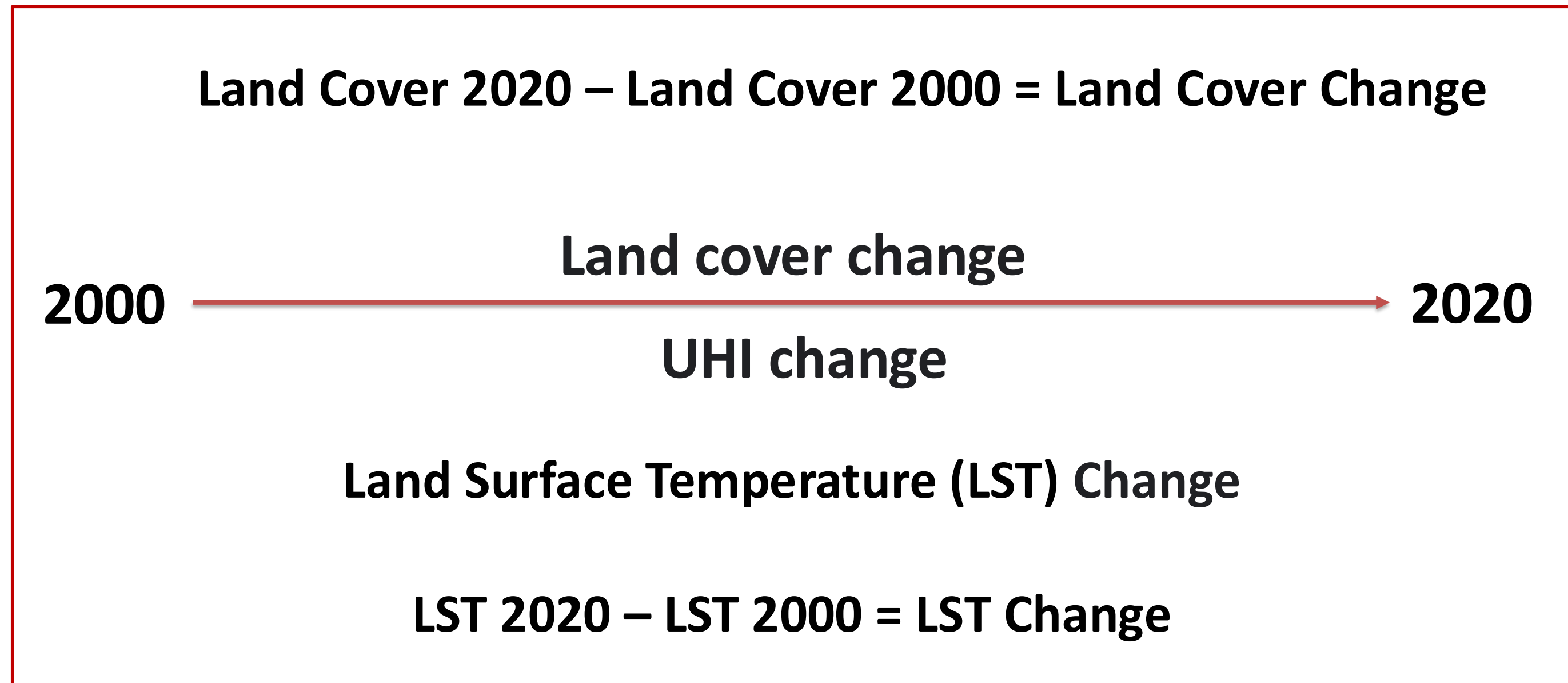


<https://www.understandinghouston.org/blog/blog-houston-is-hot>

Climate Central 2023 Analysis

- 1. Heat intensity concentrated in a distinct urban core:** High contrast in UHI index values between the urban core and surrounding less-developed areas.
- 2. Diffused zones of heat intensity:** Smaller relative difference in UHI index values between urban core and outlying areas.
- 3. Sprawling heat intensity.** High UHI index values are not concentrated in a central core but rather spread across a vast developed land area.

Has **change of landcover** affected Houston UHI?



Maps

Land Cover Analysis

Mosaicking
Multispectral Two
Raster into One

Data: Multispectral bands of the same datasets used for UHI maps.

Creating Schema
and Landcover
Raster Using
Classification
Wizard

1. Categorize landcovers (Developed Landcovers versus Planted and Water Landcovers):

- Developed Landcover: all buildings, streets, Impervious surfaces and vacant lands without vegetation.
- Planted Landcover: forests, green spaces of the city, and farming lands.
- Water Landcover: all types water bodies.

2. Train Model using Training Samples

Accuracy
Assessment

How accurate landcovers have been identified?

