

Supplementary information

Table S1. Descriptive statistics of the aerosol optical properties for all the valid data of the PM₁₀ aerosol particles.

		Wavelength (nm)	PM ₁₀ aerosol particles				
Extensive variables			25%ile	Mean	Median	75%ile	Std. dev.
	σ_{abs} (Mm ⁻¹)	520	0.87	1.95	1.43	2.33	1.82
	σ_{sca} (Mm ⁻¹)	550	6.43	14.12	10.02	16.97	12.08
	<i>PM mass</i> (μgm ⁻³)		5.86	4.11	6.66	8.79	2.54
Intensive variables	AAE (dimensionless)	370-950	1.06	1.13	1.13	1.21	0.12
	SAE (dimensionless)	450-700	1.57	1.81	1.88	2.1	0.41
	SSA (dimensionless)	550	0.84	0.87	0.88	0.91	0.05
	MAC (m ² g ⁻¹)	520	0.22	0.39	0.33	0.52	0.76
	MSC (m ² g ⁻¹)	550	1.94	2.75	2.61	3.62	7.29

Table S2. Descriptive statistics of the aerosol optical properties for all the valid data of the PM₁ aerosol particles.

		Wavelength (nm)	PM ₁ aerosol particles				
Extensive variables			25%ile	Mean	Median	75%ile	Std. dev.
	σ_{abs} (Mm ⁻¹)	520	0.78	1.77	1.3	2.12	0.78
	σ_{sca} (Mm ⁻¹)	550	4.03	10.76	7.35	13.32	10.22
	<i>PM mass</i> (µgm ⁻³)		3.53	2.4	4.03	7.64	1.4
Intensive variables	<i>AAE</i> (dimensionless)	370-950	1.1	1.18	1.19	1.28	0.14
	<i>SAE</i> (dimensionless)	450-700	2.25	2.43	2.46	2.64	0.29
	<i>SSA</i> (dimensionless)	550	0.8	0.84	0.84	0.89	0.06
	<i>MAC</i> (m ² g ⁻¹)	520	0.35	0.66	0.53	0.77	6.54
	<i>MSC</i> (m ² g ⁻¹)	550	2.47	3.85	3.28	4.1	41.91

Table S3. Long-term trends and statistical significance of PM₁₀ aerosol optical and mass properties.

S. No.	Variable	Slope	Relative trend	p-value	Statistical significance
(a)	$\sigma_{sca, 550}$ (Mm ⁻¹)	$-0.19 \pm 0.22 \text{ Mm}^{-1}\text{yr}^{-1}$	$-1.76 \pm 2.05 \text{ \%yr}^{-1}$	0.10	No
(b)	$\sigma_{abs, 520}$ (Mm ⁻¹)	$-0.11 \pm 0.03 \text{ Mm}^{-1}\text{yr}^{-1}$	$-8.18 \pm 1.94 \text{ \%yr}^{-1}$	1.64×10^{-13}	Yes
(c)	SAE (dimensionless)	$-5.24 \times 10^{-3} \pm 1.41 \times 10^{-2} \text{ yr}^{-1}$	$-0.29 \pm 0.77 \text{ \%yr}^{-1}$	0.46	No
(d)	AAE (dimensionless)	$-1.13 \times 10^{-2} \pm 5.03 \times 10^{-3} \text{ yr}^{-1}$	$-1.01 \pm 0.45 \text{ \%yr}^{-1}$	9.28×10^{-6}	Yes
(e)	PM mass (μgm ⁻³)	$-0.19 \pm 0.09 \text{ μgm}^{-3}\text{yr}^{-1}$	$-4.65 \pm 2.24 \text{ \%yr}^{-1}$	3.56×10^{-5}	Yes
(f)	SSA ₅₅₀ (dimensionless)	$6.60 \times 10^{-3} \pm 2.07 \times 10^{-3} \text{ yr}^{-1}$	$0.75 \pm 0.24 \text{ \%yr}^{-1}$	2.16×10^{-8}	Yes
(g)	MSC ₅₅₀ (m ² g ⁻¹)	$0.04 \pm 1.19 \times 10^{-2} \text{ m}^2\text{g}^{-1}\text{yr}^{-1}$	$1.65 \pm 0.45 \text{ \%yr}^{-1}$	1.91×10^{-13}	Yes
(h)	MAC ₅₂₀ (m ² g ⁻¹)	$-1.03 \times 10^{-2} \pm 2.22 \times 10^{-3} \text{ m}^2\text{g}^{-1}\text{yr}^{-1}$	$-3.08 \pm 0.67 \text{ \%yr}^{-1}$	2.73×10^{-19}	Yes

Table S4. Long-term trends and statistical significance of PM₁ aerosol optical and mass properties.

