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RESEARCH ARTICLE

STUDY OF AIR QUALITY INDEX OVER INDIAN REGION DURING LOCKDOWN PERIOD, COVID19

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ABSTRACT

India the ambient atmospheric conditions have progressively deteriorated due to urbanization, industrial development, lack of awareness, poor maintenance of motor vehicles, and poor road conditions. Transport vehicles and industrial emissions are the major sources of pollutants in the earth's atmosphere. Among the various air pollutants from various sources particulate matter, sulfur dioxide, oxides of nitrogen, carbon monoxide are having a significant role in affecting the air quality and thereby causing harm to human health. Hence, these parameters were considered to determine the air quality of India. The objective of this paper is to provide insight details about the current situation of air quality across various cities present in India, along with countless origins and effects of air pollution. An attempt is made to make people aware about various types of gases and particulate matter present in air highlighting their effects on the environment along with the various ways of overcoming this situation during the lockdown COVID19 period, which was started on 22March2020, using the Air Quality Indexis proposed for the seven major cities of India, for simplified public information and data interpretation. The 24-hourly average concentrations of six major criteria pollutants, viz. Particulate matter PM10, PM2.5, Sulfur Dioxide (SO2), and Nitrogen Dioxide (NO2) carbon monoxide and two meteorological parameters, e.g., Humidity and Temperature for the year 2018, 2019, 2010 (January, February, March and April). During the study of the meteorological parameter we observed that, there are no changes in temperature, the humidity level is also not getting any significant changes in the overall cities. Particular Matter (PM10 and PM2.5) both parameters are decreasing overall selected cities, especially in March and April month. Ozone activities are also decreasing as compared with 2018 and 2019 data, during the study of all cities. Nitrogen dioxide levels is decreasing for all cities during these periods. The sulfur dioxide level is decreasing for all cities exceptional Bengaluru city their sulfur dioxide level is very low. The carbon monoxide level is decreasing overall cities during the March and April month.

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INTRODUCTION

Air pollution occurs when harmful and excessive quantities of medicine present within the Earth's atmosphere. Sources of pollution include gases like ammonia, carbon monoxide gas, sulfur dioxide, nitrous oxides, methane, and chlorofluorocarbons, both organic and inorganic particles, and biological molecules. It is getting to cause diseases, allergies, and even death to humans; it also causes damage to other living creatures, animals, and diet products and will lose the natural or built environment. Both acts and natural processes can generate pollution. Pollution could also be a big risk factor for the spread of pollution-related diseases, including respiratory infections, heart conditions, COPD, stroke, and carcinoma.

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The human strength effects of poor air quality are far-reaching, but primarily mark the body's structure respiratory and thus the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a private is exposed to, the degree of exposure, and thus the individual's health status and genetics. Insidetoxic waste and poor metropolitan air quality are listed as two of the world's worst toxic pollution problems within 2008, Blacksmith Institute World's Worst Polluted Places report. Outdoor pollution alone causes a million deaths annually (IAQP, 2010 Reddy *et al*., 2004; Khandelwal *et al*., 2018). Overall, pollution causes the deaths of around 7 million people worldwide annually and is that the world's largest single environmental health risk. Productivity losses and degraded quality of life caused by pollution are estimated to cost the earth economy $5 trillion once a year. Various pollution control technologies and methods are available to reduce pollution. Air pollution kills an estimated seven million people worldwide once a year. WHO data shows that 9 out of 10 people breathe air containing high levels of pollutants

(WHO, 2005). WHO is functioning with countries to observe pollution and improve the air quality level. From smog droopy over cities to smoldering inside the house, pollution stances a significant threat to health and climate (Tandon *et al*., 2008;CPCB., 2000). The combined effects of ambient (outdoor) and household pollution causes about seven million premature deaths once a year, largely as a result of increased mortality from stroke, a heart disease, chronic obstructive pulmonary disease, carcinoma, and acute respiratory infections(Gupta, 1999; WHO,2005). quite 80% of people living in urban areas that monitor pollution are exposed to air quality levels that exceed WHO guideline limits, with low- and middle-income countries suffering from the absolute best exposures, both indoors and outdoors (Dhamaniya and Goyal, 2004; Kala *et al*., 2014).

For developing countries like India pollution features a strange impact on human vigor, agricultural applies climatic variations and overall modifications within the ecosystem (Shrinivas.J 2011). Almost six lakh Indians die per annum to aspect consequences of pollution which have grown to be the fifth leading reason for death across the state, other causes like pollution, nuclear pollutants. Out of these, almost 35,000 deaths rise within the capital, Delhi, relaxation 15,000 deaths are recorded in each commercial area. Maximum cities are suffering thanks to a boom within the concentration of particulate (PM) on the air along aspect gaseous pollution like oxides of nitrogen, Sulphur alongside other toxic materials that are already inflicting serious damage to the environment. The central pollutants manipulate panel that has started a state air nice display program once you consider that 1984 under which numerous pollution index. The Air Quality Index (AQI) may be a scale designed to assist one understand what the air quality around one means to one's health. It's a health protection alarming tool that's designed to assist one plan to protect one's health by limiting short term exposure to pollution and adjusting one's activity levels during increased levels of pollution. It also provides advice on how one can improve the standard of the air one inhales. This index is important for humans that are sensitive to pollution and provides them with instruction and protect their well-being during air quality levels is high. The AQI reports, present air quality supported a selected level of a secluded air pollutant. The AQI communicates varies from 1 to 500 indicating the standard of the air. The upper the amount, the greater the health risk related to the air quality. When the extent of pollution is extremely high, the amount is going to be reported above 300.

