Data Collection

Code & Data can be found in Github and in a Google Earth Engine Repo

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Tools used:

- *Google Earth Engine :* It Is a cloud-based geospatial processing platform available through Python and JavaScript Application Program Interfaces(APIs).For this study, the JavaScript API was used, which is accessible via a web-based Integrated Development Environment (IDE)called the Code Editor. This platform can be used to execute scripts in JS and perform geospatial analysis. Through the API, there is online access to GEE's archived satellite image datasets, which can be called, preprocessed, mosaicked, and processed.
- *QGIS* : is a free and Open Source Geographic Information System (GIS), which was used to extract shapefiles for getting Region of Interest (ROI), which was used in GEE to filter images.

Data Sources:

- LANDSAT-7 Satellite Dataset sourced using Google Earth Engine
- Composite Dataset : Landsat 7 Collection 1 Tier 1 Annual NDVI Composite

< *'LANDSAT/LE07/C01/T1_ANNUAL_NDVI'* >

LANDSAT-7 was chosen, as it has data from January 1999 to Present. It also provides access to Derived Datasets such as NDVI, Burn Area Index (BAI), Enhanced Vegetation Index (EVI) Normalized Difference Water Index (NDWI) etc.

Measuring changes in Land-Use

Knowledge of changes in land-use patterns and land cover change is important to understand the relationship between human activities and environmental/ecological processes. Different approaches to estimate land-use changes exist: field survey data, government data etc. With technological advancement, more studies began focusing on using remote sensing data at global and regional scales, pixel-based classification for land-use classification and change-detection. Lately however, the concept of Normalized Difference Vegetation Index (NDVI) has been developed and applied increasingly in studies of land-use dynamics.

NDVI Calculation

The LANDSAT-7 satellite captures images in the following bands:
Spectral sensitivity of Landsat 7 Bands[1]:

Band	Wavelength Interval	Spectral Response
1	0.45-0.52 µm	Blue-Green
2	0.52-0.60 µm	Green
3	0.63-0.69 µm	Red
4	0.76-0.90 µm	Near IR
5	1.55-1.75 µm	Mid-IR
6	10.40-12.50 µm	Thermal IR
7	2.08-2.35 µm	Mid-IR

NDVI is calculated as a ratio between the red (R) and near infrared (NIR) values in traditional fashion:

(NIR - R) / (NIR + R)

In Landsat 7, NDVI = (Band 4 – Band 3) / (Band 4 + Band 3).

Data Collected:

- Spatial-temporal data of Jharkhand, with NDVI values computed for:
  - every year between **1999 to 2019**
  - with raster pixel size: **1km by 1km.**
  - Buffer around Jharkhand's state boundary of **20km**

Sample screenshot from the dataset procured is shown below:

[1] https://www.usgs.gov/land-resources/nli/landsat/landsat-normalized-difference-vegetation-index?qt-science_support_page_related_con=0#qt-science_support_page_related_con

lon	lat	1999_0	2000_0	2001_0	2002_0	2003_0	2004_0	2005_0	2006_0	2007_0
83.341	24.106	0.411430568	0.312763542	0.48342663	0.386611909	0.426822066	0.302424371	0.313559324	0.376042038	0.3441559
83.35	24.097	0.267360389	0.316477329	0.498220563	0.376680076	0.418687731	0.302843422	0.331873327	0.380782872	0.3779796
83.35	24.106	0.459069222	0.358920246	0.531264126	0.41787672	0.438457102	0.325302035	0.338374257	0.403968036	0.4315351
83.359	24.106	0.228759736	0.337241799	0.592308223	0.450385809	0.441913366	0.339112431	0.406719834	0.417593241	0.4204722
83.359	24.115	0.419618934	0.382024527	0.596514761	0.442490458	0.483281046	0.312823296	0.395074219	0.447345376	0.4203037
83.359	24.124	0.596299887	0.382024527	0.543076396	0.442490458	0.458411664	0.31150806	0.352589667	0.404319346	0.4498615
83.359	24.133	0.589547157	0.358920246	0.554969907	0.450385809	0.441753864	0.319590181	0.387194097	0.4143731	0.4555096
83.368	24.106	0.273675829	0.378578633	0.616302788	0.448669165	0.413997799	0.395066828	0.464361608	0.468206853	0.4251084
83.368	24.115	0.53746587	0.436503321	0.539954901	0.504791141	0.525336623	0.330687135	0.395590544	0.48864308	0.5020456
83.368	24.124	0.556268811	0.343885779	0.470494449	0.386792958	0.433258295	0.275853068	0.307290405	0.386752188	0.4165559

