AEROSOL PHYSICAL-CHEMICAL PROPERTIES AND ITS ASSOCIATION WITH CLOUD CONDENSATION NUCLEI ACTIVATION OVER A TROPICAL COASTAL LOCATION

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Abstract

To examine the impact of aerosol size and composition on CCN activity , simultaneous measurement of cloud condensation nuclei (CCN) number, particle number size distributions , and non-refractory submicron aerosol chemical composition were carried out from a tropical coastal location, Thumba, India. The land-sea breeze circulation, boundary layer evolution and photochemical processes significantly influence the diurnal variation of aerosol chemical composition. The diurnal variation of all species except sulfate depicted a daytime –low and nighttime high. The decrease in the organics/sulfate ratio during the daytime has significant implication on the CCN concentration and its activation properties. The diurnal variation of CCN concentrations and activation ratio are distinctly different. The change in the mode diameter of the number size distribution between sea-land breeze was found to be less (~8 nm) compared to the large variation in chemical composition. This suggested the importance of mesoscale variations of aerosols, especially the contrasting diurnal variation of organics and sulfate aerosols in CCN activation.

INTRODUCTION

- ➢One of the largest uncertainties in the present understanding of climate change is the inability to accurately represent aerosol-cloud interactions and associated feedback processes.
- ➢The primary parameter required for this is cloud condensation nuclei (CCN) and its spectral variation.
- ➢The relative importance of aerosol chemical composition and mixing state, especially organics on CCN activation is still under debate.
- ➢Here we present the results from long-term observations of aerosol physical and chemical properties and CCN activation from a tropical coastal location which experiences contrasting air mass within a day.

EXPERIMENT AND DATA

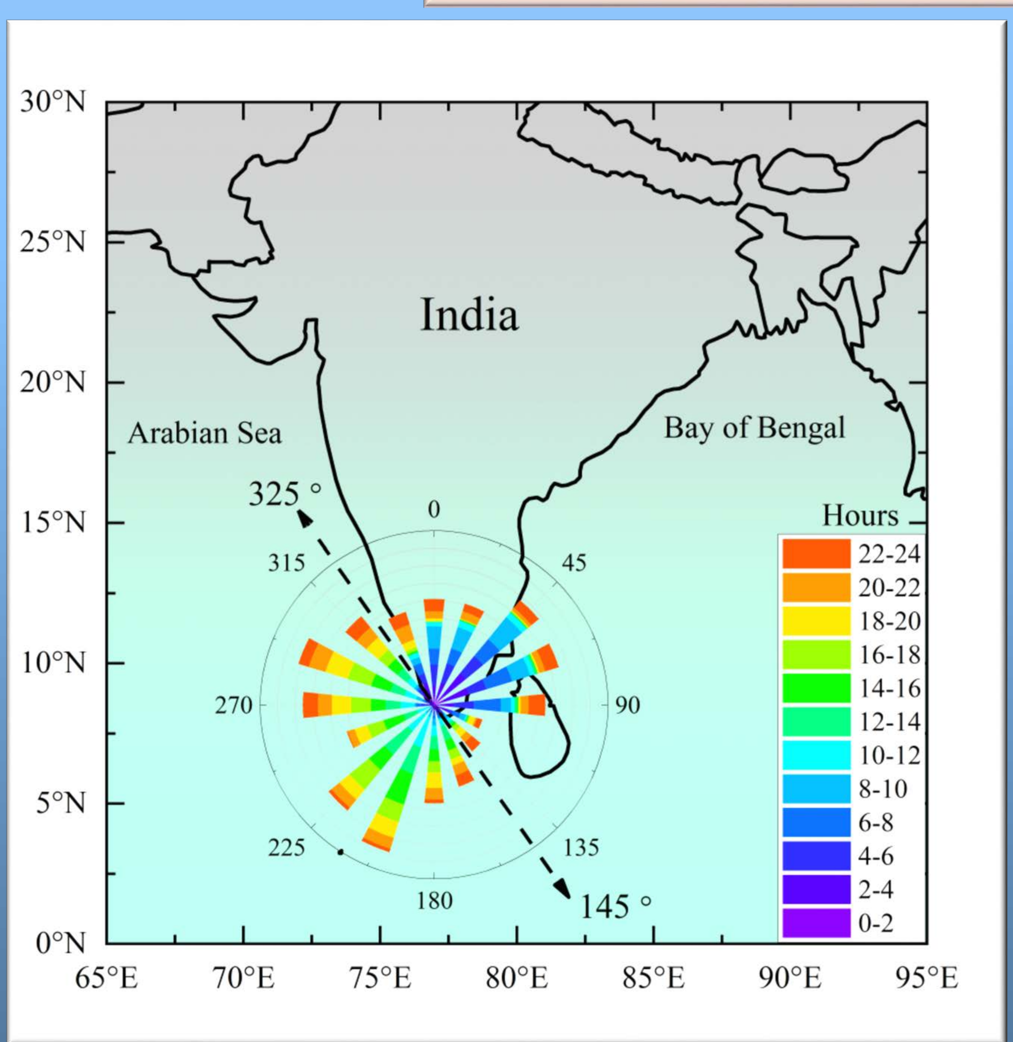


Figure 1: Study location (Thumba). The wind direction at local hours is shown, along with the direction of the local coastline.

Location: Thumba (8.5 °N, 77 °E , 5 masl) is a tropical coastal location in the southern peninsular India. Aerosol observatory is located on the south of the west coast of India, 500m due east of Arabian sea and almost 10km away from city centre.

Instrumentation: Aerosol Chemical Speciation Monitor, Cloud Condensation Nuclei Counter and Scanning Mobility Particle Sizer
Data period: Winter (2017-20).
Meteorological conditions : Mean ambient temperature and relative humidity (RH) ~27±2.8 °C and ~ 80 ± 13 %.
Synoptic scale winds are mostly north-easterly, with a strong mesoscale sea-land breeze circulation embedded in it.
Relatively calm winds (~0.4 ± 0.5 m s^{-1}) and clear sky conditions prevailed.

RESULTS AND DISCUSSION

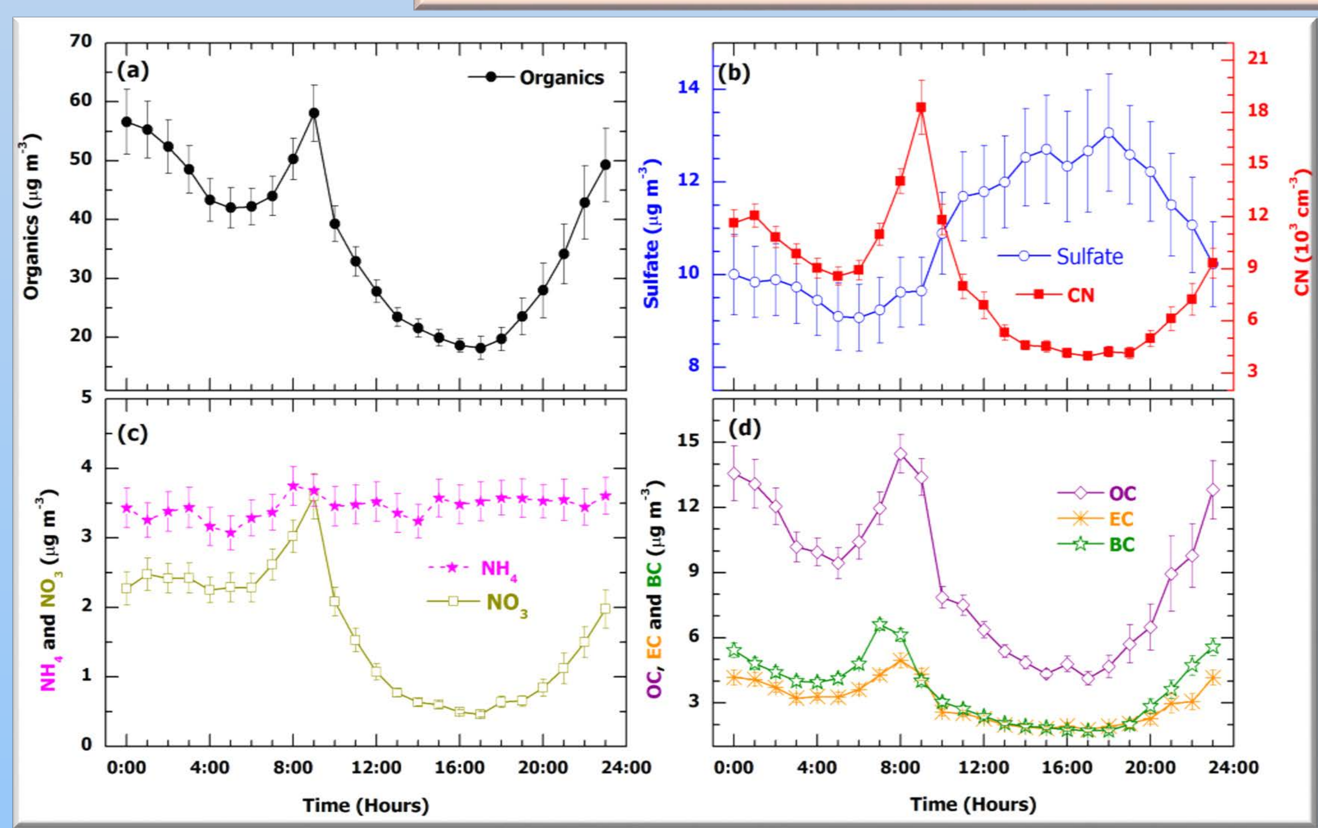


Figure 2: (top-left) Diurnal variation of mass concentrations and total number concentrations

Figure 3: (right) Diurnal variation of CCN number concentration and activation ratio

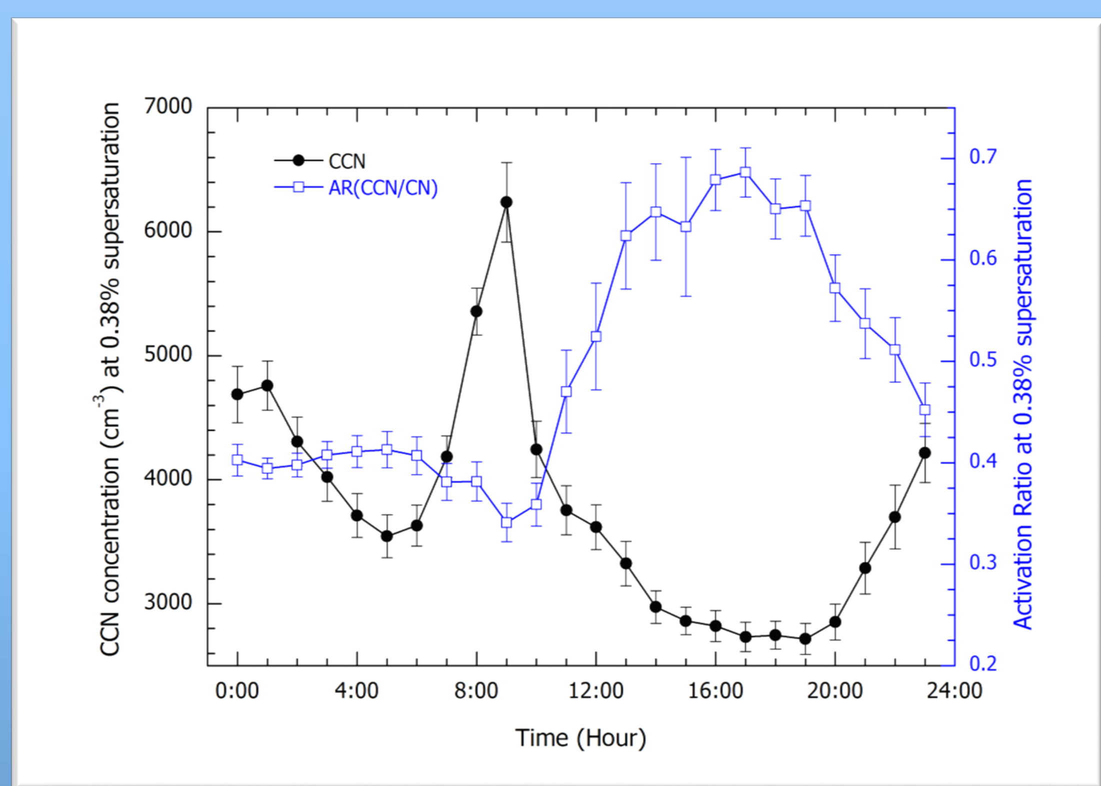
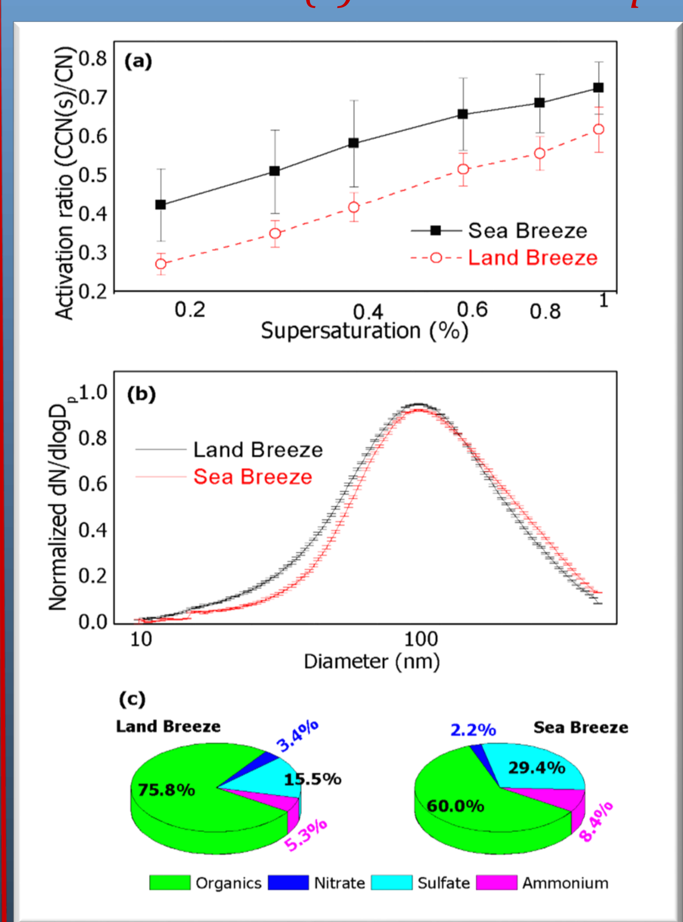


Figure 4: (below-left) Mean (a) CCN activation spectra (b) normalized number size distribution (c) chemical composition separated for sea-land breeze



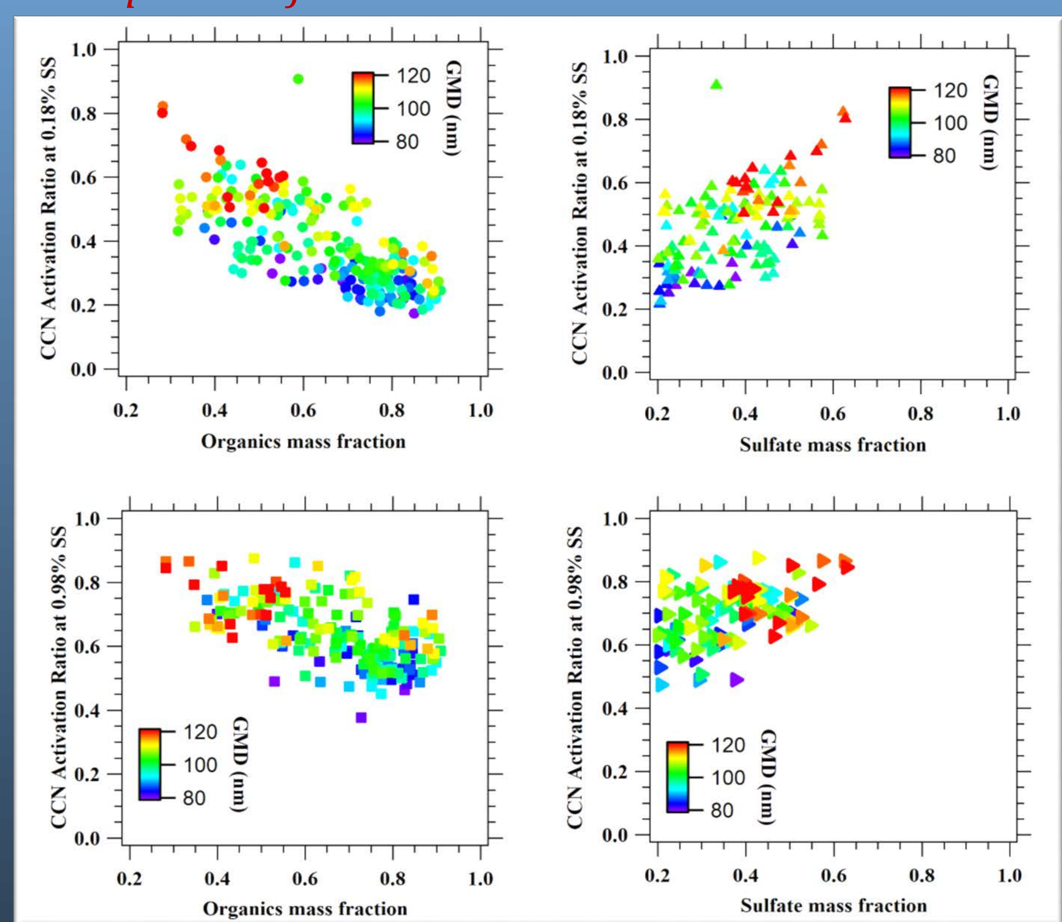


Figure 5. (top right) CCN activation ratio (at 0.38% and 0.98% supersaturation) v/s mass fraction of organics and sulfate, separated for sea-land breeze.

Major Findings

- ➢**Sulfate showed a contrasting diurnal pattern (daytime-high & nighttime-low) due to photochemical, heterogeneous aqueous- phase production.**
- ➢**Contrasting chemical composition and CCN activation spectra were observed between sea-land breeze regimes.**
- ➢**Mesoscale variation of aerosol chemical composition influenced the CCN activation.**
- ➢**Presence of sulfate enhanced CCN activation, whereas organics showed an opposite effect.**

Understanding the variation of particulate matter over Ahmedabad city

Author

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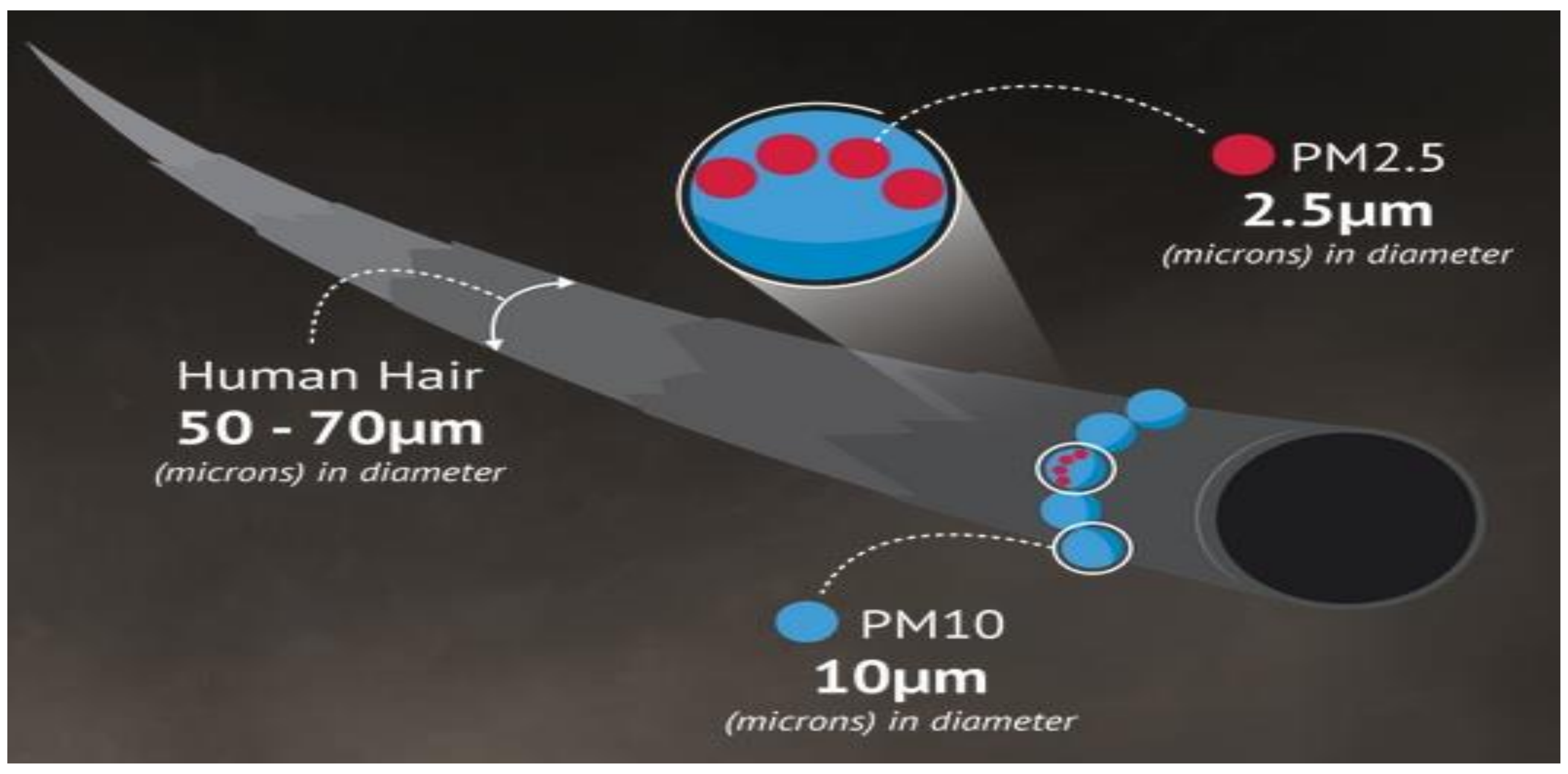
Introduction

Particulate matter is a mixture of solid particles and liquid droplets found in the air. There are 3 Types of Particulate Matter.[1] PM10, [2] PM2.5, and [3] PM0.1 Among of them this poster contains PM2.5 study. Dust, spores and pollen are some examples of PM2.5.



