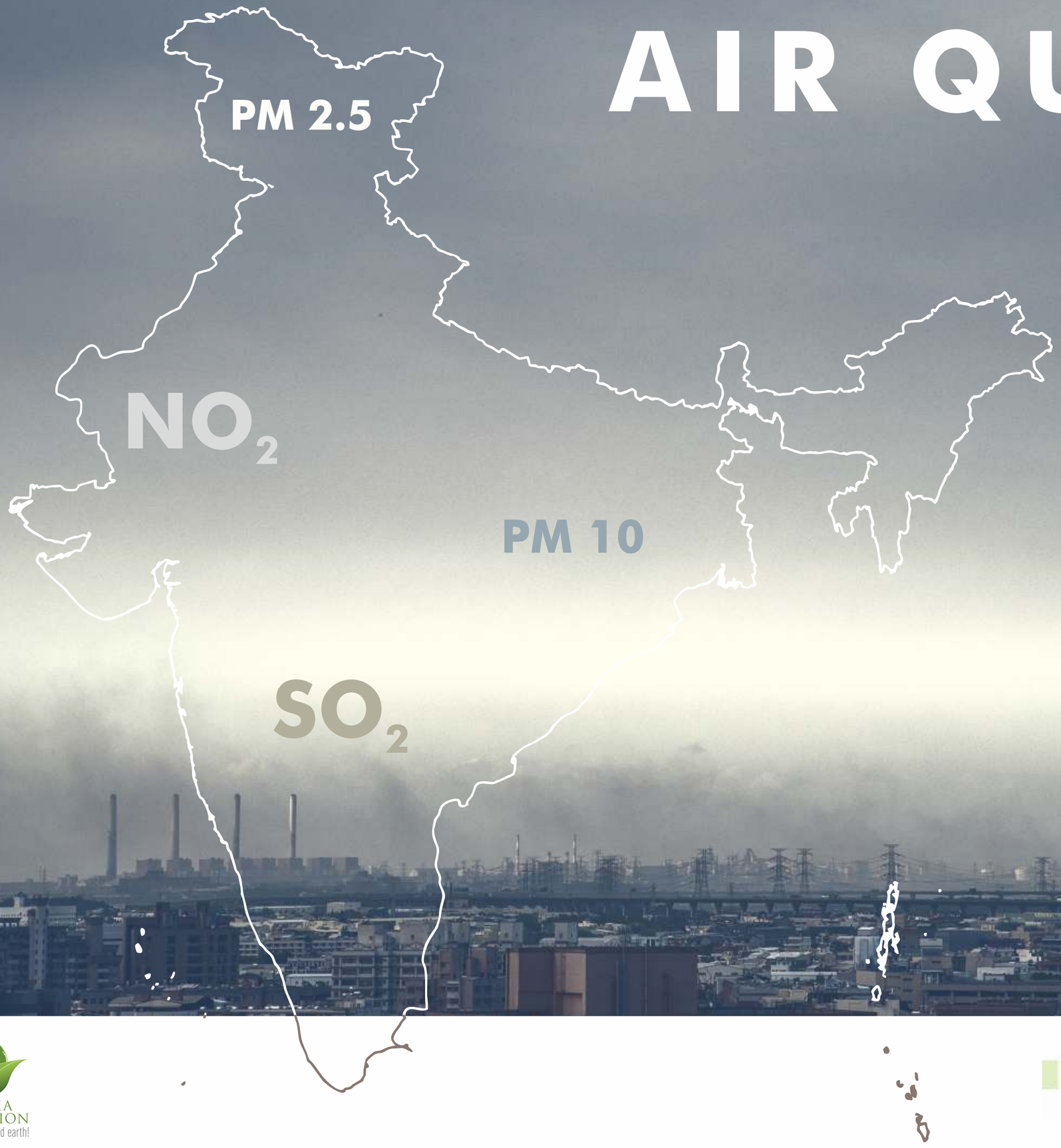
AIR QUALITY

MAPPING

Analysis
India 2020



VASUDHA FOUNDATION
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HEINRICH BÖLL STIFTUNG
INDIA

Credits

AIR QUALITY MAPPING ANALYSIS | INDIA 2020

GIS Mapping and Satellite Image Analysis

Lead
Akinchan Singhai
Assisted by
Amit Yadav

Air Quality Monitors Installation
Envrionics India

India Map
Adapted from/based on Survey of India digital boundary map
Not to scale

Design & Layout
Priya Kalia

Guided by
Srinivas Krishnaswamy, Raman Mehta

Disclaimer

This publication was prepared with the support of the Heinrich Böll Stiftung. The views and analysis contained in the publication are those of the author(s) and do not necessarily represent the views of the foundation.

New Delhi, November, 2020

Methodology

The broad methodology of approach to assess the link between coal fired power plants and coal mining operations to air quality are the following-

a) Installation of air quality monitors in and around select coal mining and coal fired power plants in India.

b) Collection of hourly and daily data from the various installed air quality monitors for a period of time.

c) Compilation of data from public air quality monitors of the State and Central Pollution Control Board in select areas and particularly focused on highly industrial and urban conglomerate, coal mining areas and areas that have clusters of coal fired power plants, either pit head coal fired power plants or independent coal fired power plants.

d) Assessment of open source satellite data, available from Sentinel 5P for NO_2 and SO_2 pollutants visualisation.

e) Air quality projection models from the global database of the European Centre for Medium-Range Weather Forecasts (ECMWF) for PM 2.5 and PM 10 emissions across India.

MAPPING OF POLLUTANTS

NATIONAL SCALE

Poor Air Quality in many of Indian cities has been a burning issue for some time now. According to the World Health Organisation (WHO), Air Pollution kills an estimated seven million people worldwide every year. The WHO data also shows that 9 out of 10 people breathe air that exceed the WHO guideline limits containing high levels of pollutants. The WHO further goes on to say that the low and middle income countries suffer from the highest exposures to poor air quality.

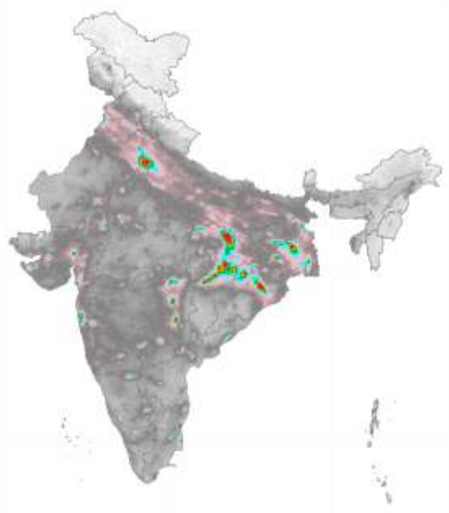
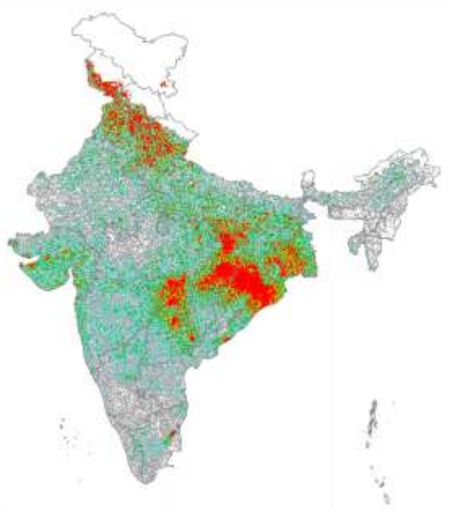
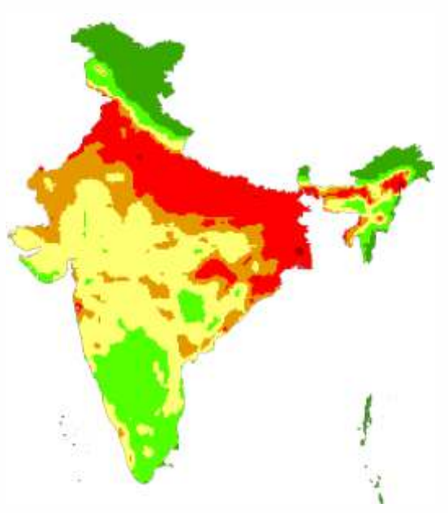
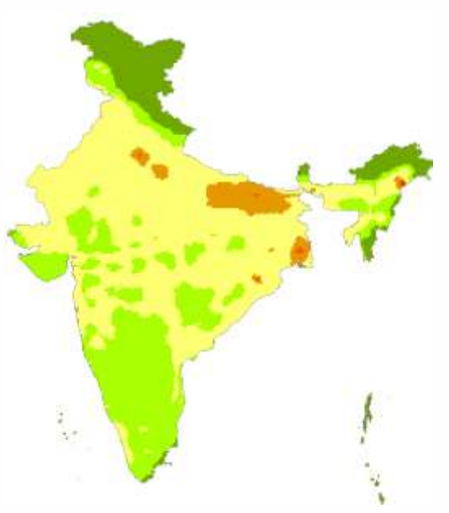
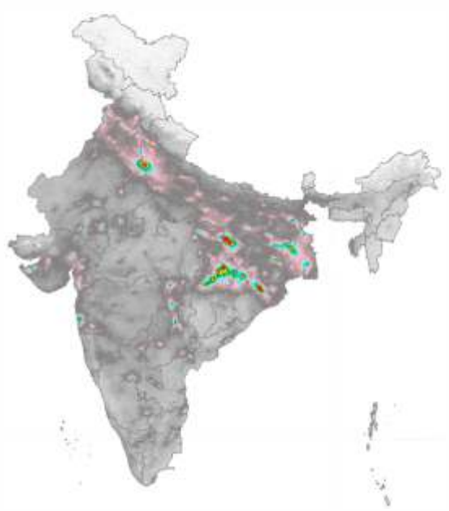
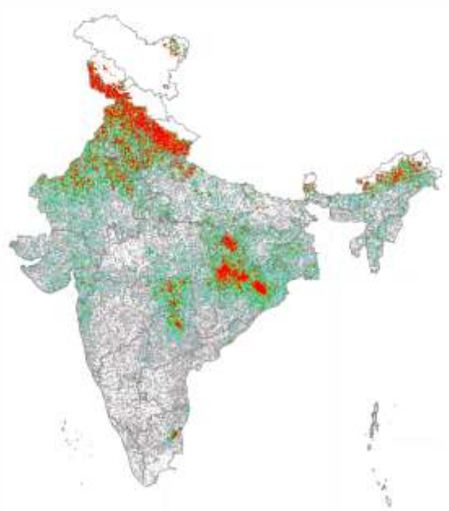
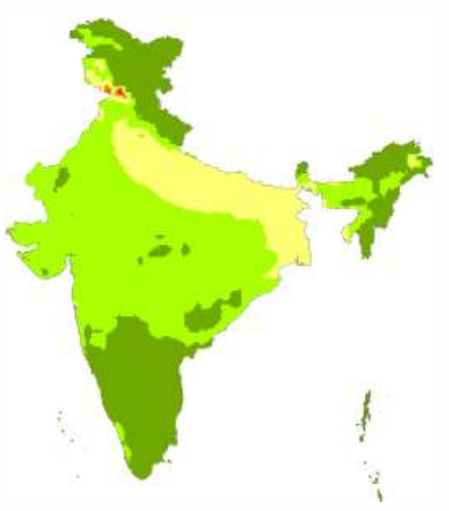
According the World Air Quality Report, published in 2019, 21 Indian cities are amongst the World's 30 most polluted cities in the World.

Amongst others, one of the contributors to poor Air Quality in India is emissions from transportation, Coal Fired Power Plants and also from coal mines and other industrial operations, biomass burning, dust amongst others.

This report is primarily focussed on the link between coal fired power plants and operations of coal mines in India, to its poor Air Quality, through a data driven approach, particularly in a scenario where emissions standards for coal power plants and coal mines are not as yet operationalised.

Further, given the fact that India has currently 205GW of Installed Capacity of Coal Fired Power plants and a further 58GW of coal fired power plants are in various stages of construction and commissioning, India would continue to be the home for a large number of coal fired power plants. This is despite the fact that overall share of coal fired power plants in the electricity generation installed capacity mix could decline by 2030, with 450 GW of new renewable energy capacity addition.

The overall objective of the mapping is to draw a clear linkage between coal fired power plants and coal mining operations to air quality levels in the region. Further, the objective of this mapping exercise is to also add to the discourse on energy transition in India, particularly from coal to renewable energy, with the end objective being to add more dimensions to the issue of energy transition in India.

POLLUTANTS	NO_2	SO_2	PM 2.5	PM 10
JANUARY 2019				
JANUARY 2020				

Tropospheric NO_2 Column Number Density

0 28 57 85 114 142 172 200

Micromol/m^2

SO_2 Vertical Column Density at Ground Level

0 70 140 210 280 350 420 500

Micromol/m^2

PM 2.5 Concentration (24 Hours Avg.)

0-30 30-60 60-90 90-120 120-250 > 250

µg/m^3

PM 10 Concentration (24 Hours Avg.)

0-50 50-100 100-250 250-350 350-430 > 430

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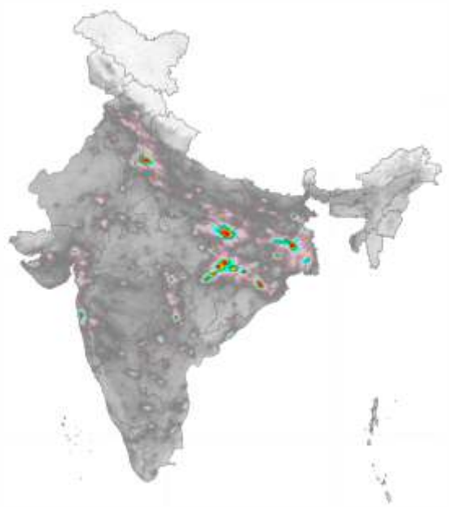
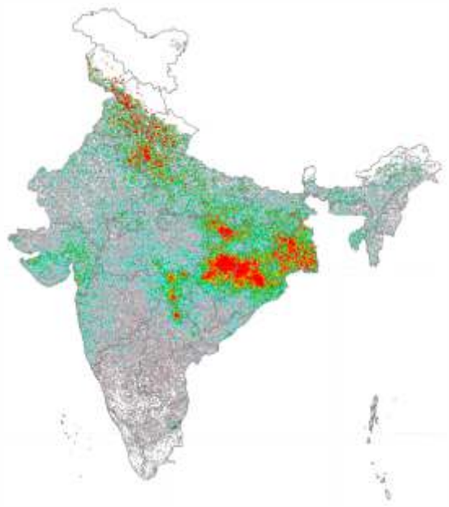
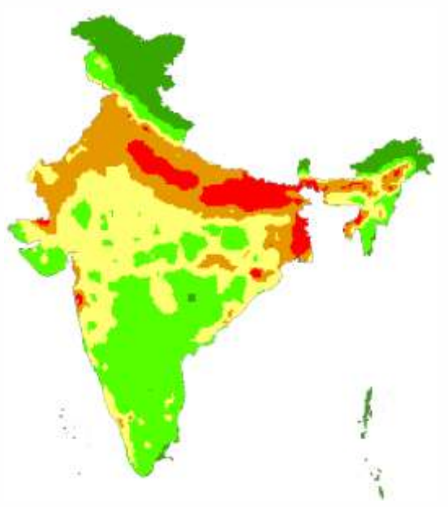
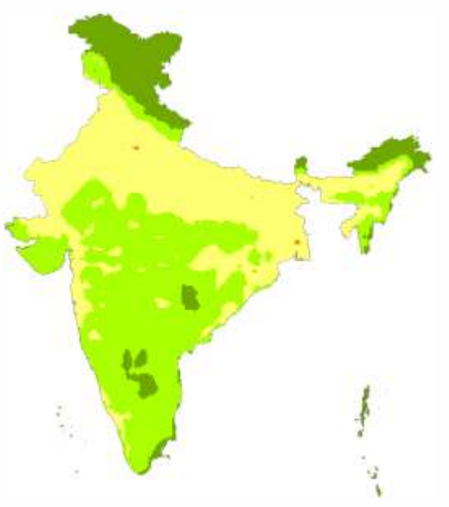
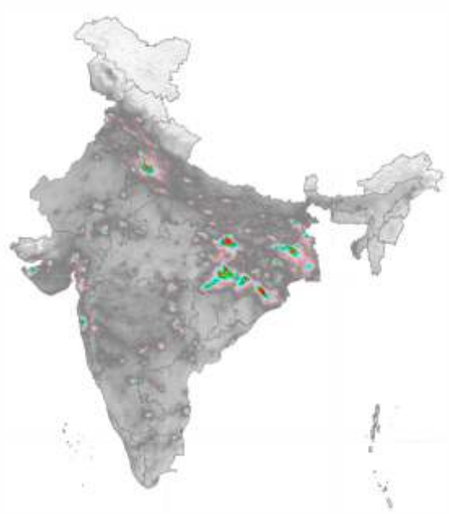
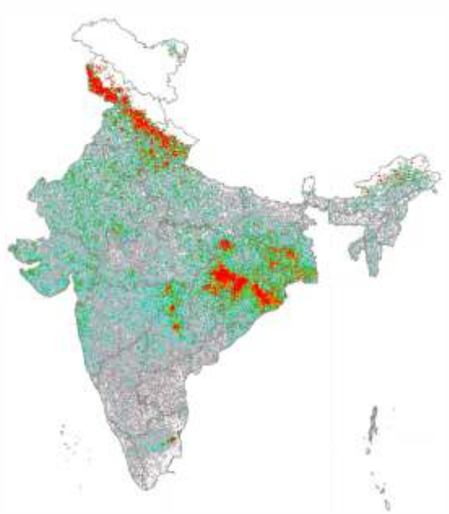
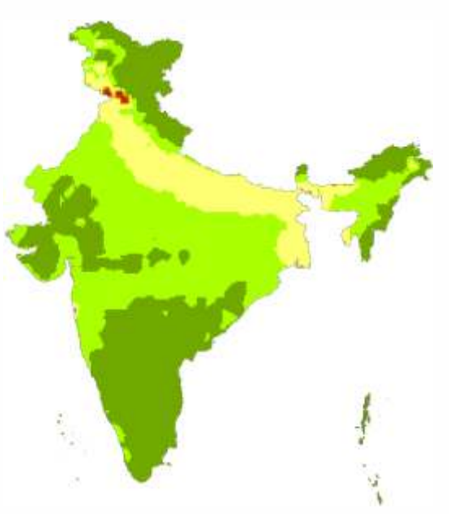
FEBRUARY 2019				
FEBRUARY 2020				

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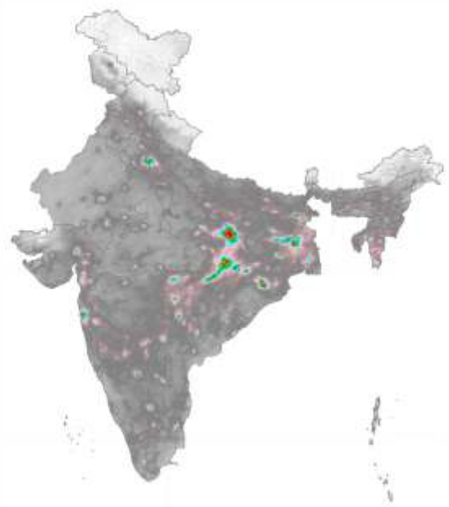
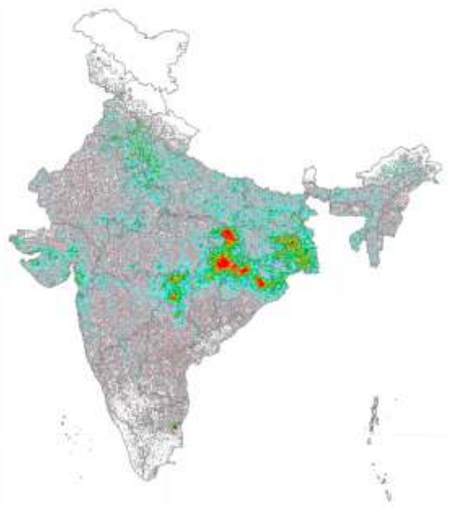
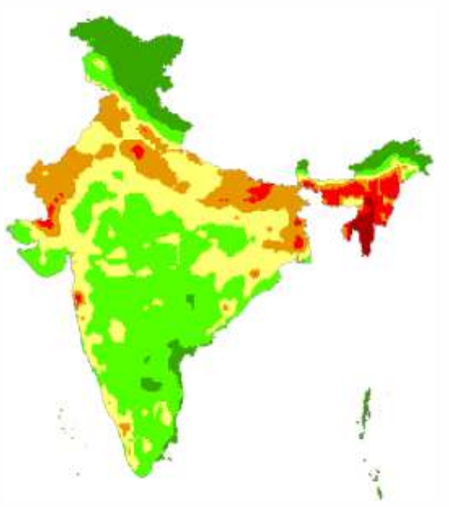
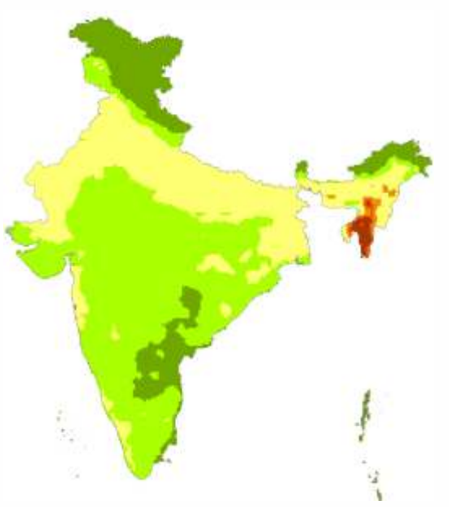
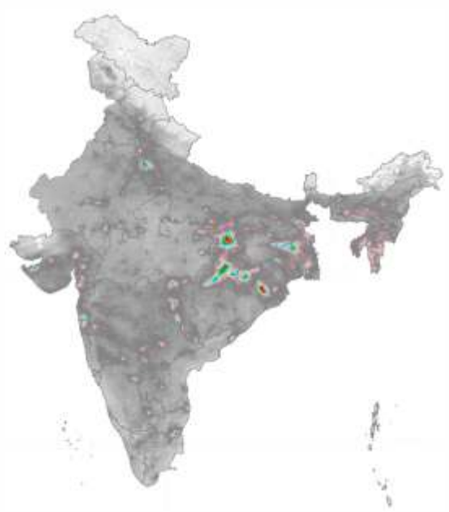
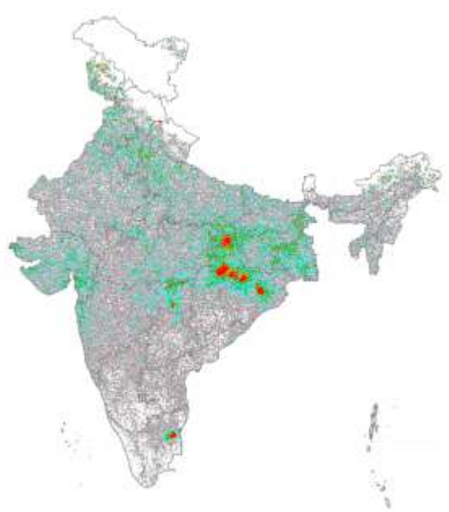
MARCH 2019				
MARCH 2020				

