Effects of an electrostatic precipitator on particle mass, composition, and number size distributions in residential wood combustion emissions

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Supplementary Material

Content

SM-1 Calculation of emission factors

Fuel-specific emission factors (EF_{fuel}) were calculated using Eqs. S1 and S2.[1]

$$EF_{energy} = C_n \times \lambda \times k \times Q_s \quad \text{(S1)}$$

$$EF_{fuel} = EF_{energy} \times H_u \quad \text{(S2)}$$

where EF_{energy} is energy-specific emission factor, C_n is the normalized concentration of a pollutant. Similarly, specific exhaust volume for stoichiometric combustion (Q_s) is constant for a given fuel (approximately 0.25 m^3/MJ for wood fuel).[1] H_u is the calorific value of wood fuel. The values of air-to-fuel ratio (λ) and fuel moisture factor (k) were calculated using Eq. S3–S5.[1]

$$\lambda = \frac{20.9}{20.9-[O_2]} \quad \text{(S3)}$$

$$k = \frac{H_u}{H_u-H_w} \quad \text{(S4)}$$

$$H_w = \left(\frac{\gamma}{1-\gamma}\right) l_v \quad \text{(S5)}$$

where $[O_2]$ is the concentration of oxygen in flue gas (13% when pollutant concentration, C_n, is already standardized to 13% O_2) and H_w is heat absorbed during fuel moisture evaporation. Similarly, γ is the mass fraction of water in wet fuel (15% for the fuel used in the present study) and l_v is the latent heat of vaporization for water (2.5 MJ/kg at 0 °C).

SM-2 Supplementary figures

Fig. S1 Photographs of the traditional wood sauna stove (SS) and modern wood stove (MS) tested in the present study.

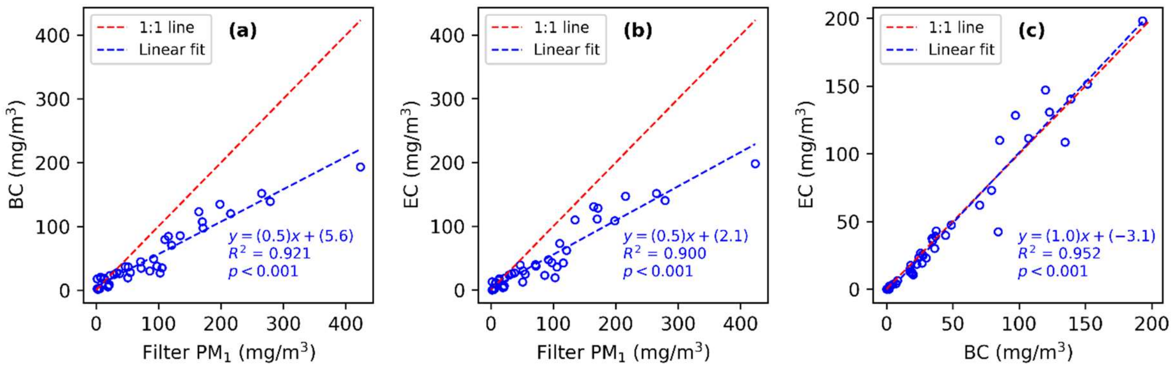

Fig. S2 Relationships between concentrations of gravimetric PM_1, BC and EC: **(a)** gravimetric PM_1 vs. BC, **(b)** gravimetric PM_1 vs. EC, and **(c)** BC vs. EC. All concentrations are standardized to NTP and 13% O_2.

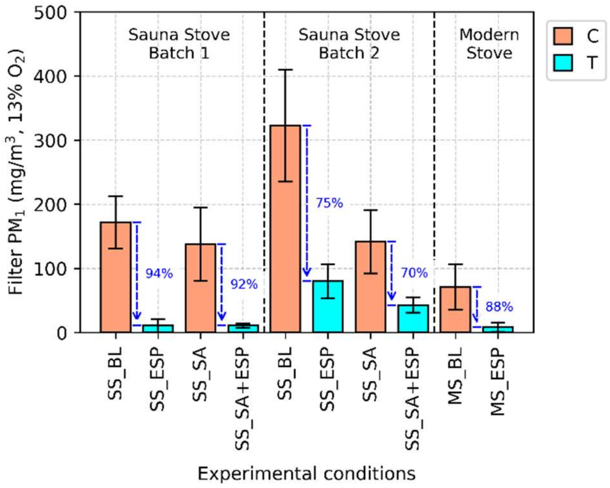

Fig. S3 Comparisons of gravimetric PM_1 between the control and treatment groups under various experimental conditions. Values in blue indicate reduction efficiencies of ESP. Error bars represent SDs.

