

# Supplementary Materials: Using Real Time Measurements to Derive the Indoor and Outdoor Contributions of Submicron Particulate Species and Trace Gases

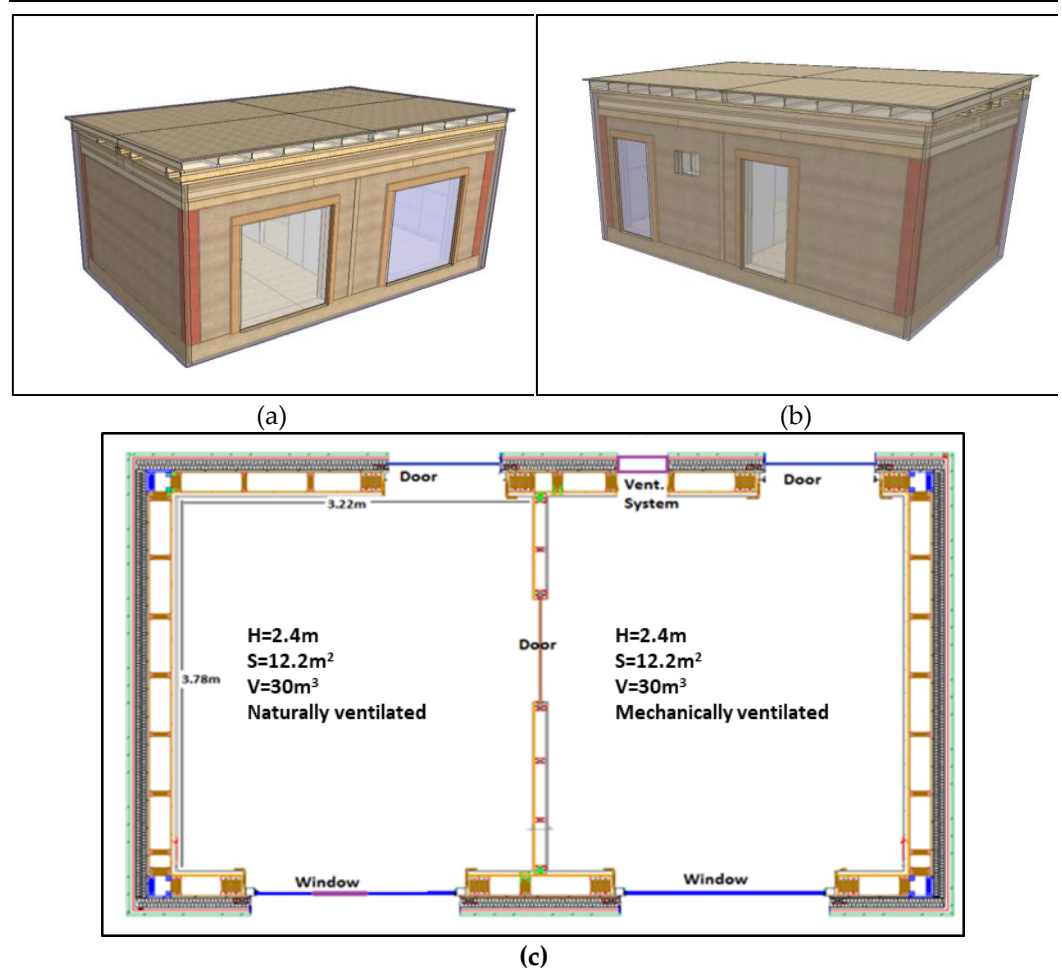
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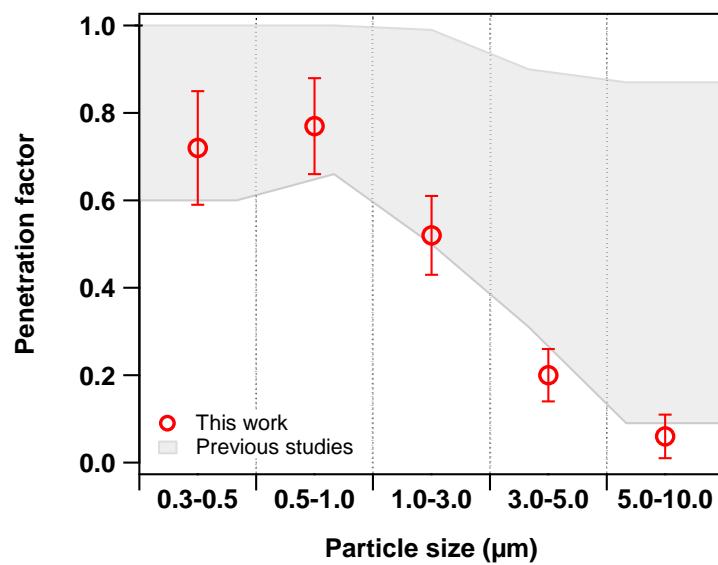
## GLOSSARY

VOC	Volatile Organic Compound
PM	Particulate Matter
AMS	Aerosol Mass Spectrometer
CPC	Condensation Particle Counter
C <sub>x</sub> H <sub>y</sub>	Hydrocarbon
C <sub>x</sub> H <sub>y</sub> O <sub>n</sub>	OVOC with n atoms of oxygen
DMA	Differential Mobility Analyzer
ER	Emission Rate
FDMS	Filter Dynamic Measurement System
I/O	Indoor to Outdoor ratio
IC	Indoor Contribution
IE	Ionization Efficiency
inorgNO <sub>3</sub>	Inorganic bonded nitrate
LOD	Limit Of Detection
NR-PM <sub>1</sub>	Non Refractory PM <sub>1</sub>
OC	Outdoor Contribution
OPC	Optical Particle Counter
orgNO <sub>3</sub>	Organic bonded nitrate
OVOC	Oxygenated Volatile Organic Compound
PSS	Photostationary State
PTRMS	Proton Transfer Mass Spectrometer
RIC	Relative Indoor Contribution
RIE	Relative Ionization Efficiency
ROC	Relative Outdoor Contribution
SMPS	Scanning Mobility Particle Sizer
SV	Solenoid Valve
TEOM	Tapered Element Oscillating Microbalance
TOC	Total Organic Carbon
WHO	World Health Organization

