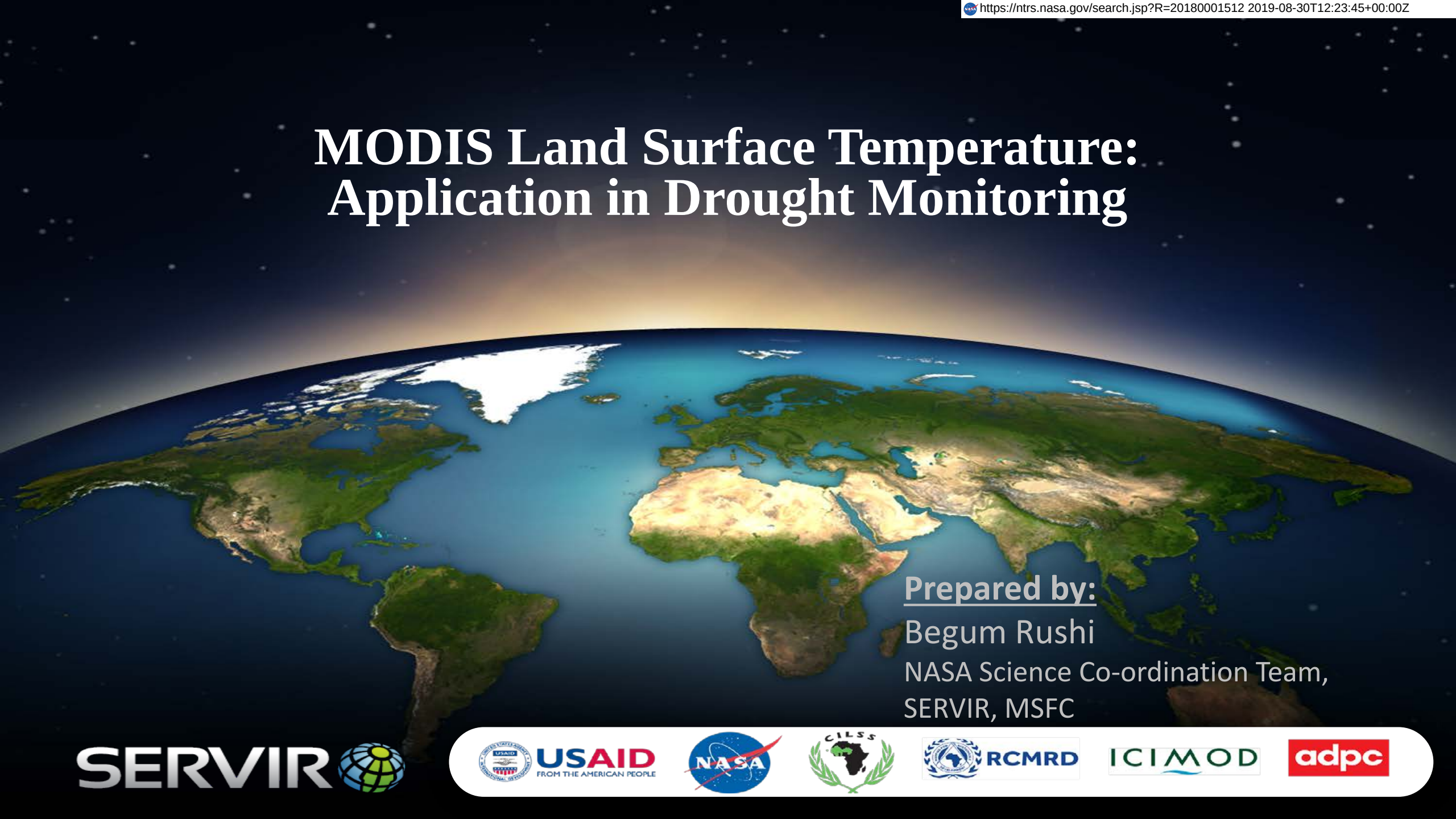
MODIS Land Surface Temperature: Application in Drought Monitoring



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SERVIR

USAID FROM THE AMERICAN PEOPLE

NASA

CILSS

RCMRD

ICIMOD

adpc

Overview of the Presentation

- Dataset Overview
- Introduction Google Earth Engine (GEE)
- Application
- Analysis and Representation