The National Air Quality Index (AQI) was launched in New Delhi on Citizenship Day, 2014, under the Swachh Bharat Abhiyan. The Central Pollution Control Board (CPCB) and State Pollution Control Boards have been operating a National Air monitoring program (NAMP) covering 240 cities of the country with 342 monitoring stations. Present study showing, Air Quality Index over seven cities of India during the COVID-19 Lockdown. We are presenting here how the proportion air quality index level is getting changes during the zero human activities. These are only the essential results of the Air Quality Index.

METHODOLOGY

Air quality standards are an essential foundation that gives a legal framework for pollution control.

An air quality standard may be a description of A level of air quality that's adopted by a regulatory agency as enforceable. the idea of the event of standards is to supply a rationale for shielding public health from the adverse effects of air pollutants, to eliminate or reduce exposure to hazardous air pollutants, and to guide national/local authorities for pollution control decisions(Jain *et al*., 2015; Biswas *et al*., 2011; Khanna *et al*., 2000; Nagendra *et al*., 2007). The Air Quality Index may be a tool for effective communication of air quality status to people in terms, which are easy to know. It transforms complex air quality data of varied pollutants into one number (index, value), nomenclature, and color. There are six AQI categories, viz. Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each of those categories is set supported ambient concentration values of air pollutants and their likely health impacts (Pal *et al*., 2018; Ghude *et al*., 2008; Sharma *et al*., 2003; Sharma *et al*., 2003a; Beig *et al*., 2010). AQ sub-index and health breakpoints are evolved for eight pollutants (PM10, PM2.5, NO2, SO2, CO, O3, NH3, and Pb) that short-term. National Ambient Air Quality Standards are prescribed. supported the measured ambient concentrations of a pollutant, sub-index is calculated, which may be a linear function of concentration (CPCB, 2014; Kamath *et al*., 2014; Rizwan, 2013). AQI categories and health cutoff point for the eight pollutants are as follows:

In the present study, we consider seven a severely polluted city of India during the Lockdown COVID19; these are shown in table 1. This study is predicated on the median of both the parameters (Pollution data and meteorological) this data is out there on Air Quality Open Data Platform Worldwide COVID-19 dataset aqicn.org/data-platform/covid19/. The info for every major city is predicated on the typical (median) of several stations. The info site provides min, max, median, and variance for every of the air pollutant species (PM2.5, PM10, Ozone, NO2, SO2, CO) also as meteorological data (Temperature, Humidity). All air pollutant species are converted to the US EPA standard. All dates are UTC based. The column count is that the number of samples used for calculating the median and variance. Within the present analysis, we are taking the daily median of all parameters. The data set has taken four-month of the last three years (January, February, March, and April).

RESULTS AND DISCUSSION

After the spreading of Noval CORONA various in the world, all countries stared to lockdown for the safety purpose of mankind, in these chains India stared lockdown period from 22 March 2020.whole India made lockdown for a while, this is the good time for nature to gate the time for recovery of the environment in contrast of this period our present study showing how much nature doing its work and how it is recovering human damage for this we are chosen six air quality index and two meteorological parameters which are observed from seven cities of India(section2) first we will describe the two meteorological parameters after that Air Quality Index data.

Temperature

During the study of temperature data we noticed that the temperature of all stations is lower as compared to 2019 data over all stations. Temperature is the most important premier for the earth's atmosphere, it defines the climate condition of the weather. Global warming is the result of temperature.

AQI Category	AQI	Concentration range*							
		PM_{10}	$PM_{2.5}$	NO_2	O_3	CO	SO_2	NH_3	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	251 - 350	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 – 400	351 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 -1800	3.1 - 3.5
Severe	401 - 500	430 +	250+	400+	748+*	34+	1600+	1800+	3.5+

* CO in mg/m^3 and other pollutants in $\mu g/m^3$; 2h-hourly average values for PM_{10}, $PM_{2.5}$, NO_2, SO_2, NH_3, and Pb, and 8-hourly values for CO and O_3.

