THE UNIVERSITY OF RHODE ISLAND
FEINSTEIN CENTER FOR A HUNGER FREE AMERICA

Project on NRS533

Analysis of Land Surface Temperature and NDVI using the Application of Thermal Infrared Remote Sensing

THINK BIG WE DO℠

Background of the study

- Since 19th century global mean surface temperature increases.
- Climate in and around urban areas are changed due to changing the land use pattern.
- Increase the land surface temperature (LST) has a relation to population growth rate and changing of land pattern and that is the reason to investigate how it varies among different NDVI types.

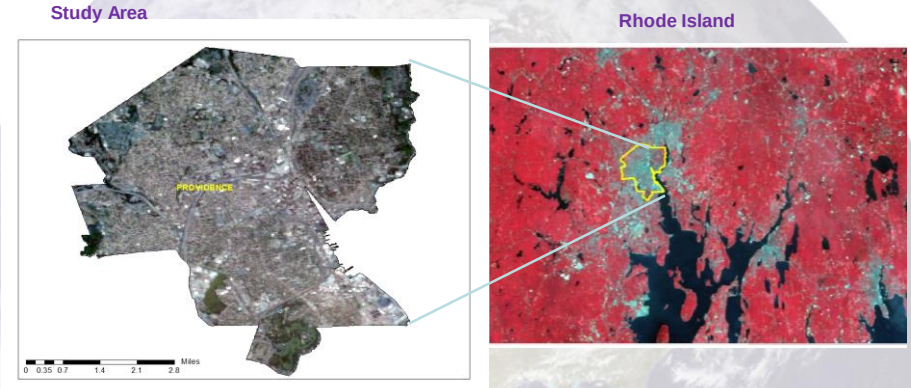
THINK BIG WE DO℠

THE UNIVERSITY OF RHODE ISLAND

Objective of the Study

- To estimate the urban heat island Effect using remote sensing image
- To analyze the relationship between LST and vegetation density of urban area.
- Evaluate the connection between LST and other urbanization parameter like population density.

Location Map of the Study Area



Methodology

I. **Data Acquisition-**

Satellite Data

Historical Data of Temperature

S.No	Date of Images	Satellite	Sensors	Resolution (m)	Bands	Thermal Band
1.	09-23-1984	LANDSAT-5	TM	30	7	6
2.	09-19-1994	LANDSAT-5	TM	30	7	6
3.	09-14-2004	LANDSAT-5	TM	30	7	6

***Data Source: USGS**

The TM band list is given in the following Table

Wavelength Region	Band Number	Wavelength (μm)	Resolution
Visible	1	0.45-0.515	30
	2	0.525-0.605	30
	3	0.63-0.69	30
NIR	4	0.75-0.90	30
SWIR	5	1.55-1.75	30
	6	10.4-12.5	120
TIR	7	2.09-2.35	30
Pan	8	0.52-0.9	15

THINK BIG WE DO

THE UNIVERSITY OF RHODE ISLAND

Methodology (continued…)

ii) RS and GIS Techniques

I. **Atmospheric Correction** – Using two steps it is prepared

a) First, the raw image is radiometrically corrected by converting the DN values to at-sensor radiance

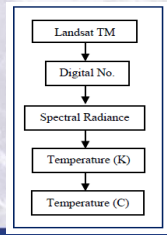
b) In the second step, the image is atmospherically corrected by calculating spectral reflectance with the use of the special radiance ascertained in the first step.

2. Land surface Temperature

An algorithm adopted from (Saleh S, 2002 & Zhao-ming et al) has been used to retrieve LST.

•The flow chart below shows the major steps of algorithm for obtaining LST. Using the thermal band 6 this LST is calculated.

•DN value range of this band is **118-156**.



$$L = L_{MIN} + (L_{MAX}-L_{MIN})*DN/255$$

Where,
L = Satellite Spectral radiance
L_{min} =1.238 (Spectral radiance of DN value 118)
L_{max} = 15.303 (Spectral radiance of DN value 156)
DN = Digital Number

THINK BIG WE DO

THE UNIVERSITY OF RHODE ISLAND

Methodology (Continued..)

3.Normalized Difference Vegetation Index (NDVI)

•The derivation of Normalized Difference Vegetation Index (NDVI) is a standard procedure and has already been enlightened in the literature. The standard mathematical formula for NDVI as below:

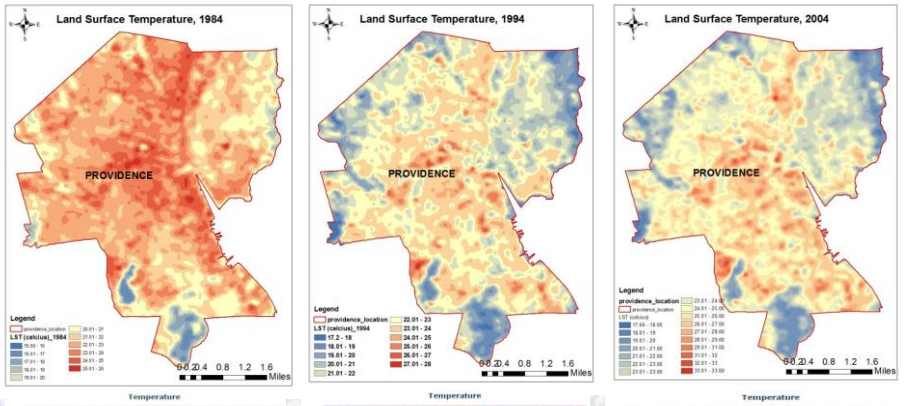
$$\frac{R_{NIR} - R_{RED}}{R_{NIR} + R_{RED}}$$