Methodology

The data used in this study is collected from Central Pollution Control Board (CPCB).Excel is used to performing monthly and yearly averages of the PM2.5 database.

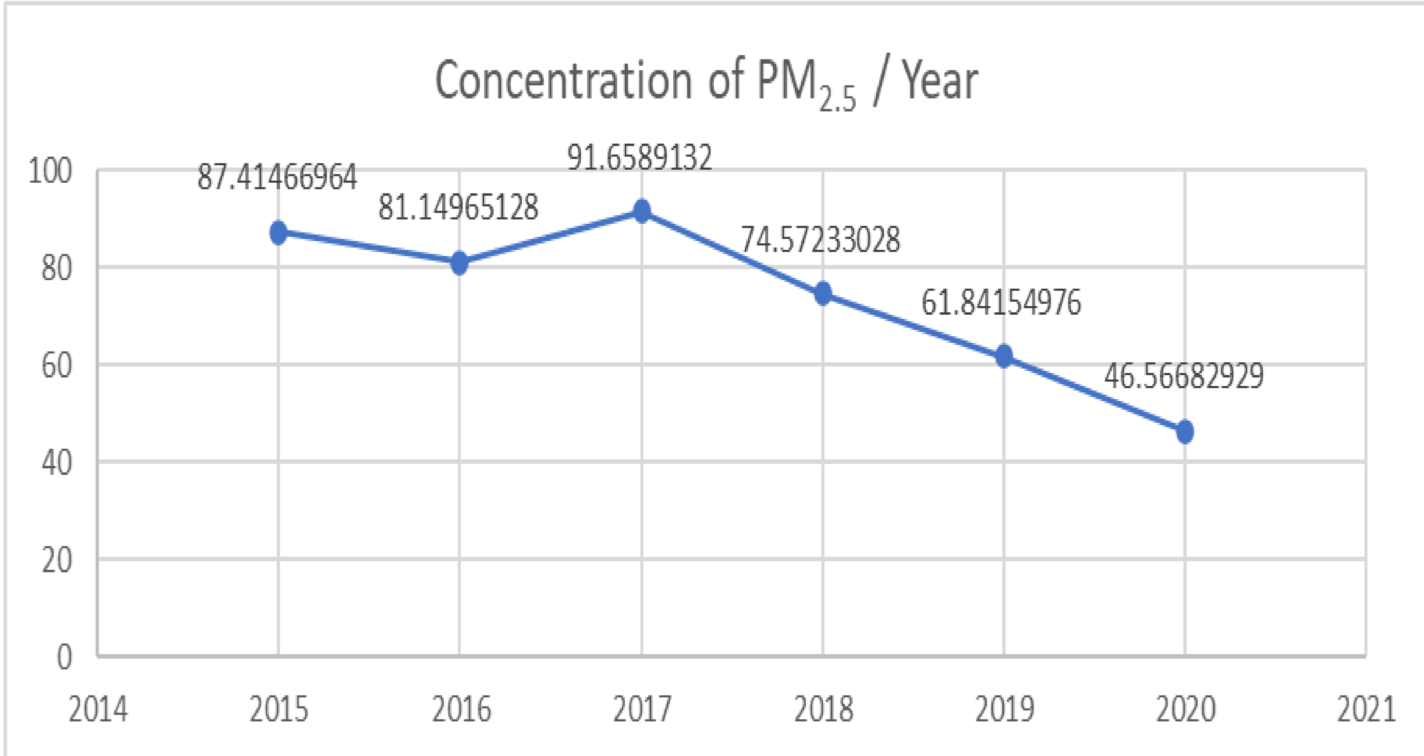
Objective

The poster is based on the observation of the concentration of PM2.5 in Ahmedabad (urban Industrial region) from 2015 to 2020.

Conclusion

In 2017 the concentration of PM2.5 is on its peak and in 2020 the concentration of PM2.5 is on its lowest. In most of the years the concentration of PM2.5 between June to September was at its lowest point due to monsoon. While during post monsoon the concentration of PM2.5 was at its peak in November due to Festivals time.

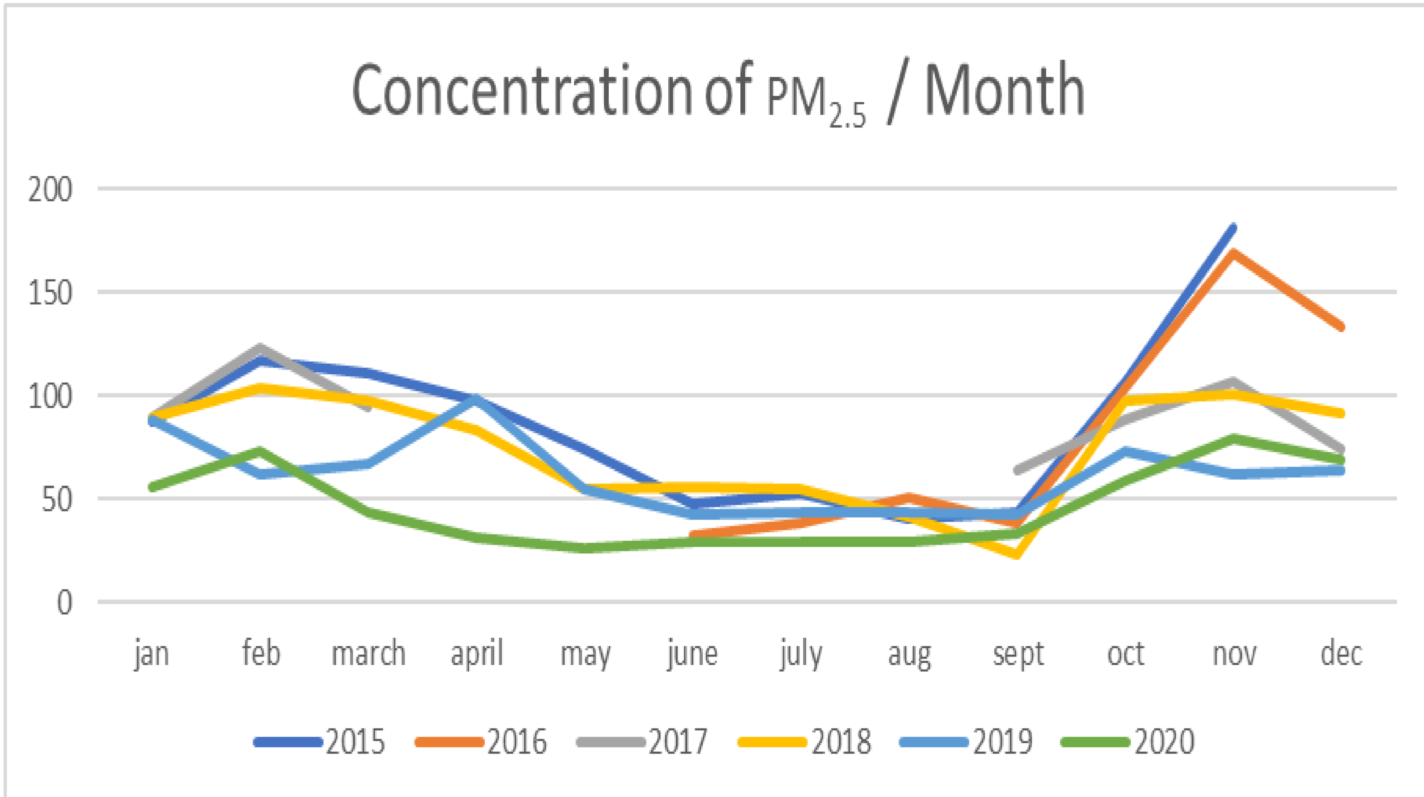
Result



Yearly Average

Max Concentration :91.6589132 µg/m³

Min Concentration :46.56682929 µg/m³ for



Monthly Average

Max Concentration :181.3882085 µg/m³

Min Concentration : 26.18758264 µg/m³ for

Acknowledgement

The author are thankful to CPCB for providing necessary data through their online portal.We are also thankful to Scientists of ISRO for providing necessary guidance.

IMPACT OF PM_{10} AND $PM_{2.5}$ ON AIR QUALITY DURING DIWALI FESTIVAL AT AGRA

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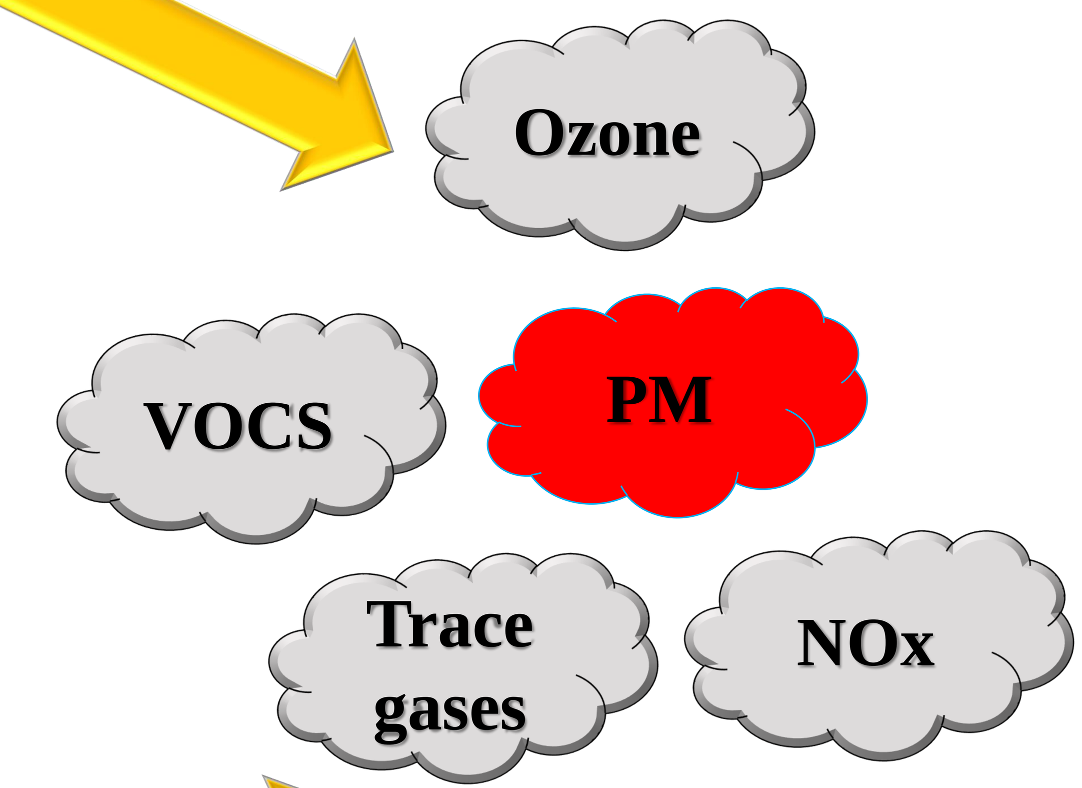


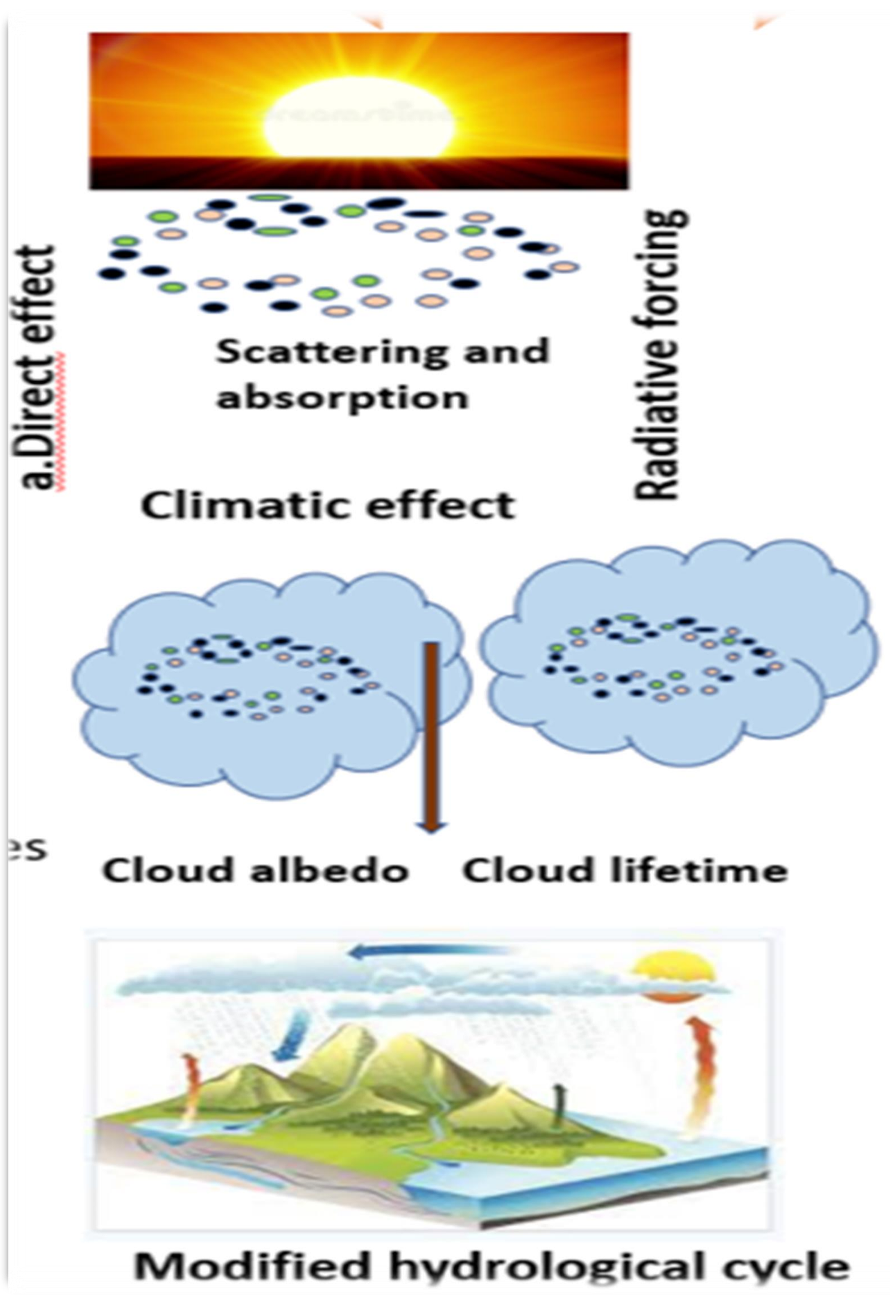
INTRODUCTION

Particulate matter are-

- ✓Solid and liquid particles
- ✓Variation in size, composition and origin
- ✓Organic and Inorganic particles
- ✓Dust, pollen, soot, smoke, and liquid droplets
- ✓Cause detrimental health effects
- ✓Environmental threat to atmosphere

The festival of Diwali is a great contributor of pollution due to firecracker, At this festival, people all over especially in India burst loads of firecrackers to celebrate it. s. At this festival, people all over especially in India burst loads of firecrackers to celebrate it.

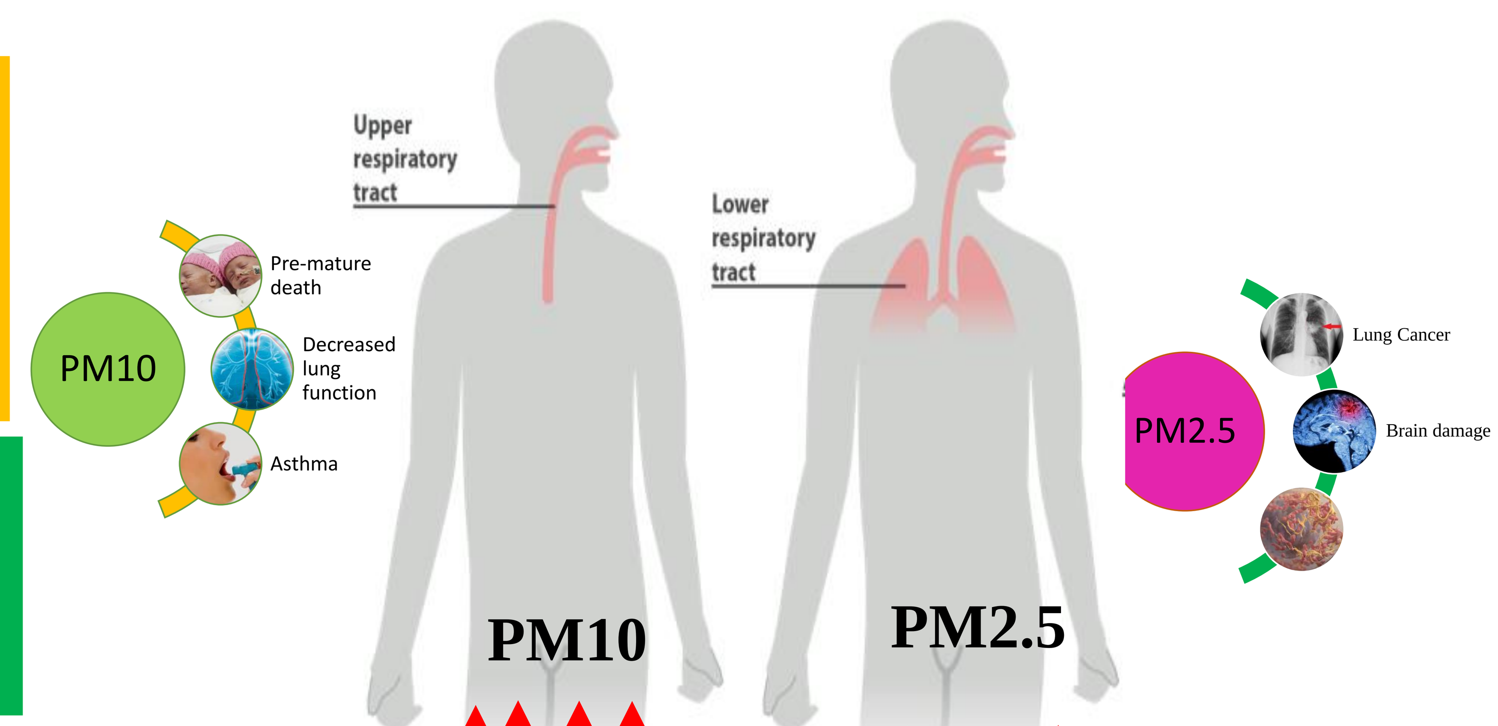
CHEMICALS THAT LITTER ENVIRONMENT FROM FIREWORKS



PM2.5
- Particles can penetrate the respiratory and cardiovascular system and cause health issues.

PM10
- particles are easily inhaled, they will reach your lungs and cause health issues.