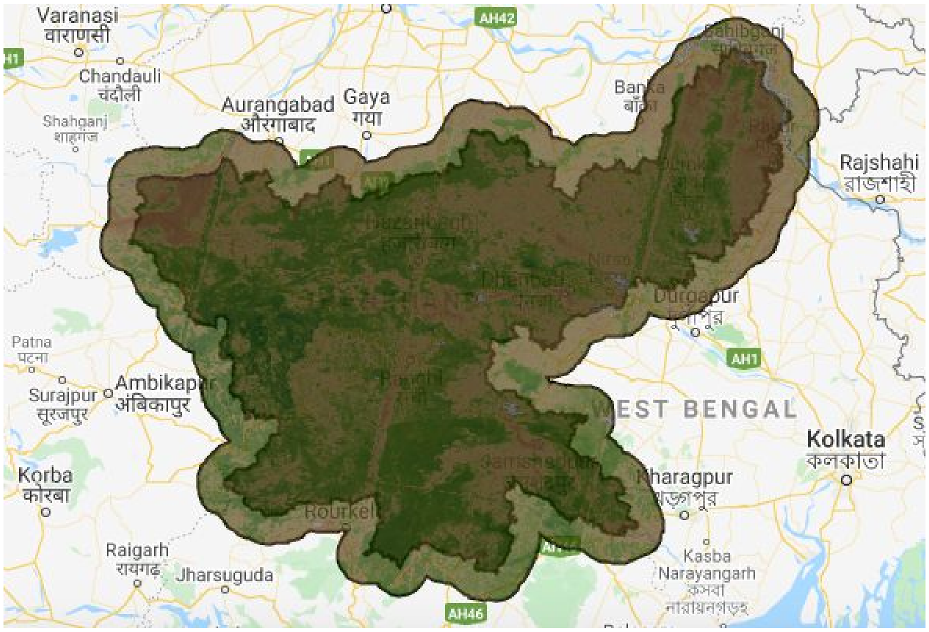
NDVI values are between 0 to 1

Satellite maps of vegetation show the density of plant growth over the entire globe. The most common measurement is called the Normalized Difference Vegetation Index (NDVI). 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), while high values indicate temperate and tropical rainforests (0.6 to 0.8).

