```
!pip install earthengine-api geemap
```

⇉ **Show hidden output**

```
import ee
import geemap
```

```
ee.Authenticate()
```

⇉

```
ee.Initialize(project='seraphic-music-47-h2')
```

⇉

```
map=geemap.Map()
districts = ee.FeatureCollection('FAO/GAUL/2015/level2') \
    .filter(ee.Filter.eq('ADM0_NAME', 'India')) \
    .filter(ee.Filter.eq('ADM1_NAME', 'Tamil Nadu')) \
    .filter(ee.Filter.eq('ADM2_NAME', 'Chennai'))

chennai_boundary = districts.geometry()
map.addLayer(chennai_boundary, {}, 'Chennai Boundary')
map.centerObject(chennai_boundary,11)
```

⇉

```
# Summer months — when UHI is most evident
start_date = '2025-04-01'
end_date = '2025-04-18'
```

⇉

```
modis_lst = ee.ImageCollection("MODIS/061/MOD11A2")  \
    .filterDate(start_date, end_date) \
    .filterBounds(chennai_boundary) \
    .select('LST_Day_1km')

lst_celsius = modis_lst.mean().multiply(0.02).subtract(273.15).clip(chennai_boundary)
map.addLayer(lst_celsius, {'min': 20, 'max': 40, 'palette': ['blue', 'green', 'yellow', 'red']}, 'Mean Land Surface Temperature')
```

⇉

```
modis_ndvi = ee.ImageCollection("MODIS/061/MOD13A2")\
    .filterDate(start_date, end_date) \
    .filterBounds(chennai_boundary) \
    .select('NDVI')

ndvi = modis_ndvi.mean().multiply(0.0001).clip(chennai_boundary)
map.addLayer(ndvi, {'min': 0, 'max': 1, 'palette': ['white', 'green']}, 'Mean NDVI')
```

⇉

```
esa = ee.Image('ESA/WorldCover/v100/2020').select('Map').clip(chennai_boundary)

# Create a mask for built-up area (class 50)
urban_mask = esa.eq(50)
map.addLayer(urban_mask, {'palette': 'gray'}, 'Urban Mask')
```

