Geoinformatics report

Mapping of Air Pollution and Time-Series Analysis in Delhi NCR Region

Group Name-Think Tank

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Project Number- 7

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Duration Taken- 2019-2022

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Objective

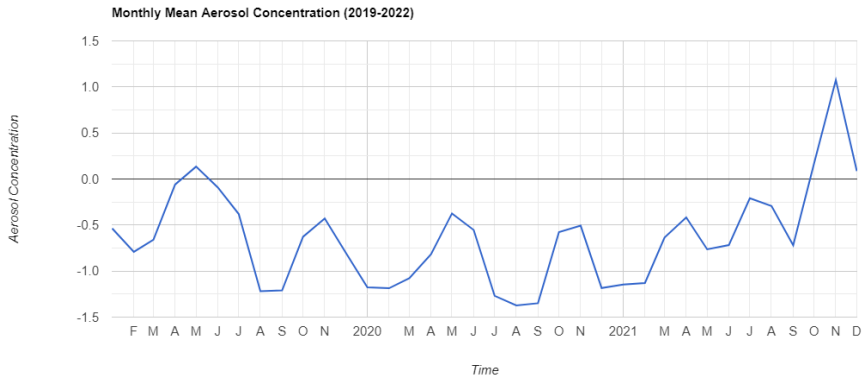
The objective is to write GEE code to map air pollution levels and conduct a time-series analysis in the Delhi NCR region.

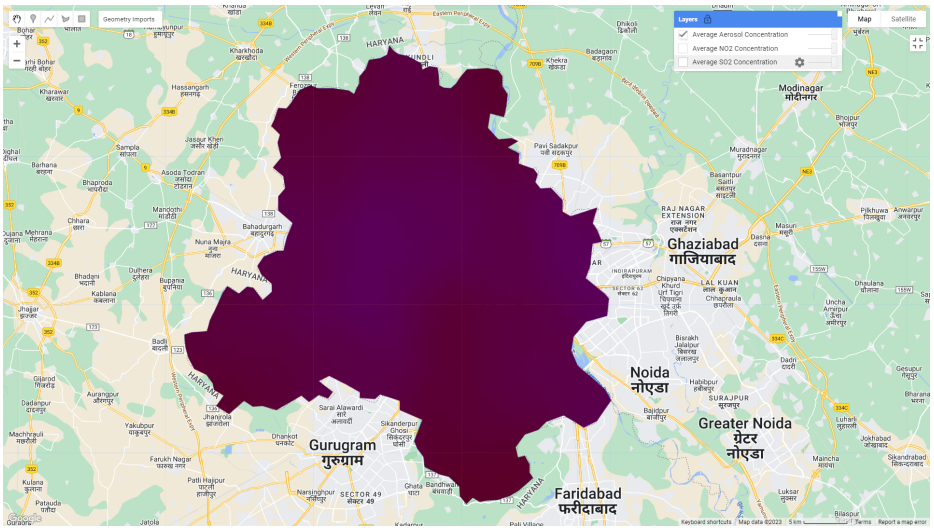
Datasets Used: We have used 3 datasets.