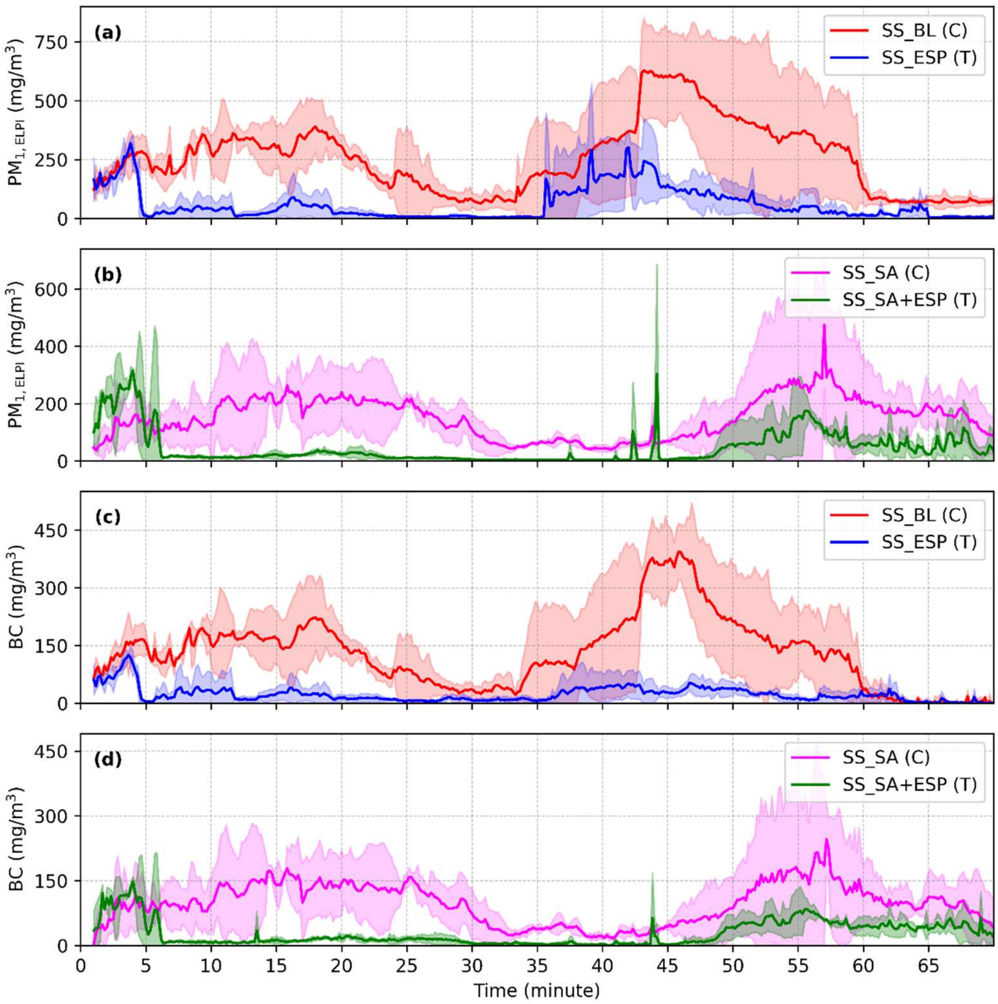

Fig. S4 Comparisons of real-time PM and BC concentrations between the control (C) and treatment (T) groups during SS tests: **(a)** $PM_{1,ELPI}$ for SS_BL vs. SS_ESP, **(b)** $PM_{1,ELPI}$ for SS_SA vs. SS_SA+ESP, **(c)** BC for SS_BL vs. SS_ESP, and **(d)** BC for SS_SA vs. SS_SA+ESP. Each curve represents the mean of three replicates and includes two sequential batches: batch 1 (0–35 min) and batch 2 (35 min to the end). All concentrations are standardized to NTP and 13% O_2. Error bands represent SD.

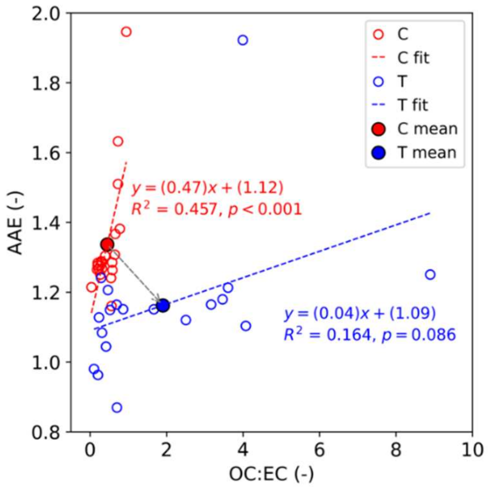

Fig. S5 Relationship between OC:EC ratio and AAE in the control (C) and treatment (T) groups; gray arrow shows the direction of change in particle properties from the control to treatment group.