S. No.	Variable	Slope	Relative trend	p-value	Statistical significance
(a)	$\sigma_{sca,550}$ (Mm ⁻¹)	$-0.26 \pm 0.17 \text{ Mm}^{-1}\text{yr}^{-1}$	$-3.48 \pm 2.33 \text{ \%yr}^{-1}$	6.85×10^{-3}	Yes
(b)	$\sigma_{abs,520}$ (Mm ⁻¹)	$-0.10 \pm 0.02 \text{ Mm}^{-1}\text{yr}^{-1}$	$-8.38 \pm 2.03 \text{ \%yr}^{-1}$	6.29×10^{-13}	Yes
(c)	SAE (dimensionless)	$0.02 \pm 1.20 \times 10^{-2} \text{ yr}^{-1}$	$0.83 \pm 0.49 \text{ \%yr}^{-1}$	9.24×10^{-4}	Yes
(d)	AAE (dimensionless)	$-1.37 \times 10^{-2} \pm 6.29 \times 10^{-3} \text{ yr}^{-1}$	$-1.16 \pm 0.54 \text{ \%yr}^{-1}$	6.41×10^{-6}	Yes
(e)	PM mass (μgm^{-3})	$-0.13 \pm 0.06 \mu\text{gm}^{-3}\text{yr}^{-1}$	$-5.17 \pm 2.48 \text{ \%yr}^{-1}$	1.38×10^{-5}	Yes
(f)	SSA ₅₅₀ (dimensionless)	$6.55 \times 10^{-3} \pm 2.89 \times 10^{-3} \text{ yr}^{-1}$	$0.78 \pm 0.34 \text{ \%yr}^{-1}$	3.68×10^{-6}	Yes
(g)	MSC ₅₅₀ (m ² g ⁻¹)	$0.05 \pm 1.21 \times 10^{-2} \text{ m}^2\text{g}^{-1}\text{yr}^{-1}$	$1.46 \pm 0.37 \text{ \%yr}^{-1}$	3.40×10^{-15}	Yes
(h)	MAC ₅₂₀ (m ² g ⁻¹)	$-1.38 \times 10^{-2} \pm 3.33 \times 10^{-3} \text{ m}^2\text{g}^{-1}\text{yr}^{-1}$	$-2.62 \pm 0.63 \text{ \%yr}^{-1}$	3.89×10^{-16}	Yes