Dataset Overview

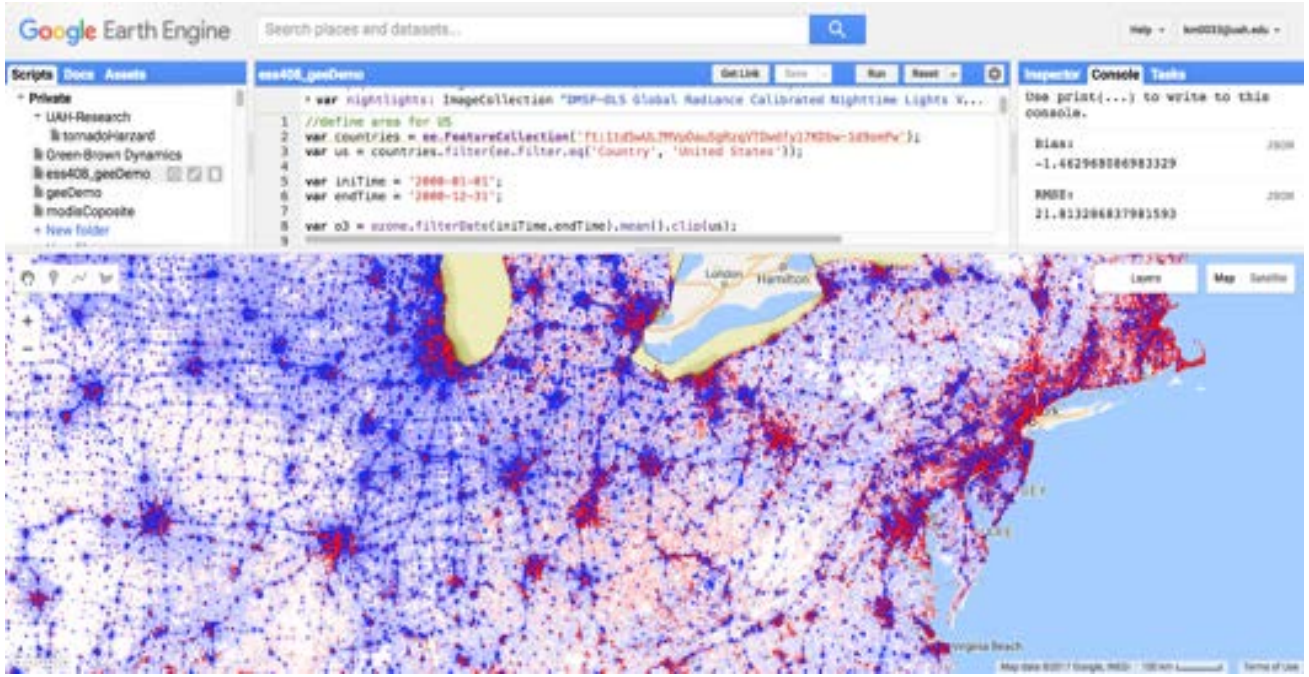
- Daily Land Surface Temperature (MODIS, MOD11A1)
- Land Cover Data (Landsat)

"Big Data" analysis and visualization platform

- Designed *for scientists*, not software engineers
- Goals: *make it easy, enable non-traditional users*

Focused on society's biggest challenges

- Reduce the time needed on analysis to spend more time on impact



Slide Courtesy: Kel Markert

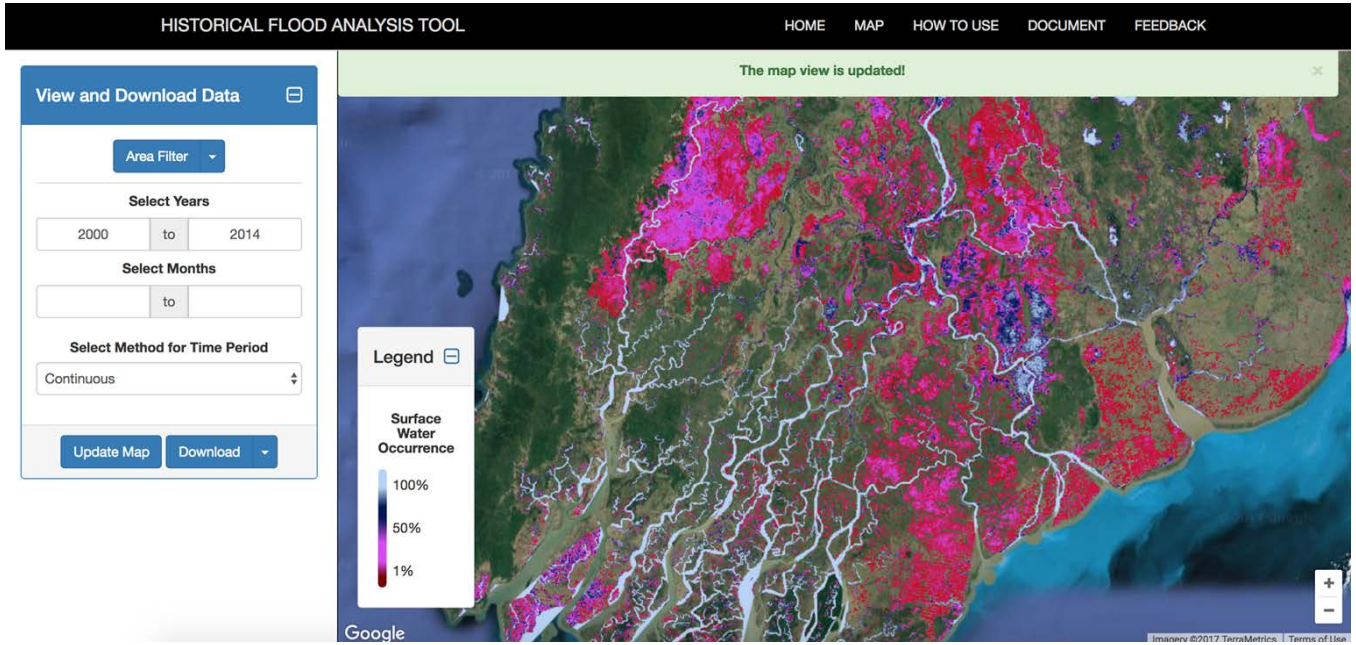
How do you use it?

JavaScript API

- Interactive Code Editor
- Easy to use and instant results

Python API

- Python module
  - Web Apps with Appengine
  - Jupyter Notebooks*



Slide Courtesy: Kel Markert

What data does it have?

