



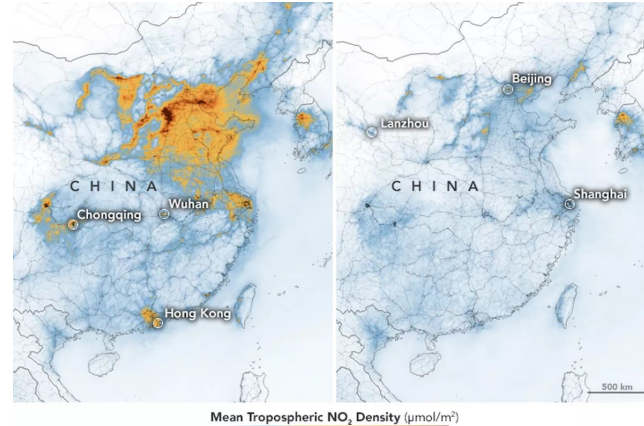
Impact of COVID-19 on Air Quality Metrics

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Background

After lockdown was mandated across the globe, air quality improved in many cities.

Various visual and scientific evidence of cleaner air.



Background

Before the pandemic 91% of the world populations lived in locations that exceed the World Health Organization's air quality guidelines.

More than 80% of citizens living in urban areas live in areas that exceed this limit.



What is AQI? (Air Pollution Metrics)

Categorizes five major pollutants from Good to Hazardous

- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO₂)
- Ground Level Ozone (O₃)
- PM_{2.5}
- PM₁₀

Air Quality Index - Particulate Matter	
301 – 500	Hazardous
201 – 300	Very Unhealthy
151 – 200	Unhealthy
101 – 150	Unhealthy for Sensitive Groups
51 – 100	Moderate
0 – 50	Good

What is Particulate Matter?



Particulate matter is made up of extremely small solid/liquid particles that can contain acids, organic compounds, metals, and dust.

Categorized by diameter: $2.5\mu\text{m}$ or $10\mu\text{m}$

Measurements are recorded in $\mu\text{g}/\text{m}^3$

Sources of particulate matter: Fires, Industrial Emission, Vehicles...



What is Particulate Matter?



WHO estimates particulate matter air pollution to contribute to 800,000 deaths each year.

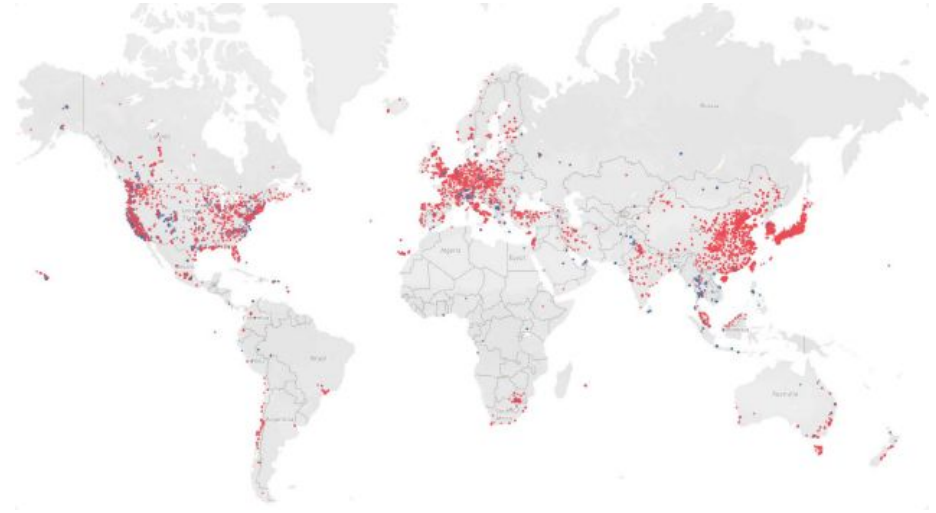
PM_{2.5} can penetrate through lung tissue and into the bloodstream causing severe health impacts.



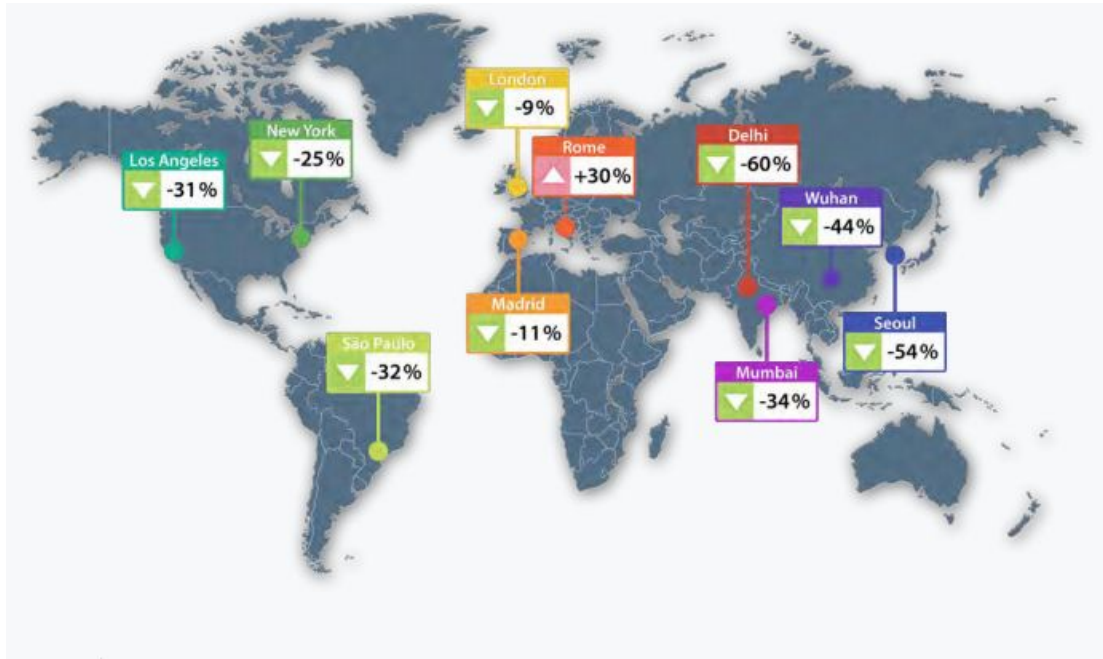
How is it measured?

