

Supplemental Material

Spatial Variations in the estimated production of Reactive Oxygen Species by PM_{2.5} iron and copper in the Epithelial Lung Lining Fluid

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Figure S1. Locations of summer (n=67; August/September, 2016) and winter (n=42; February/March, 2017) monitoring sites in Toronto, Canada. Twenty-eight sites were monitored during both seasons. Land use and traffic data were only available for locations within the boundaries of the city of Toronto.

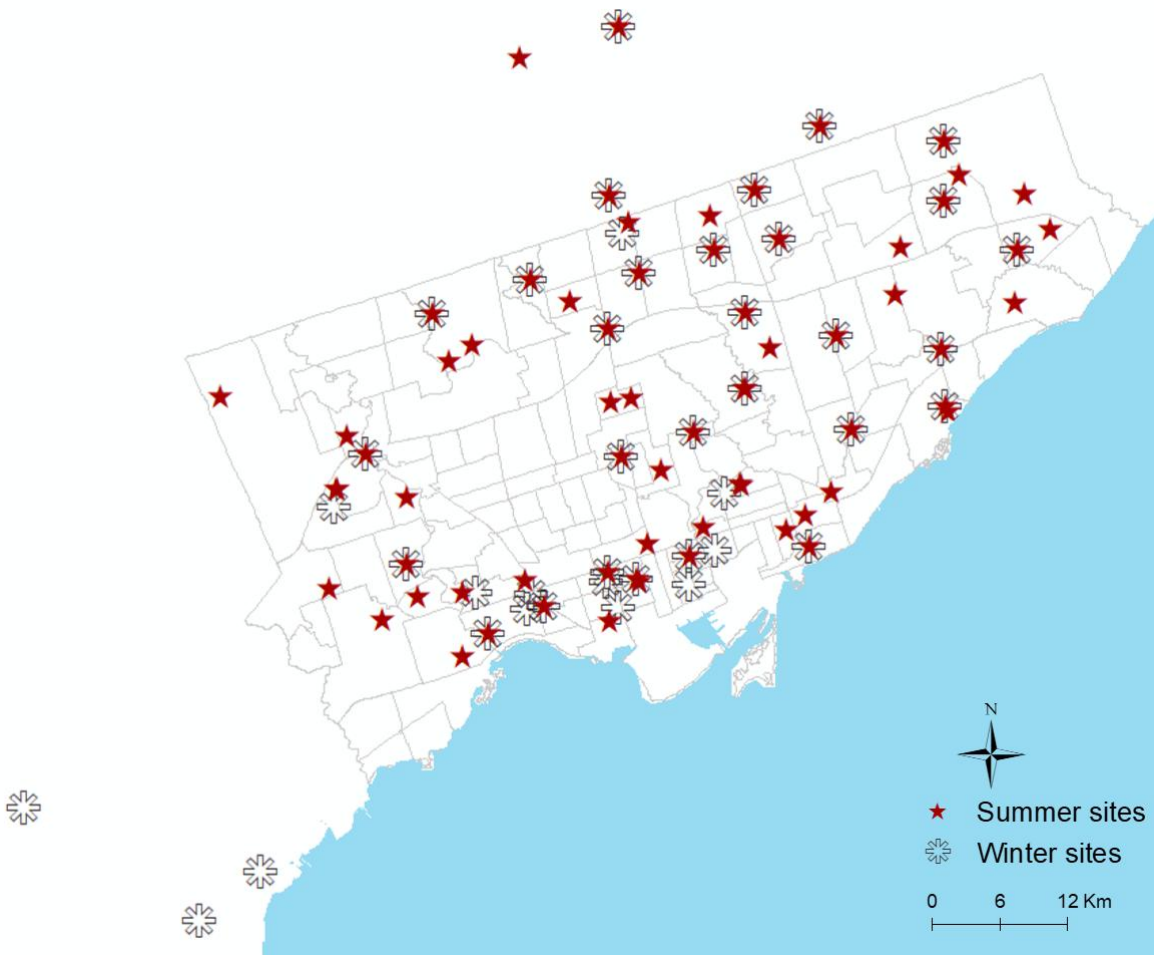


Figure S2. Boxplots for the ratio of summer and winter concentrations of PM_{2.5}, Fe, Cu, and ROS for sites with both summer and winter data in Toronto, Canada (n=28). The red line indicates a ratio of 1:1.