Table 1. Indian Cities and period of data analysis during COVID19

Cities	Data used for Study		
Delhi	2018	2019	2020
Mumbai	2018	2019	2020
Kolkata	2018	2019	2020
Chennai	2018	2019	2020
Bhopal	2018	2019	2020
Bengaluru	2018	2019	2020
Patna	2018	2019	2020

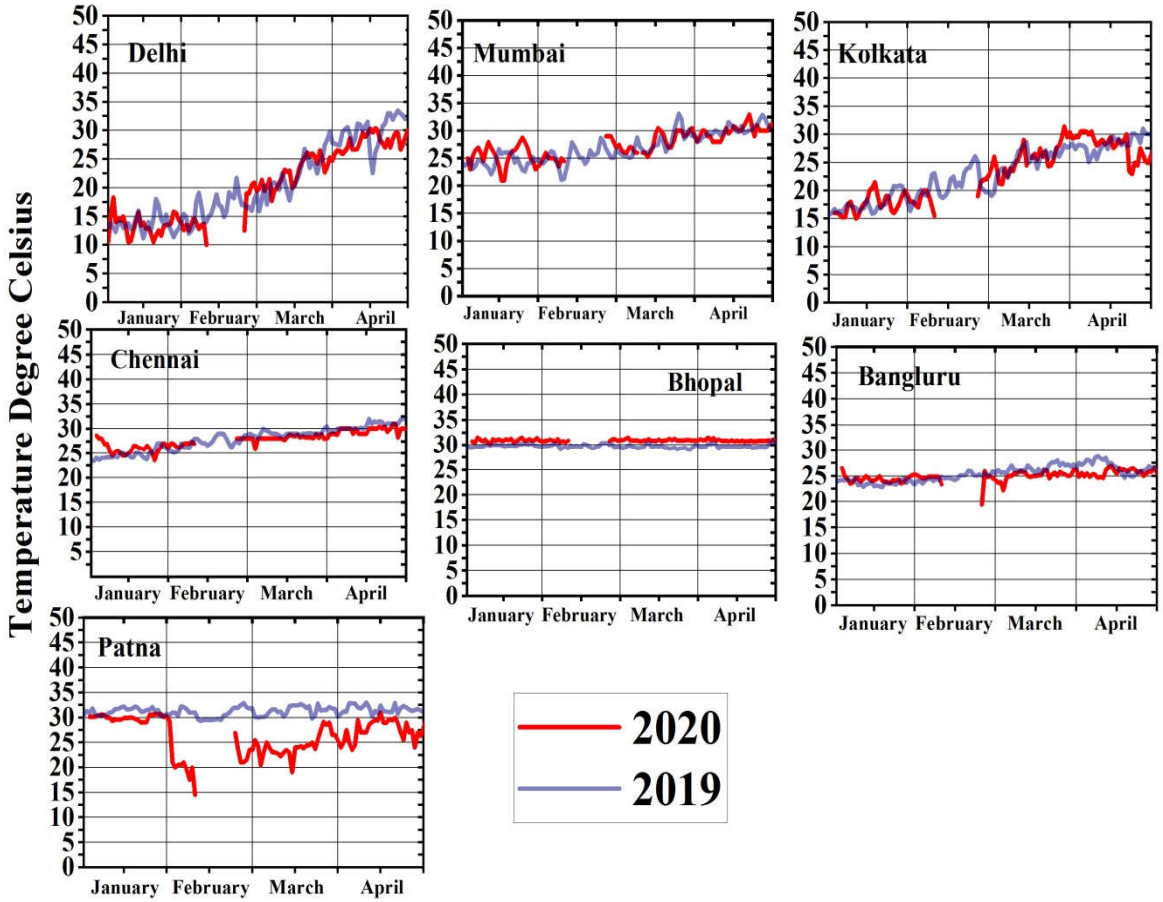

Figure 1. Temperature variation during the lockdown covid19 over India

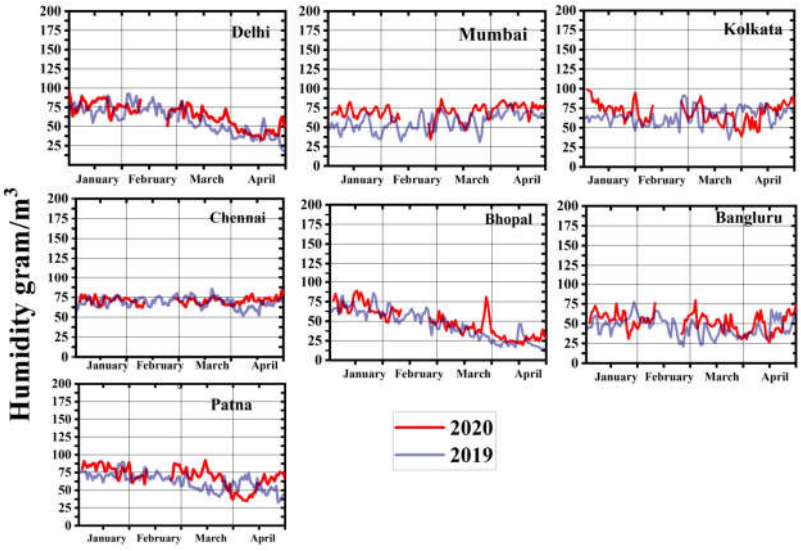

Figure 2. Humidity is showing for all seven stations during the lockdown covid19 over India