1. Accuracy Assessment Points
2. Confusion Matrix

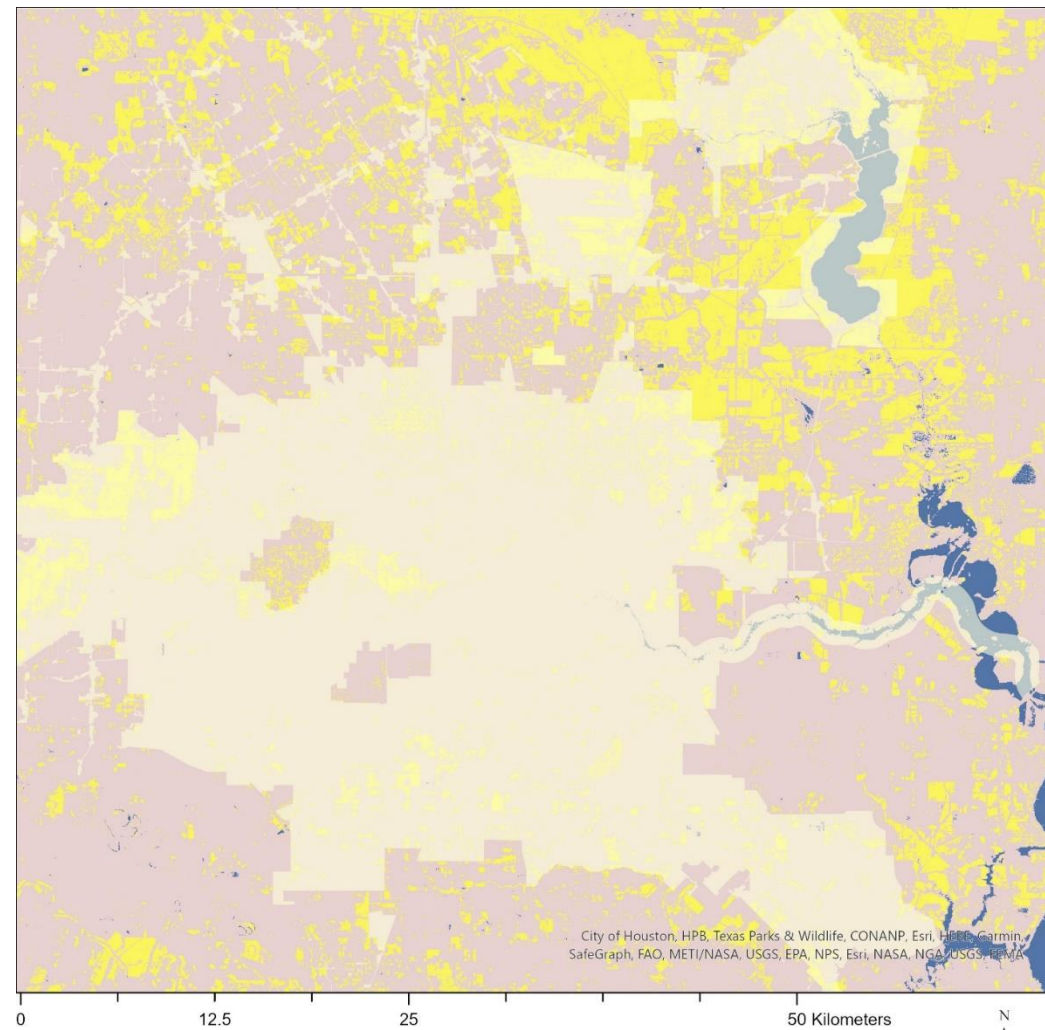
Creating Zonal
Geometry Tables

Quantifying landcover to study landcover change

Landcover
Change
Calculation

Calculate landcover change from 2000 to 2020

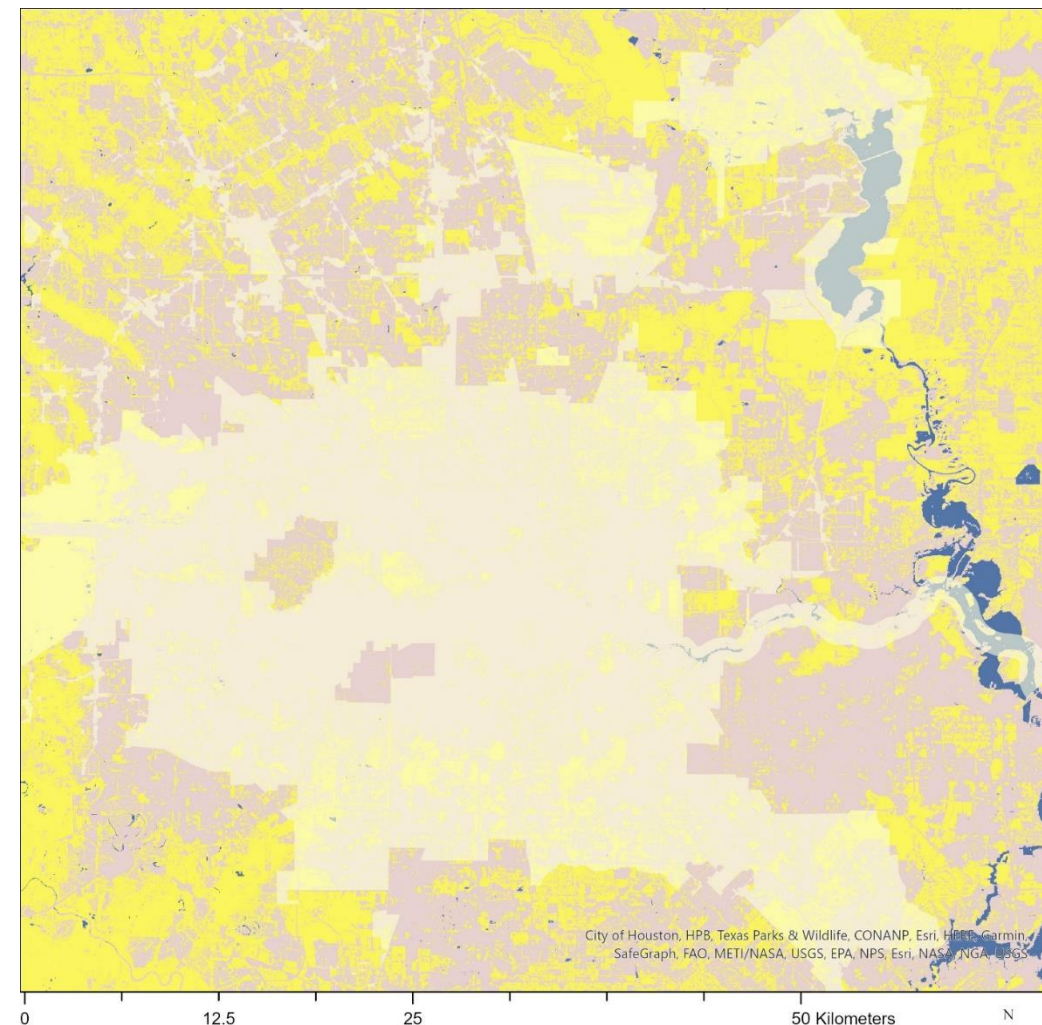
Land Cover Analysis



Houston Landcover 2000
Urban Heat Island and Landcover Project

Legend
Landcover
Water
Planted / Cultivated
Developed
Houston Urban Area

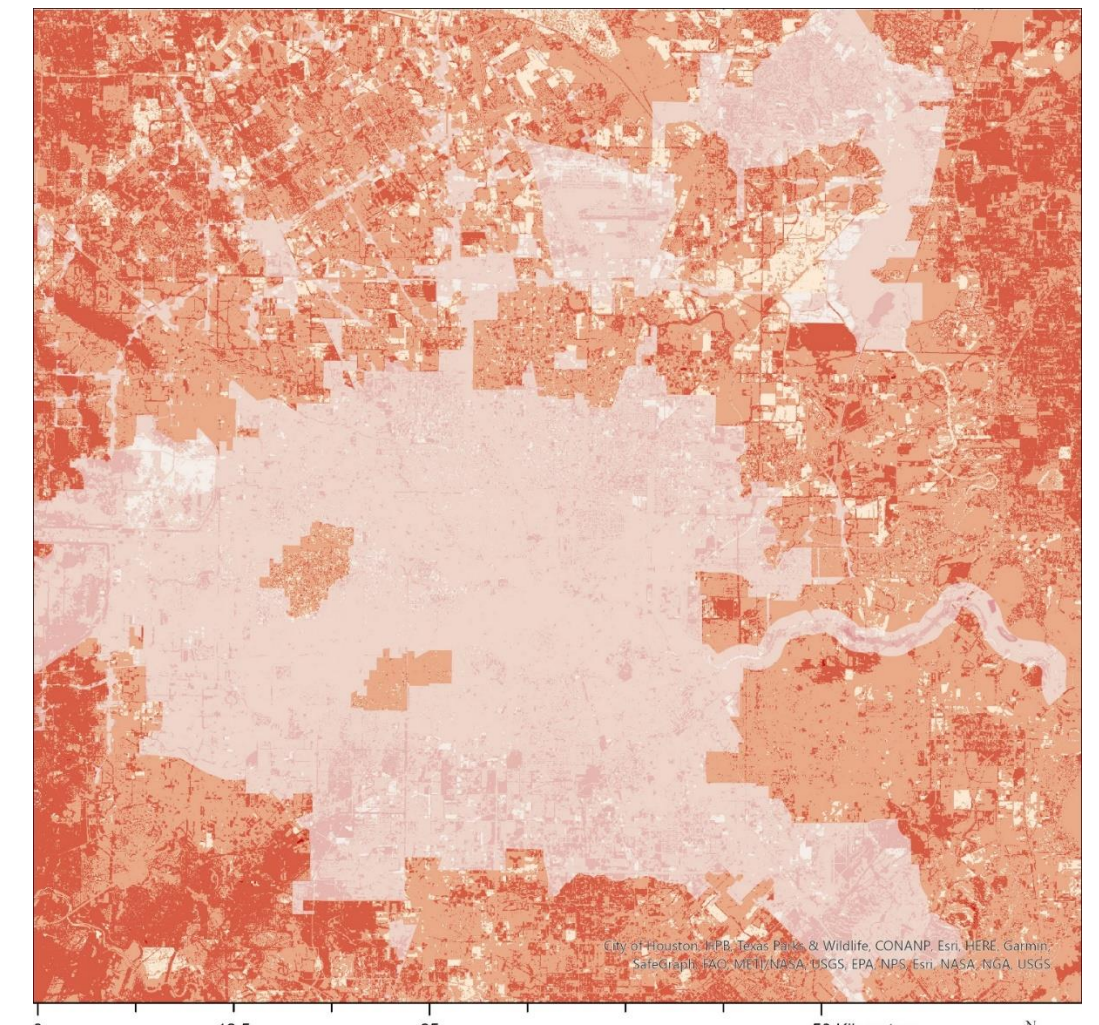
Landcover	Area	Percentage
Developed	3601458000	77.5
Planted	908720100	19.7
Water	131964300	2.8



Houston Landcover 2020
Urban Heat Island and Landcover Project

Legend
Landcover
Water
Planted / Cultivated
Developed
Houston Urban Area

Landcover	Area	Percentage
Developed	2666530000	57.6
Planted	1851097000	39.8
Water	124515900	2.6



Houston Landcover Change 2000-2020
Urban Heat Island and Landcover Project

Legend
Landcover Change
-1.999 - -1
-0.999 - 0
0.001 - 1
1.001 - 2
Houston Urban Area

Landcover change 2000 - 2020

Landcover	Change of share (%)
Developed	-19.9
Planted	20.1
Water	-0.2

LST 2020 Analysis

Data: Landsat 8 Collection 2 Level 1.

Date of data: 08/04/2020 – rows 39 and 40

Conversion to Radiance
Bands 10 and 11

Conversion of Radiance to
Satellite Brightness
Temperature (K)