IMPACT ON HUMAN HEALTH



PARTICLE SIZE
- Pollen
- Desert Dust

- Bacterial
- Fungal Spores
- Toner Dust

CONCLUSION

During Pre-Diwali, Diwali and Post Diwali 238.32, 380.24 and 170.28 $\mu g/m^3$ respectively. The concentration of $PM_{2.5}$ during Pre-Diwali, Diwali and Post Diwali 150.33,180.62 and 110.28 $\mu g/m^3$. Air Quality Index (AQI) index was very unhealthy on Diwali days comparative to pre-Diwali days due to increase in concentration of particulate matter as outcome of fireworks.

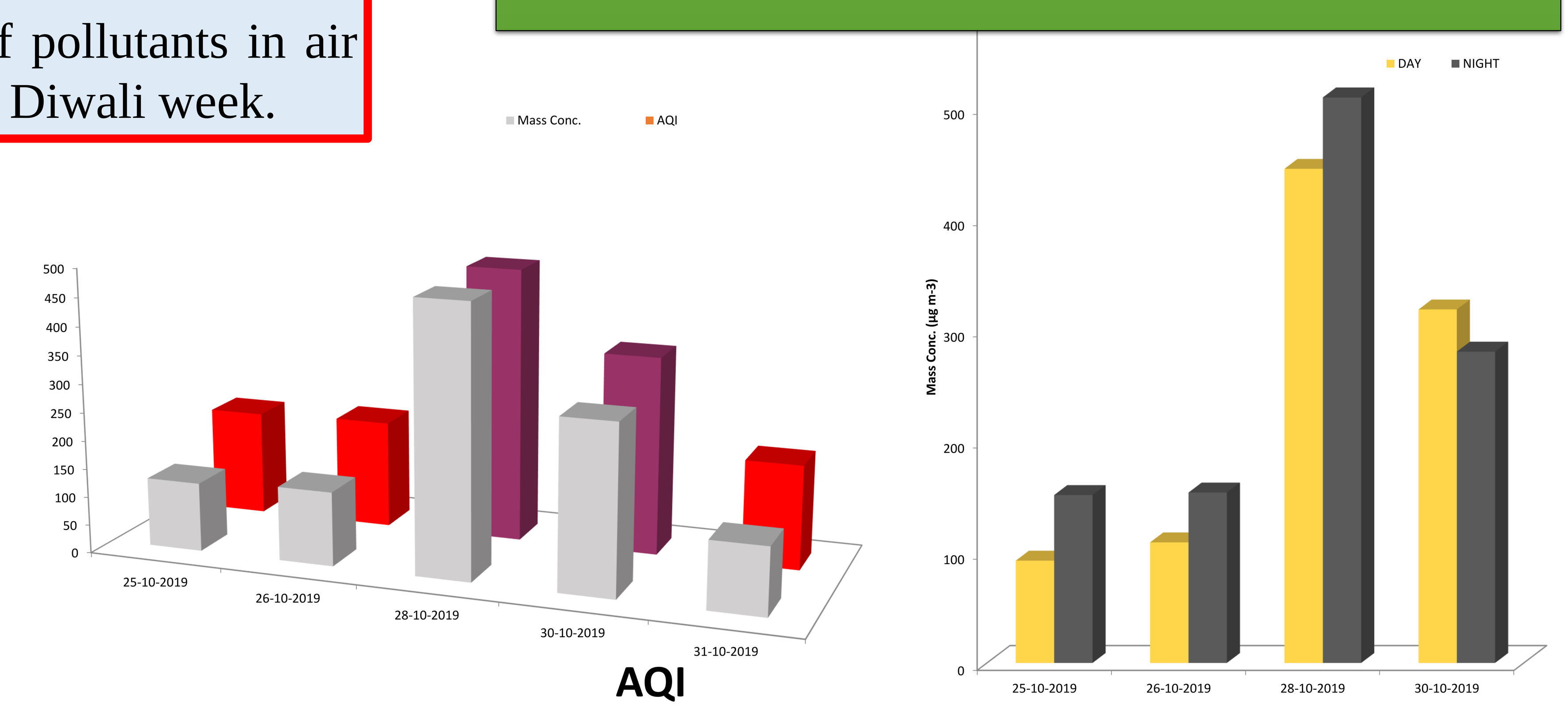
Results and Discussions

Date	Pressure (in mm Hg)	RH (%)	WD (in degree)	WS (in m/s)	SR (in W/m2)	Rainfall
24-10-2019 (Pre-Diwali)	746.59	47.16	142.3	0.99	190.8	0.0
25-10-2019 (Pre-Diwali)	746.57	51.92	232.11	1.16	191.23	0.0
26-10-2019 (Pre-Diwali)	746.5	56.69	216.1	0.94	183.41	0.0
27-10-2019 (Diwali Day 1)	746.43	51.36	136.68	1.16	182.34	0.0
28-10-2019 (Diwali Day 2)	746.38	51.65	148.28	0.59	140.15	0.0
29-10-2019 (Post-Diwali)	746.34	54.82	227.17	0.64	122.07	0.0
30-10-2019 (Post-Diwali)	746.28	59.1	214.45	0.45	98.25	0.0
31-10-2019 (Post-Diwali)	746.11	60.59	213.76	0.88	149.93	0.0

Climate Data During Diwali

Meteorological Parameters, Wind Speed and Solar radiation were decreased thoroughly because of maximum load of pollutants in air during Diwali week.

$PM_{2.5}$ mass concentration and AQI



COMPARATIVE STUDY OF $PM_{2.5}$ DIMINUTION AND HAZE EVENTS OVER DELHI AND AGRA DURING THE COVID-19 LOCKDOWN PERIOD

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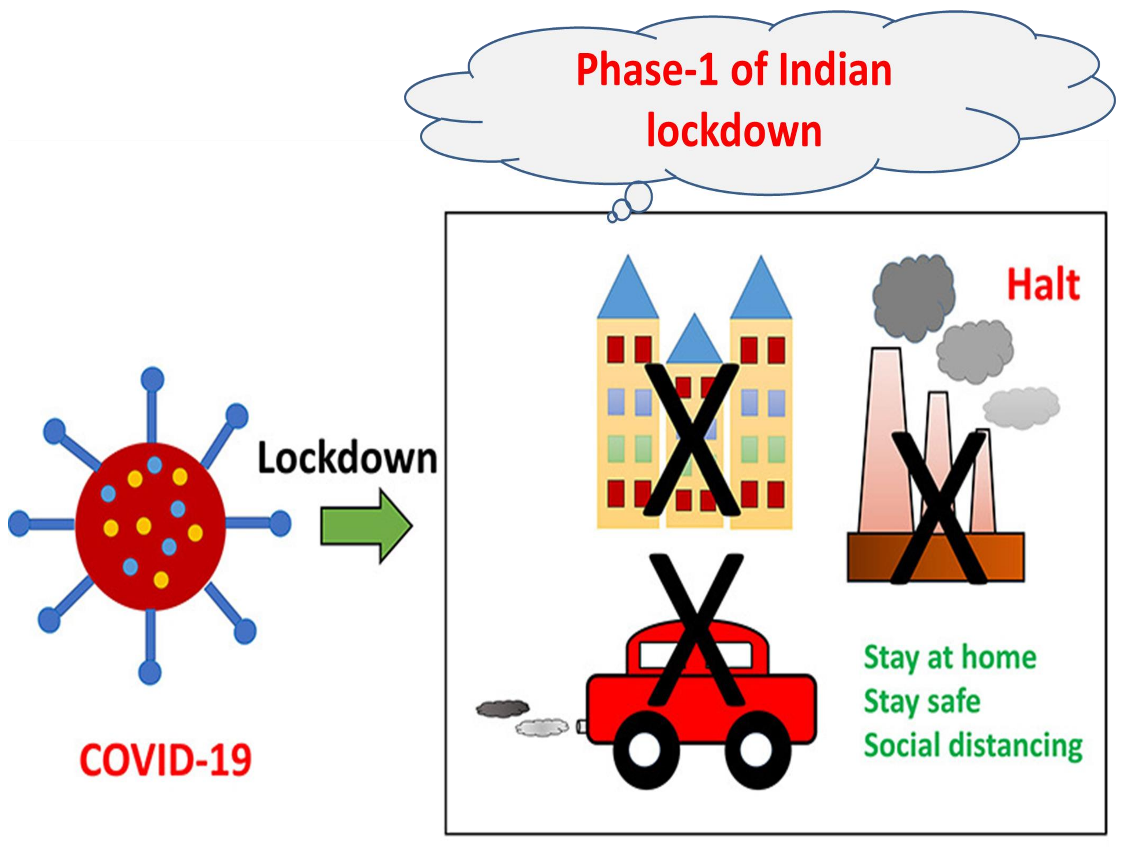
Abstract

Agra, a UNESCO World Heritage site and Delhi-NCR, a tropical Indian megacity, experience severe air pollution in the world, linked with diverse anthropogenic and biomass burning emissions. First phase of COVID-19 lockdown in India, implemented during 25 March to 14 April 2020 resulted in a dramatic near-zeroing of various activities (e.g. traffic, industries, constructions), except the "essential services". In this study, variations in the fine particulate matter ($PM_{2.5}$) over the Agra-Delhi-NCR region were studied. Results concludes that 27% increase in $PM_{2.5}$ and a 65% increase in PM_{10} compared to the first two weeks of the lockdown (25 March to 6 April) was observed in the second week of April (7 April to 15 April). However, $PM_{2.5}$ levels were still lower by 39% than pre-lockdown concentrations in Dehli-NCR region. This may primarily be attributed to change in meteorological conditions. Measurements revealed large reductions in $PM_{2.5}$ during the first week of lockdown (25–31 March 2020) as compared to the pre-lockdown conditions in Agra. However, O_3 pollution remained high during the lockdown due to non-linear chemistry and dynamics under low aerosol loading. Due to the onset of summers, temperature has started to increase with a minimum and maximum temperature of 12.6 ºC and 27 ºC on 16th March 2020 to 24 ºC and 40ºC on 15th April 2020, leading to dry and dusty conditions. Notably, it was reported that a mild dust storm from western part of the country and the gulf regions hit Delhi on 14- 15th April, thus rapidly increasing the PM levels in Agra-Delhi-NCR region. The study highlights a highly complex chemistry between the baseline pollution and meteorology leading to enhancements in pollution, besides an overall improvement in air quality during the COVID-19 lockdown in this part of the world.

Introduction



Objectives

To compare the $PM_{2.5}$ diminution and haze events over Delhi-NCR and Agra, India during the covid-19 lockdown period

Methodology

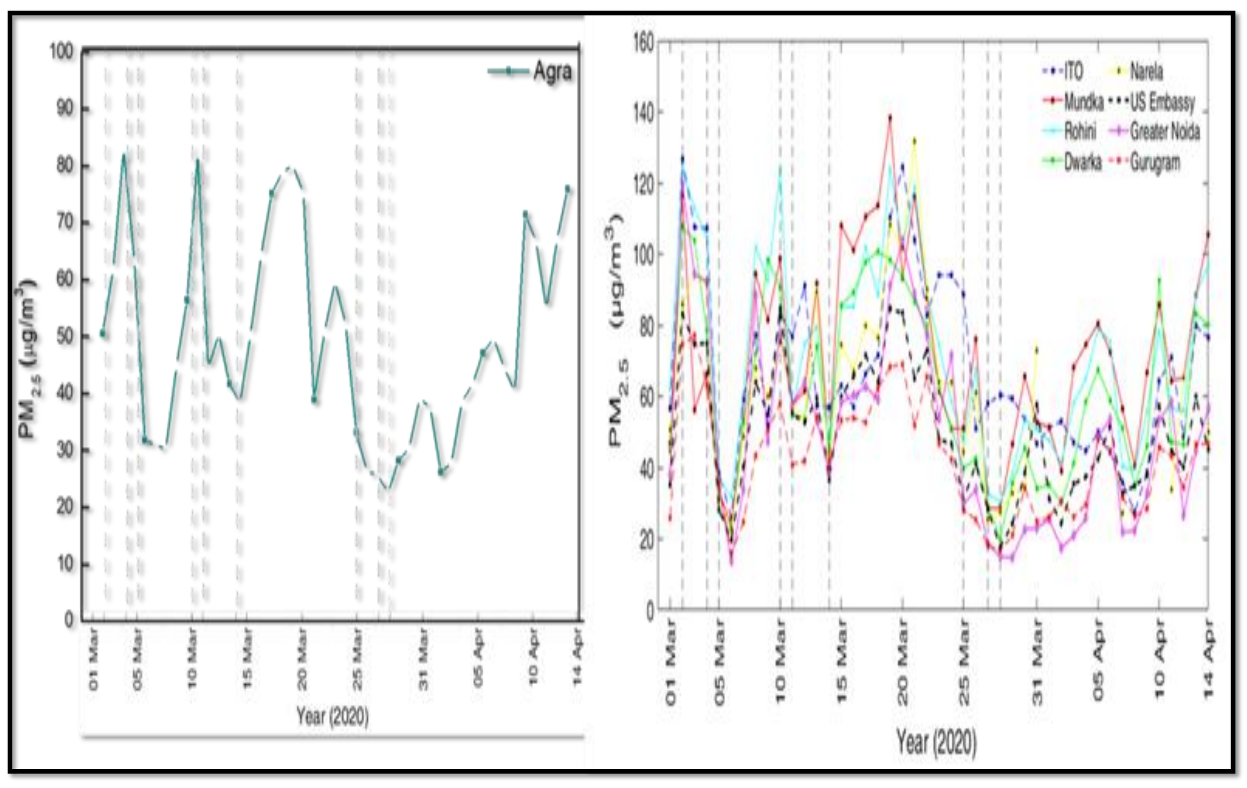
- ✓ Study Sites : Delhi- NCR and Agra, India.
- Data collection in Delhi : Online data from eight monitoring stations in the Delhi-NCR have been analyzed.
- Data collection in Agra : Online data from one monitoring station in the Agra have been analyzed.
- ✓ For, online data Continuous Ambient Air Quality Monitoring (CAAQM) systems are used.
- ✓ Study Period : 1th March to 14th April, 2020
- ✓ Data of PM and meteorological parameters taken from CPCB online portal (https://app.cpcbccr.com/ccr/#/caaqm-dashboard-all/caaqm-landing) during phase-1 of amid lockdown, 2020.

Air Mass Trajectories

The air mass back trajectory was extracted from National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory (ARL) Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model.

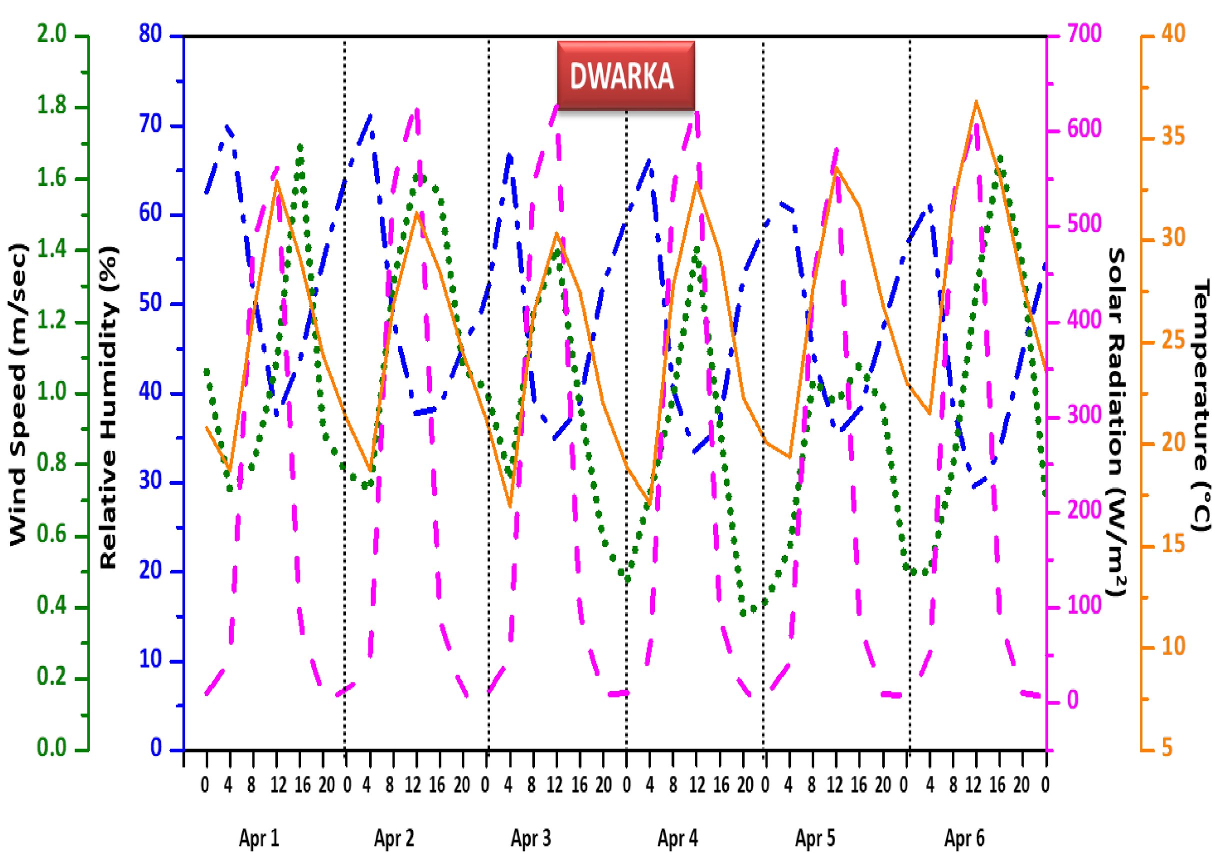
Findings

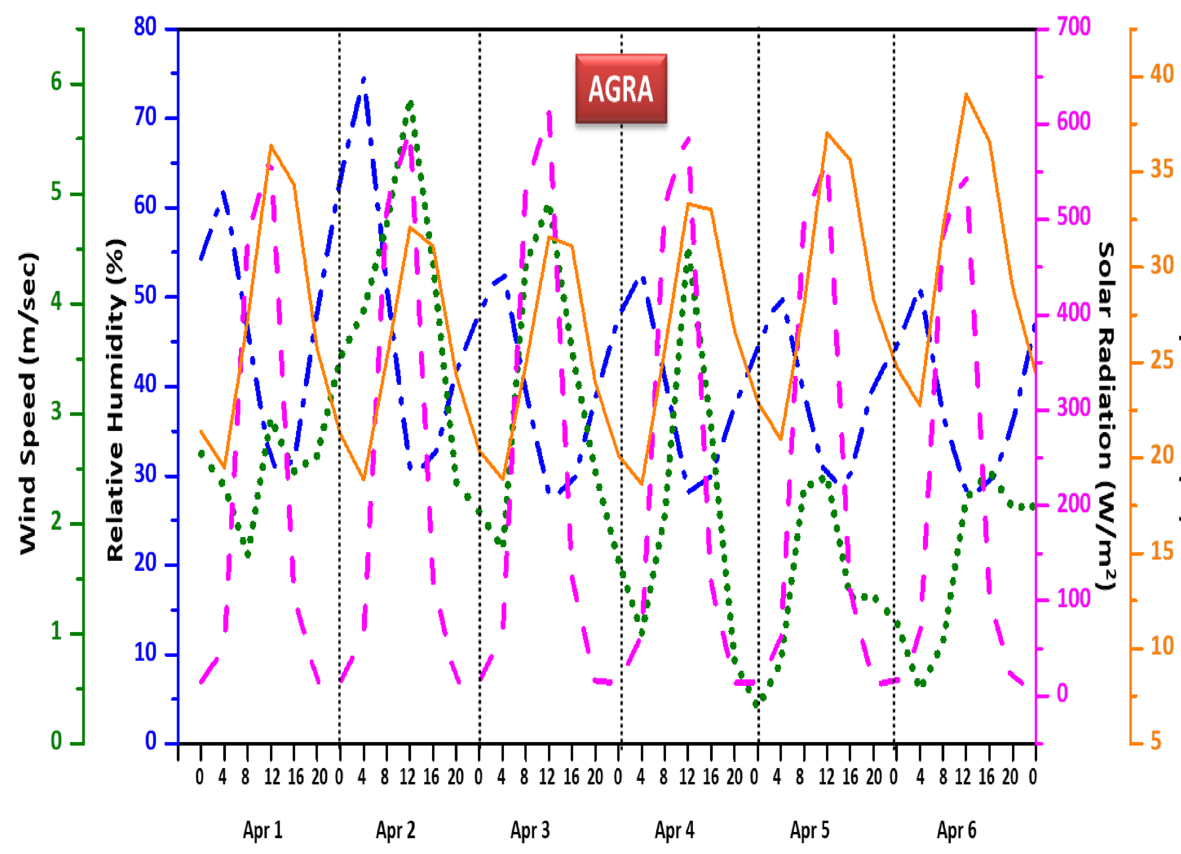
PM Concentrations



$PM_{2.5}$ levels were lower by 42% in Agra and 39% in Dehli-NCR region than pre-lockdown levels.