9PB Public Data Catalog (and growing)

Imagery

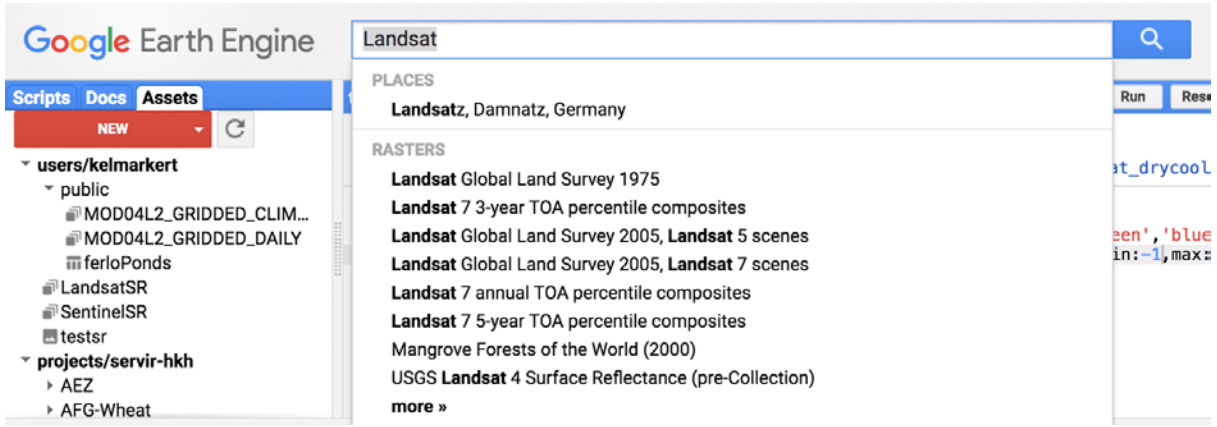
Landsat 4-8	7 bands, 30m
MODIS	250m Daily Global
Sentinel-1	10m SAR
Sentinel-2	12 bands, 10/20/60m

Geophysical

- Digital Elevation
- Land Cover
- Surface Temperature, etc.

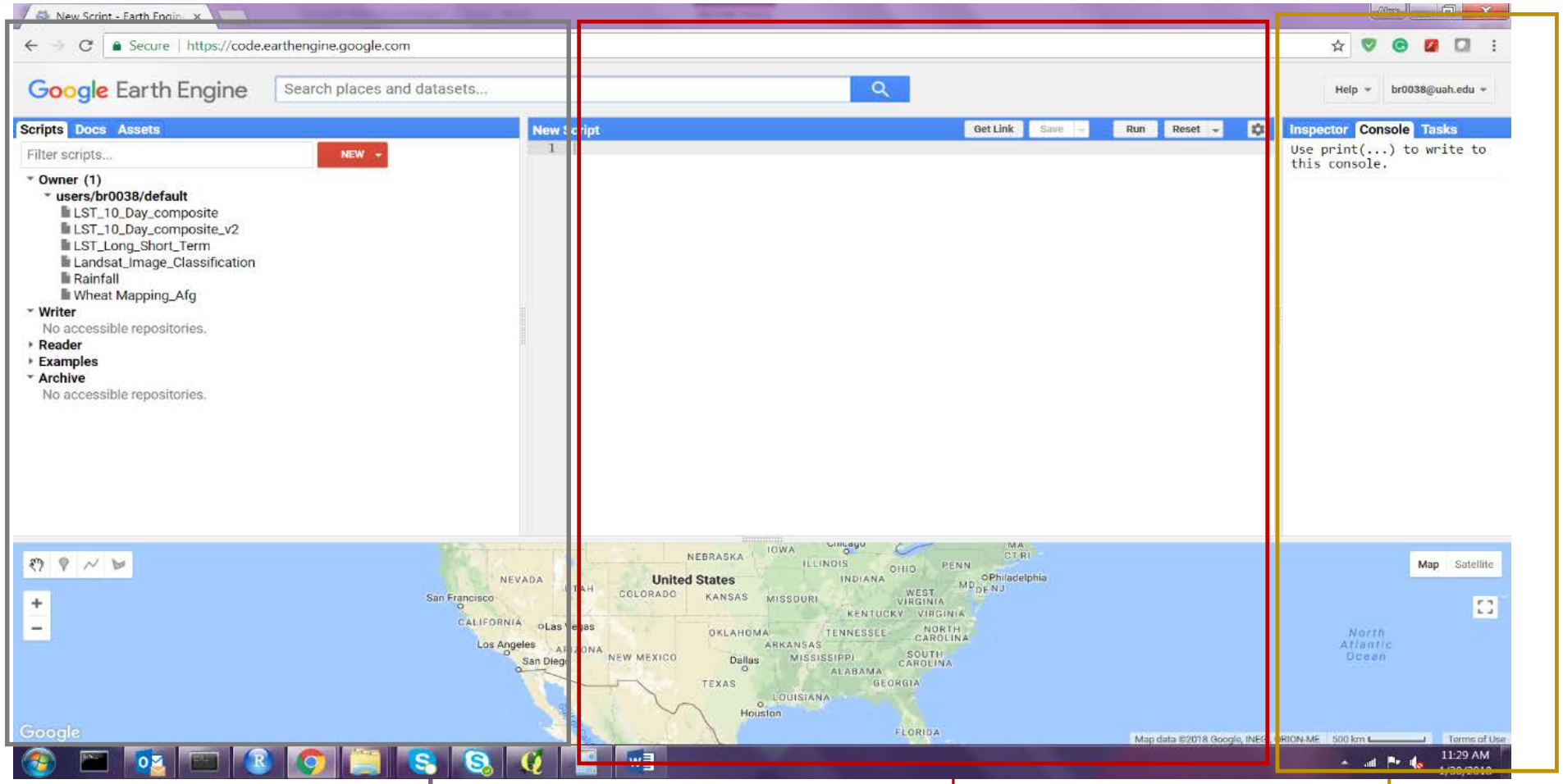
Weather Forecasts, Climate Models
+300 more analysis ready datasets

