Environmental Management

Observations on the particle pollution of the cities in China in the Coronavirus 2019 closure: Characteristics and lessons for environmental management

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ABSTRACT
Particulate matter in the air seriously affects human health and has been a hot topic of discussion. Because of the coronavirus disease 2019 (COVID-19) lockdown in cities in China, sources of particulate matter, including gasoline-burning vehicles, dust-producing building sites, and coal-fired factories, almost all ceased at the end of January 2020. It was not until early April that outdoor activities recovered. Ten cities were selected as observation sites during the period from 19 December 2019 to 30 April 2020, covering the periods of preclosure, closure, and gradual resumption. A total of 11,720 groups of data were obtained, and 4 indicators were used to assess the characteristics of the particle pollution in the period. The quality of the atmospheric environment was visibly influenced by human activities in those 5 mo. The concentrations of particulate matter with particle sizes below 10 µm (PM10) decreased slightly in February and March and then began to increase slowly after April with the gradual recovery of production. The concentrations of particulate matter with particle sizes below 2.5 µm (PM2.5) decreased greatly in most regions, especially in northern cities, during closure and maintained a relatively stable level in the following 3 mo. The trends of PM10 and PM2.5 indicated that the reduced human activities during the COVID-19 lockdown decreased the concentrations of particulate matter in the air, and the difference between the PM10 and PM2.5 trends might be due to the different sources of the 2 particles and their different aerodynamics. However, during closure, the particulate matter pollution in the cities remained at a high level, which indicated that some ignored factors other than outdoor production activities, automobile exhaust, and construction site dust might have contributed greatly to the PM10 and PM2.5 concentrations, and the tracing of the particulate matter should be given further attention in environmental management.

INTRODUCTION
With rapid industrialization and urbanization, energy and vehicle consumption in China have continued to increase in recent years and have contributed greatly to particulate pollution in the air (Jiang et al. 2020; Luo et al. 2020; Wang JZ et al. 2020; Xu and Zhang 2020; Zhang LK et al. 2020; Zhao et al. 2020). Particulate matter with particle sizes below 10 µm (PM10) and those below 2.5 µm (PM2.5) have become 2 representative pollutants that limit regional sustainability and induce adverse effects on human health (Luo et al. 2020; Wang JZ et al. 2020). Both PM10 and PM2.5 have significant light scattering and absorption effects, resulting in reduced atmospheric visibility. Because PM2.5 and its toxic components can easily enter the human body through the respiratory tract, deposit in the alveoli, and enter the blood circulation, they are seriously harmful to human health (Wang LJ et al. 2019; Wang T et al. 2019; Zhang ZY et al. 2019; Tellez-Rojo et al. 2020; Yang XL et al. 2020). Thus, the 2 pollutants have been widely considered (Bi et al. 2020; Janta et al. 2020; Nansai et al. 2020; Sulaymon et al. 2020; Tellez-Rojo et al. 2020) and are the most notable issues in the environmental management of China.

Source tracing of PM10 and PM2.5 is the basis and premise for the control of particulate pollution, representing long-term technical and complex work and requiring the comprehensive application of multiple and multidisciplinary models (Fan et al. 2020; Wang SB et al. 2020). It is concluded that these pollutants come mainly from 9 sources: industrial boilers and kilns, industrial processes, coal-fired power plants, vehicle emissions, dust, volatile sources, residents’ living activities, agricultural sources, and natural sources.

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The emission inventory method, diffusion models, and receptor models are popular methodologies for quantitatively analyzing the contribution of various sources to particle pollution in multiple cities (Zhang K et al. 2019; Liu et al. 2020; Yang JH et al. 2020; Zhang WJ et al. 2020). However, due to the limitations of each method, there were great differences in the results of source analysis on particulate pollution.

Starting in January 2020, in Wuhan City, Hubei Province of China, doctors found multiple cases of viral pneumonia. On 30 January 2020, the World Health Organization announced that the new coronavirus epidemic was listed as a public health emergency event and called it “coronavirus disease 2019” (COVID-19), which was highly infectious. Beginning on 29 January, all provinces in China launched the first-level emergency response mechanism for public health emergencies, and the controlling measures required all residents to stay at home and shut down most factories’ production, construction sites, et cetera. With the effective control of COVID-19 throughout the whole nation, the emergency level was gradually lowered, and life and production slowly resumed starting on 21 February. By the end of March, conditions had almost returned to normal. In this process, especially from 29 January to 21 February 2020, compulsory controls, such as traffic flow, the suspension of production, and the extension of the Spring Festival holiday, were implemented, and the period was called the “COVID-19 closure” (Giani et al. 2020; Silver et al. 2020).

