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Evaluation of traffic exhaust contributions to ambient carbonaceous submicron particulate matter in an urban roadside environment in Hong Kong

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Tables

Table S1. Regression statistics of two and three factor multiple linear regression analysis of HOA and EC mass concentrations as functions of gasoline (G-veh.), diesel (D-veh.), and LPG (L-veh.) vehicle number counts

Regression statistics		**HOA 3 Fac**	**HOA 2 Fac**	**EC 3 Fac**	**EC 2 Fac**
R^2_{adj}	Total	0.90	0.86	0.92	0.92
P-Value	G-veh.	5.63×10^{-3}	1.53×10^{-5}	0.63	1.51×10^{-3}
	D-veh.	5.47×10^{-3}	1.77×10^{-3}	5.04×10^{-9}	6.41×10^{-8}
	L-veh.	4.86×10^{-3}	N.A.	3.39×10^{-3}	N.A.
Var. coeff.	G-veh.	1.10×10^{-2} $\pm 3.86 \times 10^{-3}$	1.40×10^{-2} $\pm 3.01 \times 10^{-3}$	2.12×10^{-3} $\pm 4.40 \times 10^{-3}$	1.12×10^{-2} $\pm 3.40 \times 10^{-3}$
	D-veh.	7.05×10^{-3} $\pm 2.46 \times 10^{-3}$	8.33×10^{-3} $\pm 2.56 \times 10^{-3}$	1.91×10^{-2} $\pm 2.86 \times 10^{-3}$	1.82×10^{-2} $\pm 3.00 \times 10^{-3}$
	L-veh.	6.17×10^{-3} $\pm 3.08 \times 10^{-3}$	N.A.	1.06×10^{-2} $\pm 3.48 \times 10^{-3}$	N.A.

Table S2. Two factor (for EC) and three factor (for HOA) MLR regression statistics; Comparison between values obtained with raw vehicle counts & mass concentrations ("Raw") and smoothed vehicle counts & mass concentrations (3 point box smoothing; "Smth.")

Regression statistics		**HOA, 3 Fac Smth.**	**HOA, 3 Fac Raw**	**EC, 2 Fac Smth.**	**EC, 2 Fac Raw**
R^2_{adj}	Total	0.90	0.87	0.92	0.87
Residual	Ave.	0.11	0.15	0.16	0.22
Residual	Sum	7.9	10.5	11.4	15.7
P-Value	G-veh.	5.63×10^{-3}	7.46×10^{-3}	1.51×10^{-3}	8.86×10^{-4}
	D-veh.	5.47×10^{-3}	4.69×10^{-3}	6.41×10^{-8}	3.61×10^{-6}
	L-veh.	4.86×10^{-3}	6.64×10^{-3}	N.A.	N.A.
Var. coeff.	G-veh.	1.10×10^{-2} $\pm 3.86 \times 10^{-3}$	1.01×10^{-2} $\pm 3.33 \times 10^{-3}$	1.12×10^{-2} $\pm 3.40 \times 10^{-3}$	1.26×10^{-2} $\pm 3.83 \times 10^{-3}$
	D-veh.	7.05×10^{-3} $\pm 2.46 \times 10^{-3}$	7.46×10^{-3} $\pm 2.80 \times 10^{-3}$	1.82×10^{-2} $\pm 3.00 \times 10^{-3}$	1.72×10^{-2} $\pm 3.26 \times 10^{-3}$
	L-veh.	6.17×10^{-3} $\pm 3.08 \times 10^{-3}$	6.87×10^{-3} $\pm 2.47 \times 10^{-3}$	N.A.	N.A.

