Air Pollution Analysis of India's Four Regional Mega Cities Pre / Post COVID-19

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Project Abstract

Each year, India can be found among the countries with the worst levels of air pollution on global indices. The most common such pollutant measured within this metric is CO (carbon monoxide), while high levels of trace pollutants, such as SO2 (sulfur dioxide), O3 (ozone), and NO2 (nitrogen dioxide), serve to further substantiate evidence of poor regional air quality.

The production of said pollutants can be derived from the combustion of fossil fuels and alternative energy sources, of which India can be considered a significant global consumer.

Currently, India is undergoing a significant lockdown within major population centers due to COVID. Our data science project seeks to prove a **hypothesis** that an effective lockdown should lead to a sizable decrease in pollutants within the regional megacities of Mumbai (West), Delhi (North), Chennai (South), and Kolkata (East).

City Profiles

Fun fact:
New York City's density is 11,000 people per km^2

Chennai
Population (2019): 4,328,063
Density: 26,553 km^2 Growth: 2.54%
Industry: automobile, computer technology, hardware manufacturing and healthcare sectors.
COVID status: Strict lockdown
Data Center: Velachery Res. Area

Delhi
Population (2019): 10,927,986
Density: 20,412 km^2 Growth: 3.03%
Industry: formation technology, telecommunications, hotels, banking, media, and tourism
COVID status: Phase I Reopening
Data Center: Sirifort

Mumbai
Population (2019): 12,691,836
Density: 32,000 km^2 Growth: 1.12%
Industry: finance, jewellery, leather processing, IT, textiles, and entertainment.
COVID status: Phase I Reopening
Data Center: Chhatrapati Shivaji Intl. Airport (T2)

Kolkata
Population (2019): 4,631,392
Density: 24,000 km^2 Growth: 0.59%
Industry: Financial hub, major commercial and military port
COVID status: Strict lockdown
Data Center: Bidhannagar

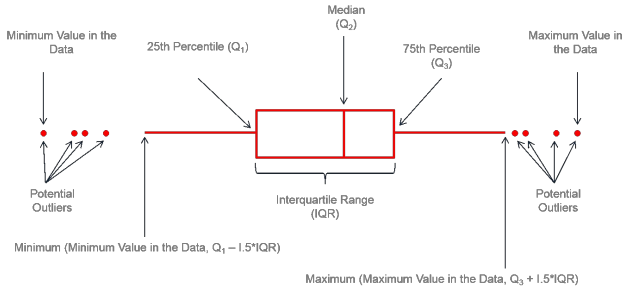
Summary Table - Carbon Monoxide (CO per µg/m3)

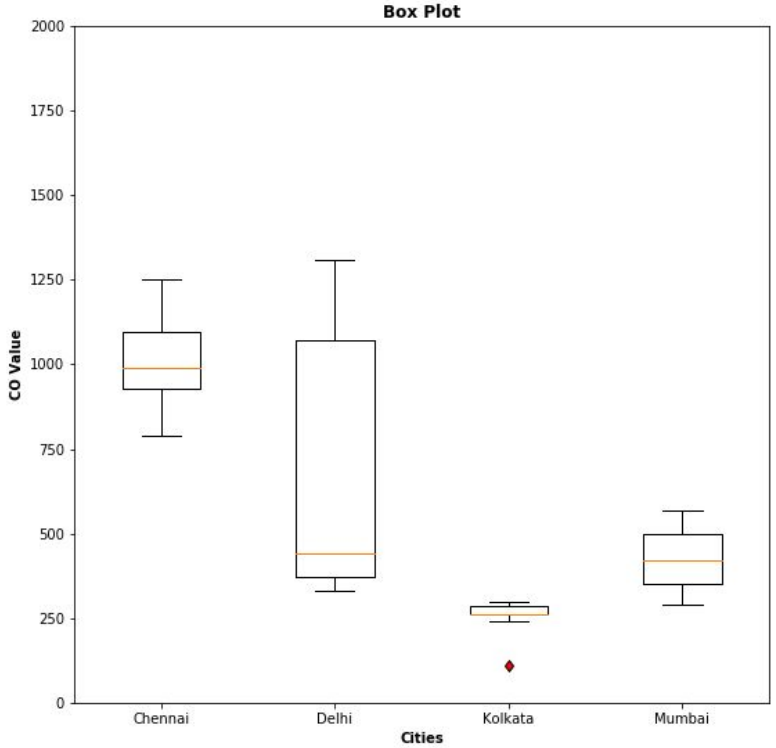
City	Mean	Median	Standard Deviation	Variance	SEM
Chennai	1007.00	990.00	120.40	14495.79	26.92
Delhi	664.33	440.00	376.05	141411.61	68.66
Kolkata	263.64	260.00	38.86	1509.96	8.28
Mumbai	420.56	420.00	87.21	7605.56	20.56

