Supplementary Materials

A Hyperspectral Method for Detection of the Three-Dimensional Spatial Distribution of Aerosol in Urban Areas for Emission Source Identification and Health Risk Assessment

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Table S1 Exposure-response coefficients and incidence rate (per person) used in the analysis

Health Outcome		Mean	Frequency(average)
Mortality	Long-term	0.00430	0.01077
	Short-term	0.00028	0.00728
Asthma attack	children < 15 years	0.00440	0.06930
	adults > 15 years	0.00390	0.05610
Chronic bronchitis		0.00450	0.01390
Acute bronchitis		0.00550	0.39000
Respiratory hospital admission		0.00130	0.01240
Cardiovascular hospital admission		0.00130	0.00850
Outpatient visits-internal medicine		0.00034	3.26000
Outpatient visits-pediatrics		0.00039	0.30000
RADs (adults >20 years)		0.00940	3.00000

Source of data in the table References Kan et al. [55].

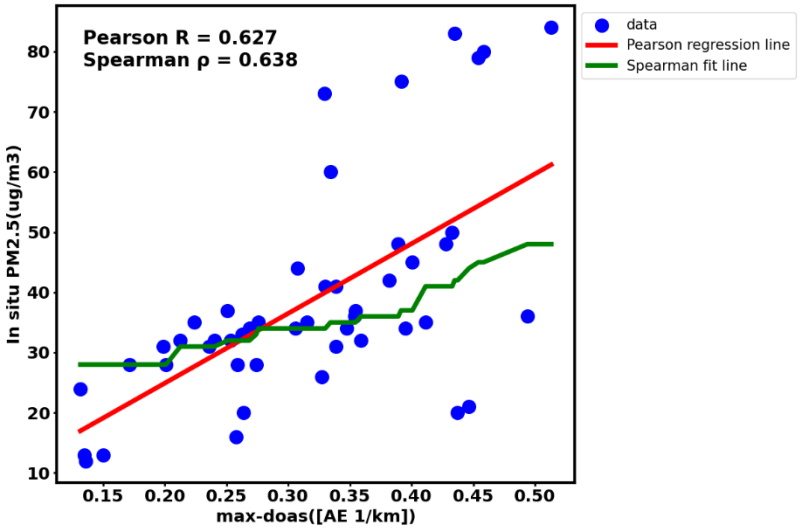


Figure S1 Fitting results chart. The red line represents the linear regression fitting, while the green line indicates the trend line based on Spearman rank correlation.

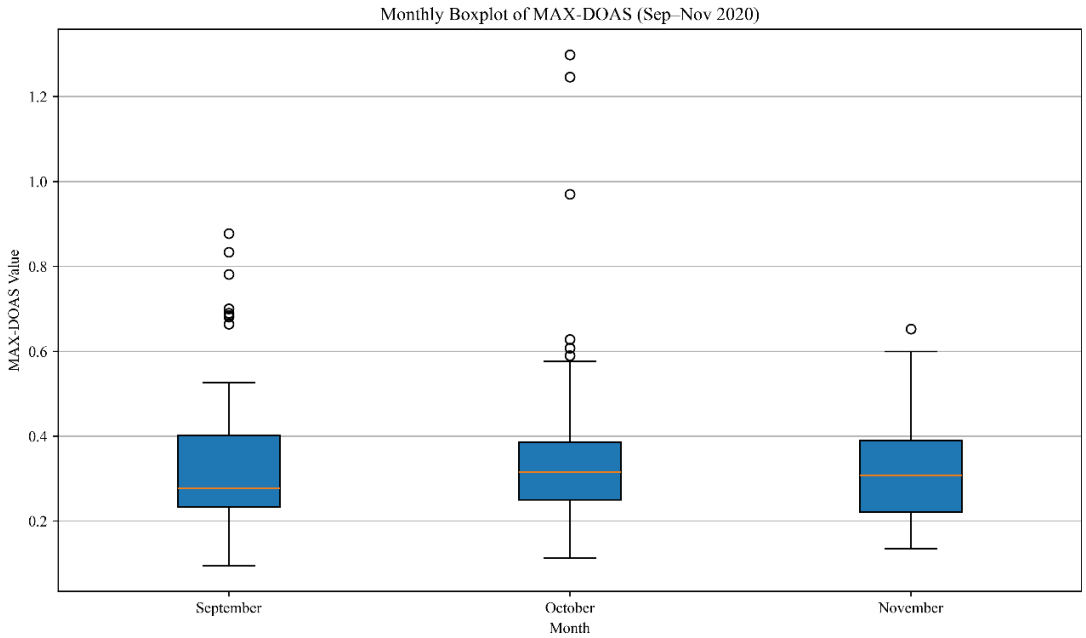


Figure S2 Monthly result box chart

Table S2 Average errors at different heights

Height(km)	Average error	Height(km)	Average error
0.04	0.14251	2.04	0.03616
0.24	0.08163	2.24	0.03028
0.44	0.09696	2.44	0.02518
0.64	0.09024	2.64	0.02085
0.84	0.08033	2.84	0.01720
1.04	0.07233	3.04	0.01416
1.24	0.06496	3.24	0.01163
1.44	0.05748	3.44	0.00955
1.64	0.04997	3.64	0.00784
1.84	0.04277	3.84	0.00643

We analyzed the monthly and seasonal variations of $PM_{2.5}$ concentrations at the observation site using in-situ monitoring data. The results show that the average $PM_{2.5}$ concentration was highest in January, reaching 141.21μg/m³, and lowest in August, with an average of 25.12μg/m³. As ambient temperatures dropped in September, $PM_{2.5}$ concentrations gradually increased. The seasonal variation plot indicates that $PM_{2.5}$ concentrations were lowest in summer, highest in winter, and moderate in autumn.