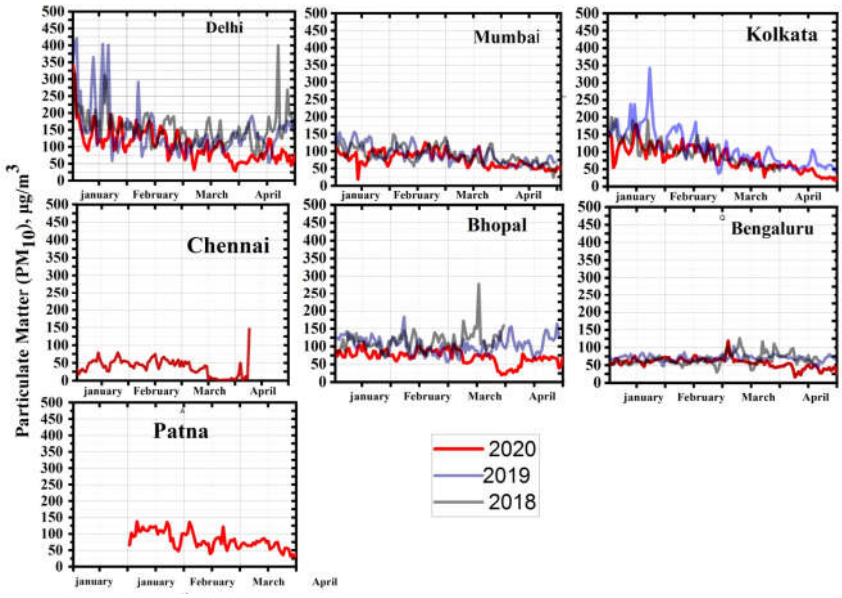

Figure 3: Variation of particulate matter 10 (PM10) during the lockdown period

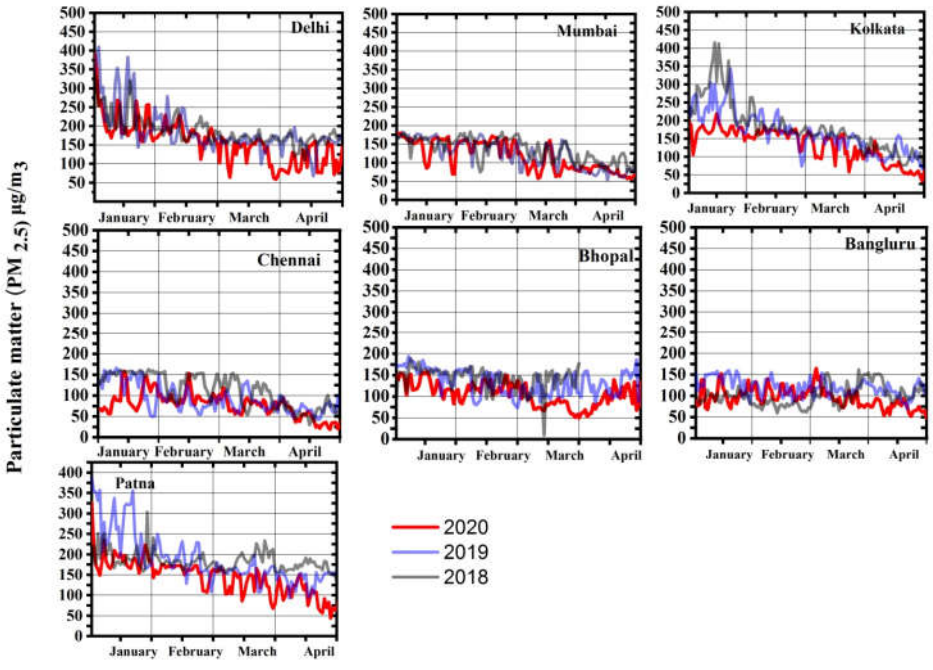

Figure 4. Variation of PM2.5 during the lockdown periods

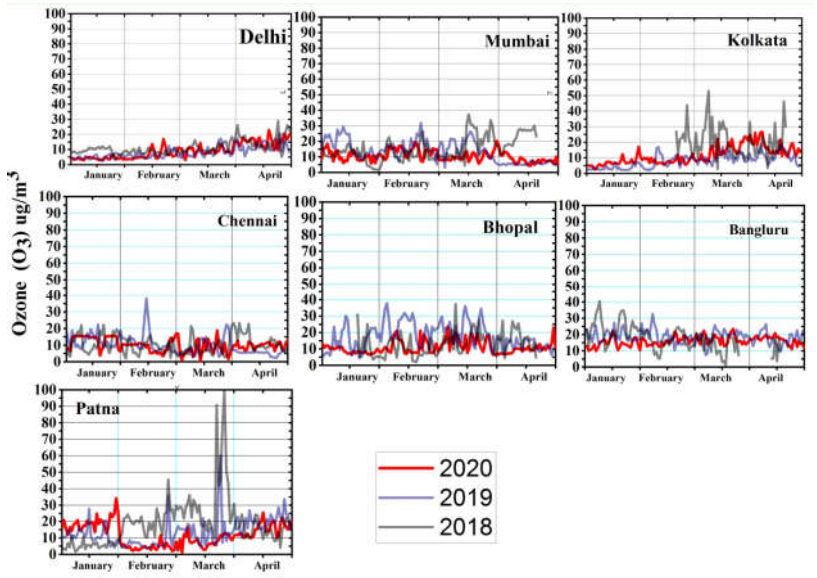

Figure 5: Ozone activity during the lockdown period

