

Practical 4: Visualizing Sentinel-2 Satellite Imagery & NDVI for Mumbai Using Google Earth Engine

Google Earth Engine is a cloud-based geospatial analysis platform developed by Google. It allows users to access a massive catalogue of satellite imagery, environmental datasets, and remote sensing products stored on Google's servers.

(a) ee – Earth Engine Python API

- Allows sending commands from Python to Google Earth Engine.
- Used for loading datasets, filtering by date, clipping, computing indices, etc.

(b) geemap – Interactive Mapping Library

- A Python package built on top of Earth Engine.
- Helps create **interactive maps**, similar to Google Maps or QGIS, but inside a notebook.
- Makes visualization easier by providing functions like adding layers, drawing ROIs, exporting data, etc.

Region of Interest (ROI)

A Region of Interest (ROI) is the specific geographic boundary where we want to perform analysis.

- Defined using longitude (x) and latitude (y) coordinates.
- Clipping satellite images to ROI reduces unnecessary data and speeds up processing.

Sentinel-2 Satellite Imagery

Sentinel-2 is a multispectral imaging mission launched by the European Space Agency (ESA).

Key features:

- 13 spectral bands (Blue, Green, Red, NIR, SWIR, etc.).
- High resolution: 10 m, 20 m, 60 m depending on band.
- Useful for land monitoring, vegetation analysis, water mapping, and disaster assessment.

NDVI (Normalized Difference Vegetation Index)

NDVI is the most widely used vegetation index in remote sensing.

Formula:

$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$$

In Sentinel-2:

- **NIR = Band 8**
- **Red = Band 4**

NDVI values:

NDVI Value	Interpretation
Near 1	Dense green vegetation
0.2 – 0.5	Moderate vegetation
0 – 0.2	Sparse vegetation
< 0	Water, built-up, barren land

NDVI helps monitor plant health, urban greenery, agriculture, and forest cover.