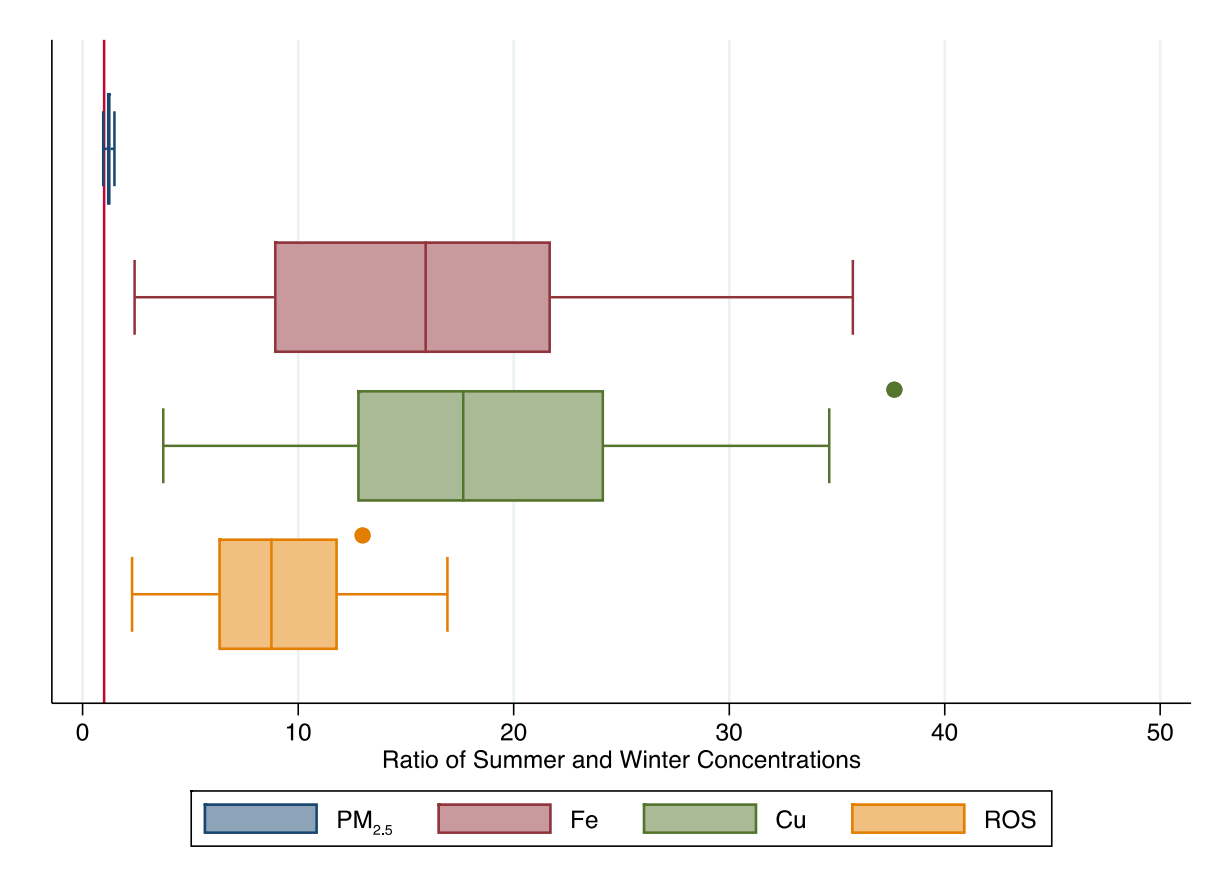
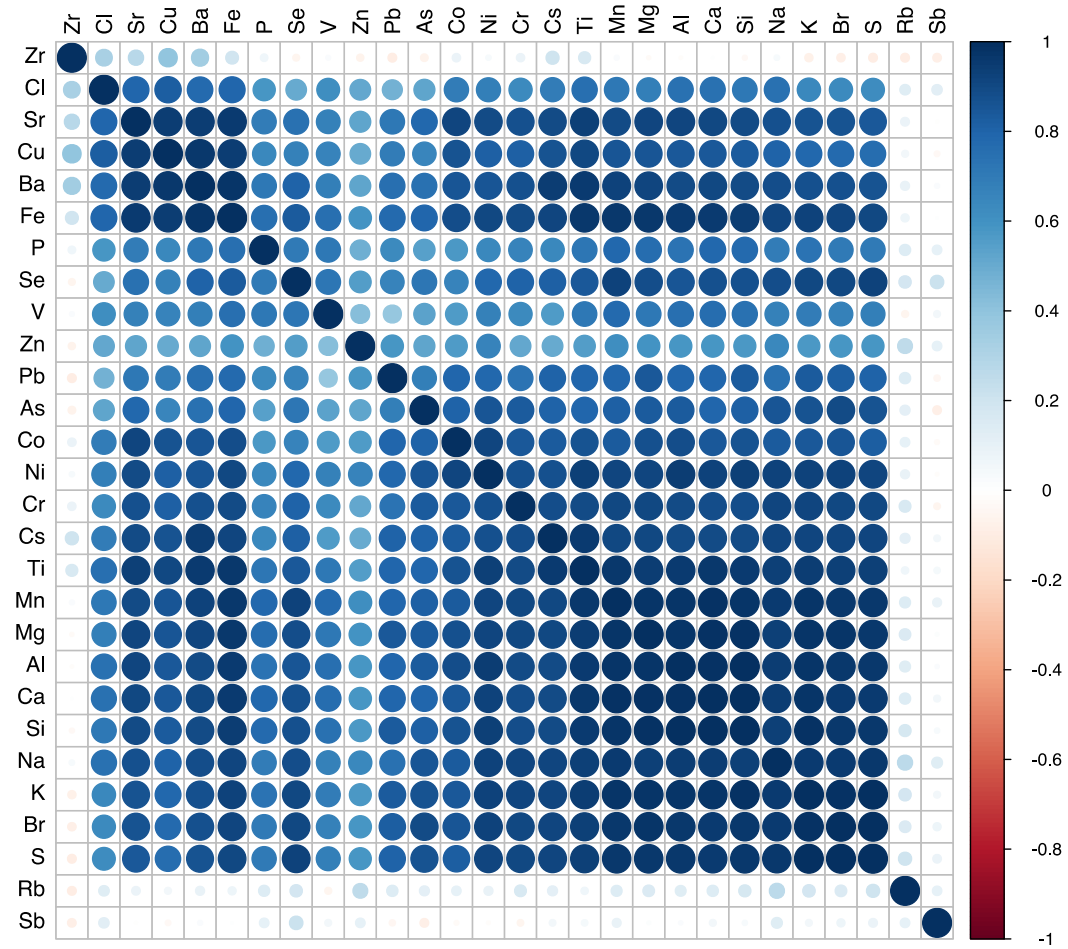