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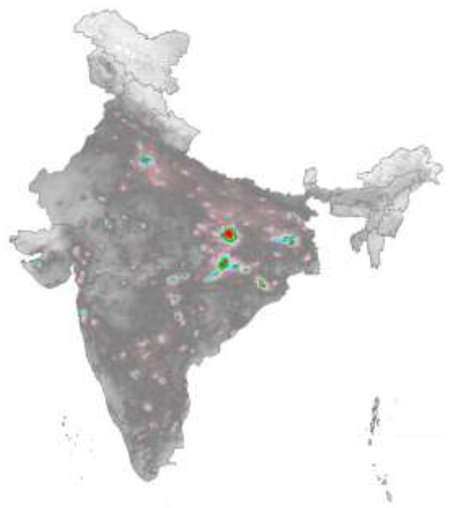
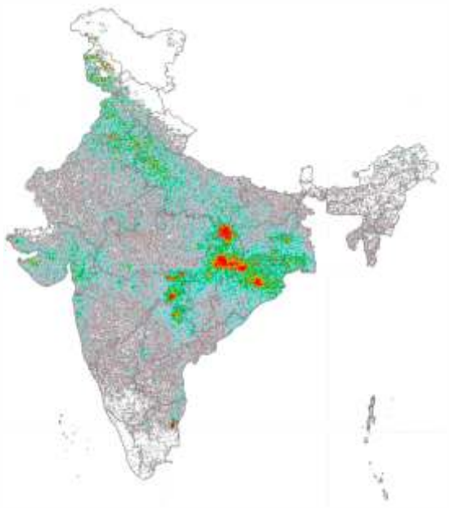
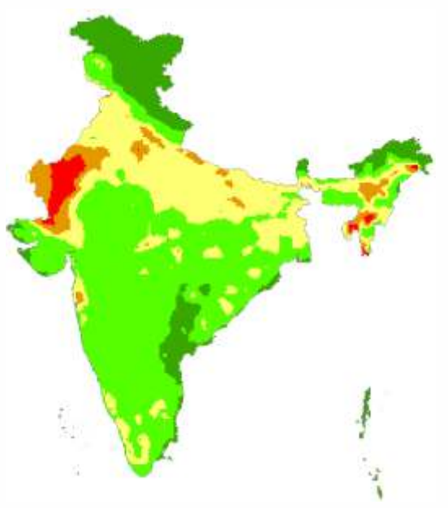
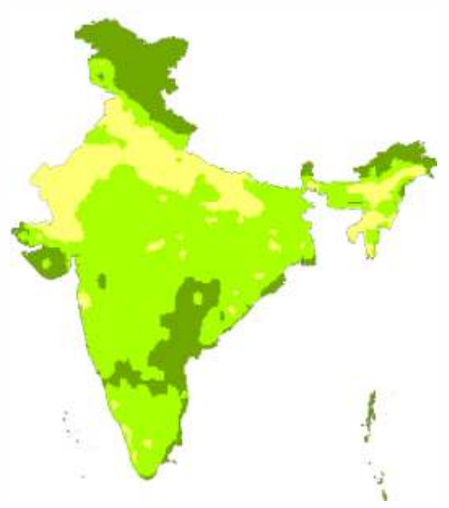
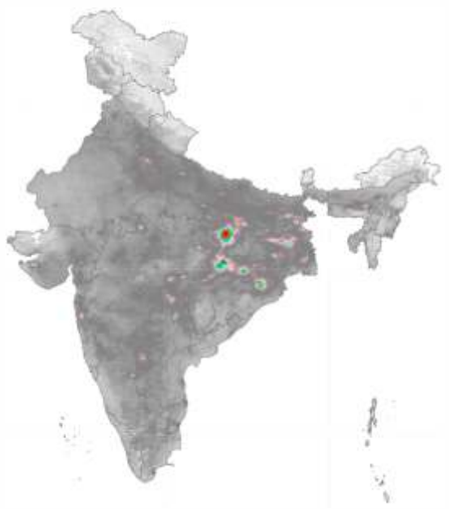
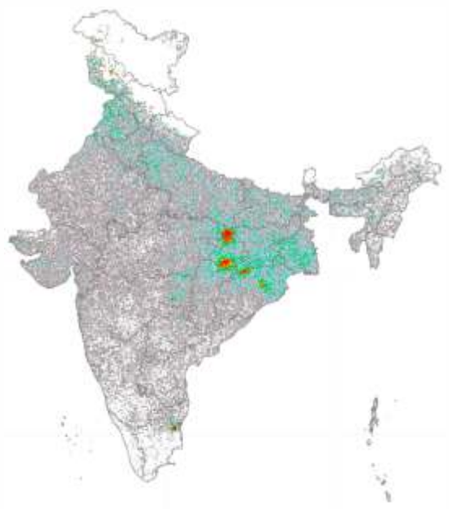
APRIL 2019				
APRIL 2020				

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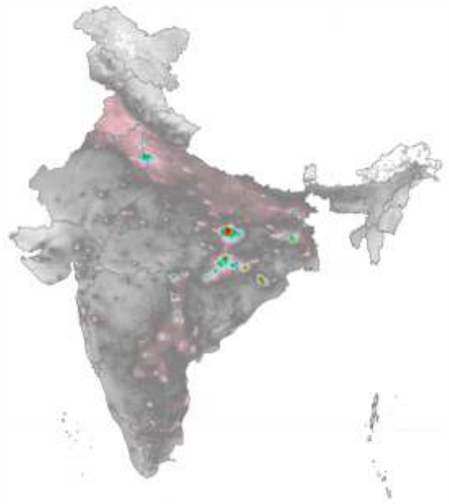
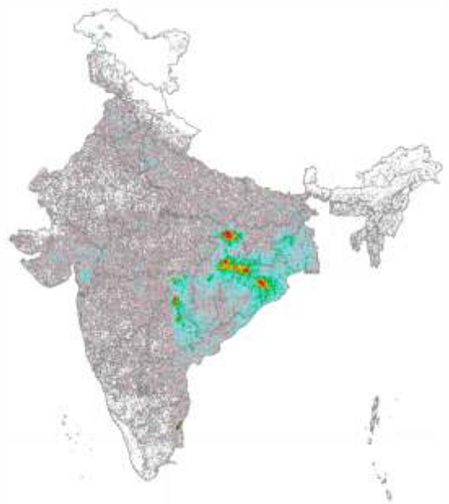
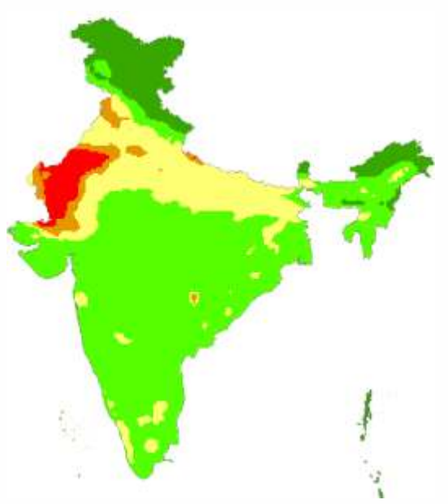
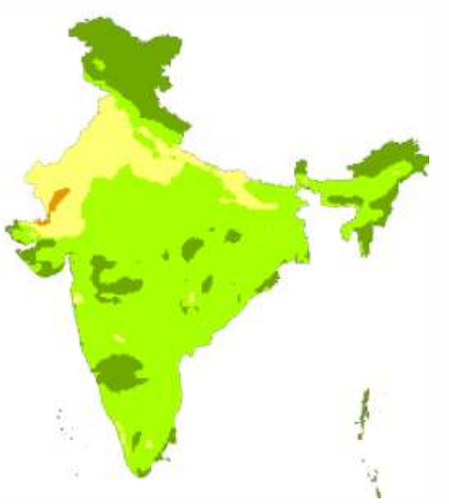
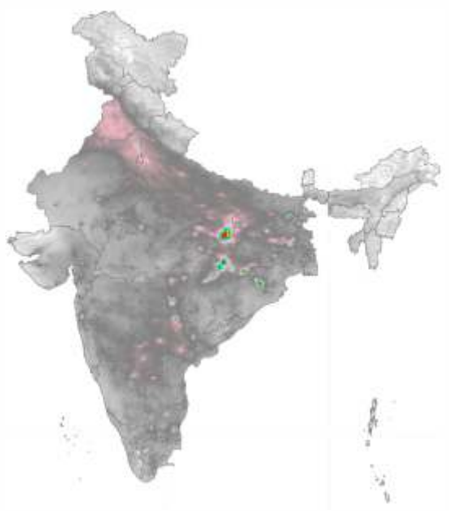
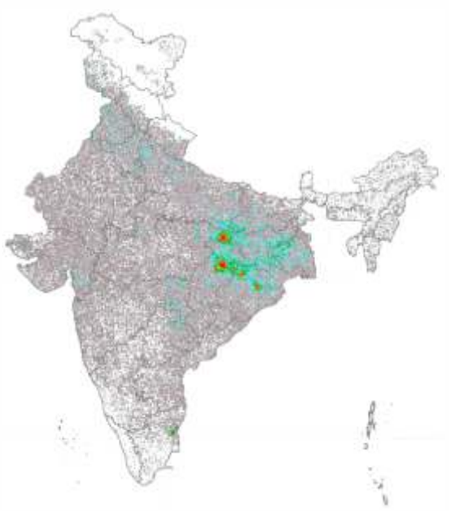
MAY 2019				
MAY 2020				

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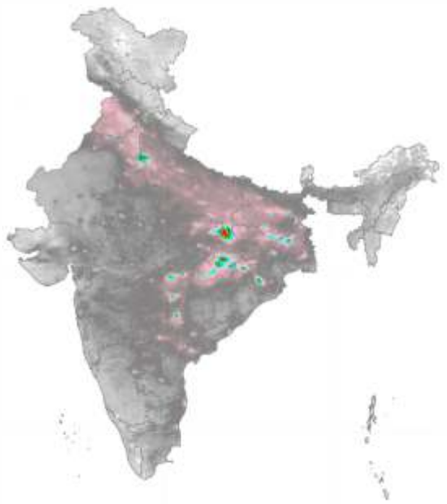
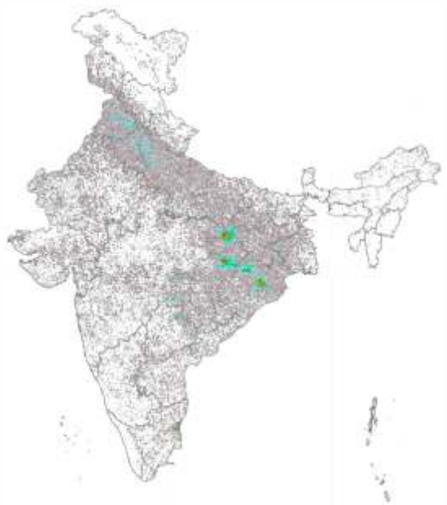
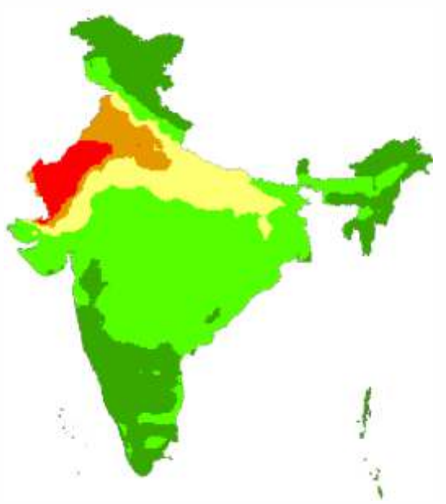
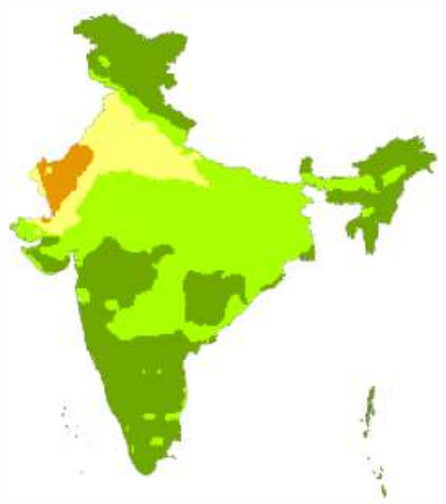
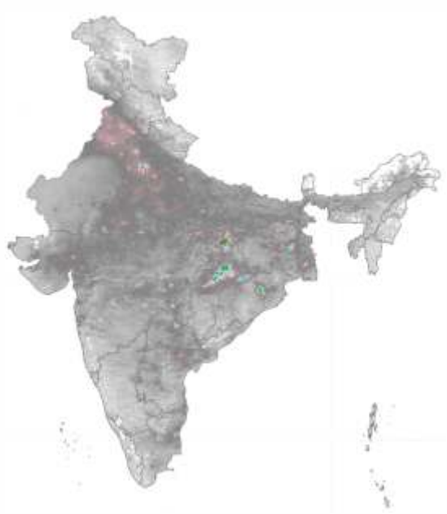
JUNE 2019				
JUNE 2020				

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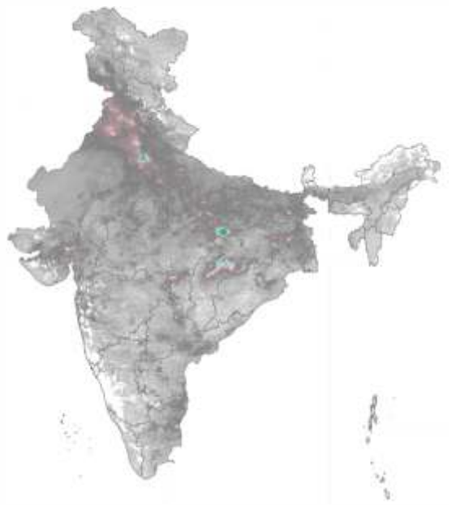
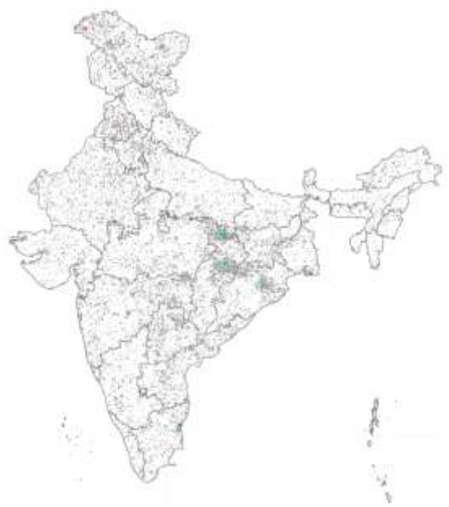
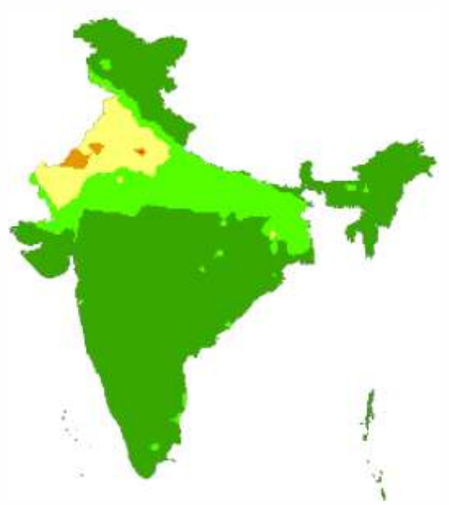
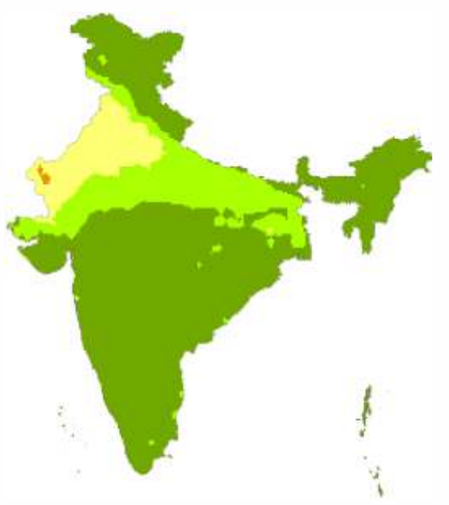
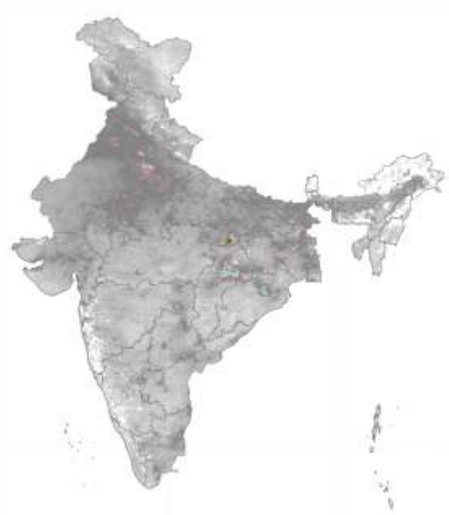
JULY 2019				
JULY 2020				

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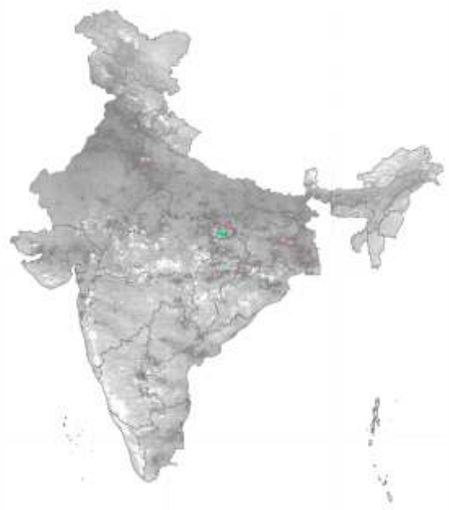
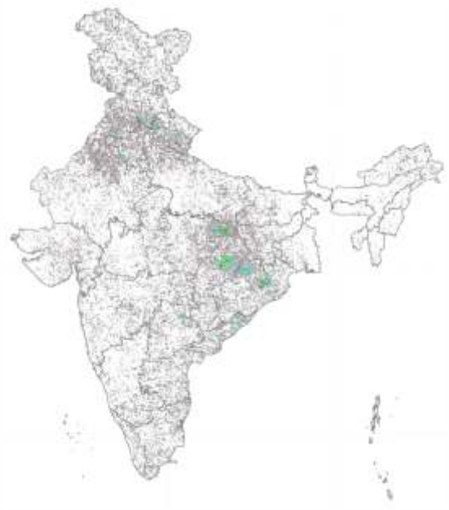
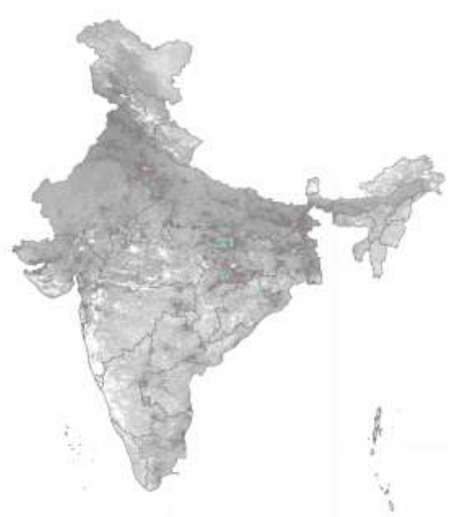
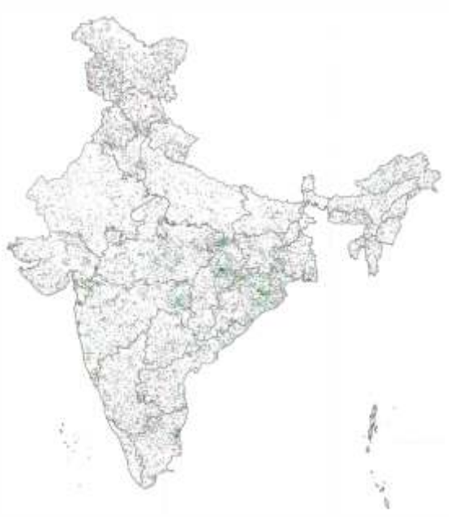
AUGUST 2019				
AUGUST 2020				

Tropospheric NO_2 Column Number Density

0 28 57 85 114 142 172 200

Micromol/m^2

SO_2 Vertical Column Density at Ground Level

0 70 140 210 280 350 420 500

Micromol/m^2

PM 2.5 Concentration (24 Hours Avg.)

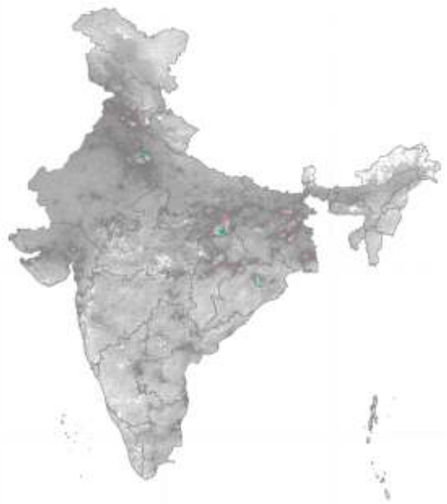
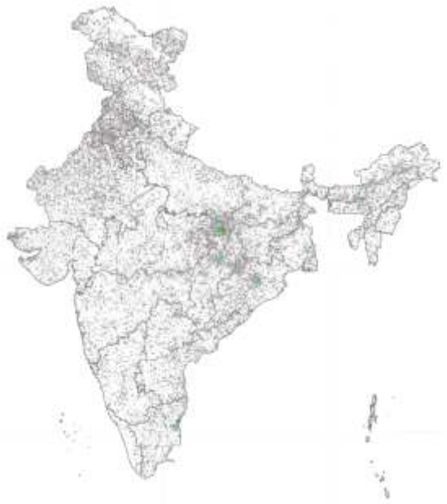
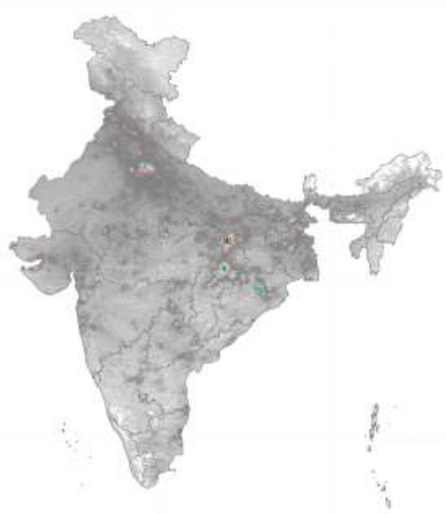
0-30 30-60 60-90 90-120 120-250 > 250

µg/m^3

PM 10 Concentration (24 Hours Avg.)