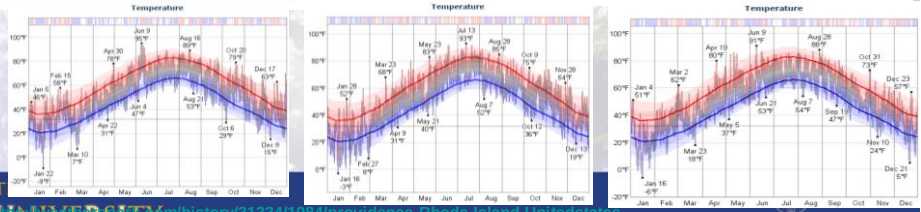
where

•R_{NIR} = Reflectance in near infrared band

•R_{RED} = Reflectance in red band

Result and Discussion





https://weatherspark.com/history/31334/1984/providence-Rhode-Island-Unitedstates
https://weatherspark.com/history/31334/1994/providence-Rhode-Island-Unitedstates
https://weatherspark.com/history/31334/2004/providence-Rhode-Island-Unitedstates

Result and Discussion

Year	Historical LST Value			Extracted LST Value		
	Min	Max	Mean	Min	Max	Mean
1984	13.3	24.4	19	15.3	26.2	20.75
1994	14.2	26.1	20.15	17.2	28.4	22.8
2004	15.6	27.8	21.7	17.8	33.1	23.95

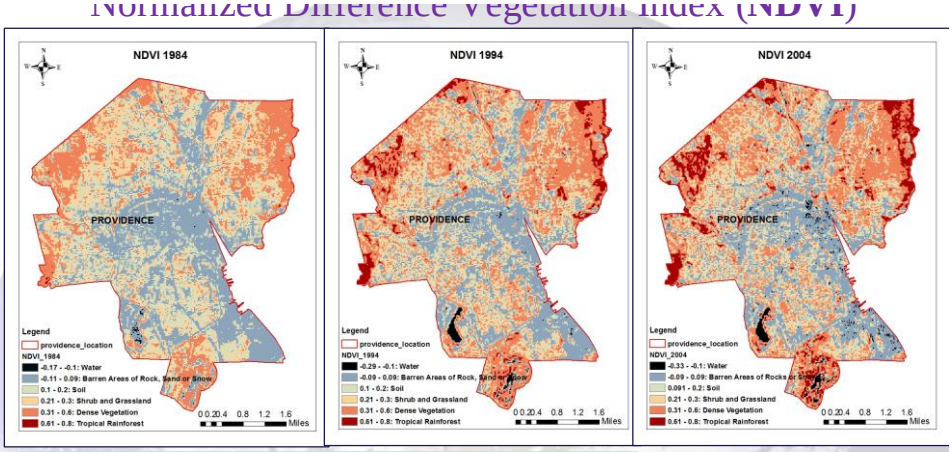
Note: LST unit degree Celsius

- Land Surface Temperature slightly increased over the time. Not remarkable but it showed an increasing pattern.

THINK BIG WE DO

THE UNIVERSITY OF RHODE ISLAND

Normalized Difference Vegetation Index (NDVI)



Characteristic NDVI Signatures

Characteristic NDVI Signatures

– NDVI of dense vegetation canopy will tend to positive values (say 0.3 to 0.8) Clouds and snow fields will be characterized by negative values of this index.

– Free standing water (e.g., oceans, seas, lakes and rivers) which have a rather low reflectance in both spectral bands (at least away from shores) and thus result in very low positive or even slightly negative NDVI values.

– Soils generally exhibit a near-infrared spectral reflectance somewhat larger than the red, and thus tend to also generate rather small positive NDVI values (say 0.1 to 0.2).

–Very low values of NDVI (0.1 and below) correspond to barren areas of rock, sand, or snow.

–Moderate values represent shrub and grassland (0.2 to 0.3),

–High values indicate temperate and tropical rainforests (0.6 to 0.8).

Ref: Jackson, R. D., and Huete, A. R. (1991). Interpreting vegetation indices

THINK BIG WE DO

OF RHODE ISLAND

Conclusion

•Literature review told that, Providence has a city population of 179,154 (2016) from 156,804 (1980). So over the 36 year the population growth of rate is low.(http://wpri.com/blog/2011/03/23/the-rise-and-fall-and-rise-of-providences-population/)

•From the Landsat image it also predicted that the landuse pattern also not changed except some rainforest implanted here.

•Both of above reason actually reflected on the LST images. That is temperature didn't go up.

•According to the NDVI it is also not remarkable changed over the time except little transform.

•Several atmospheric effects (e.g. partial water vapor absorption), variable surface emissivity, sub-pixel variation of surface temperature and urban geometry affects the measurement of land surface temperature. Therefore, these factors should be considered in computing actual LST in future.

Thank You

Any Question???

THINK BIG WE DO
THE UNIVERSITY OF RHODE ISLAND