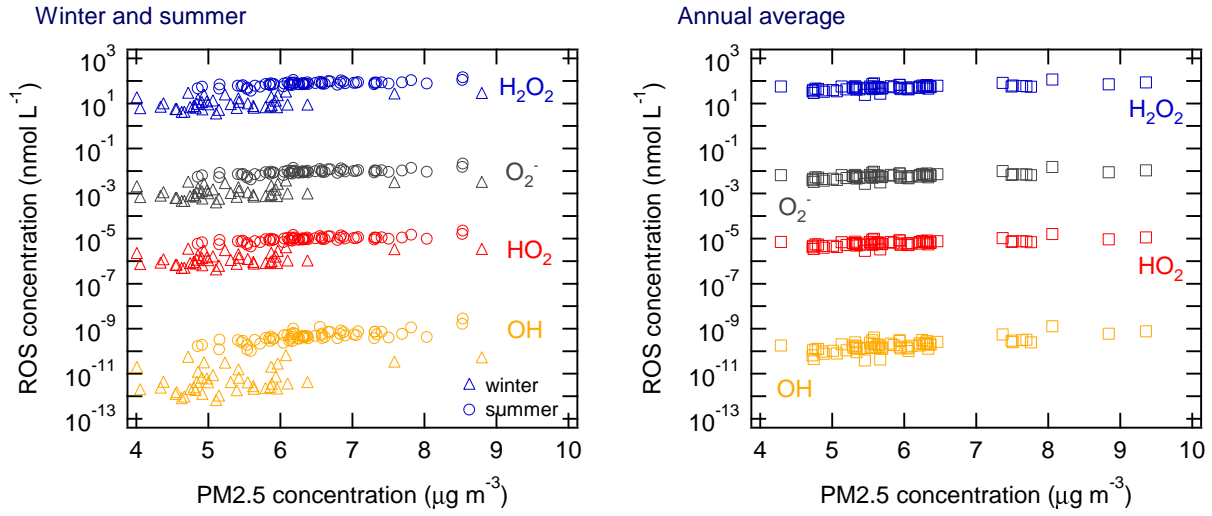