⇉

```
viirs = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG") \
    .filterDate(start_date, end_date) \
    .filterBounds(chennai_boundary) \
    .select('avg_rad') \
    .mean().clip(chennai_boundary)
map.addLayer(viirs, {'min': 0, 'max': 100, 'palette': ['black', 'blue', 'white']}, 'Nighttime Lights')
```

```
# Fix the typo from Map to map and select the correct band (assuming 'population' is the band name)
population_image = ee.ImageCollection("WorldPop/GP/100m/pop_age_sex_cons_unadj") \
    .filterDate('2020-01-01', '2020-12-31') \
    .first().clip(chennai_boundary)

# Assuming the band containing total population is named 'population'.
# You might need to inspect the image to confirm the correct band name.
total_population = population_image.select('population')

map.addLayer(total_population, {'min': 0, 'max': 1000, 'palette': ['white', 'orange', 'red']}, 'Population')
map
```
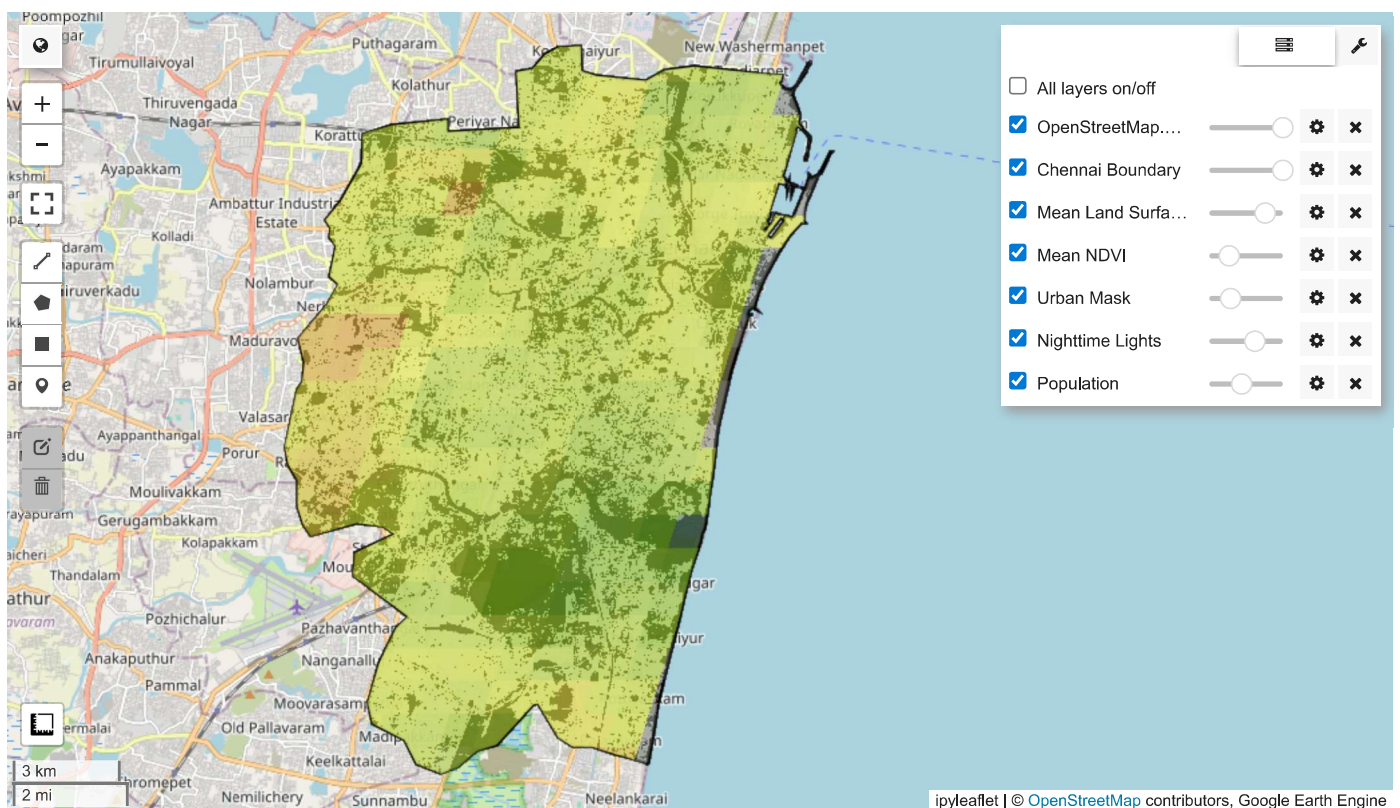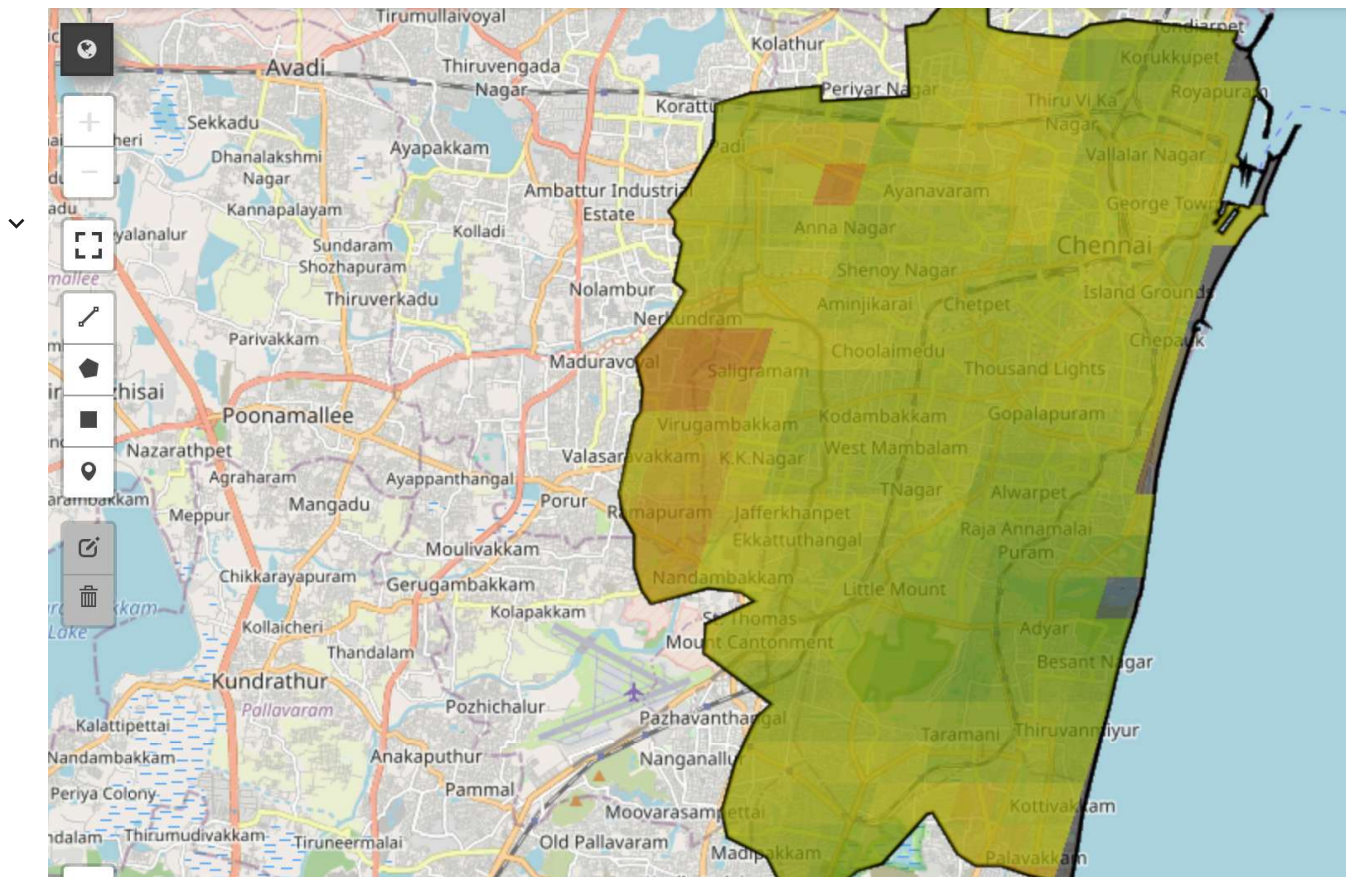

Land Surface Temperature (LST)

LST (in °C) reveals the thermal response of the land surface.

Hotspots (>38°C):

T. Nagar, Ashok Nagar, Royapettah, Mount Road Highly urbanized with low NDVI Cooler Zones (♥0°C):

Guindy Park, Adyar, Marina Beachfront, Velachery lake zones Strong inverse correlation observed: lower NDVI → higher LST.

Normalized Difference Vegetation Index (NDVI)

NDVI values range from 0 (no vegetation) to 1 (dense vegetation).

Key Observations:

Guindy Park, Adyar, Velachery Wetlands show high NDVI T. Nagar, Egmore, Triplicane, Kodambakkam show poor vegetation (< 0.2)

Areas with low NDVI are more vulnerable to UHI effects and should be priority greening targets.

Urban Land Cover Mask (ESA World Cover)

This map shows the spatial footprint of Chennai's built-up areas.

High Urban Density Zones:

T. Nagar Anna Nagar Vadapalani Choolaimedu Green / Low-Built Zones:

Pallikaranai Guindy National Park Thiruvanmiyur coast

Built-up areas correspond to higher temperatures due to albedo reduction and impervious surfaces.