1. Sentinel-5P OFFL AER AI: Offline UV Aerosol Index

   Dataset Link 1

Results

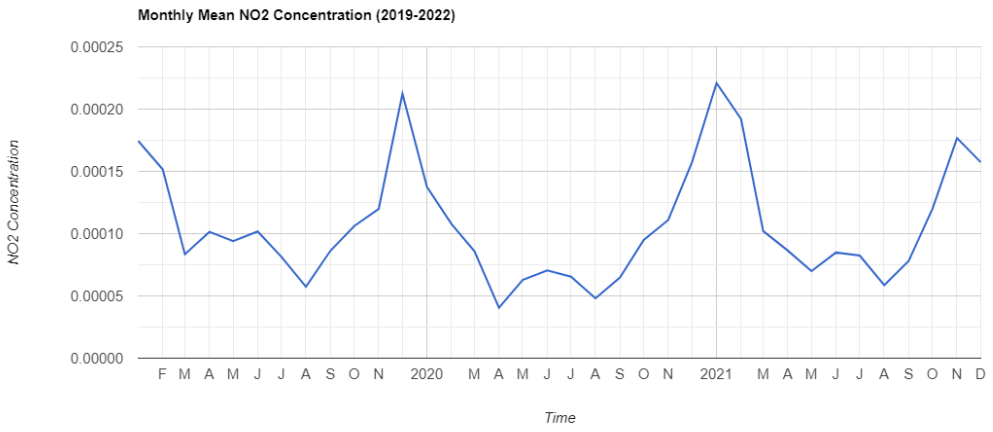


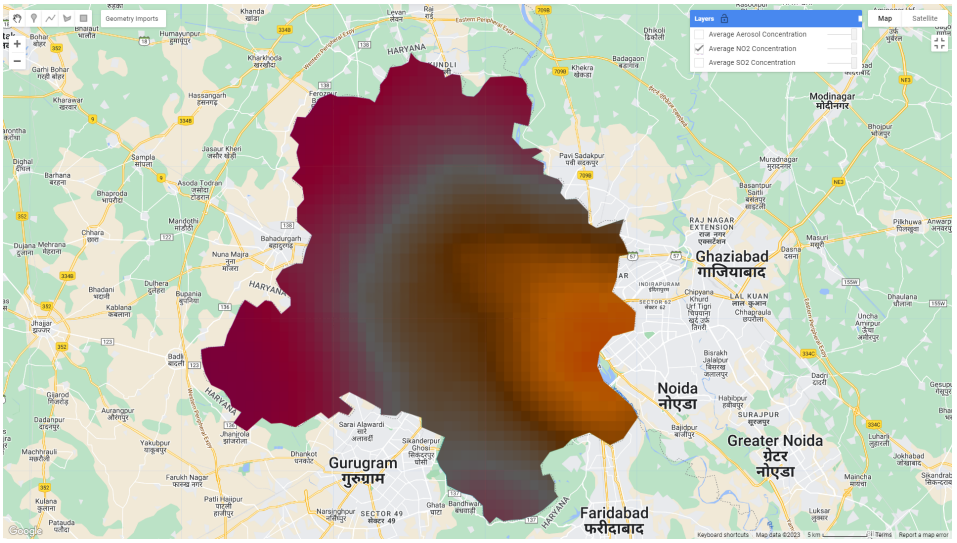


2. Sentinel-5P OFFL NO2: Offline Nitrogen Dioxide

   [Dataset link 2]

Results

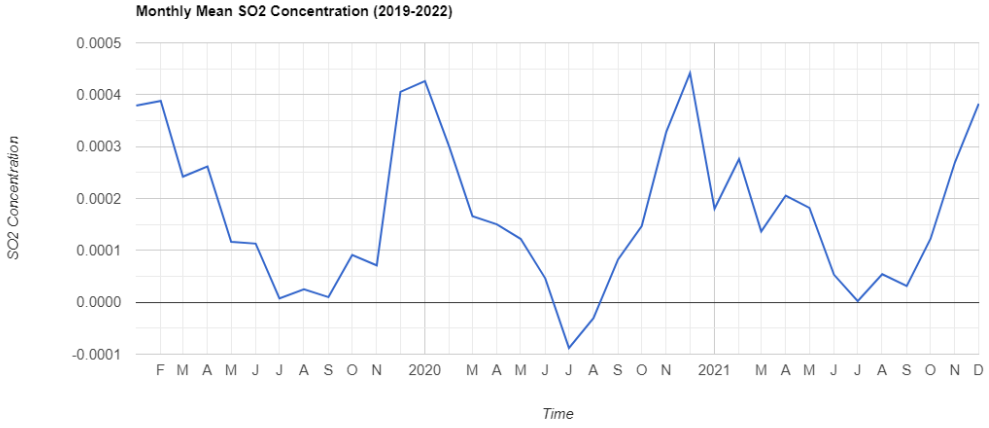


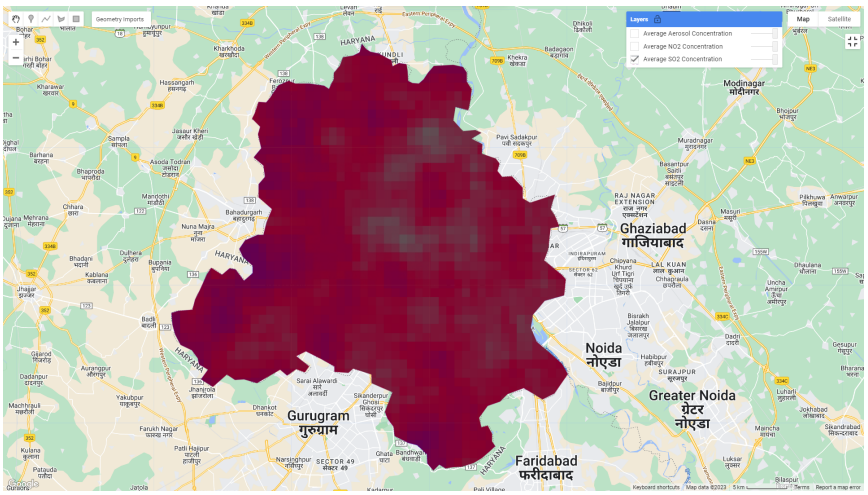


3. Sentinel-5P OFFL SO2: Offline Sulfur Dioxide

   [Dataset link 3]

Results





Interpretation and Analysis:

The study of air pollution in Delhi NCR between 2019 and 2022 shows some interesting things. Firstly, in certain areas like industrial zones and busy roads, there's more air pollution. This mostly comes from vehicles and industries. Sometimes, in specific places, the pollution from industries shoots up, especially for a gas called SO2. The dusty particles in the air, called aerosols, come from both human activities and nature and are spread out more widely.

Secondly, when we look at different times of the year, we notice some changes. In winter, there's more of a gas called NO2 because people use more energy to keep warm. Also, throughout the year, the levels of SO2 change, probably because of certain industries working more during different times.