Conversion of SBT from
Kelvin to Celsius

Combination of Band 10
and 11 Satellite
Temperature

Calculation of NDVI

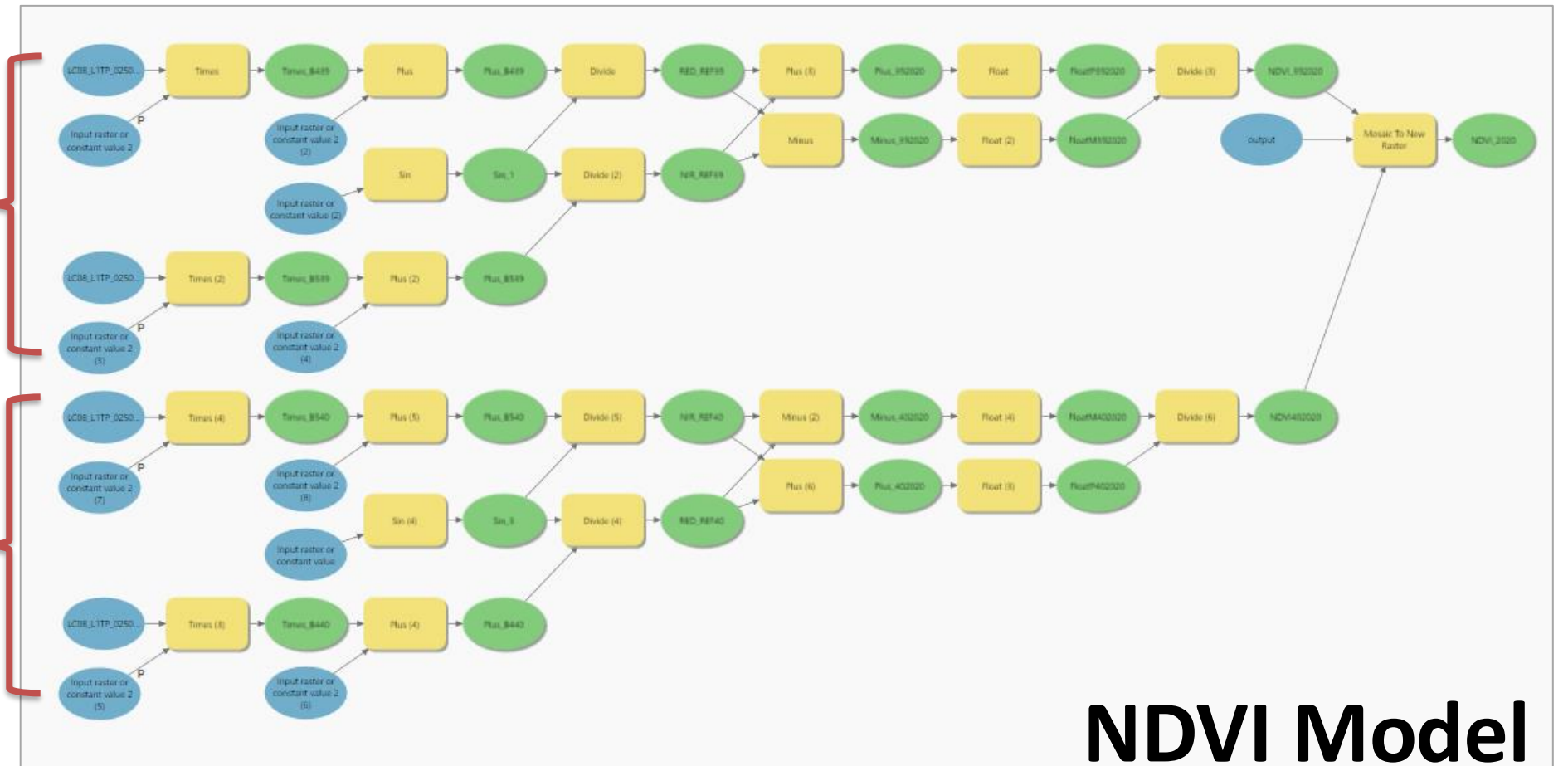
Calculation of Proportion
of Vegetation

Calculation of Land
Surface Emissivity (LSE)

Calculation of Land
Surface Temperature (C)