Figure S3. Correlations between PM_{2.5} metals during winter

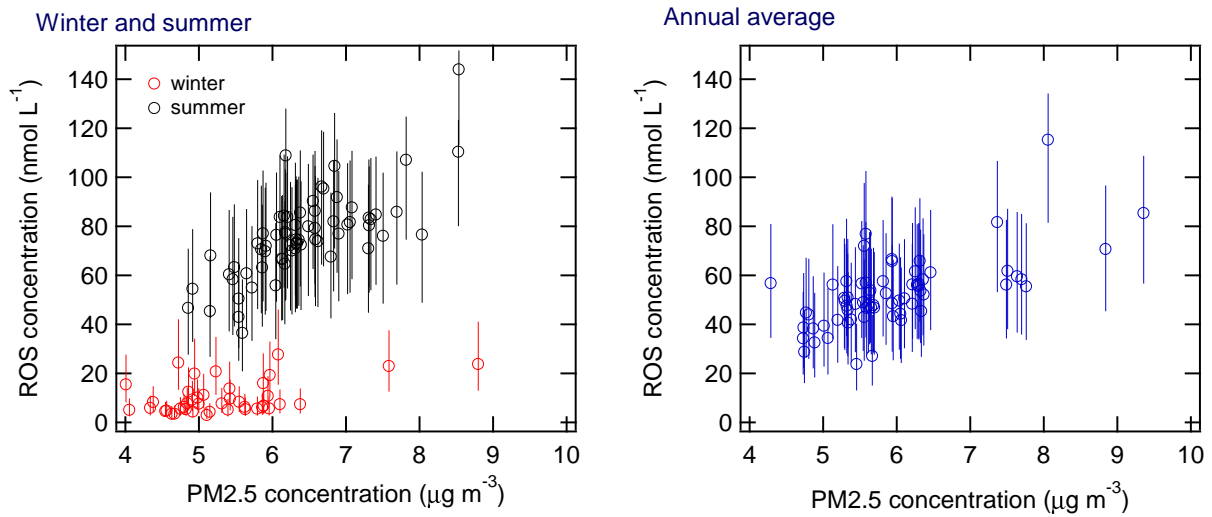


1 **Figure S4.** Estimated concentrations of specific (A) and total (B) ROS generated by PM_{2.5} during
2 summer and winter in Toronto using the KM-SUB-ELF Model. Vertical lines indicate uncertainty
3 bars.
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5 **A)**