Custom user assets



Slide Courtesy: Kel Markert

Introduction to GEE



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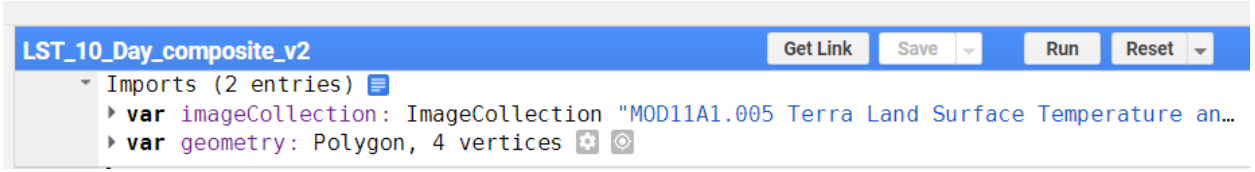
Console

Application of GEE to calculate LST 10 Day Composite: Steps

Enter the name of the MODIS Land Surface Temperature to load



Application of GEE to calculate LST 10 Day Composite: Steps

Designating the interested region

```
1
2  //Choose country using GEE Feature Collection
3   var region = ee.FeatureCollection('ft:1tdSwUL7MVpOauSgRzqVTOwdfy17KDbw-1d9omPw').filterMetadata('Country', 'equa
4
5
6
7  //Add region outline to layer - for selected countries
8  //Map.addLayer(region,{},'Bangladesh');
9
10 Map.addLayer(geometry);
11
```

Collecting bands and scale

```
11
12  // Collect bands and scale
13  var modisLSTday = ee.ImageCollection('MODIS/MOD11A1').select('LST_Day_1km');
14  var modisLSTnight = ee.ImageCollection('MODIS/MOD11A1').select('LST_Night_1km');
15  var modLSTday = modisLSTday.map(function(img) {
16    return img.multiply(0.02).subtract(273.15).copyProperties(img,['system:time_start','system:time_end']);
17  });
18  var modLSTnight = modisLSTnight.map(function(img) {
19    return img.multiply(0.02).subtract(273.15).copyProperties(img,['system:time_start','system:time_end']);
20  });
21
```

Application of GEE to calculate LST 10 Day Composite: Steps

Selecting study period

```
22
23  // Select dates
24  var collection05night = ee.ImageCollection(modLSTnight.filterDate('2001-01-01', '2017-12-31'));
25  var collection05day = ee.ImageCollection(modLSTday.filterDate('2001-01-01', '2017-12-31'));
26
27
```

Cropping the data for the region

```
31
32  // Cropping the data for the region
33
34  var collection = collection05day.filterBounds(region);
35
```

Collecting Metadata Properties

```
34
35  // Get a list of all metadata properties.
36  var properties = collection.propertyNames();
37  print('Metadata properties: ', properties); // ee.List of metadata properties
38
39  // Get the date range of images in the collection.
40
41  var dates = ee.List(collection.get('date_range'));
42  var dateRange = ee.DateRange(dates.get(0), dates.get(1));
43  print('Date range: ', dateRange);
44
45
```

Calculating 10 Day Composite Data

LST_10_Day_composite — Get Link | Save | Run | Reset

```
44
45  //Calculating the 10 Day Composite
46
47  var startyear = 2001;
48  var endyear = 2017;
49  // Run the loop
50  for (var yr= startyear; yr <= endyear; yr = yr + 1) {
51    var startdate = 1;
52    //var enddate = 365;
53    var enddate = ((yr%4)===0) ? 366 : 365;
54    //print('This is enddate ' +enddate);
55
56    for (var dt= startdate; dt <= enddate; dt = dt + 10) {
57
58    // Use ee.Filter.calendarRange to filter by year and month
59    var img = collection.filter(ee.Filter.calendarRange(yr,yr,'year'))
60    .filter(ee.Filter.calendarRange(dt,dt+9,'day_of_year'));
61    // reduce image collection with mean()
62    if (dt == 1){
63      var mean = img.mean().rename('LST_'+dt+'_' +(dt+9)+'_'+yr);
64    }
65    else {
66      mean = mean.addBands(img.mean().rename('LST_'+dt+'_' +(dt+9)+'_'+yr))
67    }
68    }
69    print(mean)
70
```

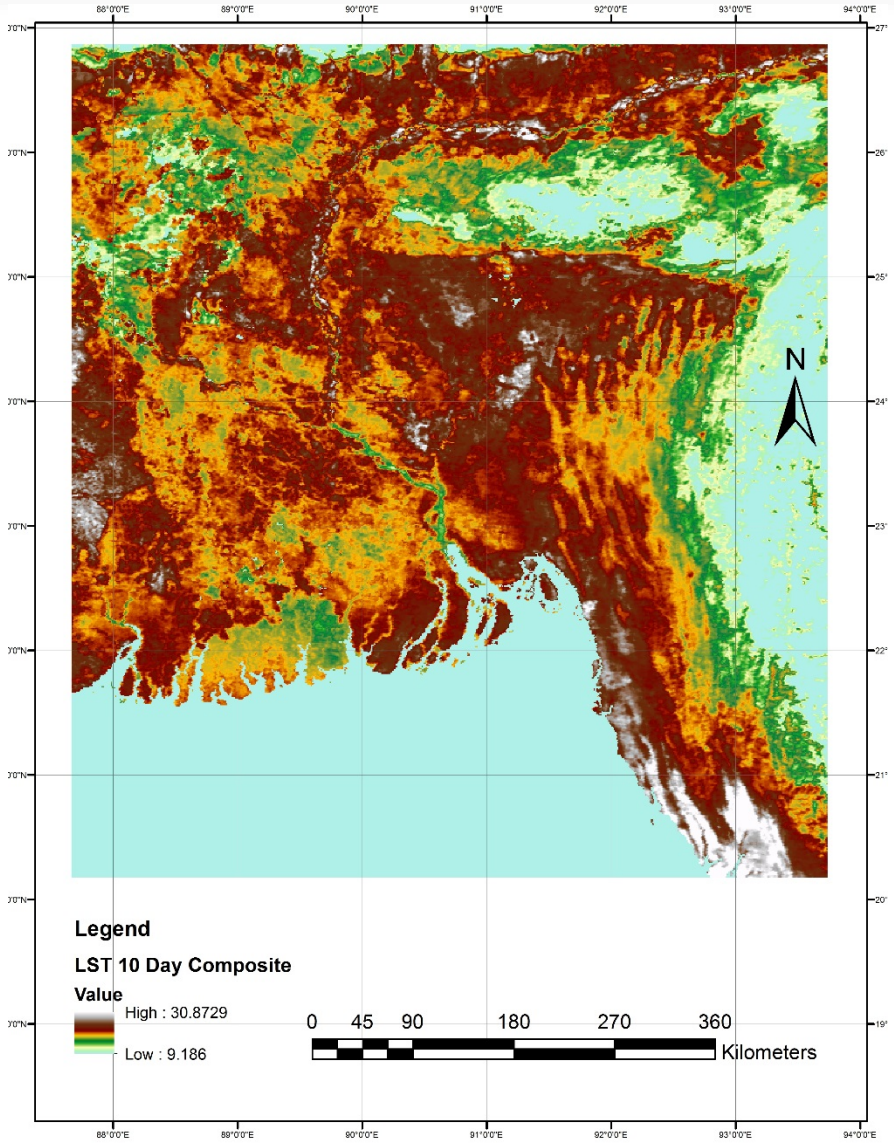
Application of GEE to calculate LST 10 Day Composite: Steps