0-50 50-100 100-250 250-350 350-430 > 430

µg/m^3

POLLUTANTS	NO_2	SO_2	PM 2.5	PM 10
SEPTEMBER 2019				
SEPTEMBER 2020				

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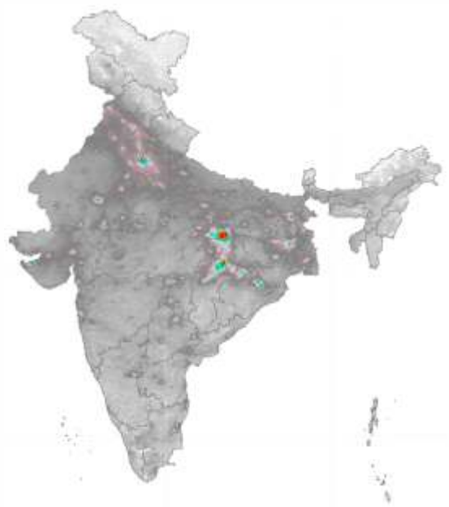
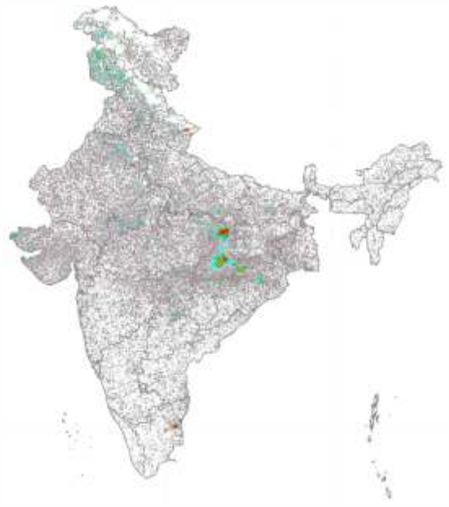
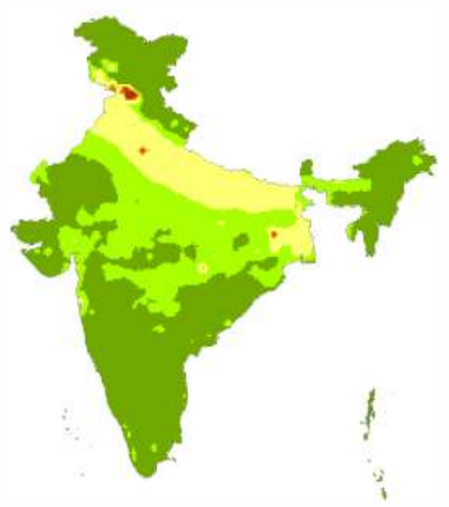
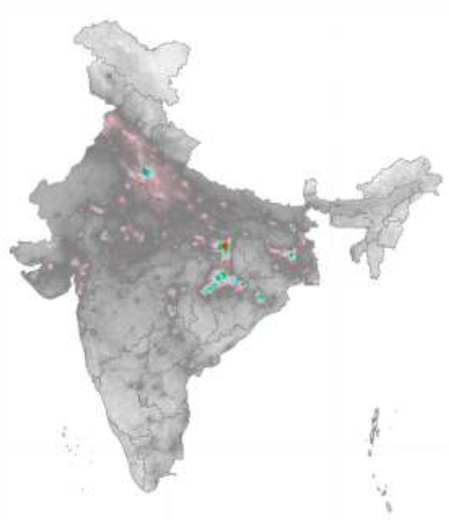
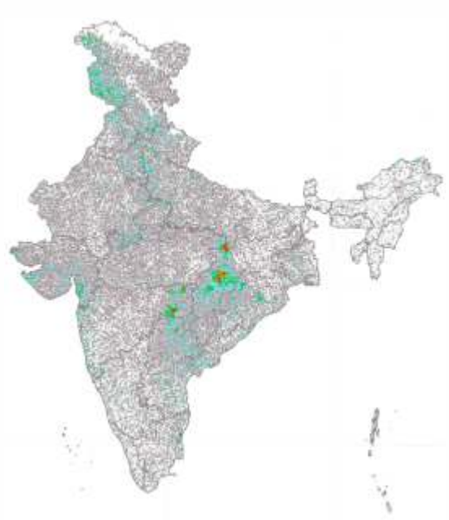
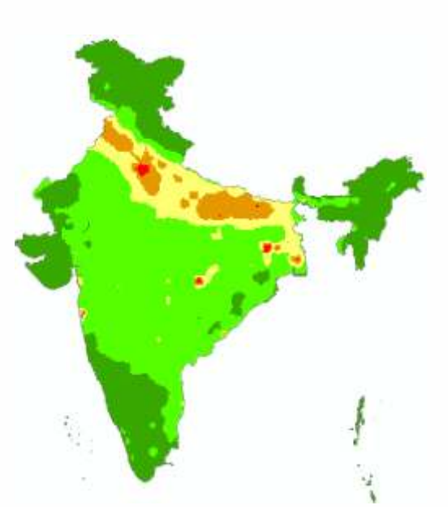
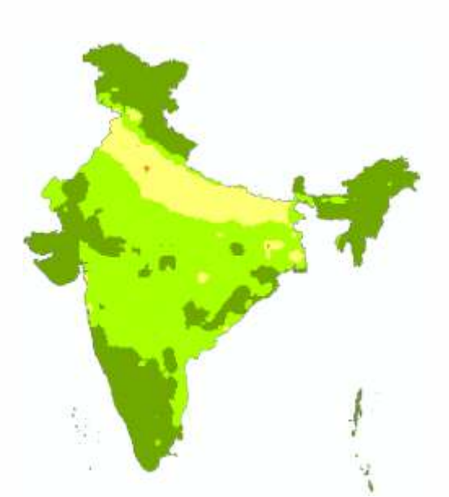
POLLUTANTS	NO_2	SO_2	PM 2.5	PM 10
OCTOBER 2019				
OCTOBER 2020				

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µg/m^3

PM 10 Concentration (24 Hours Avg.)

0-50 50-100 100-250 250-350 350-430 > 430

µg/m^3

KEY OBSERVATIONS

January to September 2020

Based on the methodology above, assessments of Air Quality in India was made, focusing on the 4 key pollutants, namely SO_2, NO_2, PM 2.5 and PM 10 for a period starting from January 2019, until October 2020.

The main findings show that, while there has definitely been an improvement in Air Quality Index in the period of March to September 2020, as compared to the corresponding period of March to September in 2019, bulk of the poor air quality locations seem to pin point to large urban agglomerations and areas that have a fairly large concentration of coal mines and coal fired power plants.

The reason for improvement of air quality index even in areas of large concentration of coal mines and coal fired power plants in India in the period of March to September 2020, could largely be attributed to the fact that many of the coal fired power plants were operating at fairly low capacities and plant load factors, due to a huge fall in electricity demand, on account of COVID-19 related lockdowns, curfews and general curtailment of economic activity.

However, the broad trends of air quality index for both 2019 and 2020 are consistent.

October 2020

The month of October 2020 shows a fast decline in the Air Quality Index, across most parts of India and particularly in the North and Central India and the Indo-Gangetic Plain. This can be attributed to winters setting in, continued emissions from coal fired power plants and also other factors such as increase in transportation to 2019 levels, particularly with most parts of India, having opened up, from the COVID-19 lockdown and also due to the contribution of bio-mass burning.

DEEP DIVE IN TO AIR QUALITY LEVELS

OF SELECT COAL MINING AND COAL FIRED POWER PLANT CLUSTERS AND LARGE URBAN CONGLOMERATE

This section deep dives in air quality levels in select areas of coal mining operations and areas that have large clusters of coal fired power plants, whether pit head coal fired power plants or independent coal fired power plants. To compare the air quality levels of these locations with other locations that do not have coal fired power plants, but have other contributors to reduce the air quality levels, we also looked at large urban agglomerations such as Delhi and Kolkata.

The reason for doing this comparison is to look at the impact of coal mining and coal fired power plants on Air Quality, vis-à-vis, other sources of pollutants.

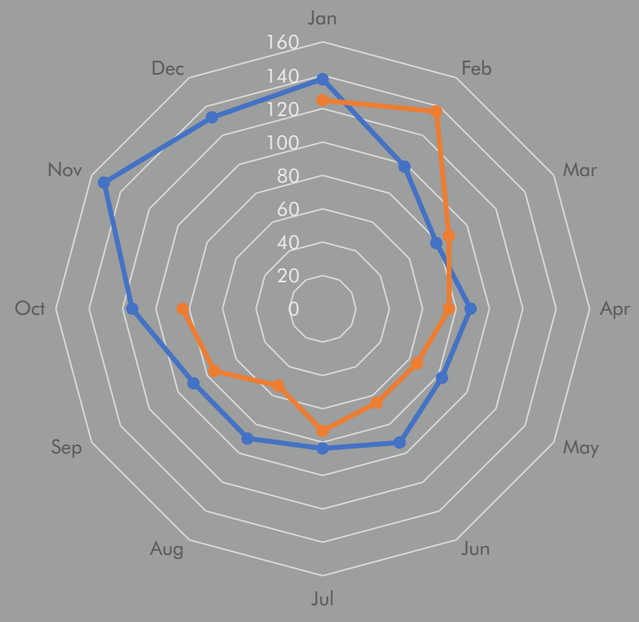
As detailed in the methodology section, the approach followed in the deep dive analysis was primarily to analyse the daily, hourly and monthly data from the various installed Air Quality Index (AQI) Monitors. Further, the data from the privately installed monitors was corroborated with AQI data from public AQI montors of the state and central pollution control boards. We also referred to Air quality projection models from the global database of the European Centre for Medium-Range Weather Forecasts (ECMWF) for PM 2.5 and PM 10 emissions across India.

The location of privately installed air quality monitors as shown on Google Earth.

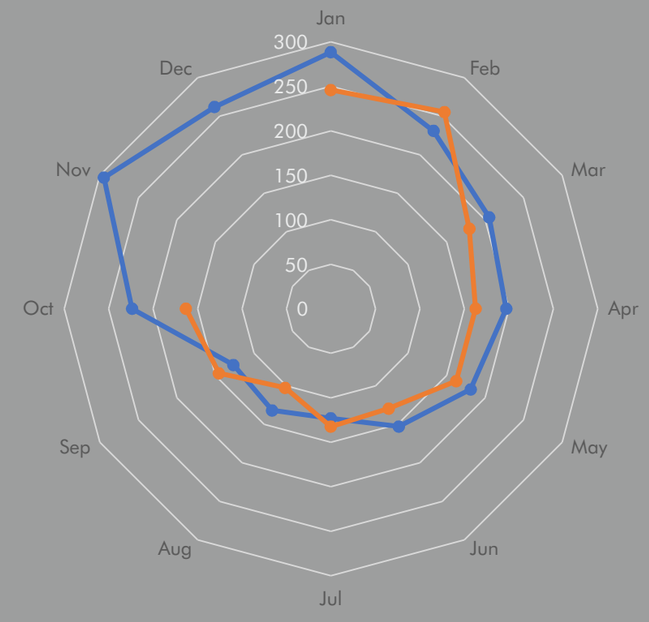
KORBA (CHHATTISGARH)

2019 vs 2020

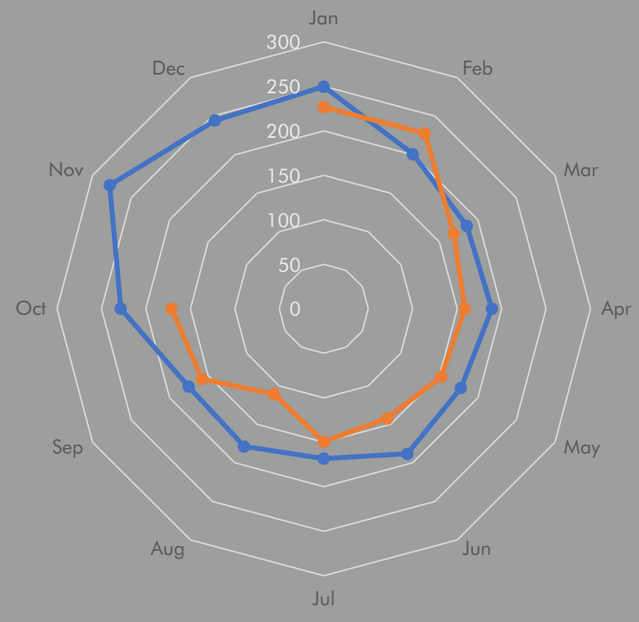
PM 2.5



PM 10



AQI



Radar/spider diagrams help to see which variables - in this case PM 2.5 and PM 10 - are closely correlated among different datasets at different points in time - in this case years 2019 and 2020.

2019 2020

KORBA

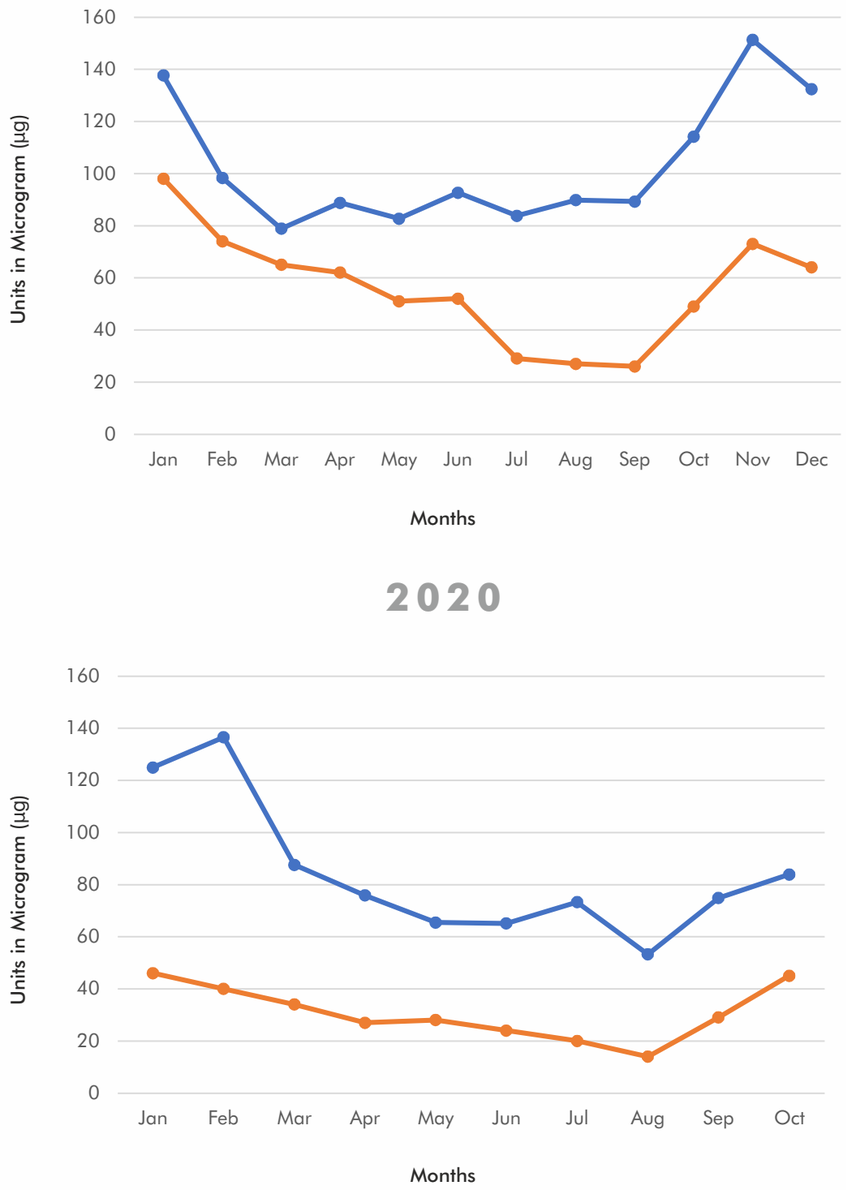
	PM 2.5			PM 10			AQI			TREND		
Location	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Count***	**AQI >100**	**AQI >100**
Dipka Mines Gandhi Nagar Sirki	73.23	706.50	5.50	178.83	1164.00	11.50	173.51	1317.50	11.50	3627	2735	75.41%
PALI (Kusmunda Mines)	69.77	889.50	0.50	143.04	1347.50	3.50	149.03	1546.88	3.50	7199	4028	55.95%
Kharmora	59.96	430.00	1.00	113.80	650.00	3.00	128.29	675.00	3.33	15734	7940	50.46%
R P Nagar	41.22	270.00	1.50	87.58	490.50	4.50	92.80	475.63	4.50	15823	5406	34.17%
Ravi Shankar Nagar	65.61	442.00	1.50	131.84	759.50	3.50	146.40	811.88	3.50	12037	7549	62.71%
Balco (Shanti Nagar)	53.11	287.00	0.50	104.56	1121.50	0.50	115.24	1264.38	0.50	12895	6092	47.24%
Gevra mines Sarai Singar	46.36	999.00	1.00	89.89	1999.00	2.00	100.61	2361.25	2.00	6009	1818	30.25%
Transport Nagar	75.74	593.00	1.00	149.89	925.00	5.50	163.61	1018.75	5.50	8582	6098	71.06%
Darri (NTPC-HTTP)	94.33	999.00	1.00	185.76	1599.50	4.00	197.33	1861.88	4.00	15949	13031	81.70%

*No of Entries

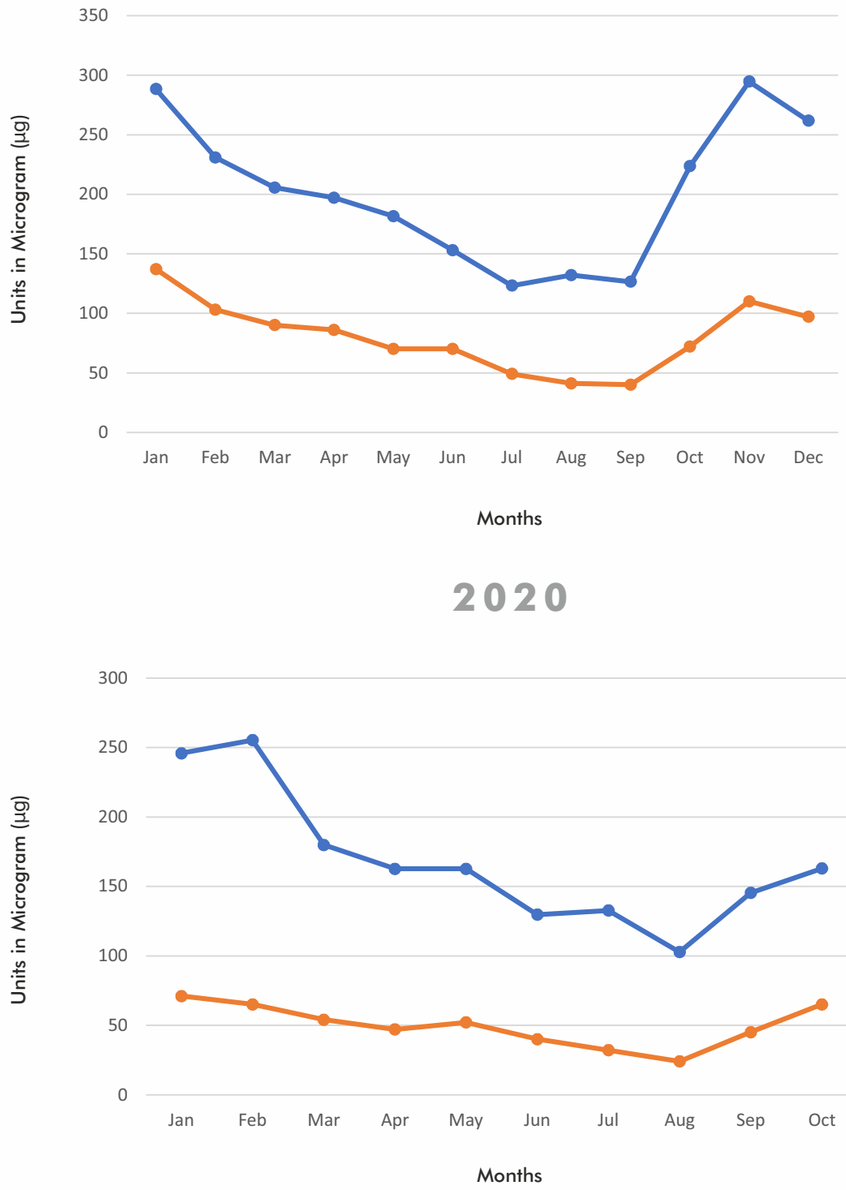
Comparison of

Emissions Recorded by Privately Installed AQI Monitors vs ECMWF Data Source

PM 2.5



PM 10



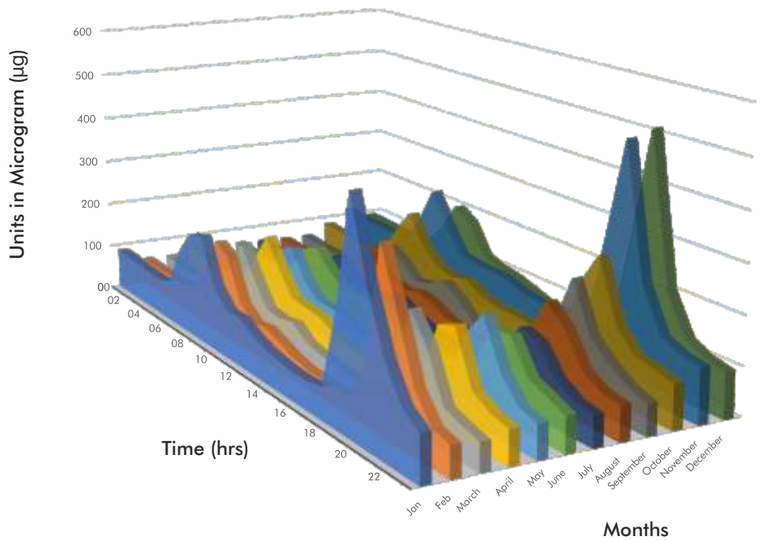
Privately Installed AQI Monitors ECMWF

KORBA

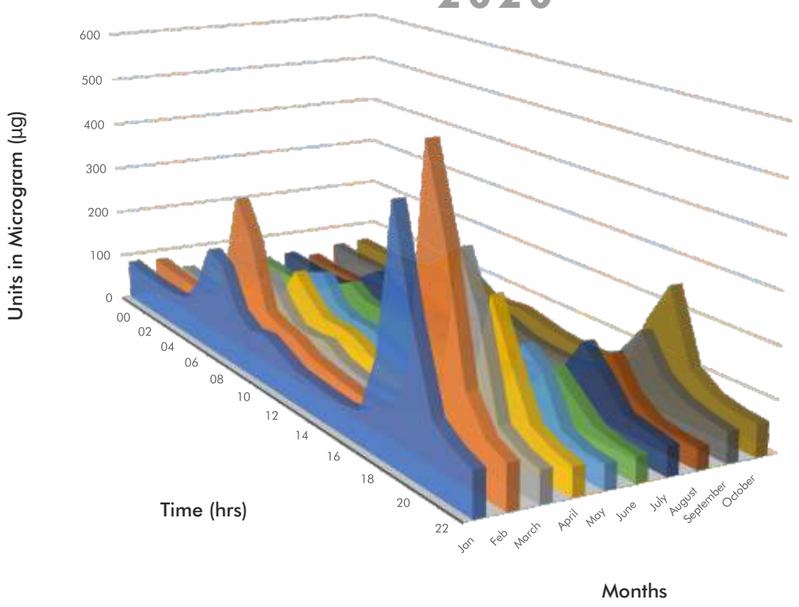
Monthly Average of Hourly
PM Concentration