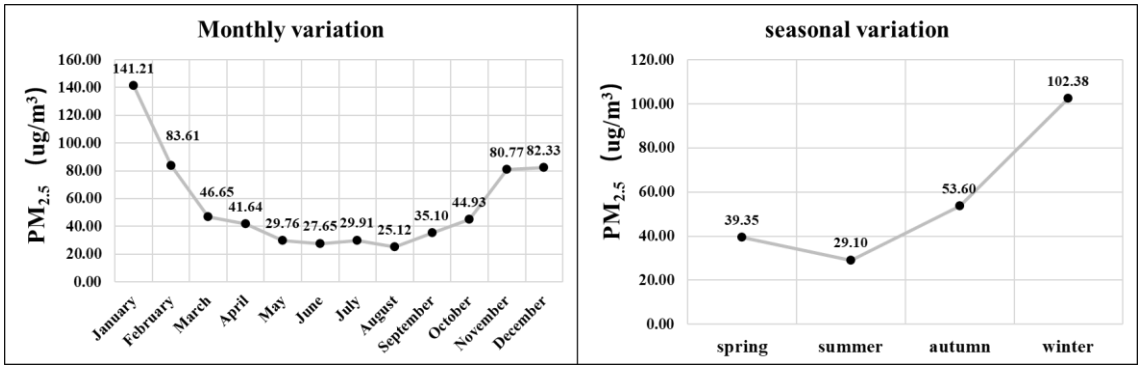


Figure S3 Line chart of monthly and seasonal variations in $PM_{2.5}$ concentration

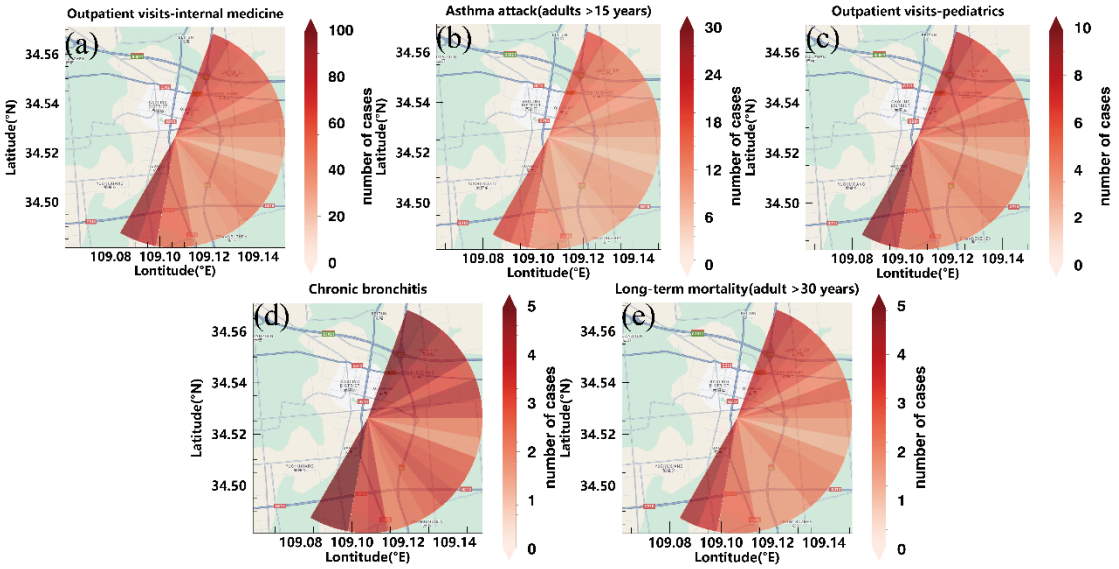


Figure S4 Horizontal distribution map (average values) of particulate matter air pollution-related case numbers in Gaoling District, Xi'an, from September to November 2020. Panels (a), (b), (c), (d) and (e) represent Outpatient visits-internal medicine, Asthma attack (adults >15 years), Outpatient visits-pediatrics, Chronic bronchitis, and Long-term mortality respectively.

Table S3 Clustering results of aerosols during the observation period.

	Cluster	Ratio (%)
40m	1	46.72
	2	28.35
	3	24.93
	all	100.00
200m	1	49.94
	2	35.67
	3	14.39
	all	100.00
400m	1	49.81
	2	31.88
	3	18.31
	all	100.00
800m	1	33.02
	2	22.60
	3	27.53
	4	16.85
	all	100.00

Table S4 Clustering results of aerosols during the observation period.

	Cluster	Ratio (%)
40m	1	75
	2	25
	all	100
200m	1	66.67
	2	33.33
	All	100
400m	1	70.83
	2	29.17
	All	100
800m	1	75
	2	25
	all	100