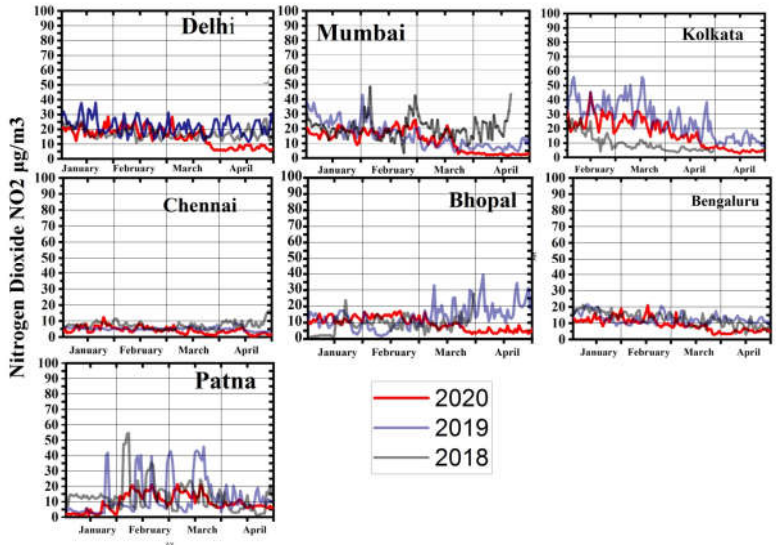

Figure 6. Nitric Oxide variation during the lockdown period

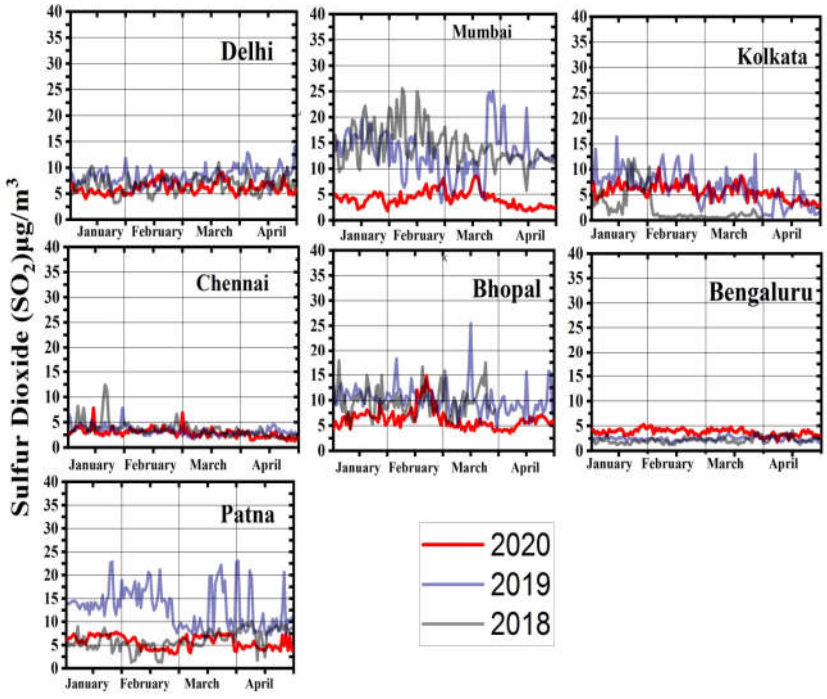

Figure 7. Variation of Sulfur Dioxide during the lockdown period

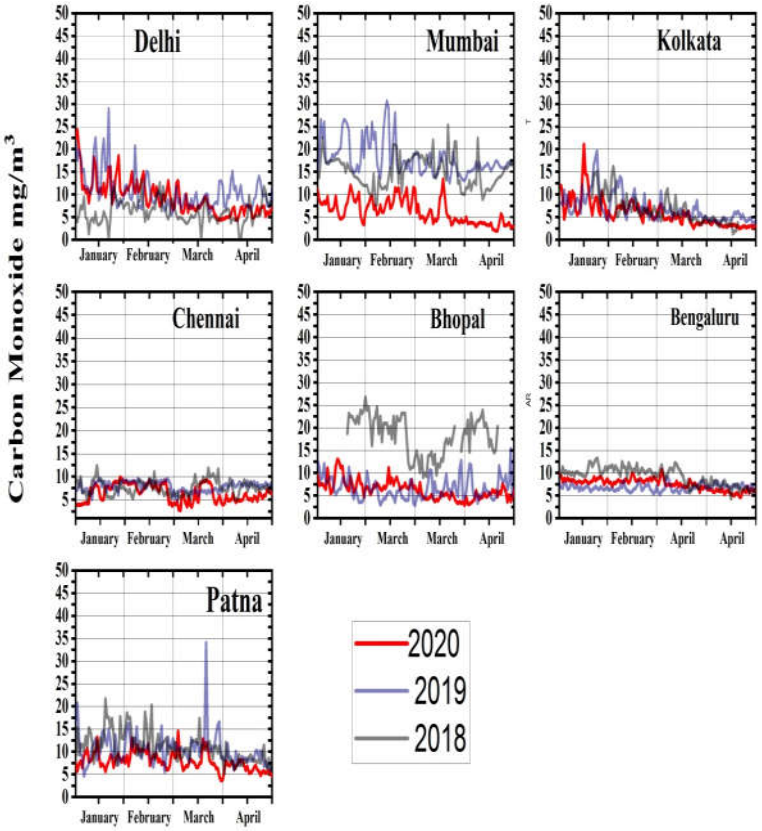

Figure 8. Carbone Monoxide variation during the lockdown period.