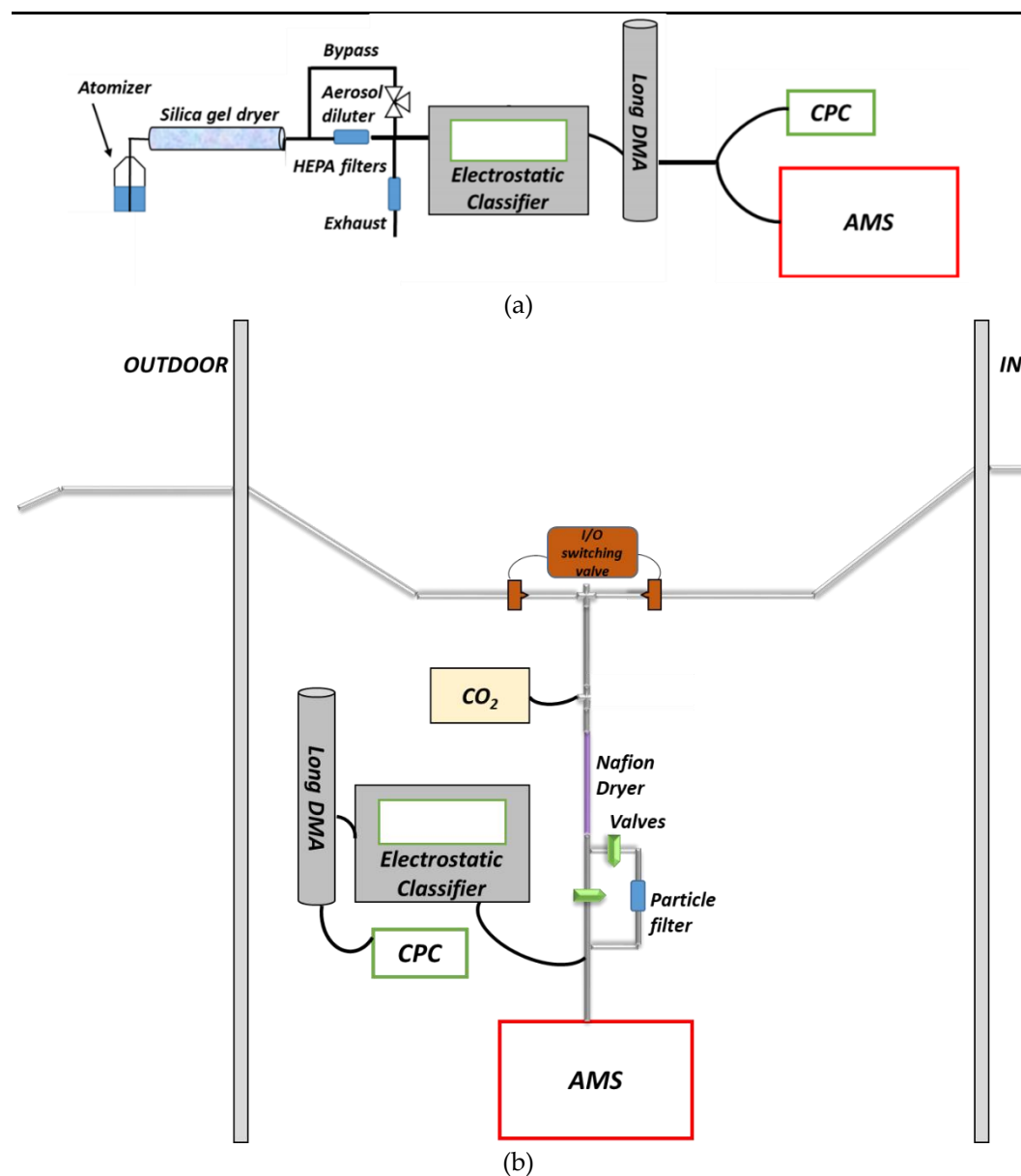
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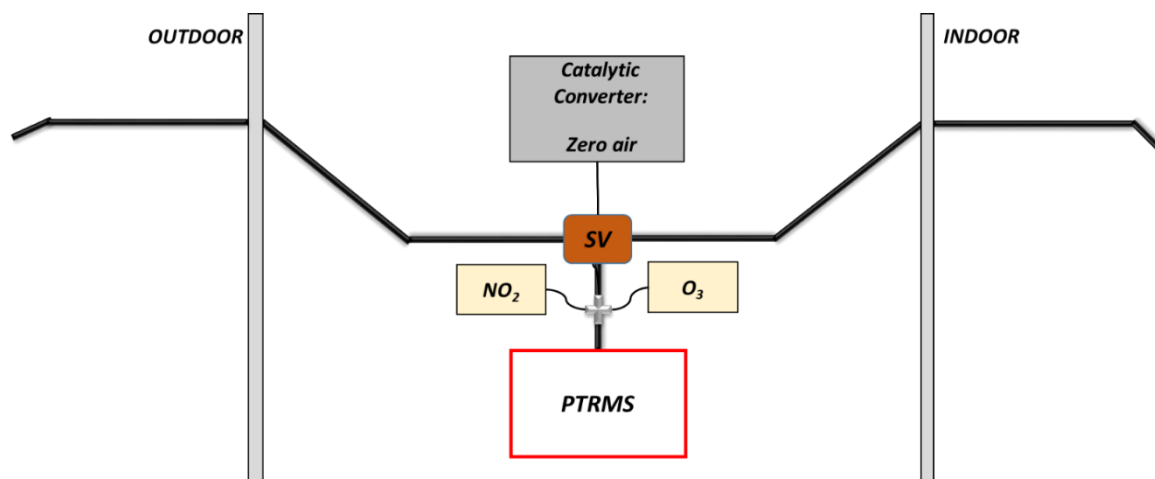
**Figure S1.** Schematic of the measurement facility: (a) front side, (b) back side, (c) floor plan of the instrumentation room (left) and the experimental room (right).



**Figure S2.** Average values of penetration factors measured during the intensive campaign as a function of particle size. Error bars represent  $\pm 1\sigma$ . Grey area represents the range of values observed in previous published studies ([1] and references therein).



**Figure S3.** Schematic of (a) AMS calibration unit and (b) AMS sampling configuration with the CPC, SMPS and CO<sub>2</sub> analyzer.



**Figure S4.** Schematic of the PTRMS setup with the O<sub>3</sub> and NO<sub>2</sub> analyzers.

## 1. PTRMS measurements

**Calibration**—The ion transmission curve (transmission vs.  $m/z$ ) was determined using a gas standard containing the compounds listed in Table S1 covering from  $m/z$  33 to 147. A catalytic converter containing platinum wool (Shimadzu, high sensitivity catalyst for Total Organic Carbon (TOC analyzer) heated to 350 °C was used to generate zero air from ambient air. During calibration, a flow of 1000 sccm of zero air was mixed with 10 sccm of the calibration gas to reach mixing ratios in the range of ~10 ppb. Calibrations were conducted before ( $n = 6$ ), during ( $n = 1$ ) and after the end ( $n = 1$ ) of the intensive campaign.

**Table S1.** PTRMS gas standard.

Compound ( $m/z$ )	Volume Mixing Ratio in the Calibration Mixture (ppb)	Uncertainty (%)
Methanol (33.03349)	990	$\pm 6$
Acetaldehyde (45.03349)	950	$\pm 5$
Acetone (59.04914)	980	$\pm 5$
Benzene (79.054)	990	$\pm 5$
Toluene (93.0689)	990	$\pm 5$
o-Xylene (107.08553)	1020	$\pm 6$
1,2-Dichlorobenzene (146.9768, 148.9739, 150.9709)	1020	$\pm 7$

**Table S2.** Calculations of VOC oxidation rates and comparison to the air exchange rate ( $a = 0.54 \text{ h}^{-1}$ ).

Chemical Category	Compound	Molecular Formula	$k_{\text{OH}}$ $\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	$k_{\text{O}_3}$ $\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	$k_{\text{NO}_3}$ $\text{cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$	Total first order oxidation rate ( $\text{h}^{-1}$ )*	Assumption break down
Aromatics	Benzene	$\text{C}_6\text{H}_6$	$1.20 \times 10^{-12}$	$1.00 \times 10^{-21}$	$3.00 \times 10^{-17}$	$2.16 \times 10^{-3}$	No
	Toluene	$\text{C}_7\text{H}_8$	$5.60 \times 10^{-12}$	-	$6.60 \times 10^{-17}$	$1.01 \times 10^{-2}$	No
	Ethylbenzene	$\text{C}_8\text{H}_{10}$	$7.00 \times 10^{-12}$	-	-	$1.26 \times 10^{-2}$	No
Dialkene	Isoprene	$\text{C}_5\text{H}_8$	$1.00 \times 10^{-10}$	$1.30 \times 10^{-17}$	$6.50 \times 10^{-13}$	0.26	Yes
Monoterpenes	$\alpha$ -pinene	$\text{C}_{10}\text{H}_{16}$	$5.30 \times 10^{-11}$	$9.60 \times 10^{-17}$	$6.20 \times 10^{-12}$	0.80	Yes
	$\beta$ -pinene		$7.60 \times 10^{-11}$	$1.90 \times 10^{-17}$	$2.50 \times 10^{-12}$	0.39	Yes
	Limonene		$1.70 \times 10^{-10}$	$2.20 \times 10^{-16}$	$1.20 \times 10^{-11}$	1.72	Yes
Alcohols	Methanol	$\text{CH}_3\text{OH}$	$8.80 \times 10^{-13}$	-	$1.30 \times 10^{-16}$	$1.60 \times 10^{-3}$	No
	Ethanol	$\text{C}_2\text{H}_5\text{O}$	$3.30 \times 10^{-12}$	-	$4.80 \times 10^{-16}$	$5.98 \times 10^{-3}$	No
Aldehydes	Acetaldehyde	$\text{CH}_3\text{CHO}$	$1.50 \times 10^{-11}$	-	$2.70 \times 10^{-15}$	$2.72 \times 10^{-2}$	No
	Benzaldehyde	$\text{C}_7\text{H}_6\text{O}$	$1.30 \times 10^{-11}$	-	$4.00 \times 10^{-15}$	$2.37 \times 10^{-2}$	No
Ketones	Acetone	$\text{C}_3\text{H}_6\text{O}$	$1.90 \times 10^{-13}$	-	$1.30 \times 10^{-18}$	$3.42 \times 10^{-4}$	No
	MEK	$\text{C}_4\text{H}_8\text{O}$	$1.05 \times 10^{-12}$	-	$1.80 \times 10^{-17}$	$1.89 \times 10^{-3}$	No
Carboxylic acids	Formic acid	$\text{CH}_2\text{O}_2$	$4.50 \times 10^{-13}$	-	-	$8.10 \times 10^{-4}$	No
	Acetic acid	$\text{C}_2\text{H}_4\text{O}_2$	$7.50 \times 10^{-13}$	-	$6.40 \times 10^{-19}$	$1.35 \times 10^{-3}$	No
	Propionic acid	$\text{C}_3\text{H}_6\text{O}_2$	$1.20 \times 10^{-12}$	-	$1.70 \times 10^{-17}$	$2.16 \times 10^{-3}$	No