Dedicated on-ground stations in areas developed areas with adequate funding.

Ground measurements are combined with satellite data of chemical transport models to provide consistent global data.

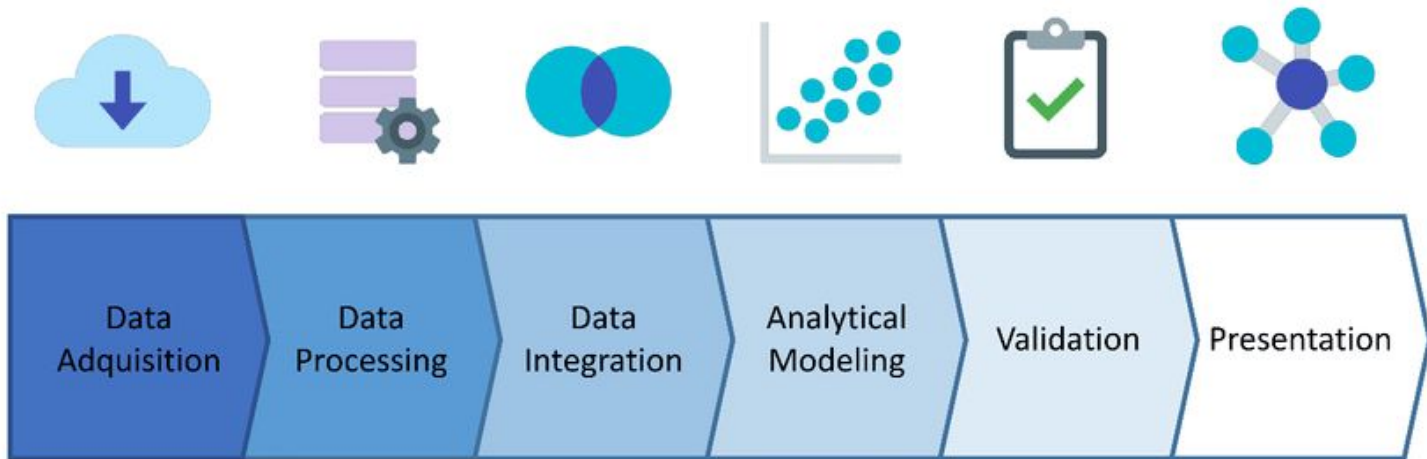


What we found out about the first 3 weeks

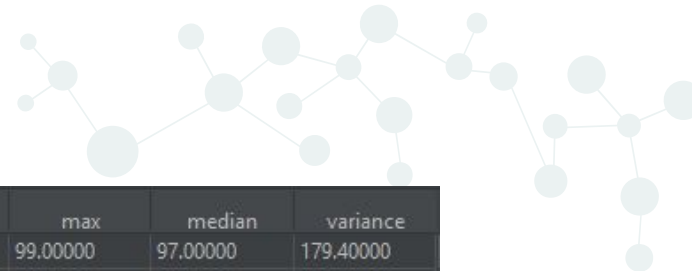


https://www2.iqair.com/sites/default/files/documents/REPORT-COVID-19-Impact-on-Air-Quality-in-10-Major-Cities_V6.pdf


Data Science Pipeline



Data Processing



	Date	Country	City	Specie	count	min	max	median	variance
0	2019-01-16	AE	Abu Dhabi	pm10	24.00000	86.00000	99.00000	97.00000	179.40000
1	2019-01-22	AE	Abu Dhabi	pm10	24.00000	51.00000	57.00000	55.00000	23.75000
2	2019-01-26	AE	Abu Dhabi	pm10	24.00000	136.00000	173.00000	160.00000	941.96000
3	2019-01-07	AE	Abu Dhabi	pm10	24.00000	60.00000	91.00000	72.00000	1006.88000
4	2019-01-10	AE	Abu Dhabi	pm10	24.00000	82.00000	93.00000	87.00000	57.97000
5	2019-01-14	AE	Abu Dhabi	pm10	24.00000	65.00000	76.00000	74.00000	88.68000
6	2019-01-15	AE	Abu Dhabi	pm10	24.00000	76.00000	97.00000	83.00000	637.66000
7	2019-01-21	AE	Abu Dhabi	pm10	24.00000	52.00000	59.00000	58.00000	69.98000



491155	2019-02-17	RS	Belgrade	o3	96.00000	0.60000	36.60000	11.20000	1474.26000
491156	2019-02-22	RS	Belgrade	o3	95.00000	1.30000	26.50000	10.50000	512.62000
491157	2019-03-15	RS	Belgrade	o3	84.00000	1.20000	30.20000	16.80000	606.07000
491158	2018-12-31	RS	Belgrade	o3	96.00000	0.80000	18.00000	6.60000	192.77000
491159	2019-03-11	RS	Belgrade	o3	96.00000	8.90000	30.50000	19.10000	278.89000
491160	2019-03-29	RS	Belgrade	o3	96.00000	1.30000	37.30000	11.50000	1131.90000

Data Modeling

24 Hour median of $\text{PM}_{2.5}$ and AQI values

- Determine the best way to visualize data:
 - Scatter plot
 - Line plot
 - Heat map