During the COVID-19 closure, the measures against the epidemic implemented by the Chinese government were unprecedented, and several sources of particulate matter almost completely stopped, including gasoline-burning vehicles, dust-producing building sites, and coal-fired factories (Brimblecombe and Lai 2020; Piccoli et al. 2020; Silver et al. 2020; Xu et al. 2020; Wang et al. 2021). Observing the PM10 and PM2.5 of the cities in the COVID-19 lockdown and characterizing the particulate pollution might provide some positive advice for regional environmental management. Thus, the aims of the present study were 1) to observe the concentrations of particulate matter during the COVID-19 lockdown in China; 2) to assess the changes of the particle pollution in the process of the 3 phases: preclosure, closure, and postclosure; and 3) to infer the impact of human activities on the particle pollution in China in order to provide scientific suggestions for decision makers on the control of regional particle pollution and reduce the damage risk to the residents’ health in the whole nation.

MATERIALS AND METHODS

The observed cities

Ten representative cities were selected as the observation sites (Figure 1). The characteristics of the cities, including location, main industry type, scale, and central heating, are listed in Table 1. Beijing is the capital of the nation. At the end of 2019, its population was 21.5 million, and the urbanization rate was 87%. Shanghai is the international economic, financial, trade, shipping, and technological center. Guangzhou is the provincial capital of Guangdong Province, located in the southeastern portion of the nation. Harbin is the provincial capital of Heilongjiang Province and one of the most vital national manufacturing bases. Hohhot is the
The instantaneous concentrations of PM10 and PM2.5 in the 10 cities were collected, and the average concentrations at all automatic monitoring stations in each city were recorded. Observation started on 19 December 2019, when the COVID-19 epidemic had not yet begun. Then, the outbreak spread in January 2020, and finally the gradual recovery of all of society occurred in April. The end time of the observation was 30 April 2020, and the total recorded period was 134 d.

During the observation, real-time data were recorded every 2 h from 6:00 AM to 10:00 PM, and each city had 9 data sampling events every day. Because of some factors (e.g., the automatic station failing to provide the instantaneous concentrations, the data failing to be updated occasionally in real time, and the data repeating previous values), the instantaneous data at some times were not obtained. Finally, 11,720 groups of data were recorded, with 1 group denoting the data in 1 real-time sampling event in 1 city. The rate of the data collection was approximately 87.5%. The 11,720 groups of data were all effective and applied in assessing the characteristics of the particle pollution during the COVID-19 closure.

### Evaluation indicators

Four indicators were used to assess the characteristics of the PM10 and PM2.5 concentrations in the COVID-19 closure period in China.

1. All instantaneous data sets were directly introduced as scatter plots and described as the time series changes in PM10 and PM2.5 concentrations from 19 December 2019 to 30 April 2020.
2. The spatial distributions of 2 pollutants were measured by the monthly average value of the concentrations (denoted Month-$PM_{m}$) and presented on a map by the kriging spatial interpolation technology. The value of the indicator was calculated by the following formula:

$$\text{Month} - PM_{m} = \frac{\sum_{j=1}^{n} \sum_{k=1}^{9} PM_{mjk}}{n}, \quad (1)$$

where Month-$PM_{m}$ is the monthly average value of the PM10 or PM2.5 concentrations in the $m$th month in the $k$th moment of the $j$th city and the unit is $\mu g/m^3$. PM$_{mjk}$ is the real-time concentration of the particle matter on the $k$th moment.
of the $j^{th}$ day in the $i^{th}$ month in the $m^{th}$ city, and $n$ represents the days of the observation in the $i^{th}$ month.