\*Total first order oxidation rate of VOCs (reactions OH,  $\text{NO}_3$ , and  $\text{O}_3$ ) calculated assuming  $[\text{OH}] = 5 \times 10^5 \text{ cm}^{-3}$  (0.025 ppt),  $[\text{NO}_3] = 2.4 \times 10^7 \text{ cm}^{-3}$  (1 ppt),  $[\text{O}_3] = 4.8 \times 10^{11} \text{ cm}^{-3}$  (20 ppb).  $k_{\text{OH}}$ ,  $k_{\text{O}_3}$ ,  $k_{\text{NO}_3}$  are bimolecular rate constants for  $\text{VOC}+\text{OH}$ ,  $\text{VOC}+\text{O}_3$  and  $\text{VOC}+\text{NO}_3$ , respectively.

**Table S3.** Exact protonated masses detected by PTRMS and non-exhaustive list of VOCs monitored at these m/z.

Formula	Name*	m/z**
$C_4H_8.H^+$	Butene, Butanol frag. (-H <sub>2</sub> O)	57.070
$C_5H_6.H^+$	Cyclopentadiene, cyclopentene	67.054
$C_5H_8.H^+$	Isoprene	69.070
$C_5H_{10}.H^+$	Pentene + isomers, Pentanol frag. (-H <sub>2</sub> O)	71.086
$C_6H_4.H^+$	-	77.037
$C_6H_6.H^+$	Benzene	79.054
$C_6H_8.H^+$	Monoterpenes frag.	81.070
$C_6H_{10}.H^+$	Cyclohexene, frag. hexenol	83.086
$C_6H_{12}.H^+$	Hexene, Hexanol frag. (-H <sub>2</sub> O)	85.102
$C_7H_8.H^+$	Toluene	93.070
$C_7H_{10}.H^+$	Cycloheptadiene	95.086
$C_8H_8.H^+$	Styrene	105.070
$C_8H_{10}.H^+$	C8-aromatics	107.0855
$C_8H_{12}.H^+$	Cyclooctadiene	109.102
$C_8H_{14}.H^+$	Octadiene + frag. alcohol	111.117
$C_8H_{16}.H^+$	Octanol fragment (-H <sub>2</sub> O)	113.132
$C_9H_{10}.H^+$	Octene + frag. alcohol	119.086
$C_9H_{12}.H^+$	C9-aromatics	121.101
$C_{10}H_{16}.H^+$	Monoterpenes	137.133
$C_{10}H_{18}.H^+$	-	139.145
$C_{15}H_{24}.H^+$	Sesquiterpenes	205.193
<b><math>C_xH_yO</math></b>		
Formula	Name	m/z
$CH_3OH.H^+$	Methanol	33.034
$CH_3CHO.H^+$	Acetaldehyde	45.034
$C_2H_5O.H^+$	Ethanol	47.049
$C_3H_4O.H^+$	Acrolein	57.034
$C_3H_6O.H^+$	Acetone	59.049
$C_4H_4O.H^+$	Furane	69.034
$C_4H_6O.H^+$	MAC+MVK	71.049
$C_4H_8O.H^+$	MEK	73.065
$C_5H_6O.H^+$	Methyl furan	83.050
$C_5H_8O.H^+$	Cyclopentanone, pentenone	85.065
$C_5H_{10}O.H^+$	Pentanal, MBO	87.080
$C_6H_6O.H^+$	Phenol	95.049
$C_6H_8O.H^+$	Dimethyl furan	97.064
$C_6H_{10}O.H^+$	Hexenal, cyclohexanone	99.080
$C_6H_{12}O.H^+$	Hexanal, hexanone	101.096
$C_7H_4O.H^+$	-	105.032
$C_7H_6O.H^+$	Benzaldehyde	107.049
$C_7H_8O.H^+$	Cresols	109.065
$C_7H_{10}O.H^+$	-	111.077
$C_7H_{12}O.H^+$	-	113.095
$C_8H_{10}O.H^+$	-	123.075
$C_8H_{12}O.H^+$	-	125.0942
$C_8H_{14}O.H^+$	-	127.110

$C_8H_{16}O.H^+$	-	129.126
$C_9H_{10}O.H^+$	-	135.041
$C_9H_{14}O.H^+$	-	139.111
$C_9H_{18}O.H^+$	-	143.141
$C_xH_yO_2$		
<i>Formula</i>	<i>Name</i>	<i>m/z</i>
$CH_2O_2.H^+$	Formic Acid	47.013
$C_2H_4O_2.H^+$	Acetic Acid	61.028
$C_2H_6O_2.H^+$	Ethylene glycol	63.032
$C_3H_4O_2.H^+$	Methylglyoxal, propanedial	73.028
$C_3H_6O_2.H^+$	Propionic Acid	75.044
$C_3H_8O_2.H^+$	Propylene glycol	77.058
$C_4H_4O_2.H^+$	Furanone	85.026
$C_4H_6O_2.H^+$	Butanedione, unsaturated carboxylic acid	87.043
$C_4H_8O_2.H^+$	Butyric Acid, ethyl acetate	89.059
$C_5H_4O_2.H^+$	Furfural (2-furaldehyde)	97.027
$C_5H_6O_2.H^+$	Furfuranol	99.041
$C_5H_8O_2.H^+$	-	101.060
$C_5H_{10}O_2.H^+$	Pentanoic Acid	103.075
$C_6H_4O_2.H^+$	-	109.028
$C_6H_6O_2.H^+$	Benzenediol	111.042
$C_6H_8O_2.H^+$	-	113.060
$C_6H_{12}O_2.H^+$	Hexanoic Acid	117.092
$C_7H_4O_2.H^+$	-	121.065
$C_7H_6O_2.H^+$	Benzoic Acid	123.043
$C_7H_8O_2.H^+$	-	125.058
$C_7H_{10}O_2.H^+$	-	127.074
$C_7H_{12}O_2.H^+$	-	129.086
$C_7H_{14}O_2.H^+$	Heptanoic Acid	131.105
$C_8H_{10}O_2.H^+$	-	139.071
$C_xH_yO_{2\geq 3}$		
<i>Formula</i>	<i>Name</i>	<i>m/z</i>
$C_2H_4O_3.H^+$	Glycolic Acid	77.021
$C_4H_2O_3.H^+$	-	99.004
$C_4H_4O_3.H^+$	-	101.023
$C_4H_6O_3.H^+$	Oxobutanoic Acid	103.039
$C_5H_4O_3.H^+$	-	113.021
$C_5H_8O_3.H^+$	Oxopentanoic Acid	117.055
$C_4H_6O_4.H^+$	Butanedioic Acid	119.046
$C_6H_8O_3.H^+$	-	129.058
$C_6H_{10}O_3.H^+$	Oxohexanoic Acid	131.068
<i>Others</i>		
<i>Formula</i>	<i>Name</i>	<i>m/z</i>
$C_2H_3N.H^+$	Acetonitrile	42.034
<i>mz 133</i>	-	133.098
<i>mz 147</i>	-	147
<i>mz 149</i>	-	149
<i>mz 151</i>	-	151
<i>mz 153</i>	-	153

<i>mz</i> 355.07	-	355.07
$[(CH_3)_2SiO]_5.H^+$	Siloxane D5	371.101
<i>mz</i> 373	Siloxane D6	373
<i>mz</i> 429	-	429
<i>mz</i> 503	-	503

MAC: methacrolein; MBO: Methyl Butenol; MEK: Methyl Ethyl Ketone; MVK: Methyl Vinyl Ketone. \*Color code: green – selectively monitored, orange – likely selectively monitored, white – species potentially monitored, pink – 50% of values below detection limit in at least one of the environments. \*\*Reported m/z values obtained by the peak fitting procedure.

