Speciated On-line PM_1 from South Asian Combustion Sources: *Part I, Fuel-based Emission Factors and Size Distributions*

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Supporting Information

1. Experimental Setup

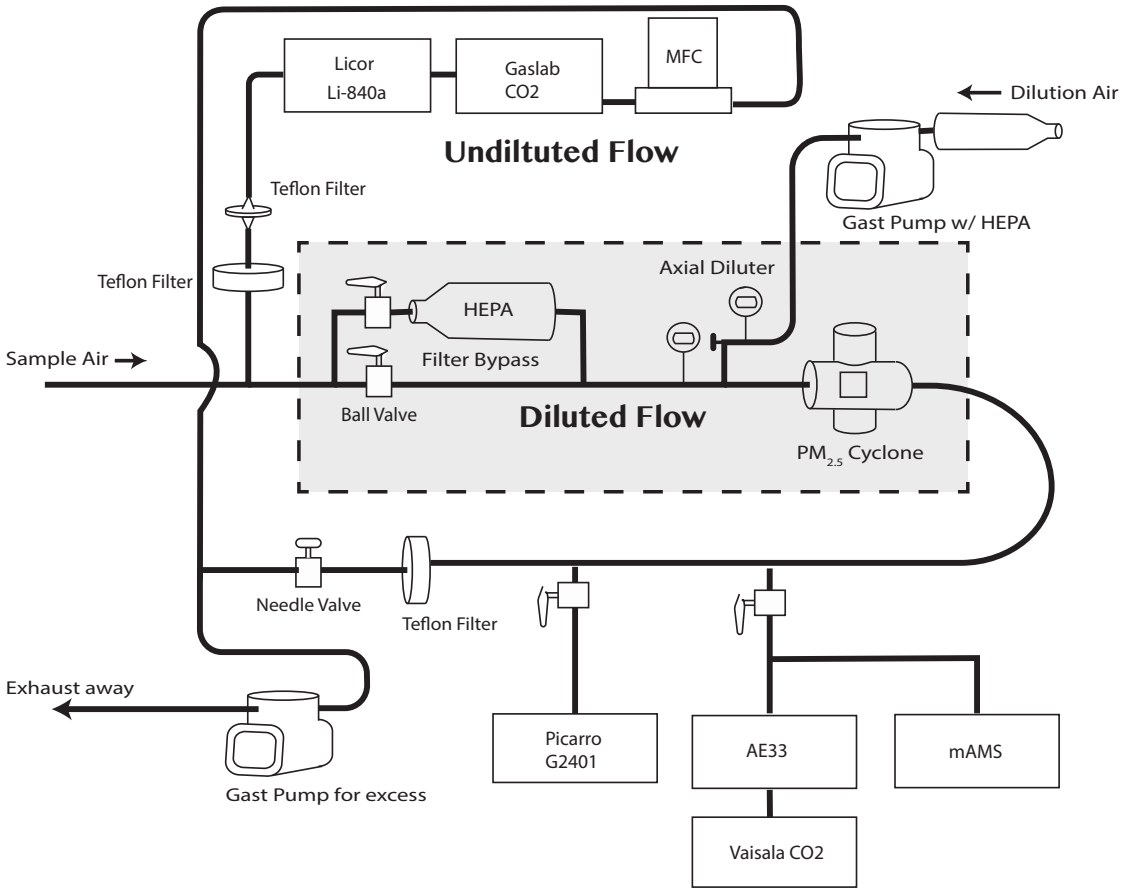

Figure S1. Diagram of the NAMaSTE on-line aerosol sampling system. The MFC is a mass flow controller fixed at ~ 1 slpm and HEPA is defined as a high efficiency particulate air filter.