Thirdly, when we link the pollution to the weather, we see that when the weather is a certain way, the pollution is higher. For example, when the air near the ground is cooler than the air above it, called a temperature inversion, the levels of NO2 go up.

These findings show that areas with a lot of people might have health problems because of the air they breathe. It's important to take care of this, especially at specific times of the year when pollution levels increase. Understanding these changes helps us make better plans to control pollution, protect people's health, and make cities better to live in.

In conclusion, the interpretation and analysis of air pollution mapping and time-series data for SO2, NO2, and aerosols provide a detailed understanding of the evolving air quality scenario in Delhi NCR, including seasonal variations in pollutant levels. These findings empower decision-makers with knowledge to implement targeted measures for pollution control, public health improvement, and sustainable urban development in the region.

Challenges :

Interpreting Sentinel-5P OFFL AER AI, especially the Offline UV Aerosol Index, for specific particulate matter measurements poses challenges in satellite observation translation. Limited spatial resolution hampers identifying localized aerosol sources, and data gaps from cloud cover impact the time-series analysis. Addressing these challenges requires refining aerosol retrieval algorithms, integrating ground-based measurements, and careful communication of findings on Google Earth.

New ideas to extend the work

Looking ahead, our project aims to explore more data sources for a better understanding of air quality. We're excited about using machine learning models to predict pollution levels and find places with high pollution. We also want to check if the things we're doing to control pollution are working well. Looking at pollution in smaller areas using detailed maps can give us a clearer picture. We're thinking of adding health information to see how pollution affects people's health. Plus, we want to see if changes in air quality match up with changes in rules about the environment. Making our tool easier to use, comparing our data with other places, and getting people in our community involved are also things we're planning for the future.

Complete Code : Project Link

```
// We have defined visualisation parameters for each dataset here

var vizParameters = {
```

```
    SO2: {
      collection: ee.ImageCollection("COPERNICUS/S5P/OFFL/L3_SO2")
        .filterBounds(Delhi)
        .filterDate('2019-01-01', '2022-12-31')
        .select('SO2_column_number_density'),
      viz: {
        min: 0.0,
        max: 0.0005,
  //Colour palette of SO2
        palette: ['black', 'blue', 'purple', 'cyan', 'green', 'yellow',
'red']
      },
      scale: 5000
    },
    NO2: {
      collection: ee.ImageCollection("COPERNICUS/S5P/OFFL/L3_NO2")
        .filterBounds(Delhi)
        .filterDate('2019-01-01', '2022-12-31')
        .select('tropospheric_NO2_column_number_density'),
      viz: {
        min: 0,
        max: 0.0002,
  //Colour palette of NO2
        palette: ['black', 'blue', 'purple', 'cyan', 'green', 'yellow',
'red']
      },
      scale: 5000
    },
    Aerosol: {
      collection: ee.ImageCollection("COPERNICUS/S5P/OFFL/L3_AER_AI")
```

```
        .filterBounds(Delhi)
        .filterDate('2019-01-01', '2022-12-31')
        .select('absorbing_aerosol_index'),
      viz: {
        min: -1,
        max: 2.0,
  //Colour palette of Aerosol
        palette: ['black', 'blue', 'purple', 'cyan', 'green', 'yellow',
'red']
      },
      scale: 5000
    }
  };


  // chart Creation
  Object.keys(vizParameters).forEach(function(key) {
    var dataset = vizParameters[key].collection;
    var band_viz = vizParameters[key].viz;
    var scale = vizParameters[key].scale;


    var monthlyMeans = ee.ImageCollection.fromImages(
      ee.List.sequence(0, 35).map(function(month) {
        var startDate = ee.Date('2019-01-01');
        var startMonth = startDate.advance(month, 'month');
        var endMonth = startMonth.advance(1, 'month');
        var datasetOfMonth = dataset.filterDate(startMonth, endMonth);
        var meanValue = datasetOfMonth.mean().set('system:time_start',
startMonth);
        return meanValue.set('month', startMonth.format('YYYY-MM'));
      })
```

```
    );

    var chart = ui.Chart.image.seriesByRegion({
      imageCollection: monthlyMeans,
      regions: Delhi,
      reducer: ee.Reducer.mean(),
      scale: scale,
      xProperty: 'system:time_start',
      seriesProperty: 'month'
    }).setOptions({
      title: 'Monthly Mean ' + key + ' Concentration (2019-2022)',
      hAxis: { title: 'Time' },
      vAxis: { title: key + ' Concentration' }
    });

    // Displaying the time-series chart
    print('Time-series chart for ' + key + ':', chart);

    // added average concentration as a layer on the map
    Map.addLayer(monthlyMeans.mean().clip(Delhi), band_viz, 'Average '
+ key + ' Concentration', false);
  });

  // Set the center of the map
  Map.setCenter(77.1025, 28.7041, 10);
```

above it, called a temperature inversion, the levels of NO2 go up.

References:

1) Google Earth Engine Official Youtube Channel

2) Earth Engine Data Catalog

3) “Study Hacks-Institute of GIS & Remote Sensing” Youtube Channel