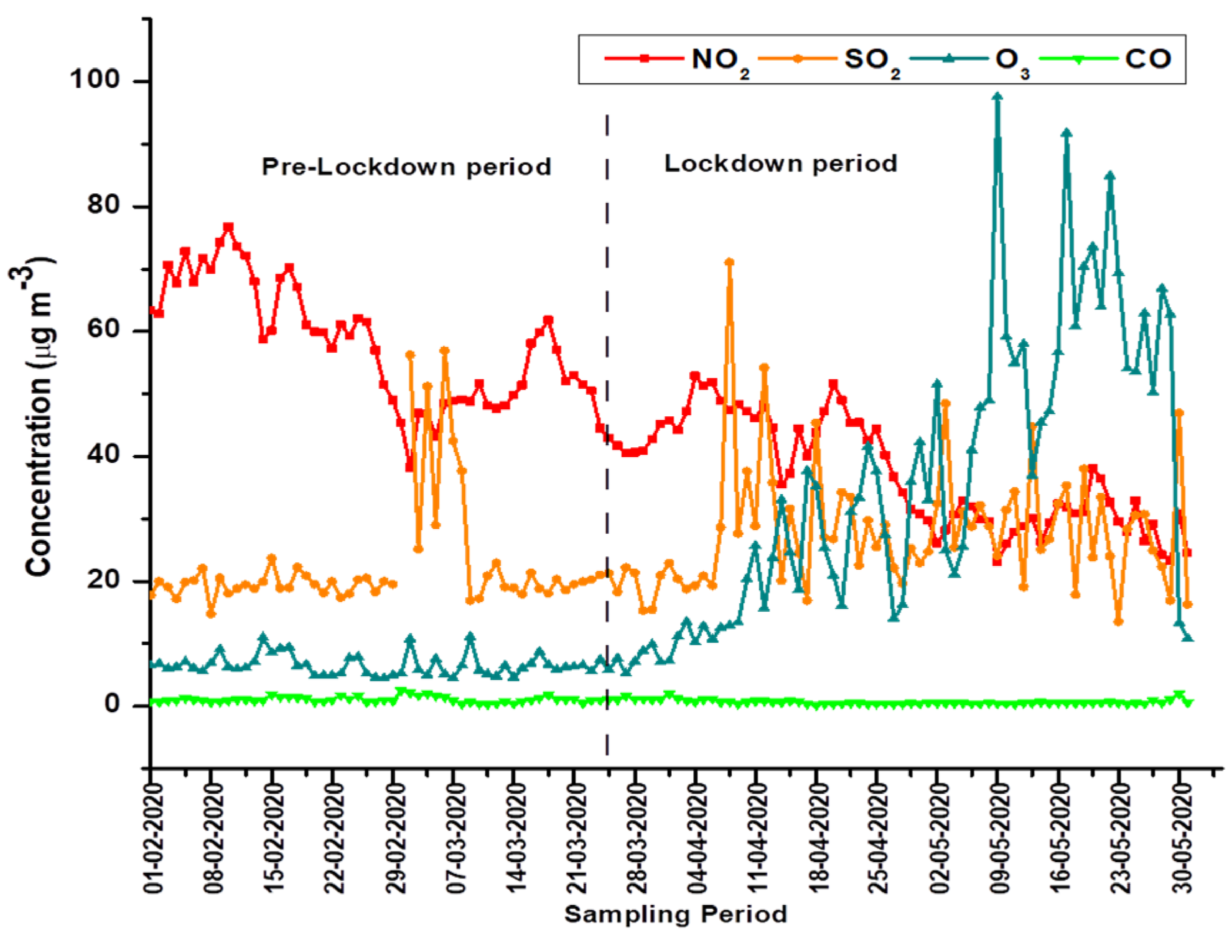
Meteorological Parameters





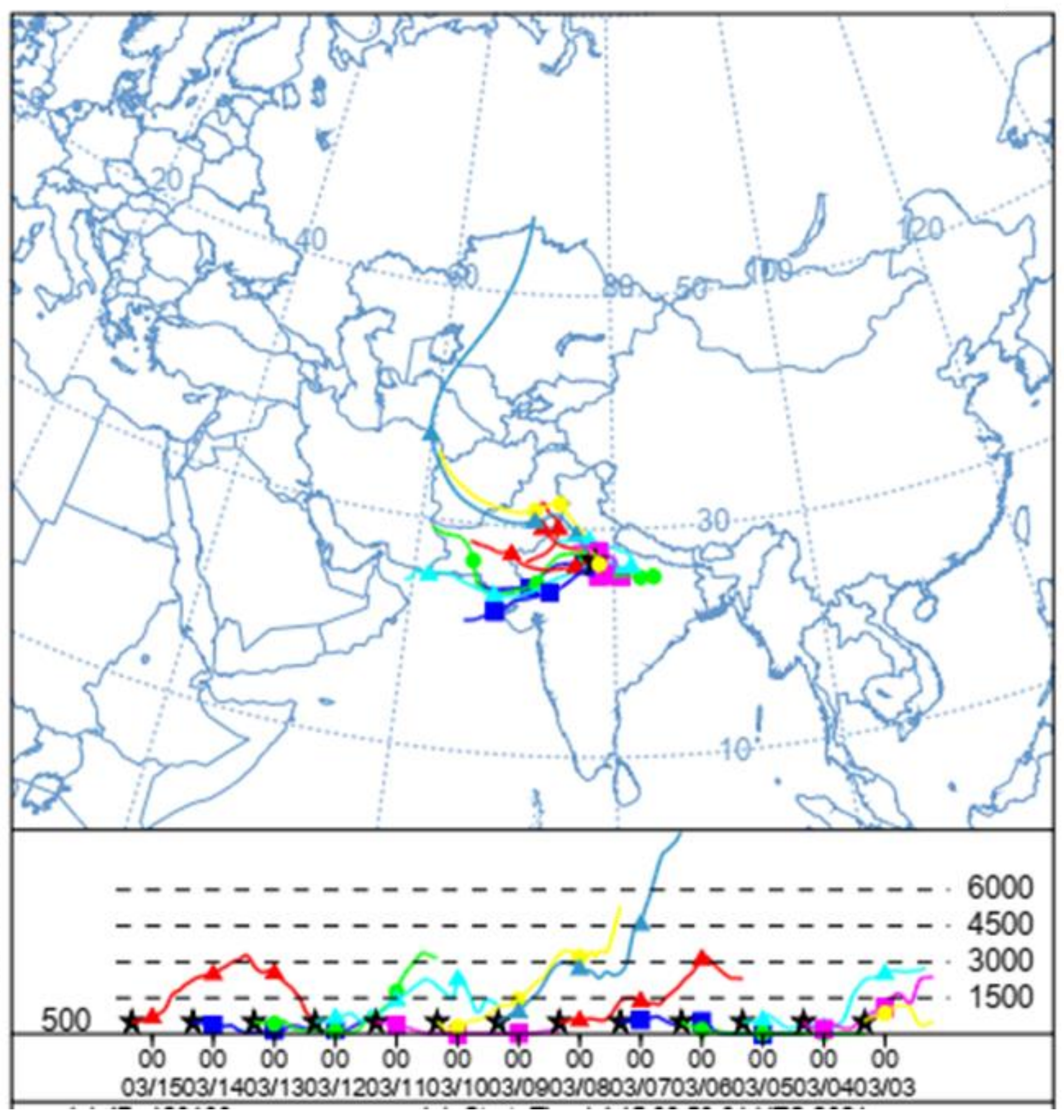
High temperature, low wind speed and increase in relative humidity in Delhi during lockdown

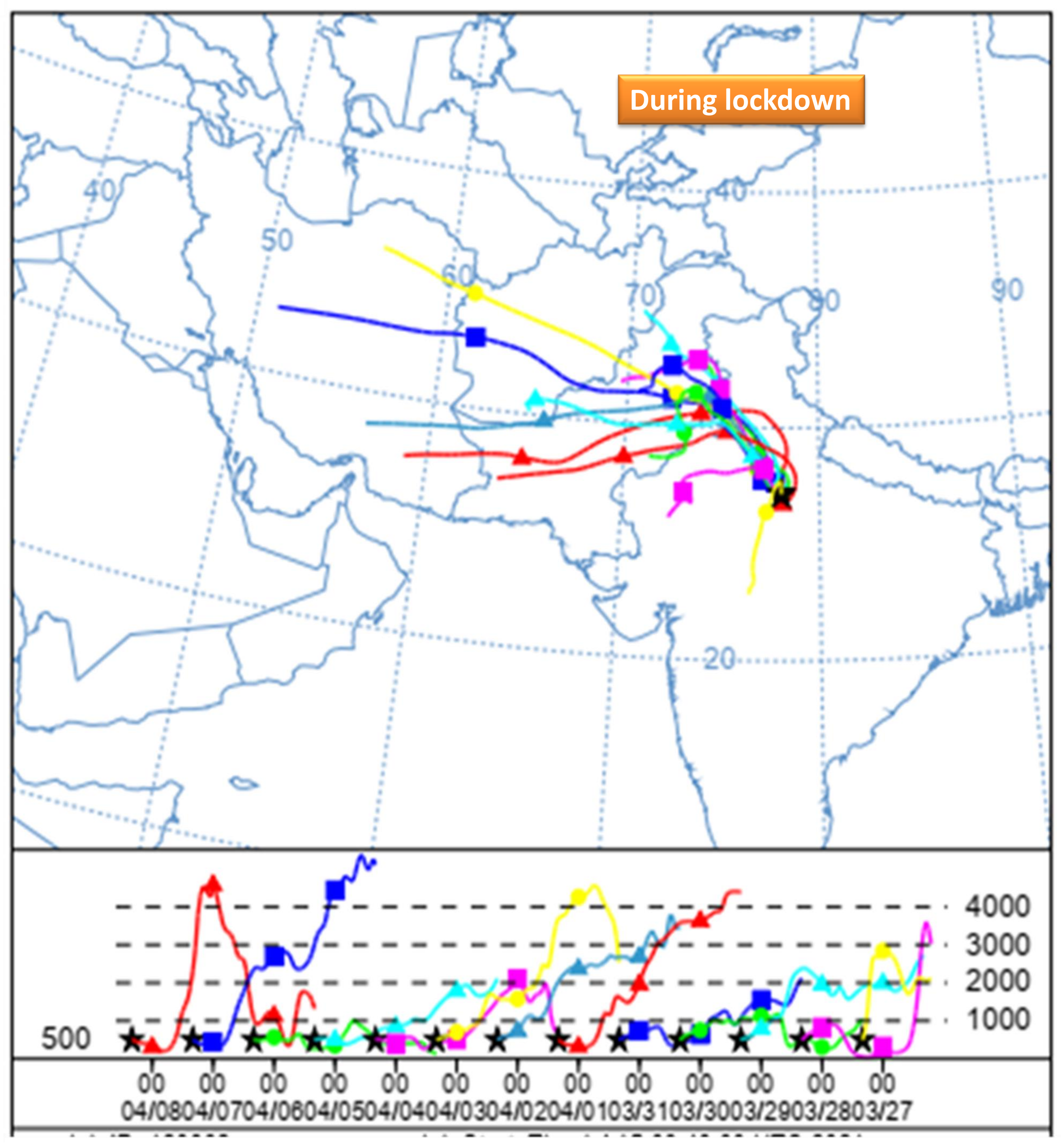
Concentration of Trace Gases at Agra



The average percent drop was observed as 45%, 22% and 38% in levels of NO_2, SO_2, CO but O_3 levels increased by 45%.

Air Mass Trajectories





The long ranged air mass is transported from European, Gulf and African region to Afghanistan via Rajasthan and Punjab to study site, whereas short trajectories were influenced by the regional/local emission from Indo-Gangetic Plain and adjacent regions in both cases.

Conclusion

- ✓ $PM_{2.5}$ levels were lower by 42% in Agra and 39% in Dehli-NCR region than pre-lockdown levels.
- ✓ Significant decrease was observed in levels of NO_2, SO_2, CO But O_3 levels increased.
- ✓ High temperature, low wind speed and increase in relative humidity in Delhi during lockdown.
- ✓ A mild dust storm from western part of the country and the gulf regions hit Delhi.
- ✓ $PM_{2.5}$ diminution was observed in Agra, however, haze event was noticed over Delhi during the covid-19 lockdown period.

References

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Acknowledgement

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FINDING AND ANALYZING THE SOURCE FOR THE PRODUCTION OF CARBON MONOXIDE OVER INDIA USING SATELLITE DATA.

Author

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Introduction

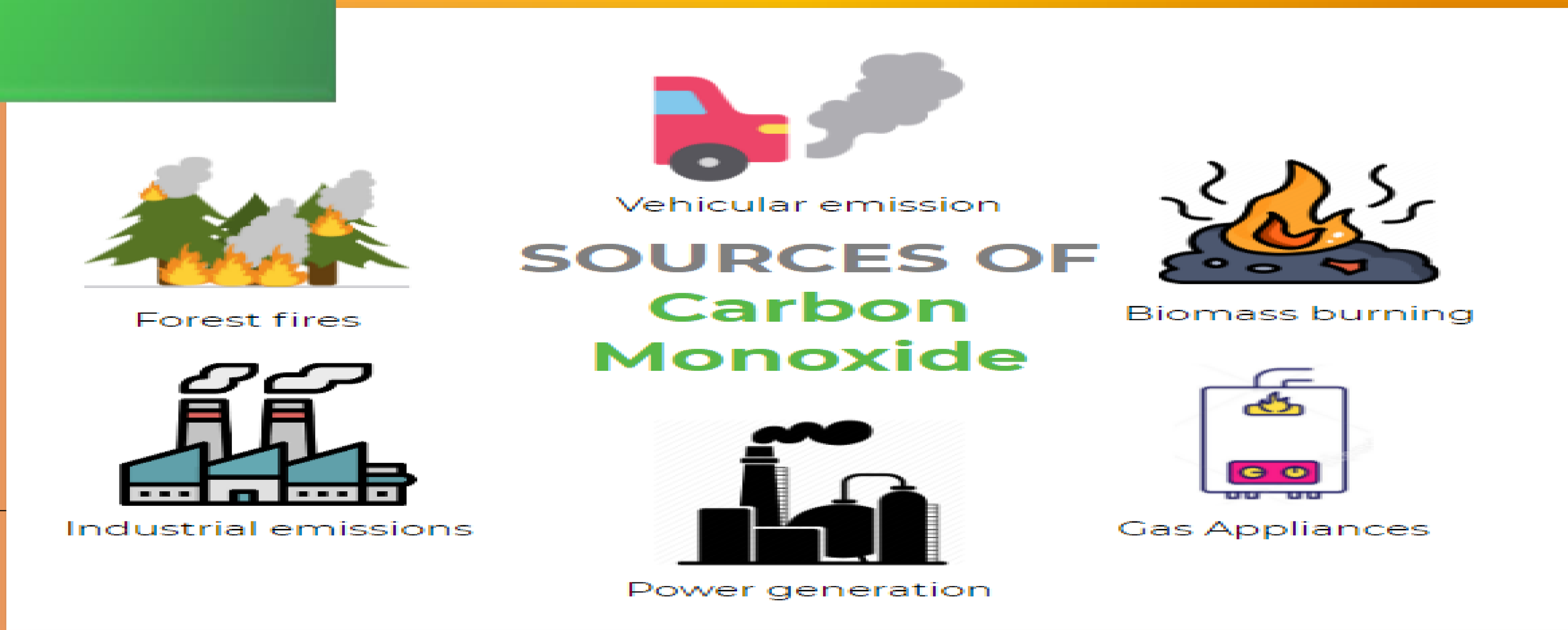
'CO' is one of the major air pollutants and indirect greenhouse gas having harmful effect on humans and animals. Average lifetime of CO is ~ 2 months. The two largest surface sources of CO are the combustion of fossil fuel and the combustion of biomass. 'CO' plays a key role in the composition of the troposphere: it is the main sink for OH radicals and it is a precursor of ozone.

Methodology

The Sentinel-5P satellite is used. Google Earth Engine is used to perform averaging and removing bad pixels from the database. Also, QGIS is then used to generate maps

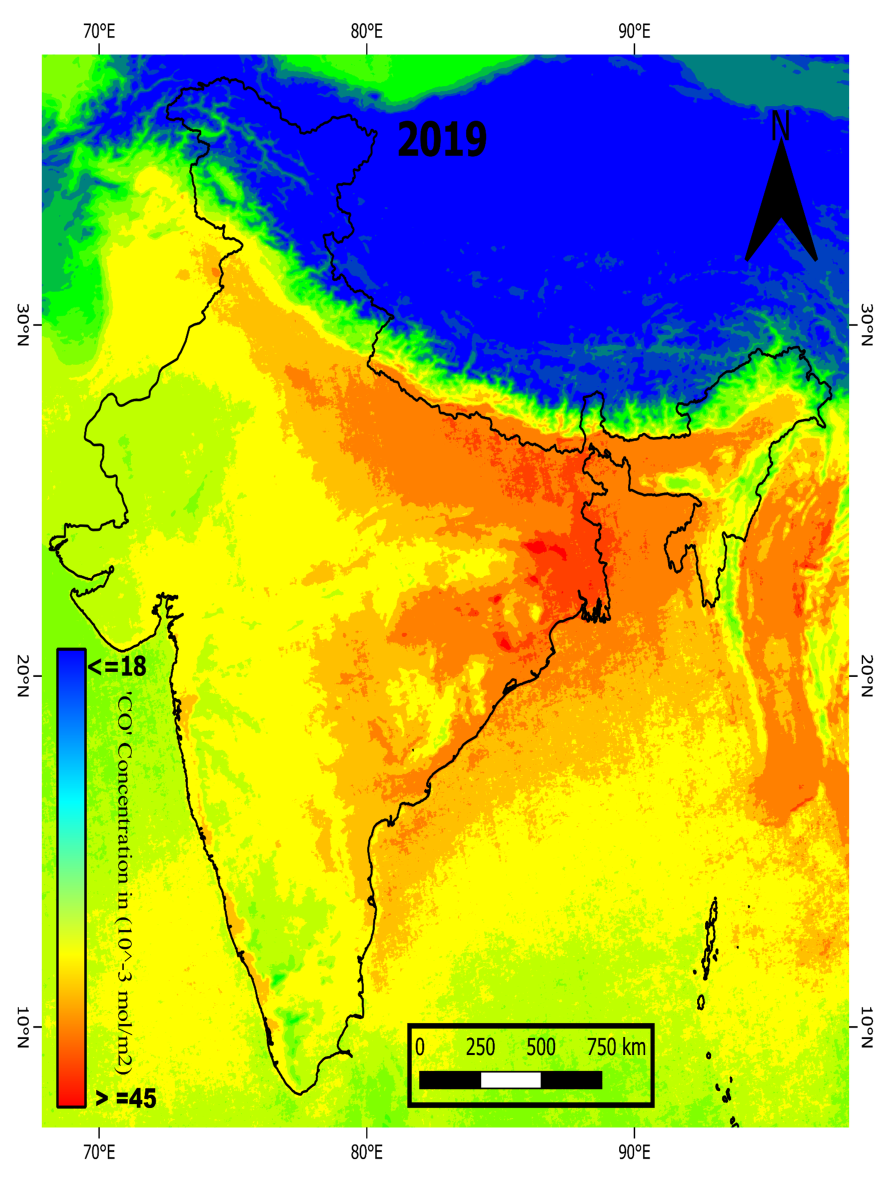
Objective

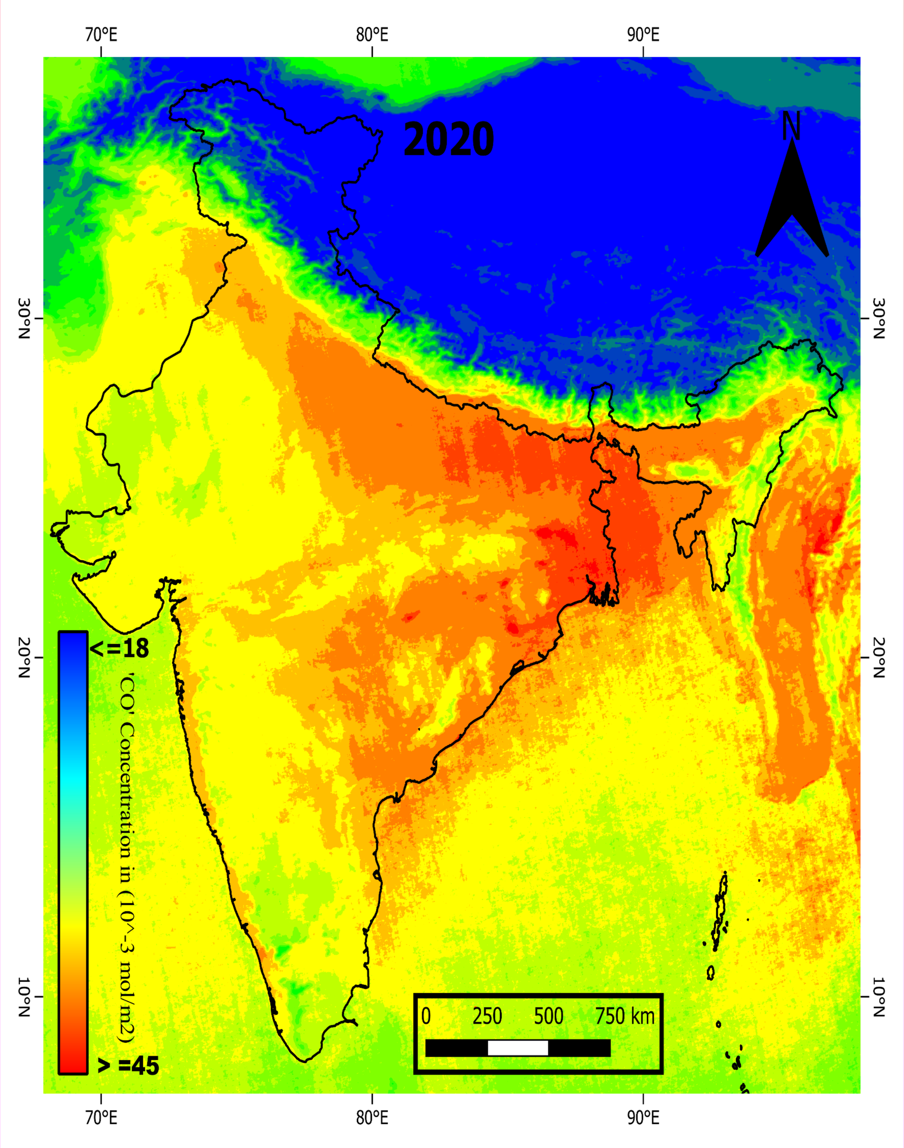
This poster is based on carbon monoxide and analyse a source contribution for the concentration of 'CO' and identify the hotspot area on India over the year 2019 and 2020.