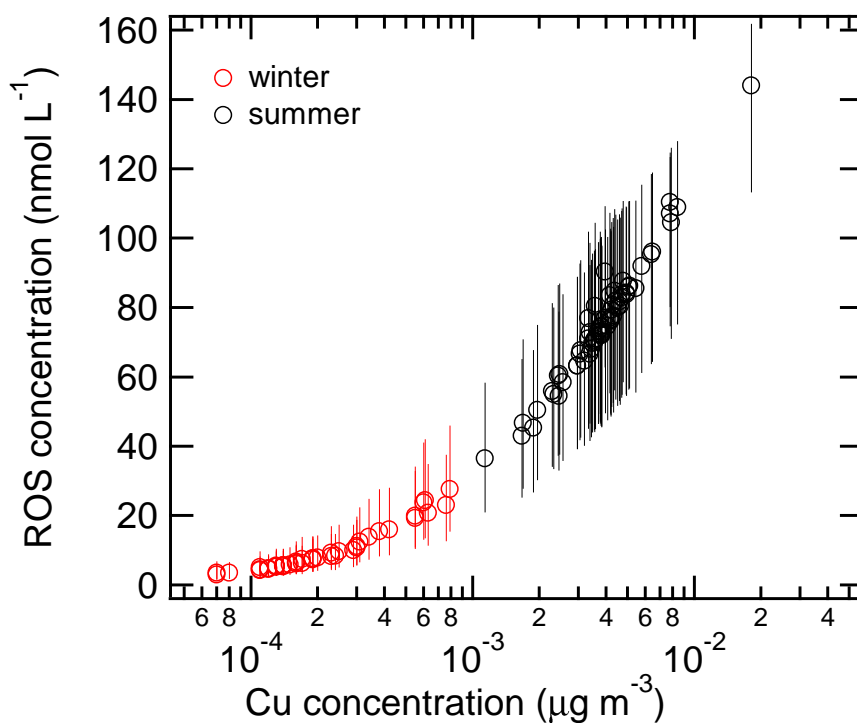
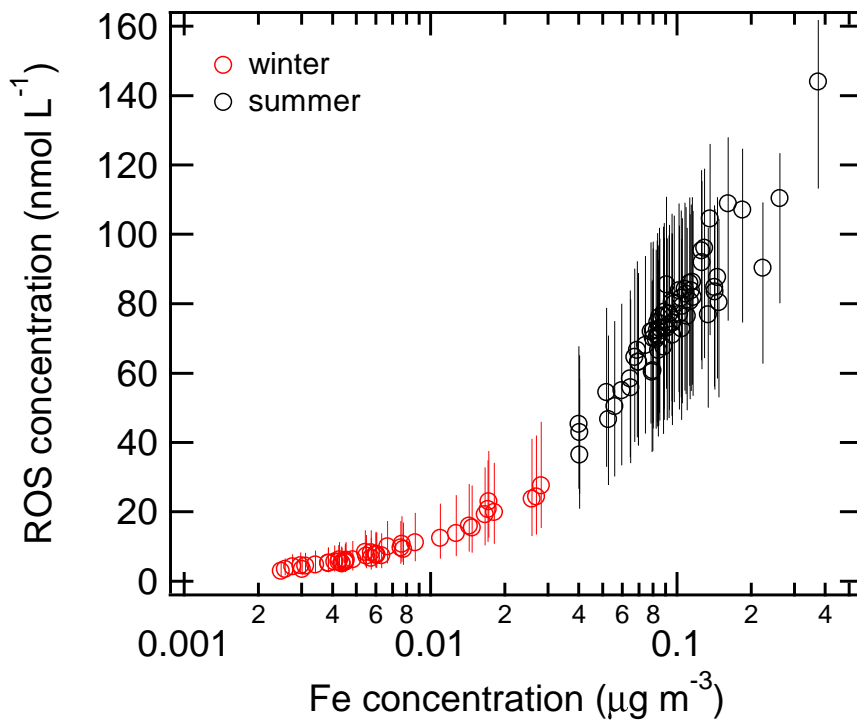


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8 **B)**
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19 **Figure S5.** Relationships between winter and summer Fe and Cu and ROS generation estimated
20 using the KM-SUB-ELF Model. Vertical lines indicate uncertainty bars.
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23 **Table S1.** Multivariable linear regression models used to predict winter data for Fe, Cu, and PM_{2.5} for sites with missing winter data

Winter Parameter	Intercept	Summer Parameter	Slope (95% CI)	Adjusted R ²	RMSE	LOOCV	
						R ²	RMSE
Fe (µg/m ³)	0.00590	Fe	0.251 (0.141, 0.360)	0.70	0.0037	0.55	0.0048
		Cu	-4.37 (-6.59, -2.16)				
		Mg	1.36 (0.541, 2.17)				
		Pb	11.9 (5.82, 18.0)				
		Rb	-62.4 (-99.6, -25.2)				
		Si	-0.484 (-0.652, -0.317)				
Cu (µg/m ³)	0.0000532	Fe	0.00774 (0.00471, 0.0108)	0.82	0.000080	0.51	0.000094
		Cu	-0.101 (-0.154, -0.0485)				
		Mg	0.0568 (0.0358, 0.0778)				
		Pb	0.241 (0.106, 0.376)				
		Rb	-1.72 (-2.52, -0.913)				
		Si	-0.0132 (-0.0169, -0.00953)				
		Co	-0.531 (-0.882, -0.181)				
		Sb	0.0217 (-0.0000746, 0.000181)				
PM _{2.5} (µg/m ³)	4.23	Fe	60.0 (42.4, 77.6)	0.73	0.52	0.37	0.79
		Cu	-838 (-1135, -540)				
		Se	-3469 (-5249, -1689)				
		As	-129 (-247, -11.9)				
		Co	-2637 (-4727, -547)				
		Mg	88.6 (-16.6, 193)				

24 All predictive models are based on data from 28 sites with both summer and winter data. LOOCV, Leave-one-out cross validation;
 25 RMSE, root mean square error.

