DS Take Home Assignment

Impact of COVID-19 on air quality

Overview:

As per WHO "Air pollution is the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere." Air pollution is caused by industry, wildfire, urbanization, transportation, burning of fossil fuels...etc. The major reason behind all these is an increase in the human population. Air pollution has a hazardous impact not only on human health but also, on the earth and all the other living organisms. According to a study, air pollution kills 7 million people every year. Sulphur dioxide, ozone, particulate matter, and Nitrogen dioxide are the main pollutants in air pollution. Aerosols emitted into the atmosphere by human activity (cars, industry) and natural phenomena (fires, dust storms) have a negative impact on human health, diminish visibility, and change the Earth's radiation budget. The Aerosol Optical Depth (AOD) is a quantitative measure of the amount of aerosol in the atmosphere that can be used as a proxy for surface Particulate Matter PM2.5 (particles with a median diameter of less than 2.5 m).In this project changes in AOD during COVID-19 lockdown are analysed using satellite data.

Introduction to datasets

Aerosol optical depth images are downloaded from NASA's LANDS DAAC website. For this study, NO2 and SO2 concentrations of pollutants were analysed year-wise. This data is available on government websites such as the central pollution control board. MOD04_L2 - MODIS/Terra Aerosol 5-Min L2 Swath 10km data was used for aerosol optical depth. It is a level to the product having a temporal resolution of 5 mins. High-resolution data is not available for the region of interest. So, the analysis was carried for the data available for region of interest. Different algorithms are used to calculate AOD over land. The deep blue algorithm was used in this project as it is best suitable for land.

The links to the above websites are as follows:

LANDS DAAC website:

https://ladsweb.modaps.eosdis.nasa.gov/search/order/1/MOD04_L2--612.

Cpcb(Central pollution control board): https://cpcb.nic.in/

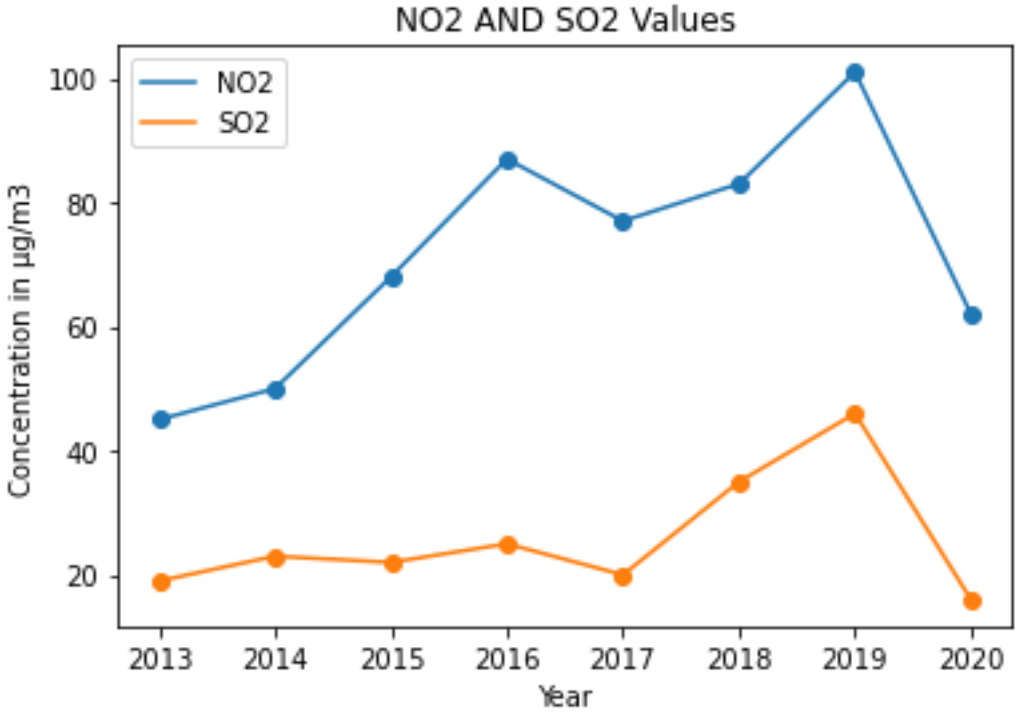
Open street Map: https://www.openstreetmap.org/#map=4/21.84/82.79

Region of Interest:

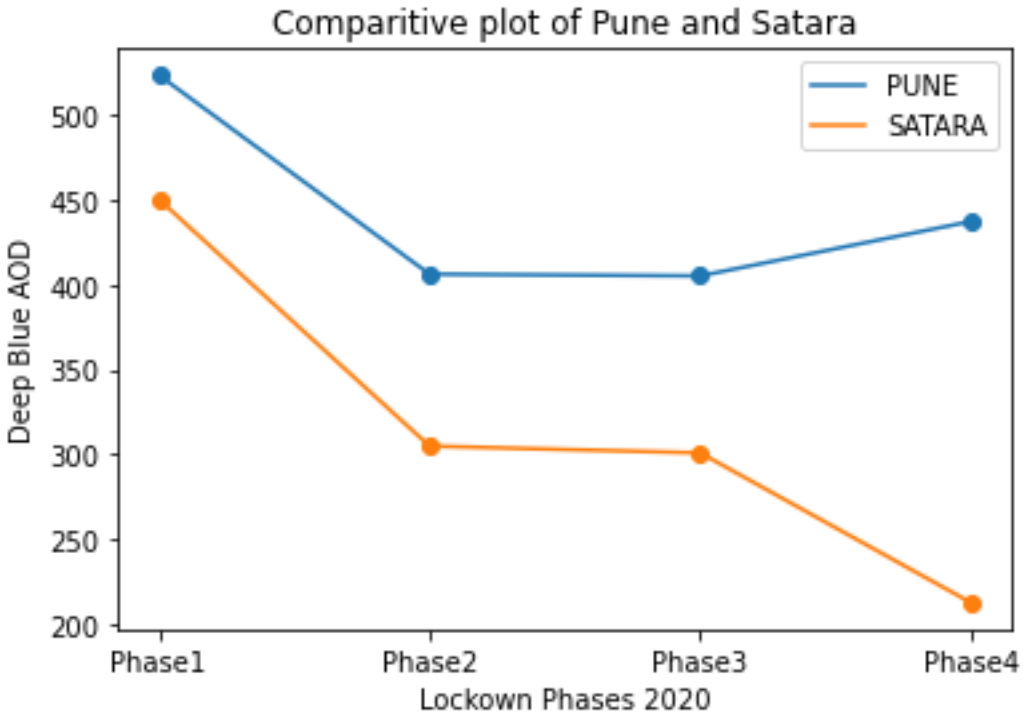
Pune is the second-largest city in Maharashtra after Mumbai and is considered to be the cultural capital of Maharashtra. Pune is widely regarded to be the second major IT hub and the most important automobile and manufacturing hub in India. Pune is situated at 18°31′13″N 73°51′24″E

Methodology and Analysis:

The major pollutants contributing to air pollution are Sulphur dioxide, ozone, particulate matter, and Nitrogen dioxide. The graphs in the above figure show the concentration of pollutants observed from 2013 to 2020. the concentration of Nitrogen dioxide and Sulphur dioxide has increased from 2013 to 2019. There is a sudden depression in the values of pollutants in the year 2020. As only the annual average of the pollutants is available on the official website further analysis is carried out using satellite data.



Daily Aerosol optical depth (AOD) was downloaded and analysed for the lockdown period. TIF files which are downloaded are reprojected in the same projection system as shapefile using Gdal library. No data values are replaced by 0. Industrialization, urbanization and vehicular traffic are some of the major factors affecting air pollution. So the values of AOD were extracted for two districts to represent the spatial variation. The first place is Pune, Maharashtra which is a highly industrial and urbanized area. The second place is Satara, Maharashtra having less industrialization. The AOD data were obtained using rasterio library. The latitude and longitude were first converted into rows and columns for the particular image. Then the image was converted into a 2D array using the Numpy library. Aod values were obtained from rows and columns which were extracted from Latlong.



Covid 19 lockdown was carried out in four different phases from 24 March to 31 May 2020. As shown in fig 1 mean value at each lockdown phase is plotted for two different districts in

Maharashtra. Phase1 (24 March – 14 April) nearly all the industries and services were suspended. During this phase, sudden depression in the AOD value can be observed. Highest AOD recorded from satellite data during this phase for Pune and Satara are 828 and 682 respectively. Phase2(15April-3May) government allowed some agricultural business. Compared to phase1 transportation and industries were opened. The mean AOD values were 406 and 305 for Pune and Satara. During phase 3(4-17 May) and phase 4(18-31 May) with some relaxation few industries started. The mean AOD of phase 3 and phase 4 are 405,565,301 and 213 for Pune and Satara respectively. Spatial variation in the values of AOD is because of land use and land cover of the two places.