Figures

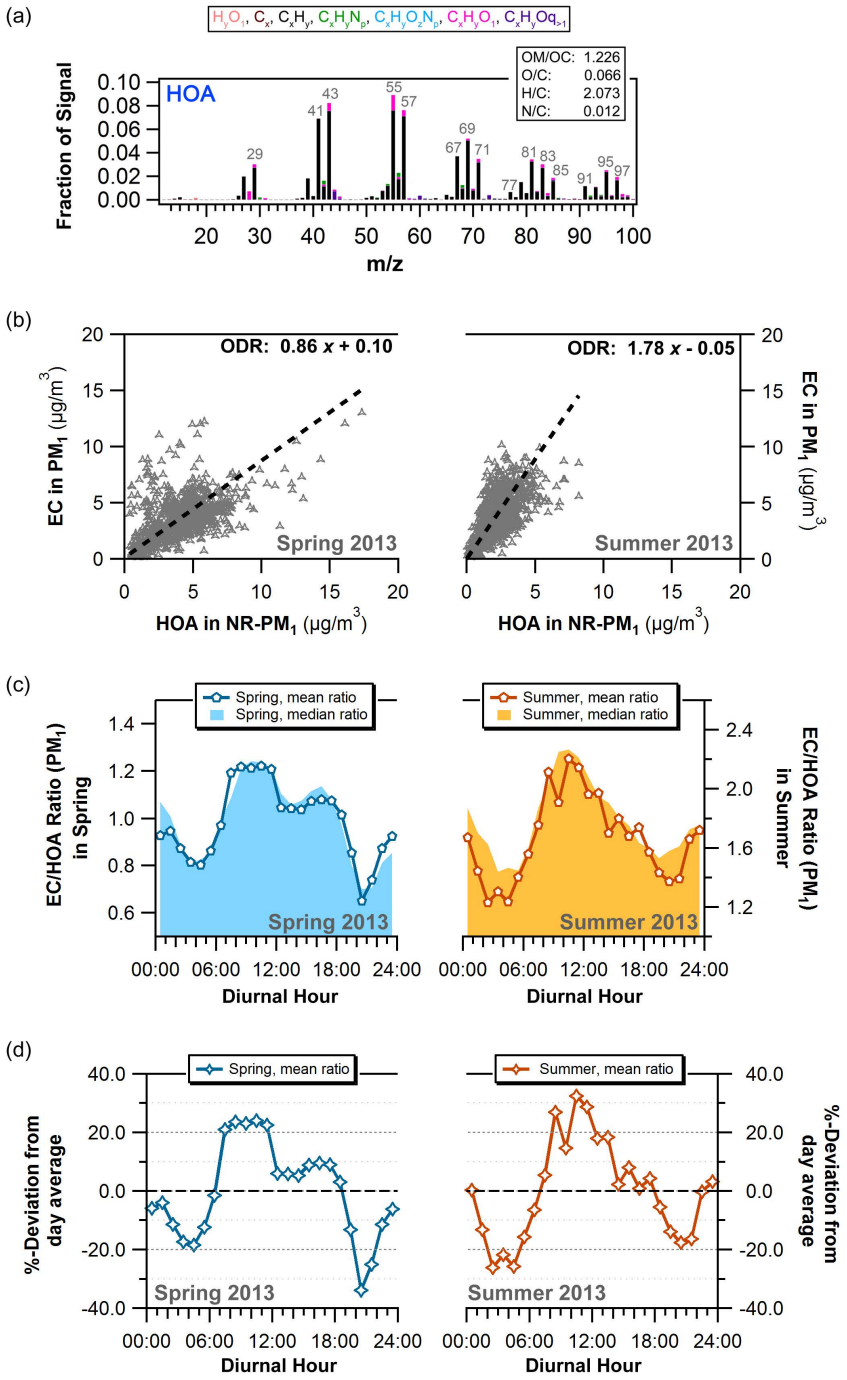

Figure S1.

(a) Mass spectrum and elemental characteristics of HOA (Lee et al., 2015)

(b) Scatter plot of EC and HOA in PM_1 at the Mong Kok site in spring (Mar to May) and summer (May to Jul) 2013

(c) Diurnal variation of EC/HOA ratio (in PM_1) based on mean concentrations *(solid line and open markers)* and based on median concentrations *(shaded area)*

(d) Relative diurnal change in EC/HOA ratio in PM_1 in relation to daily average, in %