3. Summary Statistics of Speciated Fuel-based Emission Factors

Source Type	Fuel	f [a]	MCE[b]		Fuel-based emission factor (g/kg fuel)							
					PM_1 [c]	OA[d]	BC	SO_4	NO_3	Chloride	NH_4	PAH
1-pot traditional mudstove	**dung**	**0.33**	**0.908**	median		1.039	0.064	0.007	0.002	0.250	0.068	0.003
			(0.945)	25th (10th)		0.701(0.365)	0.037(0.022)	0.004(0.003)	0.002(0.001)	0.162(0.099)	0.047(0.027)	0.002(0.001)
				75th (90th)		1.576(2.283)	0.122(0.220)	0.011(0.017)	0.004(0.006)	0.358(0.471)	0.095(0.120)	0.006(0.015)
				μ (σ)		1.367(1.472)	0.092(0.104)	0.009(0.009)	0.003(0.003)	0.268(0.149)	0.072(0.040)	0.005(0.007)
				integrated	**1.787**	**1.351**	**0.086**	**0.008**	**0.003**	**0.270**	**0.069**	**0.005**
	hardwood[e]	**0.5**	**0.914**	median		1.070	0.117	0.011		0.062		0.007
			(0.962)	25th (10th)		0.385(0.174)	0.009(0.00)	0.008(0.005)		0.021(0.009)		0.002(0.001)
				75th (90th)		2.514(4.647)	0.276(0.476)	0.017(0.030)		0.138(0.252)		0.016(0.027)
				μ (σ)		1.916(2.685)	0.184(0.226)	0.017(0.022)		0.096(0.105)		0.011(0.012)
				integrated	**2.715**	**2.370**	**0.208**	**0.016**	**-**	**0.121**	**-**	**0.012**
	sticks and twigs[f]	**0.5**	**0.933**	median		0.777	0.197	0.009	0.003	0.022		0.008
			(0.945)	25th (10th)		0.288(0.092)	0.007(0.00)	0.005(0.002)	0.002(0.001)	0.009(0.004)		0.003(0.001)
				75th (90th)		2.286(7.263)	0.566(1.201)	0.015(0.030)	0.007(0.014)	0.042(0.073)		0.020(0.052)
				μ (σ)		2.444(4.880)	0.385(0.526)	0.014(0.020)	0.006(0.008)	0.030(0.032)		0.019(0.035)
				integrated	**2.363**	**1.794**	**0.521**	**0.009**	**0.004**	**0.035**	**-**	**0.025**
2-pot traditional mudstove	**dung and hardwood**	**0.4**	**0.912**	median		2.417	0.204	0.014	0.005	0.325	0.070	0.019
			(0.965)	25th (10th)		1.430(0.602)	0.092(0.067)	0.008(0.005)	0.002(0.001)	0.246(0.117)	0.051(0.030)	0.010(0.007)
				75th (90th)		5.200(16.779)	0.273(0.488)	0.029(0.087)	0.007(0.017)	0.858(2.222)	0.270(0.533)	0.037(0.069)
				μ (σ)		4.836(5.750)	0.204(0.139)	0.026(0.031)	0.006(0.007)	0.676(0.749)	0.160(0.181)	0.027(0.023)
				integrated	**4.095**	**3.303**	**0.161**	**0.018**	**0.005**	**0.501**	**0.107**	**0.020**

a. Carbon mass fraction of fuel from Stockwell et al. (2016)
b. Average modified combustion efficiency (ΔCO2/(ΔCO+ΔCO2)) from Stockwell et al. (2016)
c. Sum of detected species (PAH not included)
d. Primary organic aerosol measured with the mAMS
e. Baikano (*Melia azedarach*)
f. *Shorea robusta* is primary component.

(-) Indicates that the species was not detected above detection limit

Source Type	fuel	f [a]	MCE [b]		Fuel-based emission factor (g/kg fuel)							
					PM_1 [c]	OA [d]	BC	SO_4	NO_3	Chl	NH_4	PAH
Crop Residue Burning	**mixed residue**	**0.42**	**0.957** (0.943)	median		1.244	0.275	0.020	0.008	0.170		0.004
				25^{th} (10^{th})		0.439(0.153)	0.079(0.002)	0.008(0.004)	0.003(0.001)	0.064(0.030)		0.002(0.001)
				75^{th} (90^{th})		3.039(7.424)	0.552(0.852)	0.068(0.168)	0.014(0.027)	0.374(0.865)		0.010(0.018)
				μ (σ)		2.754(3.970)	0.371(0.396)	0.056(0.100)	0.011(0.012)	0.341(0.560)		0.007(0.007)
				integrated	**3.436**	**2.641**	**0.410**	**0.019**	**0.008**	**0.358**	**-**	**0.006**
	wheat	**0.42**	**0.949** (0.888)	median		2.359	0.308	0.104	0.007	0.139	0.034	0.004
				25^{th} (10^{th})		1.013(0.424)	0.00(0.00)	0.039(0.013)	0.004(0.001)	0.067(0.025)	0.020(0.008)	0.003(0.002)
				75^{th} (90^{th})		4.485(18.779)	0.555(1.226)	0.289(0.407)	0.030(0.081)	0.477(1.786)	0.107(0.230)	0.013(0.042)
				μ (σ)		2.850(3.849)	0.353(0.389)	0.121(0.120)	0.013(0.018)	0.301(0.463)	0.056(0.059)	0.007(0.009)
				integrated	**4.547**	**3.339**	**0.639**	**0.051**	**0.010**	**0.446**	**0.062**	**0.009**
	mustard	**0.42**	**0.920** (0.902)	median		1.061	0.433	0.145	0.009	0.060		0.004
				25^{th} (10^{th})		0.230(0.107)	0.132(0.024)	0.025(0.014)	0.002(0.001)	0.009(0.002)		0.001(0.000)
				75^{th} (90^{th})		5.599(8.602)	1.083(2.316)	0.326(0.523)	0.041(0.094)	0.262(0.955)		0.011(0.020)
				μ (σ)		3.172(5.429)	0.677(0.761)	0.183(0.202)	0.022(0.028)	0.218(0.385)		0.006(0.007)
				integrated	**4.177**	**3.217**	**0.559**	**0.111**	**0.021**	**0.269**	**-**	**0.004**
	grass	**0.42**	**0.961** (0.866)	median		1.150	0.213		0.005	0.475	0.080	0.003
				25^{th} (10^{th})		0.404(0.175)	0.106(0.014)		0.002(0.000)	0.147(0.022)	0.024(0.010)	0.001(0.001)
				75^{th} (90^{th})		3.147(14.353)	0.443(0.949)		0.009(0.023)	1.290(2.540)	0.222(0.337)	0.008(0.029)
				μ (σ)		2.776(4.929)	0.292(0.286)		0.006(0.007)	0.735(0.906)	0.111(0.149)	0.007(0.011)
				integrated	**2.686**	**1.817**	**0.283**	**-**	**0.003**	**0.528**	**0.055**	**0.005**

