Proceedings of the 6th International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/2026.37123

Analysis on Seasonal Distribution of $PM_{2.5}$ Concentration and Control Measures in Foshan City

Chiseng Huang

Guangdong Country Garden School, Foshan, China
15820623130@163.com

Abstract. Fine particulate matter ($PM_{2.5}$) pollution poses severe threats to urban residents' physical health. As a core manufacturing hub, Foshan generates massive air pollutant emissions and is under prominent pressure in air pollution prevention and control. Taking Foshan as the research object, this paper explores the seasonal distribution characteristics of urban $PM_{2.5}$ and corresponding pollution control measures. Literature analysis and case study are adopted as the main research methods. Spatially, $PM_{2.5}$ concentrations are higher in northern and central Foshan (Sanshui, Nanhai, Chancheng) and lower in the south (Shunde, Gaoming); temporally, concentrations peak in autumn and winter and reach minimum in summer, with an additional morning rush-hour peak (08:00–09:00) in diurnal cycles. The results show that $PM_{2.5}$ concentrations in Foshan present obvious seasonal variations, with higher pollution levels in winter. Manufacturing emissions act as the primary local pollution source. Targeted industrial regulation, joint regional prevention and vegetation optimization can effectively reduce $PM_{2.5}$ concentration and improve urban atmospheric environment quality.

Keywords: $PM_{2.5}$, Foshan, measure, distribution seasonal

1. Introduction

As a key city in the Guangdong-Hong Kong-Macao Greater Bay Area adjacent to Guangzhou, Foshan boasts a well-developed manufacturing industry and complex pollution sources, mainly including vehicle exhaust and construction dust. As an important manufacturing city in the Pearl River Delta, Foshan has continuously implemented air quality management policies in recent years. Nevertheless, the seasonal fluctuation characteristics of $PM_{2.5}$ pollution remain to be further explored. Additionally, in Frontier Science, researchers demonstrate the nature of $PM_{2.5}$ and its harms to human. The chemical components of $PM_{2.5}$ mainly include five categories: organic carbon, black carbon, dust, ammonium sulfate and ammonium nitrate, so it mainly generated by combustion and gaseous precursors. Additionally, $PM_{2.5}$ can be harmful to human respiratory system by entering alveolus [1]. Moreover, Chinese scholars have investigated the temporal and spatial variation patterns of $PM_{2.5}$ in urban areas. Zhao et al. analyzed the seasonal particulate pollution in Beijing and found that wind speed and relative humidity were dominant meteorological factors affecting $PM_{2.5}$ accumulation [2]. This essay will focus on two main question, the first one. The first is to clarify the spatiotemporal distribution characteristics of $PM_{2.5}$ concentrations in Foshan. And the

DOI: 10.54254/2753-8818/2026.37123

second is how to implement the corresponding measures to control $PM_{2.5}$? Like some certain technical measures or administrative policies. This paper adopts literature analysis and case analysis as research methods to answer above questions.This paper provides references or solution for the air pollution governance of Foshan City.

2. The seasonal distribution of $PM_{2.5}$ concentrations in Foshan

$PM_{2.5}$ pollution in Foshan exhibits significant spatiotemporal heterogeneity. Spatially, the concentration generally follows a pattern of high levels in the north and low levels in the south. Continuous high-pollution zones are distributed in central Sanshui, central Nanhai and northern Chancheng, while southern Shunde and Gaoming show relatively lower $PM_{2.5}$ concentrations. Monitoring sites including Huacai Vocational School and Sanshui Stationrecord severe particulate pollution levels. This distribution is mainly attributed to dense industrial activities and heavy traffic emissions in northern Foshan, coupled with cross-border pollutant transport from adjacent Guangzhou [3].