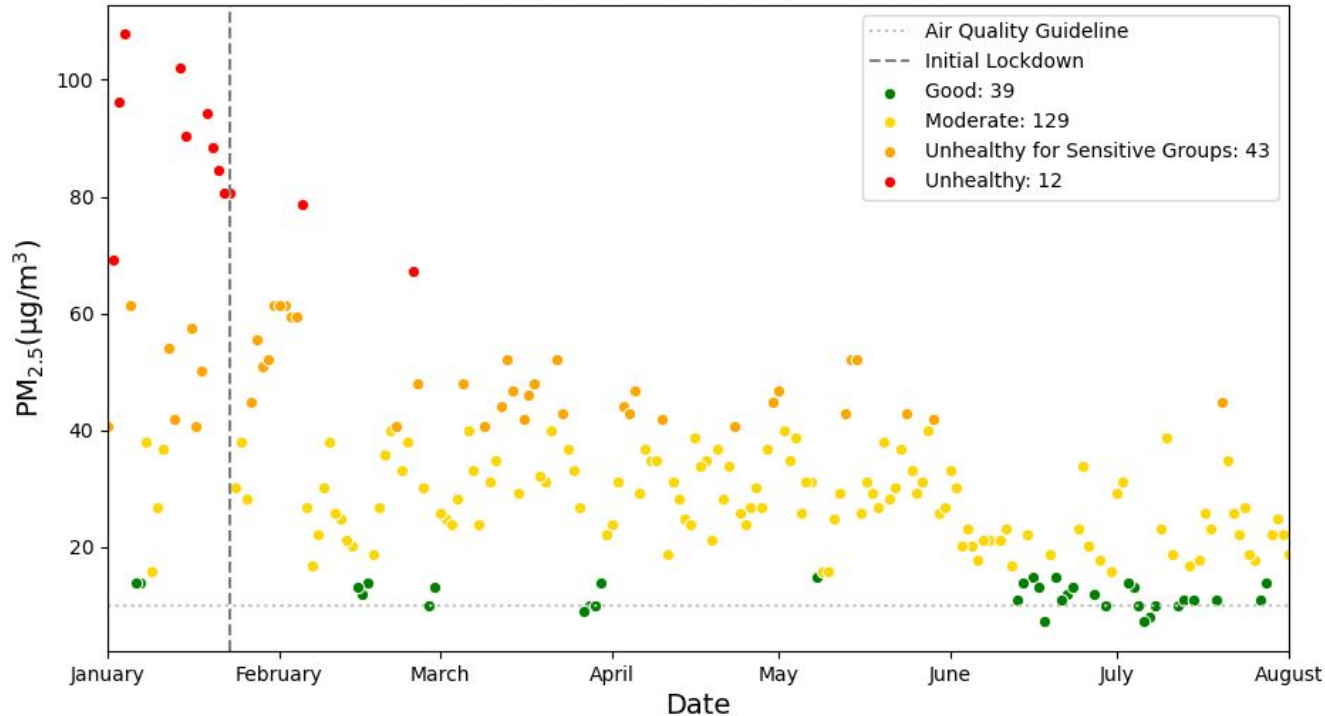
Reminder of AQI and PM_{2.5} Levels

AQI Category	Index Values	Previous Breakpoints ($\mu\text{g}/\text{m}^3$, 24-hour average)
Good	0 - 50	0.0 - 15.0
Moderate	51 - 100	>15.0 - 40
Unhealthy for Sensitive Groups	101 - 150	>40 - 65
Unhealthy	151 - 200	> 65 - 150
Very Unhealthy	201 - 300	> 150 - 250
Hazardous	301 - 400	> 250 - 350
Hazardous	401 - 500	> 350 - 500

WHO Air Quality Guideline: $10\mu\text{g}/\text{m}^3$

Data Modeling: Scatter Plot

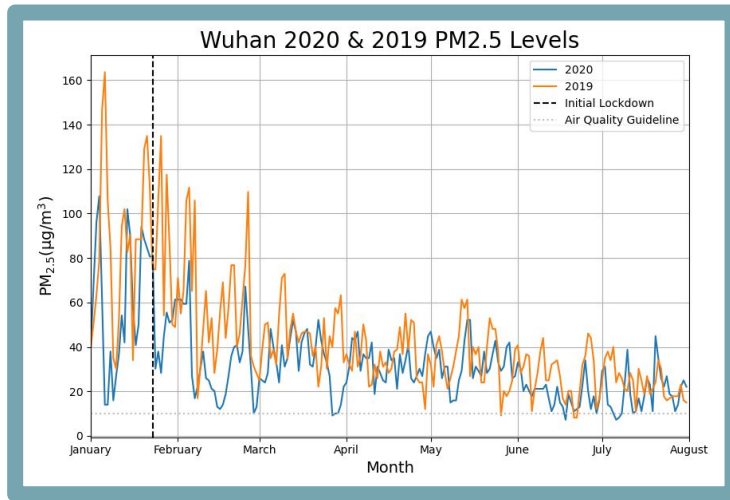
Wuhan 2020 PM2.5 Levels



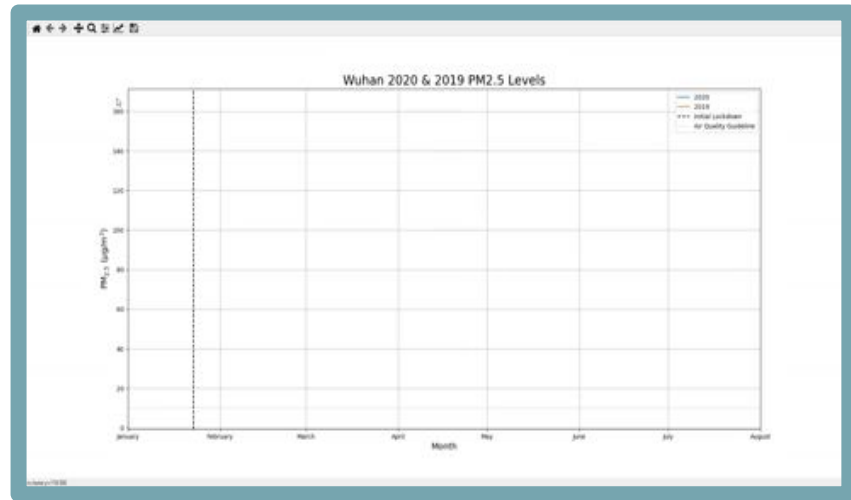
Data Modeling: Line Plot



Line Plot:

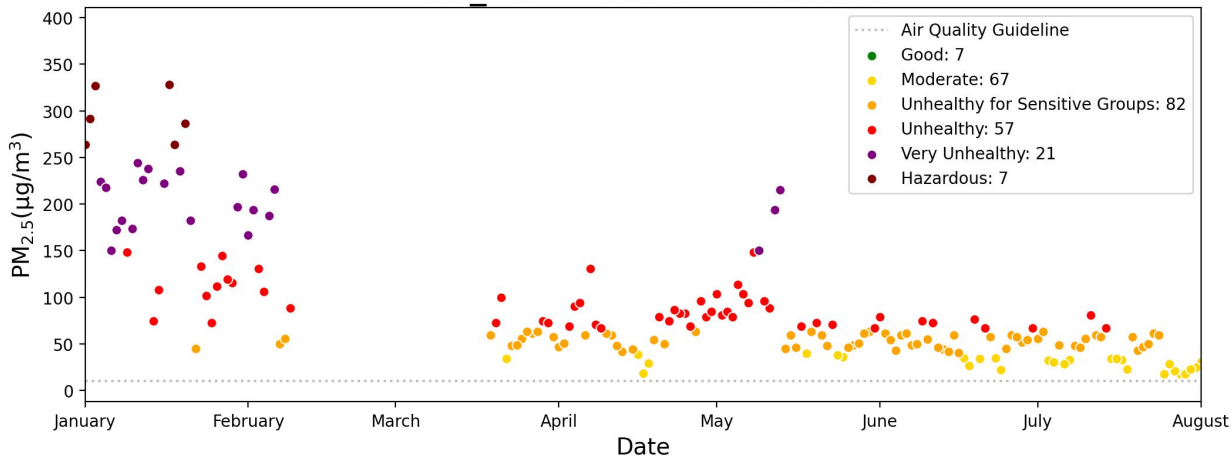


Time Series Line Plot:

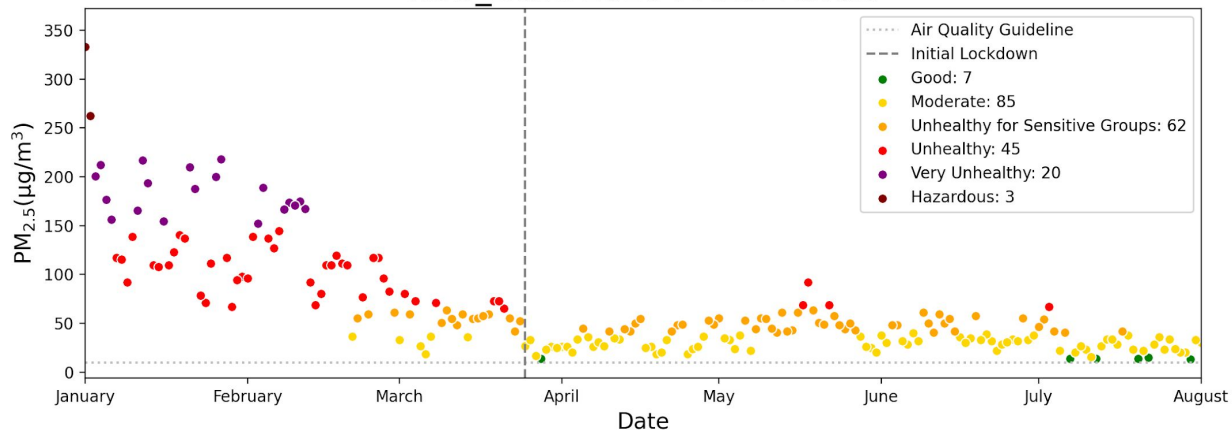


Validation

New_Delhi 2019 PM2.5 Levels

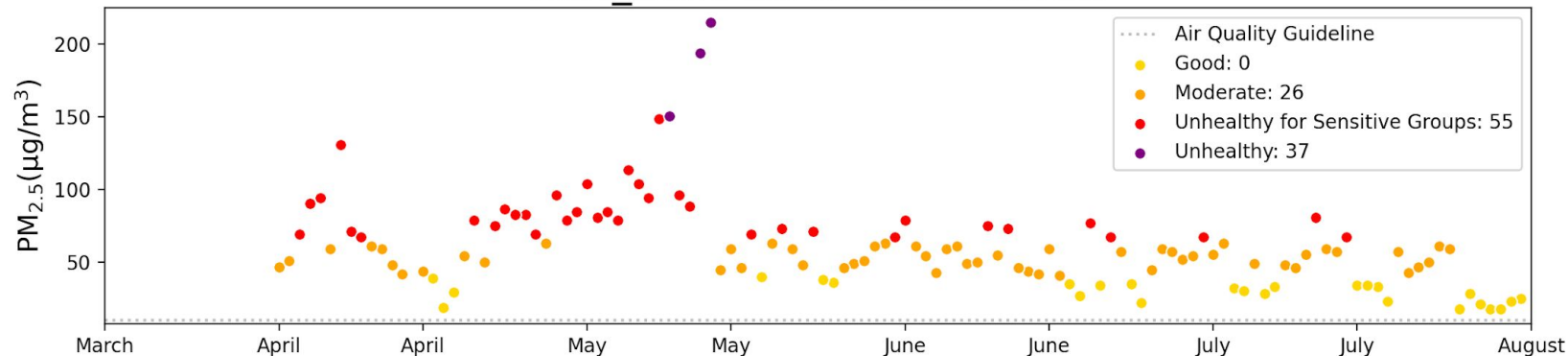


New_Delhi 2020 PM2.5 Levels

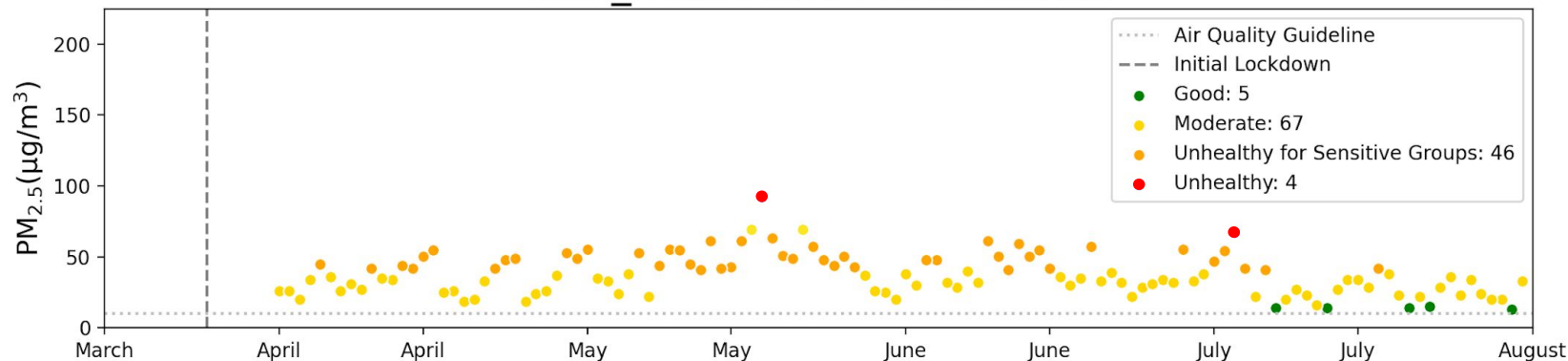


Validation

New_Delhi 2019 PM2.5 Levels



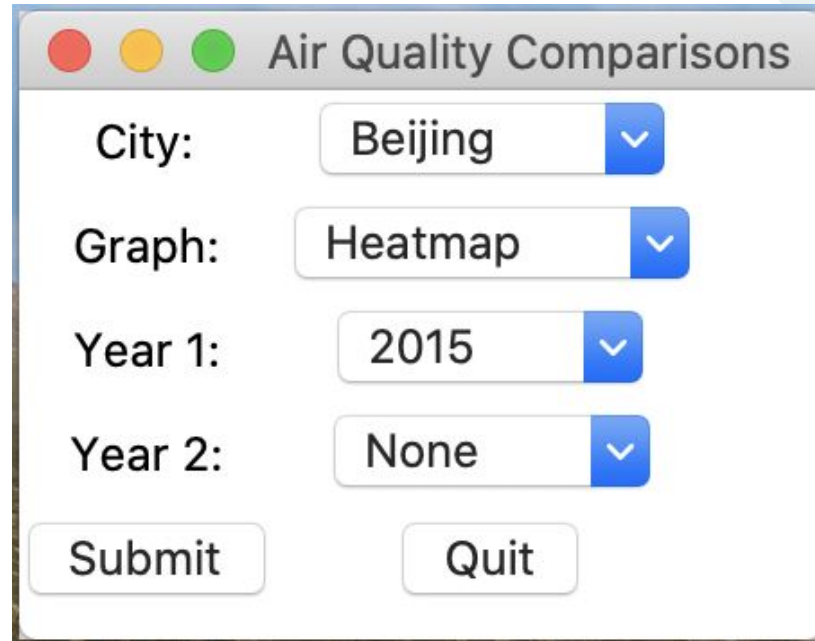
New_Delhi 2020 PM2.5 Levels



2019 vs 2020 January to July 31st

	Beijing	LA	Madrid	New Delhi	NY	Portland	Rome	Wuhan
2019	37.54	9.98	9.59	76.43	7.45	4.68	11.7	39.72
2020	35.76	10.51	9.64	49.1	6.4	4.33	11.8	31.64
Difference	-4.97%	5.04%	0.52%	-55.66%	-16.41%	-8.08%	0.85%	-25.53%

GUI for Visualizations



A screenshot of a graphical user interface (GUI) window titled "Air Quality Comparisons". The window has a standard macOS-style title bar with red, yellow, and green window control buttons. Inside the window, there are four rows of controls, each consisting of a label and a dropdown menu:

- City:** The dropdown menu shows "Beijing" and a blue arrow icon.
- Graph:** The dropdown menu shows "Heatmap" and a blue arrow icon.
- Year 1:** The dropdown menu shows "2015" and a blue arrow icon.
- Year 2:** The dropdown menu shows "None" and a blue arrow icon.

At the bottom of the window, there are two buttons: "Submit" on the left and "Quit" on the right.

Future Work

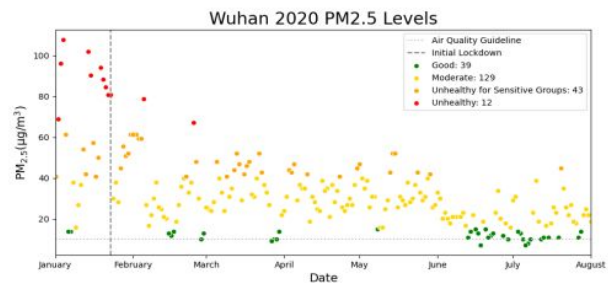
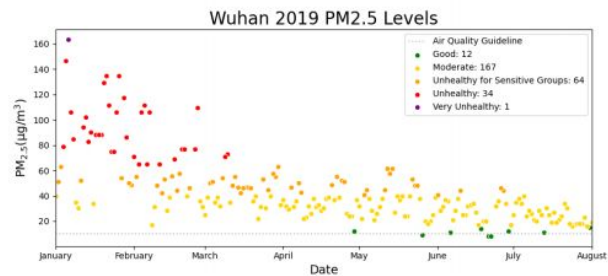
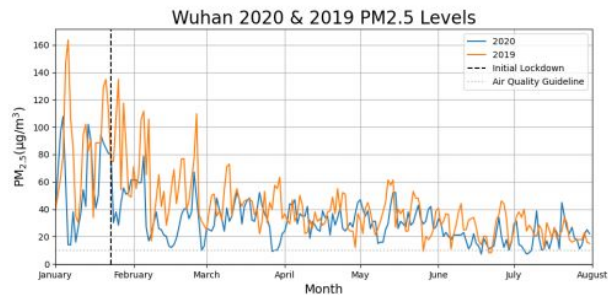
- More robust GUI for visualizations:
 - City
 - Type of plot
 - Year/s
- Statistical analysis of 2020 post-COVID-19 values vs previous years
- Using Tableau to create visualization of Air Quality over a world map
- Make the parser more robust to automatically create csv for each city.