a. Carbon mass fraction of fuel from Stockwell et al. (2016)
b. Average modified combustion efficiency ($\Delta CO2/(\Delta CO+\Delta CO2)$) from Stockwell et al. (2016)
c. Sum of detected species (PAH not included)
d. Primary organic aerosol measured with the mAMS
(-) Indicates that the species was not detected above detection limit

Source Type	Fuel	f [a]	MCE[b]		Fuel-based emission factor (g/kg fuel) PM_1[c]	OA[d]	SO_4	NO_3	Chl	NH_4	PAH
Open Garbage Burning	**Mixed Refuse 1**	**0.5**	**0.937** (0.990)	median		1.574	0.002	0.003	0.047		0.003
				25th (10th)		0.512(0.091)	0.001(0.001)	0.002(0.001)	0.016(0.009)		0.001(0.001)
				75th (90th)		5.225(11.820)	0.004(0.005)	0.005(0.008)	0.124(0.242)		0.007(0.029)
				μ (σ)		3.277(4.513)	0.002(0.002)	0.003(0.002)	0.084(0.102)		0.006(0.010)
				integrated	**3.771**	**3.497**	**0.002**	**0.003**	**0.083**	**-**	**0.004**
	Mixed Refuse 2	**0.5**	**0.980** (0.957)	median		1.024			0.046		
				25th (10th)		0.321(0.077)			0.011(0.003)		
				75th (90th)		3.076(5.416)			0.111(0.244)		
				μ (σ)		2.032(2.922)			0.076(0.091)		
				integrated	**4.086**	**1.353**	**-**	**-**	**0.059**	**-**	**-**
	Mixed Refuse (1 and 2)	**0.5**	**0.923** (0.976)	median		1.148	0.003	0.002	0.045		0.002
				25th (10th)		0.448(0.077)	0.001(0.000)	0.001(0.000)	0.013(0.003)		0.001(0.000)
				75th (90th)		3.424(6.499)	0.006(0.010)	0.004(0.007)	0.111(0.242)		0.005(0.010)
				μ (σ)		2.477(3.608)	0.004(0.003)	0.003(0.002)	0.079(0.095)		0.004(0.007)
				integrated	**3.991**	**1.998**	**0.000**	**0.002**	**0.066**	**-**	**0.003**
	Mixed Plastic	**0.74**	**0.962** (0.987)	median		11.047	0.014		0.331		0.017
				25th (10th)		4.719(2.785)	0.009(0.005)		0.160(0.121)		0.005(0.003)
				75th (90th)		35.474(73.734)	0.025(0.045)		0.782(1.807)		0.030(0.080)
				μ (σ)		23.260(30.191)	0.018(0.015)		0.576(0.631)		0.026(0.040)
				integrated	**19.836**	**16.590**	**0.015**	**-**	**0.502**	**-**	**0.023**
	Chip Bags	**0.63**	**0.989** (0.986)	median		2.456	0.004		0.012		0.004
				25th (10th)		1.238(0.567)	0.003(0.001)		0.004(0.002)		0.001(0.001)
				75th (90th)		4.965(15.976)	0.007(0.013)		0.033(0.098)		0.006(0.024)
				μ (σ)		4.846(8.504)	0.005(0.004)		0.026(0.040)		0.008(0.018)
				integrated	**5.804**	**3.484**	**0.003**	**-**	**0.021**	**-**	**0.005**

a. Carbon mass fraction of fuel from Stockwell et al. (2016)
b. Average modified combustion efficiency ($\Delta CO2/(\Delta CO+\Delta CO2)$) from Stockwell et al. (2016)
c. Sum of detected species (PAH not included)
d. Primary organic aerosol measured with the mAMS