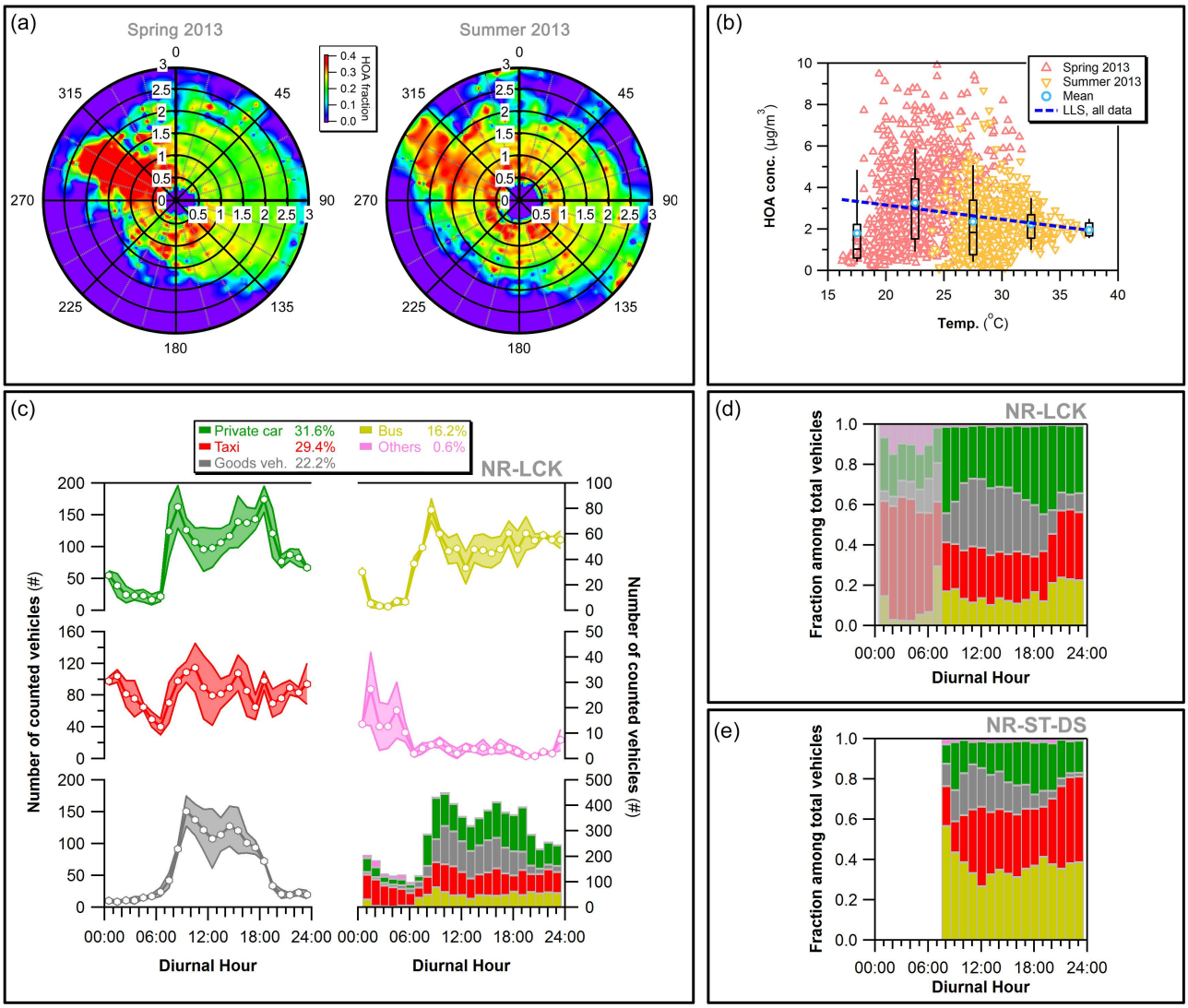

Figure S2.

(a) Wind rose plots of HOA fraction in total organics (NR-PM_1) in spring (*left*) and summer (*right*) 2013 at the Mong Kok site

(b) HOA mass concentration as a function of ambient temperature at the Mong Kok site; with linear least squares fit *(blue hashed line)* and box/whisker plots (*10^{th}, 25^{th}, 75^{th}, 90^{th} percentile, median as line in box, mean as blue circle in box)* for temperature bins from 15-40°C at fixed bin width of 5°C for all data

(c) Diurnal variation of number of vehicles (grouped by main use) passing by the measurement site *(NR-LCK: junction of Nathan Road and Lai Chi Kok Road)* between 28 May and 31 May 2013, with average fraction of total counted vehicles (vehicle mix) given in the legend box

(d) Fractional diurnal variation of vehicle groups among total counted vehicles passing by the measurement site *(NR-LCK: junction of Nathan Road and Lai Chi Kok Road)* between 28 May and 31 May 2013

(e) Fractional diurnal variation of vehicle groups among total counted vehicles at the closest major vehicle counting station (*NR-ST-DS: Nathan Road, between junction with Shantung Street and Dundas Street*), data based on Annual Traffic Census, 2013 (Transport Department, 2014)