As shown in Figure 1, the spatial distribution of annual average $PM_{2.5}$ concentrations across Foshan in 2013 displayed an obvious pattern of high values in central and northern regions and low values in the south. Severe pollution hotspots were concentrated in Sanshui District, northern Nanhai District and northern Chancheng District, forming a continuous high-concentration zone. By comparison, monitoring site data further verified this spatial characteristic. Sampling sites located in central urban areas recorded higher $PM_{2.5}$ levels, while sites in southern Shunde and Gaoming presented relatively lower concentrations.

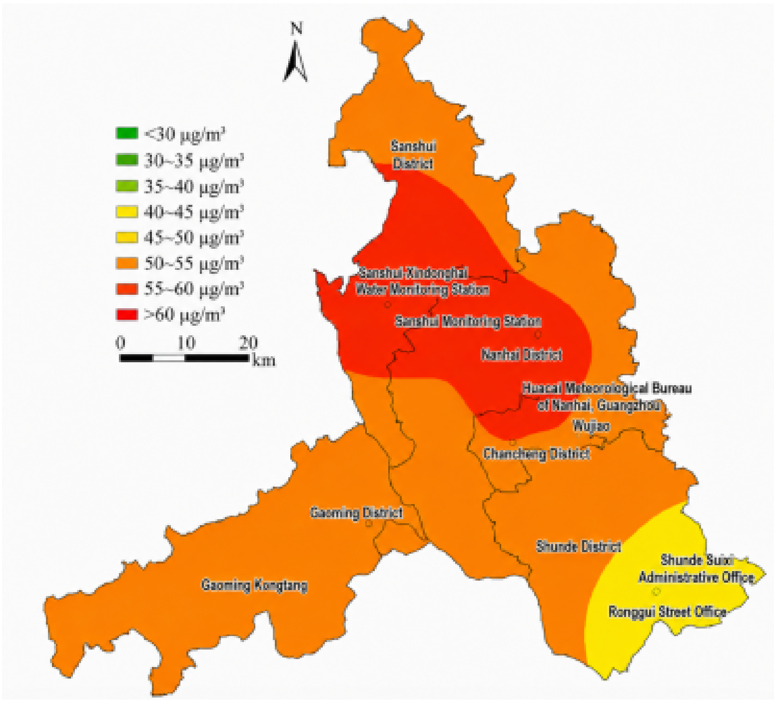

Figure 1. Spatial distribution of $PM_{2.5}$ in Foshan in 2013

As is presented in Figure 2, the spatial pattern in 2026 remains largely unchanged, with high-concentration zones still concentrated in the central and northern parts of Foshan, while the southern districts continue to show lower $PM_{2.5}$ levels.

DOI: 10.54254/2753-8818/2026.37123

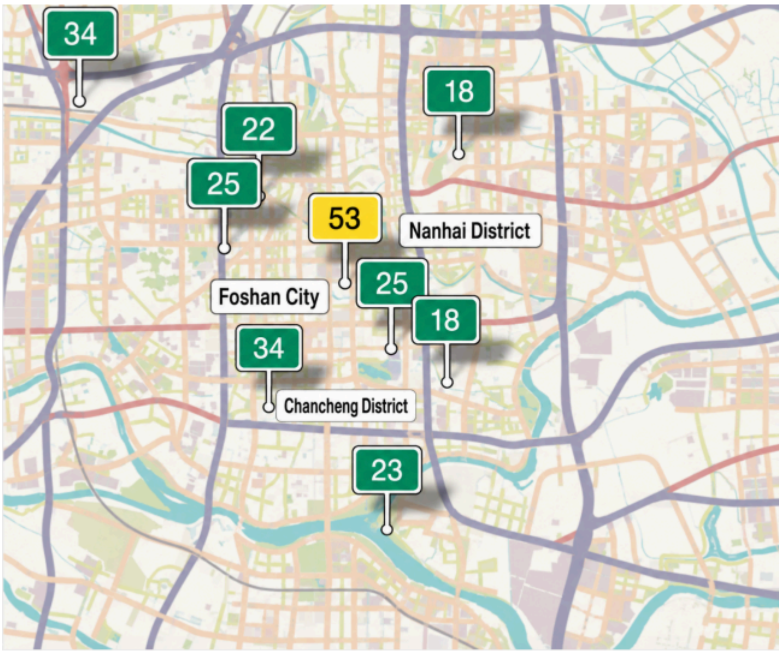

Figure 2. Spatial distribution of $PM_{2.5}$ in Foshan in 2026 [4]