Humidity

Atmospheric humidity is the amount of water vapor carried within the air. It is often measured as vapor pressure, mixing ratio, or specific humidity. Specific humidity is that the ratio of vapor mass to the total atmosphere, whereas the mixing ratio is the ratio of the mass of vapor to the mass of dry air. The atmosphere must take away the water evaporated from the surface and provide water to areas of rainfall. Water that flows from the land to the oceans in rivers was delivered to the land areas by transport within the atmosphere as vapor. The humidity might affect human health because it affects our thermal comfort layer, When the weather is warm and humidity is high, the body finds it difficult to keep cool, because it's durable to eliminate the heat via evaporation of sweat into the air. This can lead to dangerous levels of overeating. Severe illness or even death can result from heat stress, and it can trigger other problems with breathing, heart attacks, or strokes. This can be a particular problem at sporting events held during the summer months, and particular care has to be taken to ensure athletes and spectators are well hydrated and rested as often as possible. After an extended period of high humidity, the air develops a heavy feel. When it rains, humidity decreases and the air feels 'lighter'. This has been shown to lead to widespread feelings of elation. Some research suggests that this change in humidity, mostly in parts of the Tropics (where it is humid throughout the year) may contribute to an improvement in physical and mental health.

Observation of the humidity data of seven stations (Figure 2), we noticed that the humidity is gradually decreasing as compared to 2019. Delhi station, it is observed 27 grams/m3 in April 2020 month. In the Mumbai station, it is increasing as compared to 2019 data and it is observed 80 gram/m3. At the Kolkata station maximum humidity observed 40gram/m3 during the end of March month. In the Chennai station there is no significant change observed. At the Bhopal station we can see clearly that humidity is decreasing it is observed 25 gram/m3. Over the Bengaluru station, it is normal, but for Patna station, it is decreasing and observed 30 gram/m3.

Particulate Matter: The evidence of airborne particulate (PM) and its public health impact are consistent in showing adverse health effects at exposures that are currently experienced by urban populations in both developed and developing countries (Beg *et al* 2010). The range of health effects is broad, but these effects are predominantly associated with the respiratory and cardiovascular systems. All types of populations are affected, but the susceptibility to the pollution may vary with health, age. The danger for various adverse outcomes has been shown to extend with exposure, but the size to suggest a threshold below which no adverse health effects would be anticipated isn't available. The low end of the range of concentrations at which adverse health effects are demonstrated isn't greatly above the background concentration; which for particles smaller than 2.5 μm (PM2.5) has been estimated to be 3-5 μg/m3 in both the U.S. and western Europe. The epidemiological evidence shows the adverse effects of PM following both short-term and long-term exposures. The particulate (PM10) is shown in figure 3, we will see the variation of it over all stations. During the lockdown, it's decaying, we will also compare this data with 2019 and 2018 datasets. The worth of PM10 we noticed 25 μg/m3 over Delhi station during the lockdown period is decreasing as compared with 2019 and 2018. Over the Mumbai situation, it's observed 30 μg/m3, we will also compare it with the 2019 and 2018 data.

From the Kolkata station, it's 20 µg/m3 observed. Over the Chennai station we didn't get sufficient data for compression. Bhopal station we noticed the wart if PM10 is 15 µg/m3 this is often very drastic value as compared with 2019 and 2018. For the Bengaluru station we noticed it 15 µg/m3. At Patna station, it's 30 µg/m3 but we didn't get sufficient data for more prediction at this station. Particulate Matter 2.5 (PM2.5) showing in figure 4, from the figure we can notice this parameter also decreasing during the lockdown period over all stations. For the Delhi station, it is decreasing from 150 µg/m3to 50µg/m3. At Mumbai station it is 100µg/m3 to 50µg/m3. Over the Kolkata station it is observed 125µg/m3 to25 µg/m3. For the Chennai station, it is noticeable between 100µg/m3to 25 µg/m3. For the Bhopal station, this is very between 150 µg/m3to50 µg/m3 in the figure, we can see clearly after mid-April the value of PM2.5 is increasing and reaching its highest value. Over the Bengaluru station, it is a fluctuation between 160 to 50 µg/m3. It is also decreasing during the lockdown period. For the Patna station, it is decreasing from 175 to 50 µg/m3 during this period.

