

# Supporting information

For

## Mercury in air and soil on an urban-rural transect in East Africa

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Table S1: Location information. PAS from location W-25 and W-28 lost during sampling or analysis. Temperature and wind speed are means for the PAS deployment period.

Location	Category	Matrix	Deployment Date PAS	Retrieval Date PAS	Temp (°C)	Wind speed (m/s)	Location detail
RS-1	Rural/suburban	Air/soil	08.02.2019	11.04.2019	28.20	4.44	Coastal/rural
RS-2	Rural/suburban	Air/soil	09.02.2019	11.04.2019	28.82	3.13	Sparsely residential
RS-3	Rural/suburban	Air/soil	09.02.2019	11.04.2019	28.53	3.46	Sparsely residential
RS-4	Rural/suburban	Air/soil	08.02.2019	11.04.2019	28.52	3.50	Residential
U-5	Urban	Air/soil	12.02.2019	11.04.2019	28.19	2.85	Disused waste dump
U-6	Urban	Air/soil	13.02.2019	10.04.2019	28.21	2.83	Near e-waste handler
U-7	Urban	Air/soil	13.02.2019	10.04.2019	28.21	2.83	Near electronics market
U-8	Urban	Air/soil	12.02.2019	12.04.2019	28.15	2.85	Embassy neighbourhood
U-9	Urban	Air/soil	12.02.2019	12.04.2019	28.15	2.85	Residential (affluent)
U-10	Urban	Air/soil	11.02.2019	12.04.2019	28.15	2.86	Residential
U-11	Urban	Air/soil	12.02.2019	12.04.2019	28.15	2.85	Densely residential
U-12	Urban	Air/soil	12.02.2019	14.04.2019	28.10	2.84	Densely residential
RS-13	Rural/suburban	Air/soil	11.02.2019	12.04.2019	28.15	2.86	University
RS-14	Rural/suburban	Air/soil	10.02.2019	13.04.2019	28.11	2.89	Residential
RS-15	Rural/suburban	Air/soil	10.02.2019	13.04.2019	28.15	2.35	Residential
RS-16	Rural/suburban	Air/soil	10.02.2019	13.04.2019	28.15	2.35	Residential
RS-17	Rural/suburban	Air/soil	10.02.2019	13.04.2019	28.15	2.35	Sparsely residential
RS-18	Rural/suburban	Air/soil	10.02.2019	13.04.2019	28.18	2.24	Farmland
RS-19	Rural/suburban	Air/soil	11.02.2019	13.04.2019	28.48	2.14	School grounds
W-20	Waste	Air/soil	06.02.2019	10.04.2019	28.46	2.70	Near dumpsite
W-21	Waste	Air/soil	06.02.2019	10.04.2019	28.46	2.70	Dumpsite
W-22	Waste	Air/soil	06.02.2019	10.04.2019	28.46	2.70	Near dump/e-waste site
W-23	Waste	Air/soil	06.02.2019	10.04.2019	28.46	2.70	E-waste handler
W-24	Waste	Air/soil	06.02.2019	10.04.2019	28.46	2.70	Near dump/e-waste site
W-25	Waste	(Air)/soil	07.02.2019	10.04.2019	28.46	2.67	Near dump/e-waste site
W-26	Waste	Air/soil	06.02.2019	10.04.2019	28.46	2.70	Downwind dumpsite
W-27	Waste	Air/soil	07.02.2019	10.04.2019	27.96	2.48	Downwind dumpsite
W-28	Waste	(Air)/soil	07.02.2019	10.04.2019	28.46	2.67	School grounds
U-29	Urban	Air	14.02.2019	12.04.2019	28.14	2.83	Small scale e-waste site
RS-30	Rural/suburban	Air	14.02.2019	12.04.2019	28.37	3.16	Cement production
U-31	Urban	Air	14.02.2019	12.04.2019	28.14	2.83	Residential
RS-32	Rural/suburban	Air	08.02.2019	11.04.2019	28.19	4.44	Cement production
U-33	Urban	Air	14.02.2019	12.04.2019	28.14	2.83	School grounds

Table S2: Analytical results for PAS. Highlighted PAS excluded from analysis.