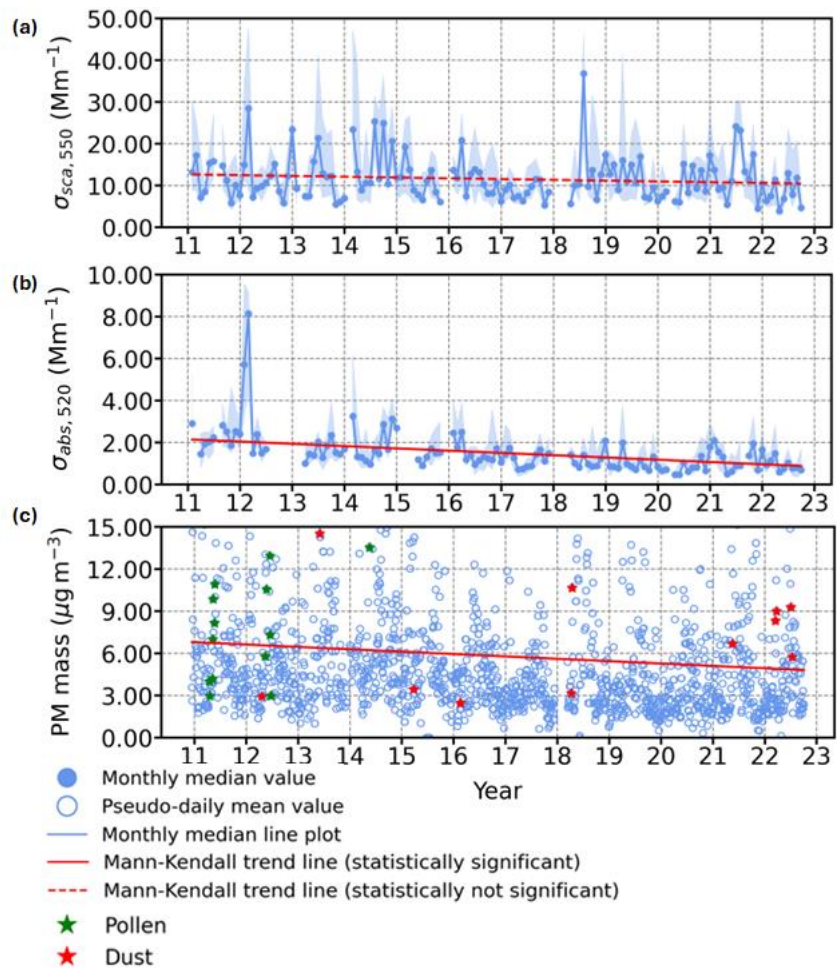


Figure S1. Time series of (a) $\sigma_{sca,550}$, (b) $\sigma_{abs,520}$ and (c) $PM\ mass$ for the PM_{10} aerosol particles from October 2010 to October 2022.

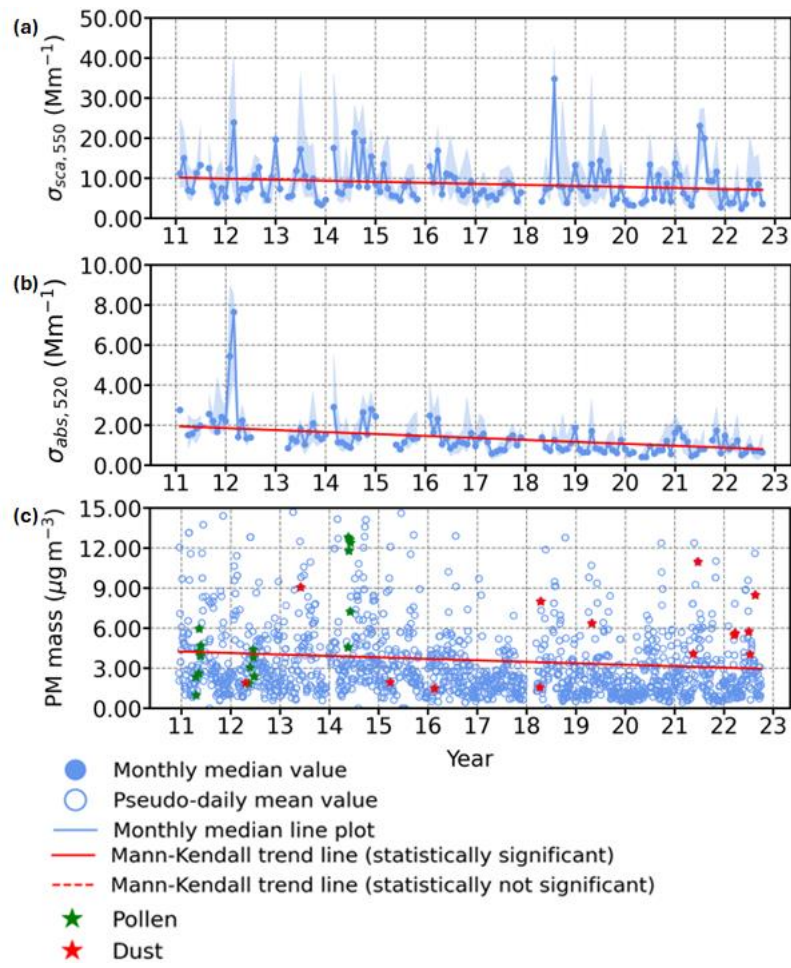


Figure S2. Time series of (a) $\sigma_{sca,550}$, (b) $\sigma_{abs,520}$ and (c) $PM\ mass$ for the PM_1 aerosol particles from October 2010 to October 2022.