3) The distributions of the particle concentrations at various moments of the sampling event in a day were evaluated by the mean values at each moment (denoted as Moment-$\text{PM}_{ijk}$) and displayed according to the time series. The value of the indicator was calculated by the formula:

$$\text{Moment} - \text{PM}_{jk} = \frac{\sum_{m=1}^{10} \text{PM}_{mjk}}{10},$$

where Moment-$\text{PM}_{jk}$ is the mean value of the PM10 or PM2.5 concentration on the $k^{th}$ moment of the $j^{th}$ day in the $i^{th}$ month, and the unit is $\mu g/m^3$. PM$_{mjk}$ is the real-time concentration of the particle matter at the $k^{th}$ moment of the $j^{th}$ day in the $i^{th}$ month in the $m^{th}$ city.

4) The distributions of the daily average particle concentration were also analyzed (denoted Daily-$\text{PM}_{mij}$) and finally displayed according to the time series. The value of the indicator was calculated by the following formula:
where \( \text{Daily-PM}_{mj} \) is the daily mean value of the particle concentration on the \( j \)th day in the \( i \)th month in the \( m \)th city, and the unit is \( \mu g/m^3 \).

### RESULTS AND DISCUSSION

#### Distribution of the instantaneous concentrations

All the PM10 and PM2.5 concentrations from 19 December 2019 to 30 April 2020 are displayed in Figures 2A and 2B. In the 2 figures, 3 periods, the preclosure, closure, and gradual resumption periods, were identified. The preclosure denotes the period before the COVID-19 lockdown, and the dates were from 19 December 2019 to 28 January 2020. From 29 January to 21 February, it was the COVID-19 closure period, when all residents stayed at home, most of the factories’ productions were shut down, and all construction sites were closed. Beginning at the end of February, the lives of the residents and the production activities slowly resumed. At the end of March, social and economic activities returned mostly to normal.

The trends of the PM10 and PM2.5 changes were not consistent in the 5-mo period. The PM10 concentrations...
decreased slightly in February and March and then began to increase gradually after entering April. The PM2.5 concentrations began to decrease from the COVID-19 lockdown at the end of January and maintained low concentrations in the following 3 mo. Overall, in the preclosure period, the PM10 ranged from 0 to 300 µg/m³, and in February, it decreased to 0 to 150 µg/m³. The PM2.5 was approximately 0 to 200 µg/m³ in the preclosure period and then decreased to less than 100 µg/m³. The 2 scatter plots indicated that the reduced human activities during the closure period generally made the concentrations of the particulate matter in the air drop, and COVID-19 control measures had an impact on the pollutant concentrations (Giani et al. 2020; Silver et al. 2020; Xu et al. 2020; Wang et al. 2021).

The meteorological data showed that there were no abnormal weather conditions during the observation period, and these conditions were relatively dry with little rainfall. Thus, the difference between the PM10 and PM2.5 trends might be due to the different sources of the 2 particles and their different aerodynamics (Xu et al. 2020). The PM2.5 came mainly from the combustion of fossil fuels, such as vehicle exhaust and coal burning, whereas PM10 might be from industrial production, vehicles, dust at construction sites, roads and buildings, and fine particles formed by the interaction of sulfur oxides and nitrogen oxides in the air (Piccoli et al. 2020). After entering April, production was gradually restored in factories and construction sites, resulting in a gradual increase in the PM10 concentration in that month. However, residents in all cities were encouraged to reduce unnecessary activities, and the activities of restaurants and megamalls were still depressed. These factors might make the PM2.5 concentrations relatively low.

The temporal distributions of the 2 particulate matter types in the 10 cities also displayed different trends. The average PM10 and PM2.5 concentrations in the different periods in the 10 cities are listed in Table 2, and the gradual resumption period was divided into 2 phases: the first resumption period and the second resumption period. During the COVID-19 closure, the PM10 concentrations in Harbin fell by 53% compared with those in the preclosure period, representing the greatest decrease among the 10 cities. The second was Guangzhou, with a decrease of 52%, and then Beijing, with a decrease of 44%. The PM10 reduction rate in Guiyang was only 3%, making it the city with the least reduction. The average percentage of decrease in the PM10 concentrations during the closure period compared with the preclosure period was 34%. The average percentage of the PM2.5 concentration reduction during the closure period was 34%.
was 26% in the 10 cities. The PM2.5 concentrations in Harbin fell by 57%, representing the greatest decrease among the cities. It is worth noting that during the closure, the average concentrations of PM2.5 in Beijing and Guiyang increased in the closure period, and the pollution of the particulate matter in the cities remained at a high absolute level, which indicated that some ignored factors other than outdoor production activities, automobile exhaust, and site dust might have contributed much to the PM10 and PM2.5 concentrations. The traceability of particulate matter should be further considered in environmental management, and there should be more focus on the sources.