**Table S4.** Descriptive statistics of compounds measured by PTRMS.

Compound	Range		Median (avg)		I/O ratio
	IN ( $\mu\text{g m}^{-3}$ )	OUT ( $\mu\text{g m}^{-3}$ )	IN ( $\mu\text{g m}^{-3}$ )	OUT ( $\mu\text{g m}^{-3}$ )	
VOCs ( $\mu\text{g m}^{-3}$ )					
C <sub>x</sub> H <sub>y</sub>					
C <sub>4</sub> H <sub>8</sub> .H <sup>+</sup>	1.43–4.05	0.24–3.26	2.10 (2.18)	0.98 (1.08)	2.33
C <sub>5</sub> H <sub>6</sub> .H <sup>+</sup>	0.10–0.23	0.01–0.15	0.13 (0.12)	0.04 (0.05)	3.42
C <sub>5</sub> H <sub>8</sub> .H <sup>+</sup>	1.13–1.71	0.08–0.75	1.30 (1.35)	0.24 (0.27)	5.85
C <sub>5</sub> H <sub>10</sub> .H <sup>+</sup>	0.45–0.77	0.04–0.37	0.57 (0.59)	0.12 (0.14)	4.95
C <sub>6</sub> H <sub>4</sub> .H <sup>+</sup>	0.01–0.03	0.01–0.03	0.01(0.01)	0.01(0.01)	1.34
C <sub>6</sub> H <sub>6</sub> .H <sup>+</sup>	0.65–2.77	0.26–2.66	1.02 (1.13)	0.69 (0.79)	1.54
C <sub>6</sub> H <sub>10</sub> .H <sup>+</sup>	1.48–2.21	0.03–0.41	1.85 (1.87)	0.16 (0.18)	13.32
C <sub>6</sub> H <sub>12</sub> .H <sup>+</sup>	0.13–0.29	0.02–0.18	0.17 (0.18)	0.06 (0.06)	3.30
C <sub>7</sub> H <sub>8</sub> .H <sup>+</sup>	0.71–4.40	0.16–4.76	1.55 (1.66)	0.99 (1.21)	1.63
C <sub>8</sub> H <sub>8</sub> .H <sup>+</sup>	0.06–1.96	0.03–2.34	0.18 (0.33)	0.12 (0.31)	1.40
C <sub>8</sub> H <sub>10</sub> .H <sup>+</sup>	0.28–2.94	0.11–3.33	0.95 (1.03)	0.80 (0.97)	1.21
C <sub>8</sub> H <sub>12</sub> .H <sup>+</sup>	0.20–0.31	0.02–0.14	0.24 (0.25)	0.06 (0.06)	4.78
C <sub>8</sub> H <sub>14</sub> .H <sup>+</sup>	0.25–0.42	0.02–0.21	0.31 (0.32)	0.07 (0.08)	4.65
C <sub>8</sub> H <sub>16</sub> .H <sup>+</sup>	0.04–0.07	0.005–0.03	0.05 (0.05)	0.01(0.01)	4.88
C <sub>9</sub> H <sub>10</sub> .H <sup>+</sup>	0.05–0.46	0.01–0.53	0.09 (0.11)	0.07 (0.09)	1.60
C <sub>9</sub> H <sub>12</sub> .H <sup>+</sup>	0.18–1.99	0.04–2.02	0.50 (0.61)	0.46 (0.56)	1.31
C <sub>10</sub> H <sub>16</sub> .H <sup>+</sup>	4.07–8.02	0.14–2.33	5.47 (5.69)	0.42 (0.53)	13.79
C <sub>10</sub> H <sub>18</sub> .H <sup>+</sup>	0.05–0.10	0.01–0.06	0.07 (0.07)	0.02 (0.02)	4.09
C <sub>15</sub> H <sub>24</sub> .H <sup>+</sup>	0.06–0.14	0.01–0.07	0.08 (0.09)	0.02 (0.02)	4.60
C <sub>x</sub> H <sub>y</sub> O					
CH <sub>3</sub> OH.H <sup>+</sup>	17.3–25.25	0.56–3.67	20.79 (21.27)	1.74 (1.83)	13.59
CH <sub>3</sub> CHO.H <sup>+</sup>	1.92–3.49	0.32–2.18	2.45 (2.46)	0.86 (0.93)	2.91
C <sub>2</sub> H <sub>5</sub> O.H <sup>+</sup>	0.25–16.27	0.91–17.99	3.88 (4.95)	4.83 (5.67)	0.79
C <sub>3</sub> H <sub>4</sub> O.H <sup>+</sup>	0.33–0.71	0.04–0.45	0.44 (0.46)	0.16 (0.18)	3.19
C <sub>3</sub> H <sub>6</sub> O.H <sup>+</sup>	3.41–4.78	0.72–2.30	4.06 (4.07)	1.24 (1.29)	3.26
C <sub>4</sub> H <sub>4</sub> O.H <sup>+</sup>	0.30–0.88	0.03–0.68	0.39 (0.44)	0.11 (0.16)	4.01
C <sub>4</sub> H <sub>6</sub> O.H <sup>+</sup>	0.11–0.32	0.02–0.27	0.16 (0.18)	0.08 (0.10)	2.16
C <sub>4</sub> H <sub>8</sub> O.H <sup>+</sup>	0.39–1.53	0.17–1.51	0.58 (0.61)	0.35 (0.39)	1.66
C <sub>5</sub> H <sub>6</sub> O.H <sup>+</sup>	0.02–0.47	0.02–0.58	0.08 (0.11)	0.09 (0.13)	0.83
C <sub>5</sub> H <sub>8</sub> O.H <sup>+</sup>	0.15–0.36	0.02–0.27	0.20 (0.22)	0.08 (0.10)	2.75
C <sub>5</sub> H <sub>10</sub> O.H <sup>+</sup>	0.16–0.26	0.04–0.15	0.20 (0.20)	0.07 (0.08)	2.78
C <sub>6</sub> H <sub>6</sub> O.H <sup>+</sup>	0.16–0.37	0.02–0.36	0.21 (0.22)	0.07 (0.09)	3.60
C <sub>6</sub> H <sub>8</sub> O.H <sup>+</sup>	0.11–0.34	0.01–0.28	0.15 (0.17)	0.06 (0.07)	2.97
C <sub>6</sub> H <sub>10</sub> O.H <sup>+</sup>	0.17–0.33	0.02–0.20	0.21 (0.22)	0.06 (0.08)	3.18