Location	Mass Carbon (g)	Measured Hg (ng)	Blank corrected (ng)	GEM concentration (ng/m <sup>3</sup> )	Adjusted sampling rate (m <sup>3</sup> /day)	LOD	LOQ
RS-1A	0.73	11.76	10.06	1.05	0.1551	0.25	0.84
RS-1B	0.71	12.32	10.67	1.11	0.1551	0.25	0.82
RS-2	0.69	9.57	7.96	0.86	0.1517	0.25	0.83
RS-3	0.69	20.12	18.52	1.99	0.1524	0.25	0.82
RS-4	0.71	10.17	8.52	0.90	0.1525	0.25	0.83
U-5A	0.70	10.79	9.15	1.05	0.1503	0.27	0.90
U-5B	0.70	11.62	10.00	1.15	0.1503	0.27	0.89
U-6	0.69	13.72	12.12	1.44	0.1503	0.27	0.91
U-7	0.72	15.91	14.24	1.69	0.1503	0.29	0.95
U-8	0.68	11.74	10.17	1.15	0.1503	0.25	0.85
U-9	0.74	11.74	10.01	1.13	0.1503	0.28	0.93
U-10	0.69	11.28	9.66	1.07	0.1503	0.26	0.86
U-11	0.72	19.09	17.42	1.97	0.1503	0.27	0.90
U-12	0.70	48.58	46.95	5.13	0.1502	0.26	0.85
RS-13	0.68	21.10	19.51	2.16	0.1503	0.25	0.84
RS-14	0.67	8.88	7.33	0.79	0.1503	0.24	0.80
RS-15	0.72	11.31	9.64	1.05	0.1487	0.26	0.87
RS-16	0.72	9.54	7.86	0.85	0.1487	0.26	0.87
RS-17	0.69	9.84	8.22	0.89	0.1487	0.25	0.84
RS-18	0.68	11.31	9.71	1.06	0.1485	0.25	0.83
RS-19	0.71	20.22	18.56	2.05	0.1484	0.26	0.87
W-20	0.72	14.21	12.52	1.32	0.1501	0.26	0.85
W-21	0.72	24.45	22.78	2.41	0.1501	0.25	0.84
W-22	0.72	17.96	16.29	1.72	0.1501	0.25	0.84
W-23	0.70	18.40	16.76	1.77	0.1501	0.25	0.82
W-24	0.70	11.87	10.23	1.08	0.1501	0.25	0.83
W-25	0.72	0.00	0.00	0.00	0.1500	0.26	0.86
W-26	0.72	12.51	10.83	1.15	0.1501	0.25	0.85
W-27	0.67	11.88	10.32	1.12	0.1490	0.24	0.81
W-28							
U-29	0.73	17.50	15.79	1.84	0.1502	0.29	0.96
RS-30	0.70	13.18	11.54	1.34	0.1514	0.27	0.90
U-31	0.73	47.43	45.73	5.34	0.1502	0.28	0.95
RS-32	0.72	15.94	14.27	1.48	0.1551	0.25	0.83
U-33	0.71	14.93	13.27	1.55	0.1502	0.28	0.93

Table S3: Field blank results for PAS. Highlighted field blank excluded as outlier.

Location	Mass Carbon (g)	Measured Hg (ng)
U-5FB	0.70	2.06
U-6FB	0.71	5.63
U-10FB	0.71	2.39
U-7FB	0.70	0.58
RS-32FB	0.72	1.57

## Emission estimates and associated uncertainty

The following equation was used to estimate emissions in the urban area:

$$\text{Emissions (kg/year)} = (L \times B \times R \times 31.6 \times 10^6 \text{ s/year} \times (O - I)) / 1 \times 10^{12} \quad (\text{eq. S1})$$

The parameters  $L$ ,  $B$ ,  $R$ ,  $O$ , and  $I$  are defined in Table S4. The uncertainty of the emission estimate was studied using a simple Monte Carlo approach using the values and variability given in Table S4 and 1000 runs (Figure S1). The value and variability in GEM concentration outflow is the mean and standard deviation, respectively, of the measured GEM concentrations in the urban area of Dar es Salaam. The two highest concentrations were excluded from this calculation as outliers. Atmospheric boundary layer (ABL) height is based on mean daytime ABL height for the tropics ( $\sim 1900\text{m}$ )<sup>1</sup>, adjusted down to account for diurnal variation. Seasonal variation, and hence variation in mean ABL height, is small in the studied region.<sup>1</sup>

Table S4: Parameters used to estimate urban GEM emissions.

Parameter	Value	Variability ( $\pm$ )	Unit
Length, width urban area ( $L$ )	10 000		m
Height atmos. boundary layer ( $B$ )	1200	200	m
Inflow/outflow rate ( $R$ ) <sup>a</sup>	2.84	0.1	m/s
GEM concentration inflow ( $I$ ) <sup>b</sup>	0.95	0.1	ng/m <sup>3</sup>
GEM concentration outflow: median (mean) ( $O$ ) <sup>c</sup>	1.44	0.3	ng/m <sup>3</sup>

<sup>a</sup> Mean and standard deviation of wind speed at urban locations in Dar es Salaam<sup>2</sup>

<sup>b</sup> From Slemr et al<sup>3</sup>

<sup>c</sup> Mean and standard deviation of GEM concentrations in urban locations in this study.