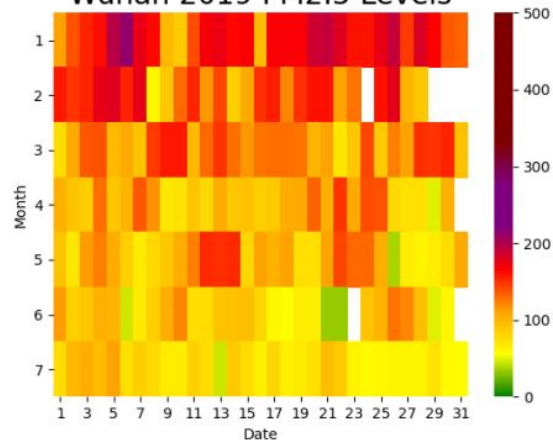
Questions?



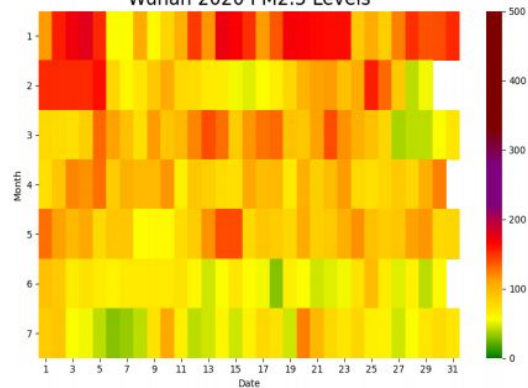
Wuhan



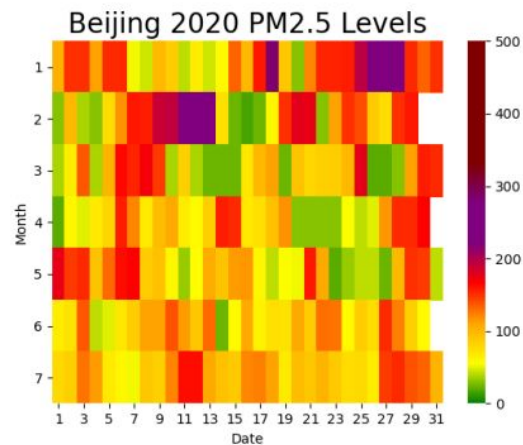
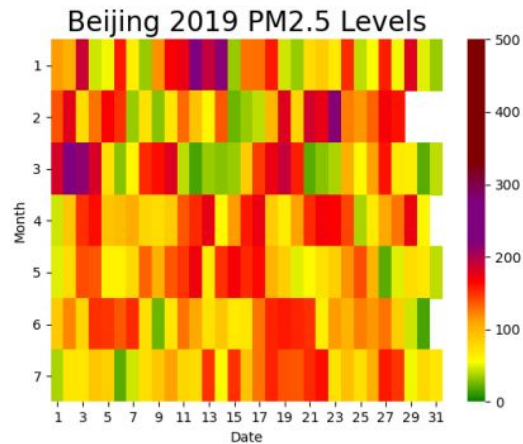
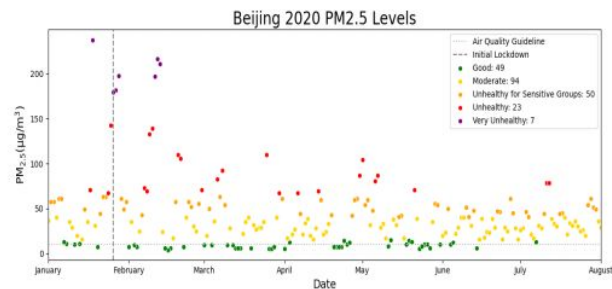
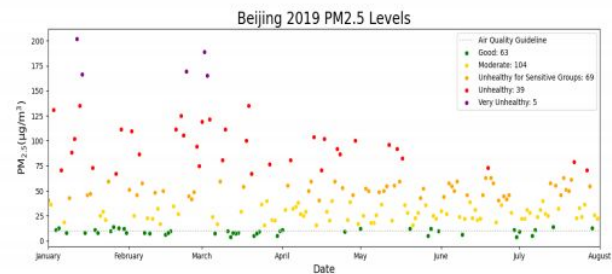
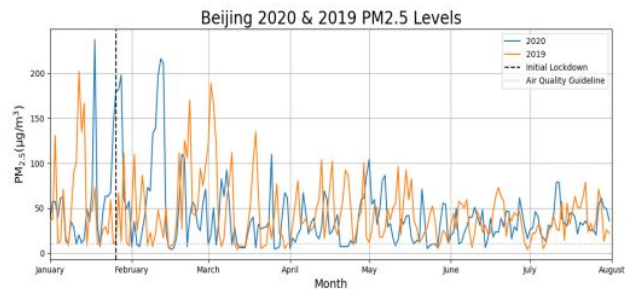
Wuhan 2019 PM2.5 Levels



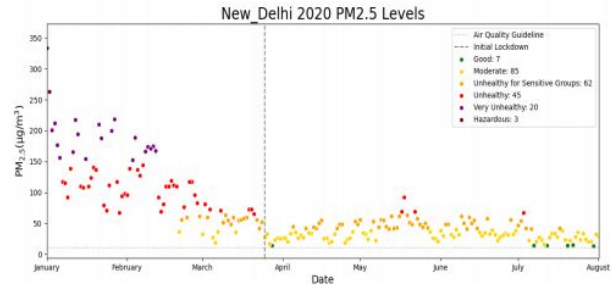
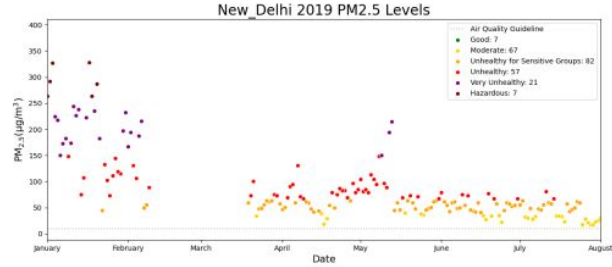
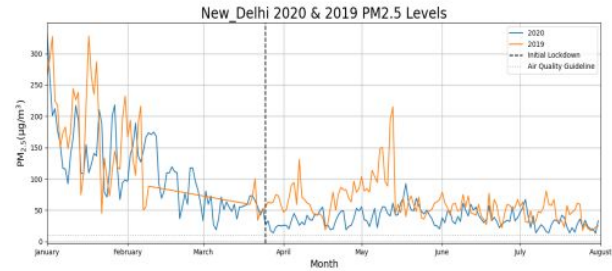
Wuhan 2020 PM2.5 Levels