$C_6H_{12}O.H^+$	0.19–0.35	0.02–0.21	0.24 (0.24)	0.04 (0.05)	5.55
$C_7H_4O.H^+$	0.03–0.15	0.01–0.03	0.12(0.12)	0.01(0.01)	10.94
$C_7H_6O.H^+$	0.56–0.94	0.01–0.08	0.74 (0.76)	0.02 (0.03)	39.05
$C_7H_8O.H^+$	0.06–0.20	0.01–0.24	0.09 (0.10)	0.04 (0.06)	2.53
$C_7H_{10}O.H^+$	0.08–0.20	0.01–0.19	0.10 (0.11)	0.04 (0.05)	2.94
$C_7H_{12}O.H^+$	0.08–0.13	0.03–0.08	0.10 (0.10)	0.03 (0.04)	4.92
$C_8H_{10}O.H^+$	0.02–0.10	0.002–0.14	0.03 (0.04)	0.02 (0.03)	1.51
$C_8H_{12}O.H^+$	0.07–0.15	0.01–0.09	0.09 (0.10)	0.02 (0.03)	3.94
$C_8H_{14}O.H^+$	0.11–0.17	0.01–0.04	0.14 (0.14)	0.03 (0.03)	5.65
$C_8H_{16}O.H^+$	0.11–0.17	0.01–0.04	0.13 (0.13)	0.02 (0.02)	8.00
$C_9H_{10}O.H^+$	0.24–0.77	0.01–0.02	0.44 (0.46)	0.01(0.01)	49.29
$C_9H_{14}O.H^+$	0.12–0.22	0.01–0.08	0.15 (0.16)	0.03 (0.03)	5.66
$C_9H_{18}O.H^+$	0.20–0.29	0.01–0.05	0.24 (0.24)	0.02 (0.03)	9.91
$C_xH_yO_2$					
$CH_2O_2.H^+$	15.7–29.67	0.60–1.39	21.26 (21.25)	0.93 (0.93)	23.30
$C_2H_4O_2.H^+$	57.4–89.26	0.14–7.54	71.46 (72.69)	3.30 (3.38)	29.63
$C_2H_6O_2.H^+$	0.32–0.51	0.02–0.16	0.40 (0.41)	0.05 (0.06)	7.89
$C_3H_4O_2.H^+$	0.16–0.35	0.03–0.15	0.23 (0.24)	0.07 (0.07)	3.54
$C_3H_6O_2.H^+$	1.42–2.37	0.16–0.86	1.84 (1.84)	0.30 (0.36)	5.88
$C_3H_8O_2.H^+$	0.01–0.04	0.005–0.01	0.03 (0.03)	0.01 (0.01)	4.02
$C_4H_4O_2.H^+$	0.09–0.21	0.02–0.23	0.11 (0.12)	0.06 (0.07)	2.11
$C_4H_6O_2.H^+$	0.43–0.85	0.08–0.56	0.60 (0.59)	0.19 (0.22)	2.96
$C_4H_8O_2.H^+$	0.39–0.88	0.07–0.62	0.52 (0.52)	0.14 (0.17)	3.68
$C_5H_4O_2.H^+$	5.74–9.05	0.10–1.19	7.17 (7.47)	0.40 (0.45)	22.73
$C_5H_6O_2.H^+$	0.10–0.29	0.02–0.32	0.14 (0.15)	0.07 (0.09)	2.05
$C_5H_8O_2.H^+$	0.16–0.36	0.04–0.25	0.21 (0.22)	0.09 (0.10)	2.73
$C_5H_{10}O_2.H^+$	0.16–0.30	0.02–0.07	0.23 (0.23)	0.03 (0.04)	7.07
$C_6H_4O_2.H^+$	0.01–0.03	0.004–0.04	0.01 (0.02)	0.01 (0.02)	1.21
$C_6H_6O_2.H^+$	0.16–0.34	0.01–0.26	0.20 (0.21)	0.05 (0.07)	4.23
$C_6H_8O_2.H^+$	0.06–0.23	0.01–0.43	0.02 (0.23)	0.05 (0.06)	2.03
$C_6H_{12}O_2.H^+$	0.35–0.77	0.03–0.14	0.54 (0.54)	0.06 (0.07)	8.32
$C_7H_6O_2.H^+$	0.18–0.53	0.02–0.15	0.30 (0.31)	0.05 (0.06)	6.30
$C_7H_4O_2.H^+$	0.01–0.40	0.01–0.43	0.08 (0.09)	0.02 (0.04)	5.44
$C_7H_8O_2.H^+$	0.03–0.16	0.01–0.20	0.05 (0.06)	0.03 (0.05)	1.67
$C_7H_{10}O_2.H^+$	0.03–0.10	0.01–0.10	0.05 (0.05)	0.01 (0.03)	2.08
$C_7H_{12}O_2.H^+$	0.07–0.17	0.02–0.15	0.10 (0.11)	0.05 (0.06)	2.04
$C_7H_{14}O_2.H^+$	0.06–0.12	0.01–0.05	0.09 (0.09)	0.02 (0.02)	5.42
$C_8H_{10}O_2.H^+$	0.02–0.11	0.01–0.14	0.04 (0.04)	0.02 (0.03)	1.73
$C_xH_yO_{z\geq 3}$					
$C_2H_4O_3.H^+$	0.01–0.03	0.003–0.01	0.01 (0.02)	0.004 (0.005)	3.54
$C_4H_2O_3.H^+$	0.02–0.07	0.02–0.15	0.03 (0.04)	0.04 (0.05)	0.77
$C_4H_4O_3.H^+$	0.01–0.04	0.01–0.05	0.02 (0.02)	0.02 (0.02)	0.80
$C_4H_6O_3.H^+$	0.29–0.49	0.01–0.08	0.39 (0.39)	0.03 (0.04)	12.63
$C_5H_4O_3.H^+$	0.02–0.06	0.01–0.07	0.03 (0.03)	0.02 (0.03)	1.27
$C_5H_8O_3.H^+$	0.01–0.08	0.01–0.12	0.02 (0.03)	0.03 (0.04)	0.49
$C_4H_6O_4.H^+$	0.004–0.05	0.003–0.06	0.01 (0.01)	0.01 (0.01)	1.37
$C_6H_8O_3.H^+$	0.04–0.19	0.01–0.24	0.07 (0.08)	0.07 (0.08)	1.16
$C_6H_{10}O_3.H^+$	0.01–0.04	0.01–0.06	0.01 (0.01)	0.02 (0.02)	0.76
<i>Others</i>					
$C_2H_3N.H^+$	0.06–0.13	0.04 – 0.13	0.08 (0.08)	0.07 (0.07)	1.10

<i>mz</i> 133.09768	0.10–0.22	0.01–0.15	0.14 (0.15)	0.05 (0.06)	3.12
<i>mz</i> 147	0.04–0.17	0.02–0.20	0.07 (0.08)	0.05 (0.07)	1.37
<i>mz</i> 149	0.09–0.23	0.03–0.20	0.14 (0.15)	0.08 (0.09)	1.91
<i>mz</i> 151	0.24–0.40	0.03–0.21	0.30 (0.30)	0.08 (0.09)	3.75
<i>mz</i> 153	0.18–0.50	0.04–0.56	0.25 (0.26)	0.10 (0.12)	2.56
<i>mz</i> 355	0.02–0.08	0.01–0.08	0.03 (0.04)	0.03 (0.03)	1.36
<i>mz</i> 371	0.02–0.06	0.02–0.06	0.03 (0.03)	0.03 (0.03)	1.22
<i>mz</i> 373	0.02–0.05	0.02–0.05	0.03 (0.03)	0.03 (0.03)	1.13
<i>mz</i> 429	0.02–0.04	< LOD	0.03 (0.03)	< LOD	< LOD
<i>mz</i> 503	0.03–0.06	< LOD	0.04 (0.05)	< LOD	< LOD