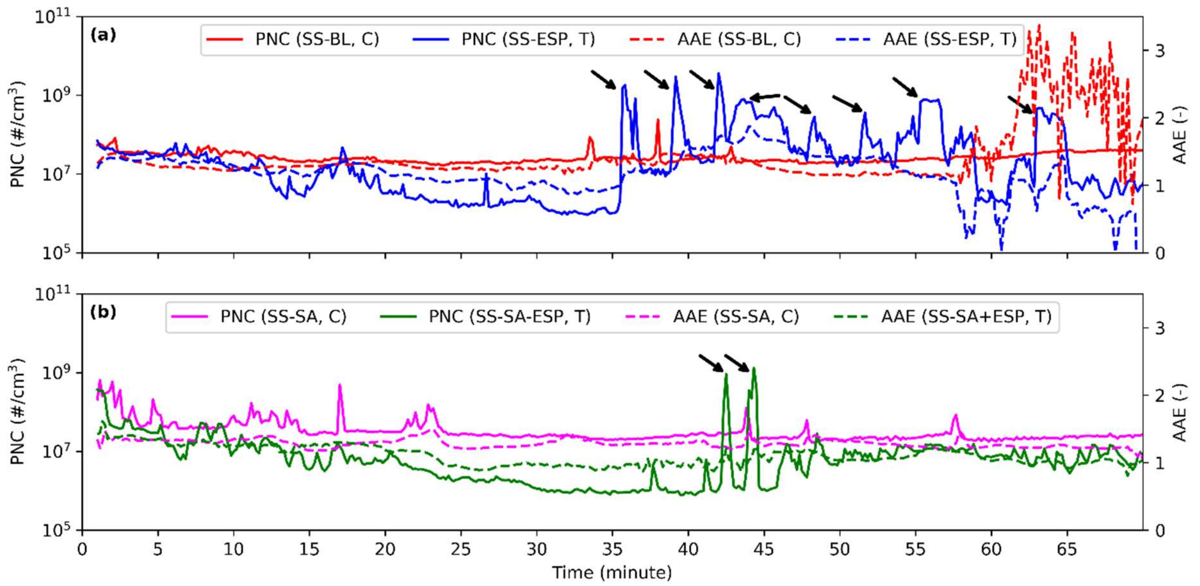

Fig. S6 Comparison of real-time PNC and AAE between the control (C) and treatment (T) groups during SS tests: **(a)** SS_BL vs. SS_ESP and **(b)** SS_SA vs. SS_SA+ESP. Each curve represents the mean of three replicates and includes two sequential batches: batch 1 (0–35 min) and batch 2 (35 min to the end). Numerous PNC peaks higher than the control levels can be observed in the treatment test curves, which are indicated by arrows. All concentrations are standardized to NTP and 13% O_2.

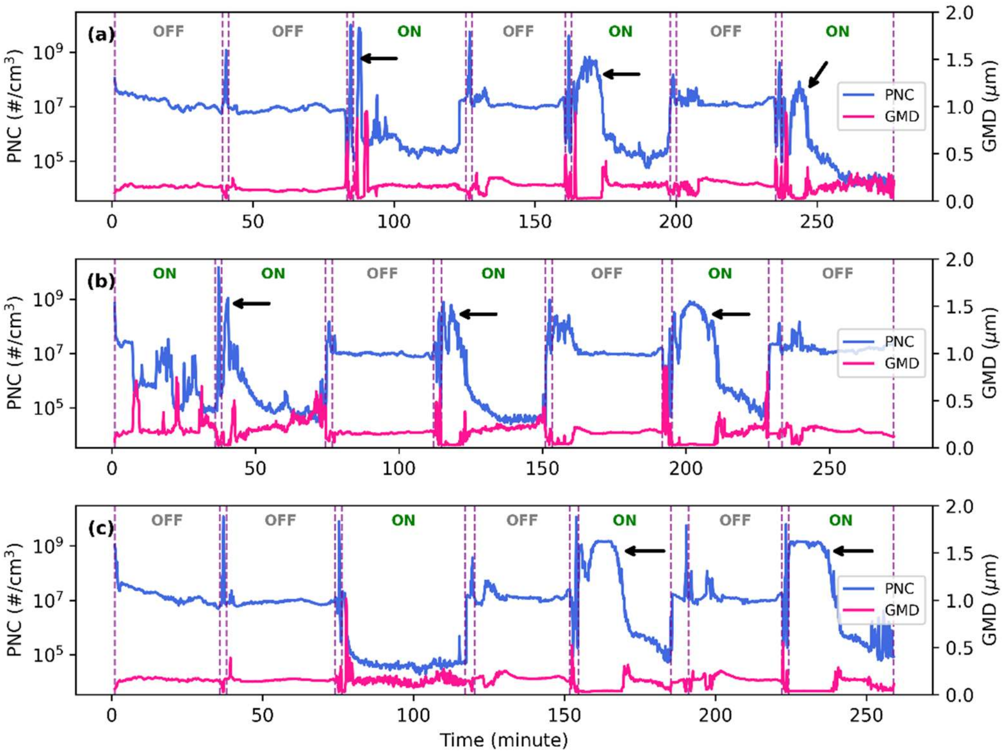

Fig. S7 Real-time PNC and AAE for the control (C) and treatment (T) batches of MS tests: **(a)** replicate test 1, **(b)** replicate test 2, and **(c)** replicate test 3. All concentrations are standardized to NTP and 13% O_2. Control and treatment batches are denoted by "OFF" and "ON", respectively, and are separated by vertical dotted lines. PNC peaks in the treatment batches are indicated by arrows.