Row 39

Row 40

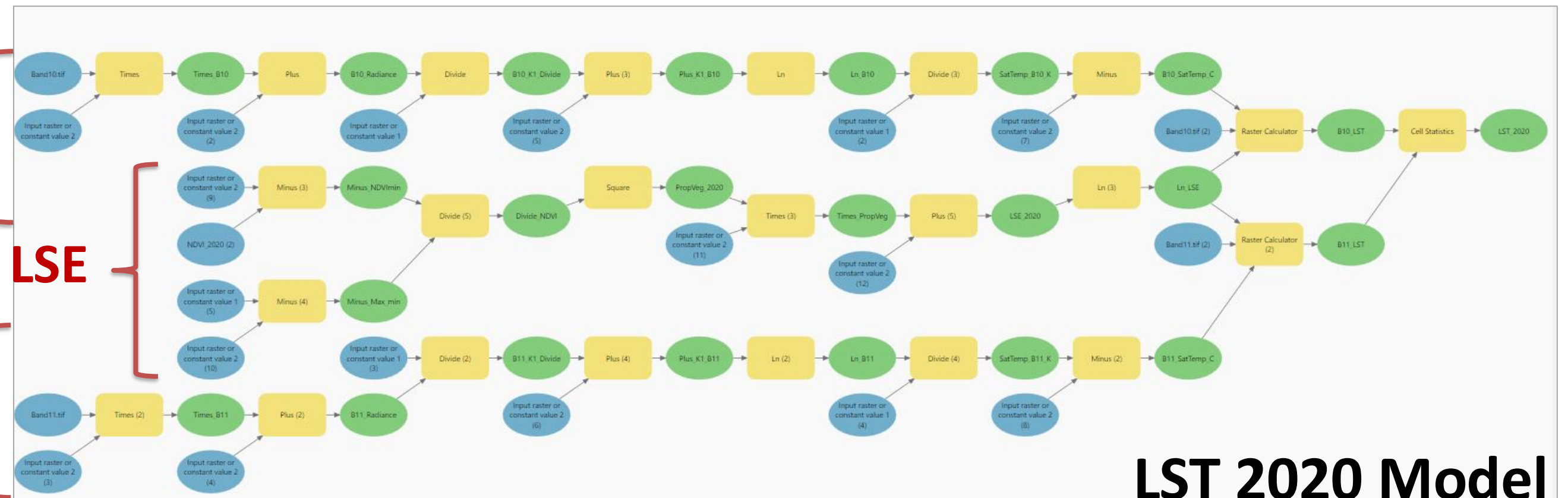


NDVI Model

B10 LST

NDVI to LSE

B11 LST



LST 2020 Model

LST 2000 Analysis

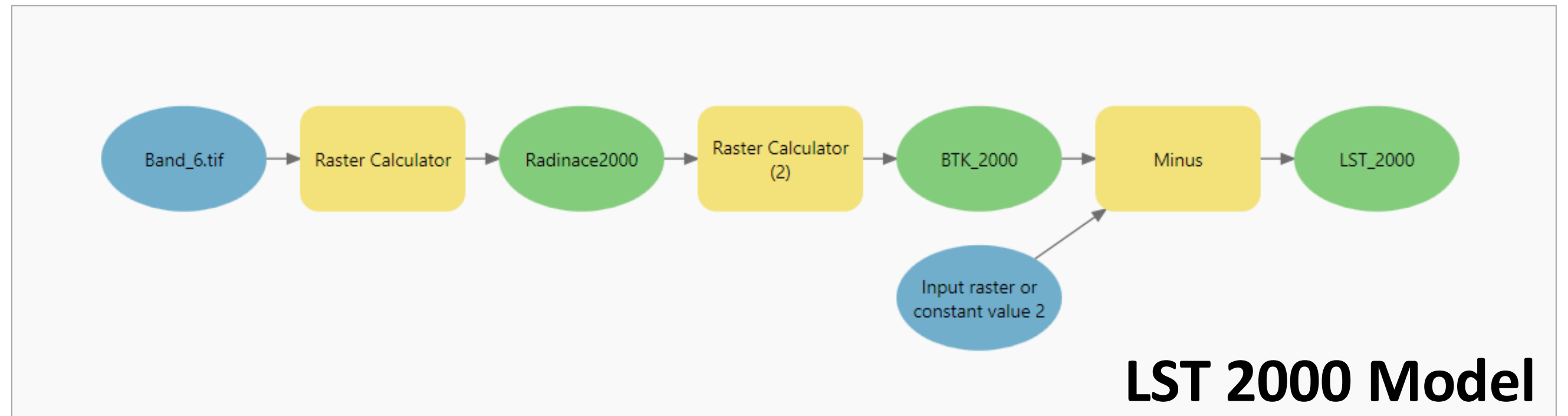
Data: Landsat 5 Collection 2 Level 1.

Date of data: 08/04/2020 – rows 39 and 40

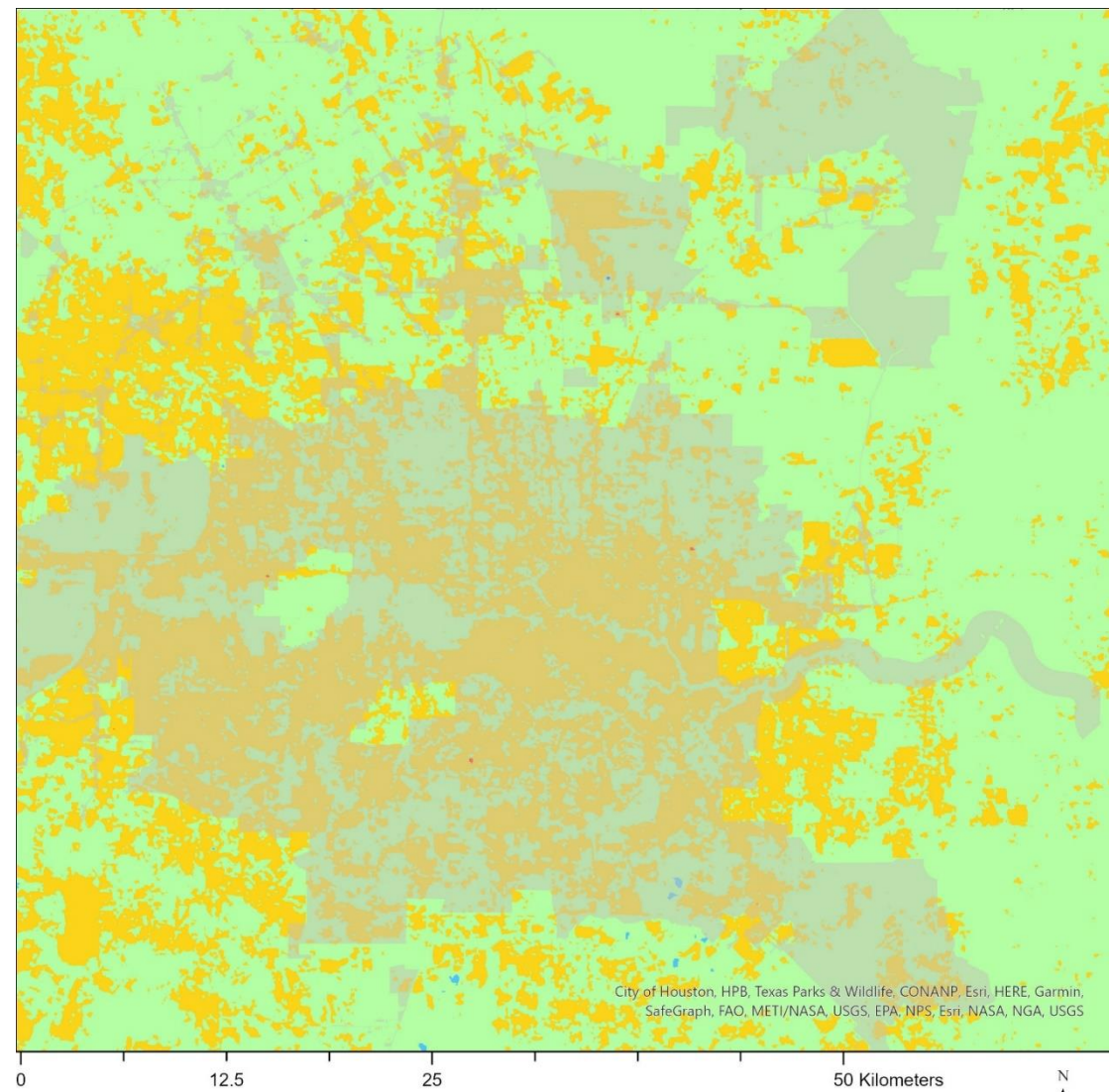
Conversion to
Radiance
Bands 6

Calculation of Land
Surface Temperature
(K)