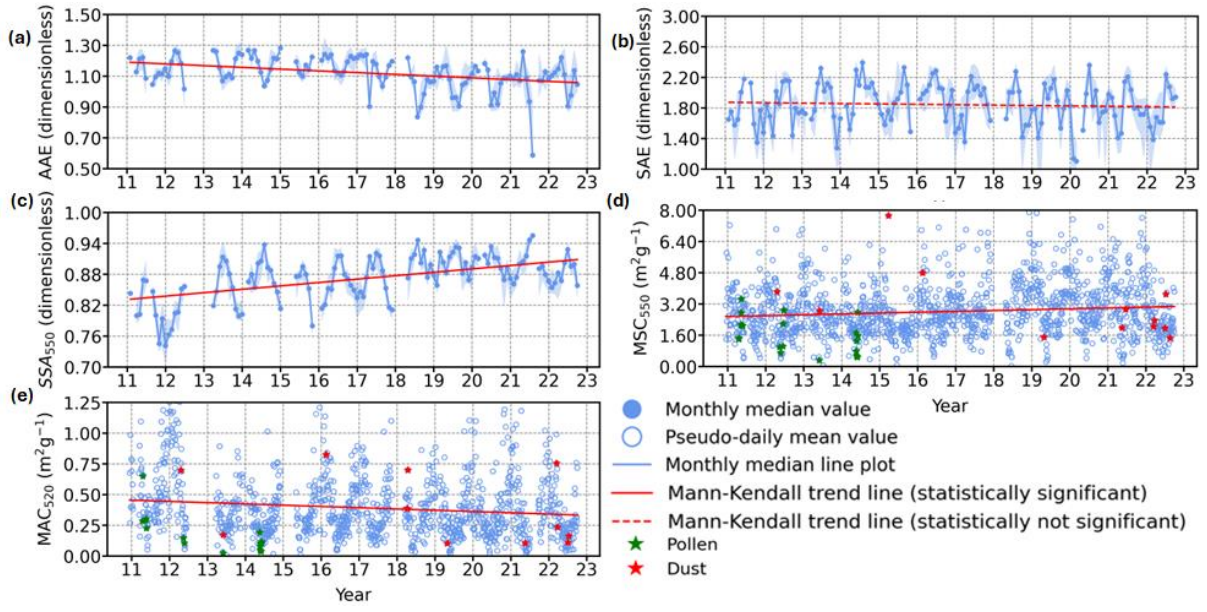


Figure S3. Time series of (a) *AAE*, (b) *SAE*, (c) *SSA*, (d) *MSC*₅₅₀ and (e) *MAC*₅₂₀ for the PM₁₀ aerosol particles from October 2010 to October 2022.

