

SUPPLEMENT INFORMATION

Comparison of Ultrafine Particles and Black Carbon Concentration Predictions from a Mobile and Short-Term Stationary Land-Use Regression Model

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Table S1 Spatial predictor variables with units, a priori defined directions of effect and buffer sizes.

Predictor variable	Variable name	Units	Direction	Buffer (m)
Industry	INDUSTRY	m ²	+	100, 300, 500, 1000, 5000
Port	PORT	m ²	+	100, 300, 500, 1000, 5000
Airport	AIRPORT	m ²	+	5000, 10000
Urban green	URBGREEN	m ²	-	100, 300, 500, 1000, 5000
Semi-natural and forested areas	NATURAL	m ²	-	100, 300, 500, 1000, 5000
Population data	POPEEA	m ²	+	100, 300, 500, 1000, 5000
Traffic intensity on nearest road	TRAFNEAR	Veh.day ⁻¹	+	
Distance to nearest road ^a	DISTINVNEAR ₁ , DISTINVNEAR ₂	m ²	+	
Product of traffic intensity on nearest road and inverse distance to the nearest road and inverse distance squared ^a	INTINVDIST, INTINVDIST ₂	Veh.day ⁻¹ m ⁻¹ , Veh.day ⁻¹ m ⁻²	+	
Traffic intensity on nearest major road	TRAFMAJOR	Veh.day ⁻¹	+	
Distance to nearest major road ^a	DISTINVMAJOR ₁ , DISTINVMAJOR ₂	m ²	+	
Product of traffic intensity on nearest major road and inverse of distance to the nearest major road and distance squared ^a	INTMAJORINVDIST, INTMAJORINVDIST ₂	Veh.day ⁻¹ m ⁻¹ , Veh.day ⁻¹ m ⁻²	+	
Total traffic load of major roads in a buffer (sum of (traffic intensity* length of all segments))	TRAFMAJORLOAD	Veh.day ⁻¹ m	+	25, 50, 100, 300, 500, 1000
Total traffic load of roads in a buffer (sum of (traffic intensity * length of all segments))	TRAFLOAD	Veh.day ⁻¹ m	+	25, 50, 100, 300, 500, 1000
Heavy-duty traffic intensity on nearest road	HEAVYTRAFNEAR	Veh.day ⁻¹	+	
Product of heavy-duty traffic intensity on nearest road and	HEAVYINTINVDIST,	Veh.day ⁻¹ m,	+	

inverse of distance to the nearest road and distance squared	HEAVYINTINVDIST ₂	Veh.day ⁻² m		
Heavy-duty traffic intensity on nearest major road	HEAVYTRAFMAJOR	Veh.day ⁻¹	+	
Total heavy-duty traffic load of major roads in a buffer (sum of (heavy-duty traffic intensity*length of all segments))	HEAVYTRAFMAJORLOAD	Veh.day ⁻¹ m	+	25, 50, 100, 300, 500, 1000
Total heavy-duty traffic load of all roads in a buffer (sum of (heavy-duty traffic intensity* length of all segments))	HEAVYTRAFLOAD	Veh.day ⁻¹ m	+	25, 50, 100, 300, 500, 1000
Road length of all roads in a buffer	ROADLENGTH	m	+	25, 50, 100, 300, 500, 1000
Road length of all major roads in a buffer	MAJORROADLENGTH	m	+	25, 50, 100, 300, 500, 1000
Distance to nearest road, inverse distance (m ⁻¹) and inverse squared distance (m ⁻²) ^a	DISTINVNEARC ₁ , DISTINVNEARC ₂	m ⁻¹ /m ⁻²	+	
Distance to nearest major road ^a	DISTINVMAJORC ₁ , DISTINVMAJORC ₂	m ⁻¹ /m ⁻²	+	

^a Variables were not used for mobile model development, due to values being zero.

Table S2. Land-Use Regression Models based upon Mobile Measurements for UFP and BC with at least two repeats.

Variables in LUR model	UFP (in particles/cm ³)	BC (in µg/m ³)
Intercept	557 (2,104))	0.71 (0.26)
Population Density in a 5000 meter buffer	10,091 (1,607)	
Airport Area in a 5000 meter buffer	5,085 (978)	0.83 (0.12)
Number of households in a 5000 meter buffer		0.67 (0.23)
Nature Area in 5000 meter buffer		
Major Road Length in a 100 meter buffer	6,885 (1,340)	0.83 (0.18)
Heavy Traffic Intensity on the Nearest Road	2,556 (1,288)	0.85 (0.17)
Heavy Traffic Load on Major Roads in a 500 meter buffer	5,047 (1,248)	
Traffic Load on Major Roads in a 500 meter buffer		0.59 (0.20)
Traffic Load in a 1000 meter buffer		
R² of model	0.18	0.30
Number of road segments used for model development	745	514

^a Regression slopes and standard error (between parentheses), multiplied by the difference between 10th and 90th percentile for all predictors to allow comparison of the effect of predictors with different units and distribution on measured concentrations.