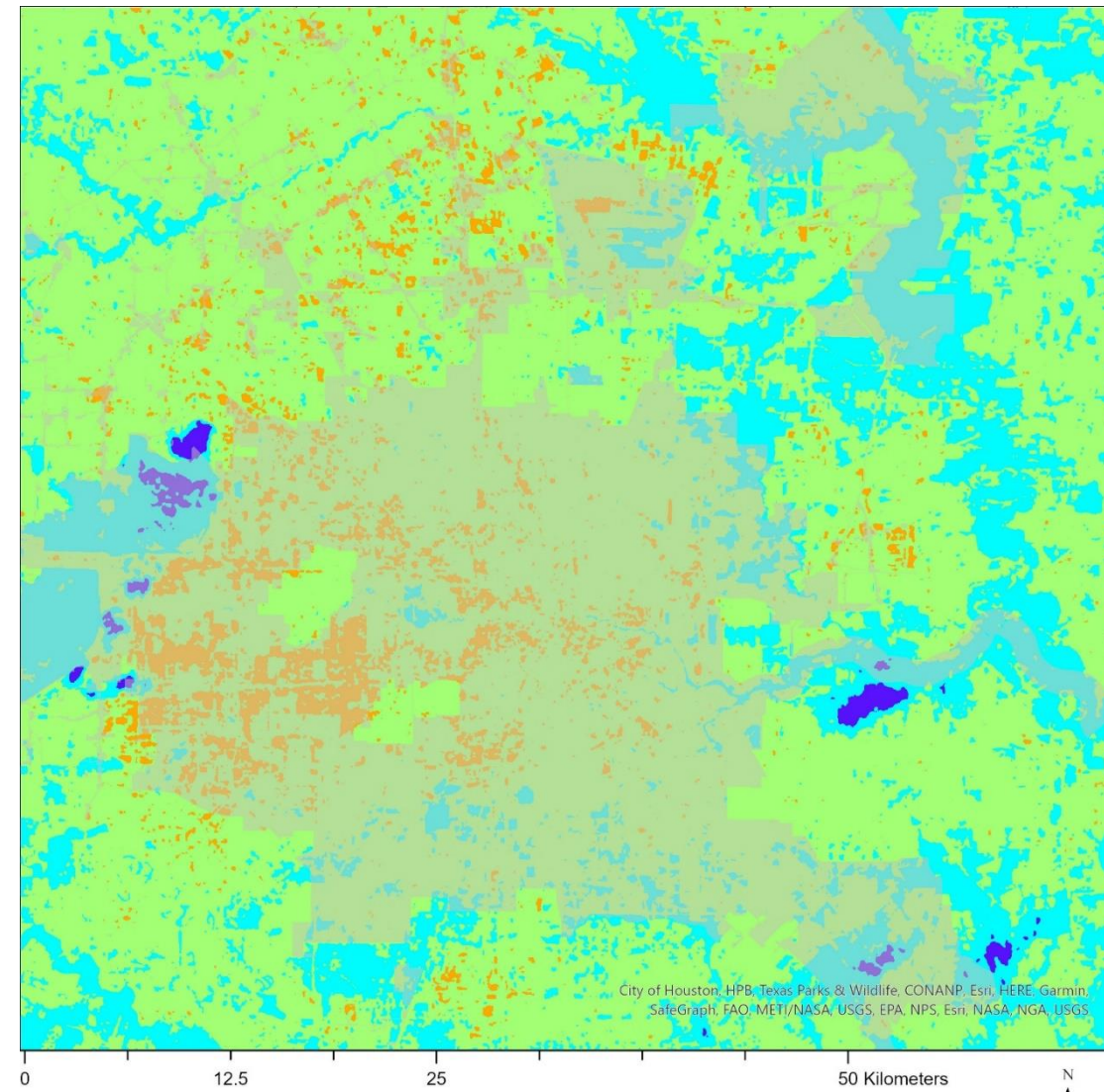
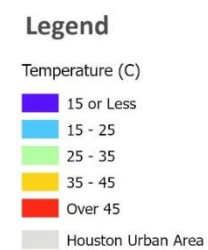
Calculation of Land
Surface Temperature
(C)