June 22nd, 2020

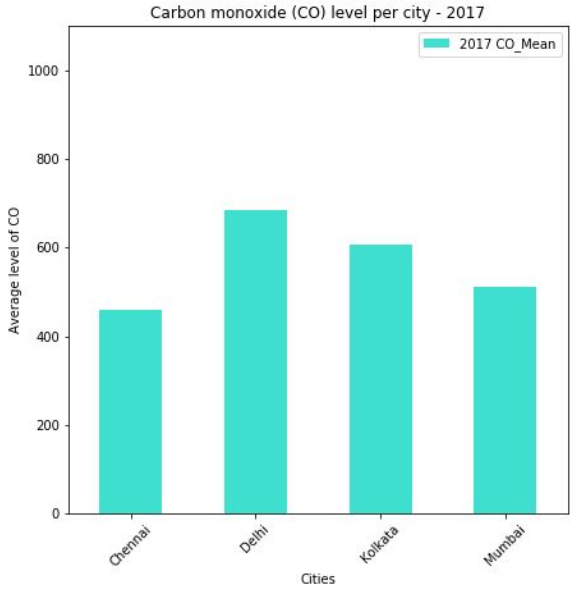
CO Levels throughout the Day *(June 22nd, 2020)* in Each City

- Kolkata had one outlier in the first interquartile at 218.75 µg/m3
- Kolkata had the smallest IQR at 260.0 µg/m3
- Kolkata had the smallest standard deviation at 38.8 µg/m3
  → low change throughout day
- Delhi had the largest IQR at 700.0 µg/m3
- Delhi had the largest standard deviation at 376.1 µg/m3
  → high change throughout day
- Limitation in box plot: does not show time

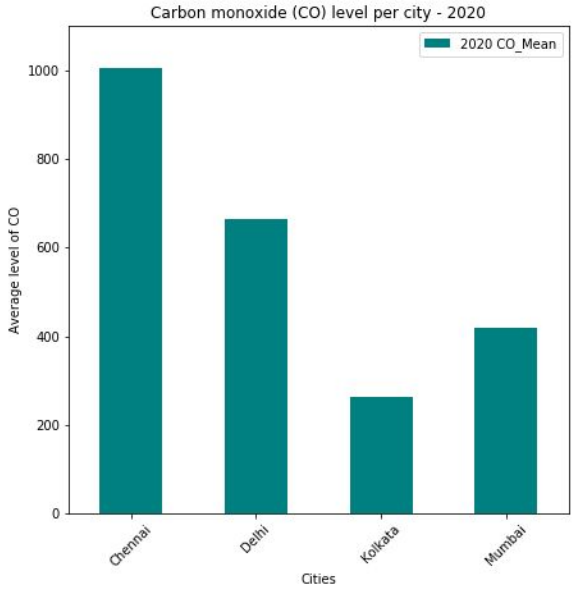




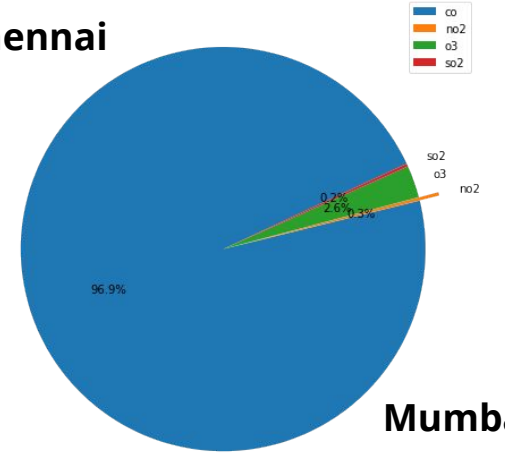
Average Level of CO in Each City -2017/2020