Table S3. Land-Use Regression models using mobile UFP measurements (*in particles/cm³*).

Variables in LUR model	With Local Exhaust Plumes		Without Local Exhaust Plumes	
	Linear Regression	AR-1 Model	Linear Regression	AR-1 Model
Intercept	2381 (1746)	5656 (2675)	1414 (1532)	1244 (2007)
Population Density in a 5000 meter buffer	7894 (1212)	8064 (1947)	8833 (1021)	9394 (1587)
Airport Area in a 5000 meter buffer	4703 (728)	4669 (1185)	5329 (663)	5240 (1077)
Port Area in a 1000 meter buffer	2155 (838)	2499 (1248)	2070 (730)	2007 (1101)
Port Area in a 5000 meter buffer	2837 (1094)		3002 (959)	3116 (1500)
Nature Area in 5000 meter buffer	-1830 (851)	-2557 (1357)	-1362 (745)	
Major Road Length in a 50 meter buffer	8540 (943)	6868 (1071)	6994 (827)	6186 (847)
Traffic Load on Major Roads in a 100 meter buffer	3562 (1055)	1928 (1095)	2780 (1018)	
Traffic Intensity on the Nearest Road			2387 (969)	3240 (825)
Traffic Load in a 500 meter buffer	2514 (1159)	2917 (1514)		
<i>R² of model</i>	0.14	0.13	0.16	0.16
<i>Number of sites used for model development</i>	2,964	2,964	2,907	2,907

Different methods were explored for developing mobile LUR models. Mobile models were generated with and without local exhaust plumes, shown as linear regression models. For both methods, an AR-1 term was added to the model to correct for autocorrelation.

^a Regression slopes were multiplied by the difference between 10th and 90th percentile for all predictors. Standard error between brackets.

Table S4. Comparison between predicted UFP concentrations at 12,682 residential addresses from a cohort in Amsterdam, based on different specifications of the LUR model. (*in particles/cm³*).

Dataset	N	5 th Percentil e	25 th Percentil e	Median	75 th Percentil e	95 th Percentil e	Pearson correlation with main model (With peaks and AR-1)
Stationary Short-Term Model	12,682	3,882	6,153	10,657	13,339	16,217	0.94
Model With Peaks	12,682	1,288	6,287	14,299	18,105	23,254	0.99
Model With Peaks and AR-1	12,682	2,531	8,494	15,629	19,318	24,247	/
Model Without Peaks	12,682	1,472	5,298	13,622	17,008	22,138	0.98
Model Without Peaks and AR-1	12,682	4,082	7,091	14,572	17,692	22,019	0.96

Different methods were explored for developing mobile LUR models. Mobile models were generated with and without local exhaust plumes, indicated by with and without peaks. For both methods, an AR-1 term was added to the model to correct for autocorrelation.

Table S5. Land-Use Regression models using mobile BC measurements (in $\mu\text{g}/\text{m}^3$).

Variables in LUR model	With Local Exhaust Plumes		Without Local Exhaust Plumes	
	Linear Regression	AR-1 Model	Linear Regression	AR-1 Model
Intercept	-1.22 (0.37)	0.48 (0.60)	-0.52 (0.23)	-0.02 (0.54)
Major Road Length in a 50 meter buffer	0.95 (0.18) ^a	0.61 (0.15)	0.85 (0.15)	0.29 (0.12)
Population Density in a 5000 meter buffer	1.01 (0.25)	1.15 (0.48)	1.34 (0.19)	0.84 (0.43)
Road Length in a 1000 meter buffer	0.65 (0.23)			
Traffic Load in a 100 meter buffer	0.45 (0.23)			
Traffic Load in a 1000 meter buffer	0.86 (0.23)	0.88 (0.36)	0.94 (0.19)	1.74 (0.28)
Traffic Intensity on the Nearest Road	0.73 (0.20)	0.30 (0.14)	0.89 (0.15)	
<i>R² of model</i>	0.13	0.12	0.12	0.12
<i>Number of sites used for model development</i>	2336	2336	2234	2234

Different methods were explored for developing mobile LUR models. Mobile models were generated with and without local exhaust plumes, shown as linear regression models. For both methods an AR-1 term was added to the model to correct for autocorrelation.

^a Regression slopes were multiplied by the difference between 10th and 90th percentile for all predictors. Standard error between brackets.

Table S6. Comparison between predicted BC concentrations at 12,682 residential addresses from a cohort in Amsterdam, based on different specifications of the LUR model (in $\mu\text{g}/\text{m}^3$).