**Table S1.** Descriptive statistics of measured particles (mass and number concentration).

Compound	Range		Median (avg)		I/O ratio
	IN	OUT	IN	OUT	
Particles					
Number Concentrations (particles m <sup>-3</sup> )					
SMPS <sub>10.2-414.2 nm</sub>	1.60 × 10 <sup>9</sup> –	2.02 × 10 <sup>9</sup> –	5.43 × 10 <sup>9</sup>	7.85 × 10 <sup>9</sup>	0.75
	1.23 × 10 <sup>10</sup>	1.74 × 10 <sup>10</sup>	(5.78 × 10 <sup>9</sup> )	(8.06 × 10 <sup>9</sup> )	
OPC <sub>0.3-0.5 μm</sub>	4.00 × 10 <sup>6</sup> –	4.44 × 10 <sup>6</sup> –	1.21 × 10 <sup>7</sup>	1.66 × 10 <sup>7</sup>	0.70
	6.62 × 10 <sup>7</sup>	1.03 × 10 <sup>8</sup>	(1.72 × 10 <sup>7</sup> )	(2.59 × 10 <sup>7</sup> )	
OPC <sub>0.5-1.0 μm</sub>	8.61 × 10 <sup>5</sup> –	1.21 × 10 <sup>6</sup> –	2.2 × 10 <sup>6</sup>	3.03 × 10 <sup>6</sup>	0.71
	1.01 × 10 <sup>7</sup>	1.62 × 10 <sup>7</sup>	(2.58 × 10 <sup>6</sup> )	(3.67 × 10 <sup>6</sup> )	
OPC <sub>1.0-3.0 μm</sub>	1.13 × 10 <sup>5</sup> –	1.96 × 10 <sup>5</sup> –	4.03 × 10 <sup>5</sup>	7.64 × 10 <sup>5</sup>	0.53
	2.04 × 10 <sup>6</sup>	3.76 × 10 <sup>6</sup>	(4.93 × 10 <sup>5</sup> )	(9.38 × 10 <sup>5</sup> )	
OPC <sub>3.0-5.0 μm</sub>	1.17·10 <sup>3</sup> –	3.16 × 10 <sup>3</sup> –	3.56 × 10 <sup>3</sup>	2.03 × 10 <sup>4</sup>	0.19
	1.19 × 10 <sup>4</sup>	1.70 × 10 <sup>5</sup>	(4.08 × 10 <sup>3</sup> )	(2.64 × 10 <sup>4</sup> )	
OPC <sub>5.0-10.0 μm</sub>	8.17 × 10 <sup>1</sup> –	4.11 × 10 <sup>2</sup> –	2.49 × 10 <sup>2</sup>	2.11 × 10 <sup>3</sup>	0.14
	9.19 × 10 <sup>2</sup>	4.84 × 10 <sup>4</sup>	(3.21 × 10 <sup>2</sup> )	(3.57 × 10 <sup>3</sup> )	
Mass Concentrations (μg m <sup>-3</sup> )					
NO <sub>3</sub>	0.02–0.39	0.05–6.38	0.44 (0.76)	1.18 (1.72)	0.48
inorgNO <sub>3</sub>	0.01–2.75	0.01–5.68	0.21 (0.44)	0.67 (1.17)	0.44
orgNO <sub>3</sub>	0.01–0.73	0.05–1.21	0.20 (0.27)	0.97 (0.44)	0.65
SO <sub>4</sub>	0.05–1.93	0.07–2.33	0.23 (0.30)	0.27 (0.35)	0.87
NH <sub>4</sub>	0.05–1.47	0.04–3.11	0.46 (0.51)	0.71 (1.00)	0.43
Org	0.39–6.20	0.20–9.23	1.59 (2.02)	1.98 (2.56)	0.85
NR-PM <sub>1</sub>	0.52–9.56	0.37–14.48	2.75 (3.53)	4.63 (5.65)	0.68
SMPS	1.13–18.09	0.93–24.56	6.87 (7.26)	7.18 (8.89)	0.87
PM <sub>1</sub> TEOM-FDMS	-	0.07–28.1	-	7.4 (8.1)	-
PM <sub>2.5</sub> TEOM-FDMS	-	0.4-29.3	-	9.9 (11.1)	-
ATMO*	-	-	-	-	-

<sup>\*</sup>Located 1.5 km away, part of the regional air quality monitoring network

**Table S6.** Parameters from *C*<sub>IN</sub> vs. *C*<sub>OUT</sub> scatter plots, indoor (IC) and outdoor contributions (OC), and emission rates (ER) for aerosols and trace gases.

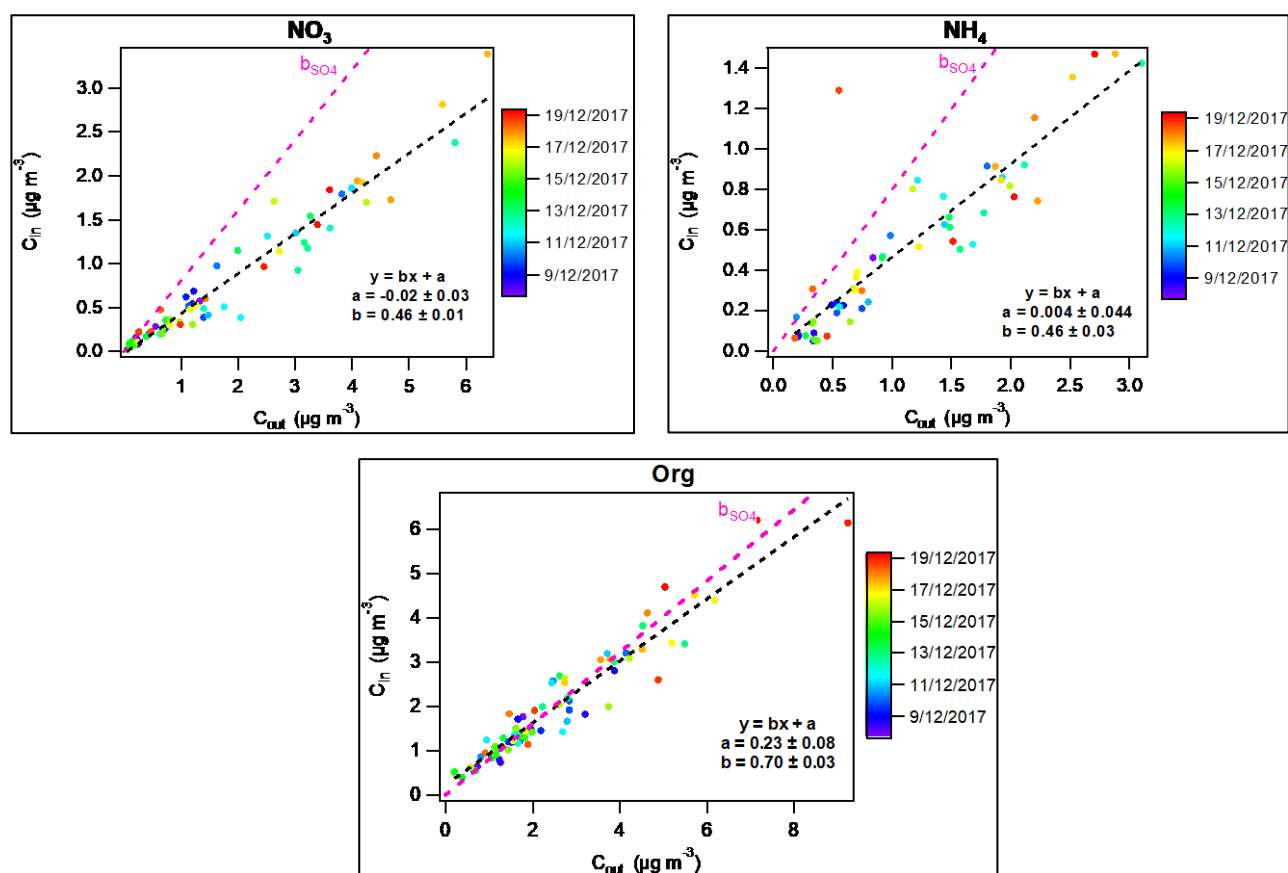
Parameter	Slope	σ <sup>*</sup>	Intercept (μg m <sup>-3</sup> )	RIC	ROC	ER (μg m <sup>-3</sup> h <sup>-1</sup> )
<b>Particles</b>						
<i>Org</i> <sup>a</sup>	0.701	0.027	0.225	6%	94%	-
<i>NO</i> <sub>3</sub> <sup>a</sup>	0.456	0.014	-0.024	-85%	100%	-
<i>SO</i> <sub>4</sub>	0.797	0.017	0.017	6%	94%	-

