Near Real-Time Air Quality Trend Monitoring in Odisha Using Multi-Sensor Satellite Images

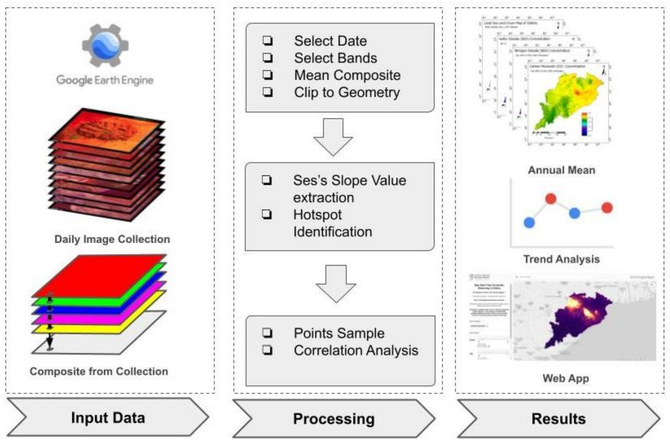
Pulakesh Pradhan* and **Dr. Ranjana Bajpai****.

*Research Scholar and **Professor & Head , Dept. of Geography, Ravenshaw University, Cuttack, Odisha.

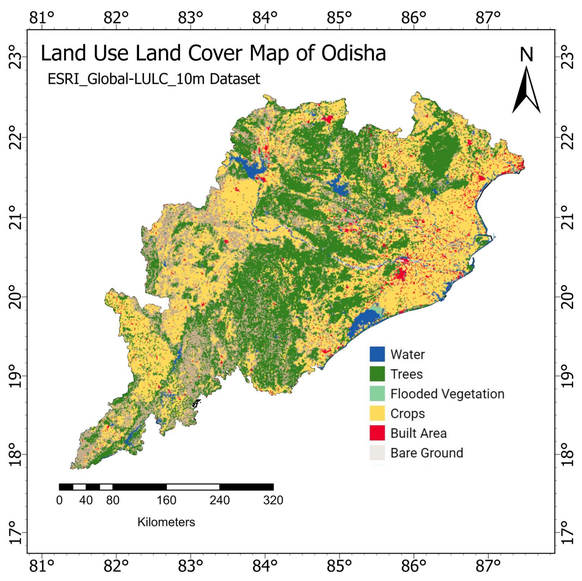
Introduction

Air pollution is a major environmental health concern, responsible for millions of deaths globally per year (WHO, 2021). India is one of the country having highest pollution levels across worldwide. Common air pollutants like SO2, NO2, and CO have been associated with increased mortality and morbidity (Ghude et al., 2016). Effective air quality management and epidemiologic research requires extensive Spatio-temporal monitoring of pollution levels across India. However, ground monitoring has limited spatial coverage in India (Guttikunda & Jawahar, 2018). In Odisha there is a lack of extensive ground monitoring infrastructure and Satellite remote sensing provides an opportunity for comprehensive pollution mapping and trend analysis.

Methods



Sentinel 5P satellite used for this study, provides daily global coverage of trace gases like SO2, NO2, and CO at high resolution (1113.2 meters) (Bauwens et al., 2020). Images from January 2019 to December 2022 processed using Google Earth Engine (GEE) and the concentrations shows in *µmol/m2* unit. Annual trends has examined by Sen's slope estimator. Pollution hotspots has identified using suitable legend colors. Air conditions over different land use land cover (LULC) classes identified with random samples and an association showed in the pair plots. Near real-time monitoring system was implemented as a web app using GEE JavaScript API. Google Earth Engine is a cloud computing platform that enables efficient analysis of massive satellite datasets (Gorelick et al., 2017). Recent studies have utilised GEE to process and analyze TROPOMI data to map pollution trends across India (Jethva et al., 2019; Beig et al., 2021). Despite a few limitations, it proves highly useful for exploring spatial patterns in air pollution and identifying potential pollution hotspots.