Dataset	N	5 th Percentile	25 th Percentile	Median	75 th Percentile	95 th Percentile	Pearson correlation with main model (With peaks and AR-1)
Stationary Short-Term Model	12,682	0.71	0.86	1.09	1.33	1.50	0.93
Model With Peaks	12,682	-0.16	0.79	1.48	2.53	3.45	0.97
Model With Peaks and AR-1	12,682	0.94	1.51	2.00	2.87	3.44	/
Model Without Peaks	12,682	0.01	0.66	1.24	2.24	2.91	0.99
Model Without Peaks and AR-1	12,682	0.41	1.09	1.65	2.72	3.53	0.98

Different methods were explored for developing mobile LUR models. Mobile models were generated with and without local exhaust plumes, indicated by with and without peaks. For both methods an AR-1 term was added to the model to correct for autocorrelation.

Table S7. LUR Models for UFP and BC based upon stationary measurements.

Variables in LUR model	UFP (in particles/cm ³)	BC (in µg/m ³)
Intercept	1807 (1965)	0.54 (0.21)
Inverse Distance to Major Road	5403 (1047) ^a	0.53 (0.13)
Population Density in 5000 meter buffer	4886 (1364)	0.41 (0.16)
Port Area in an 5000 meter buffer	2238 (1299)	
Airport Area in an 5000 meter buffer	612 (204)	
Traffic Load in 100 meter buffer	1722 (863)	
Traffic Intensity on the nearest street		0.21 (0.13)
<i>R</i>² of model	0.36	0.28
<i>Number of sites used for model development</i>	128	141

Stationary models were developed with the average of 30 minute measurements in two seasons. The old stationary model, based on three seasons, which has been published before is shown in table S7.

^a Regression slopes were multiplied by the difference between 10th and 90th percentile for all predictors. Standard error between brackets.

Table S8. Previously published LUR Models for UFP and BC based upon stationary measurements, based on three seasons.

Variables in LUR model	UFP (in particles/cm ³)	BC (in µg/m ³)
Intercept	3,221	0.54
Inverse Distance to Major Road	4,552 ^a	0.52
Population Density in 5000 meter buffer	3,959	0.37
Port Area in an 5000 meter buffer	2,255	
Traffic Load in 100 meter buffer	1,740	
Traffic Intensity on the nearest street		0.30
<i>R² of model</i>	0.37	0.35
<i>Number of sites used for model development</i>	159	160

The old stationary model based on three seasons which has been published before⁹. Airport data was not included in the paper by Montagne et al⁹.

^a Regression slopes were multiplied by the difference between 10th and 90th percentile for all predictors. Standard error between brackets.

Figure S1. Stationary versus mobile UFP measurements on the same road segment (n=184).
Concentration levels in particles/cm³.