Exporting the output

```
71
72  // Export the image, specifying scale and region.
73   Export.image.toAsset({
74   image: mean,
75   description: 'LST_10Day_' + yr,
76   assetId: 'projects/servir-hkh/MODIS_LST_10_Day_Composite/LST_10Day_'+yr,
77   scale: 1000,
78   region: geometry,
79   maxPixels:3E11,
80   pyramidingPolicy: {
81     '.default': 'mean',
82   }
83   });
84
85  }
86
87
```

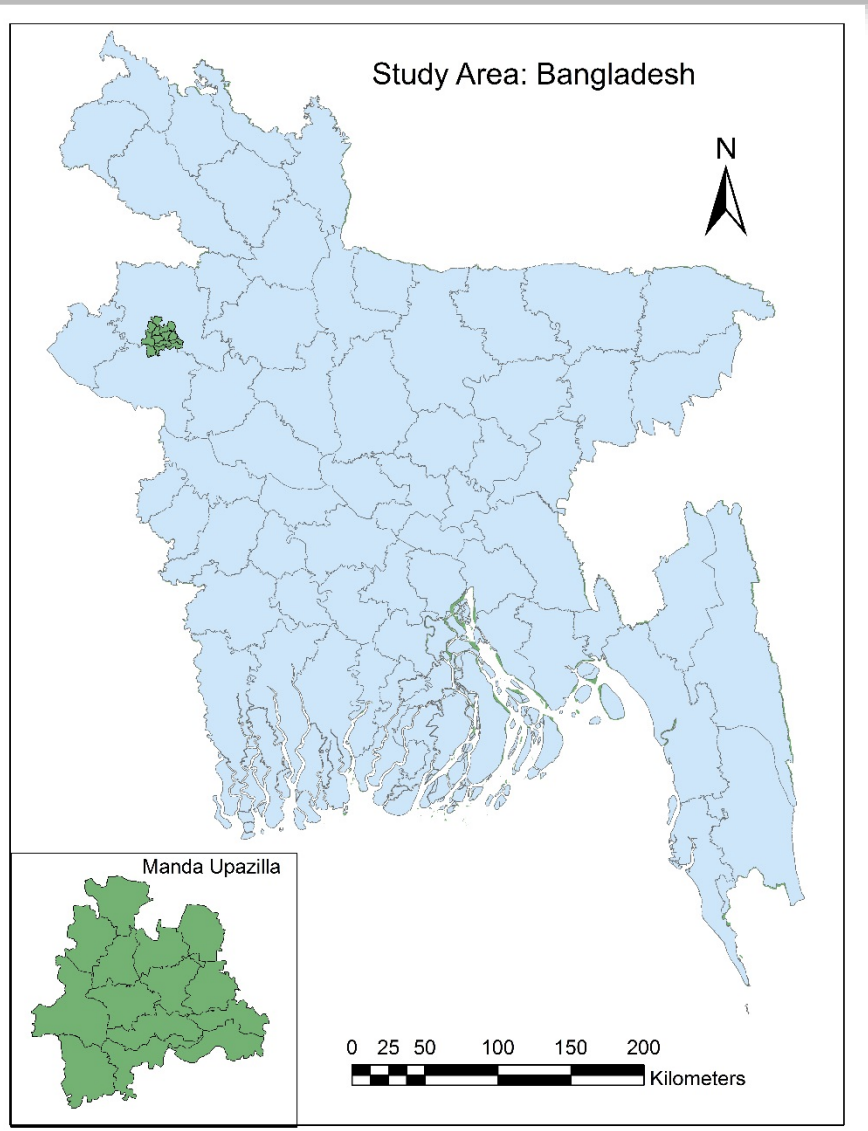
Outputs

- MODIS LST 10 Day Composite



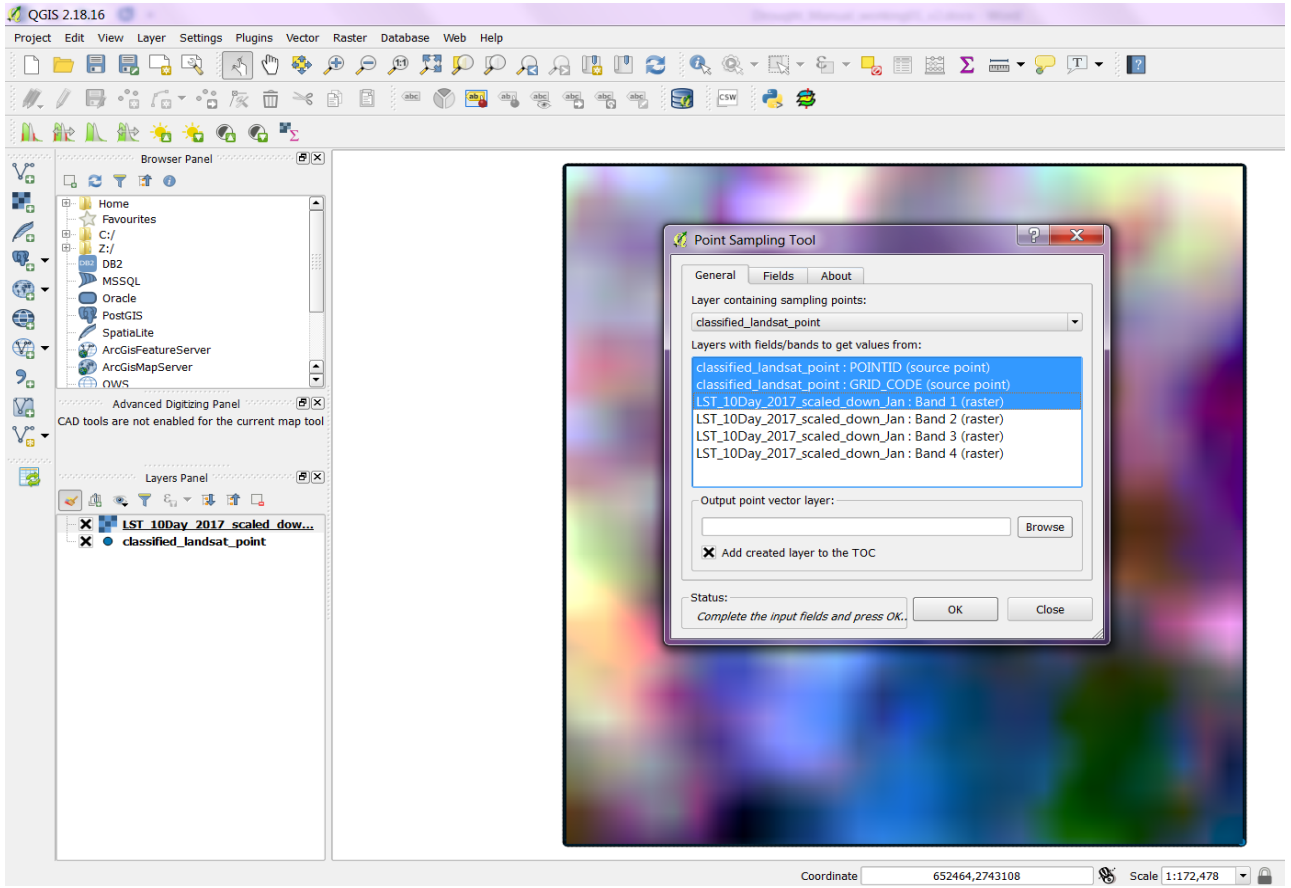
Application of LST in Identification of Heat Stressed Area

- Study Area



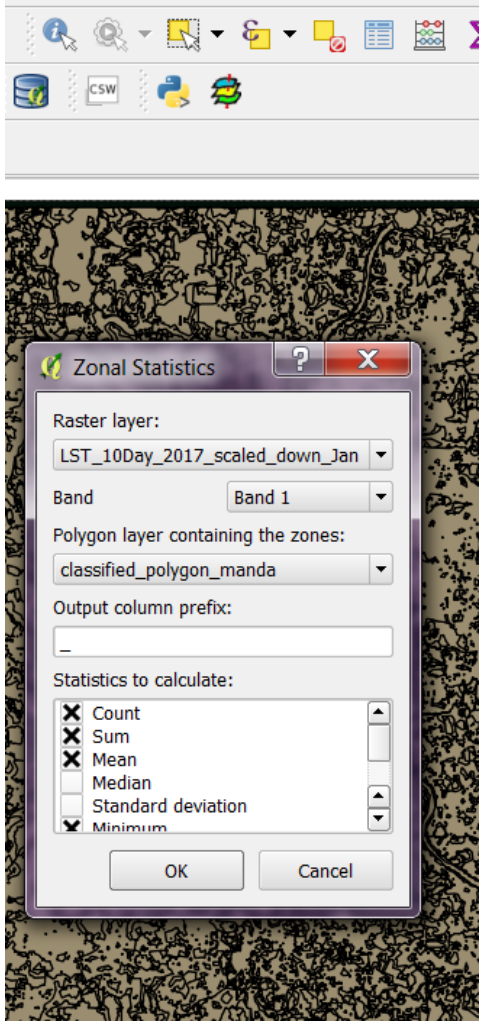
Application of QGIS in Analyzing Zonal Statistics