Such spatial pattern remained consistent: central Foshan has long acted as the core $PM_{2.5}$ pollution area. This phenomenon arises from intensive manufacturing activities and heavy road traffic emissions in central districts. Moreover, the region is subject to cross-boundary pollutant transport from Guangzhou. In contrast, southern districts feature lower industrial density and fewer emission sources, leading to milder particulate pollution.

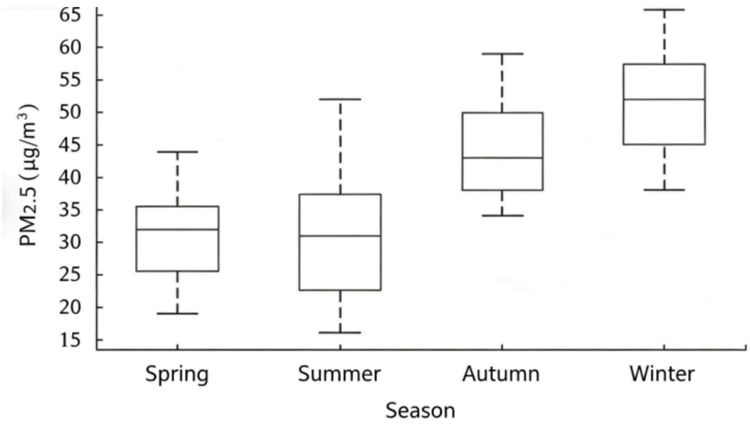

Figure 3. Seasonal distribution of $PM_{2.5}$

As shown in Figure 3, high $PM_{2.5}$ concentrations mainly occur in autumn and winter. Affected by monsoon transition, atmospheric diffusion conditions in spring are generally favourable, leading to lower $PM_{2.5}$ levels compared with autumn and winter. In summer, frequent rainfall and higher planetary boundary layer height reduce $PM_{2.5}$ concentrations across Foshan.

Nevertheless, summer is the typhoon season, and peripheral typhoon circulation occasionally causes temporary $PM_{2.5}$ accumulation.

The diurnal variation of $PM_{2.5}$ concentrations in 2013 is presented in Figure 4. Concentrations remain high from midnight to 10:00, with an obvious peak during the morning commute (08:00-

DOI: 10.54254/2753-8818/2026.37123

09:00), followed by a continuous decline. The minimum value appears at 17:00, and concentrations gradually rise again after 18:00.

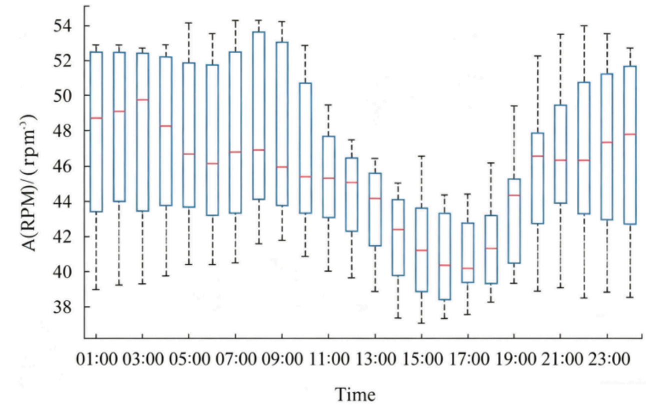

Figure 4. Diurnal variation characteristics of $PM_{2.5}$ concentrations in Foshan, 2013