(-) Indicates that the species was not detected above detection limit

Source	Type (fuel)	f[a]	MCE[b]		Fuel-based emission factor (g/kg fuel) PM_1[c]	OA[d]	BC	SO_4	NO_3	Chl	NH_4	PAH
Motorcycles	**idling (gasoline)**	**0.85**	**0.6** (0.678)	median		0.067						
				25th (10th)		0.024(0.010)						
				75th (90th)		0.218(1.329)						
				μ (σ)		0.408(1.142)						
				integrated	**0.127**	**0.127**	-	-	-	-	-	-
Irrigation pumps	**Pump 1 (diesel)**	**0.87**	**0.987** (0.978)	median		5.892	2.342					
				25th (10th)		4.654(4.024)	2.038(1.794)					
				75th (90th)		7.304(10.284)	2.698(3.490)					
				μ (σ)		5.983(2.167)	2.366(0.620)					
				integrated	**7.245**	**5.178**	**2.067**	**-**	**-**	**-**	**-**	**-**
	Pump 2 (diesel)	**0.87**	**0.996** (0.997)	median		0.419	3.402	0.006				0.003
				25th (10th)		0.309(0.203)	2.643(2.329)	0.003(0.002)				0.002(0.001)
				75th (90th)		0.583(0.759)	4.840(5.912)	0.008(0.010)				0.005(0.015)
				μ (σ)		0.452(0.223)	3.685(1.458)	0.005(0.003)				0.009(0.030)
				integrated	**2.713**	**0.445**	**2.264**	**0.004**	**-**	**-**	**-**	**0.006**
Brick Kilns	**Batch Style Clamp Kiln (coal and harwood[e])**	**0.64**	**0.950** (0.961)	median		0.604	0.011	0.353		0.042	0.126	
				25th (10th)		0.231(0.113)	0.003(0.000)	0.158(0.059)		0.015(0.004)	0.055(0.022)	
				75th (90th)		1.341(2.587)	0.024(0.043)	0.700(1.239)		0.101(0.207)	0.242(0.414)	
				μ (σ)		0.977(1.110)	0.022(0.056)	0.504(0.564)		0.082(0.113)	0.179(0.202)	
				integrated	**1.759**	**0.999**	**0.014**	**0.484**	**-**	**0.094**	**0.168**	**-**
	Forced-draft Zig-zag Kiln (coal and bagasse[f])	**0.72**	**0.994** (0.991)	median		0.317	0.191	1.009			0.113	
				25th (10th)		0.136(0.077)	0.113(0.033)	0.582(0.229)			0.066(0.055)	
				75th (90th)		0.474(0.561)	0.871(1.111)	1.458(1.628)			0.142(0.179)	
				μ (σ)		0.295(0.183)	0.381(0.386)	0.912(0.528)			0.106(0.045)	
				integrated	**1.823**	**0.294**	**0.466**	**0.955**	**-**	**-**	**0.108**	**-**

a. Carbon mass fraction of fuel from Stockwell et al. (2016)
b. Average modified combustion efficiency ($\Delta CO2/(\Delta CO+\Delta CO2)$) from Stockwell et al. (2016)
c. Sum of detected species (PAH not included)
d. Primary organic aerosol measured with the mAMS
e. Kiln estimated to be co-fired with 10% hardwood
f. Used as a starter fuel

(-) Indicates that the species was not detected above detection limit

4. AE33 Scattering Corrected Absorption Coefficient Emission Factors of Field Tested Emission Sources

		Absorption Coefficient (m^2/kg)	
Source Type	**Type (Fuel)**	**370 nm**	**880 nm**
1-pot traditional mudstove	dung	16.385	0.659
	hardwood	19.245	1.619
	sticks and twigs	24.652	4.045
2-pot traditional mudstove	dung and hardwood	13.824	1.251
Crop residue burning	mixed residue	21.219	3.189
	wheat	32.140	4.962
	mustard	35.462	4.345
	grass	17.254	2.201
Open garbage burning	mix 1	3.165	1.443
	mix 2	60.865	20.776
	mixed plastic	69.736	21.205
	chip bags	51.469	17.838
Motorcycles		bdl	bdl
Irrigation pumps	pump 1 (diesel)	50.639	16.060
	pump 2 (diesel)	44.093	17.573
Brick kilns	clamp (coal)	3.824	0.112
	zig-zag (coal)	7.149	3.618

Bdl = below detection limits