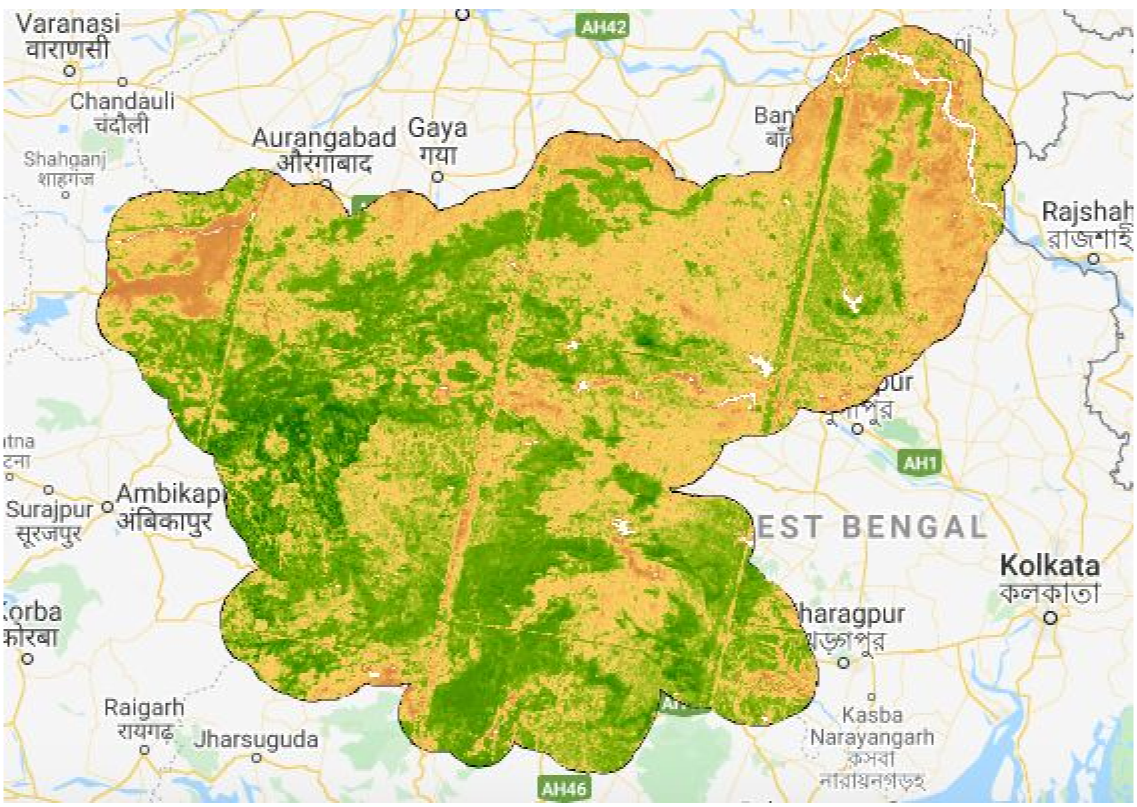
The data above is also available as an image collection of both