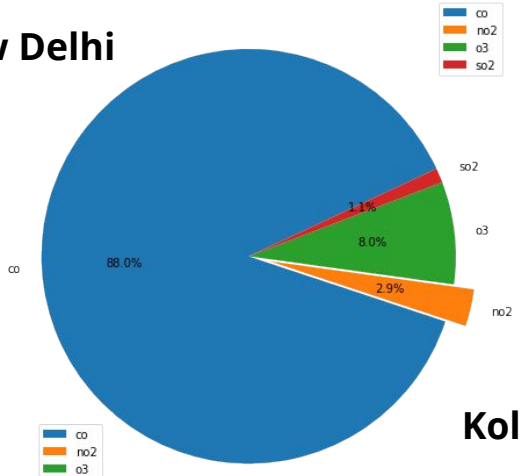
- Chennai's population will grow 2.5x by 2025
- Kolkata's CO levels decrease can be correlated with their strict lockdown
- The CO levels for Delhi and Mumbai have shown minimal change



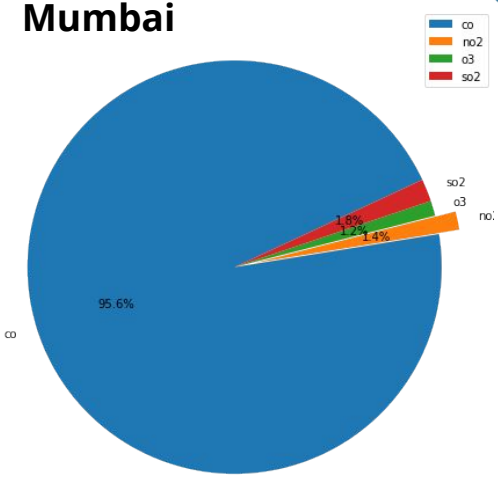
Chennai



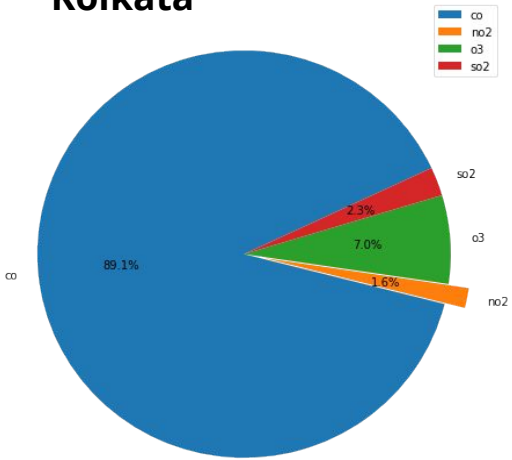
New Delhi



Mumbai



Kolkata

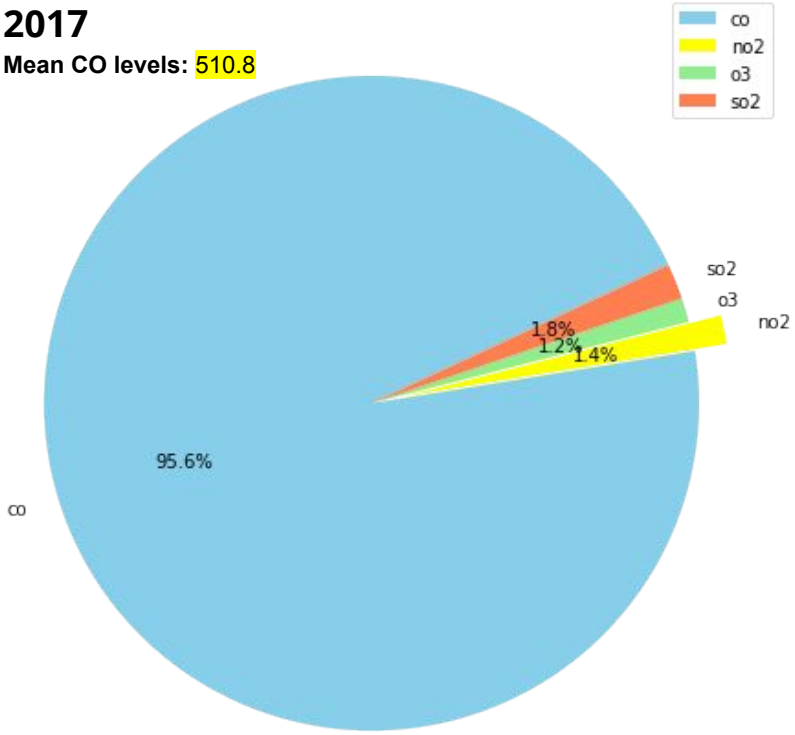


Pie Charts of City Pollutants during "COVID" era

June 22nd, 2020

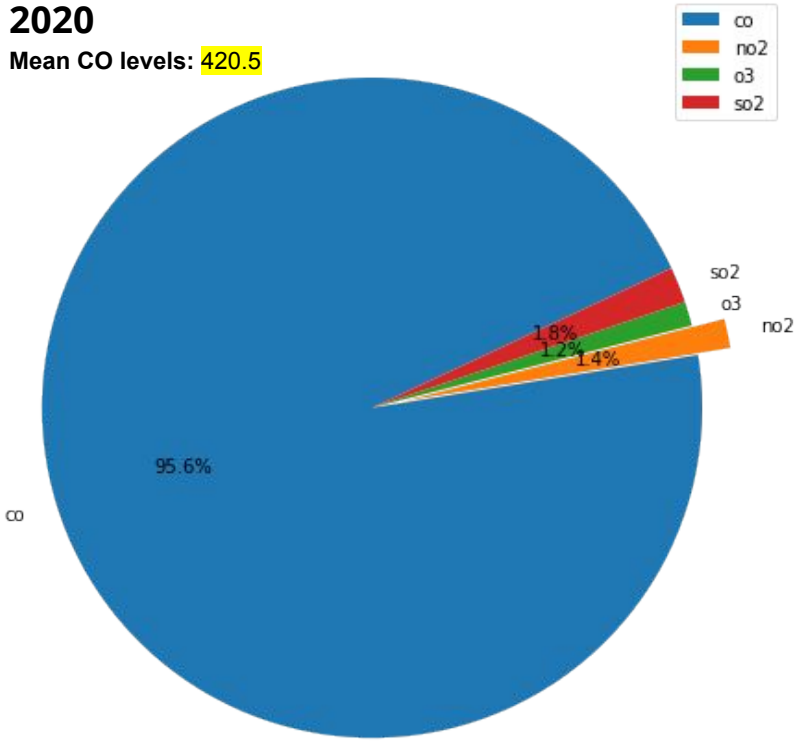
2017

Mean CO levels: 510.8



2020

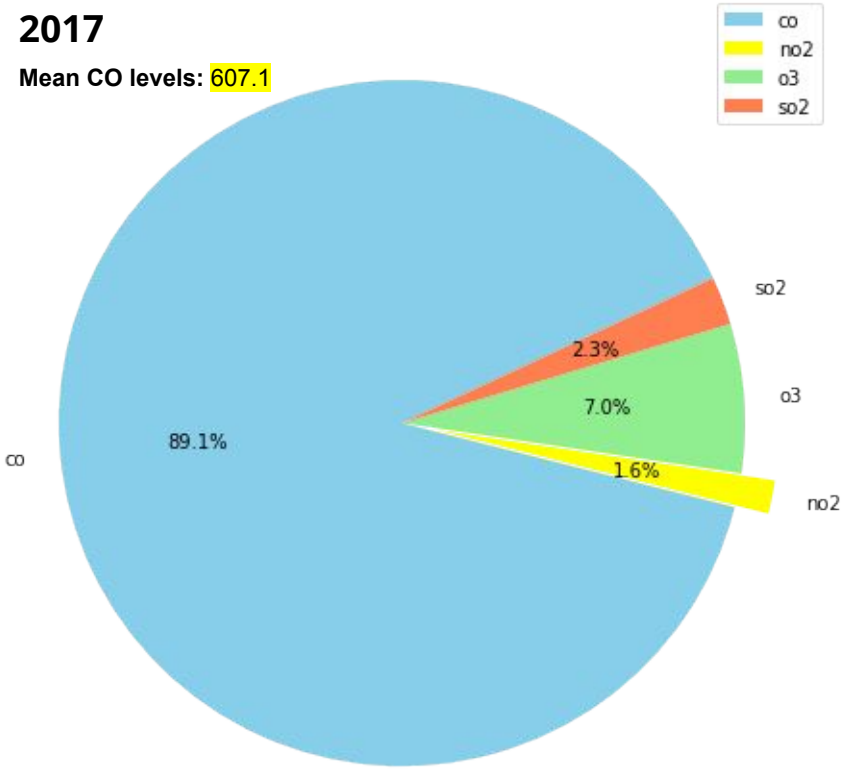
Mean CO levels: 420.5



Mumbai Pre / Post COVID

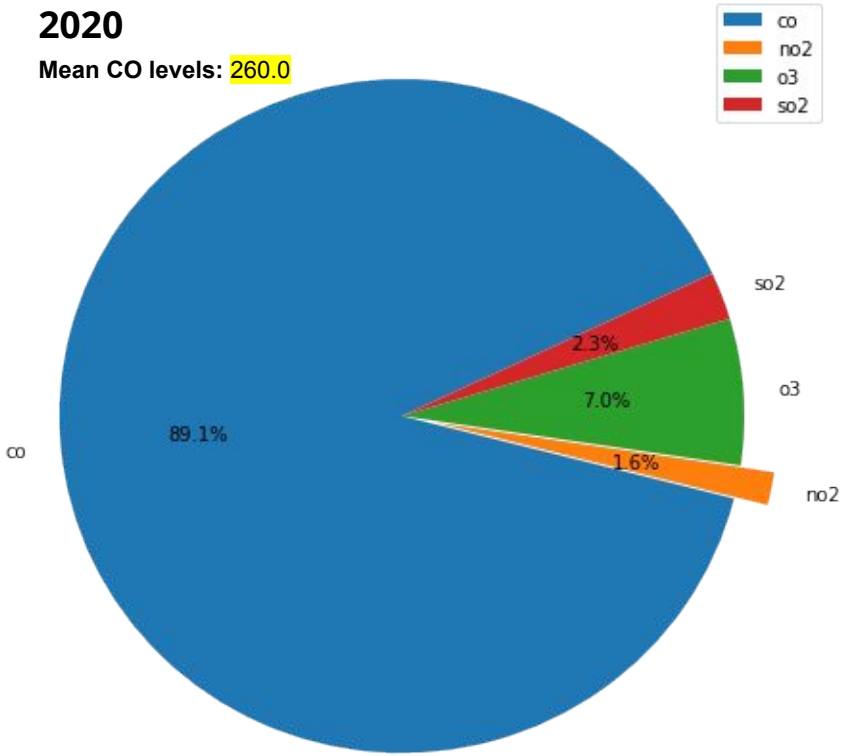
2017

Mean CO levels: 607.1



2020

Mean CO levels: 260.0



