

Supplemental Information

Use of Inverse Modeling to determine Particulate Emission Rates from Rural Unpaved Roads

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Tables

Table S1 Descriptive Statistics of Hourly PM₁₀ Measurements at Sites 1 and 2.

Parameter	Site 1 µg/m ³	Site 2 µg/m ³
Sample Size	871	558
Geometric Mean	50 (3.3 ¹)	26 (2.0)
Arithmetic Mean	106 (162 ²)	34 (30.6)
Minimum	1	0
Maximum	1717	256

¹Geometric standard deviation

²Standard deviation

Table S2 Descriptive Statistics of Emission Rates and Emission Factors (n = 64).

Parameter	Emission Rate, g/s	Emission Rate/ Vehicle, g/s-V	Emission Factor, g/VKT
Geometric Mean	1.09 (4.9 ¹)	0.26 (4.3 ¹)	444 (4.3 ¹)
Arithmetic Mean	3.34 (5.67 ²)	0.67 (1.06)	1153 (1826)
Minimum	0.02	0.01	8.5
Maximum	25.70	4.28	8430

¹Geometric standard deviation

²Standard deviation

Table S3. Summary of Sensitivity Analysis of Variables Affecting the Value of the AP-42 Emission Factor

Variable	Variable Range	Variable Mid-value	Unit Change ¹	Range Change ²
% Silt	1 - 16	8	50	745
% Moisture	0.4 – 1.2	0.8	-113	-90
Speed, kph	48 - 113	80	2.5	162

¹Change in emission factor per unit change of the variable

²Change in emission factor from lowest to highest value of the variable

Table S4. Sensitivity of the Inversely Modeled Emission Rate (G/S) to Changes in Vehicle Width and Vehicle Height

		Vehicle Width, m					
		1.73	1.83	2.21	2.59	2.59	5.03
Vehicle height, m	1.42	0.647 ¹					0.650
	1.45	0.648	0.649 ²				0.651
	2.03	0.671		0.672 ³			0.676
	3.53	0.798			0.798 ⁴		0.801
	4.11	0.857				0.857 ⁵	0.860
	3.81	0.825					0.829 ⁶

¹Small car²Medium car³Pickup truck/SUV⁴Grain truck⁵Tractor-trailer⁶Farm combine, transport width and height**Table S5** Descriptive Statistics for Vehicle-Generated Plume Characteristics (n = 147).

	Average Conc. µg/m ³	Max Conc. µg/m ³	Total Mass µg	Time to Peak sec	Residence Time sec
Geomean	4278 (1.96 ¹)	18743 (2.19 ¹)	3.4 (2.57 ¹)	8.2 (1.98 ¹)	7.4 (5.2 ¹)
Minimum	1137	2385	0.3	2.0	2.2
Maximum	32780	221017	54.0	62.0	147

¹Geometric standard deviation**Table S6.** Regression Coefficients for Plume Sampling Outcomes

	In Maximum Concentration	In Average Concentration	In Time to Peak Concentration	In Residence Time	In Total Mass
vehicle speed	0.021***	0.016***	0.001	0.003	0.022***
wind speed	-0.047*	-0.048**	-0.108***	-0.056***	-0.132***
wind direction	0.006	0.004	0.004	-0.007*	0.001

p: *<0.05, **<0.01, ***<0.001

Figures



Fig. S1. Site 1 and Site 2 BAM sample locations.



Fig. S2. Site 3 southerly-wind aerosol photometer sampling site.



Fig. S3. Site 4 northerly-wind aerosol photometer sampling site.



Fig. S4. The Site 1 sample shed containing a BAM monitor positioned near a rural unpaved road.



Fig. S5. The Site 1 sample shed showing configuration of the BAM monitor.