Analysis

It is observed that Orrisa, West Bengal, and Jharkhand are considered to be the hotspot area with concentrations (≥50 mMol/m^2) and 'CO' in the zone like Bihar, Delhi and Indo-Gangetic Plain having concentration (≥40 mMol/m^2). Also, CO over the Bay of Bengal was much higher compared to the Arabian Sea.





Results

Factor	Source area for 'CO'	CO' concentration in (10^-3) Mol/m2	
		2019	2020
Highest coal mine	Jorakhpur (Jharkhand)	47.999	48.106
	Talcher (Odisha)	48.43	46.99
Thermal power plant	Singrauli (M.P)	40.6	41.257
	Chandrapur (Maharashtra)	40.748	41.601
	Talcher (Odisha)	48.43	46.99
Vehicle	Delhi	41.76	41.72
	Kolkata	45.49	45.41
	Mumbai	38.88	40
Biomass burning	W.B	45.345	45.531
	Odisha	46.235	44.97
Industries	Patna, Gaya & Muzaffarpur (Bihar)	43.258	43.716

Conclusion

The key contribution to the hotspot area is anthropogenic activities like coal mining, Coal based thermal power plant and biomass burning in India. Besides, other factors like Industrial activities, Vehicles emission also contribute to the concentration (≥40 mMol/m2) as shown in table. Also, for Bay of Bengal the situation explains the fact that proximity of land directly affects CO levels.

Impact of Covid-19 pandemic on the variation of Black carbon over an urban city Delhi

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Introduction

Black Carbon is a black colored particulate matter in the atmosphere, which are solid or liquid particles of diameter of the order of micrometer, suspended in air. D≤ 2.5 µm.

These particulates stay in the atmosphere for several days to weeks. And thus their effect is more regional than global. It has harmful effects on human health as it causes respiratory and cardiac problems.

Methodology

This work is aimed to the study the impact of Covid-19 lockdown on Black carbon concentrations in the atmosphere of an urban city Delhi. For this purpose, we have acquired the data from three continuous monitoring stations in Delhi operated by The Centre of Pollution Control Board for the years 2019, 2020, 2021.

AyaNagar - 28.46° N, 77.12°E

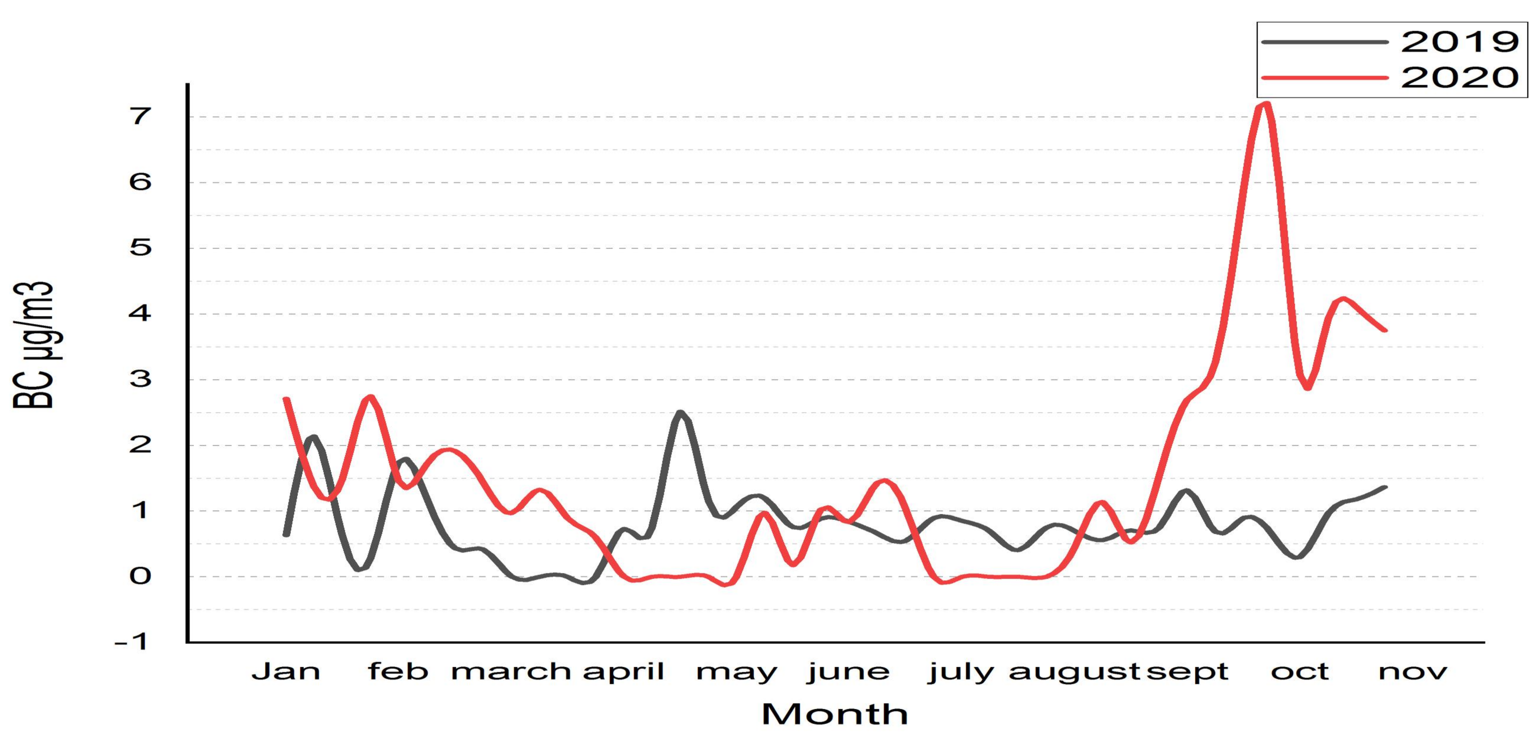
Lodhi Road - 28.46°N, 77.12°E

DPCC Pusa Station - 28.64°N, 77.15°E

The concentration of black carbon levels is plotted against the respective months of the three years and against the period of phases of lockdown.

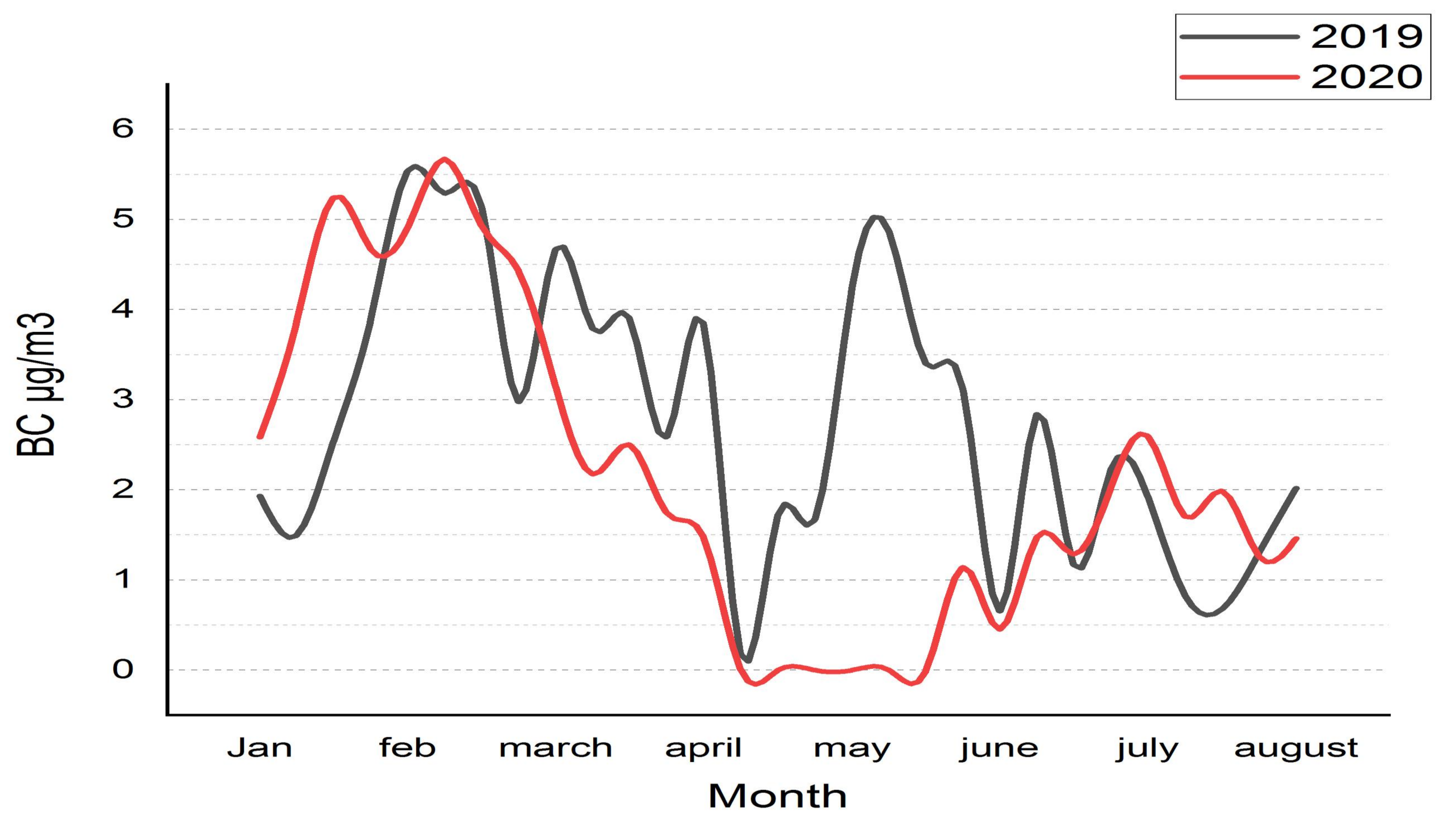
Results

AyaNagar



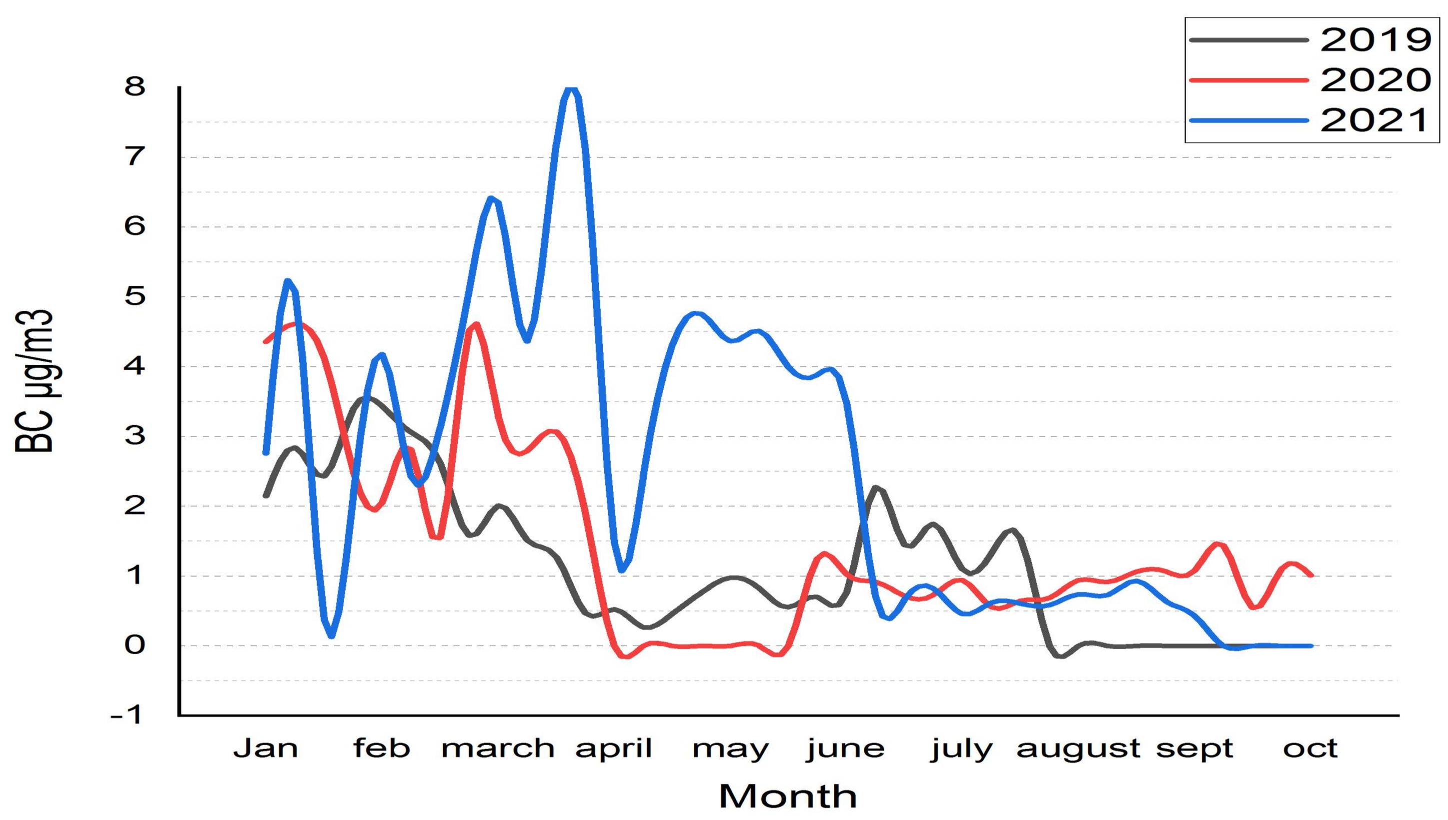
Lockdown average: 0.69 µg/m^3
Reduction: 57.9 %
Unlock Average: 2.71 µg/m^3

Pusa



Pre Lockdown average: 4.01µg/m^3
Lockdown average: 1.45µg/m^3
Reduction: 63.8%
Unlock Average: 1.58µg/m^3

Lodhi Road



Pre Lockdown average: 3.24 µg/m^3
Lockdown average: 1.58µg/m^3
Reducton: 51.2%
Unlock average: 0.91 µg/m^3

Conclusion

The Black Carbon levels decreased at least by half with the onset of lockdown for all the three locations. When compared to years 2019, 2020, the BC values were considerably lower during the pandemic for location Pusa, which can be attributed to decrease in the anthropogenic sources of BC due to lockdown restrictions.

Acknowledgement

The authors are thankful to CPCB for providing necessary data through their online portal. We are also thankful to Scientists of ISRO for providing necessary guidance.

Reference:

[1] Jyotishree Nath, subhasmita Panda, Satya S. Patra, Boopathy Ramasamy and Trupti Das – "Variation of black carbon and particulate matter in Bhubaneshwar during the pre-monsoon: possible impact of metereology and COVID-19 lockdown"

A three-years record of chemical composition and $^{87}Sr/^{86}Sr$ in rainwater over Bhopal