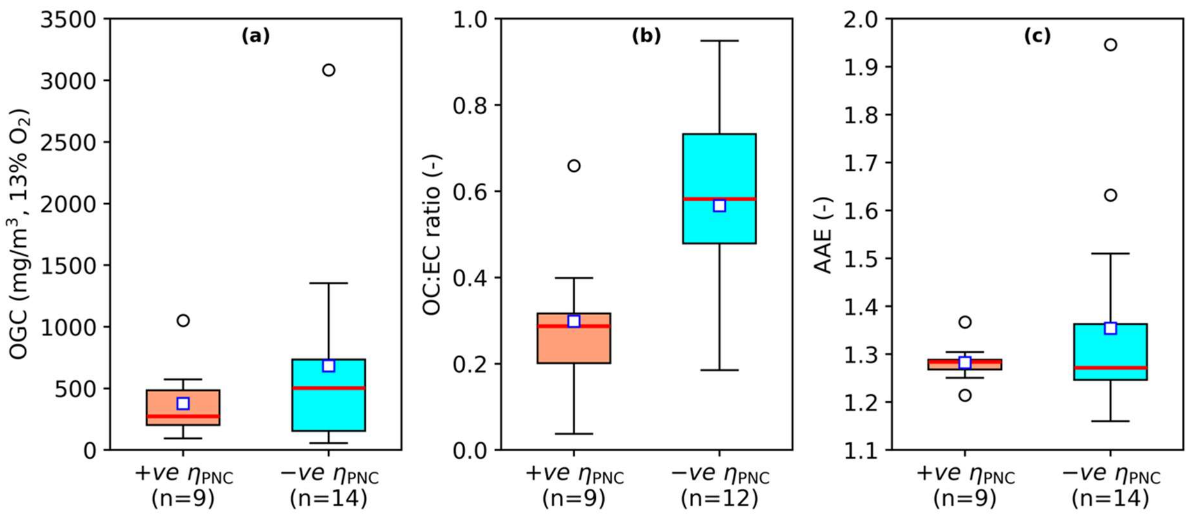

Fig. S8 Comparison of flue gas properties upstream of the ESP between the cases with positive efficiency on PNC (+ve η_{PNC}) and negative efficiency on PNC (–ve η_{PNC}): **(a)** organic gaseous carbon (OGC) concentration, **(b)** OC:EC ratio and **(c)** AAE.

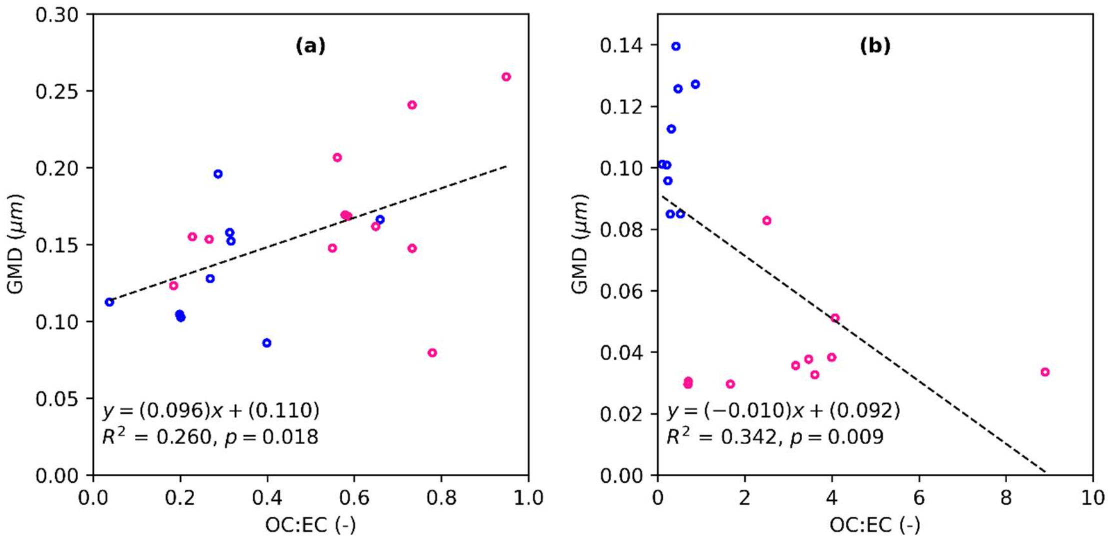

Fig. S9 Relationship between OC:EC ratio and GMD: **(a)** control batches and **(b)** treatment batches. Scatter points in blue represent the experimental conditions exhibiting positive ESP efficiency on PNC (+ve η_{PNC}), whereas scatter points in pink represent those exhibiting negative ESP efficiency on PNC (-ve η_{PNC}). One of the batches in the treatment group had a very high OC:EC (>8), which could be due to high measurement uncertainty at low particulate matter emissions.

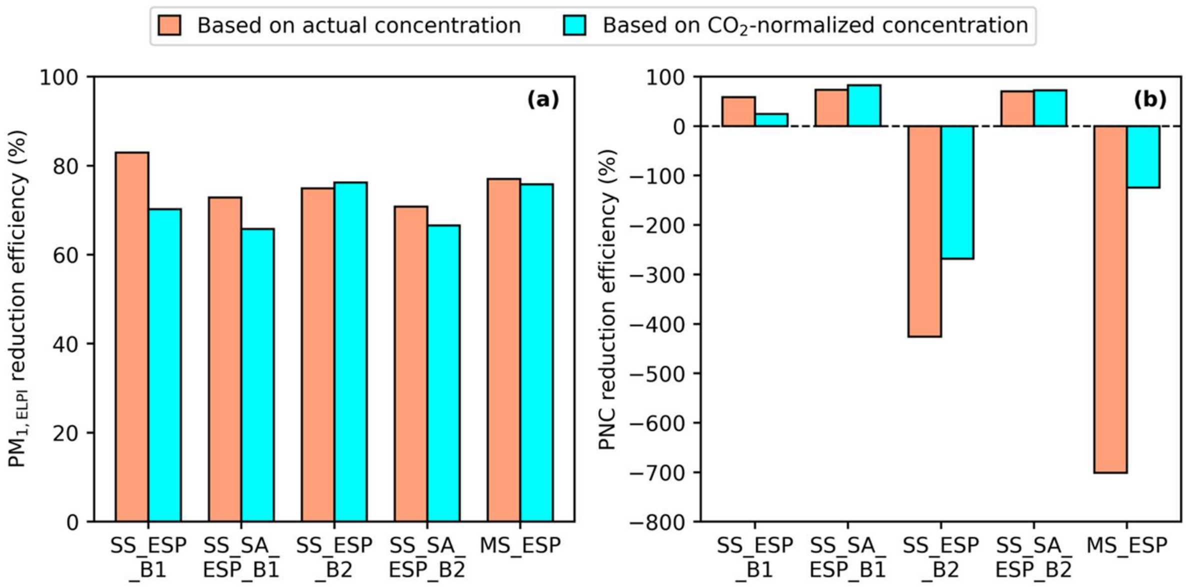

Fig. S10 Comparison of emission reduction efficiencies of ESP calculated using actual concentrations and CO_2-normalized concentrations : **(a)** efficiencies for PM_1 and **(b)** efficiencies for PNC.