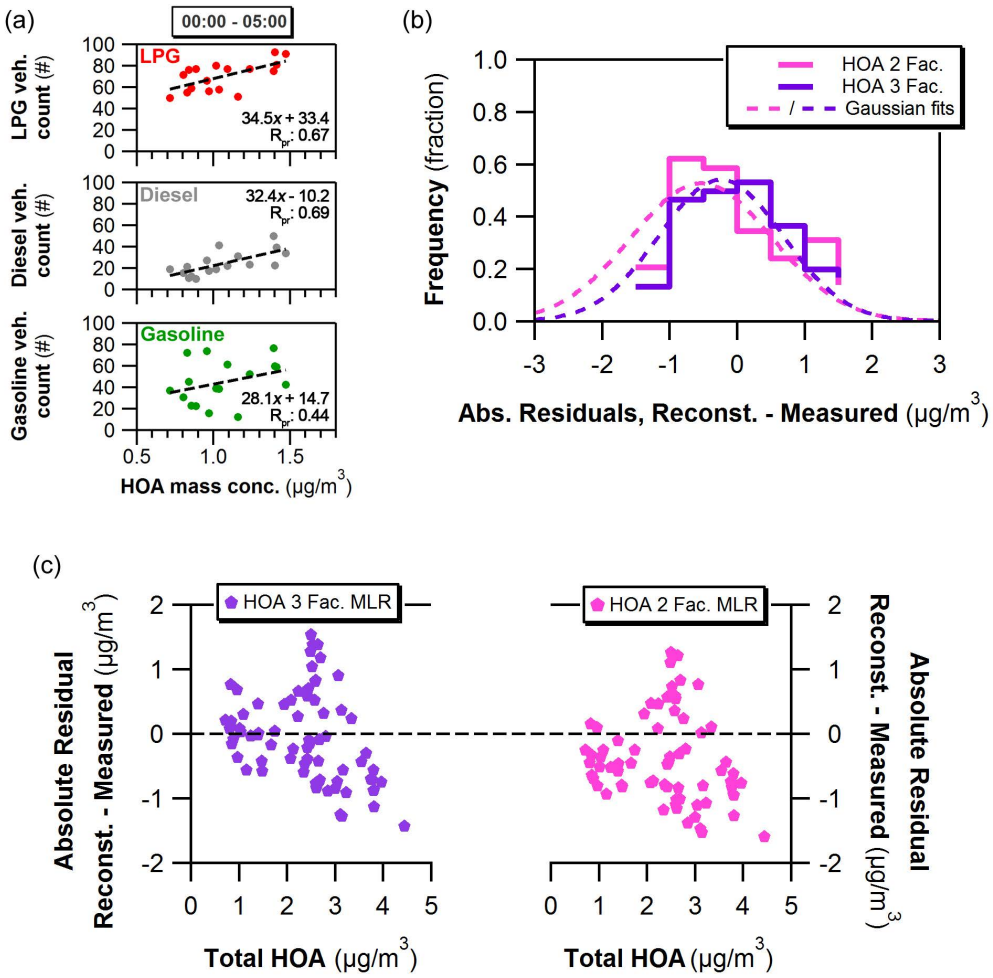

Figure S3.

(a) Number of counted gasoline, diesel and LPG powered vehicles as a function of total HOA mass concentration during the low traffic hours *(00:00 to 05:00)*

(b) Frequency distribution of absolute residuals *(in µg/m^3)* and their Gaussian fits for three factor and two factor MLR solutions for HOA

(c) Scatter plot of absolute residuals *(in µg/m^3)* for three factor and two factor MLR solutions against total HOA mass concentrations