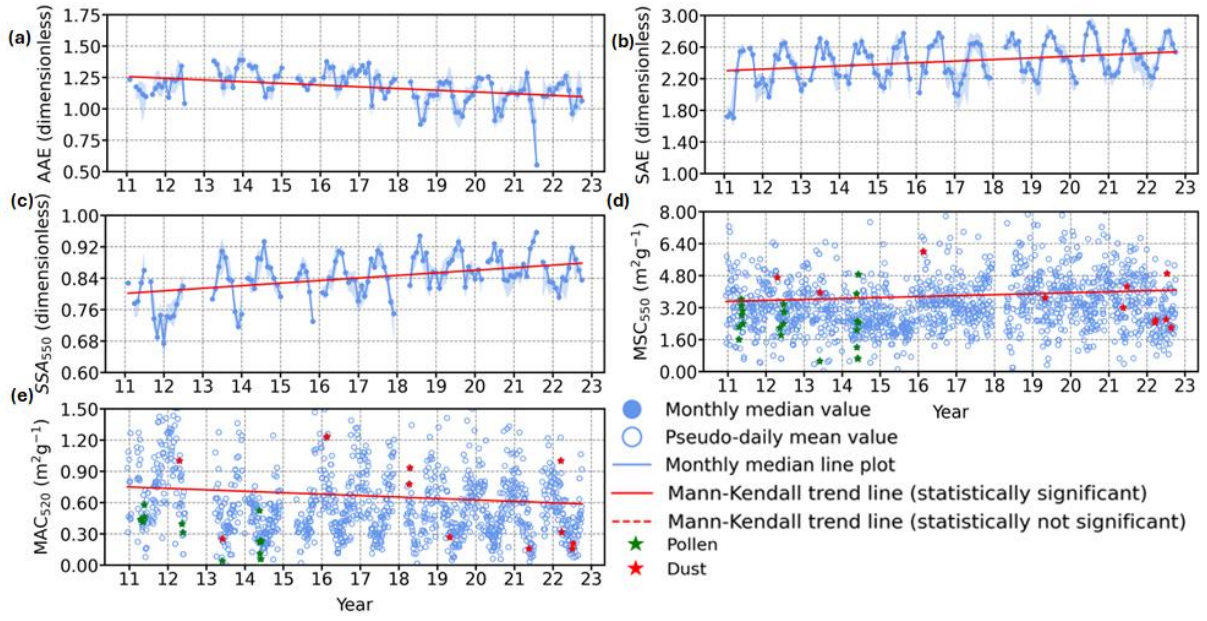


Figure S4. Time series of (a) *AAE*, (b) *SAE*, (c) *SSA₅₅₀*, (d) *MSC₅₅₀* and (e) *MAC₅₂₀* for the PM₁ aerosol particles from October 2010 to October 2022.