PM 2.5

2019

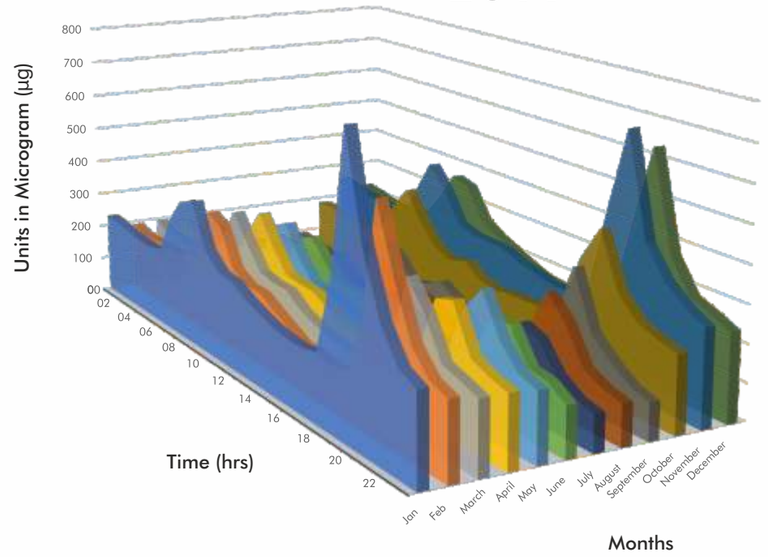


2020

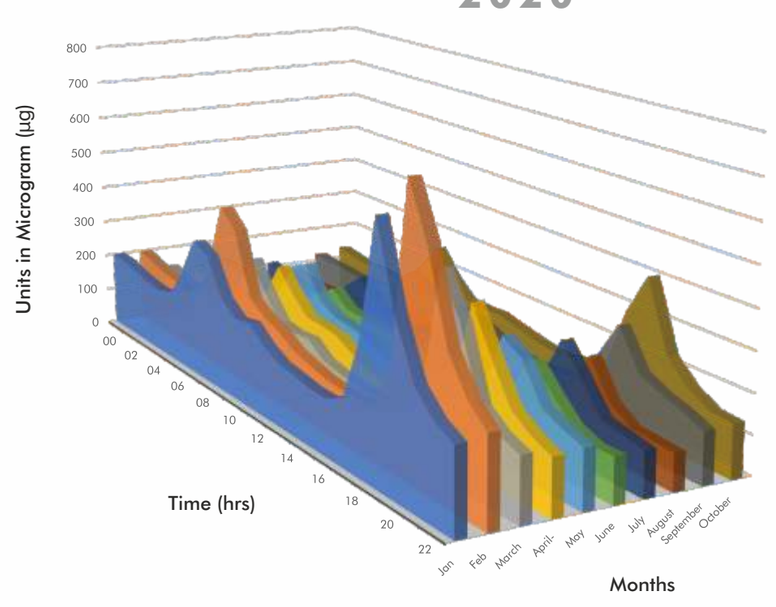


PM 10

2019



2020



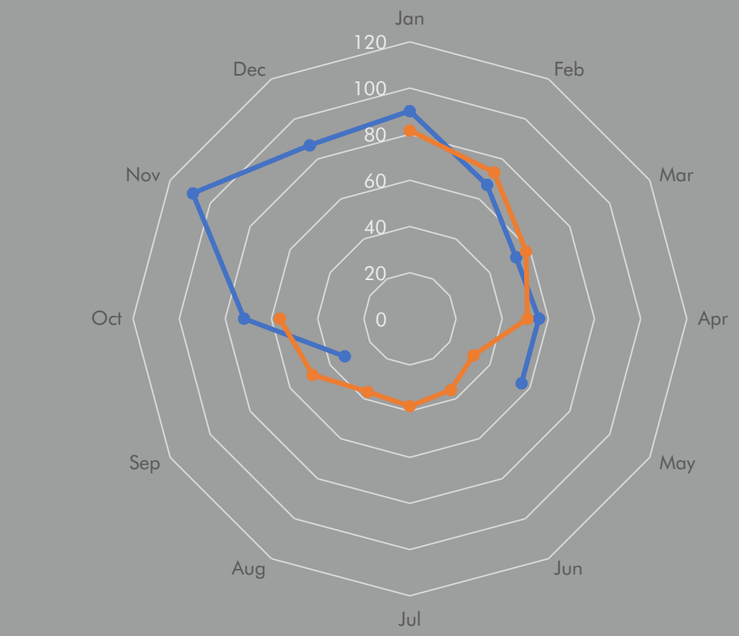
KORBA

The location of privately installed air quality monitors as shown on Google Earth.

JHARSUGUDA (ODISHA)

2019 vs 2020

PM 2.5



PM 10

AQI

Radar/spider diagrams help to see which variables - in this case PM 2.5 and PM 10 - are closely correlated among different datasets at different points in time - in this case years 2019 and 2020.

2019 2020

Location	PM 2.5 Avg	PM 2.5 Max	PM 2.5 Min	PM 10 Avg	PM 10 Max	PM 10 Min	AQI Avg	AQI Max	AQI Min	TREND Count*	TREND AQI >100	TREND AQI >100
Pandaloi	180.16	999.00	1.00	359.06	1999.00	5.00	410.00	2361.25	5.00	7461	3090	41.42%
Malda	66.96	970.00	2.00	112.03	1670.50	5.00	136.35	1950.63	5.00	9054	4471	49.38%
Bomalai	60.82	518.50	1.50	110.52	655.50	4.50	127.77	681.88	4.50	13038	6882	52.78%

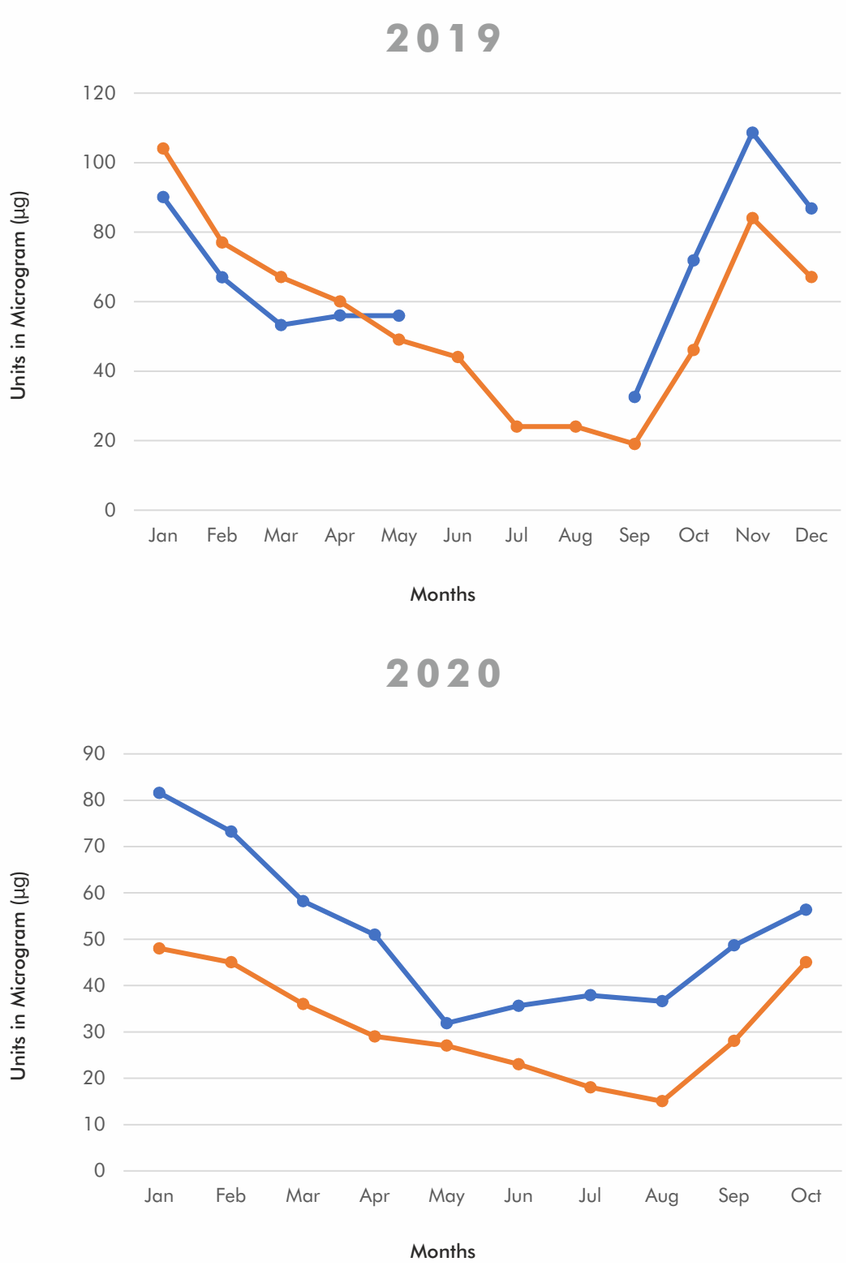
*No of Entries

JHARSUGUDA

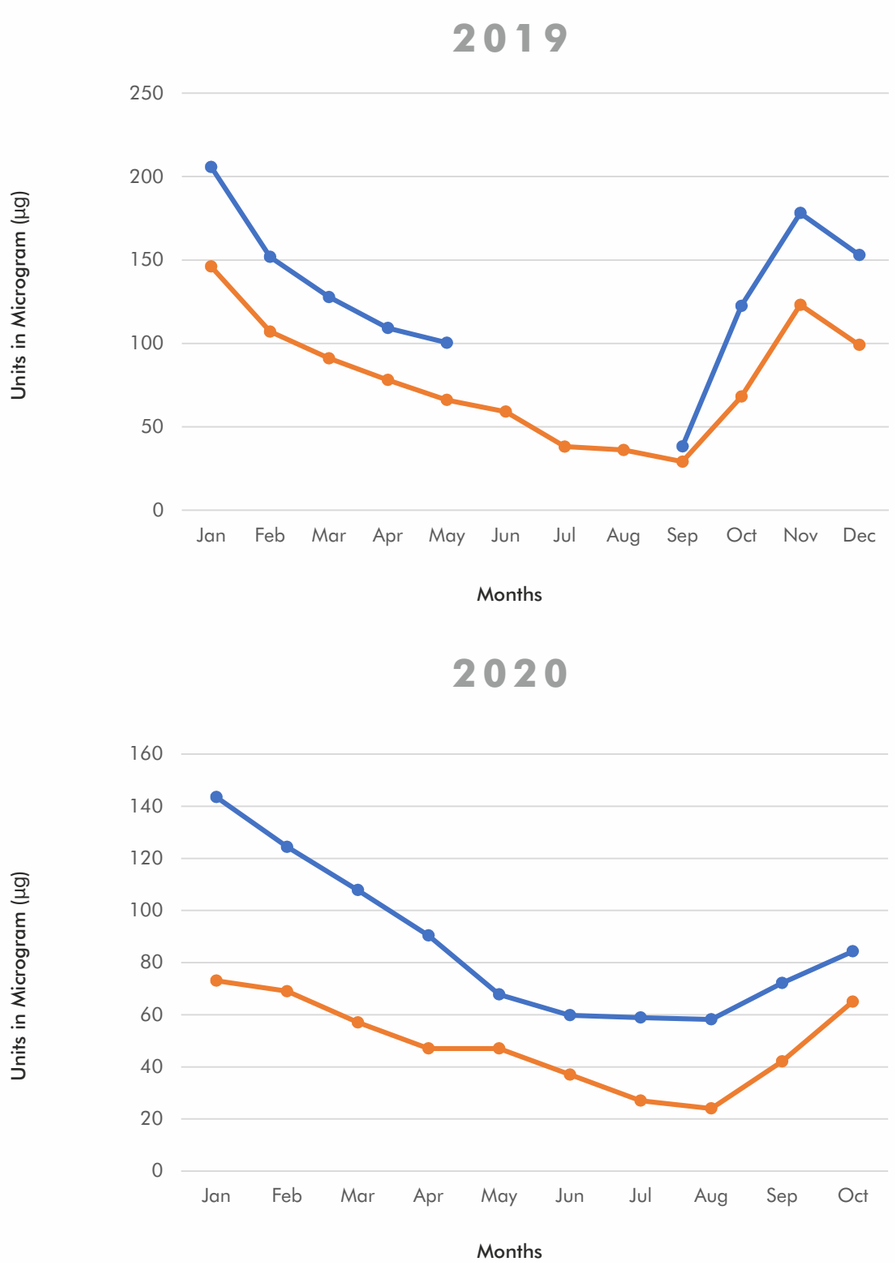
Comparison of

Emissions Recorded by Privately Installed AQI Monitors vs ECMWF Data Source

PM 2.5



PM 10

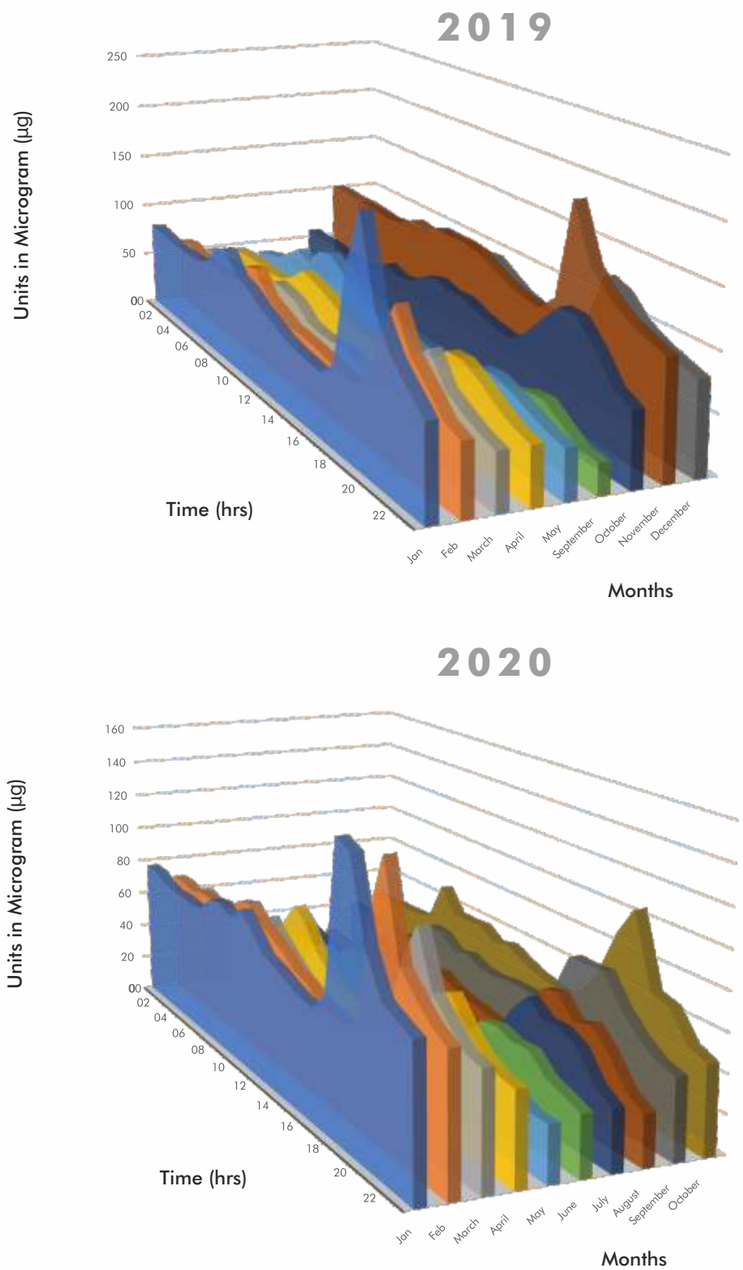


Privately Installed AQI Monitors ECMWF

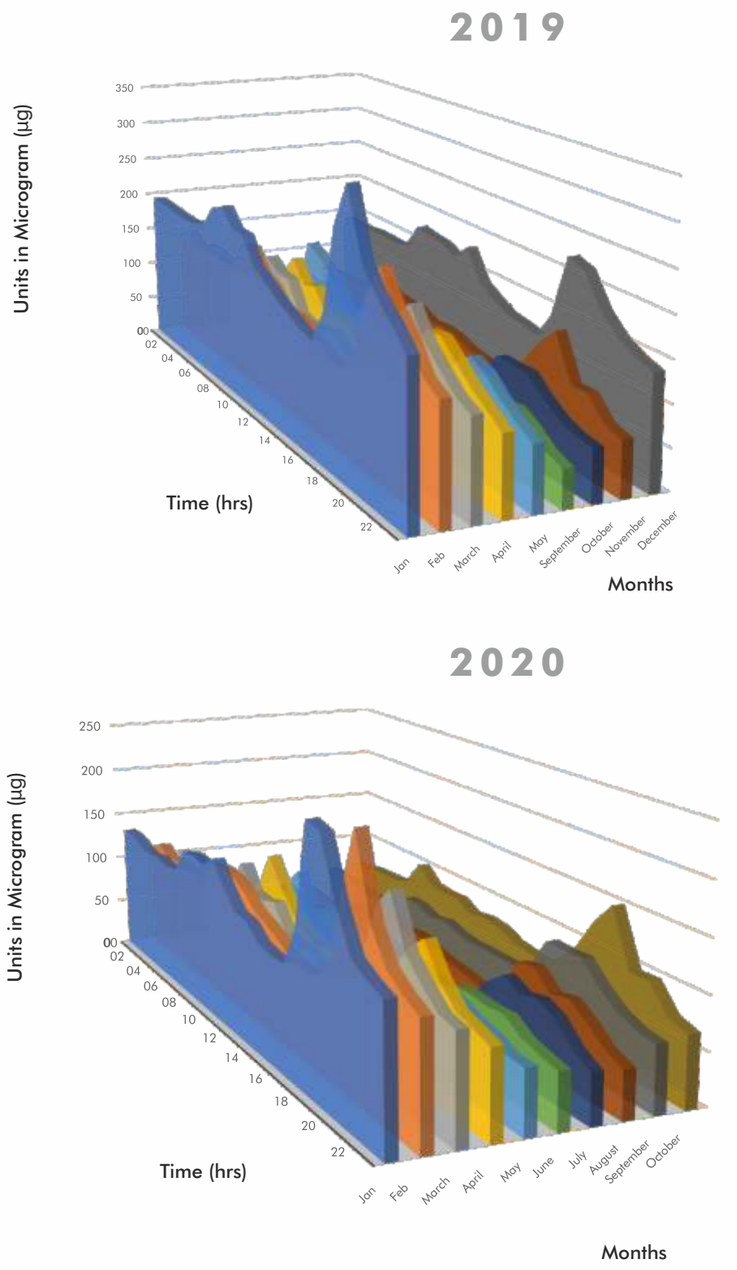
JHARSUGUDA

Monthly Average of Hourly
PM Concentration

PM 2.5



PM 10



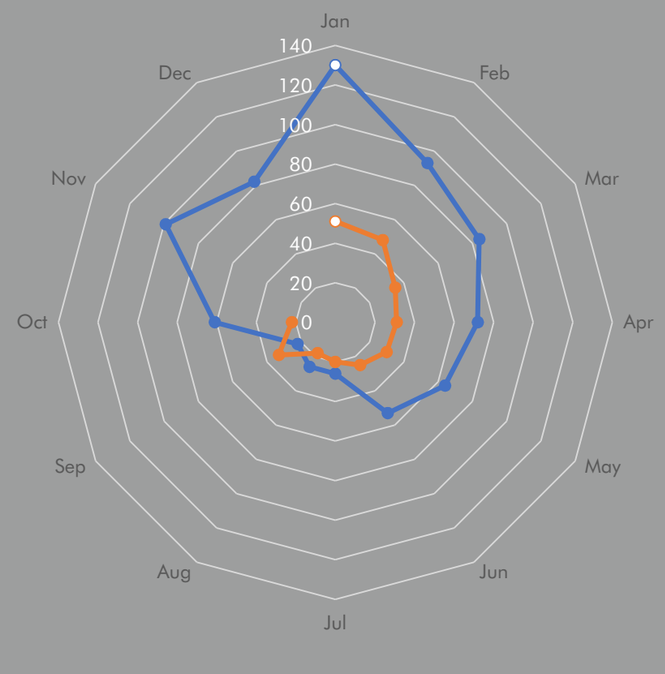
JHARSUGUDA

The location of privately installed air quality monitors as shown on Google Earth.

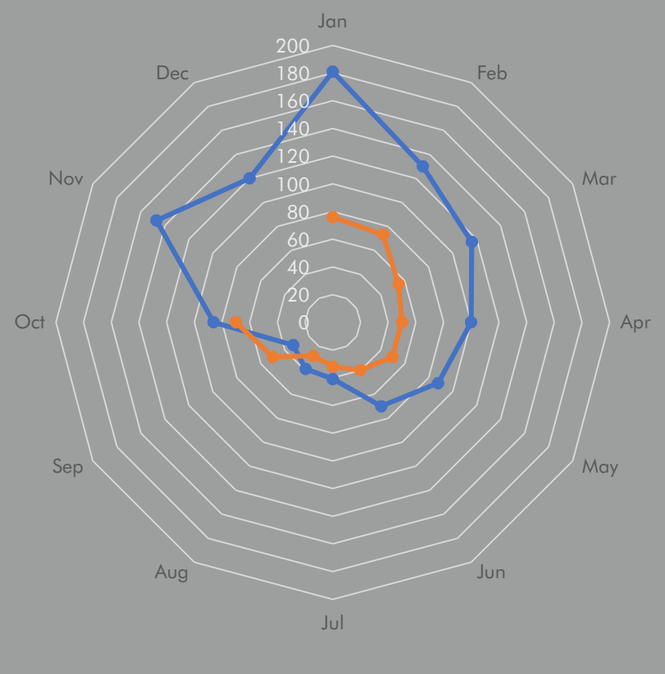
ROURKELA (ODISHA)

2019 vs 2020

PM 2.5



PM 10



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2019 2020

Location	PM 2.5			PM 10			AQI			TREND		
	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Count*	AQI >100	AQI >100
Roourkela	45.66	527.5	6.5	92.63	1037.5	16.5	101.10	1159.37	17	2283	766	35.55%