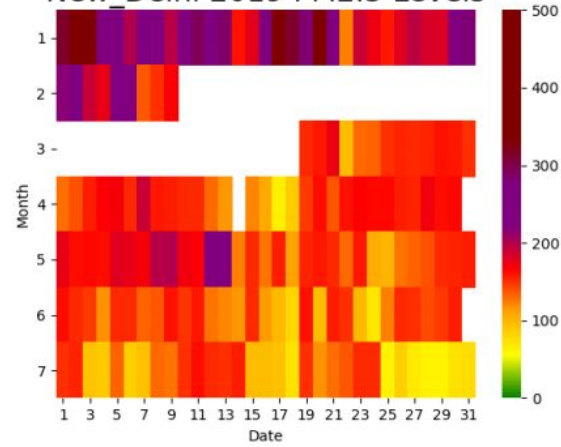
Beijing



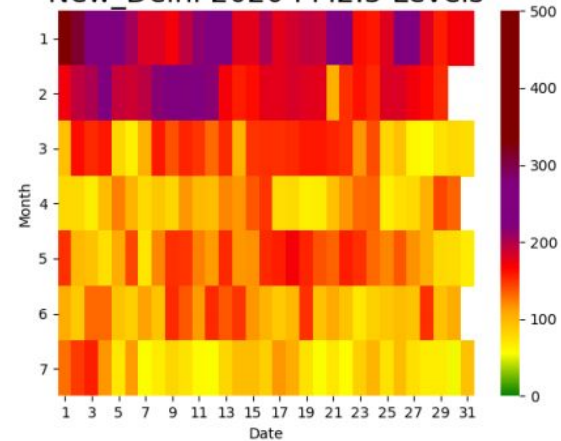
New Delhi



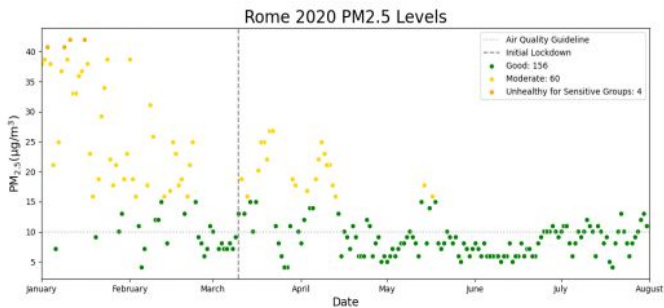
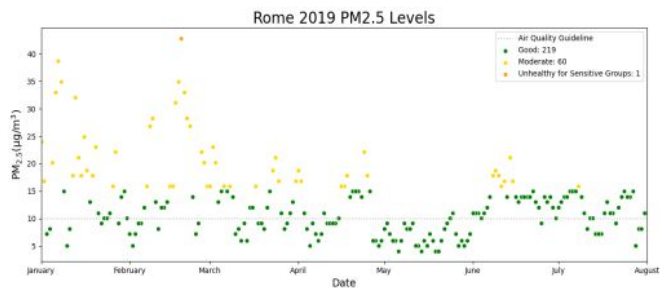
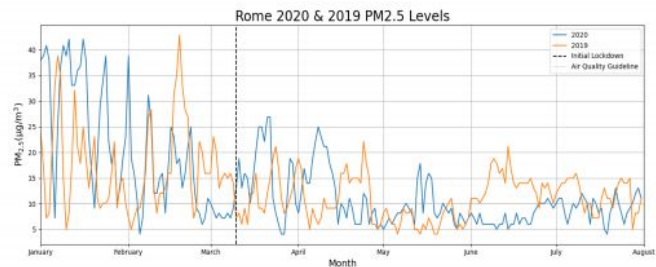
New_Delhi 2019 PM2.5 Levels