- Extracting LST for each landcover type



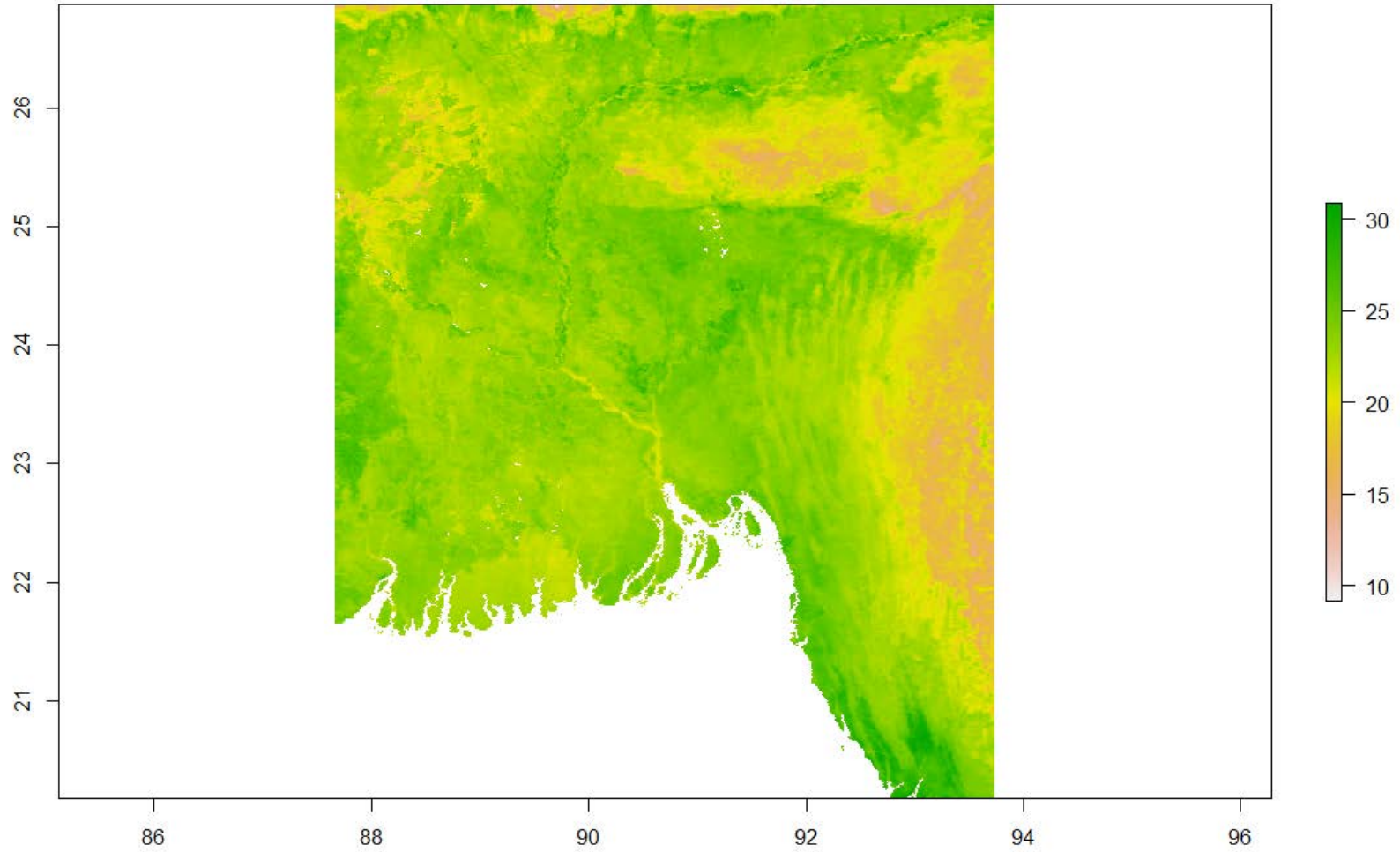
Application of QGIS in Analyzing Zonal Statistics