3. Implementation of $PM_{2.5}$ control measures

As urbanization advances rapidly, the implementation of targeted $PM_{2.5}$ pollution control measures has become increasingly essential. So government must take decisive action on controlling $PM_{2.5.}$ Most $PM_{2.5}$ originates from two pathways. Primary $PM_{2.5}$ is directly emitted by industrial combustion, vehicle exhaust and construction dust. Secondary $PM_{2.5}$, the dominant component in the Pearl River Delta, forms when gaseous precursors including sulfur dioxide and nitrogen oxides undergo atmospheric photochemical reactions to produce ammonium sulfate and ammonium nitrate [1]. Accordingly, targeted governance strategies can be formulated for these two pollution pathways.

3.1. Controlling vehicles waste emission

Firstly, as a core city in the Guangdong-Hong Kong-Macao Greater Bay Area with a large population, Foshan witnesses high traffic flow and intensive urban construction activities, which substantially contribute to local pollutant emissions.

(1) Improvement in technology

Upgrading vehicle manufacturing and emission reduction technologies can effectively reduce automobile exhaust emissions. To be specific, completely electric vehicles can reduce lesser vehicles waste emission compared to traditional vehicles. So it is critical to have improvement in new energy vehicles. In addition, government can provide more subsidies in helping develop electric vehicle manufacturing.

(2) Controlling vehicles volume

Government can have corresponding policies to control the number of vehicles in urban area. For example, Foshan can implement a series of vehicle travel restriction policies to cut exhaust $PM_{2.5}$ emissions, including truck time-based bans and emergency traffic control during heavy pollution episodes.

(3) Improving urban public transportation

If the public transportation like bus, subways can be improved in efficiency, there will be more people to use, which can directly reduce the use of private vehicle and decrease the vehicle waste emission.

(4) Improve public environmental awareness

DOI: 10.54254/2753-8818/2026.37123

It is essential to raise public environmental awareness. Economic incentives can be provided for vehicle owners to promote fuel conservation, energy saving, and active exhaust emission reduction. Special attention should be paid to preventing black smoke emissions from vehicles

3.2. Coal burning pollution control

Emissions of smoke and dust from coal combustion are a primary anthropogenic source of $PM_{2.5}$. Relevant control measures are put forward as follows:

(1) Replacing fossil fuel use

Although fossil fuel use are not familiar in southern city with advanced manufacturing sector , it still need to highlight the combustion of fossil fuel. So factories should use renewable energy like solar power , wind power, and natural gas instead of using fossil fuel, and producing zero-carbon energy to use.

(2) Strengthen environmental supervision

Establish coal-burning forbidden zones, ban scattered coal combustion, and punish enterprises with excessive pollutant emissions.

(3) Upgrade coal-burning equipment

Install integrated dust removal, desulfurization and denitrification facilities for large coal-fired units to control particulate emissions, which help reducing the emission of smoke and dust.

3.3. Controlling construction dust

Construction dust constitutes a major source of urban $PM_{2.5}$ pollution. As a core city in the Guangdong-Hong Kong-Macao Greater Bay Area with frequent urban construction activities, Foshan requires targeted management strategies to mitigate construction dust pollution.

(1) Building Dust Prevention Work in constructing area

Foshan government should pay attention is building dust prevention is construction area, cover exposed soil at construction sites with dust-proof nets and enclose stacked materials. Vehicles shall be cleaned timely to prevent soil carried by wheels from polluting road surfaces.

(2) Strengthen the Cultivation of Landscape Plants

Green vegetation can stabilize soil, conserve water, purify air and mitigate pollution. Through photosynthesis, plants absorb carbon dioxide and release oxygen. Many landscape plants are tolerant to atmospheric pollutants.Urban greening should follow principles of suitable species selection, ecological priority and biodiversity. Roads and highways emit large amounts of SO_2 and NO_x. Shrub vegetation can be planted along road dividers and verges. Such vegetation removes traffic-related air pollutants and protects human health [5].