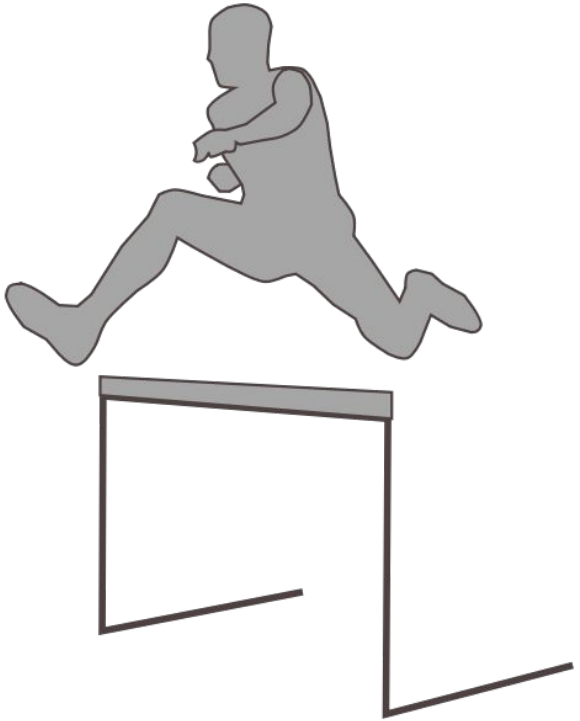
Kolkata Pre / Post COVID

Analysis

- The ratio of pollutants remains remarkably consistent pre/post COVID.
- Chennai has the highest CO pollution at 1007.00 µg/m3, whereas Kolkata has 263.63 µg/m3.
- The sizable standard deviation value of CO in Delhi supports the existence of high levels of industry in the city within the COVID period.
- There is no major redistribution of carbon monoxide (CO) to trace pollutants in the air for our four regional cities, between the COVID period and a historical time period 3 years earlier, which removes the consideration of the accumulation of a poisonous trace pollutant.

Hurdles

- Narrowing down the scope
  - Where and when
- Finding an API with historical data
- Cleaning the data
  - Leverage Python for historical data
  - Historical inconsistencies
- Framing visualizations
  - Cohesive analysis
- Creating a comprehensive project within a limited timeframe



Final Thoughts

- Expected a more consistent drop between all four cities between pre/post COVID.
  - Chennai INCREASED in its CO levels
- COVID has a silver lining with its positive environmental changes.
- Air Quality Data & Analysis can be used as a determinant of community health.

Resources

The Natural Resources Defense Council
India's consumption
API: OpenAQ, Archived CSV files
Longitudinal and Cross Sectional Studies
https://www.worldometers.info/demographics/india-demographics/
https://worldpopulationreview.com/world-cities/kolkata-population/