$NH_4^a$	0.460	0.033	0.004	-113%	100%	-
$NR-PM_{10}^a$	0.579	0.019	0.260	-15%	100%	-
$SMPS_{10.2-414.2\text{ nm}}^a$	0.701	0.018	0.152	6%	94%	-
$OPC_{0.3-0.5\text{ }\mu m}$	0.534	0.022	0.130	23%	77%	-
$OPC_{0.5-1.0\text{ }\mu m}$	0.648	0.031	0.056	8%	92%	-
$OPC_{1.0-3.0\text{ }\mu m}$	0.427	0.016	0.387	18%	82%	-
$OPC_{3.0-5.0\text{ }\mu m}$	0.102	0.010	0.640	37%	63%	-
$OPC_{5.0-10.0\text{ }\mu m}$	0.086	0.010	0.021	9%	91%	-
<b>Inorganic Gases</b>						
$O_3^b$	0.764	0.029	-0.624	-40%	100%	-
$NO_2^b$	0.892	0.031	1.844	15%	85%	-
<b>VOCs</b>						
<b><math>C_xH_y</math></b>						
$C_4H_8.H^+$	0.909	0.037	1.200	54%	46%	0.61
$C_5H_6.H^+$	0.963	0.042	0.088	68%	32%	0.05
$C_5H_8.H^+$	0.857	0.104	1.123	83%	17%	0.61
$C_5H_{10}.H^+$	1.021	0.095	0.448	77%	23%	0.24
$C_6H_4.H^+$	1.077	0.101	0.004	62%	37%	0.004
$C_6H_6.H^+$	0.918	0.027	0.403	38%	62%	0.22
$C_6H_{10}.H^+$	0.850	0.298	1.720	92%	8%	0.93
$C_6H_{12}.H^+$	1.076	0.074	0.112	64%	36%	0.06
$C_7H_8.H^+$	0.829	0.034	0.661	44%	56%	0.36
$C_7H_{10}.H^+$	1.242	0.092	0.179	68%	32%	0.10
$C_8H_8.H^+$	0.858	0.030	0.066	32%	68%	0.04
$C_8H_{10}.H^+$	0.805	0.033	0.249	28%	72%	0.13
$C_8H_{12}.H^+$	0.837	0.105	0.199	80%	20%	0.11
$C_8H_{14}.H^+$	0.852	0.083	0.250	79%	21%	0.14
$C_8H_{16}.H^+$	1.008	0.147	0.041	80%	20%	0.02
$C_9H_{10}.H^+$	0.833	0.036	0.039	42%	58%	0.02
$C_9H_{12}.H^+$	0.749	0.042	0.191	36%	64%	0.10
$C_{10}H_{16}.H^+$	1.661	0.183	4.786	84%	16%	2.49
$C_{10}H_{18}.H^+$	1.037	0.076	0.048	71%	29%	0.03
$C_{15}H_{24}.H^+$	1.037	0.170	0.064	75%	25%	0.03
<b><math>C_xH_yO</math></b>						
$CH_3OH.H^+$	0.631	0.173	20.040	95%	5%	10.86
$CH_3CHO.H^+$	0.794	0.060	1.724	71%	29%	0.93
$C_2H_5O.H^+$	1.000	0.049	-0.960	-32%	100%	-
$C_3H_4O.H^+$	0.802	0.042	0.318	71%	29%	0.01
$C_3H_6O.H^+$	0.614	0.125	3.149	81%	19%	1.77
$C_4H_4O.H^+$	0.937	0.041	0.291	69%	31%	0.16
$C_4H_6O.H^+$	0.784	0.028	0.100	59%	41%	0.05
$C_4H_8O.H^+$	0.850	0.046	0.275	47%	53%	0.15
$C_5H_6O.H^+$	0.824	0.026	0.0004	-4%	100%	-
$C_5H_8O.H^+$	0.719	0.028	0.147	70%	30%	0.08
$C_5H_{10}O.H^+$	0.691	0.061	0.149	74%	26%	0.08
$C_6H_6O.H^+$	0.544	0.044	0.172	80%	20%	0.09
$C_6H_8O.H^+$	0.837	0.039	0.106	66%	34%	0.06
$C_6H_{10}O.H^+$	0.949	0.107	0.144	67%	33%	0.09
$C_6H_{12}O.H^+$	0.817	0.171	0.201	83%	17%	0.11
$C_7H_4O.H^+$	0.724	0.880	0.116	97%	3%	0.06

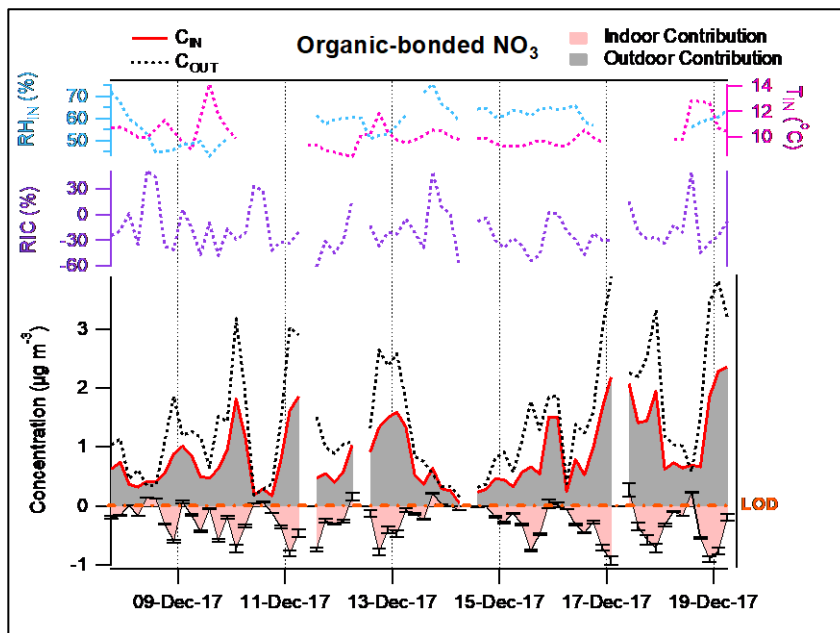
<i>C<sub>7</sub>H<sub>6</sub>O.H<sup>+</sup></i>	0.749	1.150	0.755	98%	2%	0.40
<i>C<sub>7</sub>H<sub>8</sub>O.H<sup>+</sup></i>	0.470	0.024	0.069	75%	25%	0.04
<i>C<sub>7</sub>H<sub>10</sub>O.H<sup>+</sup></i>	0.696	0.036	0.076	71%	29%	0.04
<i>C<sub>7</sub>H<sub>12</sub>O.H<sup>+</sup></i>	0.612	0.027	0.085	86%	14%	0.05
<i>C<sub>8</sub>H<sub>10</sub>O.H<sup>+</sup></i>	0.445	0.027	0.024	62%	38%	0.01
<i>C<sub>8</sub>H<sub>12</sub>O.H<sup>+</sup></i>	0.819	0.056	0.072	76%	24%	0.04
<i>C<sub>8</sub>H<sub>14</sub>O.H<sup>+</sup></i>	1.035	0.0270	0.111	80%	20%	0.06
<i>C<sub>8</sub>H<sub>16</sub>O.H<sup>+</sup></i>	0.840	0.312	0.116	89%	11%	0.06
<i>C<sub>9</sub>H<sub>10</sub>O.H<sup>+</sup></i>	7.946	6.360	0.368	92%	8%	0.23
<i>C<sub>9</sub>H<sub>14</sub>O.H<sup>+</sup></i>	1.794	0.179	0.111	66%	34%	0.06
<i>C<sub>9</sub>H<sub>18</sub>O.H<sup>+</sup></i>	0.730	0.397	0.220	92%	8%	0.12
<i>C<sub>x</sub>H<sub>y</sub>O<sub>2</sub></i>						
<i>CH<sub>2</sub>O<sub>2</sub>.H<sup>+</sup></i>	5.498	1.752	11.324	76%	24%	8.73
<i>C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.556	0.956	67.158	97%	3%	38.45
<i>C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.591	0.132	0.375	91%	9%	0.20
<i>C<sub>3</sub>H<sub>4</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.789	0.125	0.177	75%	25%	0.10
<i>C<sub>3</sub>H<sub>6</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.670	0.096	1.600	87%	13%	0.87
<i>C<sub>3</sub>H<sub>8</sub>O<sub>2</sub>.H<sup>+</sup></i>	2.177	0.378	0.011	50%	50%	0.01
<i>C<sub>4</sub>H<sub>4</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.403	0.034	0.092	77%	23%	0.05
<i>C<sub>4</sub>H<sub>6</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.631	0.067	0.453	77%	23%	0.59
<i>C<sub>4</sub>H<sub>8</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.679	0.068	0.412	79%	21%	0.22
<i>C<sub>5</sub>H<sub>4</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.686	0.240	7.231	96%	4%	3.89
<i>C<sub>5</sub>H<sub>6</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.621	0.028	0.095	65%	35%	0.05
<i>C<sub>5</sub>H<sub>8</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.565	0.087	0.166	76%	24%	0.09
<i>C<sub>5</sub>H<sub>10</sub>O<sub>2</sub>.H<sup>+</sup></i>	1.180	0.251	0.167	82%	18%	0.10
<i>C<sub>6</sub>H<sub>4</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.536	0.027	0.007	50%	50%	0.004
<i>C<sub>6</sub>H<sub>6</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.696	0.051	0.162	78%	22%	0.09
<i>C<sub>6</sub>H<sub>8</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.702	0.037	0.061	60%	40%	0.03
<i>C<sub>6</sub>H<sub>12</sub>O<sub>2</sub>.H<sup>+</sup></i>	2.191	0.433	0.384	72%	28%	0.21
<i>C<sub>7</sub>H<sub>4</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.721	0.383	0.076	88%	12%	0.04
<i>C<sub>7</sub>H<sub>6</sub>O<sub>2</sub>.H<sup>+</sup></i>	1.483	0.376	0.220	74%	26%	0.12
<i>C<sub>7</sub>H<sub>8</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.636	0.030	0.030	55%	45%	0.02
<i>C<sub>7</sub>H<sub>10</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.705	0.037	0.031	62%	38%	0.02
<i>C<sub>7</sub>H<sub>12</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.616	0.045	0.069	67%	33%	0.04
<i>C<sub>7</sub>H<sub>14</sub>O<sub>2</sub>.H<sup>+</sup></i>	1.465	0.188	0.061	71%	29%	0.03
<i>C<sub>8</sub>H<sub>10</sub>O<sub>2</sub>.H<sup>+</sup></i>	0.628	0.040	0.022	57%	43%	0.01
<i>C<sub>x</sub>H<sub>y</sub>O<sub>≥3</sub></i>						
<i>C<sub>2</sub>H<sub>4</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.765	0.204	0.012	85%	15%	0.01
<i>C<sub>4</sub>H<sub>2</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.260	0.033	0.022	62%	38%	0.01
<i>C<sub>4</sub>H<sub>4</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.899	0.097	-0.003	-18%	100%	-
<i>C<sub>4</sub>H<sub>6</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.844	0.402	0.357	92%	8%	0.19
<i>C<sub>5</sub>H<sub>4</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.563	0.047	0.016	53%	47%	0.01
<i>C<sub>5</sub>H<sub>8</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.744	0.051	-0.013	-71%	100%	-
<i>C<sub>4</sub>H<sub>6</sub>O<sub>4</sub>.H<sup>+</sup></i>	0.787	0.034	0.004	43%	57%	0.002
<i>C<sub>6</sub>H<sub>8</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.669	0.024	0.031	39%	61%	0.02
<i>C<sub>6</sub>H<sub>10</sub>O<sub>3</sub>.H<sup>+</sup></i>	0.607	0.031	0.003	18%	82%	0.001
<i>Others</i>						
<i>C<sub>2</sub>H<sub>3</sub>N.H<sup>+</sup></i>	0.821	0.027	0.020	25%	75%	0.01
<i>mz 133.09768</i>	0.871	0.058	0.098	68%	32%	0.05
<i>mz 147</i>	0.711	0.024	0.034	45%	55%	0.02