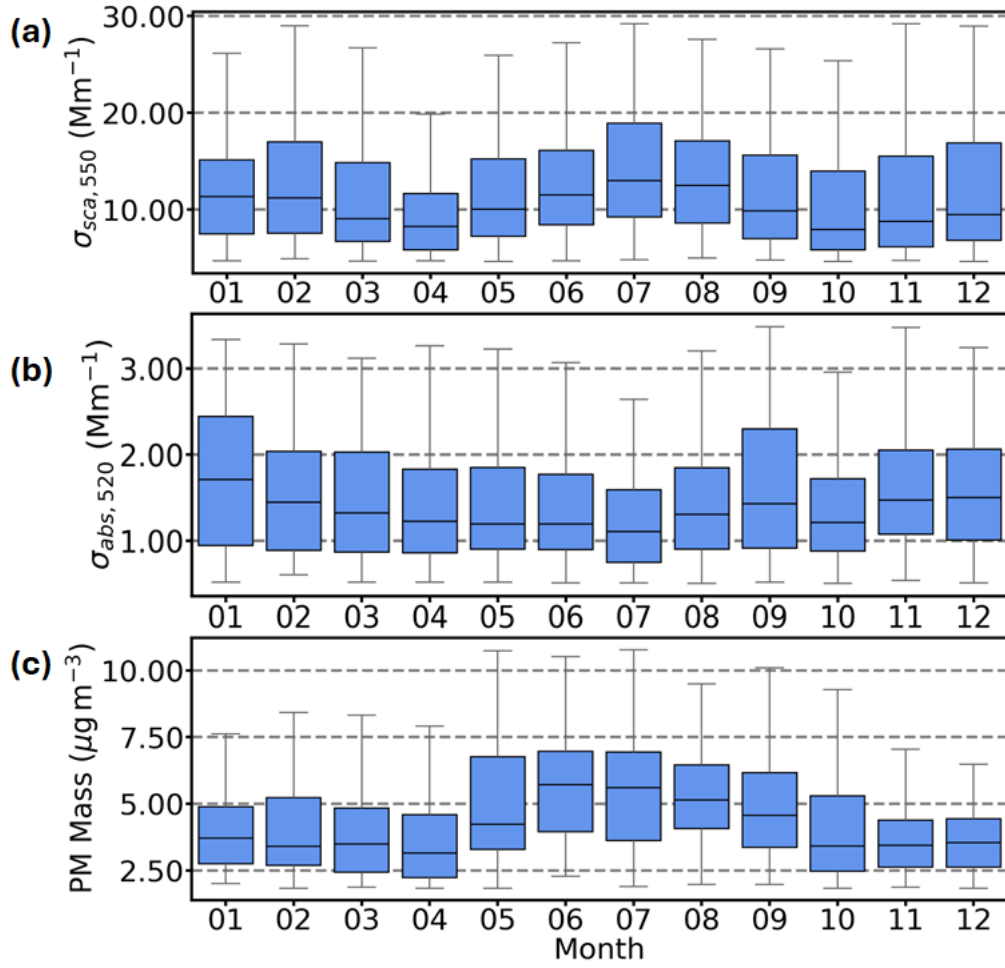


Figure S5. Monthly variations of aerosol optical properties for PM₁₀ aerosol particles from October 2010 to October 2022 (a) $\sigma_{sca, 550}$, (b) $\sigma_{bsca, 550}$, (c) $\sigma_{abs, 520}$ and (d) $PM\ mass$. Box plots represent the interquartile range, with the first horizontal line showing the 25th percentile, the middle line showing the median (50th percentile), and the third horizontal line showing the 75th percentile. Whiskers extend to the 10th and 90th percentiles.

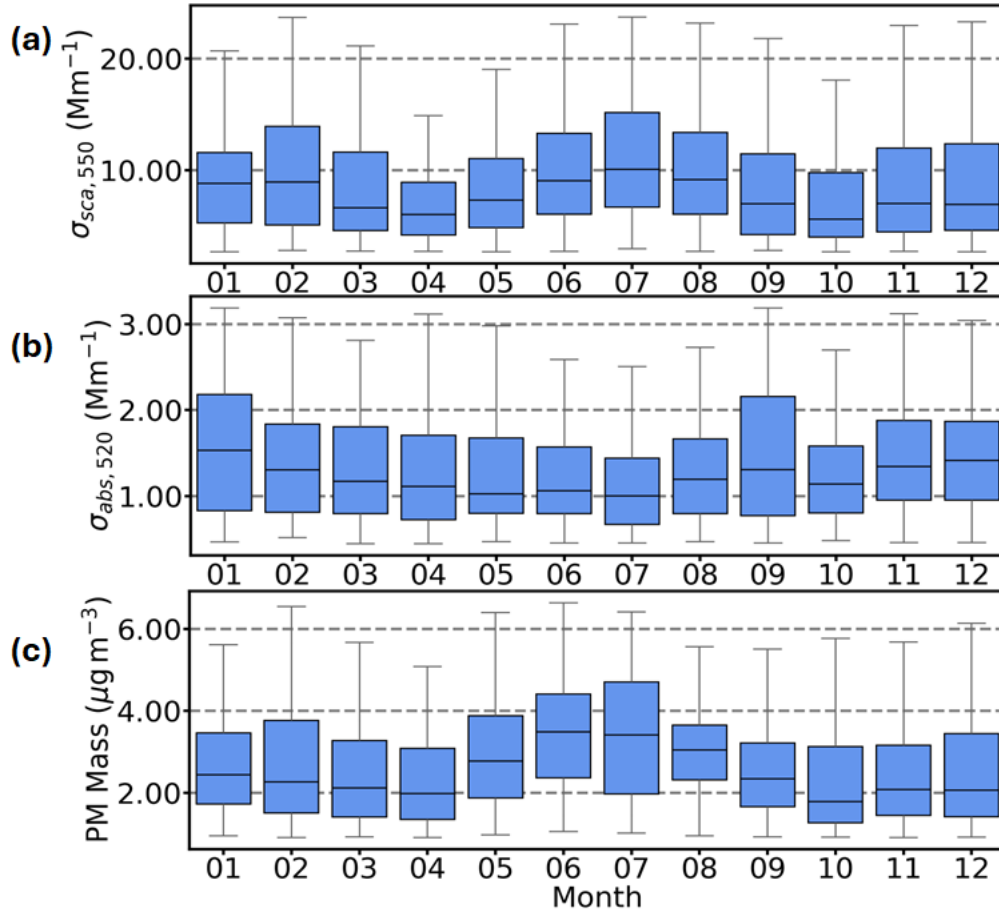


Figure S6. Monthly variations of aerosol optical properties for PM₁ aerosol particles from October 2010 to October 2022 (a) $\sigma_{sca, 550}$, (b) $\sigma_{abs, 520}$, and (d) *PM mass*. Box plots represent the interquartile range, with the first horizontal line showing the 25th percentile, the middle line showing the median (50th percentile), and the third horizontal line showing the 75th percentile. Whiskers extend to the 10th and 90th percentiles.