The toxic pollutants released from various vehicles are a major source of air pollution. Rapid growth in the use of personal vehicles rather than using private vehicles has not only increased the extensive demand for vehicle oil but also have increased the concentration of particulate matter in the air. This steady shift has also led to a change in transport pattern as nowadays people prefer roadways rather than using railways. By the end of 2010 it was estimated that India has more than 5million vehicles running out of which 65% of vehicles are two-wheelers working on petrol. Across major cities of country 800 to 1000 tons of pollutants are released into the air daily out of which 50 percent come from vehicle exhausts

Ozone: The ozonosphere or ozone layer is a child of Earth's stratosphere that absorbs most of the Sun's ultraviolet radiation. It contains a high concentration of ozone relating to other parts of the atmosphere, although still small around other gases within the stratosphere. The ozonosphere contains less than 10 parts per million of ozone, while the typical ozone concentration in Earth's atmosphere as an entire is about 0.3 parts per million. The ozonosphere is especially found within the lower portion of the stratosphere, from almost 15 to 35 kilometers above Earth, although its thickness varies seasonally and geographically. Formation of Ozone in the atmosphere by photochemical reactions in the presence of sunlight and precursor pollutants, like the oxides of nitrogen and volatile organic compounds. It's destroyed by reactions with NO_2 and is deposited at the bottom. Several studies have shown that ozone concentrations correlate with various other toxic photochemical oxidants arising from similar sources, including the peroxyacetyl nitrate, nitric acid, and hydrogen peroxide, and. Measures to regulate tropospheric ozone levels focus its precursor gas emissions but are likely to also control the amount and impacts of the many other pollutants. Significant additions to the health effects evidence base have come from epidemiological time-series studies. Collectively these studies have revealed positive, small, though convincing, associations between daily mortality and ozone levels, which are independent of the consequences of particulate. Similar associations are observed in both North America and Europe. During the lockdown, we study the ozonosphere variation which is shown in figure 5, we noticed that over the Delhi station, it's increasing from 5 to 20 µgram/m3 it's may due to the low chemical reactivity. There's no change with the past data. At Mumbai station, it's observed normally, but if we compare it with the last two years, it's less than in 2018 and 2019. Over the study at Kolkata, station ozone is increasing after the second week of March and it's reached a maximum on the first week of April then it's decreasing from 28 to 10 µg/m3 in the last week of April but if we compare this data from the past two years we get the lowest value it means ozone activity is decreasing during the lockdown period. Over the Chennai station, ozone activity is decreasing in April month and ranging between 10 to fifteen µg/m3, as compared with previous years it's decreasing. To the continued study for Bhopal station, we noticed it's decreasing and observed 5 µg/m3 in April month, we also compare it with the past 2 years and that we noticed it's less than the last two years 2019 and 2018. Over the study of Bengaluru station ozone activity is decreasing as compared with 2019 and 2018.For the Patna station ozone activity may be a bit high but as compared with last year it's observed lower. It's clear from figure all station data show the ozone activity is less than the past two years during the lockdown period**.**

Nitrogen Dioxide: Atmospheric NO_2 is emitted as NO, which is fast oxidized by ozone molecules to NO_2. The existence of hydrocarbons and ultraviolet is the corebasis of tropospheric ozone and nitrate aerosols, which form a critical segment of the ambient air PM2.5. As an air pollutant, NO2 has multiple roles, which are often difficult to separate from each other. The first sources of nitrogen oxides are automobiles, power plants, and waste disposal systems. There's still no healthy basis for the situation an annual average advice rate for NO2 concluded any direct toxic outcome. Evidence has emerged, however, that increases the priority over health effects related to outdoor pollution mixtures that include NO_2. As an example, epidemiological studies have shown that bronchitis symptoms of asthmatic children increase in association with annual NO_2 concentration which reduced lung function growth in children is linked to higher NO_2 absorptions within population snow at current North American and European urban ambient air levels. Numerous recent studies have confirmed that NO_2 can have an improved spatial dissimilarity than other traffic-related air pollutants, for instance. These studies also found adverse effects on the health of youngsters living in metropolitan areas characterized by higher levels of NO_2.

Nitrogen Dioxide variation showing in figure 6 during the lockdown period, in the figure we can see clearly that nitric oxide is decreasing during these periods and we can also compare it with the last two years' data. During the study over Delhi station we observed 5 µg/m3 after 20th march according to the last two years it is observed 30µg/m3. Over Mumbai station, it is noticeable **< 5** µg/m3 we can compare this data with the past two years we will get the maximum value of nitric oxide was 30 µg/m3. For the Kolkata station, it is also observed 5µg/m3. Over the Chennai station, it is observed **< 5**µg/m3. For the Bhopal station, it is observed ≈ 5µg/m3 while it was 40µg/m3 in the last two years. Over the Bengaluru station, it is noticeable **< 5** µg/m3. For Patna station, it is also observed the low value of nitric oxide. All data we can compare with the last two years and we can see the lower value of nitric oxide during the lockdown periods.