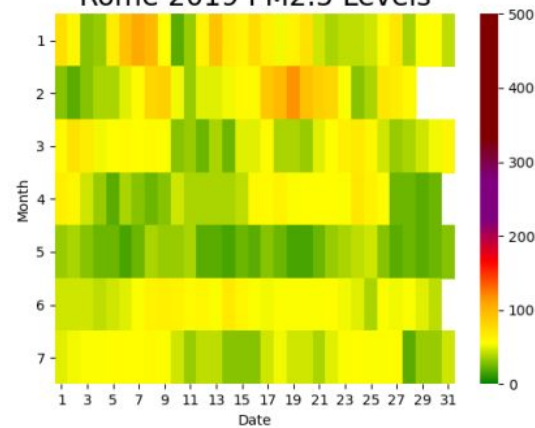
New_Delhi 2020 PM2.5 Levels



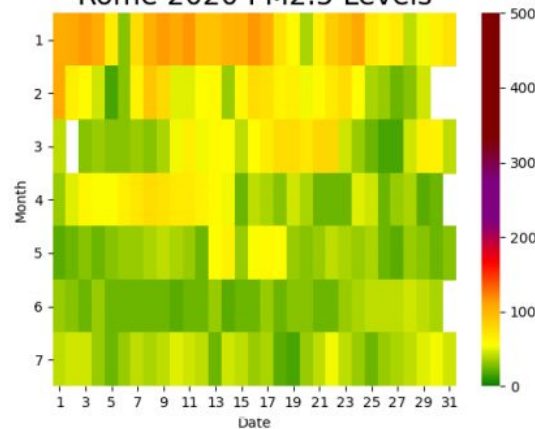
Rome



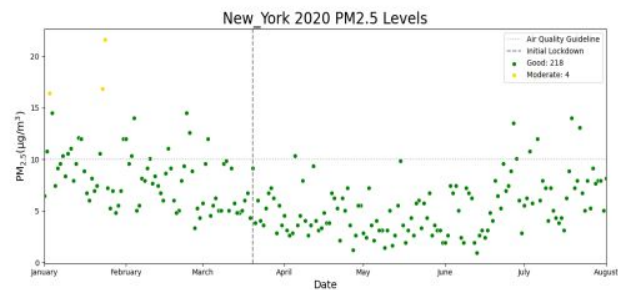
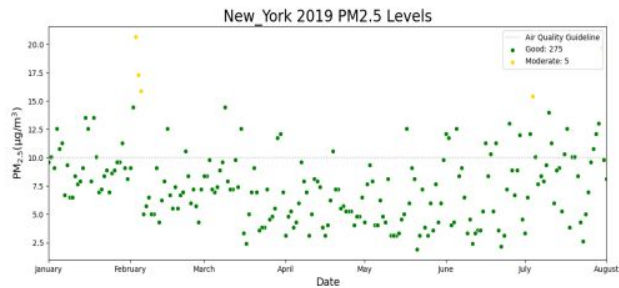
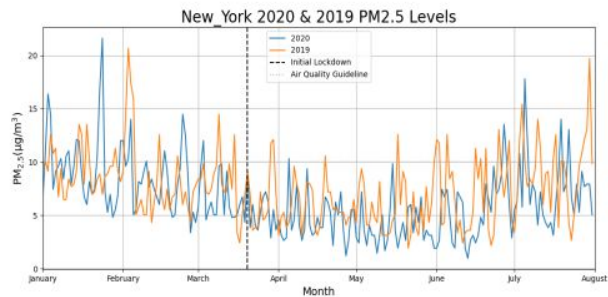
Rome 2019 PM2.5 Levels



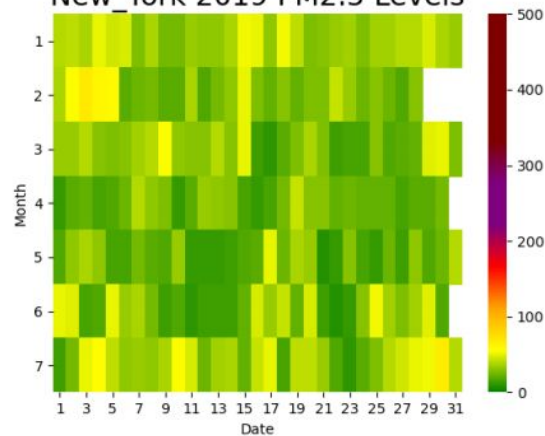
Rome 2020 PM2.5 Levels



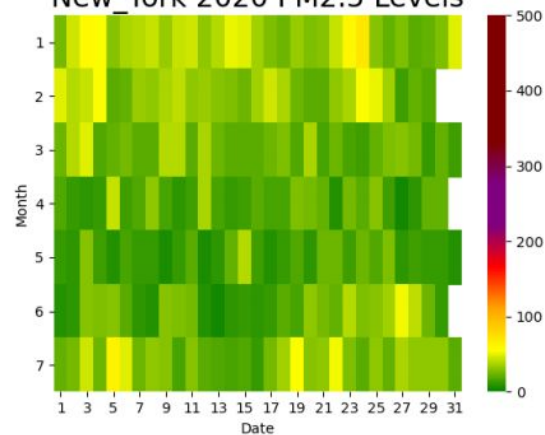
New York



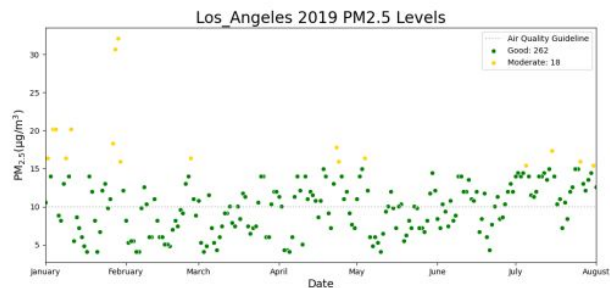
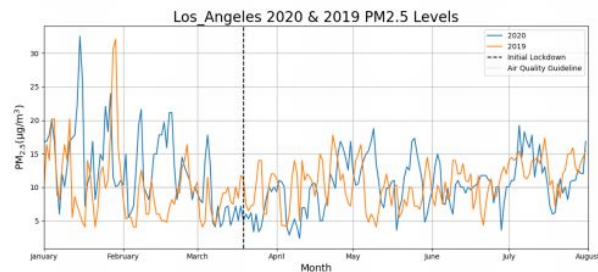
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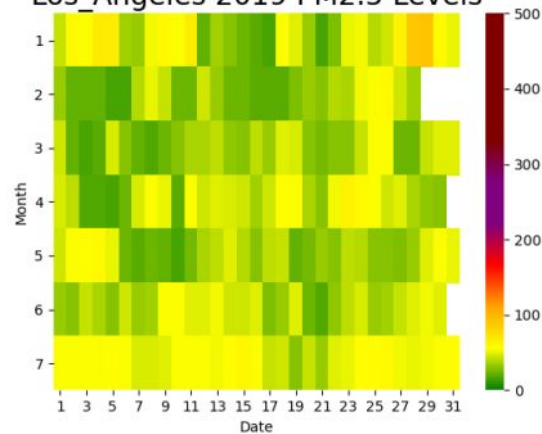
New_York 2020 PM2.5 Levels



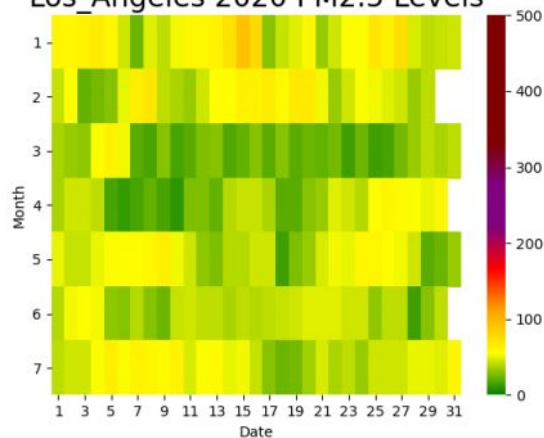
Los Angeles



Los Angeles 2019 PM2.5 Levels



Los Angeles 2020 PM2.5 Levels



Portland