<i>mz</i> 149	0.700	0.038	0.087	60%	40%	0.05
<i>mz</i> 151	0.409	0.123	0.265	88%	12%	0.14
<i>mz</i> 153	0.794	0.097	0.178	66%	34%	0.09
<i>mz</i> 355.070	0.843	0.029	0.013	43%	57%	0.01
<i>mz</i> 371.101	0.860	0.057	0.010	58%	42%	0.01
<i>mz</i> 373	0.995	0.110	-0.003	51%	49%	0.004
<i>mz</i> 429	0.636	0.220	0.024	100%	0%	0.01
<i>mz</i> 503	0.777	0.306	0.042	100%	0%	0.02

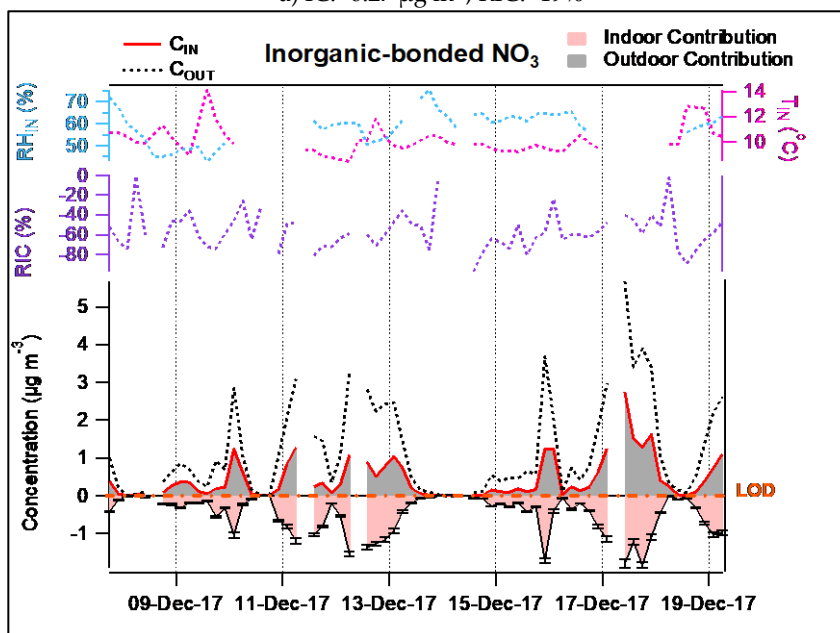
<sup>a</sup> Slope of SO<sub>4</sub> has been used for the IC-OC analysis. <sup>b</sup> Slope of C<sub>x</sub>H<sub>y</sub> has been used for the IC-OC analysis. \*Compounds exhibiting a 3σ RSD larger than 50% for the slope were not included in the analysis.



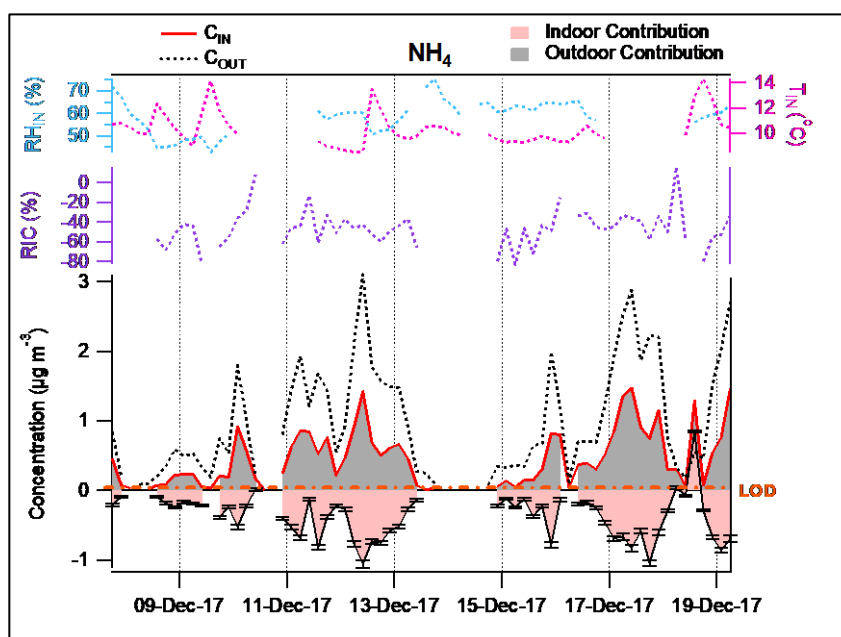
**Figure S5.** Scatter plots of  $C_{IN}$  vs.  $C_{OUT}$  for  $NH_4$ ,  $NO_3$ , and Org. Color-coding corresponds to date; dashed black line corresponds to linear fit, dashed pink line corresponds to the slope observed for sulfate.



a) IC:  $-0.27 \mu\text{g m}^{-3}$ , RIC: -19%



b) IC:  $-0.50 \mu\text{g m}^{-3}$ , RIC: -57%



c) IC:  $-0.38 \mu\text{g m}^{-3}$ , RIC:  $-47\%$

**Figure S6.** IC-OC contributions (a)  $\text{orgNO}_3$ , (b)  $\text{inorgNO}_3$  and (c)  $\text{NH}_4$ . Error bars represent  $1\sigma$ .

## References

- [1] E. Stratigou, S. Dusanter, J. Brito, and V. Riffault, "Investigation of PM<sub>10</sub>, PM<sub>2.5</sub>, PM<sub>1</sub> in an unoccupied airflow-controlled room: How reliable to neglect resuspension and assume unreactive particles?," *Building and Environment*, vol. 186, p. 107357, Dec. 2020, doi: 10.1016/j.buildenv.2020.107357.