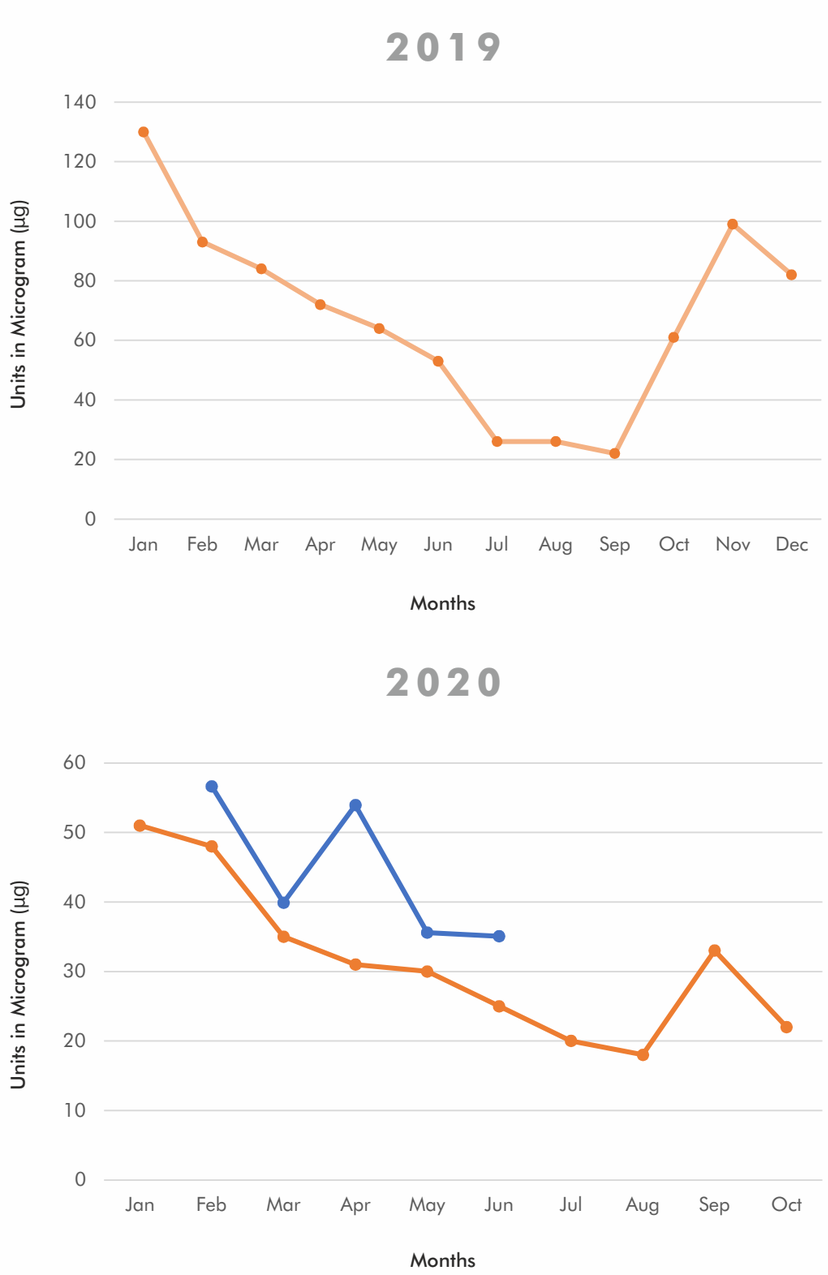
*No of Entries

ROURKELA

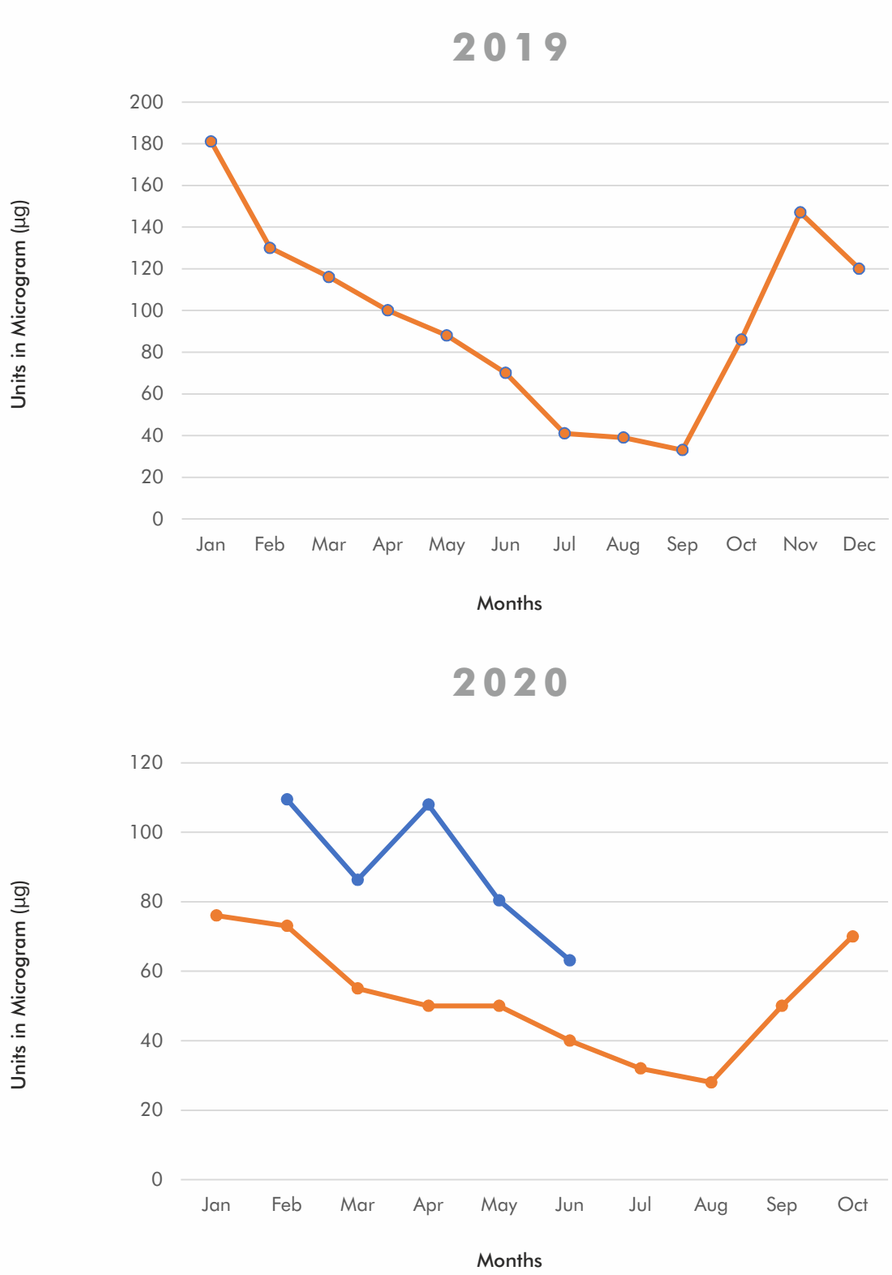
Due to insufficient data of monitoring device charts were prepared using ECMWF data

Comparison of
Emissions Recorded by Privately Installed AQI Monitors vs **ECMWF Data Source**

PM 2.5



PM 10



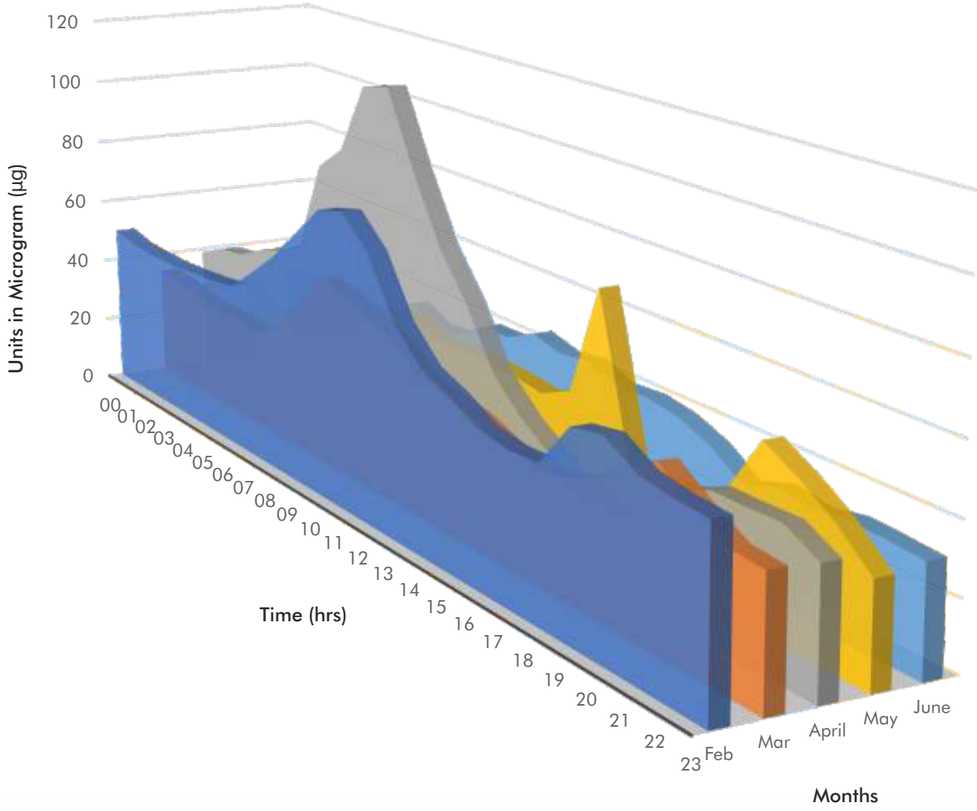
Privately Installed AQI Monitors ECMWF

ROURKELA

Monthly Average of Hourly
PM Concentration

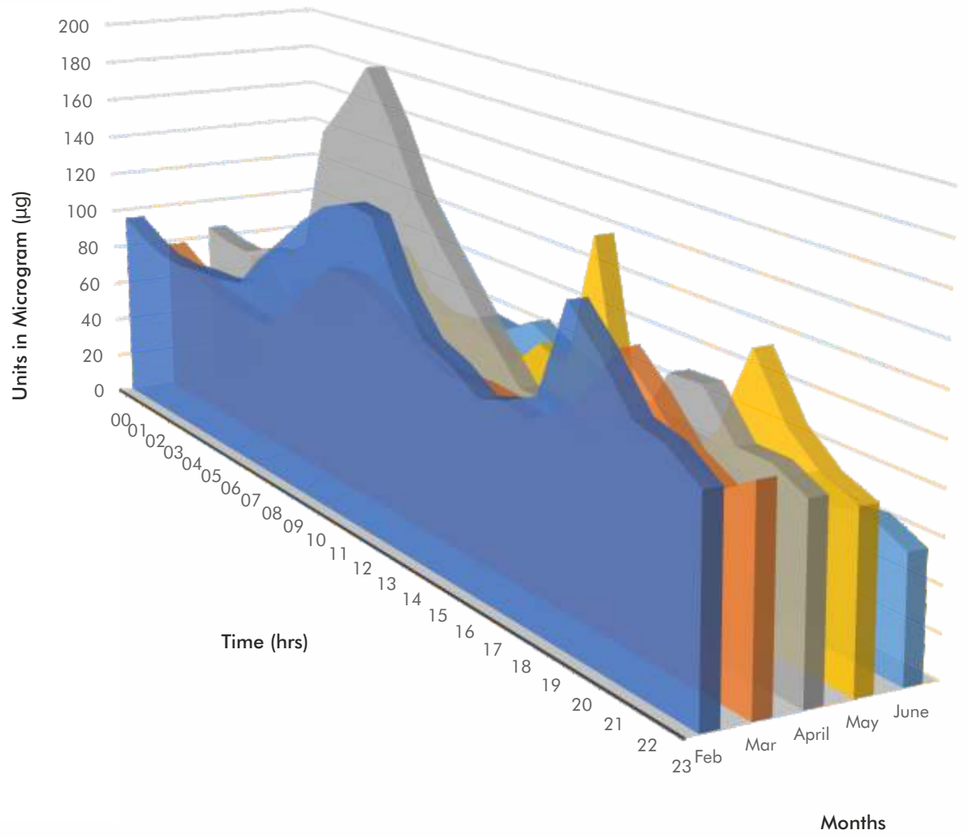
PM 2.5

2020



PM 10

2020



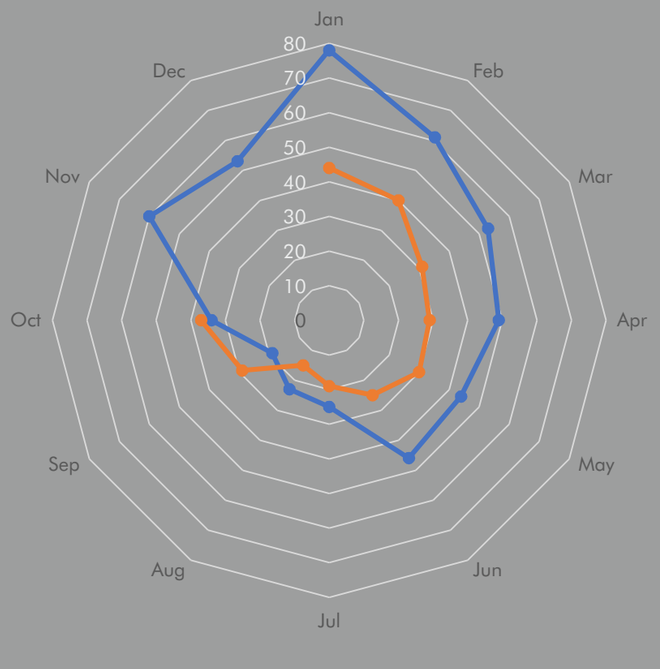
ROURKELA

The location of privately installed air quality monitors as shown on Google Earth.

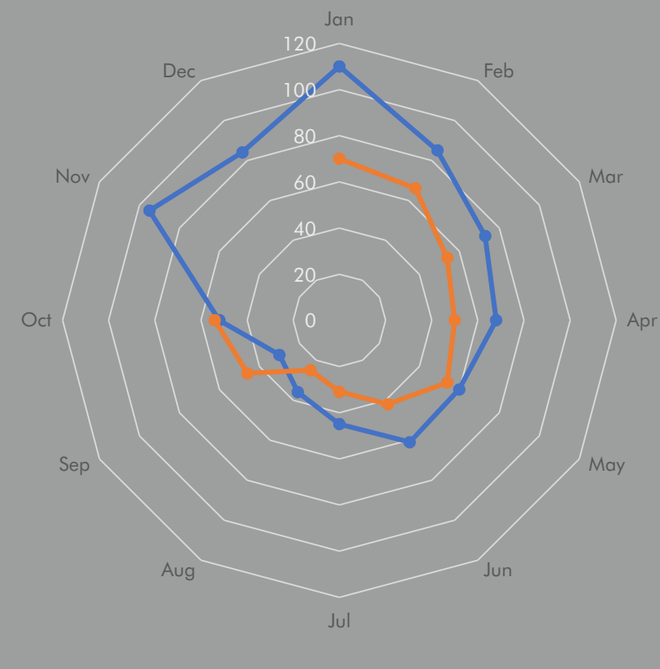
RAIGARH (CHHATTISGARH)

2019 vs 2020

PM 2.5



PM 10



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2019 2020

	PM 2.5			PM 10			AQI			TREND		
Location	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Avg**	**Max**	**Min**	**Count***	**AQI >100**	**AQI >100**
Sarasmal	82.16	957	1.0	156.46	1482.00	0.50	170.29	1715.00	0.50	5380	3376	62.75%

*No of Entries

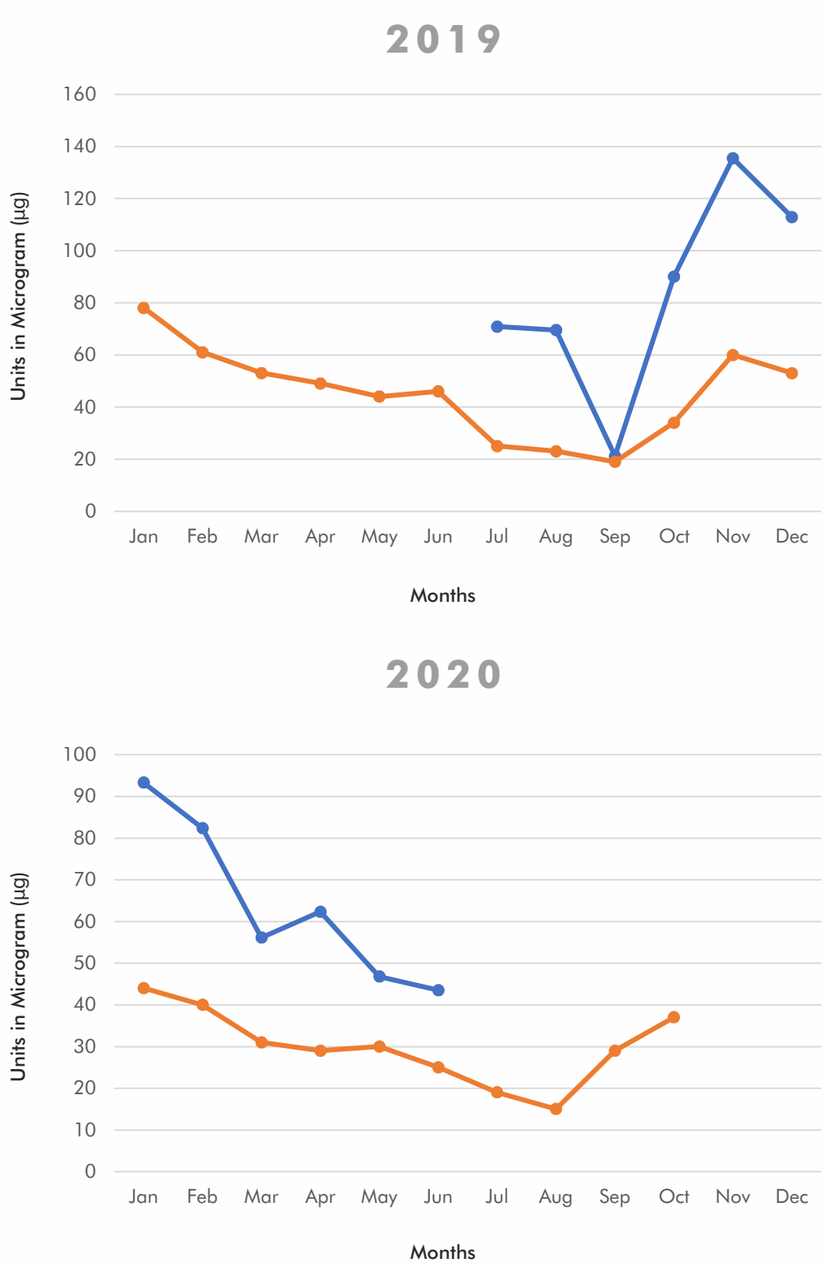
RAIGARH

Due to insufficient data of monitoring device charts were prepared using ECMWF data