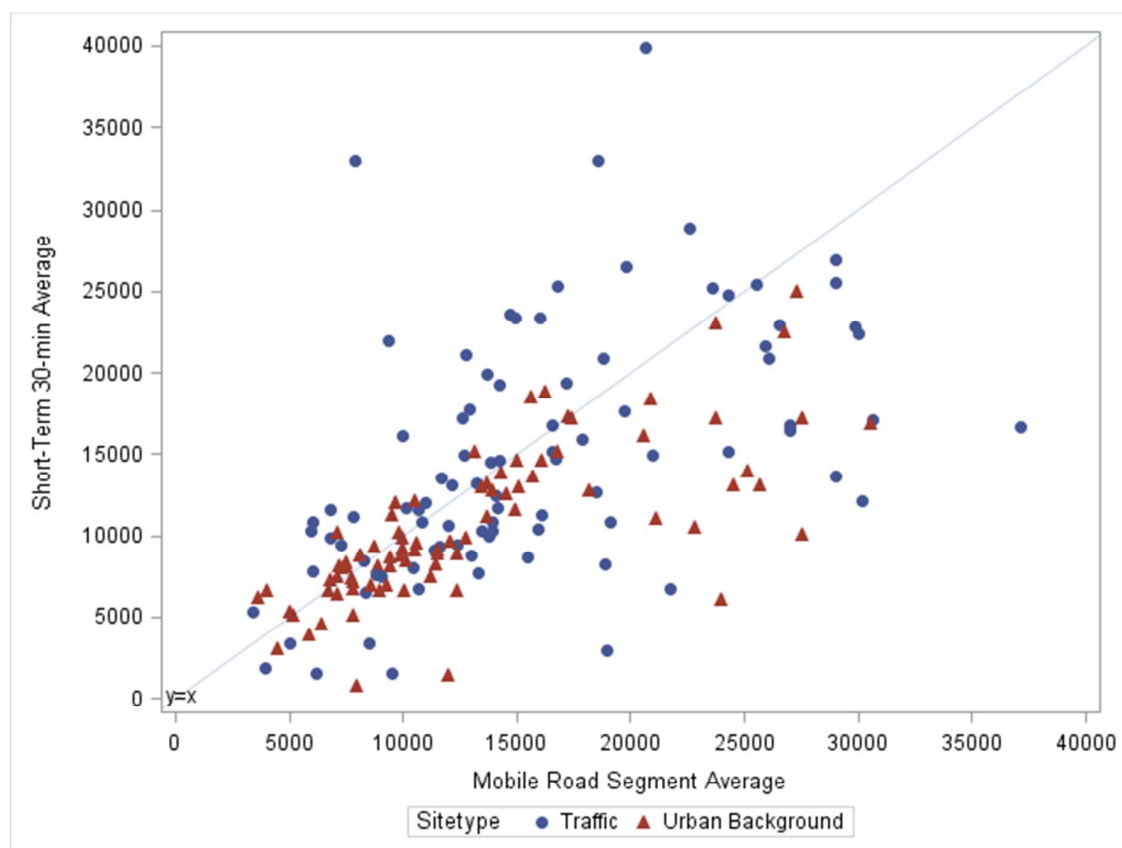
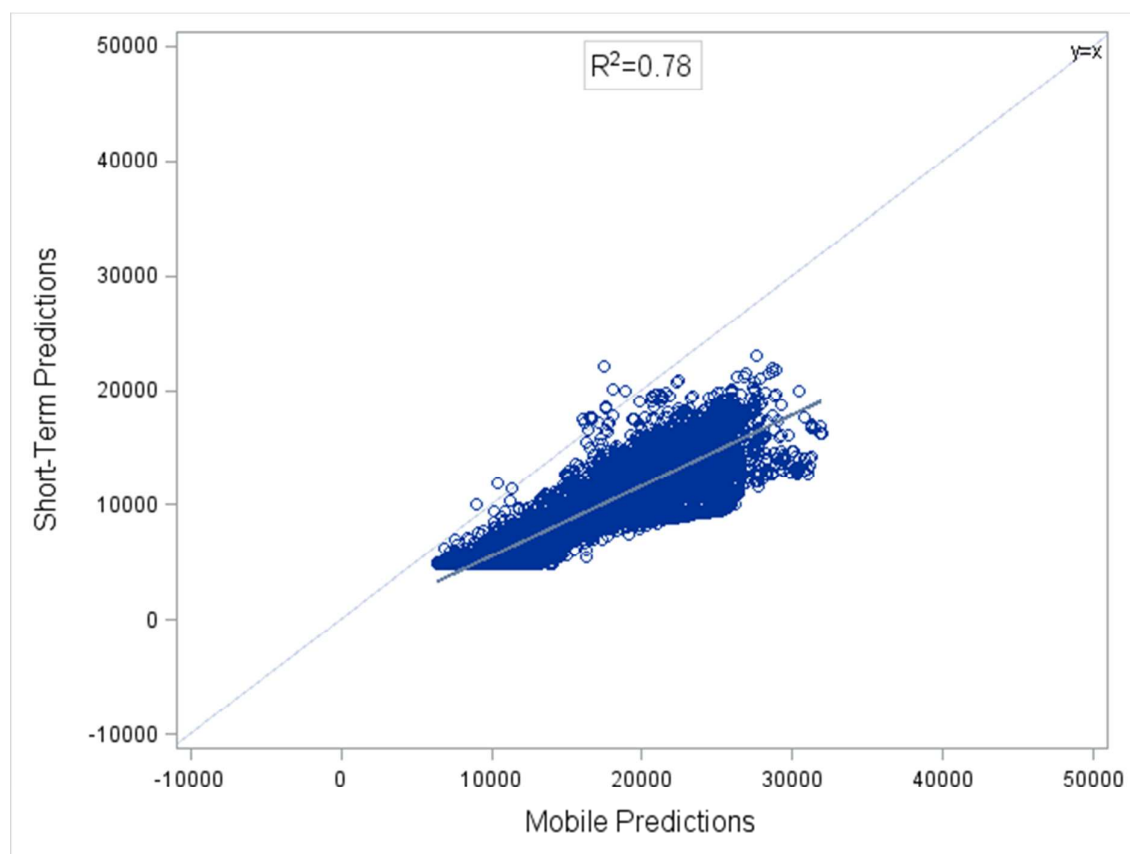


Figure S2. Mobile versus Stationary predicted concentrations on an external dataset for UFP averages based on the same averaging method as the BC instrument.



Mobile predictions are based on UFP road segment averages that were calculated with the same method as the BC instrument, so based on the minimal attenuation change of 0.05 of the BC device.