- **raw-satellite images**
- **NDVI composites**

1. **Buffer of 20kms surrounding Jharkhand's state-boundary**

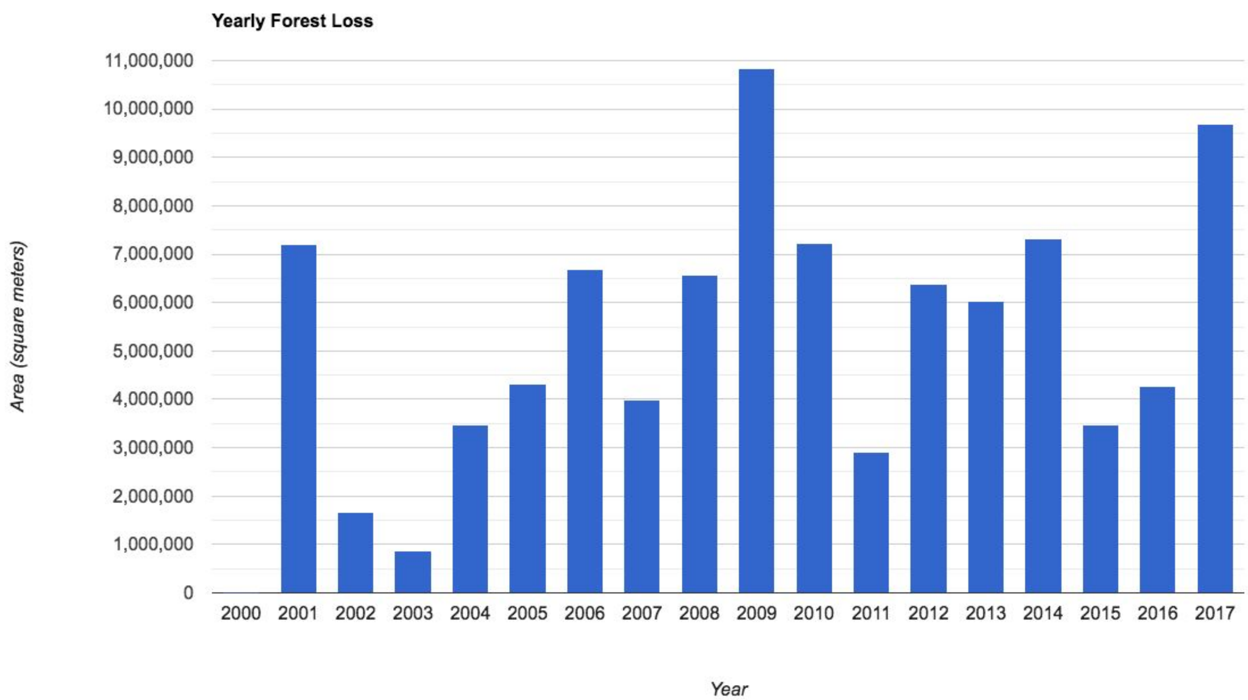


2. **NDVI composite:**

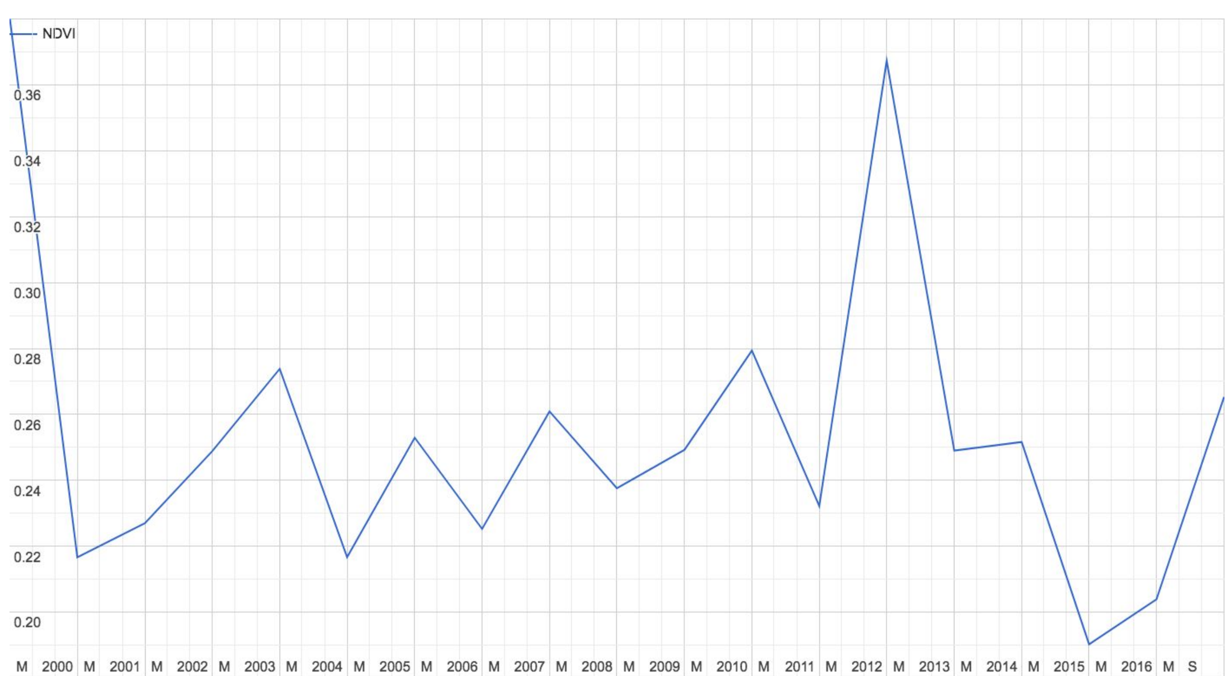


Several data-points can also be obtained:

1. **Annual yearly forest cover loss in the region:**



2. **NDVI values year by year (for a random pixel. Can be obtained for any pixel):**



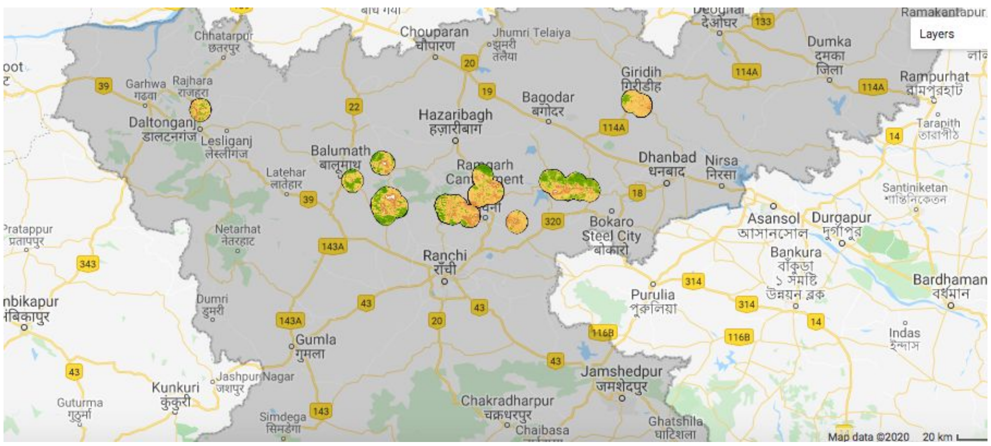
Next steps:

- **Land Surface Temperature data** can be obtained at the same spatial-temporal resolution
- **Climate Change** data can be obtained at the same spatial-temporal resolution
- **Geopandas** can be used for exploratory data analysis of the csv data that was exported.

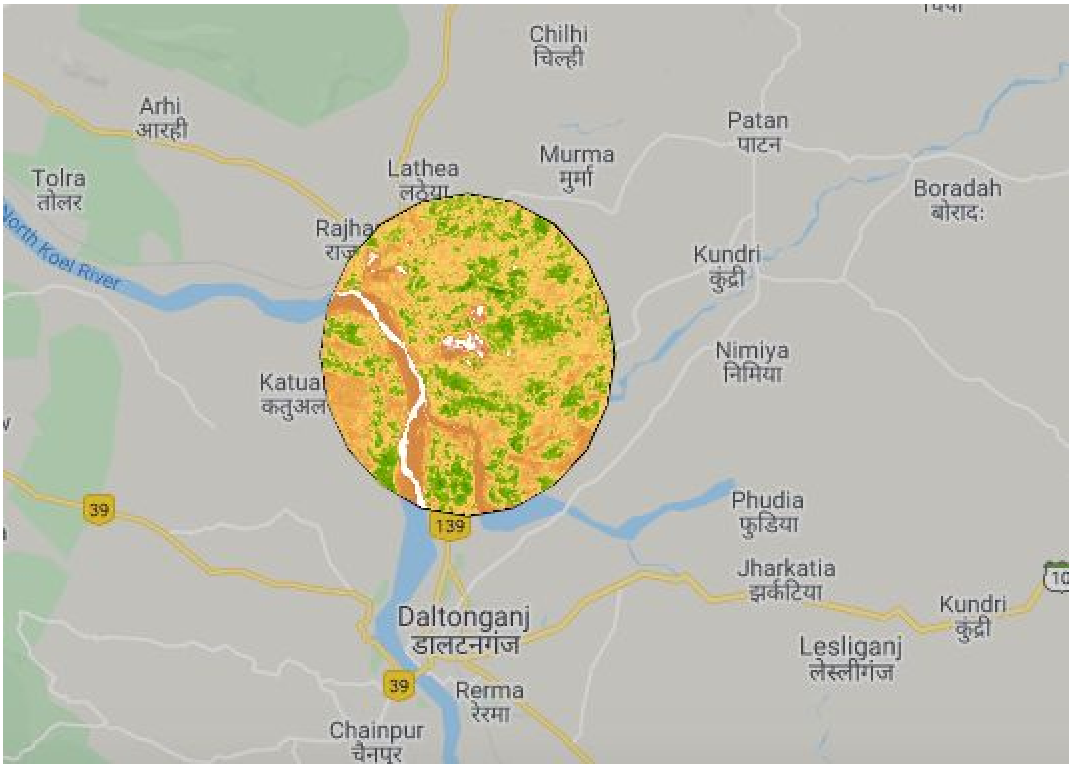
Further exploration at mine-level (please ignore if not required. I simply wanted to explore the possibility)

For a mine-level analysis, the locations of mines can be input in GEE, along with a buffer area of (say) 5km around a mine and calculate changes in NDVI, yearly forest loss in that region as well.

1. For example some CCL mine locations were input:



2. And raster level data can be obtained and analysed for each mine. **An example below.**



This data can be exported into csv and trends like forest loss and changes before and after opening a mine can be analysed using Geopandas, as data is time series.