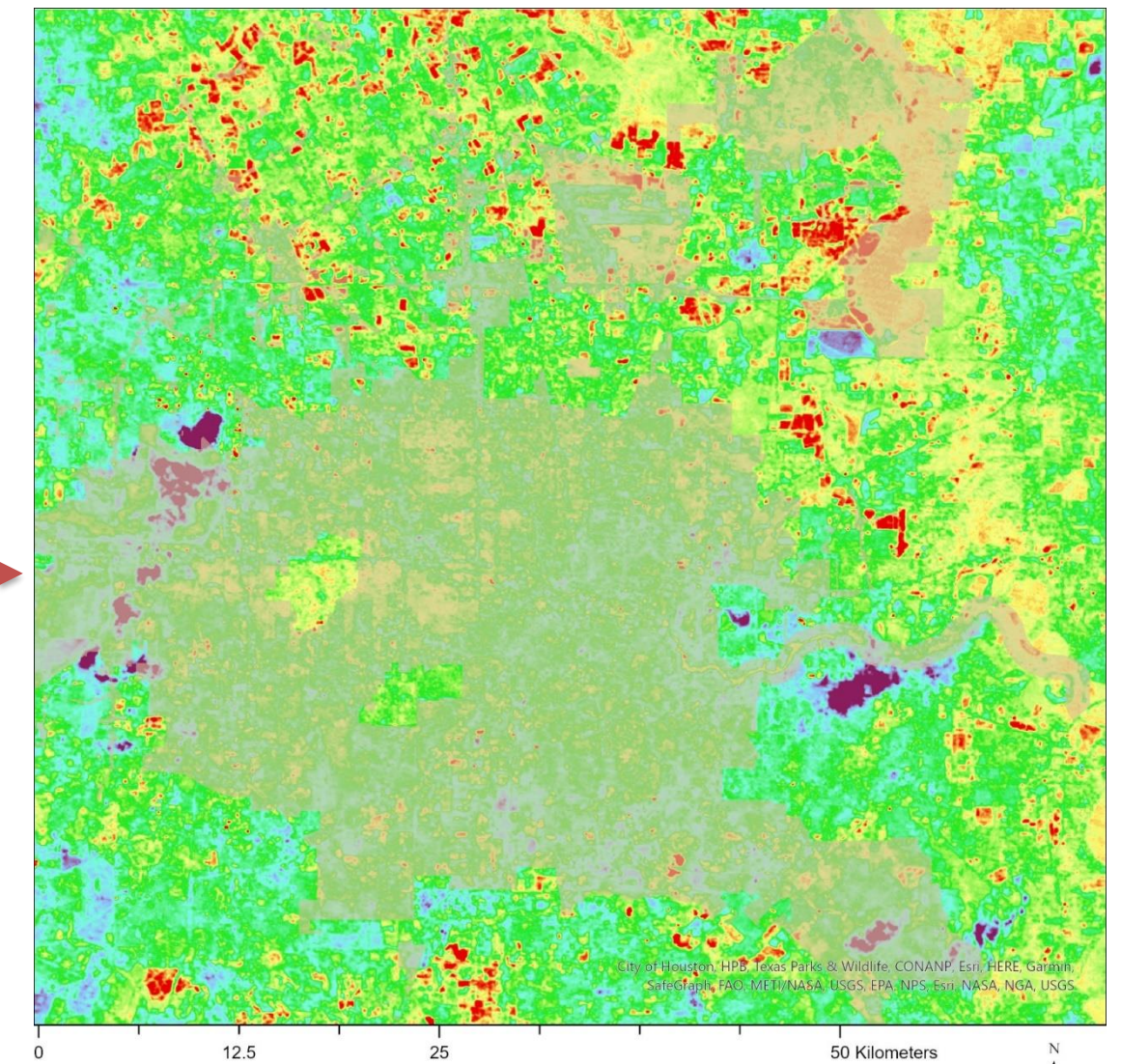
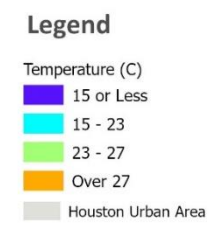
LST Analysis



Houston Land Surface Temperature 2000
Urban Heat Island and Landcover Project



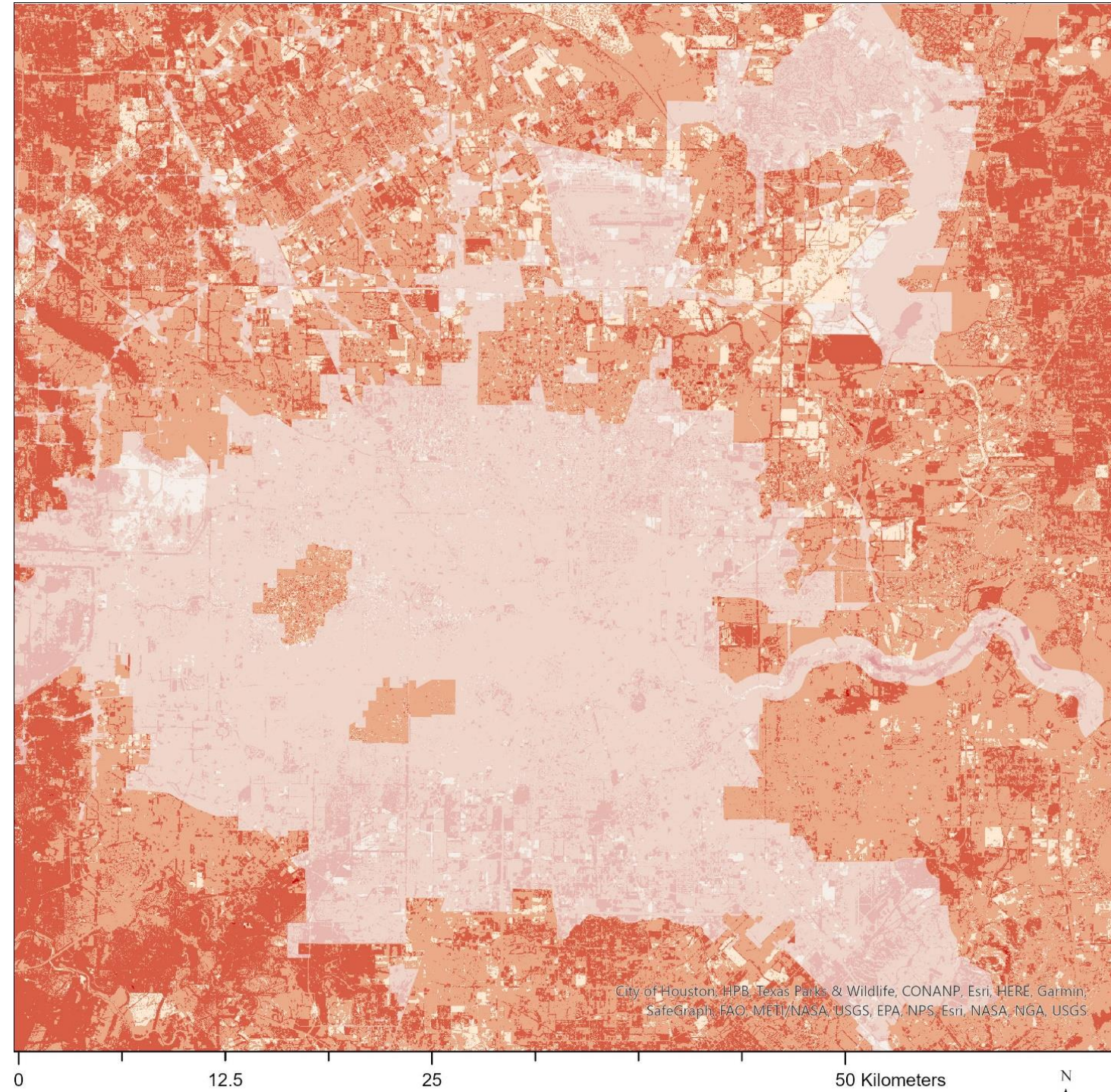
Houston Land Surface Temperature 2020
Urban Heat Island and Landcover Project