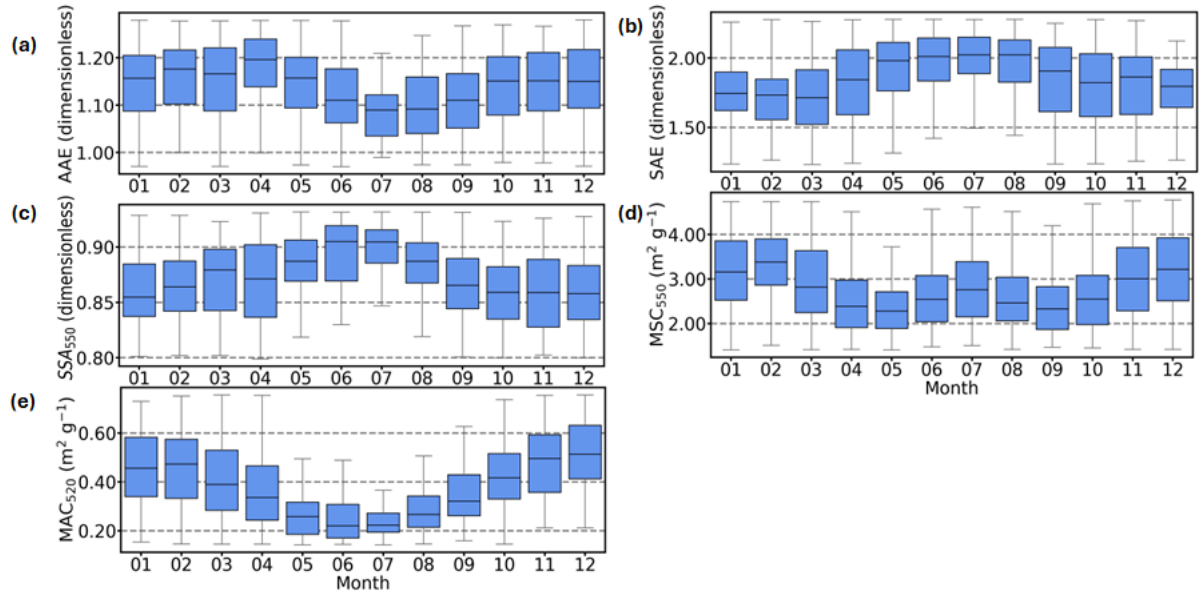


Figure S7. Monthly variations of aerosol optical properties PM₁₀ aerosol particles from October 2010 to October 2022 (a) AAE, (b) SAE, (c) SSA₅₅₀, (d) MSC₅₅₀ and (e) MAC₅₂₀. Box plots represent the interquartile range, with the first horizontal line showing the 25th percentile, the middle line showing the median (50th percentile), and the third horizontal line showing the 75th percentile. Whiskers extend to the 10th and 90th percentiles.