Land Use Land Cover Map

Data Analysis

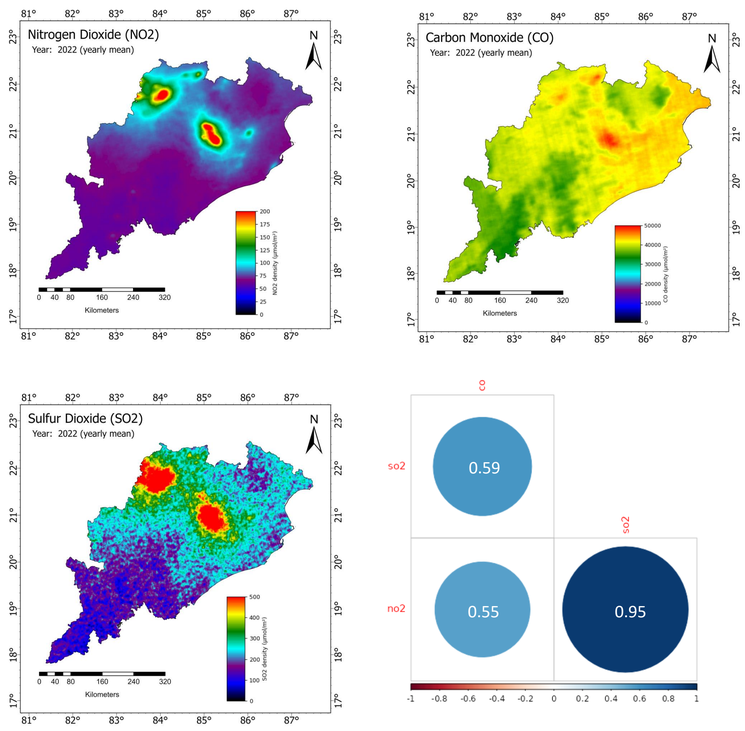


Figure A:
Anural Concentration of NO2, CO and SO2. (2022) (µmol/m2) and Correlation Among Them.

The NO2 and SO2 have very high positive correlation whereas the SO2 , CO and NO2 , CO has moderate positive correlation. The major concentration of these pollutants are found in the industrial regions of the state. In theses areas the concentration of the gases are much higher that the safety level. As per the trend the SO2 showing strong positive trend over those industrial centers, same gores for NO2 also. The CO positive trend distributed throughout the state. Overall the yearly graph shows that in Cuttack city the aerosol level has increasing in recent years. High correlation with built-up land and the pollutant gases found in the state.

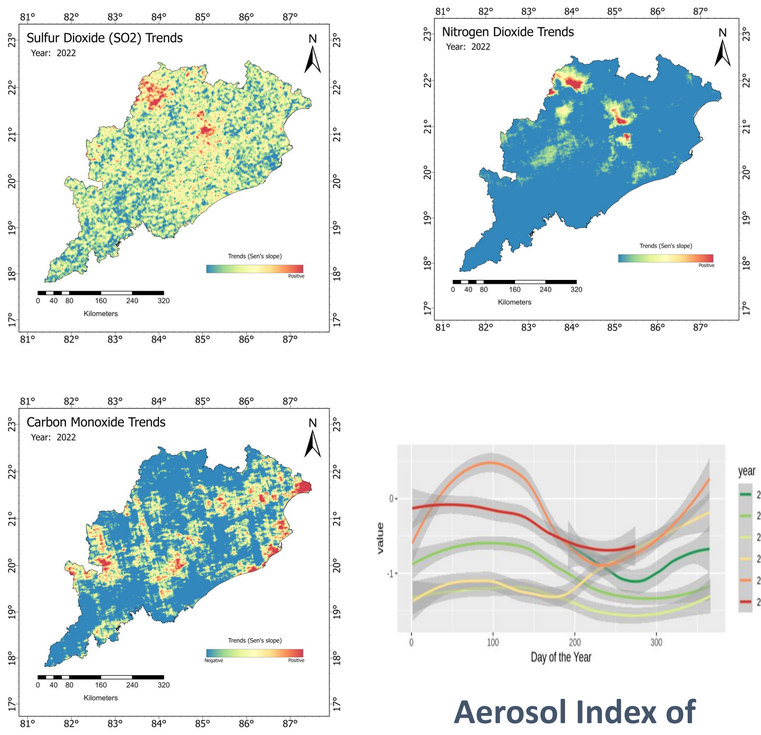


Figure B:
Sen's Slope Trend of NO2, CO and SO2. (2022)

Table 1 – Trends of the Gasses (Sen's Slope)

Pollutant	Minimum	Average	Maximum
SO2	-0.0205	0.0020	0.0265
NO2	-0.0030	0.0097	0.0008
CO	-0.8505	-0.1048	0.7123