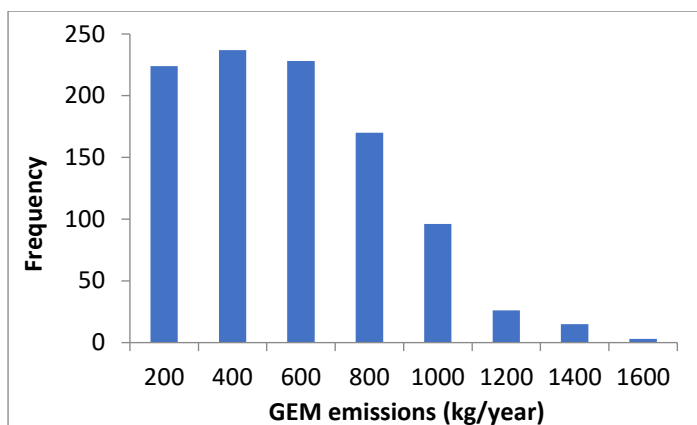


Figure S1: Histogram showing results from Monte Carlo uncertainty estimation

Table S5: Analytical results for soil.

	Measured Hg (ng)	Concentration (mg/kg)	SOM (%)
RS-1	0,60	0,012	8.6
RS-2	0,62	0,012	1.4
RS-3	0,37	0,0074	0.4
RS-4	1,11	0,022	2.2
U-5	0,92	0,018	3.3
U-6	4,89	0,098	2.1
U-7	0,55	0,011	1.9
U-8	1,33	0,027	3.0
U-9	1,54	0,031	7.4
U-10	0,57	0,011	1.7
U-11	2,05	0,041	0.3
U-12	1,40	0,028	1.7
RS-13	4,62	0,092	9.6
RS-14	1,06	0,021	0.2
RS-15	0,54	0,011	1.5
RS-16	0,34	0,0067	0.9
RS-17	0,55	0,011	2.3
RS-18	0,74	0,015	3.6
RS-19	0,57	0,011	1.8
W-20	0,54	0,011	0.8
W-21	1,14	0,023	1.5
W-22	0,34	0,0069	1.0
W-23	1,66	0,033	1.1
W-24	0,39	0,0078	0.9
W-25	0,46	0,0093	<0.01
W-26	0,76	0,015	<0.01
W-27	3,23	0,065	7.4
W-28	1,08	0,022	2.4

Table S6: Blank results soil. Highlighted blank excluded as outlier.

	<b>Measured Hg (ng)</b>
B-1	0,016
B-2	0,014
B-3	0,011
B-4	0,0097
B-5	0,010
B-6	0,011
B-7	0,0098
B-8	0,0092
B-9	0,0096
B-10	0,0096

Table S7: Detection limit (LOD) and quantification limit (LOQ) for soil.

Mean blank (ng)	0,011
Standard deviation blank (ng)	0,0014
Mean sample amount (mg)	50
LOD (mg/kg)	0,00030
LOQ (mg/kg)	0,00049

Table S8: Soil properties in the Dar es Salaam region by location category.

	<b>Category</b>	<b>Mean</b>	<b>Median</b>	<b>Min</b>	<b>Max</b>
<b>CEC (cmol<sup>+</sup>/kg)</b>	Rural/suburban	18.52	16.87	9.18	32.80
	Urban	13.66	10.89	4.53	36.21
	Waste	7.90	7.26	2.50	16.56
<b>pH</b>	Rural/suburban	7.33	7.71	6.73	8.32
	Urban	8.00	8.34	7.39	8.78
	Waste	6.84	7.84	6.10	8.71
<b>OM (%)</b>	Rural/suburban	2.96	1.84	0.20	9.56
	Urban	2.68	2.01	0.29	7.40
	Waste	1.68	0.99	<0.01	7.35
<b>Clay content (%)</b>	Rural/suburban	18.10	17.50	15.00	21.35
	Urban	15.34	17.50	5.00	21.35
	Waste	14.44	17.50	5.00	17.50

Table S9: Spearman rank correlation between soil Hg concentrations and soil properties.

	Hg	p-value
OM	0.44	0.019
c(H)	-0.31	0.11
CEC	0.13	0.52
Clay content	0.00	0.99

## References

1. E. L. McGrath-Spangler and A. S. Denning, Global seasonal variations of midday planetary boundary layer depth from CALIPSO space-borne LIDAR, *Journal of Geophysical Research: Atmospheres*, 2013, **118**, 1226-1233.
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3. F. Slemr, H. Angot, A. Dommergue, O. Magand, M. Barret, A. Weigelt, R. Ebinghaus, E.-G. Brunke, K. A. Pfaffhuber and G. Edwards, Comparison of mercury concentrations measured at several sites in the Southern Hemisphere, *Atmospheric Chemistry and Physics*, 2015, **15**, 3125-3133.