Retraction

Retraction: Ambient Air Quality During Covid 19 Pandemic in Chennai-An Urban Metro City of India (IOP Conf. Ser.: Mater. Sci. Eng. 1145 012114)

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This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

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Ambient Air Quality During Covid 19 Pandemic in Chennai - An Urban Metro City of India

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Abstract. COVID’19 pandemics has brought a tremendous change in the regular human life style due to the severity of the virus. In addition, a positive impact was observed in the ambient air quality due to complete absence of anthropogenic activities contributing to the air pollutants in the urban sprawl for a short duration because of the lockdown restrictions imposed by the government. In this study, we have discussed the trend of air quality with respect to pre-lockdown, lockdown, and post-lockdown. It was observed that on an average 50% - 70% decrease in pollutant concentration measured during lockdown compared to pre-lockdown measurements. However, post-lockdown showed an increasing trend in concentration but are within the permissible limits due to the restrictions imposed in the post-lockdown. This short analysis presented in this paper highlights the effect of lockdown over air quality improvement observed in a densely populate metro city of Tamil Nadu.

Keywords: COVID19, Air Quality, NAAQS, Pollutants, Lockdown.

1. Introduction
Air being a foremost important source for any living creature to live in the earth. The quality of atmospheric air is being depleted or polluted through various natural and anthropogenic actives. Several measures have been taken by the researchers, scientific communities and regulatory authorise to improve the air quality every year. However, in the recent past an international pandemic alert was declared by the World Health Organization (WHO) due to the spread of extremely contagious viral disease named COVID 19 [1]. This pandemic has negatively influenced the social relationship of human and economic sector in the entire world. The first COVID 19 case was reported in Wuhan, China in the end of 2019 [2]. Later the spread of disease was confirmed through the cases reporting in each country [3]. During the drafting of this paper, India tops the second highest position with total cases. Also, a new variant of corona virus was in spread identified to exist in 240 varying strains. The first COVID 19 cases in India was identified in Kerala located in the southern part of India [4]. Once after all, several COVID 19 cases started to emerge in all parts of the country having reported the highest number of cases in Maharashtra and the lowest in Mizoram [5]. Thereafter, the prime minister of India “Narendra Modi” imposed a national curfew / lockdown for a period of 21 days initially to curtail the spread of disease [6]. Later the lockdown was extended for a longer duration, during which all the industries, commercial places and educational institutions were closed till the next announcement.
This disease was reported to communicate between humans through release of aerosols (diameter > 5 to 10 micron) from the infected person when on close contact (6 feet and less) through various activities like coughing, sneezing [7] and the virus present in the aerosols released from the infected human respiratory track remains suspended in the atmosphere for a longer period in closed and poorly ventilated environment and crowded locations. So, it is to note that regions with dense population needs more attention on taking precautionary measures and actions to maintain hygiene in the public gathering places in addition to imposing guidelines recommended by WHO.

So, in this article the air quality scenario of Chennai, a southern urban metro city of India (as in Figure 1a) is analysed to understand the impact of the impose of lockdown during the year 2020 due to pandemic. The objective of this article is to analyse the air quality trend of a southern metro city during the pre-lockdown (1st January 2020 to 23rd March 2020), lockdown (24th March 2020 to 04th May 2020) and post-lockdown / unlock period (05th May 2020 onwards).

2. Study area and Data acquisition
Chennai, recognised as a metropolitan city in the state of Tamil Nadu (Figure 1b). It is the capital of Tamil Nadu with dense population. It is a well known tourist spot as the city has more than 500 temples and a longest beach in the world. Also, it has numerous and well established educational and research institutes. Since 1990s, the economy of Chennai corporation is largely boomed by the multinational software companies, automobile and electronic manufacturing industries. The air quality of Chennai city is studied by various research groups around the world through numerous readily available online resources and through field-based monitoring.

We in this article, accessed the air quality data acquired from the Central Pollution Control Board (CPCB) website [8]. These are the real time data monitored and uploaded by the state and central pollution control board agencies for the monitored locations through National Air Quality Monitoring Programme (NAMP). Through this programme, 344 monitoring stations were setup to cover 29 states and 6 union territories [9]. In this monitoring programme, major air pollutants i.e. PM, NOx, SOx, Ozone, carbon monoxide and in addition meteorological parameters such wind velocity, temperature, and relative humidity were also monitored.

The above said air pollutants and meteorological parameters data were downloaded for the Chennai metro city for the year 2020 and is investigate through statistical tools to understand the impact of lockdown over the air quality. The regular and complete data for the Chennai region was made available in the CPCB website for three locations, (i) Alanthur, (ii) Velachery, and (iii) Manali (Figure 1c). The details of sampling location chosen for the study is briefed under Table 1.