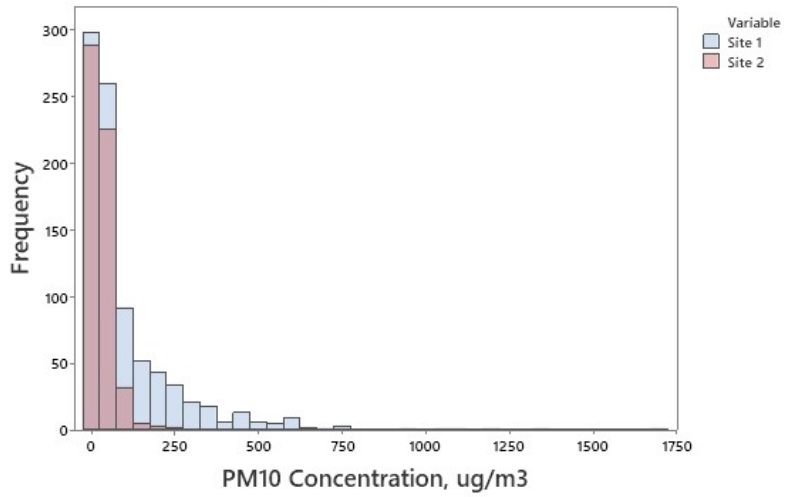


Fig. S6. Site 1 and Site 2 PM₁₀ concentration frequency distributions.

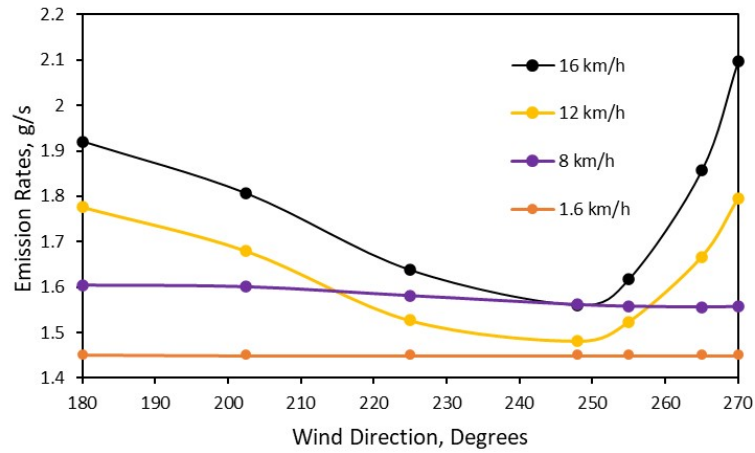


Fig. S7. Inverse modeled emission rates given varying wind directions and wind speeds while all other model inputs remained constant over a one-hour meteorological period.

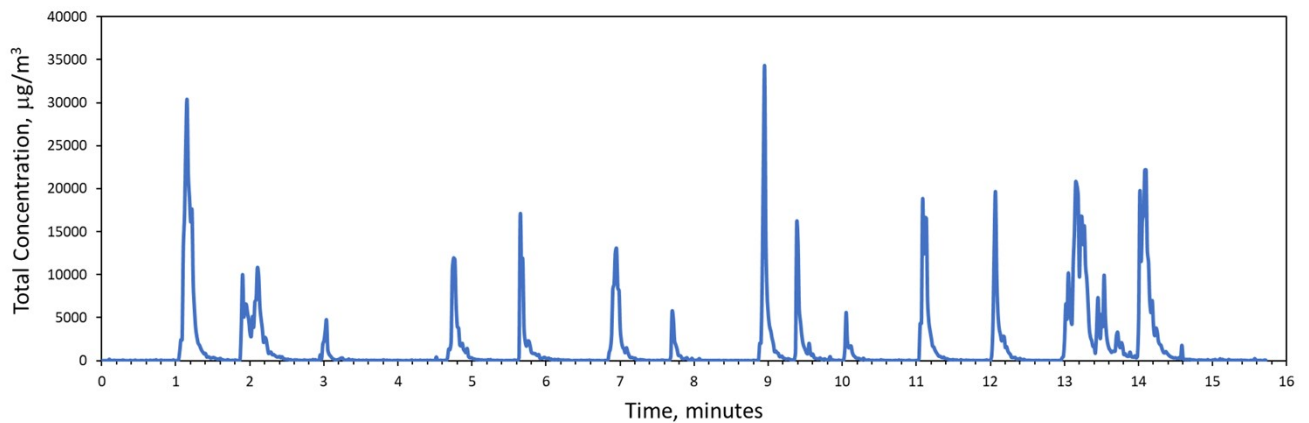


Fig. S8. Particulate matter plume profiles resulting from a car passing the aerosol photometer every one to three minutes.