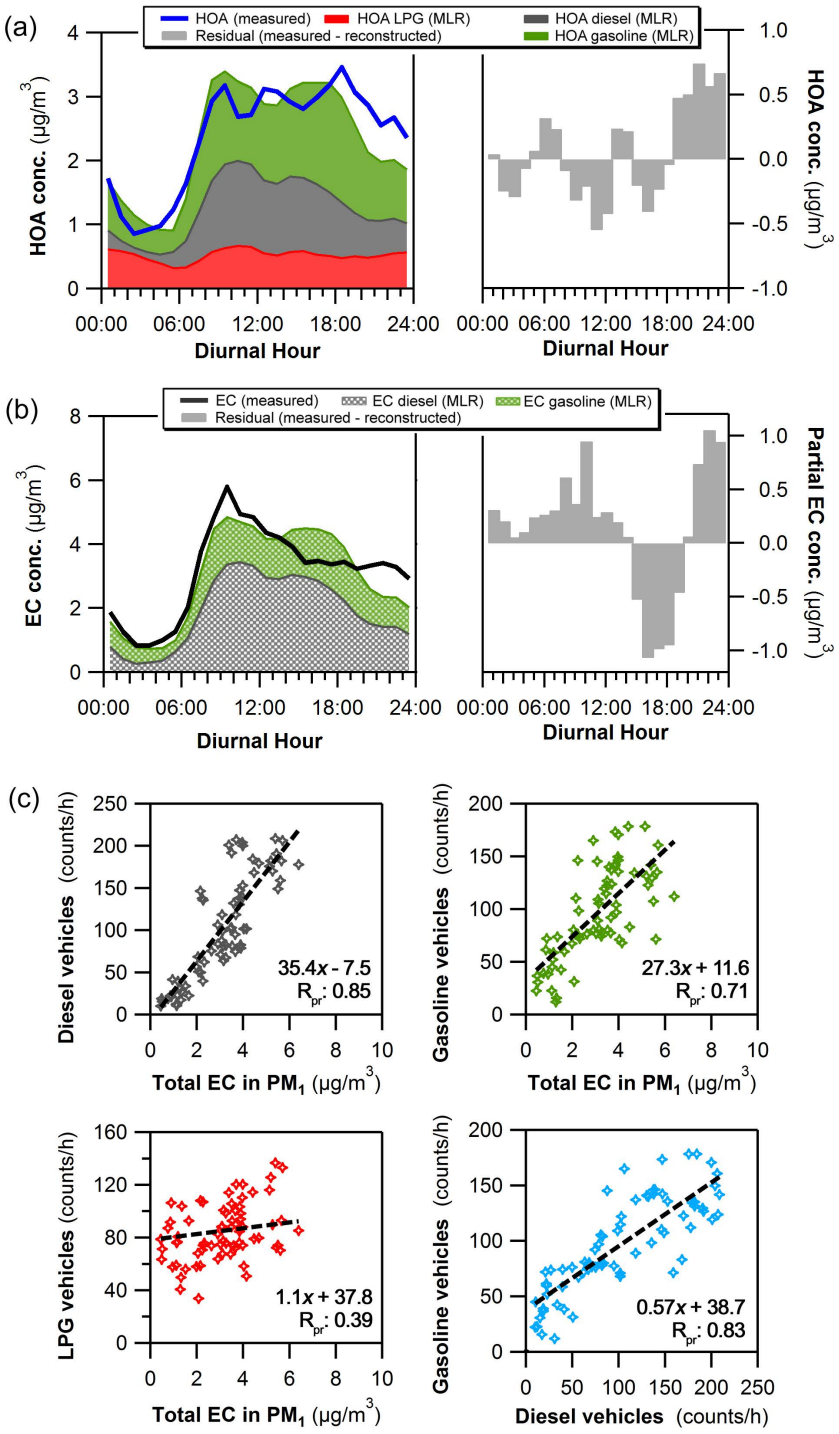

Figure S4.

(a) Diurnal variations of engine-type resolved HOA concentrations and actual measured HOA *(left)*, and diurnal variation of HOA residual as the difference between actual and reconstructed HOA *(right)*

(b) Diurnal variations of engine -type resolved EC concentration and actual measured EC in PM_1 *(left)*, and diurnal variation of EC residual as the difference between actual and reconstructed EC in PM_1 *(right)*

(c) Scatter plots of vehicle counts (by engine type) against total EC in PM_1 *(grey, green, red)*, and gasoline against diesel vehicle count *(blue)*