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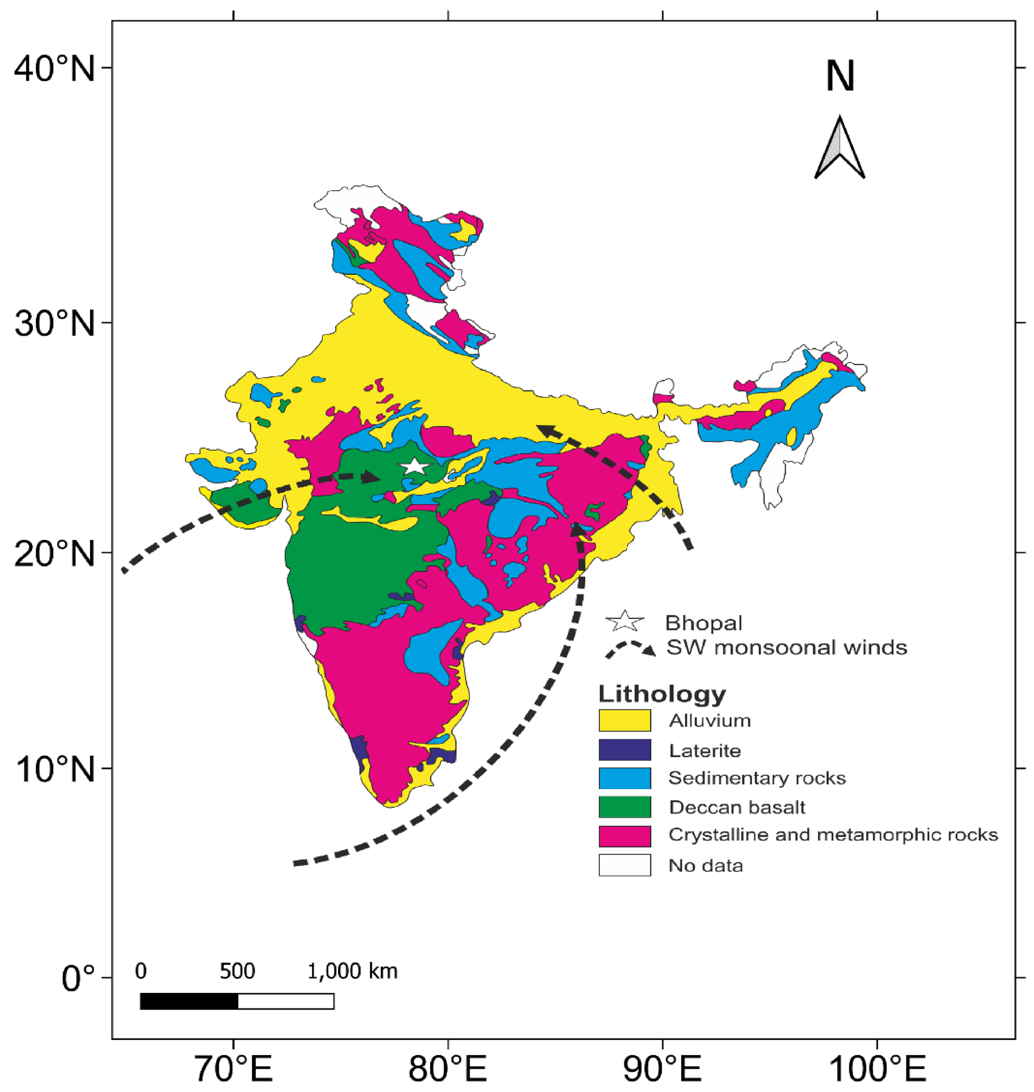
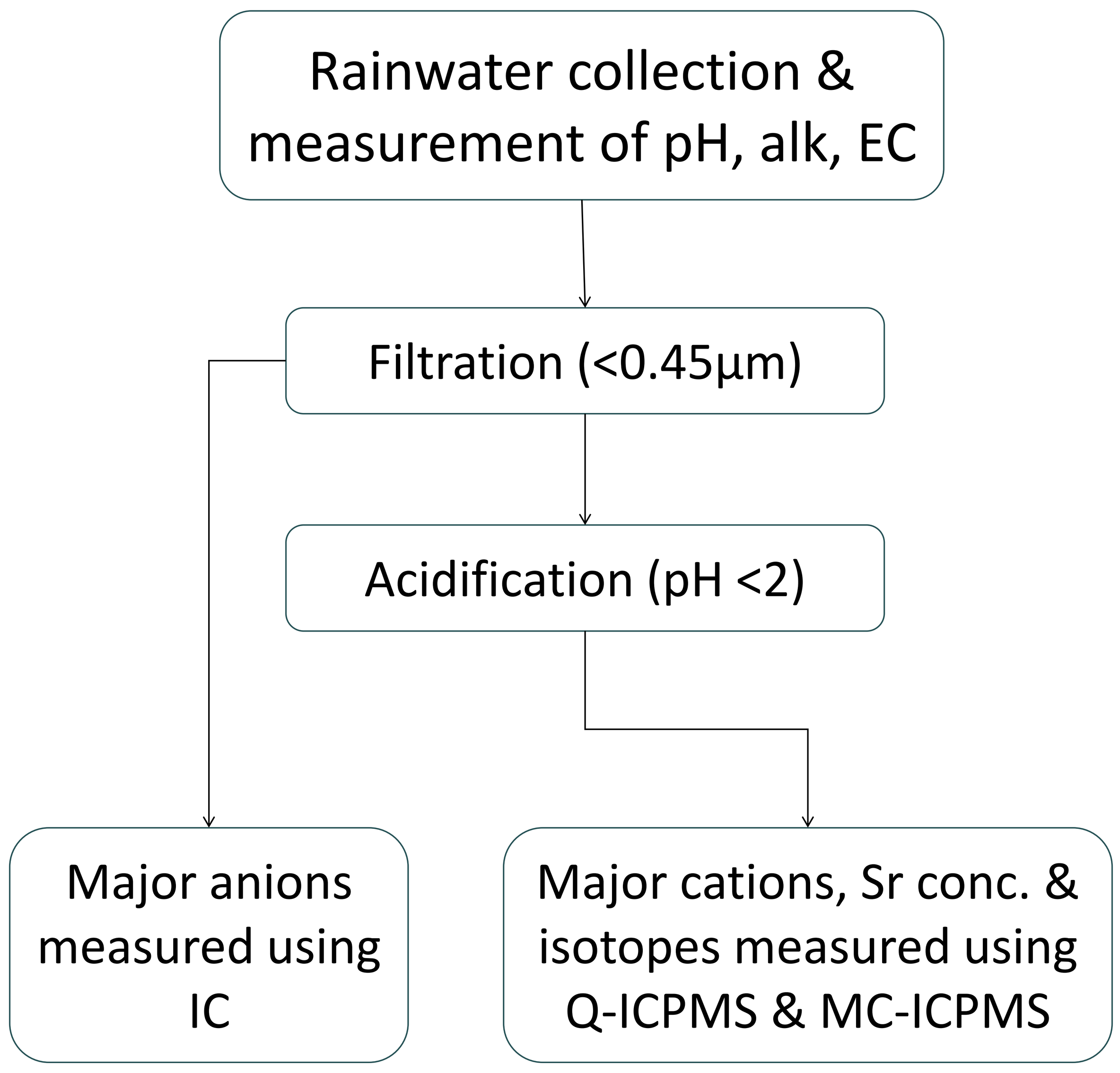
Introduction

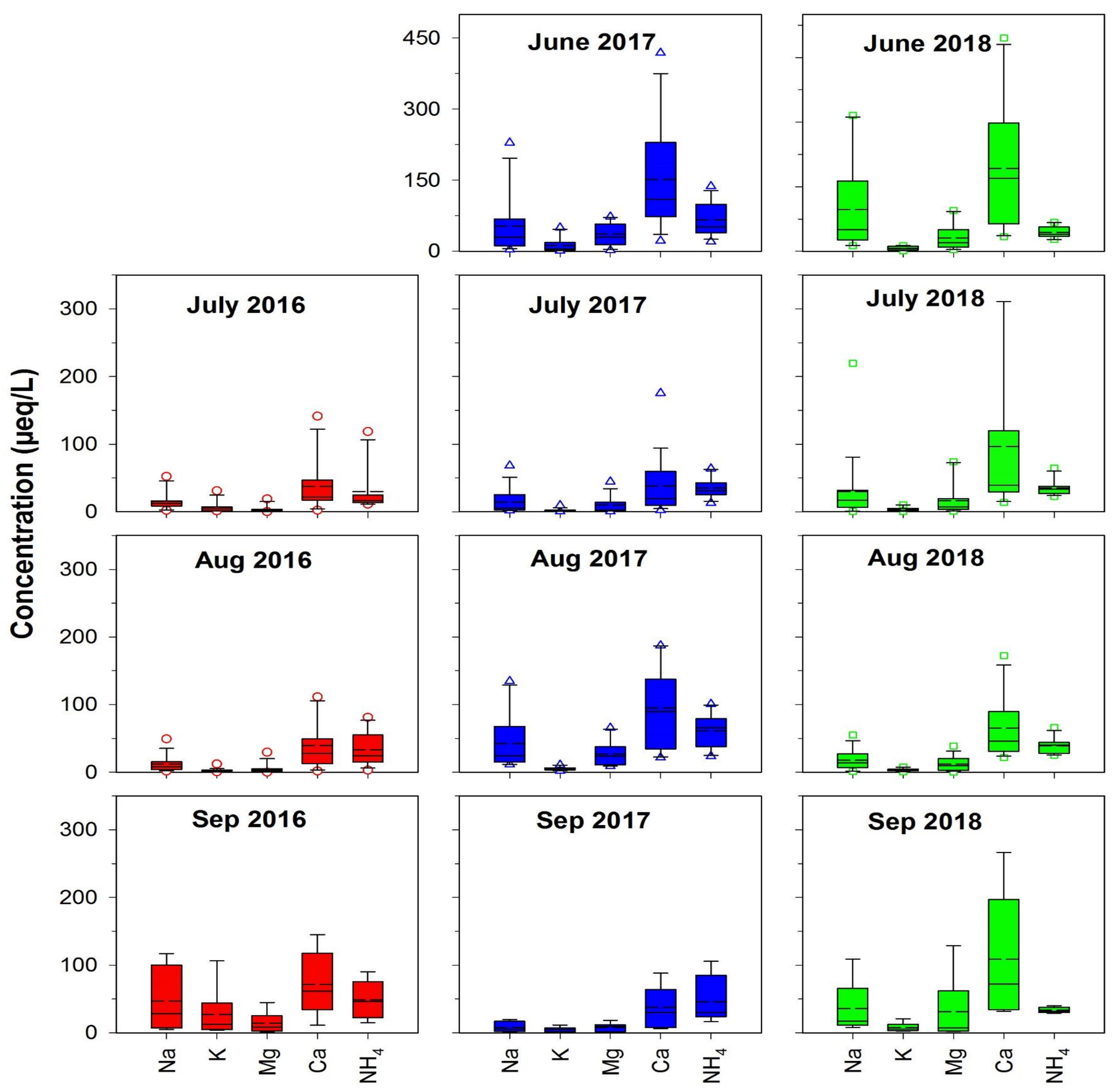
- Rainfall acts as a natural scavenger of atmospheric pollutants such as aerosols and anthropogenic gases [1, 2].
- Acidic rainwater deleteriously impacts biota thriving in surface soils/aquatic bodies, and is also responsible for infrastructure and monument degradation by mineral weathering.
- The rainwater chemistry helps to evaluate the regional atmospheric condition.
- This study mainly focuses on natural and anthropogenic source apportionment of rainwater solutes in the outskirts of Bhopal, Central India.