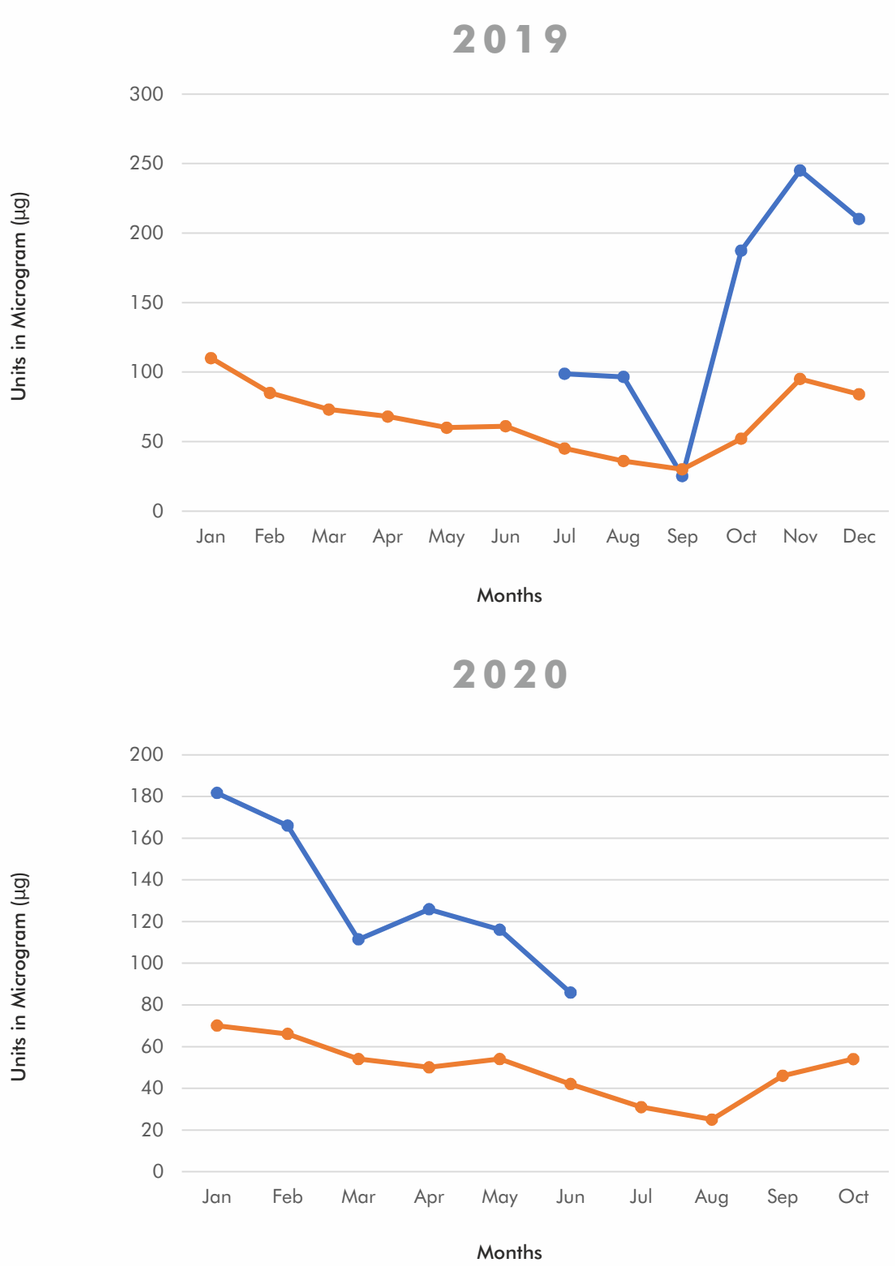
Comparison of

Emissions Recorded by Privately Installed AQI Monitors vs ECMWF Data Source

PM 2.5



PM 10

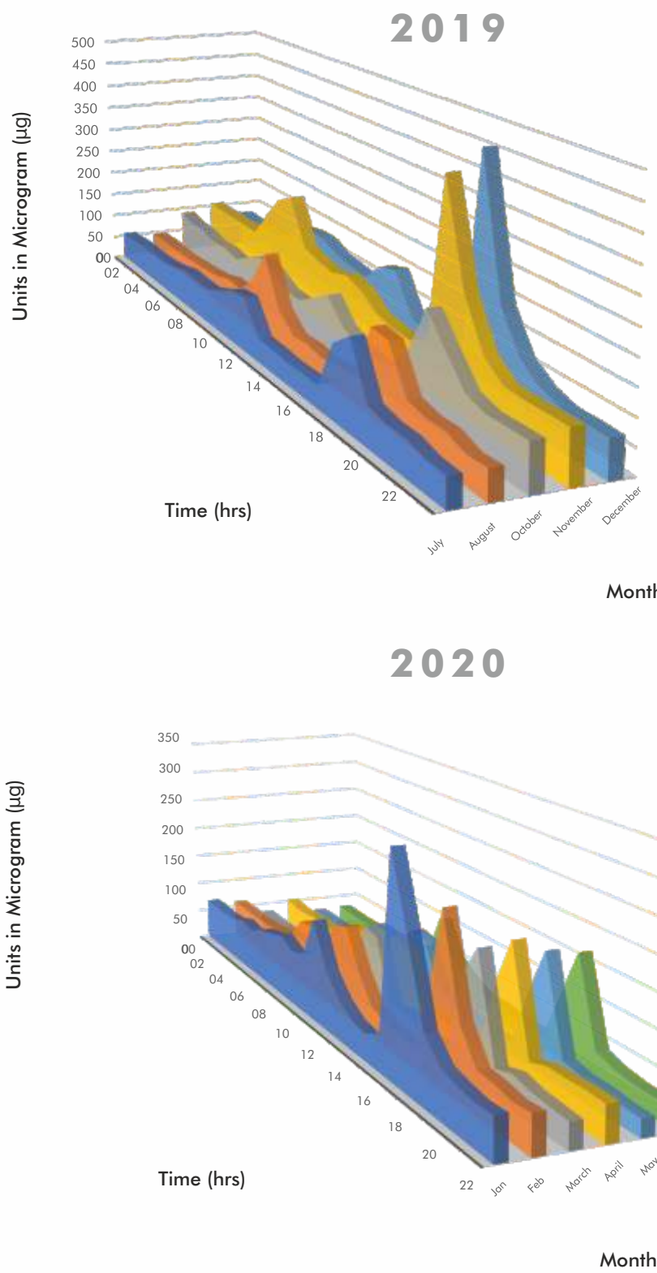


Privately Installed AQI Monitors ECMWF

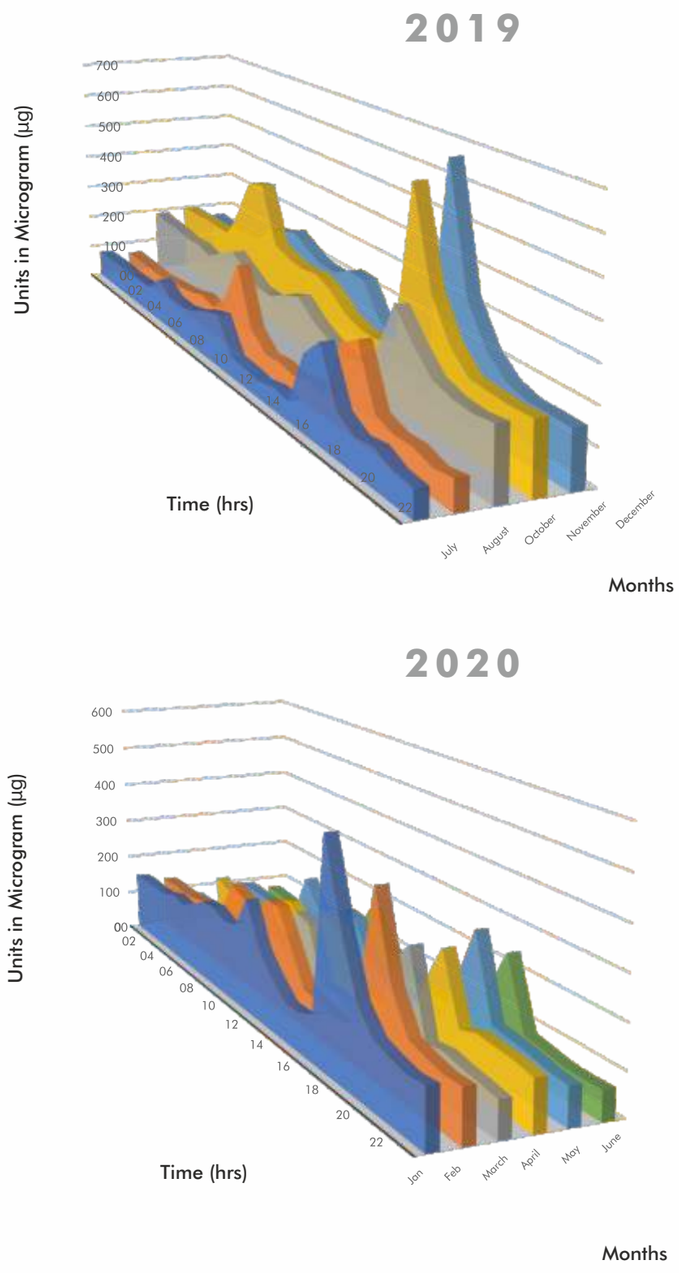
RAIGARH

Monthly Average of Hourly
PM Concentration

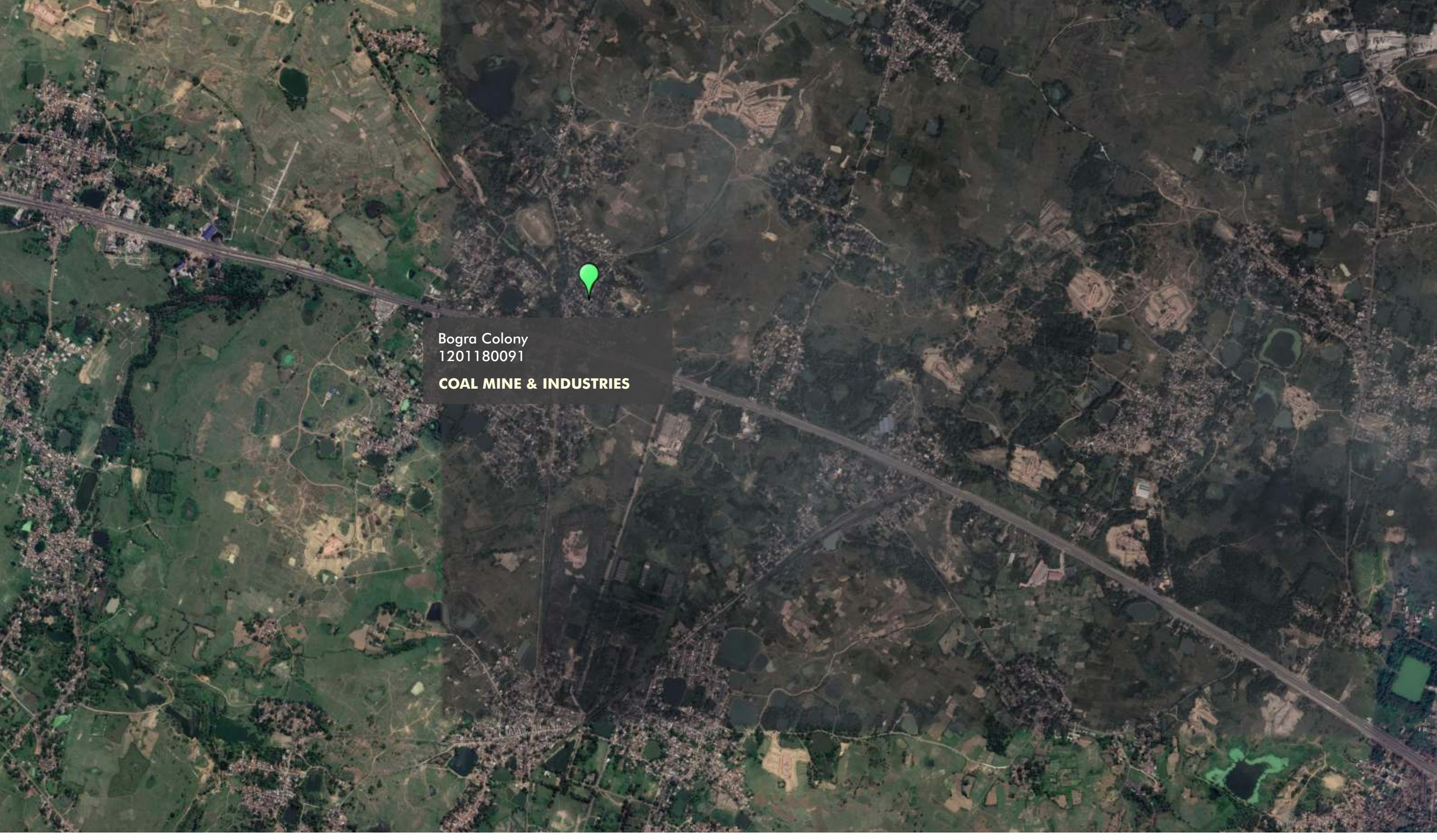
PM 2.5



PM 10



RAIGARH

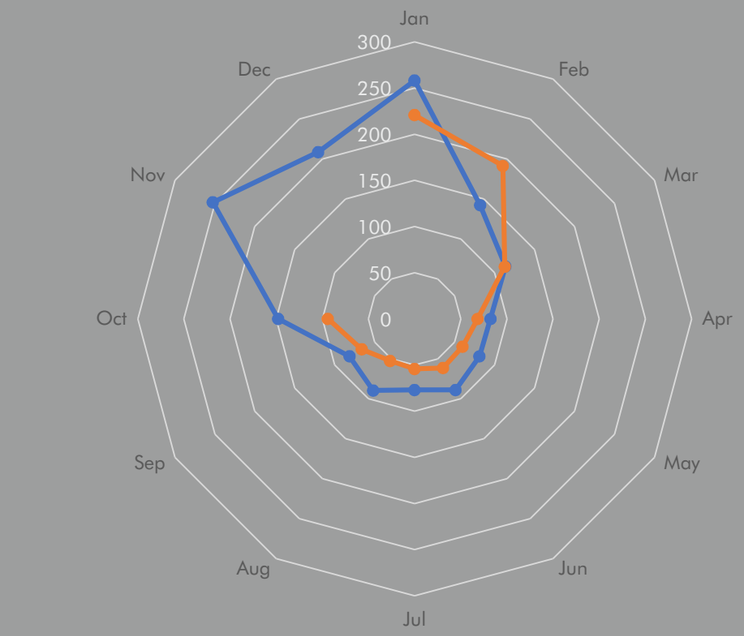


The location of privately installed air quality monitors as shown on Google Earth.

ASANSOL (WEST BENGAL)

2019 vs 2020

PM 2.5



PM 10

AQI

Radar/spider diagrams help to see which variables - in this case PM 2.5 and PM 10 - are closely correlated among different datasets at different points in time - in this case years 2019 and 2020.

2019 2020

Location	PM 2.5 Avg	PM 2.5 Max	PM 2.5 Min	PM 10 Avg	PM 10 Max	PM 10 Min	AQI Avg	AQI Max	AQI Min	TREND Count*	TREND AQI >100	TREND AQI >100
Bogra Colony	126.37	999.00	2.00	216.67	1999.00	0.50	241.82	2361.25	0.50	13182	10050	76.24%

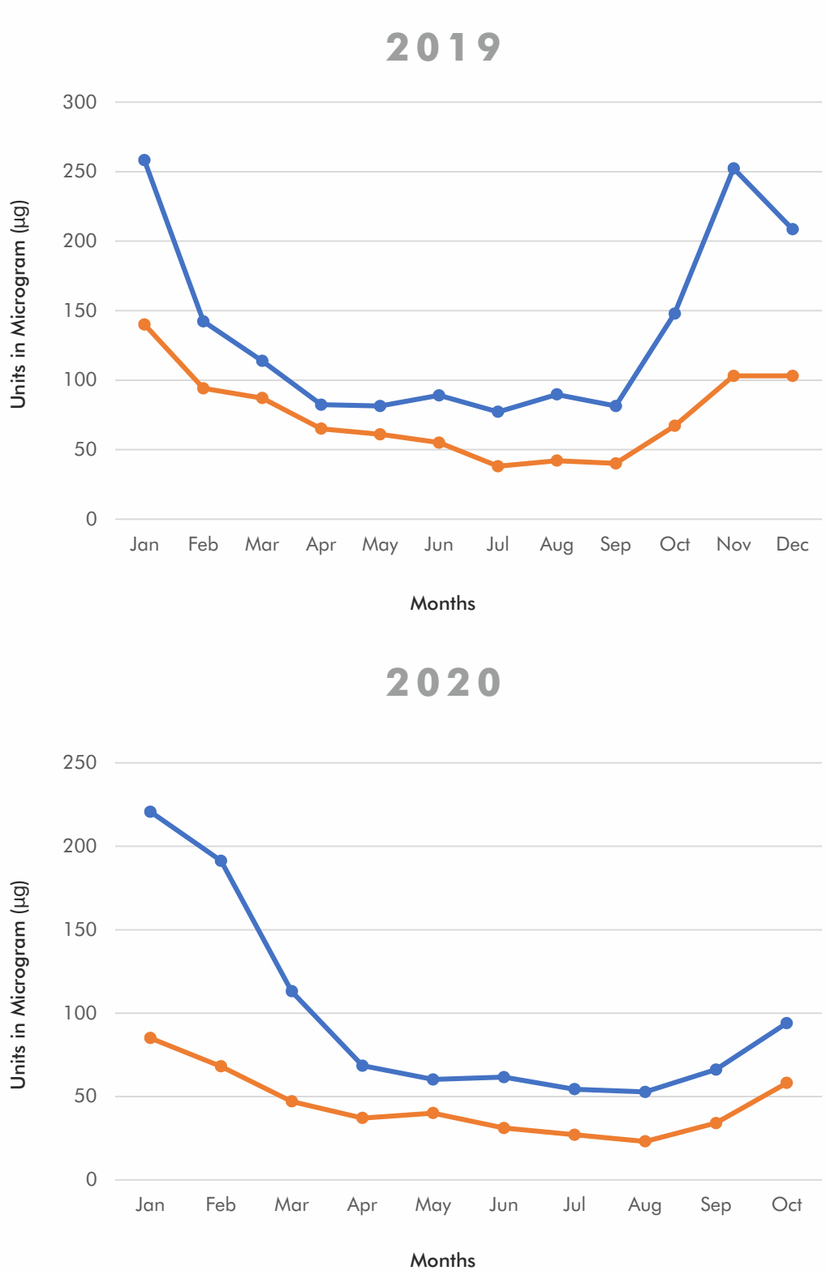
*No of Entries

ASANASOL

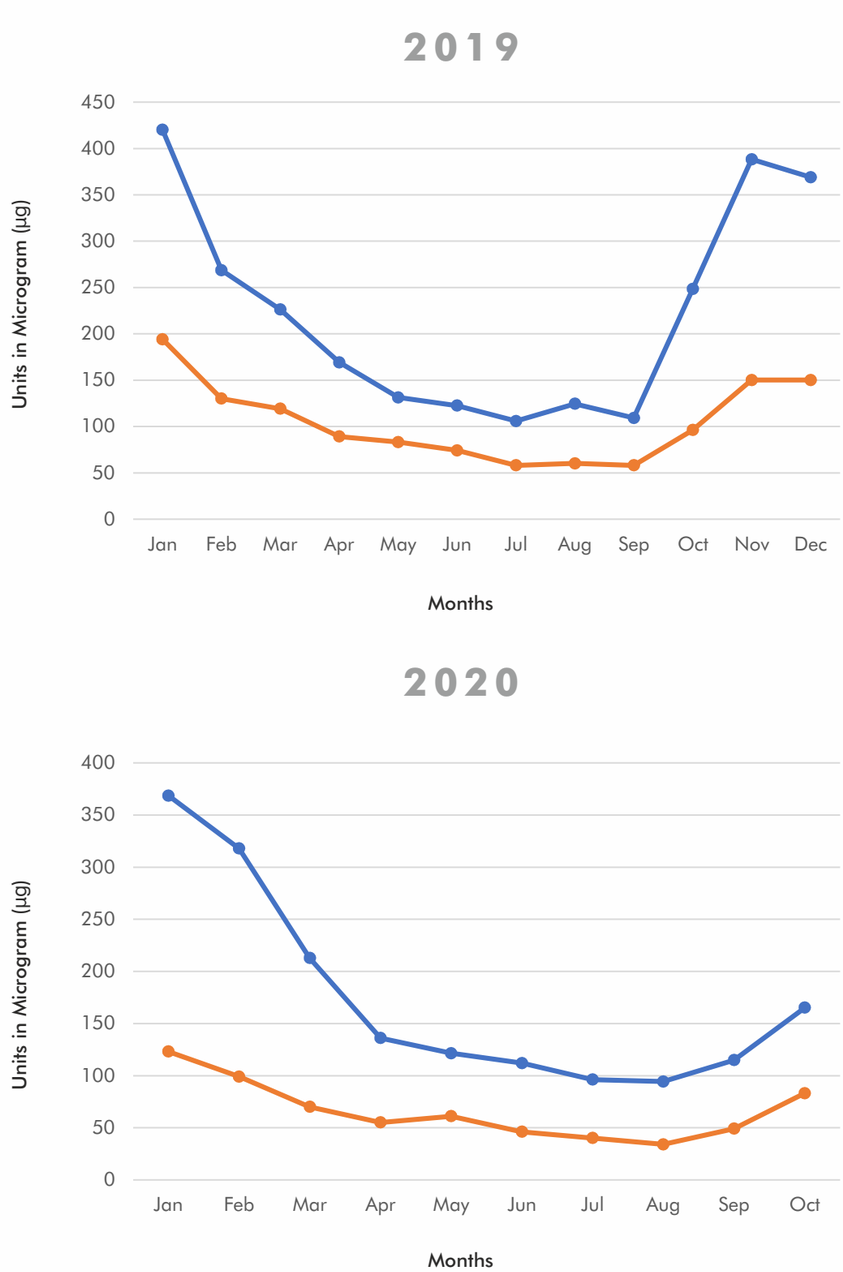
Comparison of

Emissions Recorded by Privately Installed AQI Monitors vs ECMWF Data Source

PM 2.5



PM 10



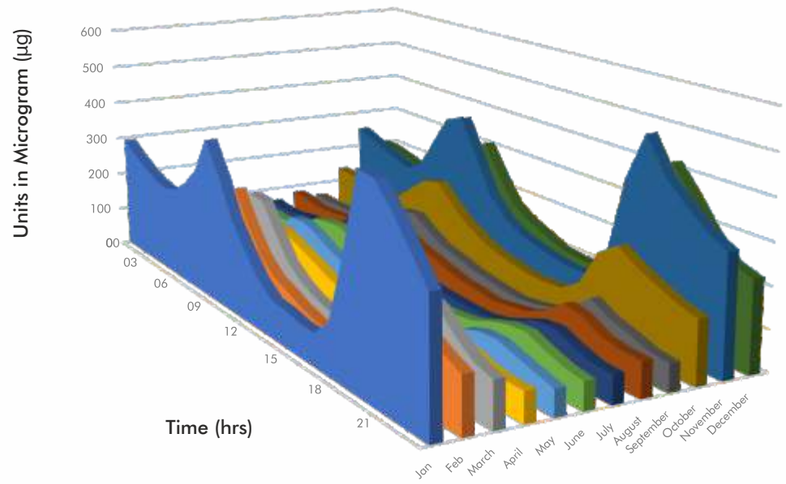
Privately Installed AQI Monitors ECMWF

ASANASOL

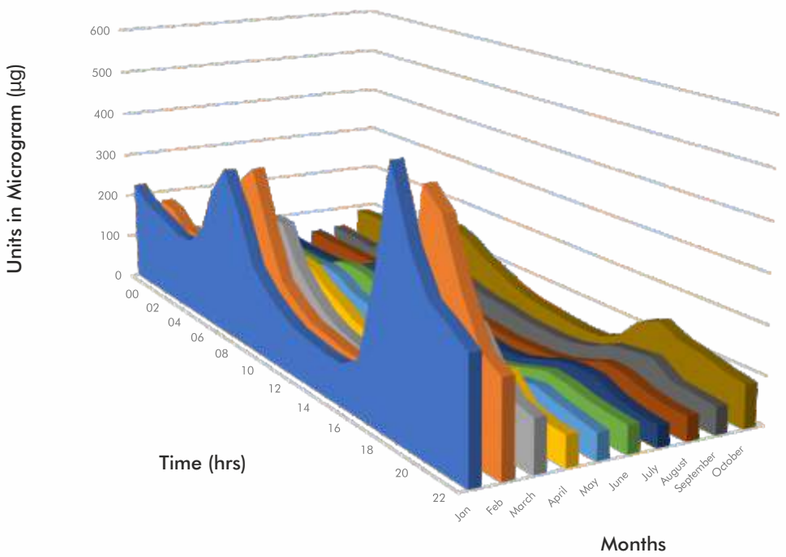
Monthly Average of Hourly
PM Concentration

PM 2.5

2019

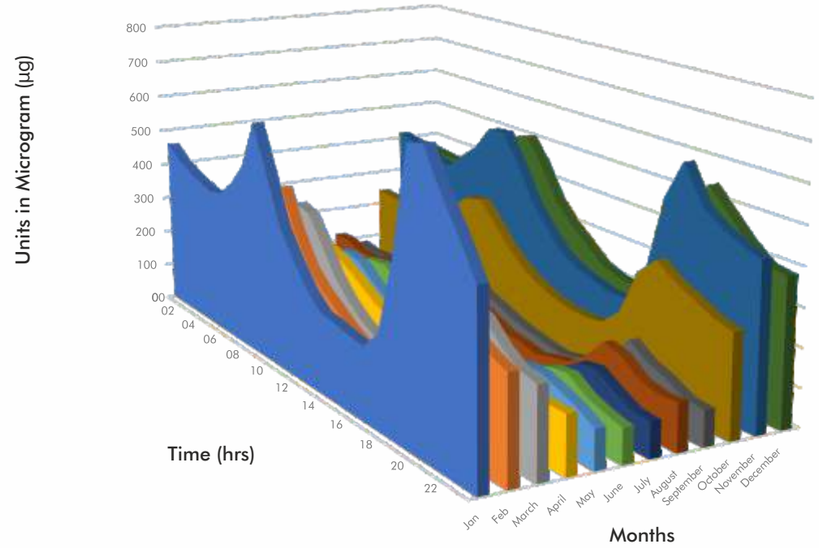


2020

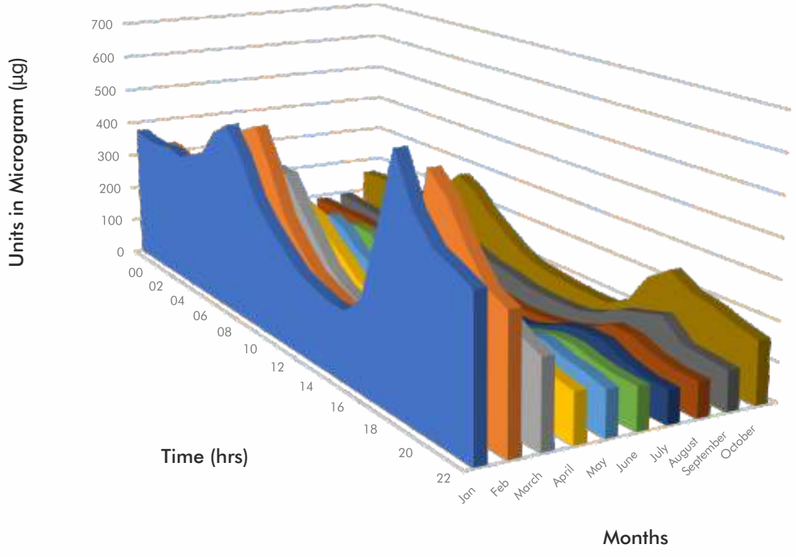


PM 10

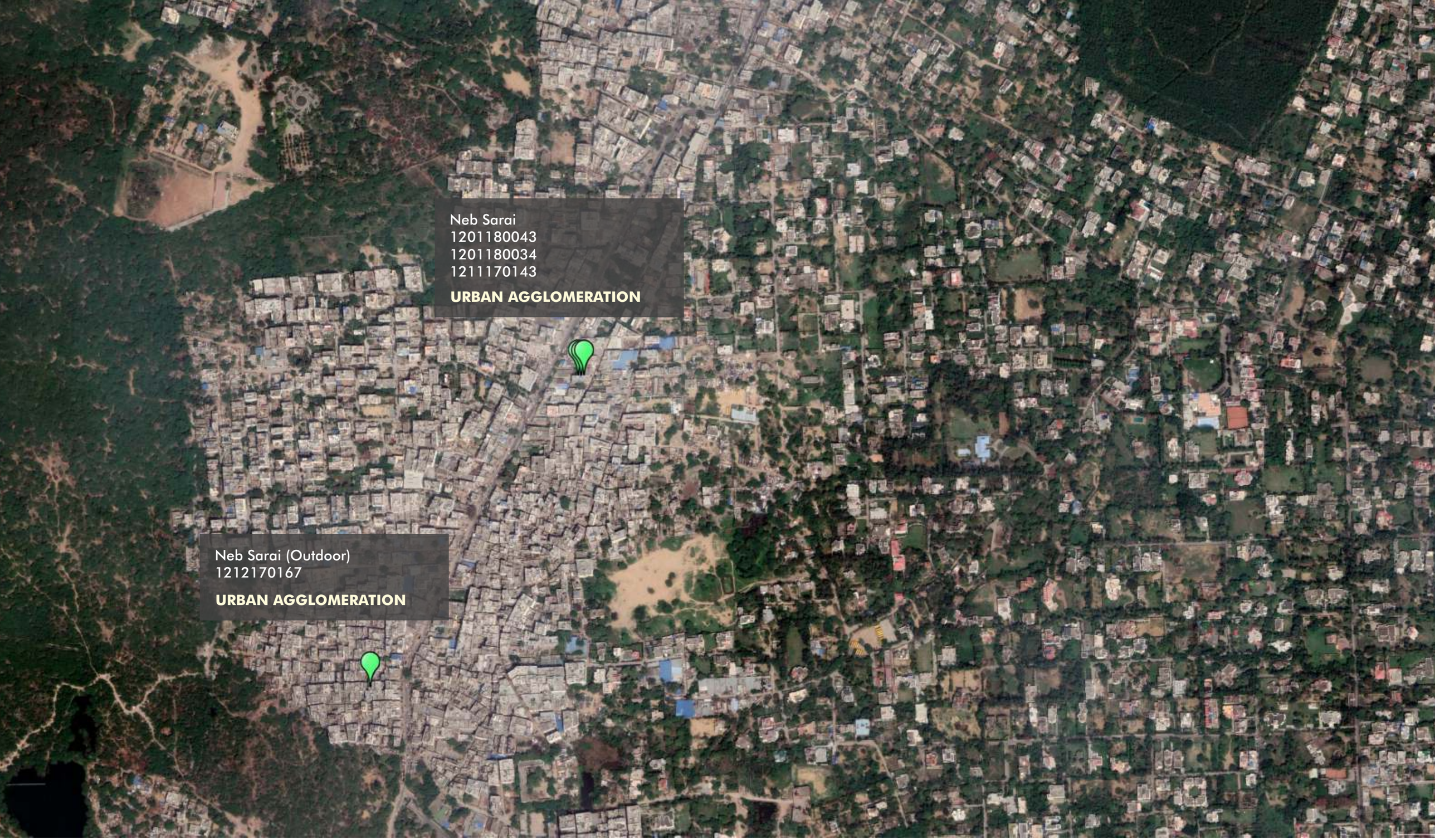
2019



2020



ASANASOL

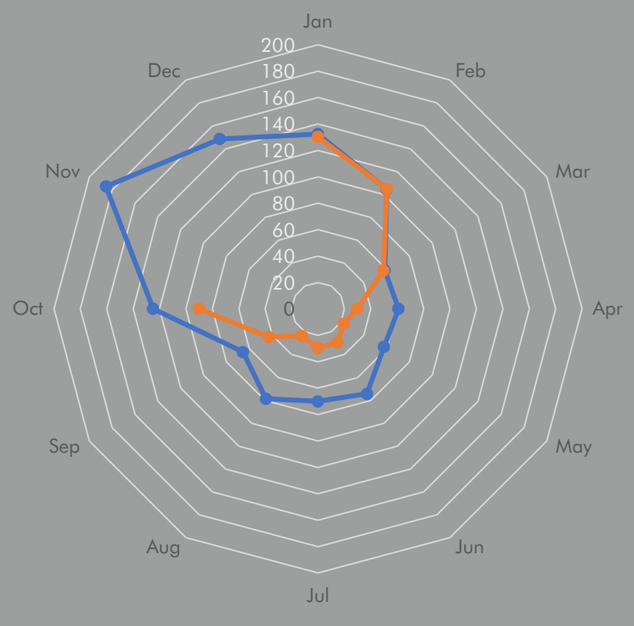


The location of privately installed air quality monitors as shown on Google Earth.