Monthly average PM10 and PM2.5

The monthly average PM10 and PM2.5 concentrations (denoted Month-PM<sub>m</sub>) are presented in Figure 3 using the kriging interpolation method. The monthly average PM10 was 33 to 177 µg/m³, and the PM2.5 ranged from 19 to 150 µg/m³. All the figures were represented by the same color classification to visually distinguish the distribution differences among the 5 mo (Figure 3).

The PM10 concentration was greatly affected by the climate of the cities (Yu 2013). Chengdu and Guiyang are located in southwestern China, and the climate is humid, so the PM10 concentrations remained low and PM10 pollution was not serious. Beijing and Shanghai, as 2 megacities with a public focus, have invested much in recent years and made achievements in pollutant concentration control. The PM10 concentrations were relatively high in other cities. Cities have expanded rapidly in the past 2 decades in China. There were many construction sites in the cities throughout the year, which produced considerable dust during the preclosure and resumption periods after the COVID-19 closure. In addition, in the northern cities, the air was dry, and cars and pedestrians could both cause dust pollution.

Most of the PM2.5 came from human activities, such as industrial emissions, pollutant emissions in the process of energy utilization, secondary conversion of other pollutants, et cetera (Zikova et al. 2016). In general, the spatial distributions of the PM2.5 concentrations were similar to those of PM10. Due to the mechanism of PM2.5 pollution formation, the differences in the PM2.5 concentrations among the months were noticeable in cities with developed industries and high coal demand (Figure 3). In addition, the central heating in winter in the 5 northern cities contributed greatly to the particulate pollution in northern China, and

![Figure 5. Daily PM10 and PM2.5 concentrations in the 10 cities. BJ = Beijing; CD = Chendu; GY = Guiyang; GZ = Guangzhou; HB = Harbin; HH = Hohhot; NT = Nantong; PM2.5 = particulate matter with particle sizes below 2.5 µm; PM10 = particulate matter with particle sizes below 10 µm; SH = Shanghai; TY = Taiyuan; UQ = Urumqi.](image-url)
| Moment | BJ | SH | GZ | HH | HB | UQ | CD | GY | TY | NT | Average |
|--------|----|----|----|----|----|----|----|----|----|----|----------|
| 6 AM   |    |    |    |    |    |    |    |    |    |    |          |
| Preclosure a | 54 | 36 | 65 | 162 | 106 | 94 | 32 | 134 | 57 | 88 | 49 45 | 35 134 135 114 72 22 22 96 57 76 |
| Closure  b | 18 | 36 | 31 | 97 | 71 | 66 | 34 | 90 | 43 | 55 | 59 69 | 41 23 69 62 93 49 24 36 42 53 |
| Resumption 1 | 54 | 40 | 42 | 58 | 49 | 64 | 79 | 47 | 105 | 44 | 58 53 | 30 24 32 44 42 49 31 34 38 38 |
| Resumption 2 | 6 AM | 49 | 43 | 43 | 76 | 71 | 119 | 70 | 47 | 105 | 48 | 67 30 | 28 23 31 126 27 28 47 38 42 |
| Resumption 3 | 7 AM | 54 | 38 | 62 | 142 | 153 | 108 | 92 | 31 | 129 | 56 | 86 41 | 46 34 114 149 113 72 22 93 58 |
| Resumption 4 | 8 AM | 57 | 46 | 46 | 72 | 86 | 108 | 92 | 34 | 106 | 47 | 68 46 | 49 33 112 159 72 13 23 94 63 |
| Resumption 5 | 9 AM | 56 | 43 | 59 | 135 | 166 | 108 | 93 | 34 | 131 | 65 | 69 46 | 49 33 112 159 72 13 23 94 63 |
| Resumption 6 | 10 AM | 26 | 35 | 32 | 109 | 91 | 93 | 65 | 37 | 82 | 38 | 61 69 | 42 24 74 74 81 | 94 49 26 59 38 |
| Resumption 7 | 11 AM | 50 | 47 | 41 | 58 | 60 | 160 | 99 | 99 | 45 | 45 | 32 | 34 32 | 24 24 32 122 | 25 135 72 23 94 63 |
| Resumption 8 | 12 AM | 57 | 46 | 46 | 72 | 108 | 108 | 92 | 34 | 106 | 47 | 68 46 | 49 33 112 159 72 13 23 94 63 |
| Resumption 9 | 1 PM | 26 | 35 | 32 | 109 | 91 | 93 | 65 | 37 | 82 | 38 | 61 69 | 42 24 74 74 81 | 94 49 26 59 38 |
| Resumption 10 | 2 PM | 50 | 47 | 41 | 58 | 60 | 160 | 99 | 99 | 45 | 45 | 32 | 34 32 | 24 24 32 122 | 25 135 72 23 94 63 |
| Resumption 11 | 3 PM | 57 | 46 | 46 | 72 | 108 | 108 | 92 | 34 | 106 | 47 | 68 46 | 49 33 112 159 72 13 23 94 63 |
| Resumption 12 | 4 PM | 26 | 35 | 32 | 109 | 91 | 93 | 65 | 37 | 82 | 38 | 61 69 | 42 24 74 74 81 | 94 49 26 59 38 |
| Resumption 13 | 5 PM | 50 | 47 | 41 | 58 | 60 | 160 | 99 | 99 | 45 | 45 | 32 | 34 32 | 24 24 32 122 | 25 135 72 23 94 63 |
| Resumption 14 | 6 PM | 57 | 46 | 46 | 72 | 108 | 108 | 92 | 34 | 106 | 47 | 68 46 | 49 33 112 159 72 13 23 94 63 |