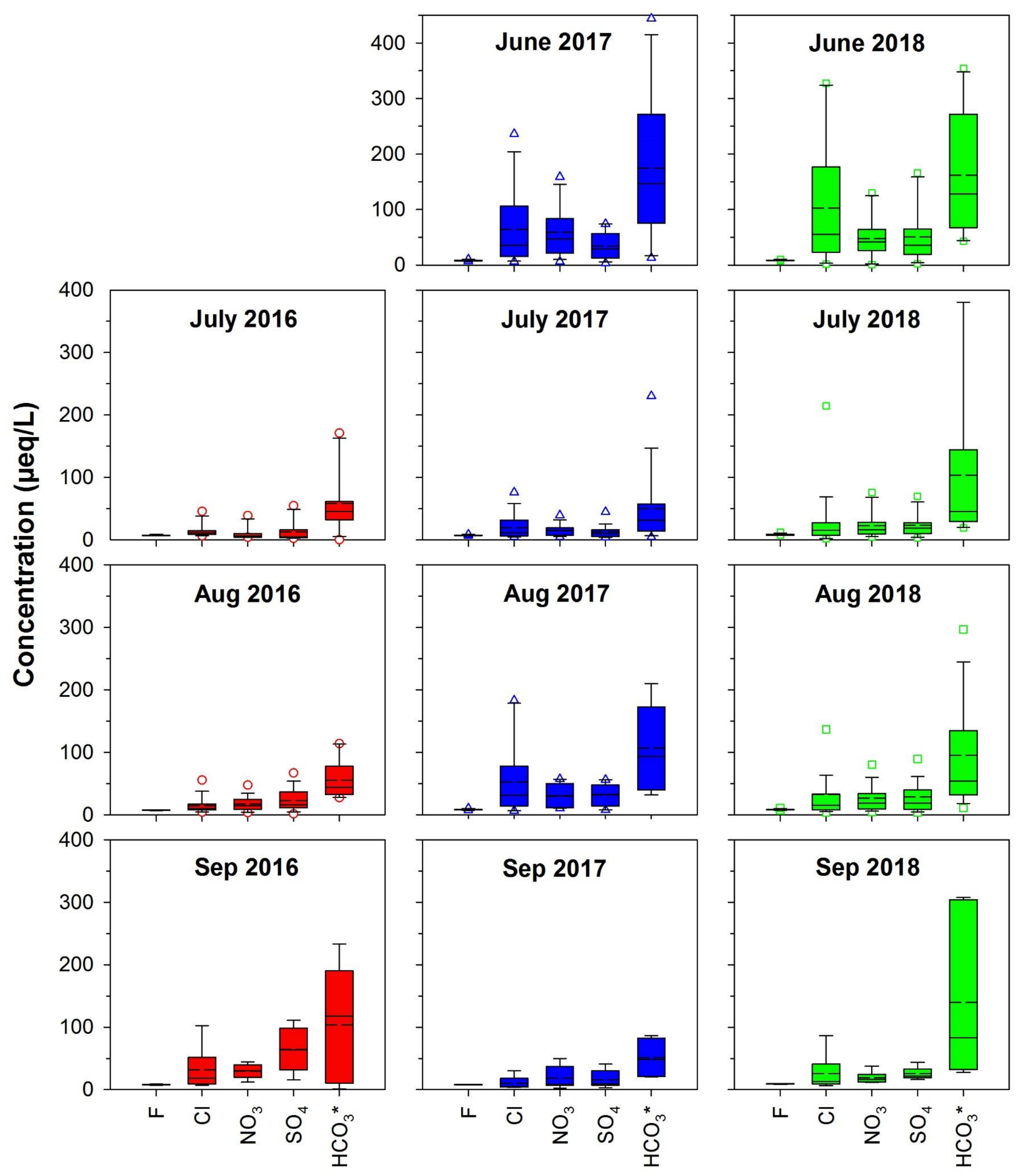


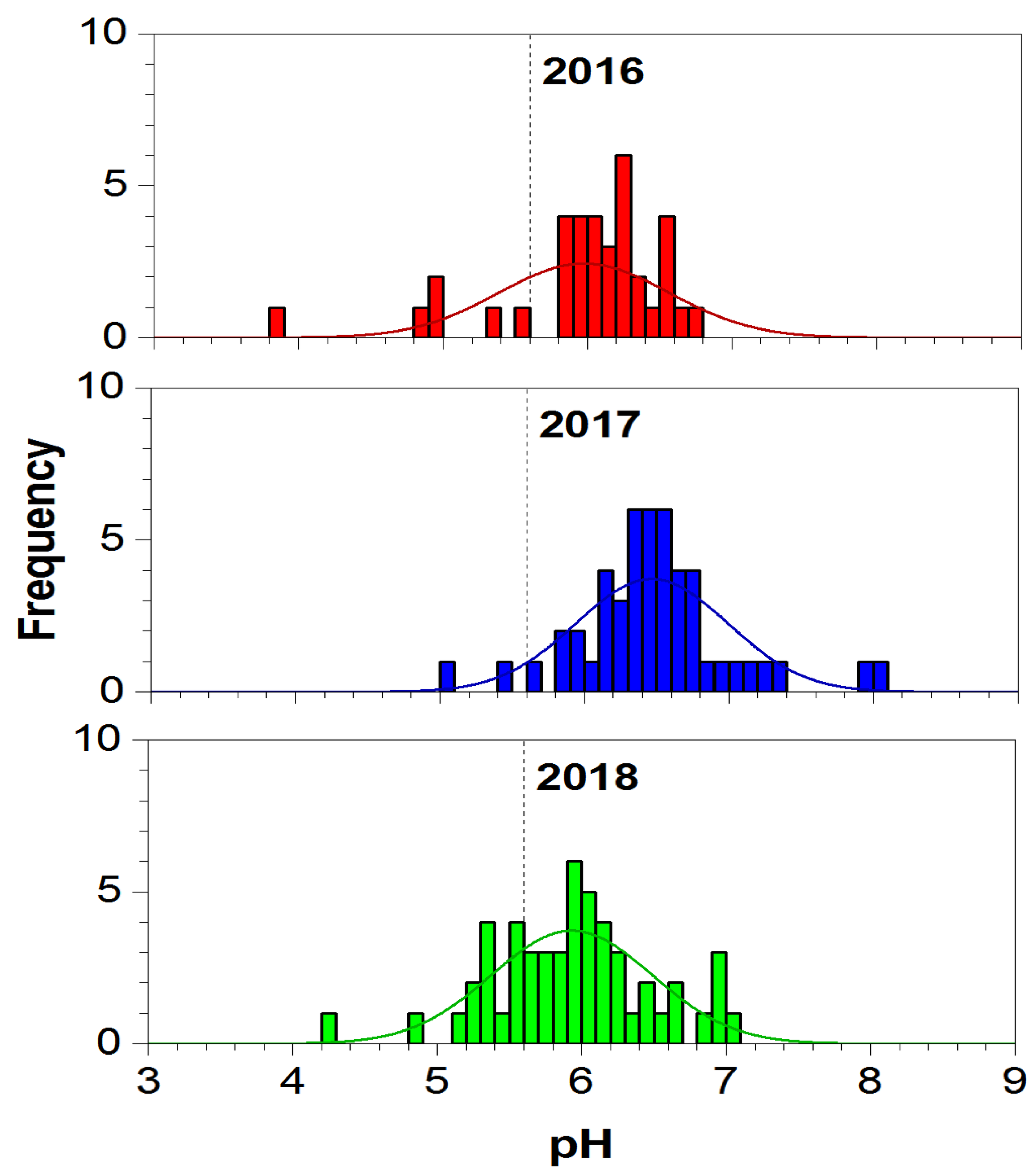
Methods

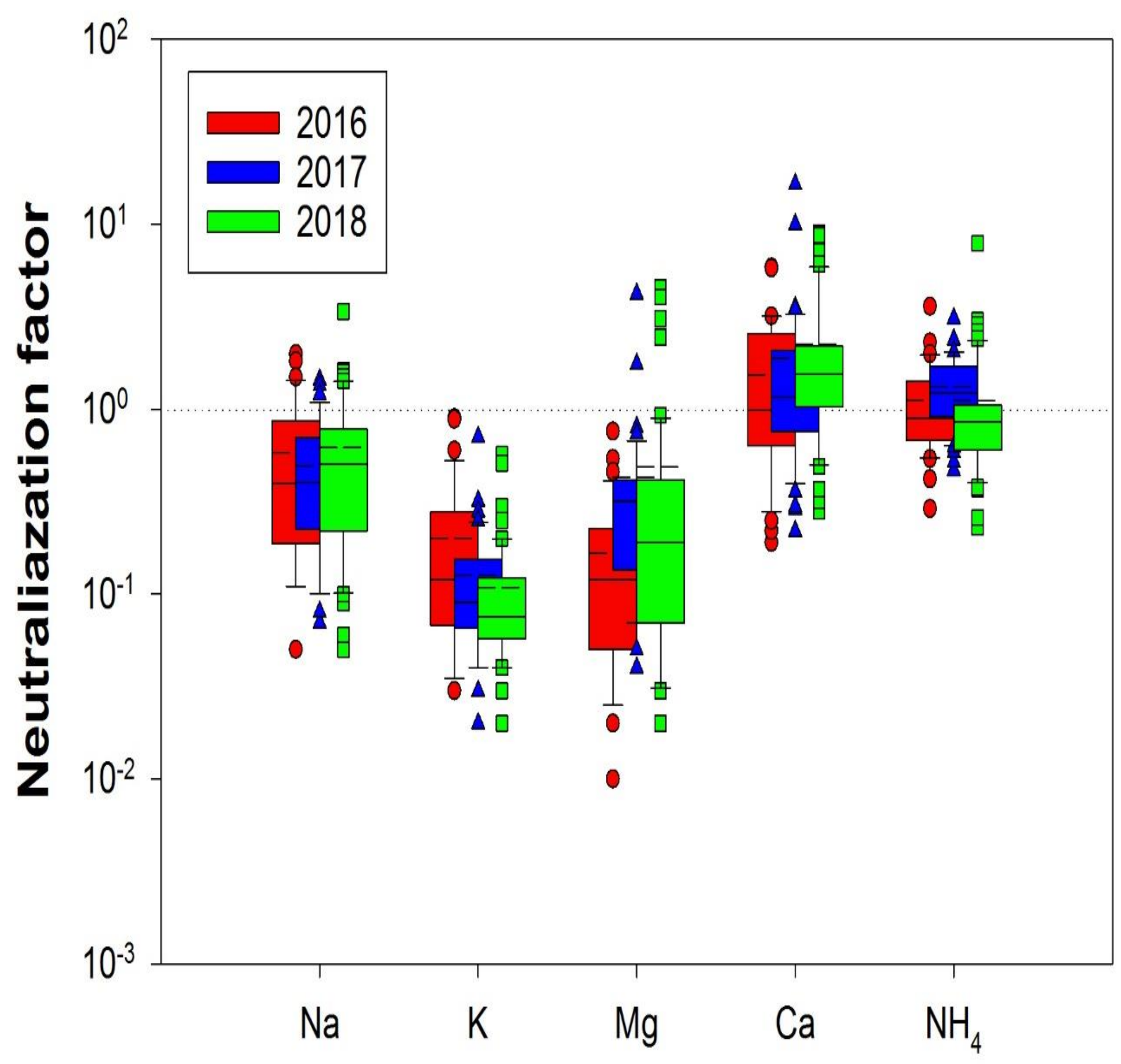


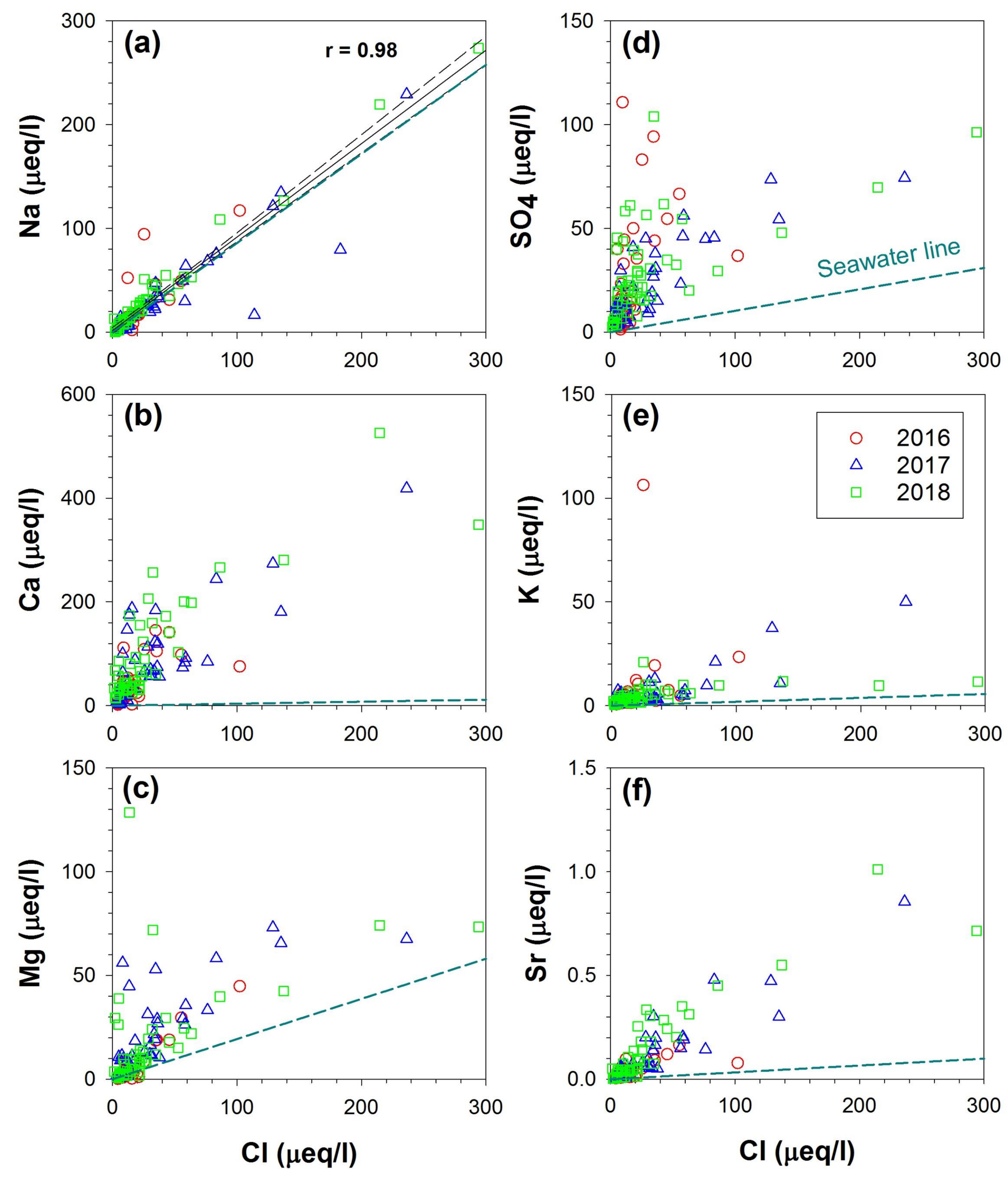
Results

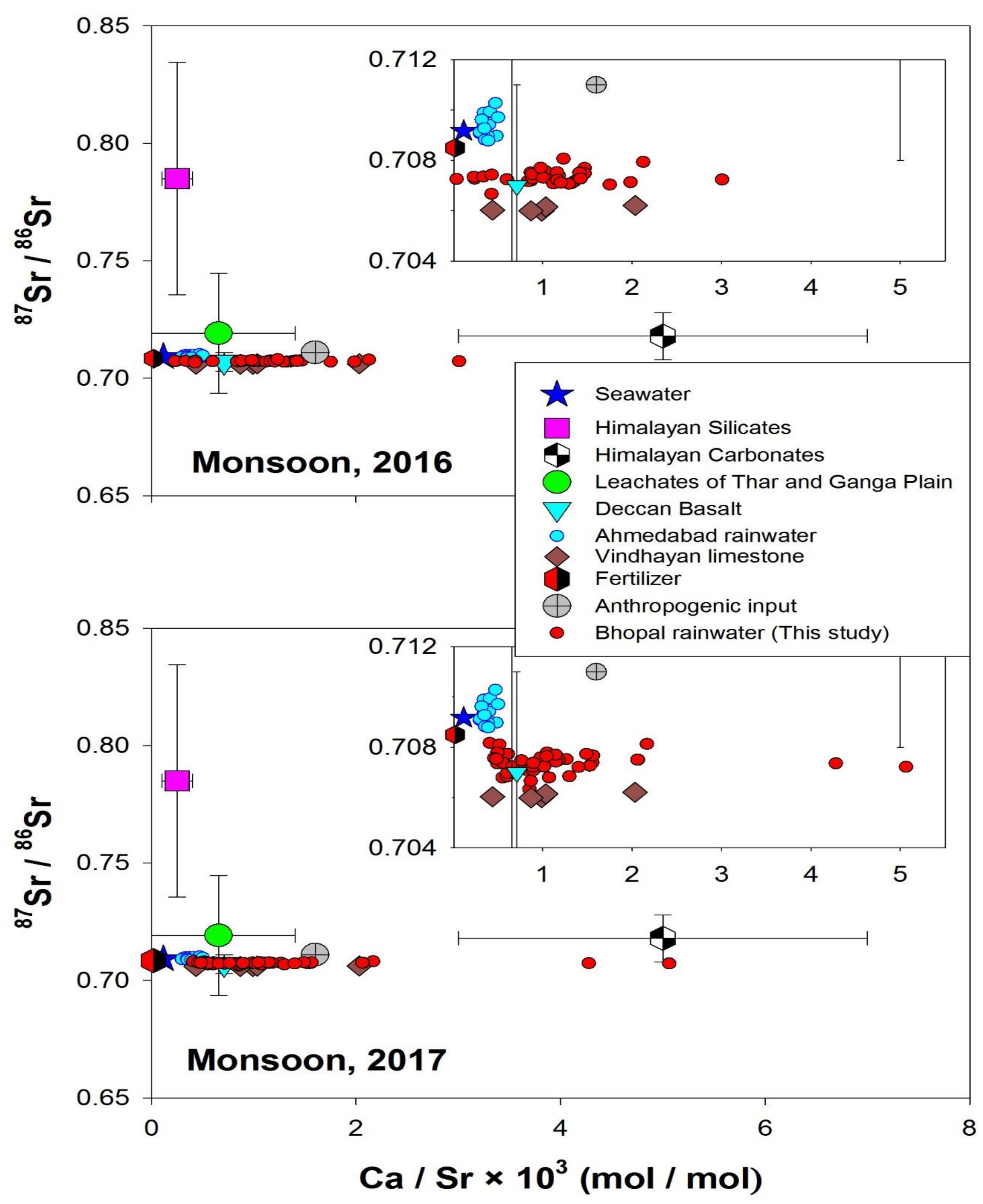












Summary

1. Alkaline nature of the rainwater is due to acid neutralization by Ca and NH_4.
2. Na and Cl are predominantly supplied from sea-salt, while NH_4, NO_3 and SO_4 are from anthropogenic sources.
3. Ca, Mg, K, and Sr are mostly sourced from fertilizer enriched soil dust of western India

References

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Acknowledgement

1. We thank IISER Bhopal for providing the necessary research facilities.
2. Nafees Ahmad received the DST-INSPIRE Ph.D. fellowship (2017/IF/170451)

THE IMPACT OF LOCKDOWN ON AIR POLLUTION LEVELS AND CHANGE IN AIR QUALITY AT SUB-URBAN SITE DAYALBAGH, AGRA

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FGRC 2021

Introduction

SARS = severe acute respiratory distress syndrome
SARS-CoV-2 is the virus that causes coronavirus disease -19 (COVID-19).

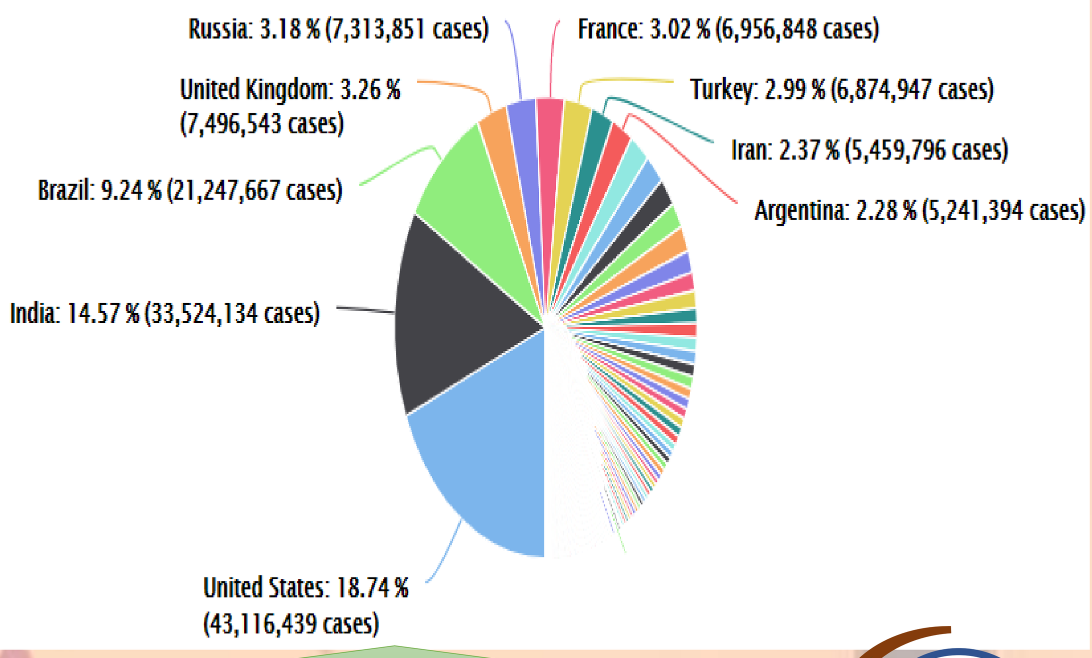
On January 7, 2020 it was discovered that SARS-CoV-2 Virus is responsible for this pneumonia

Starting
On December 31,2019 , first case of unusual pneumonia in Wuhan, China was reported.

Transmission
COVID-19 is spread from person to person mainly through coughing, sneezing and talking and breathing.

Pandemic
COVID-19 was declared as pandemic by WHO (World Health Organization) on March 11,2020 due to its rapid spread across world.

As for September , 2021 across the world total **230,020,680** COVID-19 cases (**4,716,876 Death**, **206,704,075 Recovered** and **18,599,732 Active** cases) were reported.



Some Positive Impact of COVID-19 on Atmosphere

All type of Industries were closed during the lockdown

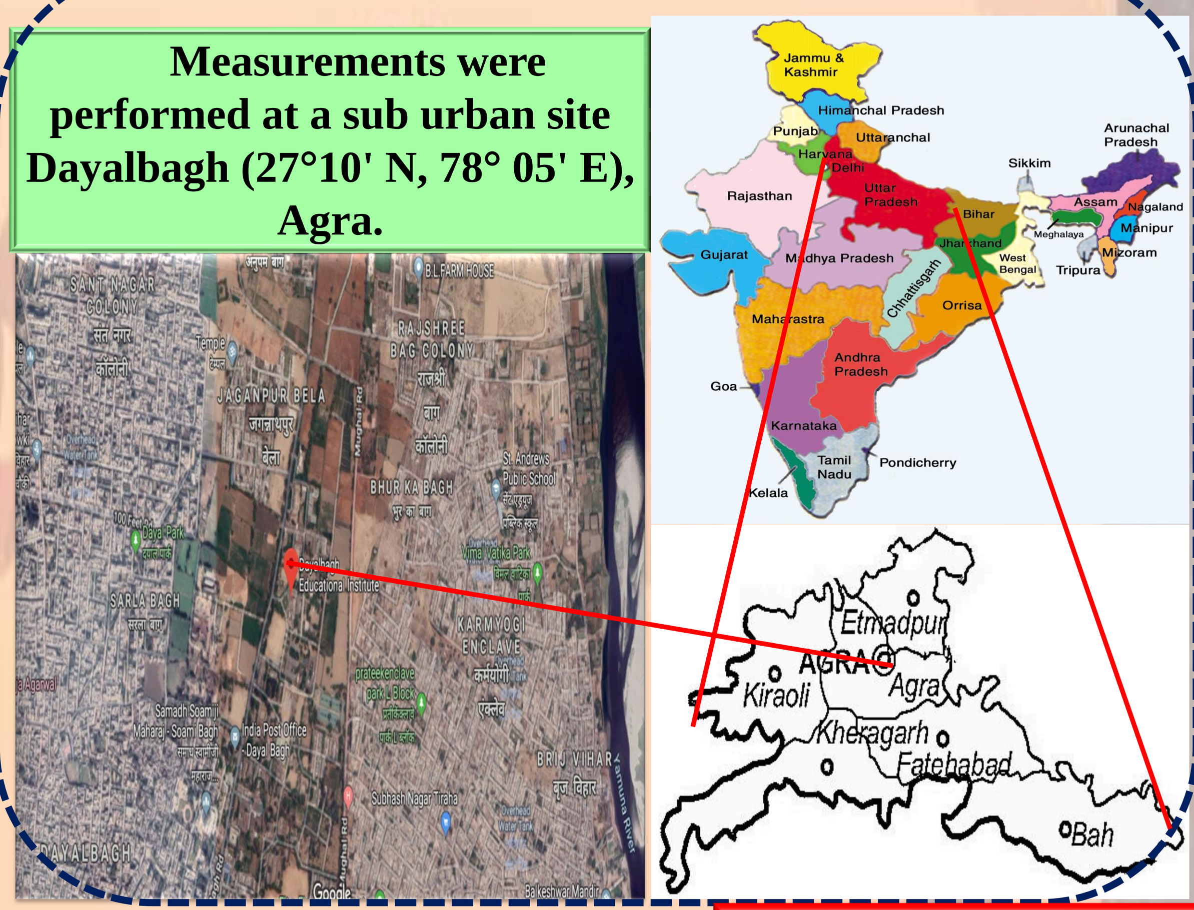
60-70% decline in fuel consumption in lockdown because only essential vehicles were allowed

15% Increase in Liquefied Petroleum Gas consumption during lockdown

In the lockdown period 9.2% decrease in electricity demand.

Site Description

Measurements were performed at a sub urban site Dayalbagh (27°10' N, 78° 05' E), Agra.



METHODOLOGY

Teledyne *Model T300* CO Analyzer

It operates on the principle of infrared absorption at 4.67 µm vibration-rotation band of CO

Thermo Scientific Model 42i NO_X Analyzer

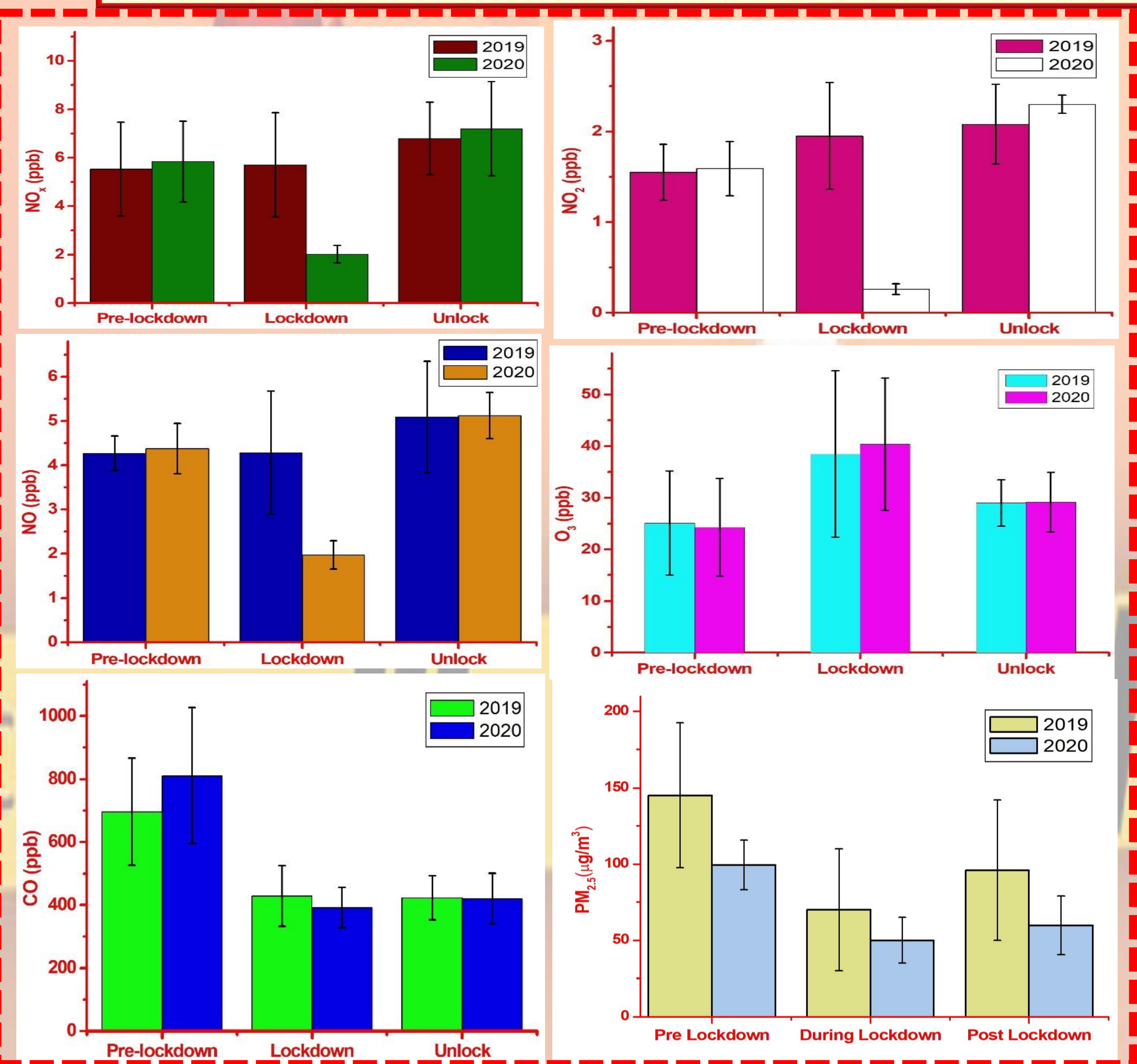
Infrared light emission results when electronically excited NO_2 molecules decay to lower energy states.

Thermo Scientific Model 49i Ozone Analyzer

O_3 absorb UV light at a of 254 nm. Absorption of UV is directly related to the ozone concentration Beer-Lambert Law

Results

Comparison of pollutants 2019 and 2020 in lockdown period



The concentration of NO, NO_2, NO_x, PM 2.5and CO decreased by 54.1%, 86.7%, 64.6%, 28.7% and 8.6% respectively during lockdown period in 2020 as compared to same duration in 2019.