3. Results and discussion
In recent researches published after the spread of the COVID-19 pandemic have shown strong evidence of relationship between air pollution and COVID-19 adverse outcomes (contagions and deaths). In scope of those findings, this paper discusses the levels of criteria air pollutants prescribed in the National Ambient Air Quality Standards (NAAQS) for India. The annual mean concentration of six monitored pollutants is shown in figure 2. The annual mean concentrations of six pollutants for all observed locations were found well below the NAAQS permissible limits. But the highest PM$_{2.5}$ concentrations was observed in Manali compared to other two locations. The high concentration levels could be due to the continuous emissions from the refineries. These observations show that the low annual mean concentration of pollutants in the Chennai region was comparatively less observing good air quality due to the lockdown imposed by the government due to the COVID’19 pandemic which drastically arrested the traffic movement causing the major air pollution problem in the city. However, the annual trend shows quite good air quality but the best results are found during lockdown period. So, it is obvious to analyse deep the air quality trend with respect to the pre-lockdown, lockdown, and post-lockdown periods [10].
**Figure 1.** The geographical view of (a) India, (b) TamilNadu, and (c) Chennai (Green coloured location symbol specifies the CPCB online sampling stations).

**Table 1.** A detailed classification about each study location.

| Location     | Types of location              | Population count | About the location                                                                                                                                 |
|--------------|--------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Alandur      | Residential zone               | 1,64,430         | • Surrounding by major traffic routes with round the clock transport movement as the road network in this location connects the transport movement in all four directions.  
• An elevated metro rail corridor is also located, where majority of the population access it. |
| Velachery    | Residential + Commercial zone  | 1,43,991         | • Major connecting route from the commuters traveling for work towards Old Mahabalipuram Road where the multinational software companies are located.      |
| Manali       | Residential + Industrial zone  | 35,248           | • It is the largest industrial hub of north Chennai.  
• Largest industry in this location is Chennai Petroleum Corporation Limited (CPCL), which a refinery plant. In addition to this, few more refineries and other ore
processing industries are also located.

Figure 2. Annual mean concentrations of three monitoring locations considered in this study

Figure 3, 4 and 5 shows the monthly air pollutant trend of six criteria pollutants and the graph is bifurcated mentioning the lockdown scenarios. Irrespective of the pollutant, the concentration trend shows drastic variations with respect to the lockdown period. All six pollutants observed a maximum fall in concentration during the lockdown period compared to pre and post lockdown periods. This signifies the contribution of anthropogenic activities to the urban air quality. During pre-lockdown, Alandur measured the maximum PM$_{2.5}$ compared to other two locations. The reason could be that, the site proximate to the busy traffic routes and elevated roundabout connecting the four part of Chennai city. The routes are always busy round the clock occupied with dense traffic movement mostly with ques due to signalised junctions. The least was observed for Velachery location, as it is residential zone. Though the roads in this location provides the major traffic route to the MNCs located in the southern region, the busy traffic movement happens during morning and evening for a shorter time span. Hence we find no higher concentrations of PM$_{2.5}$ in this location [11].

In post-lockdown, the pollutant trend found to increase further however, the concentrations where low compared to pre-lockdown observations as the post-lockdown period was summer followed by monsoon. Summer are the climatic periods generally observing good atmospheric environment suitable to easy disperse the pollutant plumes. This further reduces the risk of COVID’19 contaminant stagnation in the air. Whereas in the monsoon, the pollutants get precipitated thus observing low concentration. The sudden increase of all pollutants in three locations after lockdown, clearly specifies the impact of traffic emissions and other industrial sources. But these concentrations levels are well below the previous decades which has given us a favourable air quality improvement in the pandemic situation.
Figure 3. Monthly pollutant trend of the Alandur sampling location for the year 2020
Figure 4. Monthly pollutant trend of the Velachery sampling location for the year 2020
Figure 5. Monthly pollutant trend of the Manali sampling location for the year 2020
The comparative concentration variations in terms of percentage with respect lockdown implications are given in table 2.
### Table 2. Percentage variation in pollutants during the lockdown scenarios

| Location | Pre-Lockdown to Lockdown | Lockdown to Post-lock down |
|----------|--------------------------|----------------------------|
|          | PM$_{2.5}$ | NO | NO$_2$ | SO$_2$ | CO | PM$_{2.5}$ | NO | NO$_2$ | SO$_2$ | CO |
| Alandur  | -60%       | -72%| -53%  | -54%  | -18%| 102%      | 29%| 30%   | 78%   | 13%|
| Velachery| -61%       | -30%| -63%  | -34%  | 2%  | 128%      | -44%| 337%  | 34%   | -17%|
| Manali   | -47%       | -3% | -36%  | -89%  | -21%| 54%       | 8% | 7%    | 311%  | 29%|

*percentage values were computed from the monthly mean values for the specific duration. Minus indicates decrease.

## 4. Conclusion

It is to observe from the results discussed in this paper that impose of lockdown has brought a tremendous improvement in the urban air quality in a short span of time. This brings a thought provoking note to the researchers, scientific communities and regulators to think about how this reduced or improved ambient concentration can be further prolonged in the forthcoming days. Our findings conclude that reduction of pollutant concentration from pre-lockdown to lockdown is seemingly higher compared to the increasing rate from lockdown to post-lockdown measurements except for PM$_{2.5}$ (table 2). In case of PM$_{2.5}$, post-lockdown concentration increased by twice in comparison to the decrease in concentration observed during lockdown in Alandur and Velachery. This could be due to movement of traffic as the unlock was announced. However, the scenario was quite found an equivalent increase in post-lockdown with respect to decrease in concentration at Manali. This observation can be related to the reduced less traffic movement and functioning of the industries on a regulated timing imposed by the government.

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