Summary

The focus of this study was on Air Quality, Air Temperature and Land Temperature, while considering rainfall as control parameter.

Observation from satellite and ground measurements in **Bengaluru district** reveal a significant decrease in pollutants for Mar-May 2020 and 2021.

Our analysis on effect of covid-19 on environment revealed the following

- Air Quality Index was used as the primary indicator to ascertain the impact of lockdown on environment. It has non-linear relation with air pollutants.

- There was a drop in AQI for Bengaluru of about 43.791 ± 7.86 for the year 2020 as compared to 2019.

- Land Surface Temperature did not have any significant effect as a result of improved air quality in 2020, but showed slight decrease for the year 2021, as compared to 2019.

- Air Temperature showed a significant decrease for the year 2019 and 2021; 2020 and 2021.

- Moderate to strong correlation between remote sensing and ground measurements.

Key outcomes or takeaways from your solutions.

- The outcome from our analysis is that air quality improved as a result of the lockdown. Moreover the effect seems to have lasted for another year.

Tropospheric NO$_2$ for Bengaluru [Mar 24 - May 30]
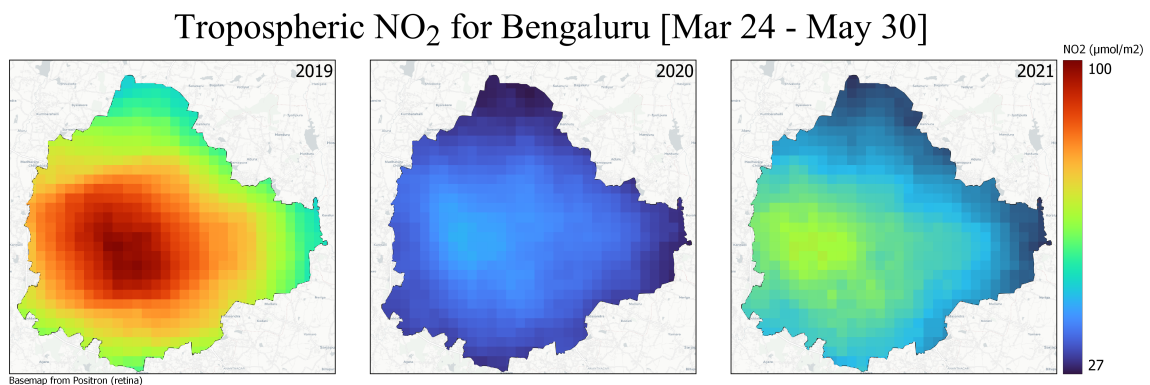
- Year 2021 was cooler than 2020 and 2019 as consequence of pandemic.

- Near identical condition are necessary to ascertain the difference in various atmospheric parameter are not a coincidence but in fact because of decline in

anthropogenic activity during lockdown. To ascertain this, we undertake measures to control for precipitation.

- In case of LST, a single point statistic cannot be representative of entire region due to natural variability.

- Remotely sensed data is certainly a valuable tool for mapping and assessing air pollution due to its synoptic view and systemic delivery.

Involvement of geospatial data

The solution heavily relied on geospatial data. Rainfall, Atmospheric parameter, Land and Air Temperature measurements were taken from various satellites. Data Collection from CPCB, CHIRPS, Terra MOD11A1, Sentinel-5P, Landsat 8, ECMWF ERA5.

- <u>CPCB</u> — Daily Air Quality data for Silk Board Station

- <u>CHIRPS</u> - Daily Rainfall data at $5566\ m$ resolution. Used as control parameter.

- <u>Sentinel-5P TROPOMI NO_2</u> — Daily Tropospheric vertical column NO_2 data at $7 \times 3.5\ km$ resolution. Used for air quality monitoring.

- <u>MODIS LST product MOD11A1</u> — Daily Land Surface Temperature at $1\ km$ resolution. Used for Time Series analysis with Air Temperature

- <u>Landsat 8 Collection 2 Level 2</u> — 16-day Land Surface Temperature at $30\ m$ resolution. Used for representing LST during he month of April.

- <u>ERA-5 Single Level 2-m Temperature</u> - Hourly $2\ m$ Air Temperature at $0.25\ °$ resolution. Used for Time Series analysis with Land Surface Temperature.

Further modification in terms of data and methodology

In terms of data,

- Use of Air temperature measurement (from IMD AWS) to quantify the relationship with satellite based measurements.

- Sixteen day temporal visit is not adequate and1000 m resolution LST from MODIS is coarse. Improvement in LST by combining MODIS, Landsat and ERA-5 product to increase temporal and spatial resolution.

- Look at traffic condition (number of accidents reported, number of vehicle purchases) or noise pollution levels as a result of drop in air quality. Verify if cause of air/noise pollution is traffic or industry with MODIS AOD product.

In terms of methodology,

- Control for other meteorological parameters: fires, storm.

- Compare and contrast for a large time-scale.

- Perform spatial-temporal analysis i.e., include more geographical location to measure the difference in results.

- Model ground-measurements (AQI) with satellite data to provide insights at higher spatial and temporal resolution.

Assumptions

- A threshold of 5mm is set to exclude rainfall in air quality and temperature measurements. This is to avoid bias in measurements due to precipitation

- Single ground station is representative of Bengaluru district Air Quality

Anomalous behavior is observed with Land Surface Temperature and Air Temperature which can be attributed to the capacity of earth to hold the heat over the years. Air quality improvement does not necessarily translate linearly to surface temperature. A decrease in concentration of pollutants could modify land temperature in both positive and negative ways as a result of changes in solar radiation, absorption and scattering.

To state that decrease in air quality affects AT would not be wrong but to assert the statement with confidence would require additional research including correction for bias in AT which result from meteorological effect and natural variability.

Further work is needed to understand and attribute the cause of decrease in atmospheric temperature through application of net radiation on earth.