26 **Table S2.** Land use regression models for Fe, Cu, and ROS during summer in Toronto, Canada

Exposure	Intercept	Parameter	Slope (95% CI)	Adjusted R ²	RMSE	LOOCV	
						R ²	RMSE
Fe/PM _{2.5} (%)	1.57	Distance to City Center (m)	0.191 (-0.0655, 0.448)	0.68	0.33	0.53	0.40
		Distance to Airport (YYZ) (m)	-0.188 (-0.407, 0.0312)				
		Industrial land use (300 m)	0.239 (0.0555, 0.422)				
		Length of Major Roads (100 m)	0.302 (0.0972, 0.508)				
		Length of Highways (300 m)	0.737 (0.571, 0.902)				
		Length of Bus Routes (200m)	0.157 (-0.0477, 0.362)				
		Length of Rail (1000 m)	0.389 (0.172, 0.605)				
Cu/PM _{2.5} (%)	0.0643	Distance to Highway (m)	-0.00526 (-0.0117, 0.00117)	0.81	0.011	0.77	0.013
		Distance to Airport (YYZ) (m)	-0.0100 (-0.0159, -0.00408)				
		Length of Major Roads (100 m)	0.00794 (0.00196, 0.0139)				
		Length of Highways (300 m)	0.0322 (0.0237, 0.0407)				
		Traffic counts (500 m)	0.0126 (0.00361, 0.0217)				
ROS (nmol/L)	77.0	Distance to Highway (m)	-6.11 (-12.2, -0.000814)	0.64	10.1	0.56	11.1
		Distance to Airport (YYZ) (m)	-9.68 (-15.2, -4.20)				
		Length of Bus Routes (1000 m)	-8.33 (-15.4, -1.25)				
		Length of Highways (300 m)	9.81 (2.42, 17.2)				
		Population Density (100 m)	5.42 (-0.311, 11.1)				
		Length of Rail (1000 m)	6.77 (1.19, 12.4)				
		Traffic counts (500 m)	10.7 (2.62, 18.8)				

27 All regression coefficients reflect a 1-unit change in standardized variables (divided by 2 x standard deviation). LOOCV, Leave-one-out cross validation; RMSE,
 28 root mean square error.

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33 **Table S3.** Land use regression models for annual mean Fe, Cu, and ROS in Toronto, Canada

Exposure	Intercept	Parameter	Slope (95% CI)	Adjusted R ²	RMSE	LOOCV R ²	LOOCV RMSE
Fe/PM _{2.5} (%)	0.960	Distance to rail line (m)	-0.169 (-0.268, -0.070)	0.72	0.158	0.68	0.169
		Distance to City Center (m)	0.315 (0.153, 0.477)				
		Distance to Airport (YYZ) (m)	-0.183 (-0.283, -0.0823)				
		Length of Major Roads (100 m)	0.164 (0.0815, 0.246)				
		Length of Highways (300 m)	0.378 (0.298, 0.459)				
		Population Density (100 m)	0.159 (0.0591, 0.260)				
		Maximum Building Height (700m)	-0.153 (-0.259, -0.0467)				
Cu/PM _{2.5} (%)	0.0385	Distance to highway (m)	-0.00258 (-0.00658, 0.00142)	0.81	0.0068	0.79	0.0071
		Distance to City Center (m)	0.00703 (0.00157, 0.0125)				
		Distance to Airport (YYZ) (m)	-0.00905 (-0.0133, -0.00480)				
		Length of Major Roads (200 m)	0.00276 (-0.00113, 0.00665)				
		Length of Highways (300 m)	0.0156 (0.0104, 0.0208)				
		Population Density (100 m)	0.00584 (0.00154, 0.0101)				
		Traffic counts (500 m)	0.00969 (0.00379, 0.0156)				
ROS (nmol/L)	53.1	Distance to rail line (m)	-5.28 (-10.3, -0.267)	0.71	7.51	0.65	8.20
		Distance to City Center (m)	5.55 (-0.958, 12.1)				
		Distance to Airport (YYZ) (m)	-7.27 (-12.1, -2.39)				
		Industrial land use (200 m)	6.47 (1.40, 11.5)				
		Length of Major Roads (100 m)	8.74 (4.82, 12.7)				
		Length of Highways (300 m)	17.4 (13.4, 21.4)				
		Population Density (100 m)	7.35 (2.64, 12.1)				
		Residential land use (300m)	4.57 (-0.519, 9.66)				