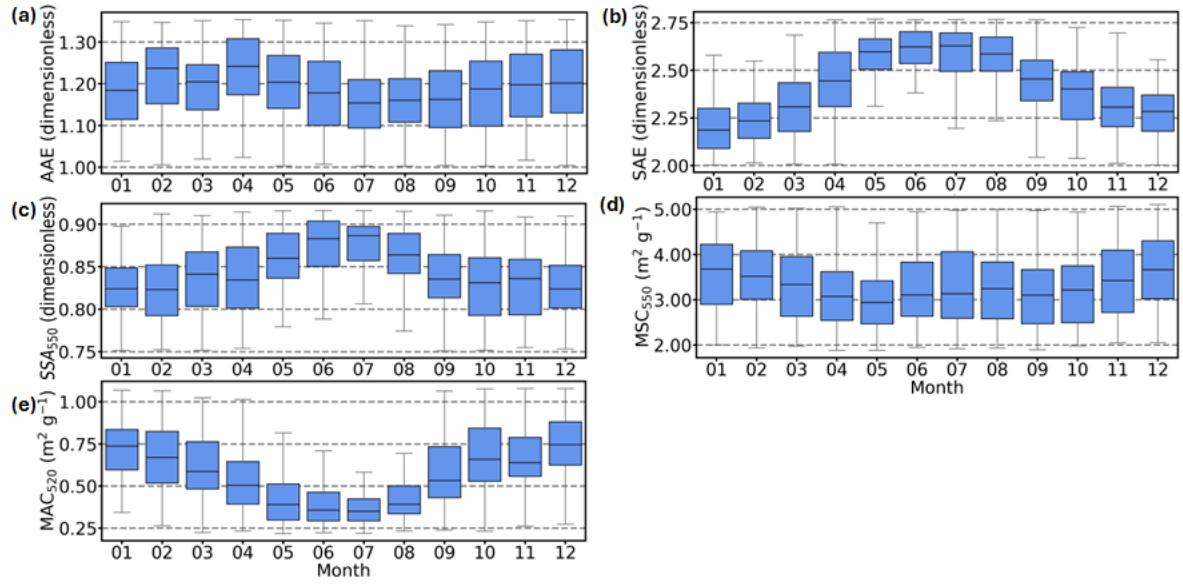


Figure S8. Monthly variations of aerosol optical properties PM₁ aerosol particles from October 2010 to October 2022 (a) *AAE*, (b) *SAE*, (c) *SSA*₅₅₀, (d) *MSC*₅₅₀ and (e) *MAC*₅₂₀. Box plots represent the interquartile range, with the first horizontal line showing the 25th percentile, the middle line showing the median (50th percentile), and the third horizontal line showing the 75th percentile. Whiskers extend to the 10th and 90th percentiles.

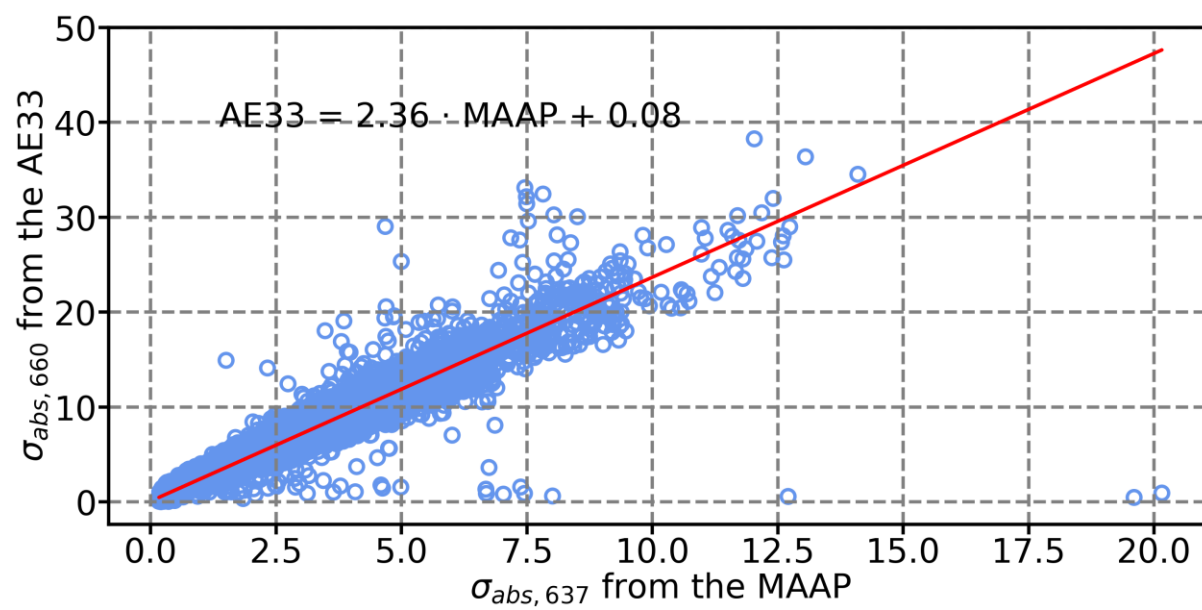


Figure S9. Ordinary least squares regression of $\sigma_{abs,660}$ from the AE33 with respect to $\sigma_{abs,637}$ from the MAAP.