- Calculating mean temperature for each landcover type



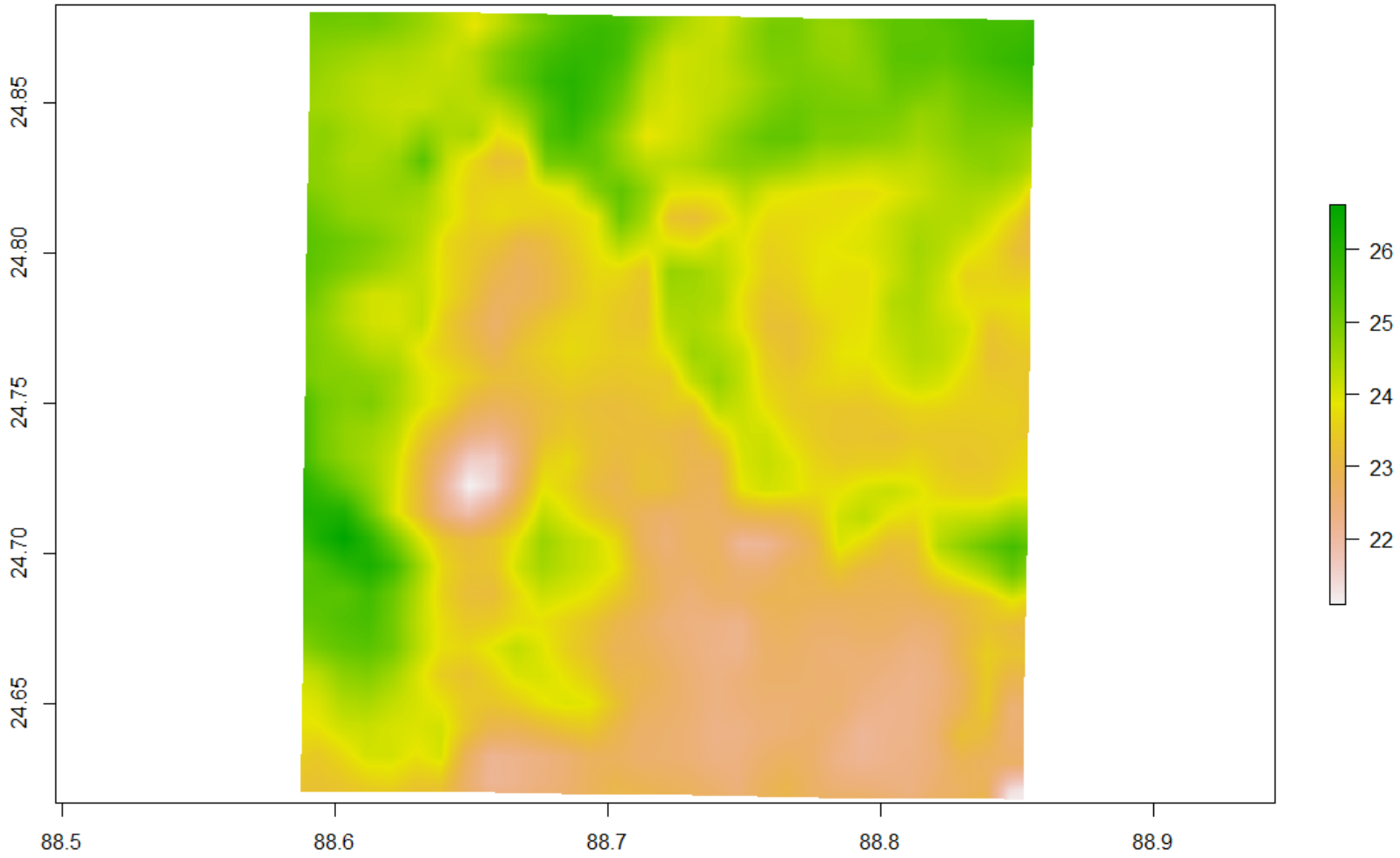
Outputs

LST 10 Day Composite (January 1-10, 2017)

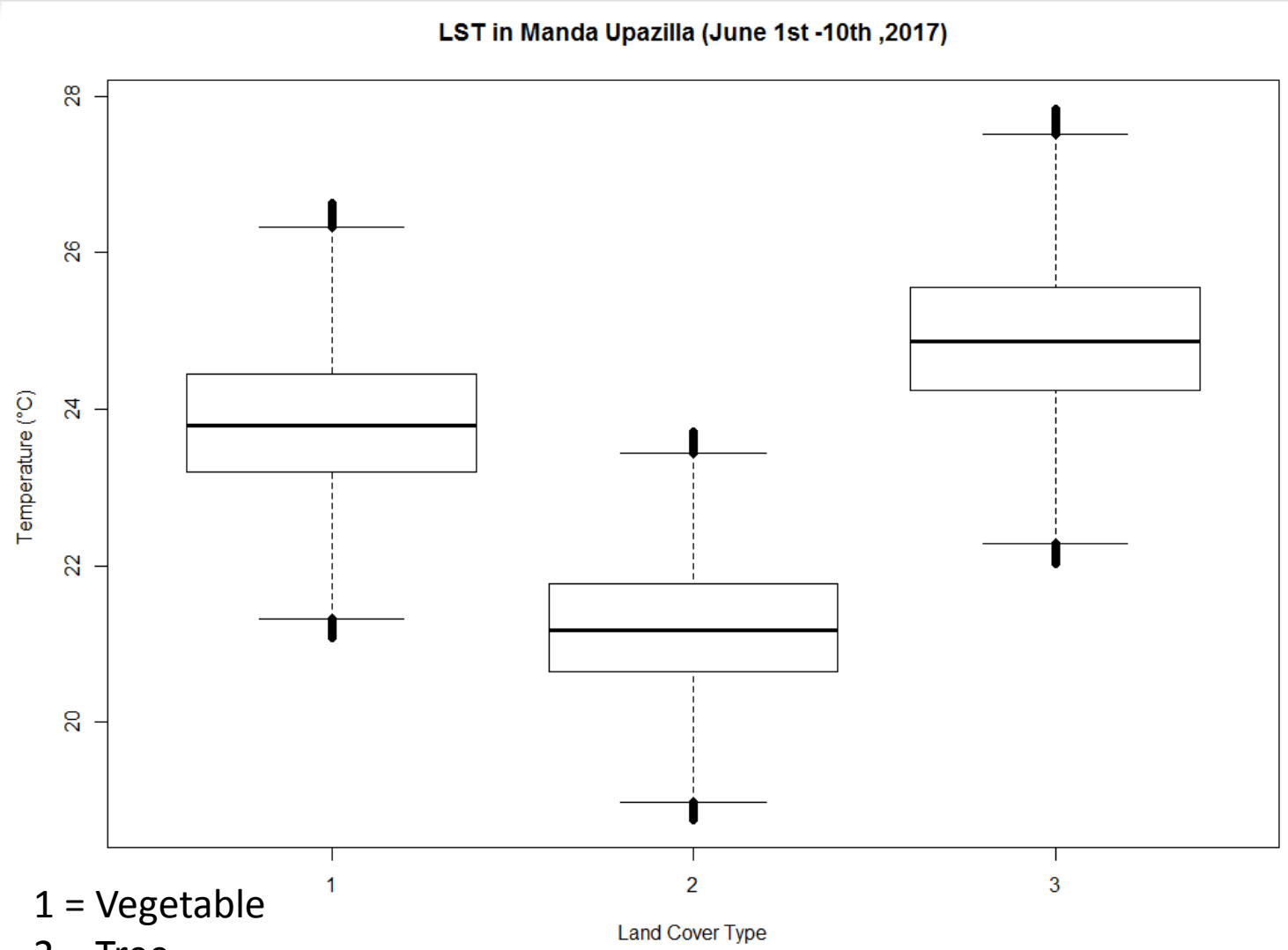


Outputs

LST 10 Day Composite (June 1-10, 2017): Manda Upazilla



LST 10 Day Composite Comparison among Land Cover Types



1 = Vegetable
2 = Tree
3 = Rice

Temperature Distribution for Crop Landcover (Manda Upazilla)