SM-3 Supplementary tables

Table S1 Description of the measurement equipment

Parameters	Analytical instrument	Additional information
THC	FID (FIDAMAT 6, Siemens AG, Nürnberg, Germany)	Calibration at 0 and 500 ppm propane Measurement range: 0–99999 ppm Signal processing time < 1 s Zero drift < 1%/month of the smallest possible measuring span
CO	Siemens gas analyzers (Ultramat 23, Siemens AG, Nürnberg, Germany)	Calibration at 0 and 1000 ppm Measurement range: 0–2.5%
NO	Siemens gas analyzers (Ultramat 23, Siemens AG, Nürnberg, Germany)	Calibration at 0 and 100 ppm Measurement range: 0–500 ppm
CO_2 (flue gas)	Siemens gas analyzers (Ultramat 23, Siemens AG, Nürnberg, Germany)	Calibration at 0% and 10% Measurement range: 0–25%
CO_2 (dilution air)	Vaisala Carbocap (GMP343, Vaisala, Vantaa, Finland)	Factory calibrated Measurement range: 0–1000 ppm
VOCs and OGC	Fourier-transform infrared analyzer (DX4000, Gasmet Technologies Ltd., Vantaa, Finland)	Accuracy within ±2% of the measured range Wave number range: 900–4200 /cm
Gravimetric PM_1	Microbalance (Mettler Toledo, MT5, Ohio, USA)	Accuracy within ±1 μg
EC and OC	Thermal-optical carbon analyzer (Sunset Laboratory Inc., Portland, USA)	Total carbon measurement range: 0.20–600 $\mu g/cm^2$ Detection limit: 0.10 $\mu g/cm^2$
Real-time PM, PNC, and particle number size distribution	Electrical low-pressure impactor (ELPI, Dekati Inc., Kangasala, Finland)	Particle cut size: 7 nm to 10 μm Number of stages: 12 Response time < 5 s
PNC	Condensation particle counter (CPC 3775, TSI Inc., Minnesota, USA)	Lower detection size: 4 nm Accuracy: ±10% at $< 5 \times 10^4$ particles/cm^3 and ±20% at $< 10^7$ particles/cm^3
BC	Aethalometer (AE33-7, Magee Scientific, Berkeley, USA)	LED optical source range: wavelength 370–950 nm Detection limit: < 0.005 $\mu g/m^3$

Table S2 Flue gas characteristics and concentrations of particulate and gaseous pollutants (standardized to NTP and 13% O_2) for individual test batch (n = 45)