Discussion

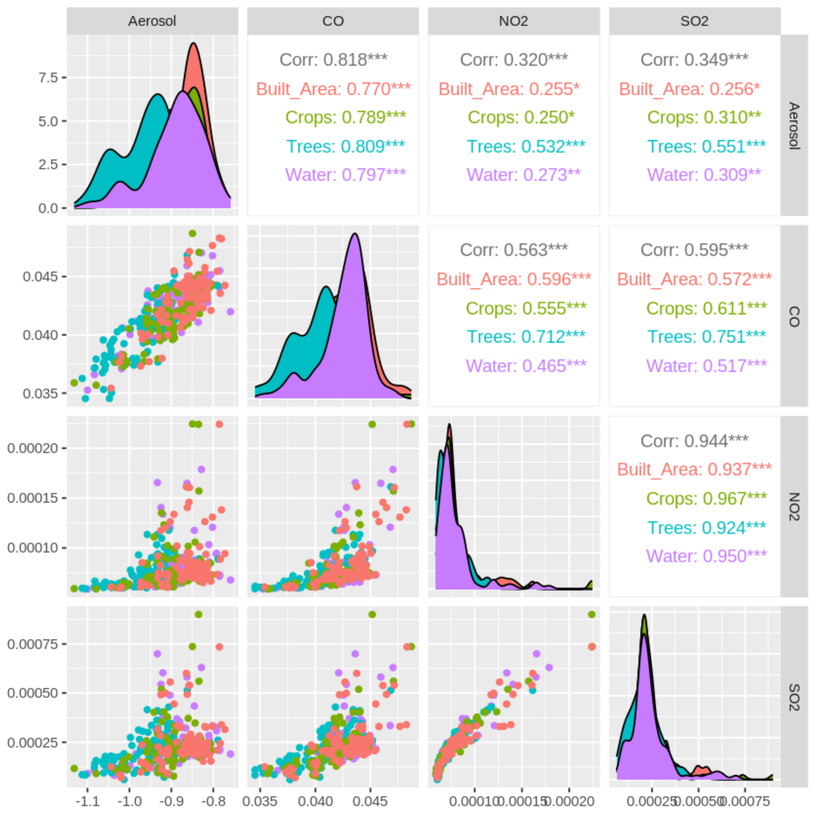


Figure C:
LULC and NO2, CO and SO2 Correlation. (2022)

Conclusion

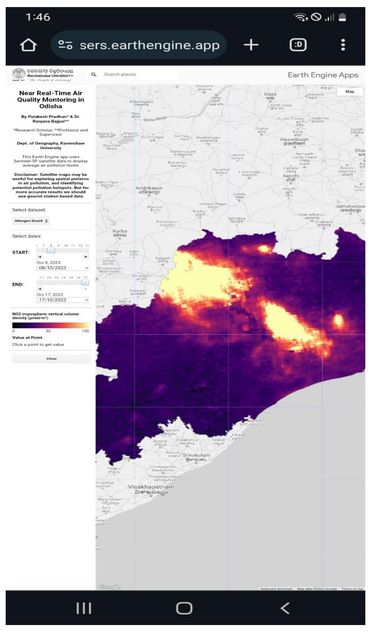
- A high concentration of pollutant gases is observed in industrial regions and urban centers, primarily attributed to industrial activities, the escalating use of fissile fuel, and vehicular emissions. Sen's slope analysis predominantly reveals positive trends in these regions.
- Correlation plots illustrate the relationship between pollutant gases and land-use classes, indicating an overall positive correlation with variations in land-use changes.
- The yearly chart of Cuttack City unmistakably depicts an increase in aerosol levels in recent years.

References

1.World Health Organization (WHO). (2021). Air pollution.

2.Gorelick, N., Hancher, M., Dixon, M., Ilyushchenko, S., Thau, D., & Moore, R. (2017). Google Earth Engine: Planetary-scale geospatial analysis for everyone. Remote Sensing of Environment, 202, 18-27.

3.Guttikunda, S. K., & Jawahar, P. (2018). Air pollution knowledge assessments (APnA) for 20 Indian cities. Urban Climate, 27, 124-141



To know more...

- Nitrogen dioxide (NO2)
- Carbon monoxide (CO)
- Sulphur Dioxide (SO2)
- Methane
- Formaldehyde (HCHO)
- Ozone (O3)
- Cloud
- Aerosol Index

Dept. of Geography
Ravenshaw University, Cuttack, Odisha

Air Quality Monitoring App Link →