(Continued)
Table 3. (Continued)

| Moment | Period        | BJ  | SH  | GZ  | HH  | HB  | UQ  | CD  | GY  | TY  | NT  | Average | BJ  | SH  | GZ  | HH  | HB  | UQ  | CD  | GY  | TY  | NT  | Average |
|--------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 6 PM   | Closure<sup>b</sup> | 33  | 33  | 27  | 105 | 69  | 80  | 46  | 46  | 96  | 36  | 57      | 64  | 30  | 20  | 66  | 60  | 107 | 36  | 34  | 71  | 32  | 52     |
| 6 PM   | Resumption1<sup>c</sup> | 65  | 52  | 40  | 70  | 52  | 56  | 66  | 57  | 86  | 51  | 60      | 29  | 34  | 22  | 24  | 24  | 40  | 42  | 39  | 35  | 48  | 32  | 34     |
| 6 PM   | Resumption2<sup>d</sup> | 75  | 54  | 45  | 62  | 64  | 93  | 54  | 53  | 71  | 57  | 63      | 33  | 29  | 23  | 19  | 39  | 23  | 29  | 28  | 35  | 32  | 29     |
| 8 PM   | Preclosure<sup>a</sup> | 65  | 50  | 60  | 160 | 170 | 129 | 91  | 50  | 161 | 60  | 55      | 53  | 30  | 136 | 165 | 141 | 67  | 33  | 120 | 60  | 86     |
| 8 PM   | Closure<sup>b</sup> | 42  | 35  | 31  | 111 | 91  | 92  | 50  | 45  | 91  | 40  | 62      | 62  | 32  | 23  | 87  | 75  | 116 | 36  | 33  | 67  | 38  | 57     |
| 8 PM   | Resumption1<sup>c</sup> | 65  | 49  | 45  | 72  | 64  | 59  | 76  | 59  | 91  | 51  | 63      | 34  | 34  | 25  | 50  | 94  | 44  | 38  | 51  | 32  | 38     |
| 8 PM   | Resumption2<sup>d</sup> | 80  | 59  | 46  | 61  | 64  | 77  | 57  | 55  | 78  | 59  | 64      | 33  | 30  | 23  | 21  | 43  | 21  | 30  | 30  | 38  | 34  | 30     |
| 10 PM  | Preclosure<sup>a</sup> | 67  | 48  | 73  | 182 | 182 | 136 | 99  | 52  | 161 | 68  | 107     | 56  | 53  | 36  | 156 | 176 | 144 | 73  | 119 | 63  | 91     |
| 10 PM  | Closure<sup>b</sup> | 38  | 35  | 36  | 123 | 84  | 84  | 61  | 47  | 88  | 47  | 64      | 69  | 36  | 26  | 86  | 78  | 105 | 45  | 36  | 64  | 50  | 59     |
| 10 PM  | Resumption1<sup>c</sup> | 53  | 47  | 45  | 81  | 63  | 58  | 80  | 64  | 115 | 52  | 66      | 37  | 35  | 26  | 40  | 58  | 35  | 46  | 43  | 63  | 32  | 41     |
| 10 PM  | Resumption2<sup>d</sup> | 79  | 56  | 44  | 62  | 82  | 116 | 61  | 54  | 106 | 57  | 72      | 34  | 31  | 22  | 28  | 60  | 24  | 34  | 31  | 52  | 33  | 35     |