Test batch [a]	C/T [a]	Fuel load (g)	T (°C)	Draft (Pa)	Filter PM_1 (mg/m^3)	$PM_{1,ELPI}$ (mg/m^3)	BC (mg/m^3)	EC (mg/m^3)	OC (mg/m^3)	AAE (–)	ELPI PNC (#/cm^3)	GMD (μm)	CPC PNC (#/cm^3)	CO (mg/m^3)	NO (mg/m^3)	THC (mg/m^3)	CO_2 (%)
SS_BL_1_B1	C	3003	321	6.8	215.6	214.3	119.9	147.0	46.5	1.29	4.55×10^{7}	0.152	3.10×10^{7}	4688	63.8	369.8	7.2
SS_BL_1_B2	C	3014	430	7.9	265.2	280.3	151.6	151.4	84.9	1.16	3.78×10^{7}	0.207	2.59×10^{7}	6835	71.6	988.3	9.3
SS_BL_2_B1	C	3002	307	7.4	134.8	194.0	85.3	109.8	34.5	1.27	3.59×10^{7}	0.158	2.48×10^{7}	2412	70.7	164.3	6.5
SS_BL_2_B2	C	3034	443	8.8	423.3	446.7	193.1	198.1	187.9	1.95	2.88×10^{7}	0.259	2.67×10^{7}	12418	66.6	2570.6	9.7
SS_BL_3_B1	C	3002	312	7.4	164.7	211.7	122.9	130.7	37.5	1.29	3.49×10^{7}	0.196	2.45×10^{7}	4816	63.9	434.5	7.3
SS_BL_3_B2	C	3032	463	8.5	279.0	248.1	138.9	140.2	102.7	1.63	2.73×10^{7}	0.241	2.49×10^{7}	7691	65.5	1317.9	9.8
SS_ESP_1_B1	T	3000	265	7.1	2.1	24.0	17.7	12.8	3.7	1.24	1.66×10^{7}	0.085	1.17×10^{7}	3130	64.7	216.4	5.5
SS_ESP_1_B2	T	2995	457	8.3	57.2	58.8	19.3	12.4	39.4	1.16	1.41×10^{8}	0.036	2.81×10^{8}	11228	60.6	1561.8	10.2
SS_ESP_2_B1	T	3000	301	6.6	8.2	34.1	19.3	11.4	4.8	1.04	6.98×10^{6}	0.140	5.86×10^{6}	2041	68.6	148.0	6.5
SS_ESP_2_B2	T	3019	438	7.7	86.3	84.7	30.0	23.0	57.6	1.12	1.42×10^{7}	0.083	1.80×10^{7}	9056	63.3	1674.3	9.7
SS_ESP_3_B1	T	3000	295	7.8	22.4	50.3	22.9	18.4	8.6	1.21	1.06×10^{7}	0.126	1.57×10^{7}	3563	72.8	313.5	6.3
SS_ESP_3_B2	T	3013	465	9.1	102.8	107.8	26.9	19.2	78.3	1.10	4.77×10^{7}	0.051	1.09×10^{8}	10236	65.5	1860.8	10.1
SS_SA_1_B1	C	3000	273	6.5	170.3	155.4	107.2	111.3	22.1	1.28	7.09×10^{7}	0.105	4.42×10^{7}	2399	65.9	230.3	5.7
SS_SA_1_B2	C	3000	486	8.0	116.0	129.7	84.3	42.4	1.6	1.21	5.90×10^{7}	0.113	2.53×10^{7}	3116	65.0	59.0	9.6
SS_SA_2_B1	C	2999	291	6.5	171.5	147.1	97.2	128.3	25.8	1.28	6.57×10^{7}	0.103	3.41×10^{7}	2004	77.2	157.4	5.2
SS_SA_2_B2	C	3010	467	7.7	198.5	253.1	134.7	108.5	71.5	1.37	4.18×10^{7}	0.166	2.73×10^{7}	6292	60.7	1032.9	10.0
SS_SA_3_B1	C	3011	252	6.9	71.6	69.9	44.6	39.7	15.8	1.30	5.40×10^{7}	0.086	6.73×10^{7}	1482	75.6	151.0	4.4
SS_SA_3_B2	C	3003	464	8.7	110.4	127.3	79.2	72.9	19.6	1.25	5.06×10^{7}	0.128	2.68×10^{7}	3489	68.8	209.3	9.3
SS_SA_ESP_1_B1	T	2901	265	6.2	7.2	39.9	20.3	10.6	5.6	1.15	1.75×10^{7}	0.085	2.19×10^{7}	2315	72.0	193.5	5.7
SS_SA_ESP_1_B2	T	3002	449	7.8	51.6	65.1	36.4	30.0	26.0	1.15	1.07×10^{7}	0.127	1.08×10^{7}	4959	53.6	628.4	9.8
SS_SA_ESP_2_B1	T	3000	302	6.6	13.6	26.6	18.2	17.6	5.5	1.08	1.05×10^{7}	0.113	1.07×10^{7}	1951	69.9	176.7	5.6