Houston Temperature Change 2000-2020
Urban Heat Island and Landcover Project



Landcover Change vs LST Change



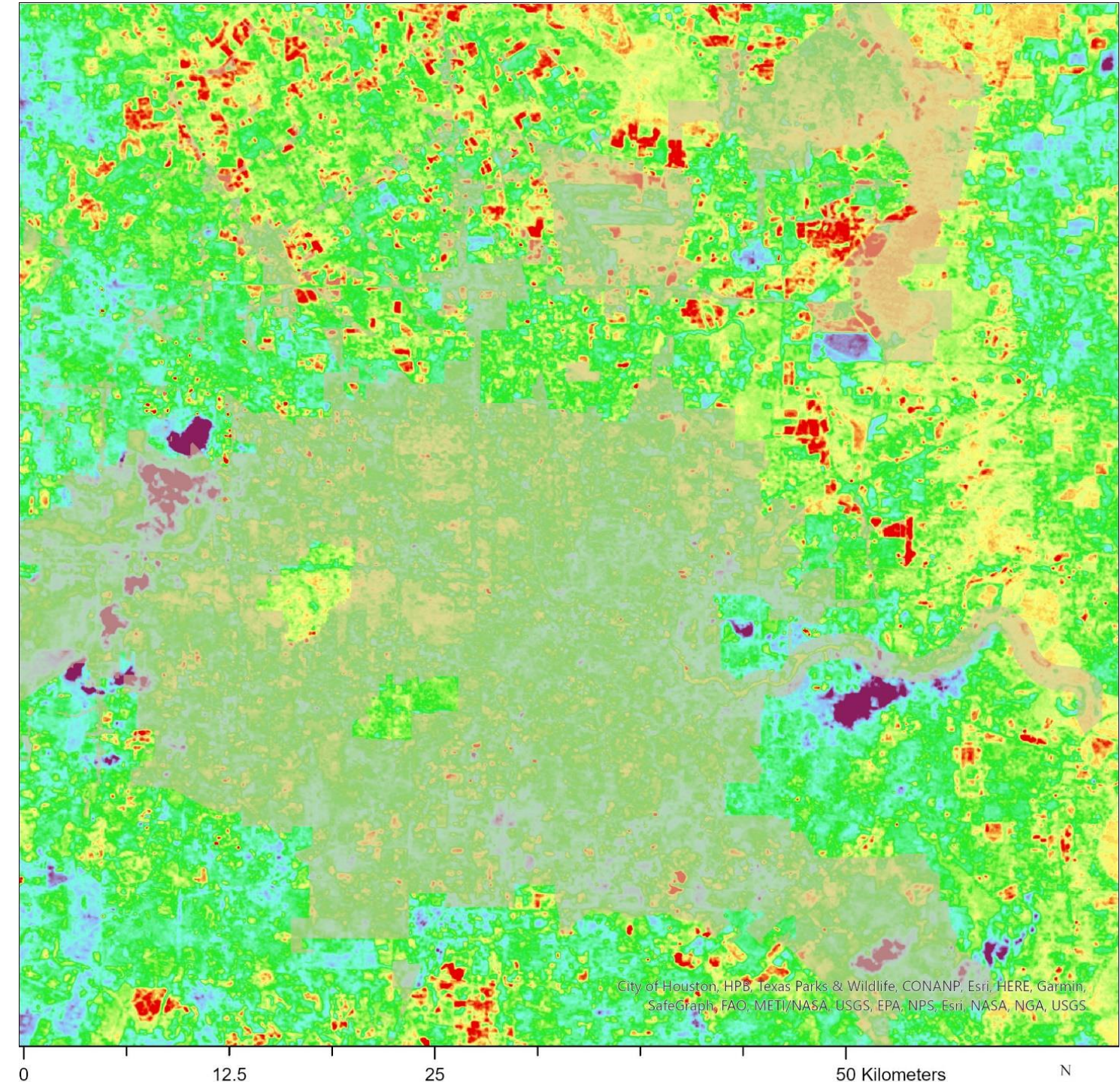
Houston Landcover Change 2000-2020

Urban Heat Island and Landcover Project

Legend

Landcover Change (C)

- 1.999 - -1
- 0.999 - 0
- 0.001 - 1
- 1.001 - 2
- Houston Urban Area



Houston Temperature Change 2000-2020

Urban Heat Island and Landcover Project

Legend

Temperature Change

- 14.4777
- 31.6785
- Houston Urban Area

Yes! Vegetating the land, even as farming, helps to control UHI effect!
Temperature might still rise as the result of global warming and climate
change, but it will **slow down...**



Romina Tafazzoli

Senior Planner
City of Austin Planning Department
romina.tafazzoli@austintexas.gov

Thank you!