(3) Government responsibility

Government should have long-term policies to support the green development, and environmental monitoring authorities to provide accurate monitoring data reports. Government also need to improve their efficiency in implementing emission reduction policies without any delay or doubt, having more eco-friendly subsidies and technological support to companies and factories.

3.4. Integrated Multi-pollutant Control

Cut emissions of primary pollutants (vehicles, coal and biomass combustion) and popularize integrated dust, sulfur, nitrogen and mercury removal technologies.Restrict secondary precursors (SO_2, NO_x, VOCs, NH_3) and advance coordinated pollutant reduction. Secondary particles account for 30%-60% of $PM_{2.5}$. Curbing NO_x and VOCs can lower atmospheric oxidation, mitigate compound pollution, decrease ozone and weaken secondary particle formation [6].

To sum up, the Foshan municipal government should introduce more long-term incentive policies to support green manufacturing, new energy vehicles and renewable energy development, and strengthen the formulation and implementation of environmental regulations to reduce $PM_{2.5}$ pollution. The public should maintain environmental awareness of emission reduction and actively reduce $PM_{2.5}$ emissions. Companies and enterprise should implement eco-friendly projects and technologies, put emission reduction as the primary part, promoting more environmentally friendly product to help restrict $PM_{2.5}$ emission.

4. Conclusion

This paper mainly focuses on $PM_{2.5}$ seasonal distribution in Foshan and the specific measures to control $PM_{2.5}$ emissions. As a result, $PM_{2.5}$ distribute spatially in the center part of the Foshan, the northern area have higher concentration of $PM_{2.5}$ than southern area, due to the intensive manufacturing sector and excessive vehicles waste emission. In terms of seasonal variation, $PM_{2.5}$ concentrations in Foshan are higher in autumn and winter, while lower in spring and summer. Located in the subtropical monsoon climate zone, Foshan receives abundant summer rainfall, which effectively dilutes atmospheric particulate matter. Additionally, Foshan government should pay more attention in helping environment supervision and more subsidies in green manufacturing, boosting the formulation and implementation of environmental policies to mitigate $PM_{2.5}$ pollution, trying to mitigate vehicles waste emission,construction dust and coal combustion by improving technologies and having new policies.

This study primarily investigates the influence of manufacturing industries on $PM_{2.5}$ pollution in Foshan. Nevertheless, it fails to quantitatively analyse vital elements such as atmospheric variations and terrain effects on particulate dispersion. Another limitation is that the analysis is built solely on data collected in 2013.For further research, numerical simulation can be used to explore how terrain and meteorology change $PM_{2.5}$ distribution. Long-term monitoring datasets are suggested to identify interannual pollution trends. Furthermore, source apportionment methods can distinguish contributions from local industry and regional pollutant transportation to formulate targeted environmental policies.

References

[1] Wei, P., Yang, X. X., & Feng, L. H. (2012). Air particulate matter PM2.5 in Beijing and its harm. *Frontier Science, 6*, 6–10.

[2] Zhao, C. X., Wang, Y., & Wang, Y. J. (2014). Temporal and spatial distribution of PM2.5 and PM10 pollution status and the correlation of particulate matters and meteorological factors during winter and spring in Beijing. *Environmental Science, 35*, 3–6.

[3] Situ, S. P., Wu, L., & Zhou, L. Y. (2017). Analysis on pollution properties of PM2.5 in Foshan city and the inducing weather systems. *Environmental Monitoring and Forewarning, 9*, 2–5.

[4] WAQI. (2026). Foshan air pollution: Real-time air quality index (AQI). https://aqicn.org/city/foshan/cn/

[5] Duan, Y. F., Li, C. M., & Tian, C. Y. (2022). Study on synergistic control of fine particulate matter (PM2.5) and ozone (O3). *Journal of Anyang Institute of Technology, 21*, 3–4.

[6] Li, Z. (2013). Combating PM2.5 pollution requires multipronged approach. *SI-NO Global Energy, 18*, 4–5.