SS_SA_ESP_2_B2	T	3005	433	8.2	29.2	32.6	24.5	23.3	4.8	0.96	1.35×10^{7}	0.101	6.19×10^{6}	1824	76.1	72.6	8.1
SS_SA_ESP_3_B1	T	3000	299	6.6	12.5	34.7	17.9	14.8	3.5	1.13	1.37×10^{7}	0.096	6.50×10^{6}	1645	64.9	142.7	5.6
SS_SA_ESP_3_B2	T	3035	456	8.2	47.0	51.3	37.0	39.1	4.1	0.98	1.78×10^{7}	0.101	6.68×10^{6}	2160	66.6	33.2	8.4
MS_1_BL_B1	C	1849	248	11.9	NA	101.1	74.2	NA	NA	1.20	3.26×10^{7}	0.150	1.77×10^{7}	1484	60.3	128.0	5.1
MS_1_BL_B2	C	2001	368	12.0	21.4	14.7	8.4	6.3	1.2	1.26	6.16×10^{6}	0.123	8.16×10^{6}	741	67.5	28.1	6.3
MS_1_BL_B4	C	1999	433	12.0	105.9	56.4	34.8	35.9	23.3	1.31	1.40×10^{7}	0.162	1.31×10^{7}	4596	52.2	500.1	9.1
MS_1_BL_B6	C	1999	434	11.9	97.7	63.1	37.5	42.9	24.8	1.29	1.59×10^{7}	0.169	1.48×10^{7}	3647	44.9	328.9	9.3
MS_1_ESP_B3	T	1978	409	12.0	4.8	15.4	1.8	0.7	6.0	1.25	5.02×10^{7}	0.034	1.47×10^{8}	1549	56.0	131.1	8.0
MS_1_ESP_B5	T	2013	429	12.0	5.8	11.3	2.1	2.2	3.6	1.15	5.16×10^{7}	0.030	6.86×10^{7}	3308	45.7	277.4	8.8
MS_1_ESP_B7	T	1998	420	12.1	NA	0.7	0.3	0.0	0.8	2.12	2.74×10^{6}	0.030	4.20×10^{6}	1875	57.5	101.8	8.4
MS_2_BL_B3	C	1992	417	12.4	37.6	42.4	25.8	26.6	7.1	1.28	1.36×10^{7}	0.154	1.00×10^{7}	770	63.7	43.7	8.4
MS_2_BL_B5	C	2001	419	11.9	55.1	50.9	27.6	24.9	19.4	1.38	2.17×10^{7}	0.080	2.74×10^{7}	3173	51.4	332.7	8.5
MS_2_BL_B7	C	1999	427	11.9	72.3	62.6	34.4	37.5	20.6	1.24	1.66×10^{7}	0.148	1.78×10^{7}	4015	57.3	345.4	8.4
MS_2_ESP_B1	T	1851	258	11.8	NA	27.7	20.6	NA	NA	1.06	9.07×10^{6}	0.153	1.00×10^{7}	1772	65.0	132.6	5.5
MS_2_ESP_B2	T	1996	396	12.0	5.4	3.0	3.6	2.8	1.9	0.87	1.09×10^{7}	0.031	2.22×10^{7}	1274	65.6	91.3	8.1
MS_2_ESP_B4	T	1997	416	12.0	3.3	4.4	1.2	0.7	0.5	1.16	1.85×10^{7}	0.030	3.44×10^{7}	1366	59.7	110.5	8.5
MS_2_ESP_B6	T	2000	434	11.9	5.8	16.1	2.3	1.5	5.3	1.21	5.71×10^{7}	0.033	1.43×10^{8}	3028	48.4	255.2	9.3
MS_3_BL_B1	C	1852	252	11.8	NA	93.1	64.3	NA	NA	1.22	3.04×10^{7}	0.159	2.98×10^{7}	1541	54.0	105.8	5.4
MS_3_BL_B2	C	2000	391	12.0	33.4	36.0	27.2	25.4	5.8	1.27	1.24×10^{7}	0.155	8.77×10^{6}	677	65.1	22.0	7.7
MS_3_BL_B4	C	2007	439	13.2	121.2	85.9	70.3	62.0	36.3	1.26	1.90×10^{7}	0.168	1.48×10^{7}	3785	46.5	480.0	9.1
MS_3_BL_B6	C	2005	438	12.0	92.3	64.2	48.9	47.3	34.7	1.51	1.56×10^{7}	0.148	1.51×10^{7}	3935	49.2	458.3	9.4
MS_3_ESP_B3	T	1996	398	12.1	2.1	0.2	2.1	0.0	1.6	1.00	2.33×10^{5}	0.079	5.49×10^{5}	578	66.9	24.6	7.6
MS_3_ESP_B5	T	1996	442	12.0	20.6	32.3	7.3	4.1	14.2	1.18	8.29×10^{7}	0.038	4.07×10^{8}	3743	47.7	396.0	9.4
MS_3_ESP_B7	T	2001	444	12.0	19.3	28.9	5.2	3.7	14.7	1.92	7.59×10^{7}	0.038	4.54×10^{8}	4987	42.1	431.7	9.2