BJ = Beijing; CD = Chendu; GY = Guiyang; GZ = Guangzhou; HB = Harbin; HH = Hohhot; NT = Nantong; PM2.5 = particulate matter with particle sizes below 2.5µm; PM10 = particulate matter with particle sizes below 10µm; SH = Shanghai; TY = Taiyuan; UQ = Urumqi.

<sup>a</sup> Preclosure denotes the average concentration from 19 December 2019 to 28 January 2020.
<sup>b</sup> Closure period is from 29 January to 21 February 2020.
<sup>c</sup> Resumption1 period is from 22 February to 21 March 2020.
<sup>d</sup> Resumption2 period is from 22 March to 30 April 2020.
the PM2.5 concentrations were higher than those in the other 5 cities. The PM2.5 concentrations, especially in northern cities, decreased greatly in most regions during the closure period compared with the preclosure period (December and January). However, the PM2.5 emissions did not increase significantly in most regions after production resumed in April, which was different from those of PM10.

**The Moment-PM and Daily-PM**

The time series of the city-average PM10 and PM2.5 at various moments of the day and those of the daily average particle concentrations in the 10 cities are described in Figures 4 and 5, respectively.

The time series curves of the city-average PM10 and PM2.5 at various moments of the day described in Figure 4 were consistent with the trend of the instantaneous concentrations plotted in Figure 2. Table 3 lists the average concentrations at various moments in the diverse periods in the 10 cities. The distribution of the particulate matter concentration in different periods and cities was similar to that listed in Table 2.

The time series curves of the daily average concentrations of the particles were also consistent with the trend of the concentrations described in Figure 2. As Figure 5 shows, there were obvious differences among the daily mean values of the 10 cities, and those of PM10 were highly differentiated. The concentrations of PM10 and PM2.5 in the 5 cities located in the north were higher than those in the other 5 cities. Correspondingly, the concentrations of the particulate matter in these cities decreased the most during the COVID-19 closure.

**CONCLUSIONS**

Particle pollution seriously affects human health and has been a hot topic of discussion. Due to the suspension of factory production and the reduction in people’s travel, the particle concentrations decreased during the COVID-19 outbreak in China. The changes in PM10 and PM2.5 were not consistent from 19 December 2019 to 30 April 2020. The PM10 concentrations decreased slightly in February and March and then began to increase gradually after the beginning of April. The concentrations of PM2.5 began to fall from the beginning of the COVID-19 closure in February and maintained a relatively lower level in the following 3 mo. The trends indicated that the reduced human activities during the closure period to a rather great extent decreased the concentrations of the particulate matter in the air. The different trends between PM10 and PM2.5 might be due to the different sources of the 2 particles and their different aerodynamics.

The particles displayed spatial differences across the nation. Beijing and Shanghai, 2 megacities with a public focus, have made large investments in pollutant control in recent years. The PM10 concentrations were relatively higher in other cities than in Beijing and Shanghai, and year-round construction sites in these other cities might produce considerable dust during the preclosure period and resumption period after the COVID-19 lockdown. In addition, central heating in winter in the 5 northern cities might contribute greatly to particulate pollution, and the PM2.5 concentrations were higher in cities in northern China than in other cities. Correspondingly, the PM2.5 concentrations in northern cities decreased greatly in most regions during the closure period.

It is worth noting that during the COVID-19 closure, the particulate matter pollution in the cities remained at a high absolute level, which indicated that some ignored factors in addition to the outdoor production activities, automobile exhaust, and construction site dust might have contributed greatly to the PM10 and PM2.5 concentrations. The tracing of particulate matter should be given further attention in environmental management, and there should be more focus on the sources.

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**Data Availability Statement**—Data are available upon request from the corresponding author Hong Yao at yaohong@ntu.edu.cn.

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