Sulfur Dioxide (SO2): Controlled studies involving exercising asthmatics indicate that a proportion of the population experiences changes in pulmonary function and respiratory

symptoms after periods of exposure to SO2 as short as 10 minutes. Early estimates of day-to-day changes in mortality, morbidity, or lung function about24 -hour average concentrations of SO2 were necessarily based on epidemiological studies in which people were typically exposed to a mixture of pollutants. There is still considerable uncertainty as to whether SO2 is the pollutant responsible for the observed adverse effects or whether it is a surrogate for ultrafine particles or some other correlated substance. The variation of sulfur dioxide protesting in figure 7, from the figure over Delhi station, the observed value of SO2 is **< 7** µg/m3 and if we compare it with the past year data we can get it is lower after mid-month of march. For the Mumbai situation, it is observed **< 5** µg/m3, the figure is shown after march 21st it is decreasing. Over the Kolkata station, it is observed **4** µg/m3 during the lockdown period. For the Chennai station, it is observed normal value **< 5** µg/m3 but if we compare it with last year data it is decreasing. Over the Bhopal station we can see it is decreasing. For the Bengaluru, it is observed as a normal value. At the Patna station, it is getting lower than in 2019 and 2018 data.

Carbon Monoxide: Carbon monoxide is an odorless, colorless, and poisonous gas, because it's miles not possible to see, flavor or smells the toxic fumes, CO can kill you before you're aware it's miles from your home. At lower stages of exposure, CO causes slight results which can be regularly fallacious for the flu. These signs consist of headaches, dizziness, disorientation, nausea, and fatigue. The consequences of CO publicity can vary substantially from individual to person depending on age, typical health, and the attention and length of publicity. Sources of Carbon Monoxide are unvented kerosene and gasoline area heaters; leaking chimneys and furnaces; back-drafting from furnaces, fuel, water heaters, wood stoves, and fireplaces; gas stoves; generators and other gasoline-powered equipment; vehicle exhaust from connecting garages; and tobacco smoke. Incomplete oxidation in the course of combustion in fuel stages and invented gasoline or kerosene heaters may additionally cause high concentrations of CO in indoor air. Worn or poorly adjusted and maintained combustion devices (boilers, furnaces) can be huge sources, or if the drift is improperly sized, blocked, disconnected, or is leaking. Auto, truck, or bus exhaust from attached garages, close by roads, or parking areas also can be a source.

At low concentrations, fatigue is visible in wholesome humans and chest ache in human beings with heart disease. At better concentrations, impaired imaginative and prescient and coordination; headaches; dizziness; confusion; nausea can motive flu-like symptoms that solve after leaving home. It may be deadly at very high concentrations. Acute results are due to the formation of carboxyhemoglobin within the blood, which inhibits oxygen intake. At moderate concentrations, angina, impaired vision, and reduced brain characteristic may additionally result. During the analysis of carbon monoxide, we can see the level of CO is decreasing during the lockdown period march and April month overall monitoring stations it means that during this period there is pollution level is deducing and level of fresh air is increasing. For the study of Delhi station we can see from figure 8, the level of CO in decreasing after the last week of March, and it continues till the end of April month it is observed 5mg/m3. Over the Mumbai station level of CO is decreasing and observed less than 5mg/m3 during the lockdown period. Over the Kolkata station, it is also decreasing. For the Chennai station we can see it is < 5mg/m3. Over the Bhopal station, it is observed < 10mg/m3. From the Bangalore station, it is near about 5mg/m3. For the Patna station level of CO is decreasing. We can compare all data with the last two year data we will get CO level is very low during the lockdown period.

Conclusion

The major outdoor pollution sources include vehicles, power generation, building heating systems, agriculture/waste incineration, and industrial. Policies and investments supporting cleaner transport, energy-efficient housing, power generation, industry, and better municipal waste management can effectively reduce key sources of ambient pollution. The present study based on the average value of all data set which is analyzed for the lockdown period COVID19. During this period, there is all human activity is shutdown, total industries, vehicles are stopped, and this is the golden time for recovery of air pollutions overall world. In contrast to this period our study is concluding the following:

During the study of the meteorological parameter we observed that, there are no changes in temperature, the humidity level is also not getting any significant changes in the overall cities. Even if we compare this data with the past two year's data we will get no changes. The humidity level is very low over the Bhopal region as compared with other cities. Particular Matter (PM10 and PM2.5) both parameters are decreasing overall selected cities, especially in March and April month.PM level is higher in Delhi and lowers at Bengaluru and Bhopal regions as compared with other cities. Ozone activities are also decreasing as compared with 2018 and 2019 data. During the study of all cities, we noticed that the ozone level is very low over Bengaluru area and highest over Bhopal Kolkata and Patna station. Nitrogen dioxide levels are decreasing for all cities during this period.NO2 levels are very low for the Chennai area and highest over Mumbai, Kolkata, and Patna. The sulfur dioxide level is decreasing for all cities exceptional Bengaluru city their sulfur dioxide level is very low. SO2 level is observed highest in Mumbai, Kolkata and Bhopal areas and minimum at Chennai and Bengaluru regions. The carbon monoxide level is decreasing overall cities during the March and April month. The highest level of CO in observing at Delhi, Mumbai and Patna regions, and minimum activities observed at Chennai and Bengaluru regions.

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