[a] SS = traditional sauna stove; MS = modern wood stove; BL = baseline; SA = secondary air supply; ESP = electrostatic precipitator; B1 = batch 1 combustion; B2 = batch 2 combustion; C = Control; T = Treatment

Table S3 Fuel-mass-specific emission factors of particulate and gaseous pollutants for individual test batch (n = 45)

Test batch [a]	C/T [a]	Filter PM_1 (g/kg-fuel)	$PM_{1,ELPI}$ (g/kg-fuel)	BC (g/kg-fuel)	EC (g/kg-fuel)	OC (g/kg-fuel)	ELPI PNC (#/kg-fuel)	CPC PNC (#/kg-fuel)	CO (g/kg-fuel)	NO (g/kg-fuel)	THC (g/kg-fuel)
SS_BL_1_B1	C	2.70	2.69	1.50	1.84	0.58	5.7×10^{14}	3.9×10^{14}	58.8	0.80	4.63
SS_BL_1_B2	C	3.32	3.51	1.90	1.90	1.06	4.7×10^{14}	3.2×10^{14}	85.7	0.90	12.4
SS_BL_2_B1	C	1.69	2.43	1.07	1.38	0.43	4.5×10^{14}	3.1×10^{14}	30.2	0.89	2.06
SS_BL_2_B2	C	5.31	5.60	2.42	2.48	2.36	3.6×10^{14}	3.3×10^{14}	156	0.83	32.2
SS_BL_3_B1	C	2.06	2.65	1.54	1.64	0.47	4.4×10^{14}	3.1×10^{14}	60.4	0.80	5.45
SS_BL_3_B2	C	3.50	3.11	1.74	1.76	1.29	3.4×10^{14}	3.1×10^{14}	96.4	0.82	16.5
SS_ESP_1_B1	T	0.03	0.27	0.22	0.16	0.05	2.1×10^{14}	1.5×10^{14}	39.2	0.81	2.71
SS_ESP_1_B2	T	0.64	0.66	0.24	0.16	0.49	1.8×10^{15}	3.5×10^{15}	141	0.76	19.6
SS_ESP_2_B1	T	0.10	0.43	0.24	0.14	0.06	8.7×10^{13}	7.3×10^{13}	25.6	0.86	1.85
SS_ESP_2_B2	T	1.08	1.06	0.38	0.29	0.72	1.8×10^{14}	2.3×10^{14}	114	0.79	21.0
SS_ESP_3_B1	T	0.28	0.63	0.29	0.23	0.11	1.3×10^{14}	2.0×10^{14}	44.7	0.91	3.93
SS_ESP_3_B2	T	1.29	1.35	0.34	0.24	0.98	6.0×10^{14}	1.4×10^{15}	128	0.82	23.3
SS_SA_1_B1	C	2.13	1.95	1.34	1.39	0.28	8.9×10^{14}	5.5×10^{14}	30.1	0.83	2.89
SS_SA_1_B2	C	1.45	1.63	1.06	0.53	0.02	7.4×10^{14}	3.2×10^{14}	39.1	0.82	0.74
SS_SA_2_B1	C	2.15	1.84	1.22	1.61	0.32	8.2×10^{14}	4.3×10^{14}	25.1	0.97	1.97
SS_SA_2_B2	C	2.49	3.17	1.69	1.36	0.90	5.2×10^{14}	3.4×10^{14}	78.9	0.76	12.9
SS_SA_3_B1	C	0.90	0.88	0.56	0.50	0.20	6.8×10^{14}	8.4×10^{14}	18.6	0.95	1.89
SS_SA_3_B2	C	1.38	1.60	0.99	0.91	0.25	6.3×10^{14}	3.4×10^{14}	43.7	0.86	2.62
SS_SA_ESP_1_B1	T	0.09	0.50	0.25	0.13	0.07	2.2×10^{14}	2.7×10^{14}	29.0	0.90	2.43
SS_SA_ESP_1_B2	T	0.65	0.82	0.46	0.38	0.33	1.3×10^{14}	1.4×10^{14}	62.2	0.67	7.88
SS_SA_ESP_2_B1	T	0.17	0.33	0.23	0.22	0.07	1.3×10^{14}	1.3×10^{14}	24.5	0.88	2.22
SS_SA_ESP_2_B2	T	0.37	0.41	0.31	0.29	0.06	1.7×10^{14}	7.8×10^{13}	22.9	0.95	0.91
SS_SA_ESP_3_B1	T	0.16	0.44	0.22	0.19	0.04	1.7×10^{14}	8.1×10^{13}	20.6	0.81	1.79
SS_SA_ESP_3_B2	T	0.59	0.64	0.46	0.49	0.05	2.2×10^{14}	8.4×10^{13}	27.1	0.83	0.42
MS_1_BL_B1	C	NA	1.27	0.93	NA	NA	4.1×10^{14}	2.2×10^{14}	18.6	0.76	1.60
MS_1_BL_B2	C	0.27	0.18	0.11	0.08	0.01	7.7×10^{13}	1.0×10^{14}	9.28	0.85	0.35
MS_1_BL_B4	C	1.33	0.71	0.44	0.45	0.29	1.8×10^{14}	1.6×10^{14}	57.6	0.65	6.27
MS_1_BL_B6	C	1.22	0.79	0.47	0.54	0.31	2.0×10^{14}	1.9×10^{14}	45.7	0.56	4.12
MS_1_ESP_B3	T	0.06	0.19	0.02	0.01	0.08	6.3×10^{14}	1.8×10^{14}	19.4	0.70	1.64
MS_1_ESP_B5	T	0.07	0.14	0.03	0.03	0.05	6.5×10^{14}	8.6×10^{14}	41.5	0.57	3.48
MS_1_ESP_B7	T	NA	0.01	0.00	0.00	0.01	3.4×10^{13}	5.3×10^{14}	23.5	0.72	1.28
MS_2_BL_B3	C	0.47	0.53	0.32	0.33	0.09	1.7×10^{14}	1.3×10^{14}	9.65	0.80	0.55
MS_2_BL_B5	C	0.69	0.64	0.35	0.31	0.24	2.7×10^{14}	3.4×10^{14}	39.8	0.64	4.17
MS_2_BL_B7	C	0.91	0.78	0.43	0.47	0.26	2.1×10^{14}	2.2×10^{14}	50.3	0.72	4.33
MS_2_ESP_B1	T	NA	0.35	0.26	NA	NA	1.1×10^{14}	1.3×10^{14}	22.2	0.82	1.66
MS_2_ESP_B2	T	0.07	0.04	0.04	0.03	0.02	1.4×10^{14}	2.8×10^{14}	16.0	0.82	1.14
MS_2_ESP_B4	T	0.04	0.06	0.02	0.01	0.01	2.3×10^{14}	4.3×10^{14}	17.1	0.75	1.39
MS_2_ESP_B6	T	0.07	0.20	0.03	0.02	0.07	7.2×10^{14}	1.8×10^{15}	38.0	0.61	3.20
MS_3_BL_B1	C	NA	1.17	0.81	NA	NA	3.8×10^{14}	3.7×10^{14}	19.3	0.68	1.33
MS_3_BL_B2	C	0.42	0.45	0.34	0.32	0.07	1.6×10^{14}	1.1×10^{14}	8.49	0.82	0.28
MS_3_BL_B4	C	1.52	1.08	0.88	0.78	0.45	2.4×10^{14}	1.9×10^{14}	47.4	0.58	6.02
MS_3_BL_B6	C	1.16	0.81	0.61	0.59	0.43	2.0×10^{14}	1.9×10^{14}	49.3	0.62	5.74
MS_3_ESP_B3	T	0.03	0.00	0.03	0.00	0.02	2.9×10^{12}	6.9×10^{12}	7.24	0.84	0.31
MS_3_ESP_B5	T	0.26	0.40	0.09	0.05	0.18	1.0×10^{15}	5.1×10^{15}	46.9	0.60	4.96
MS_3_ESP_B7	T	0.24	0.36	0.06	0.05	0.18	9.5×10^{14}	5.7×10^{15}	62.5	0.53	5.41

[a] SS = traditional sauna stove; MS = modern wood stove; BL = baseline; SA = secondary air supply; ESP = electrostatic precipitator; B1 = batch 1 combustion; B2 = batch 2 combustion; C = Control; T = Treatment

References

1 J. Tissari, Fine Particle Emissions from Residential Wood Combustion (Ph.D. Dissertation), University of Kuopio, 2008.