34 All regression coefficients (i.e. slopes) reflect a 1-unit change in standardized variables (divided by 2 x standard deviation). LOOCV, Leave-one-out cross
 35 validation; RMSE, root mean square error.

36 **Table S4.** Land use regression models for summer and annual mean ln(Fe) in Toronto, Canada

Exposure	Intercept	Parameter	Slope (95% CI)	Adjusted R ²	RMSE	LOOCV	
						R ²	RMSE
<i>Summer</i>							
ln(Fe)	-2.35	Distance to Airport (YYZ) (m)	-0.137 (-0.277, 0.00176)	0.59	0.255	0.49	0.283
		Industrial land use (300 m)	0.187 (0.0414, 0.332)				
		Length of Major Roads (100 m)	0.225 (0.0661, 0.383)				
		Length of Highways (300 m)	0.365 (0.237, 0.493)				
		Length of Bus Routes (200m)	0.0995 (-0.0577, 0.257)				
		Length of Rail (1000 m)	0.135 (-0.0541, 0.324)				
		Road Junctions (1000 m)	0.103 (-0.0894, 0.295)				
<i>Annual</i>							
ln(Fe)	-2.91	Distance to rail line (m)	-0.261 (-0.417, -0.105)	0.55	0.250	0.46	0.272
		Distance to City Center (m)	0.311 (0.0582, 0.564)				
		Distance to Airport (YYZ) (m)	-0.224 (-0.382, -0.0652)				
		Length of Major Roads (100 m)	0.249 (0.119, 0.379)				
		Length of Highways (300 m)	0.289 (0.162, 0.415)				
		Population Density (100 m)	0.200 (0.0434, 0.356)				
		Maximum Building Height (700m)	-0.151 (-0.319, 0.0161)				

37 All regression coefficients reflect a 1-unit change in standardized variables (divided by 2 x standard deviation). LOOCV, Leave-one-out cross validation; RMSE,
38 root mean square error.

Table S5. Land use regression models for summer and annual mean ln(Cu) in Toronto, Canada

Exposure	Intercept	Parameter	Slope (95% CI)	Adjusted R ²	RMSE	LOOCV	
						R ²	RMSE
<i>Summer</i>							
ln(Cu)	-5.56	Distance to Highway (m)	-0.126 (-0.269, 0.0173)	0.62	0.256	0.60	0.262
		Distance to Airport (YYZ) (m)	-0.252 (-0.384, -0.120)				
		Length of Major Roads (100 m)	0.187 (0.0538, 0.320)				
		Length of Highways (300 m)	0.236 (0.0475, 0.425)				
		Traffic counts (500 m)	0.265 (0.0636, 0.465)				
<i>Annual</i>							
ln(Cu)	-6.15	Distance to highway (m)	-0.0948 (-0.247, 0.0571)	0.58	0.258	0.51	0.277
		Distance to City Center (m)	0.123 (-0.0850, 0.330)				
		Distance to Airport (YYZ) (m)	-0.285 (-0.447, -0.124)				
		Length of Major Roads (200 m)	0.108 (-0.0398, 0.256)				
		Length of Highways (300 m)	0.221 (0.02260.419)				
		Population Density (100 m)	0.193 (0.0294, 0.356)				
		Traffic counts (500 m)	0.215 (-0.00947, 0.439)				

All regression coefficients reflect a 1-unit change in standardized variables (divided by 2 x standard deviation). LOOCV, Leave-one-out cross validation; RMSE, root mean square error.