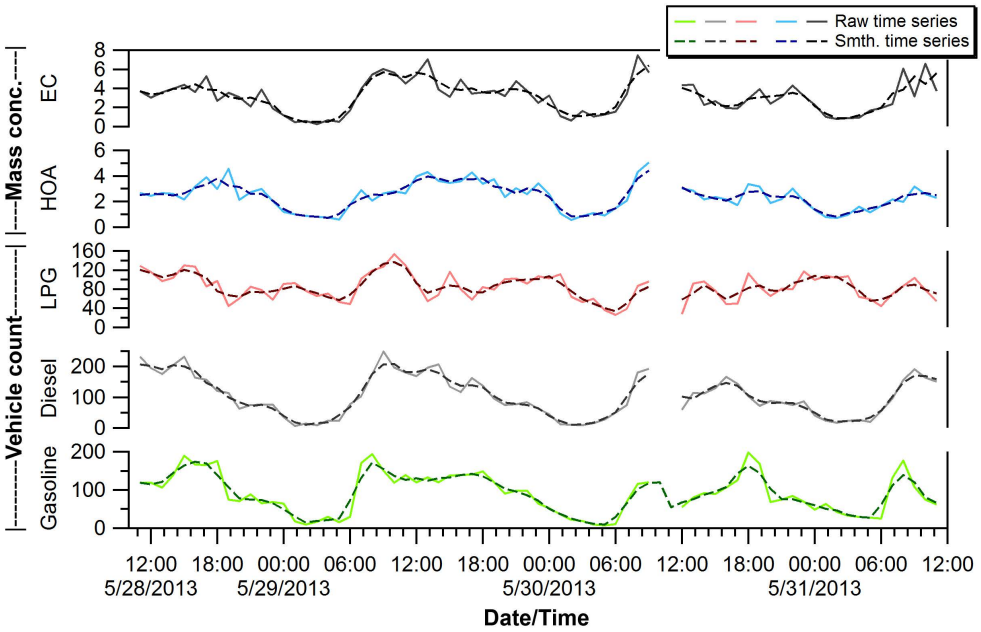

Figure S5.
Time series of raw vehicle count and raw EC and HOA mass concentrations (solid lines) and their counter parts after three point box smoothing (hashed lines) between 28 May and 31 May 2013 at the Mong Kok measurement site

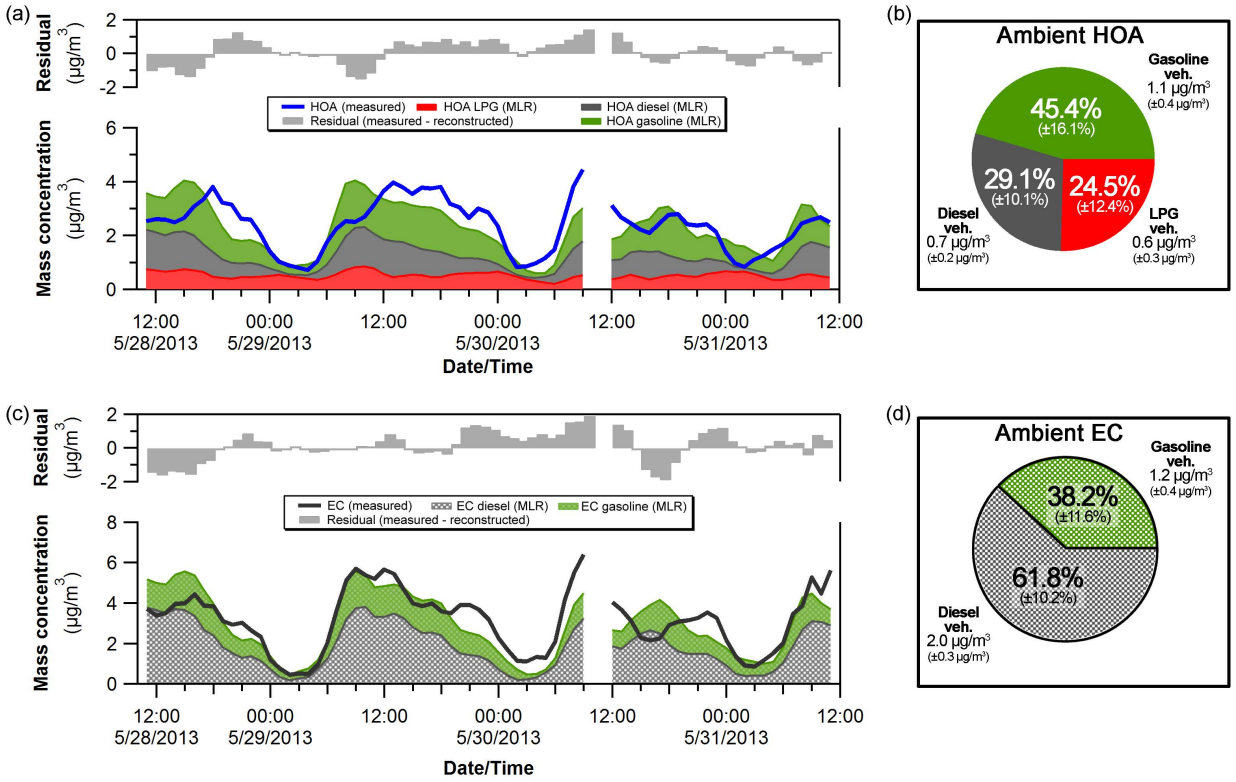

Figure S6.