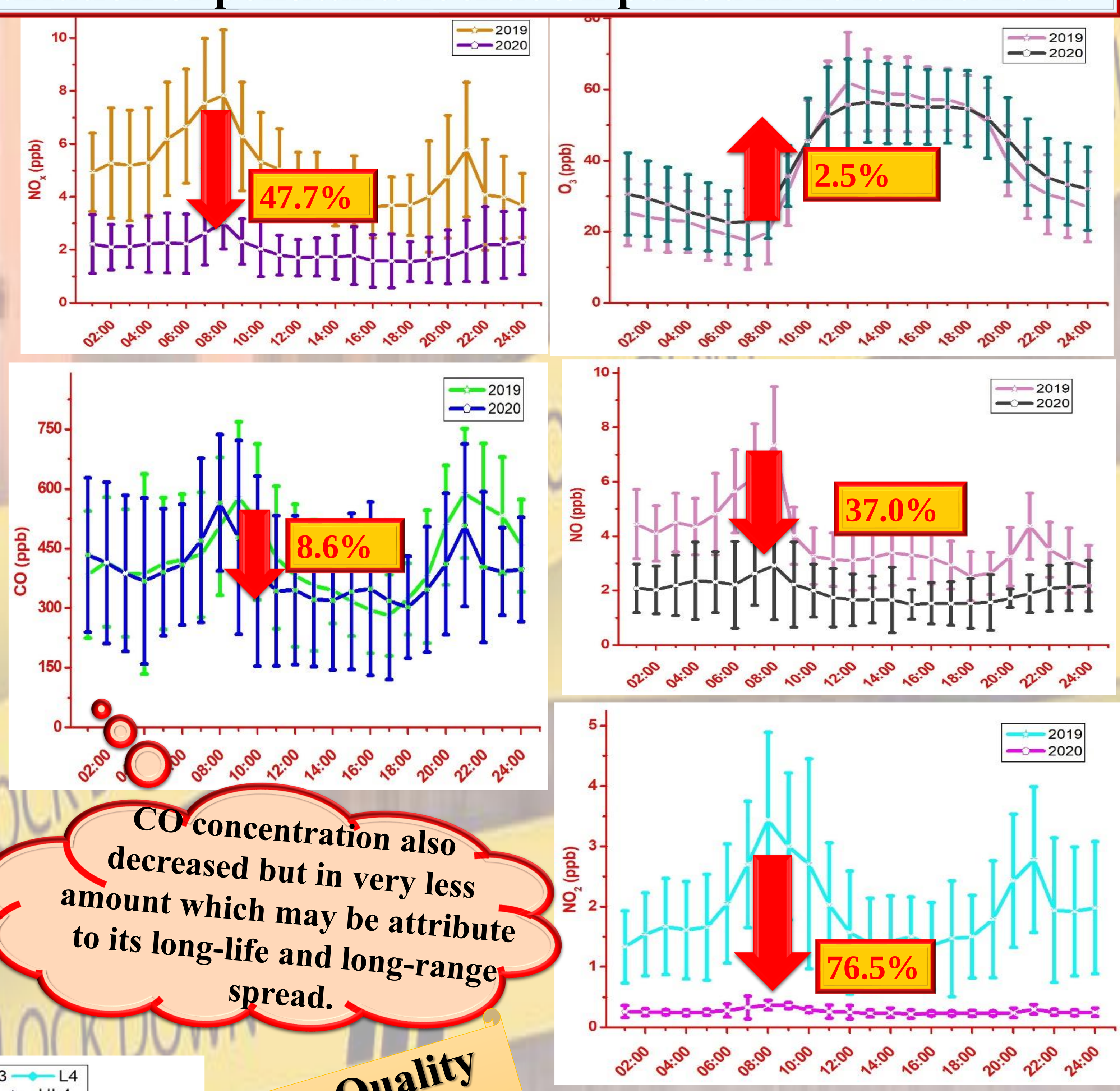
The concentration of O_3 increased by 5.07% during lockdown period as compared to same duration in 2019.

The change in pollutants concentration during pre-lockdown and unlock period didn't show any significant change compared to their previous year concentrations which may be attributed to same meteorological conditions.

NO, NO_2 and NO_x showed suppressed rushed hour peaks/no bi-modal peaks were observed during lockdown period.

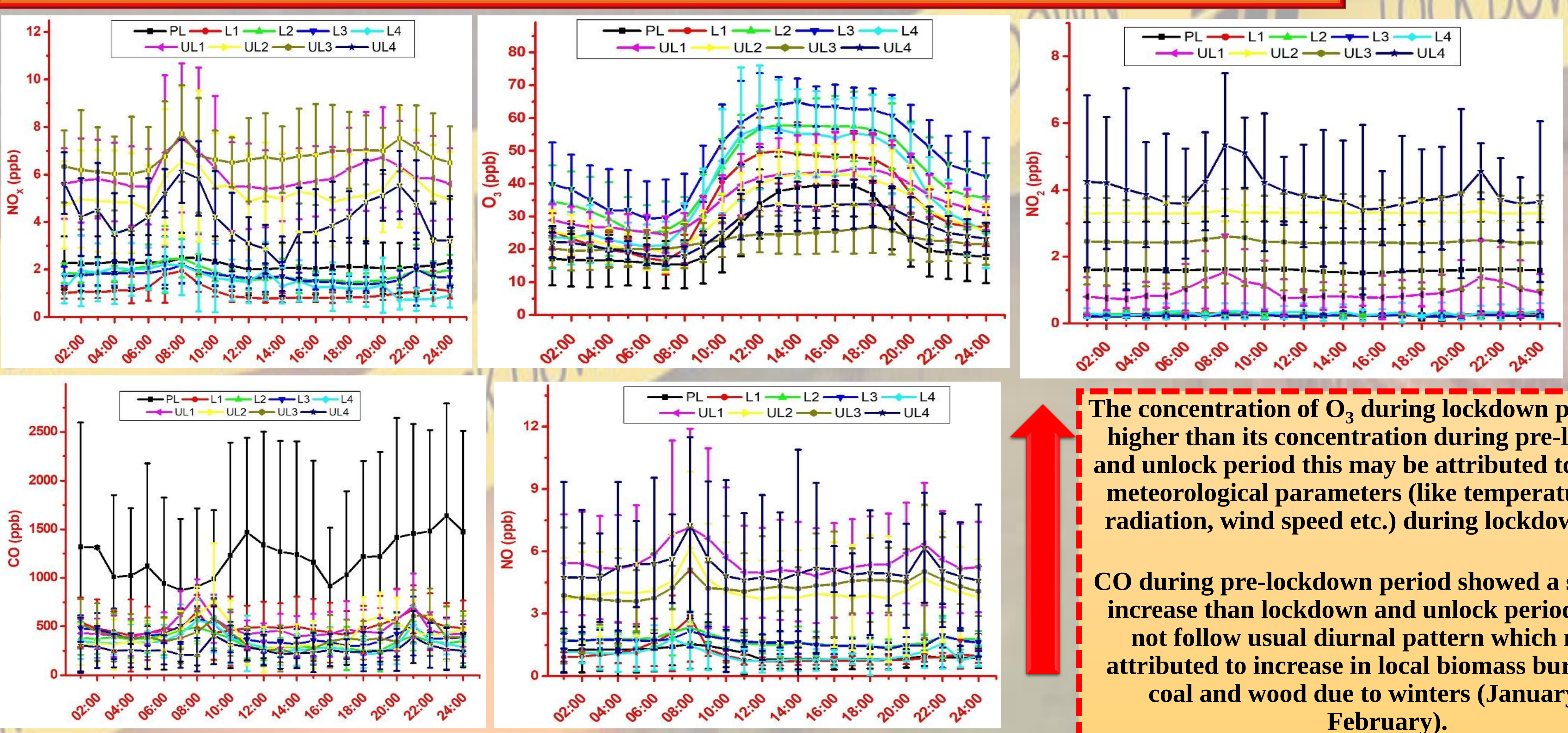
CO showed prominent bi-modal peaks but little supressed than its peaks previous year during same duration.

Diurnal Variation of pollutants lockdown period in 2019 and 2020



CO concentration also decreased but in very less amount which may be attribute to its long-life and long-range spread.

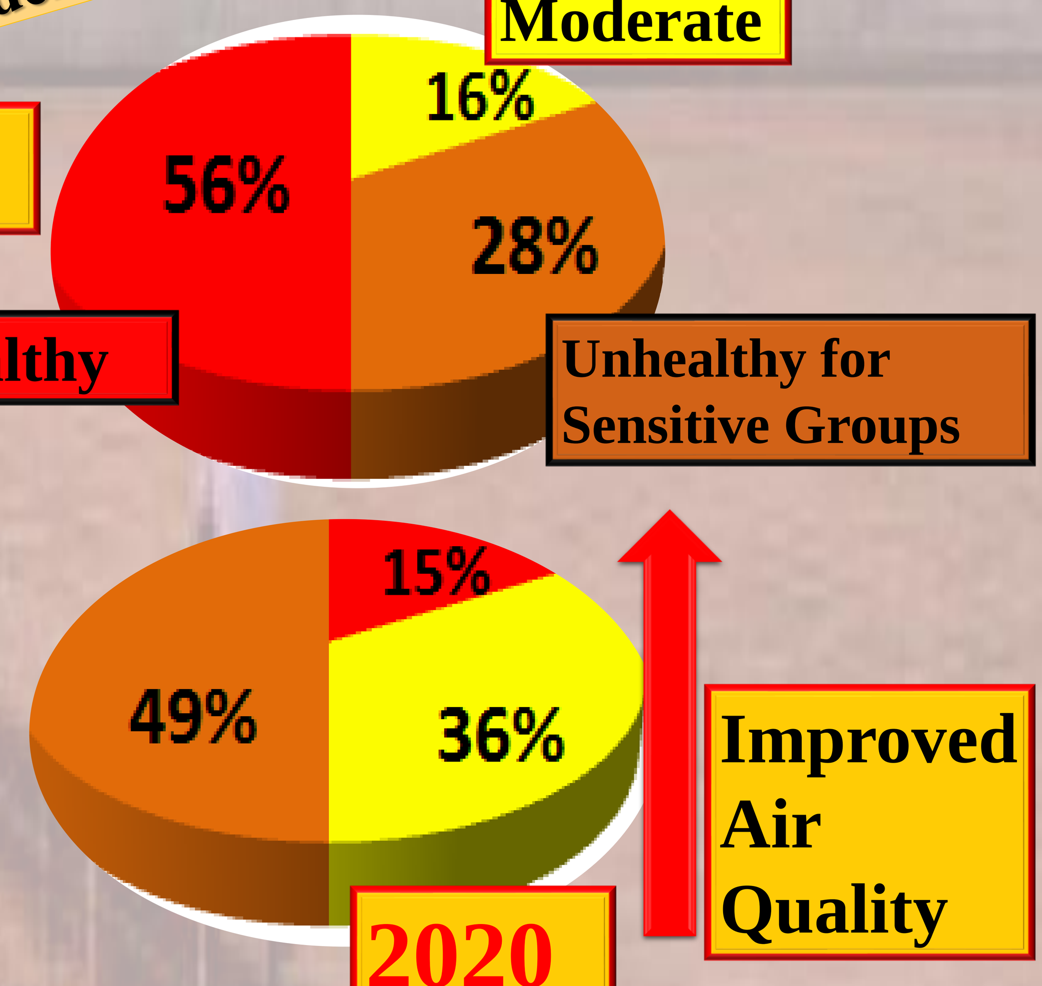
Comparison of pollutants during the different Phases of lockdown and Unlock period in 2020



The concentration of O_3 during lockdown period were higher than its concentration during pre-lockdown and unlock period this may be attributed to favoured meteorological parameters (like temperature, solar radiation, wind speed etc.) during lockdown period

CO during pre-lockdown period showed a significant increase than lockdown and unlock period and did not follow usual diurnal pattern which may be attributed to increase in local biomass burning like coal and wood due to winters (January and February).

Air Quality Index



- Primary pollutants NO_x (NO and NO_2) reduced by 65% (54% and 87%) and CO (9%) respectively during lockdown period (2020) in comparison to the same period of the previous year (2019).
- O_3 concentration increase by 5% during lockdown period compared to previous year concentration.
- Change in AQI unhealthy to moderate and unhealthy for sensitive group.

Acknowledgement
The authors are gratefully acknowledged the financial support for this work, which is provide d by ISRO GBP under AT-CTM project and to the Director, Dayalbagh Educational Institute Agra, Head, Department of Chemistry for providing necessary help.

Mixing Ratios and Stable Isotopes in a North western Province of Asia

-UDDALAK CHAKRABORTY

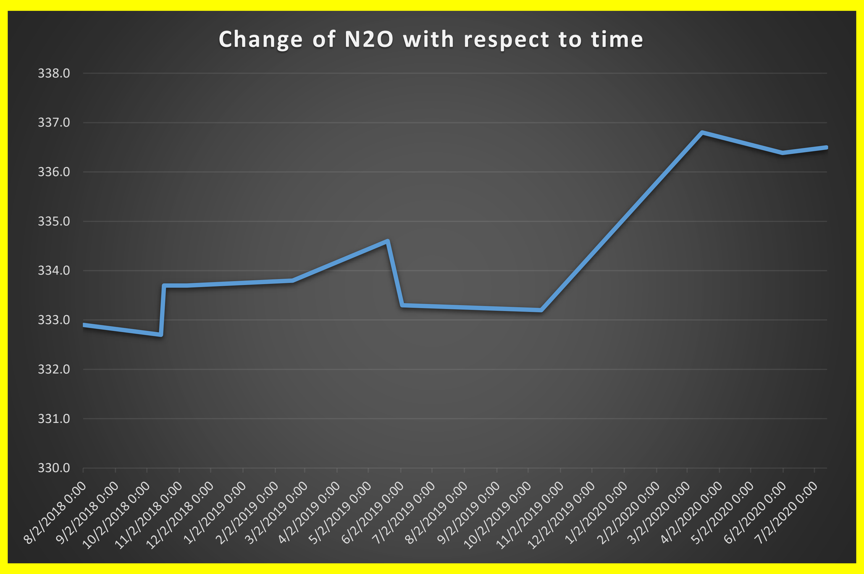
WHY STABLE ISOTOPES OF N2O AND CO2?

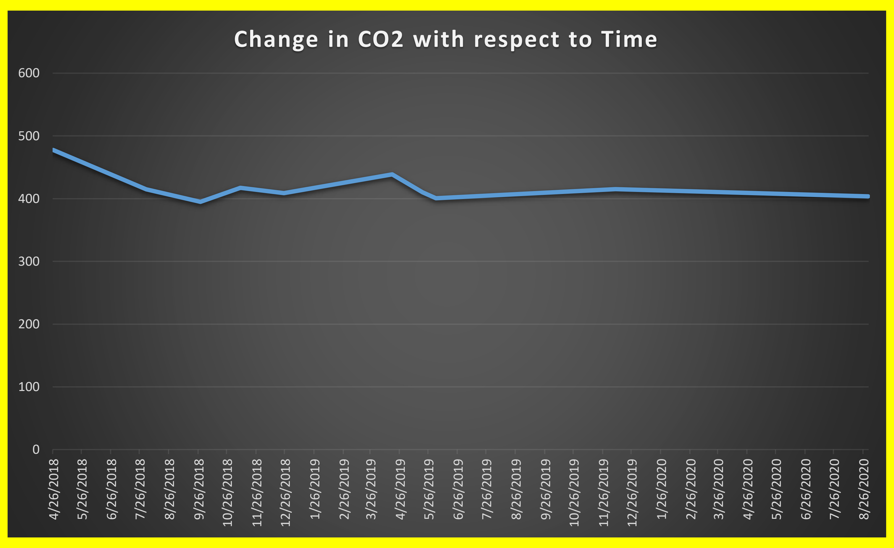
Mixing ratios and stable isotopic compositions of CO_2 and N_2O have widely been used to identify and quantify the sources of greenhouse gases and pollutants. The gases in consideration of our measurement are N_2O and CO_2, which are two important greenhouse gases responsible for global warming. CO_2 is the main greenhouse gas which has different sources and the recent warming is mainly caused by excess release from anthropogenic activities. N_2O has an atmospheric lifetime of 120 years (IPCC 2001, Guha et.al 2020) with a global warming potential of 250-300 times CO_2 on a 100 year time scale. The application of stable isotope ratios of both CO_2 and N_2O in identifying their sources lie in the fact that the isotopic ratios ($\delta^{13}C$ and $\delta^{18}O$ in CO_2 and $\delta^{15}N$, $\delta^{18}O$ and Site Preference in N_2O) are different in the CO_2 and N_2O emitted from different sources such as anthropogenic emission and respiration.

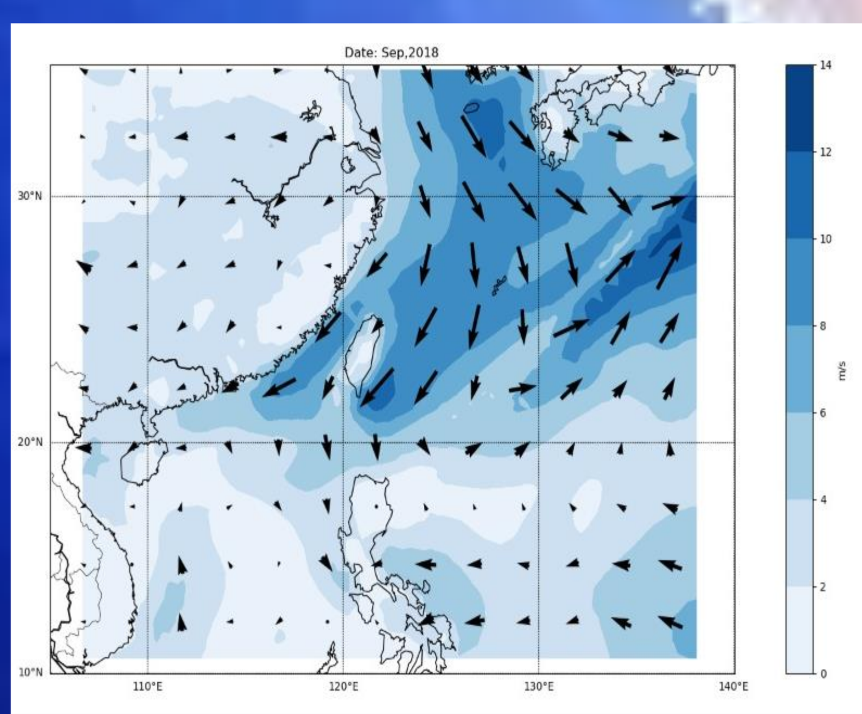
Why Taiwan was chosen?

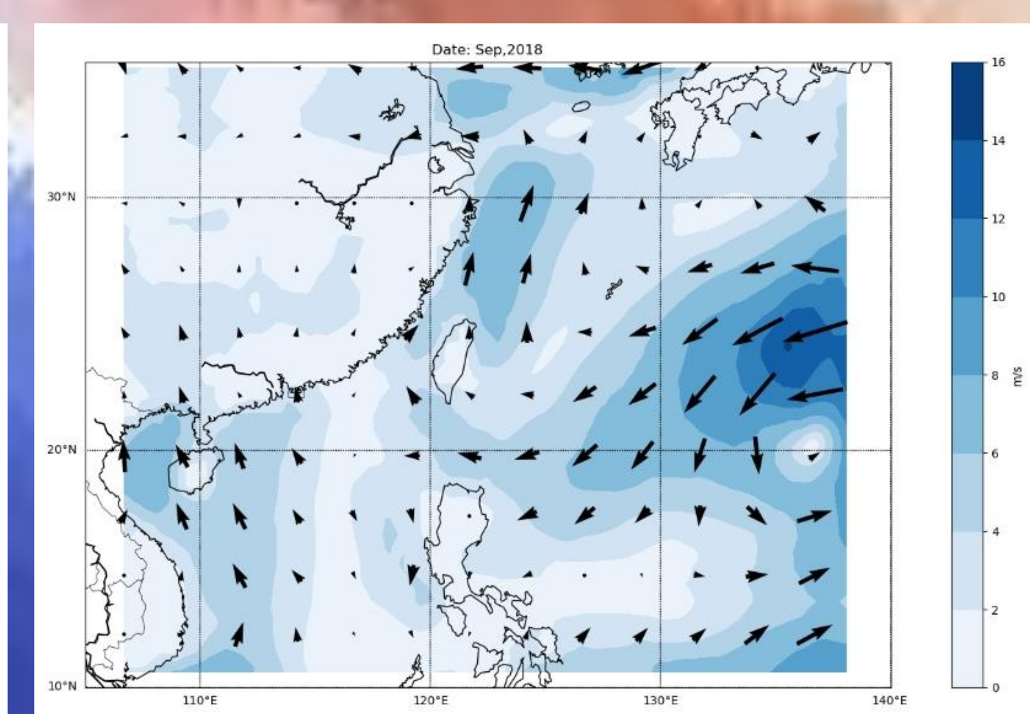
The locational advantage of Taiwan being the convergence point of winds from four directions

Change in N2O and CO2 Concentration with time









The fugue cap data was taken from the year 2018 to 2020 and the wind directions are plotted with the help of NOAA HYSPLIT Data, Google Earth and ECMWF.

RESULTS AND DISCUSSIONS

The wind coming from the South China Sea, notably the data collected in the dates of 2nd August 2018, 3rd June 2019, 7th January 2020, 1st June 2020 and 24th June 2020, show a prominent increase in the $\delta^{13}C$, and $\delta^{15}N$, due to relatively clean marine air reaching the study site.

Another wind trajectory cluster is found to come from the Eastern China with prominent known industrial emissions, on the dates, 15th October 2018, 18th October 2018, 9th November 2018, 22nd November 2018, 25th December 2018, 31st January 2019, 18th February 2019, 4th March 2019, 18th April 2019, 18th April 2019, 4th January 2020. The Anthropogenic effects from the Chinese Industrial belts, caused higher concentrations of CO_2 and N_2O and lower $\delta^{13}C$ and $\delta^{15}N$ values. For example, on 31st January 2019, there is an increase in the N_2O concentration to 334.2 ppb.

Wind back trajectory cluster for wind coming from Sea of Japan, on the dates 29th September 2018, 20th May 2019, 14th October 2019, 1st April 2020, mainly shows oceanic influences as most of the wind passes through the Sea of Japan. Although there is an increase in N_2O concentration probably due to upwelling. The higher N_2O concentration in the upwelled water could be due to denitrification in the deeper ocean.