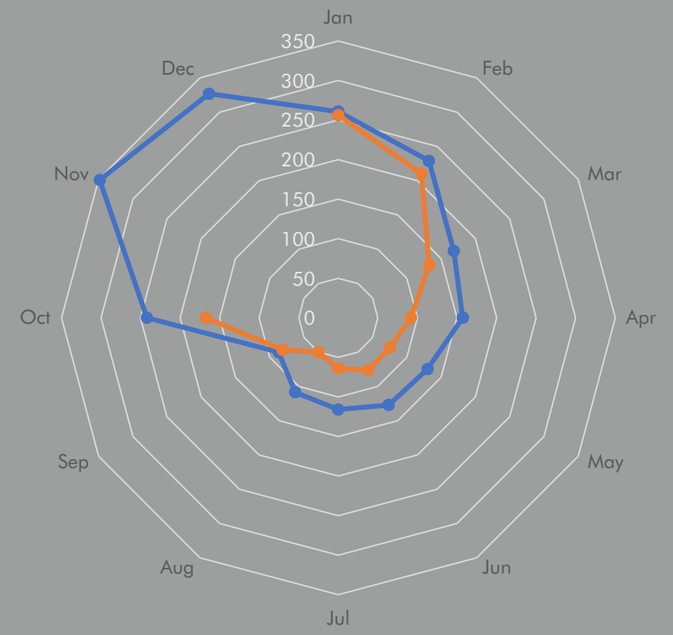
NEW DELHI (DELHI)

2019 vs 2020

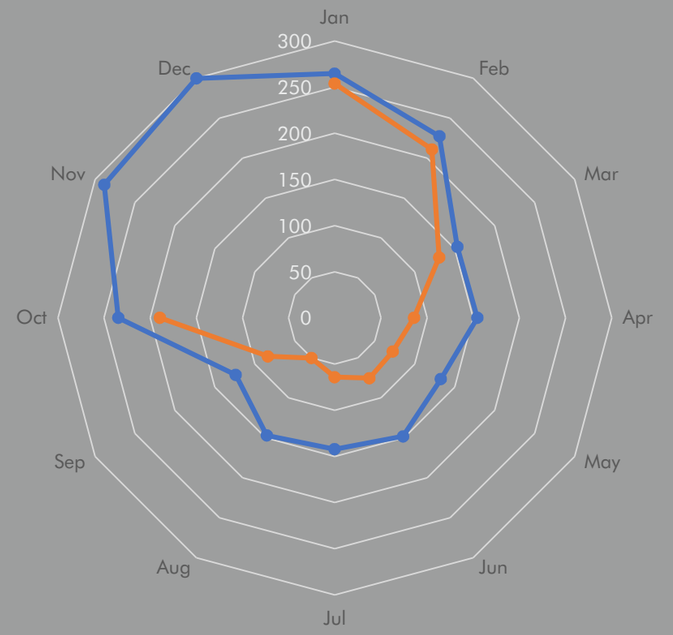
PM 2.5 (Fine Particulate)



PM 10 (Coarse Particulate)



AQI



Radar/spider diagrams help to see which variables - in this case PM 2.5 and PM 10 - are closely correlated among different datasets at different points in time - in this case years 2019 and 2020.

2019 2020

Location	PM 2.5 Avg	PM 2.5 Max	PM 2.5 Min	PM 10 Avg	PM 10 Max	PM 10 Min	AQI Avg	AQI Max	AQI Min	TREND Count*	TREND AQI >100	TREND AQI >100
Neb Sarai (Outdoor)	73.15	999.00	0.50	170.84	1096.00	0.50	167.45	1232.50	0.50	14635	9624	65.76%
Neb Sarai	79.93	999.00	2.00	144.73	1365.50	5.00	158.21	1569.38	5.00	13129	6783	51.66%
Neb Sarai	65.12	798.50	1.00	121.11	1306.00	7.00	136.94	1495.00	7.00	9089	4164	45.81%
Neb Sarai	79.27	985.50	2.00	162.54	1607.00	6.50	169.93	1871.25	7.50	14984	9074	60.56%

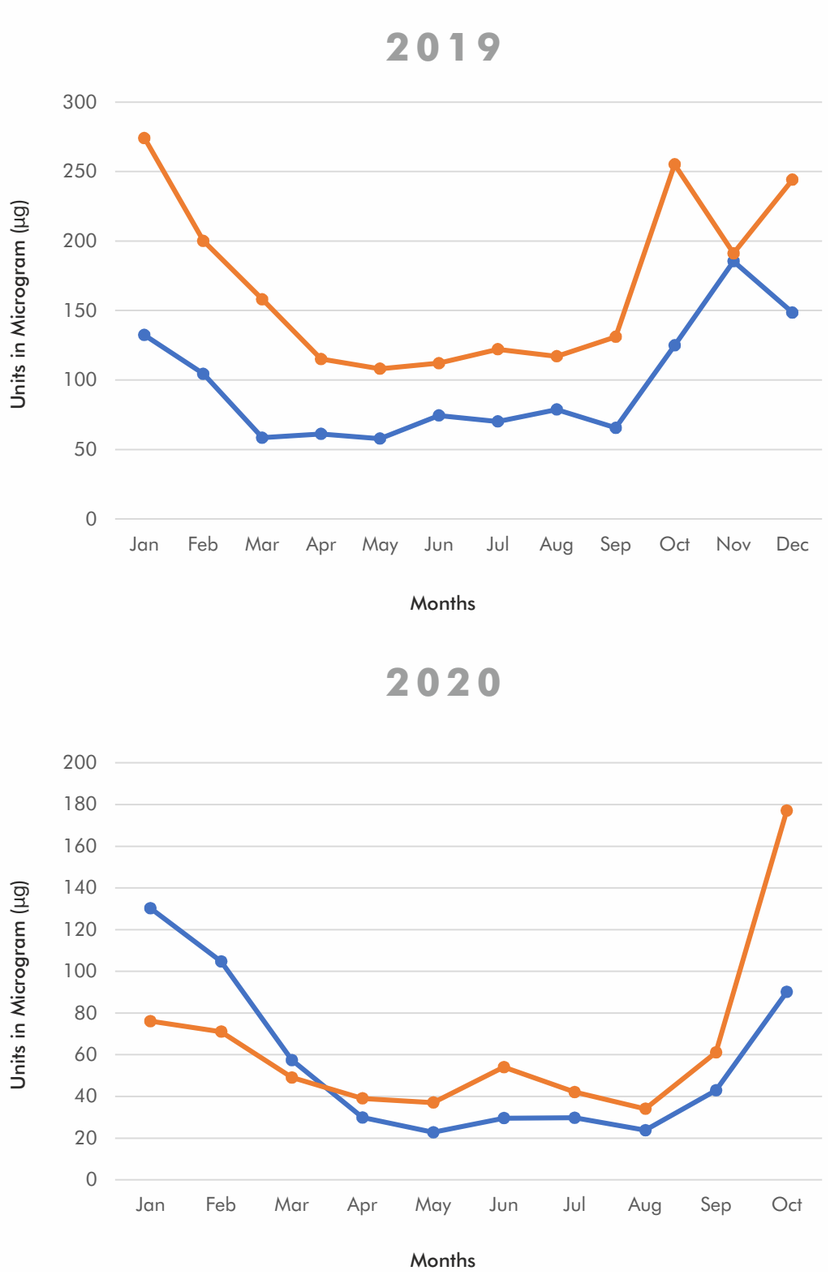
*No of Entries

NEW DELHI

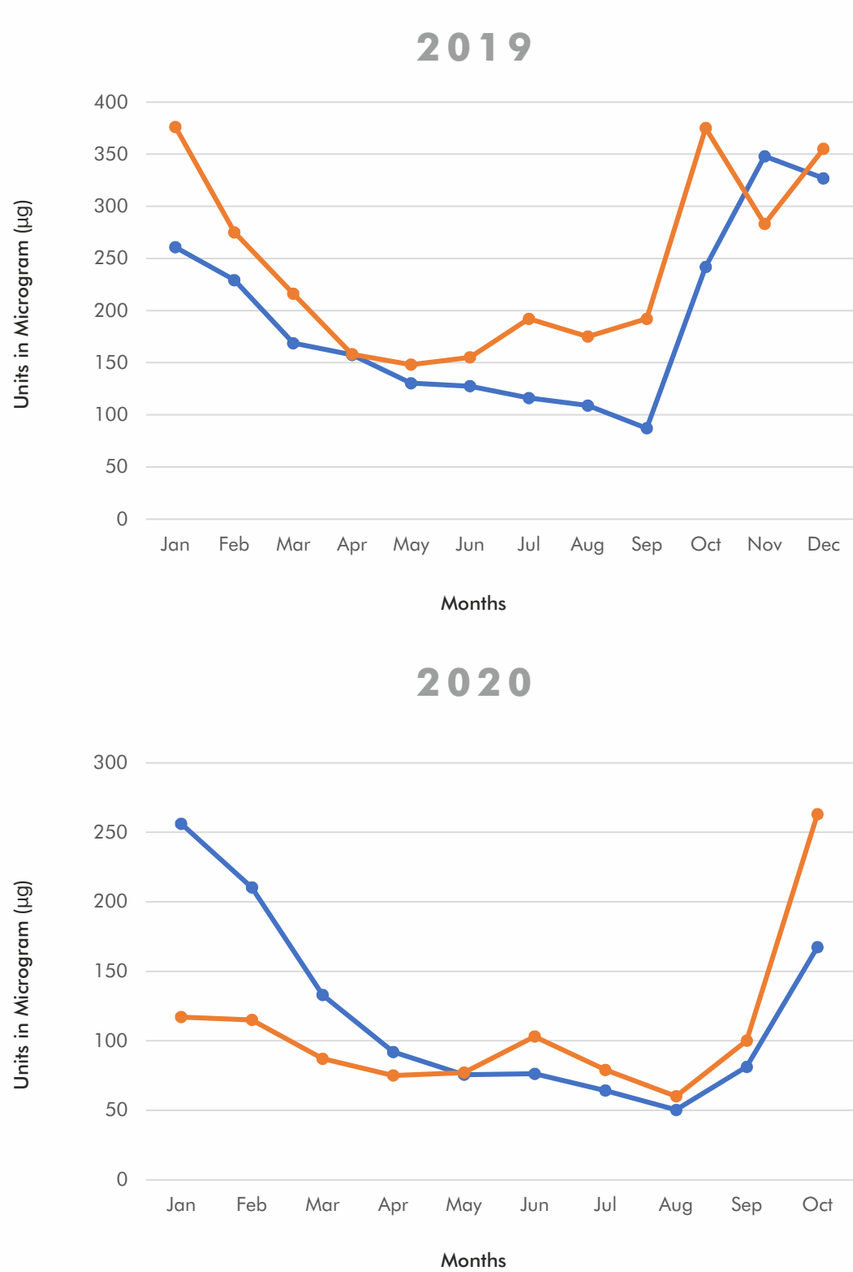
Comparison of

Emissions Recorded by Privately Installed AQI Monitors vs ECMWF Data Source

PM 2.5



PM 10



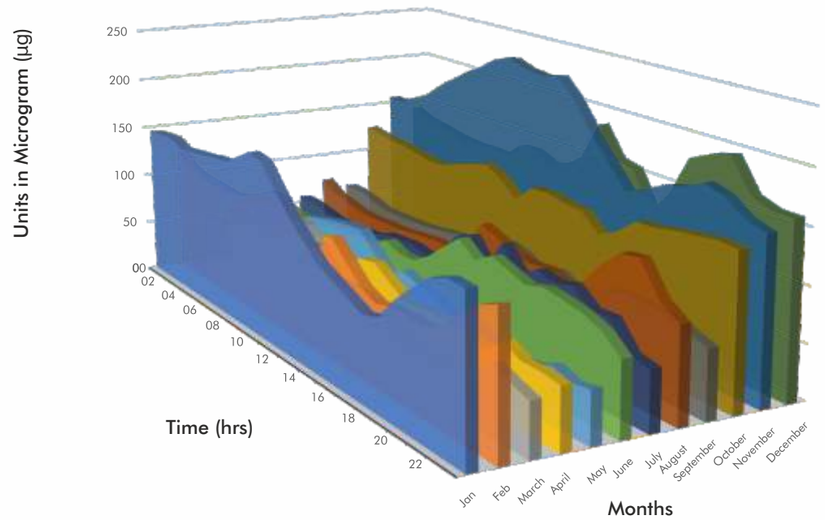
Privately Installed AQI Monitors ECMWF

NEW DELHI

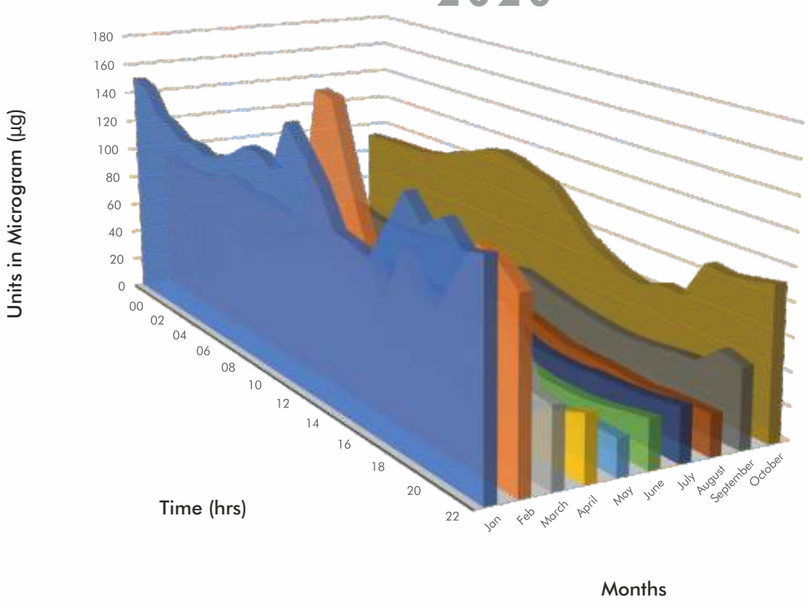
Monthly Average of Hourly
PM Concentration

PM 2.5

2019

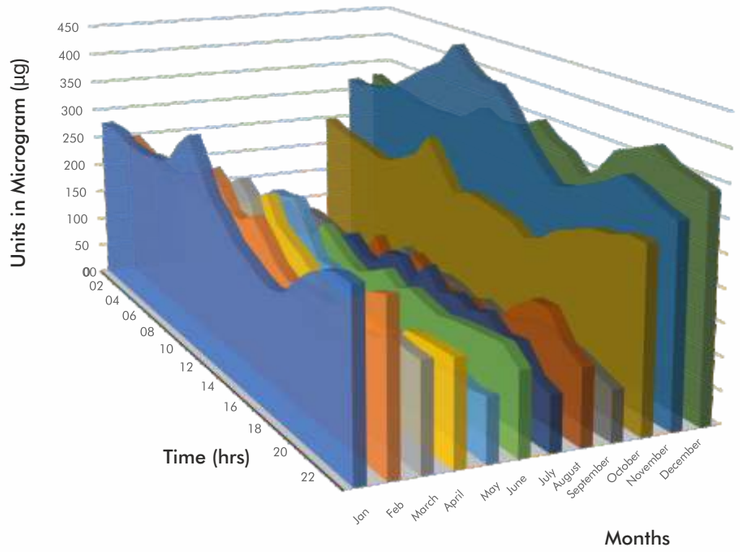


2020

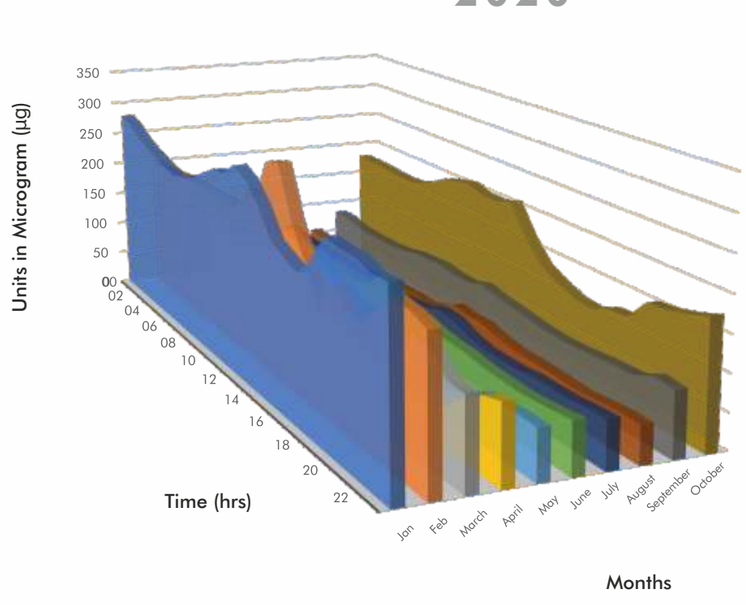


PM 10

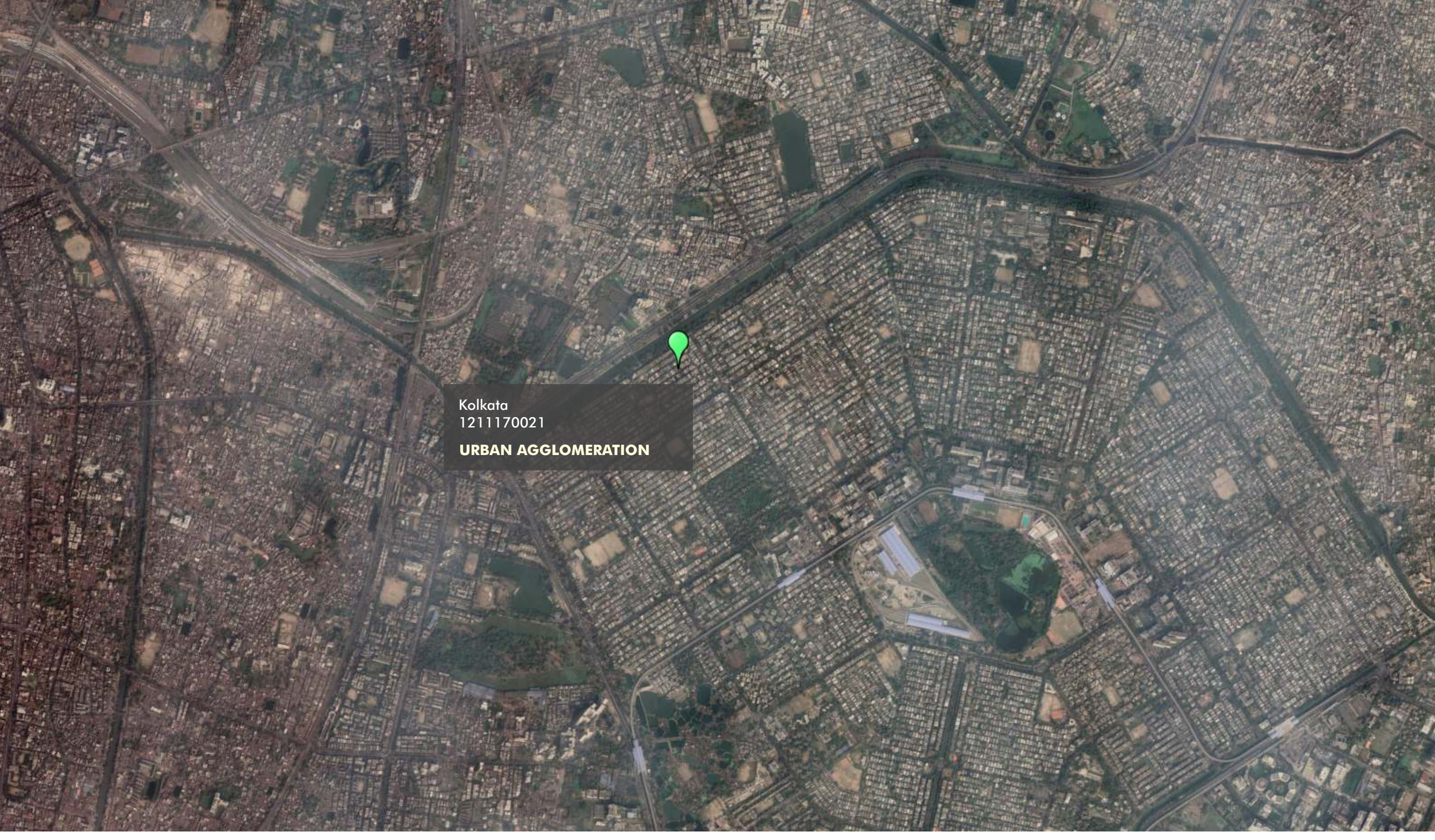
2019



2020



NEW DELHI

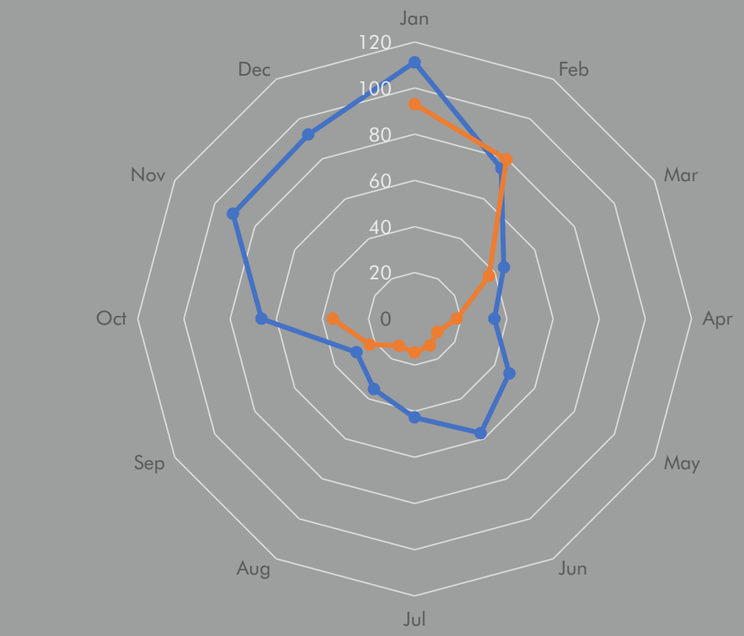


The location of privately installed air quality monitors as shown on Google Earth.