(a) Time series of engine-type resolved HOA, actual measured HOA, as well as residuals as the difference between resolved HOA and measured HOA in PM_1

(b) Average contribution of engine-type resolved HOA in total reconstructed HOA in PM_1

(c) Time series of engine-type separated EC, actual measured EC, as well as residuals as the difference between resolved EC and measured EC in in PM_1

(d) Average contribution of engine-type separated EC in total reconstructed EC in PM_1

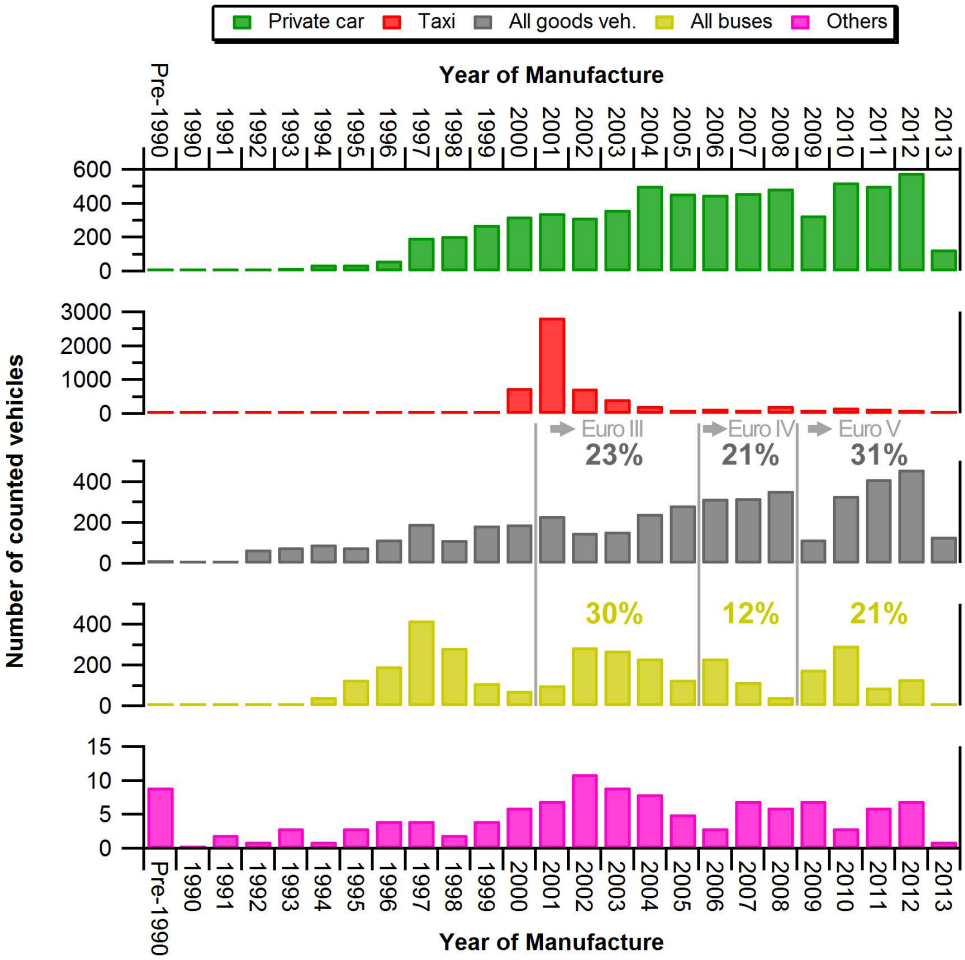

Figure S7.
Year of manufacture of vehicles identified at the measurement site between 28 May 2013 and 31 May 2013. Vertical gray lines indicate the year of introduction of respective Euro emission standards for heavy diesel vehicles and percentage numbers indicate the fraction of vehicles within each bin.

References

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