KOLKATA (WEST BENGAL)

2019 vs 2020

PM 2.5



PM 10

AQI

Radar/spider diagrams help to see which variables - in this case PM 2.5 and PM 10 - are closely correlated among different datasets at different points in time - in this case years 2019 and 2020.

2019 2020

Location	PM 2.5 Avg	PM 2.5 Max	PM 2.5 Min	PM 10 Avg	PM 10 Max	PM 10 Min	AQI Avg	AQI Max	AQI Min	TREND Count*	TREND AQI >100	TREND AQI >100
Kolkata	48.52	359.50	0.50	97.54	1999.00	4.00	105.79	2361.25	4.00	12093	4682	38.72%

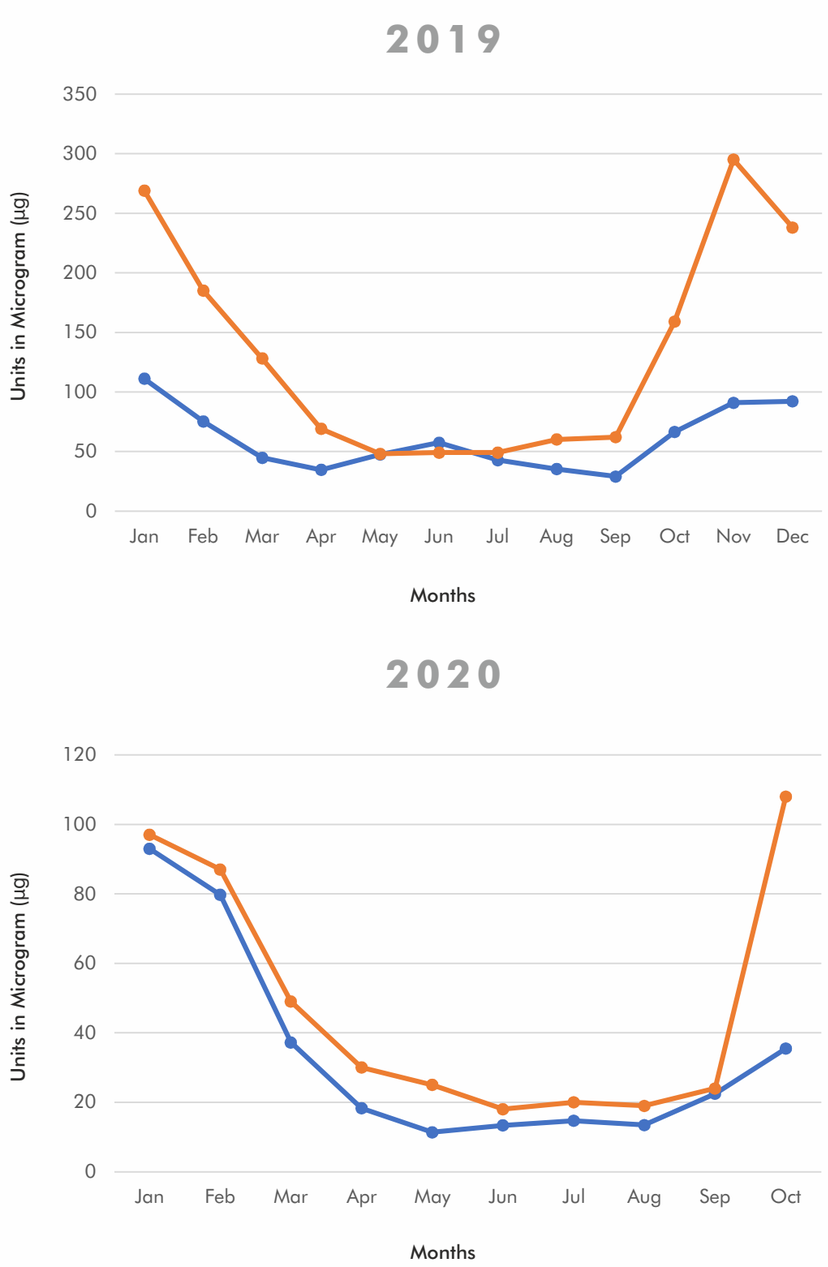
*No of Entries

KOLKATA

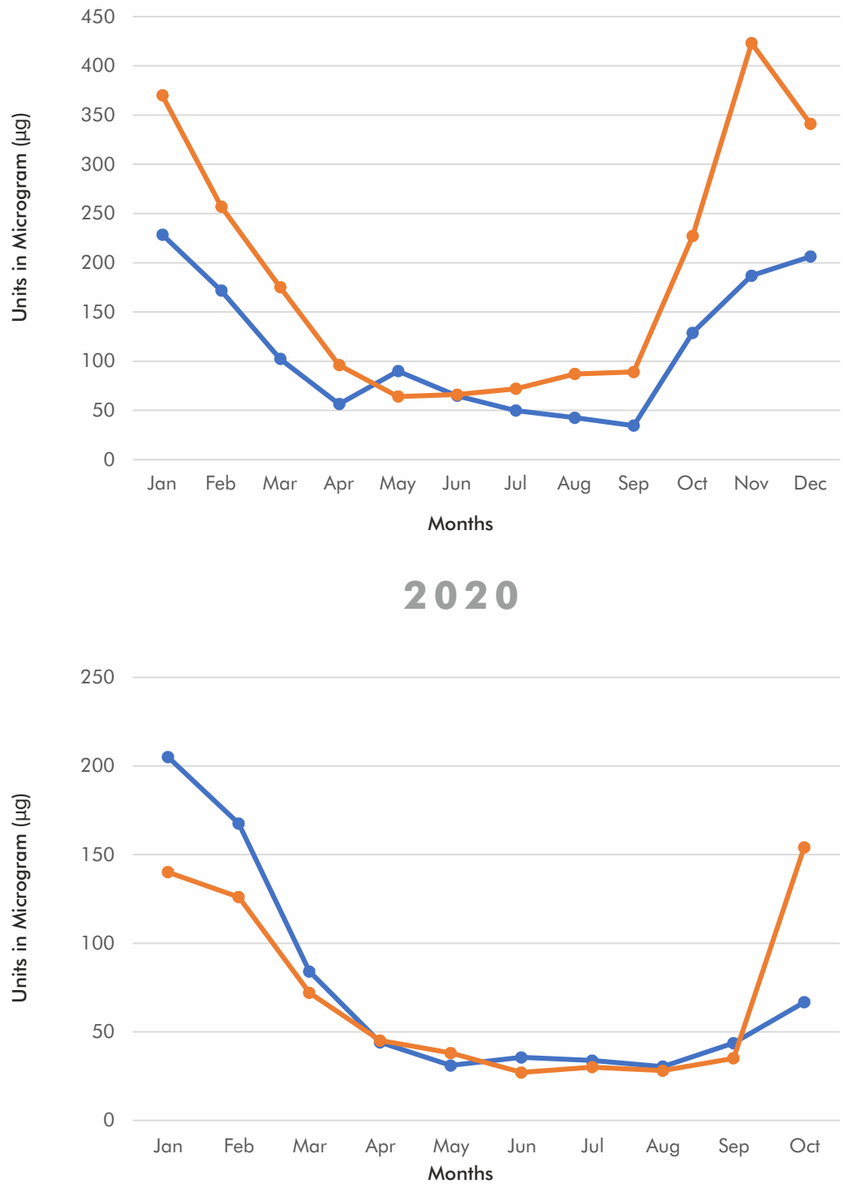
Comparison of

Emissions Recorded by Privately Installed AQI Monitors vs ECMWF Data Source

PM 2.5



PM 10



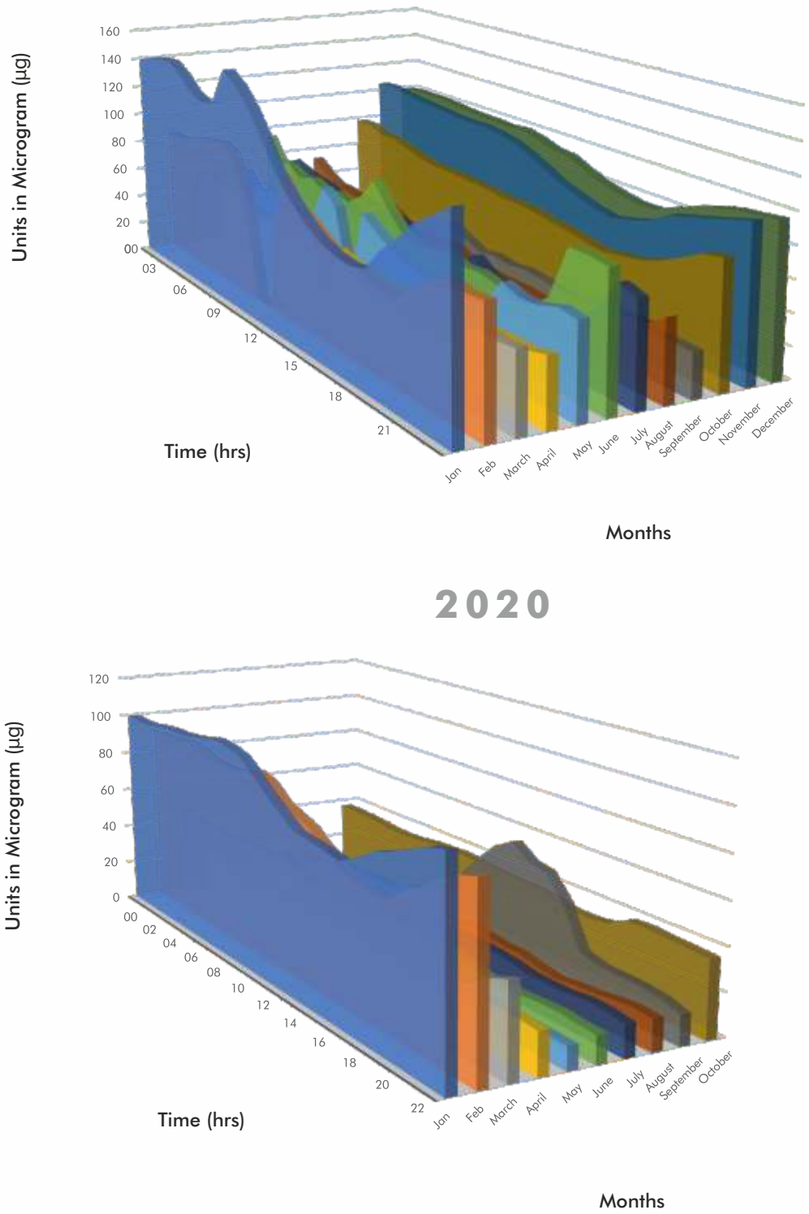
Privately Installed AQI Monitors ECMWF

KOLKATA

Monthly Average of Hourly
PM Concentration

PM 2.5

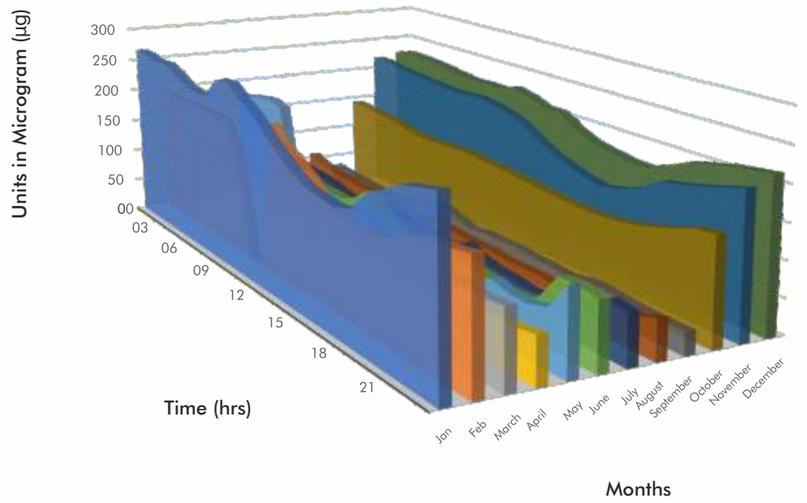
2019



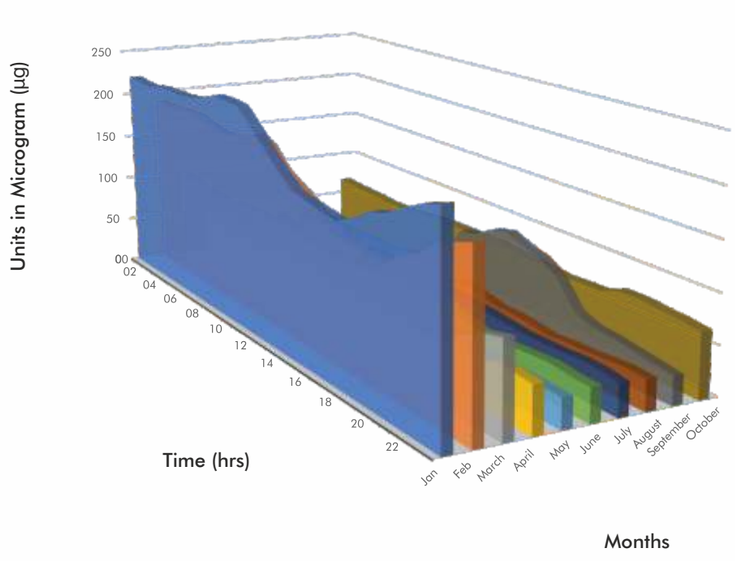
2020

PM 10

2019



2020



KOLKATA

CONCLUSION & RECOMMENDATIONS

This mapping clearly shows that there is definitely a strong link between pollution from coal fired power plants and coal mining areas to poor air quality levels. While, this is not something that is new, efforts to address this issue is not adequate and timely.

One way to address the issue of reducing the pollution of coal fired power plants is to have all of those power plants install, Flue Gas-De-sulphurisation (FGD) units.

As on 30th November 2020, only 1320 MW (0.07% of installed capacity) of power plants had FGD Installed.

FGD Commissioned as of November 2020

Further, it appears that the Concentration of PM 10 pollutants in much higher than the concentration of PM 2.5 at almost every site/city.

The air quality levels in 2020, particularly in the period of March 2020 to June 2020 was relatively much better than the corresponding months of 2019. This is largely attributed to the lock down period in India due to COVID-19. The lock down in India, also resulted in a fairly large fall in electricity demand for the period of March to June 2020. The electricity demand fell by roughly 25% in those months, as compared to the electricity demand for the same period in 2019.

The fall in electricity demand resulted in power plants operating at very low plant load factor and hence reduced generation. This has resulted in low pollution levels from the coal fired power plants in the period of the lock down.

It should be noted that coal fired power plants and coal operations are not the only contributors to poor air quality, but, do play a significant role in contributing to the poor air quality. While, despite the fact, that India has a very ambitious renewable energy capacity addition, coal is likely to remain an important, if not a dominant fuel for electricity generation for some time to come. In view of this, it is important, the coal fired power plants are made to follow stringent environmental norms, with FGD installations being fast tracked.

Further, continuous emission monitoring system for all coal fired power plants amongst other industrial operations should also be mandated and made available in public domain. In addition to this, and in order to ensure reliable assessment of pollutants and suspended particulate matters, most accurate air quality monitors needs to be installed in large numbers across the length and breadth of India.

Further, this mapping also reiterates the need for scaling up the process of energy transition in India, primarily, a further push towards shifting from fossil fuel-based energy systems to a renewable energy-based energy systems.

The mapping exercise is primarily aimed at Energy and Clean Air Sector Policy Makers at the National and State Levels, Energy sector investors and bankers, Power Producers, Think Tanks and Environment NGOs, State Climate Change Departments, State Energy Department, Electricity Distribution Utilities, Environmentalists, city planners amongst others.

Data source (satellite data and forecast analytics) used in this study (Pre and Post Covid-19 outbreak scenario)

Pollutants	Data Source	Spatial resolution/ processing scale	Display value & Unit
NO_2 Nitrogen dioxide enters the atmosphere as a result of anthropogenic activities such as fossil fuel combustion and biomass burning, as well as natural processes including microbiological processes in soils, wildfires and lightning.	Sentinel 5P satellite, Sensor: Tropomi Band: tropospheric_NO2_column_number_density	0.01 arc degrees, L3	Mol/m^2
SO_2 SO_2 enters Earth's atmosphere through both natural and anthropogenic processes, though the majority is of anthropogenic origin. SO_2emissions adversely affect human health and air quality and also have an effect on climate through radiative forcing.	Sentinel 5P satellite, Sensor: Tropomi Band: SO2_column_number_density	0.01 arc degrees, L3	Mol/m^2
PM 2.5 & **PM 10** "PM" refers to particulate matter—particles in the air. Those particles are things like organic dust, airborne bacteria, construction dust, and coal particles from power plants. Particles in the PM2.5 and PM10 size range are commonly present in air and may be drawn into the body with every breath. In the lungs particles can have a direct physical effect and/or be absorbed into the blood.	ECMWF-CAMS real time forecast	0.125 arc degrees	$Microgram/m^3$

Sentinel 5P satellite (for NO_2 and SO_2 charts)

- The Copernicus Program is an ambitious initiative headed by the European Commission in partnership with the European Space Agency (ESA). The Sentinels satellite series developed by ESA to operationalize the Copernicus program, include air quality data from Sentinel-5P.
- The Sentinel-5 Precursor mission instrument collects data useful for assessing air quality. The TROPOMI instrument is a multispectral sensor that records reflectance of wavelengths important for measuring atmospheric concentrations of ozone, methane, formaldehyde, aerosol, carbon monoxide, nitrogen oxide, and sulphur dioxide, as well as cloud characteristics at a spatial resolution of 0.01 arc degrees.

ECMWF CAMS real time model forecast (for PM 2.5 and PM10)

- The Copernicus Atmosphere Monitoring Service (CAMS) of European Centre for Medium-Range Weather Forecasts provides the capacity to continuously monitor the composition of the Earth's atmosphere at global and regional scales. Prediction of PM 2.5 and PM 10 is a part of Global forecasts of aerosol service under the theme of Air quality and atmospheric composition.
- This service provides daily global forecasts of aerosol mass mixing ratios up to five days in advance

Details of Privately Installed Air Quality monitors

S. No	City	Place	Lat	Long	Sheet nos.	AQI monitor identification	Description of location
1	Korba	Dipka mines gandhi nagar sirki	22.3478	82.5147	5	1212170015	Coal mine
2	Korba	PALI (Kusmunda mines)	22.3168	82.6843	7	1211170149	Mine and coal power plant
3	Korba	Kharmora (Korba)	22.3522	82.7414	11	1201180184	Coal mine
4	Korba	R P Nagar (Korba)	22.3589	82.7276	12	1201180141	Industrial area
5	Korba	Ravi Shankar Nagar	22.3498	82.7272	13	1201180122	Commercial and industrial
6	Korba	Balco (Shanti Nagar)	22.4008	82.7516	14	1201180096	Coal mine
7	Korba	Gevra mines Sarai singar	22.3080	82.5551	20	1201180067	Coal mine
8	Korba	Transport Nagar (Korba)	22.3605	82.7059	27	1201180030	Commercial and industrial
9	Korba	Darri (NTPC - HTTP)	22.4046	82.6916	29	1201180019	Industrial area and Aluminium plant
10	Jharsuguda	Pandaloi	21.6958	84.0401	9	1201180004	Coal mines and industries
11	Jharsuguda	Malda	21.7852	83.9699	25	1201180058	Coal mines and industries
12	Jharsuguda	Bomalai	21.7263	84.0154	28	1201180069	Coal mines and industries
13	Rourkela	Roourkela	22.2221	84.8541	2	1212170018	Coal mines and steel plant
14	Raigarh	Sarasmal	22.1338	83.5041	8	1201180094	Industries
15	Asansol	Bogra Colony	23.6642	87.0658	16	1201180091	Coal mines and industries
16	Kolkata	Kolkata	22.5955	88.4031	24	1211170021	Urban agglomeration
17	Delhi	Neb Sarai (Outdoor)	28.5093	77.2017	3	1212170167	Urban agglomeration
18	Delhi	Neb Sarai	28.5093	77.2018	22	1201180034	Urban agglomeration
19	Delhi	Neb Sarai	28.5093	77.2018	23	1211170143	Urban agglomeration
20	Delhi	Neb Sarai	28.5093	77.2018	6	1201180043	Urban agglomeration

HEINRICH BÖLL STIFTUNG
INDIA

The Heinrich Böll Stiftung is a German foundation and part of the Green movement that has developed worldwide as a response to the traditional politics of socialism, liberalism, and conservatism. We are a green think-tank and an international policy network, our main tenets are ecology and sustainability, democracy and human rights, self-determination and justice. We place particular emphasis on gender democracy, meaning social emancipation and equal rights for women and men. We are also committed to equal rights for cultural and ethnic minorities. Finally, we promote non-violence and proactive peace policies. To achieve our goals, we seek strategic partnerships with others who share our values.

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For more information visit: www.in.boell.org

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New Delhi 110016, India

VASUDHA FOUNDATION
Green ways for a good earth!

Vasudha Foundation is a not for profit organization set up in April 2010 with the belief in the conservation of Vasudha, which in Sanskrit means the Earth, the giver of wealth and with the objective of promoting sustainable consumption of its bounties.

The core mission is to promote environment -friendly, socially just and sustainable models of energy by focusing on renewable energy and energy efficient technologies and lifestyle solutions. The organization focuses to bring about reduction in greenhouse gas emissions in the environment and ensure energy efficiency, energy security, energy independence, and sustainable development and simultaneously, promoting the concept of "Low Carbon Solutions" and "Green Economies". To know more about the Foundation visit, www.vasudha-foundation.org

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