Supplement of

Speciated online PM$_1$ from South Asian combustion sources – Part 1: Fuel-based emission factors and size distributions

J. D. Goetz et al.

Correspondence to: Peter F. DeCarlo (pfd33@drexel.edu)

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.
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.
2. Intercomparison of undiluted CO$_2$ measurements by the Picarro CRDS and Li-Corr Li840A

![Graph showing the scatter plot of undiluted Picarro CRDS CO$_2$ and Li840A measurements](image)

**Figure S2.** Scatter plot of undiluted Picarro CRDS CO$_2$ and Li840A measurements throughout the NAMaSTE campaign. Markers represent 1-second measurements and lines represent the linear fit for each sampling event.
3. Size Distribution Conversions from Vacuum Aerodynamic Diameter

Continuum regime vacuum aerodynamic diameter bins measured by the mAMS were converted to volume equivalent diameter and transition regime aerodynamic diameter based on estimates of density (or literature values) for each aerosol component and with the assumption a sphericity using methods described in DeCarlo et al. (2004). Volume equivalent diameter ($D_{ve}$) was calculated using eq. S1 (DeCarlo et al., 2004, Eq. 31), where $D_{ve}$ is vacuum aerodynamic diameter in nanometers, $\rho_p$ is the particle density in g cm$^{-3}$, $\rho_0$ is the standard density (1 g cm$^{-3}$), and $\chi$ is the dynamic shape factor.

$$D_{ve} = \frac{D_{va} \chi \rho_0}{\rho_p} \quad (S1)$$

For $\chi$, all non-refractory aerosol measured by the mAMS was assumed to be spherical and without voids and therefore $\chi = 1$. Organic particle density was estimated using elemental ratios (e.g. H:C, O:C) from the average mass spectral profiles of each emission source type using methods described in Kuwata et al. (2011). The $\rho_p$, for OA can be found in Table 2 of the main text. For inorganic materials, $\rho_p$ is from literature values for the major inorganic species, including HCl, NH$_4$Cl, H$_2$SO$_4$, NH$_4$HSO$_4$, (NH$_4$)$_2$SO$_4$ and can be found in Table S1. To simplify the sulfate density the average density of the three major components (1.8 g cm$^{-3}$) was used for the conversion of the sulfate related size distributions. It should be noted that chloride species, HCl or NH$_4$Cl, used for the size distribution conversions of chloride aerosol was assumed based on whether ammonium was observed above detection limits in the same emissions and had a similar $D_{ve}$ size distribution to chloride. For example, with the Clamp kiln emissions, ammonium was detected and had a similar $D_{ve}$ distribution to chloride and therefore NH$_4$Cl was assumed to be the dominant aerosol species. Alternatively, for garbage burning ammonium was not detected and therefore HCl was assumed to be the dominant chloride species. Assumptions about other chloride species like organic chloride salts or KCl cannot be discussed because we did not have the capability to differentiate these species from HCl or NH$_4$Cl.

Table S1. Density of aerosol components found in NAMaSTE measured emissions.

| Aerosol Component     | Material Density [g/cm$^3$] |
|-----------------------|-----------------------------|
| Refractory Black Carbon | 1.80                        |
| H$_2$SO$_4$           | 1.84                        |
| NH$_4$HSO$_4$         | 1.78                        |
| (NH$_4$)$_2$SO$_4$    | 1.77                        |
| Sulfate Average       | 1.80                        |
| HCl                   | 1.19                        |
| NH$_4$Cl              | 1.54                        |

Assuming aerosol mass and volume are proportional, the total density ($\rho_{total}$) for each emission source was calculated using an additive approach as described in DeCarlo et al. (2004) for material density and found in equation S2:
\[
\rho_{\text{total}} = \frac{MF_{\text{total}}}{\rho_{OA}MF_{OA} + \rho_{BC}MF_{BC} + \rho_{SO4}MF_{SO4} + \rho_{Cl}MF_{Cl} + \rho_{NH4}MF_{NH4}} \quad (S2)
\]

Where \( \rho_x \) and \( MF_x \) are the density and mass fraction for that aerosol component, respectively. Component mass fractions and \( \rho_{\text{total}} \) can be found in Table S2.

Transition regime aerodynamic diameter \( (D_a) \) was estimated using equation S2 (DeCarlo et al., 2004, Eq. 28), where \( C_c \) is the Cunningham slip correction factor as a function of \( D_a \) and \( D_{ve} \).

\[
D_a = D_{ve} \sqrt{\frac{\rho_0 C_c(D_{ve})}{\rho_0 C_c(D_a)}} \quad (S3)
\]

The shape factor, \( \chi \) is assumed to be 1 and the \( C_c \) as a function of \( D_{ve} \) was calculated using equation 9.34, from Seinfeld and Pandis (2016) and assuming standard temperature and pressure. The values of \( D_a \) and \( C_c(D_a) \) were then solved for simultaneously by constraining \( D_a \) to be greater than or equal to \( D_{ve} \) and \( C_c(D_a) \) to be less than or equal to \( C_c(D_{ve}) \) as discussed in DeCarlo et al. (2004).

For each emission source, \( D_{va} \) was converted to \( D_{ve} \) and \( D_a \) by assuming \( \rho_p = \rho_{\text{total}} \). Because the relationship between the different distribution types are linear at the reported bin sizes, the conversions are reported as diameter ratios (e.g. \( D_{va}/D_{ve}, D_a/D_{va}, D_a/D_{ve} \)). Full results for the \( D_{va} \) to \( D_{ve} \) and \( D_a \) conversions can be found in Table S2.

**Table S2.** Aerosol component mass fraction (MF), density (\( \rho \)), and diameter conversion factors for NAMaSTE tested emission sources.

| Emission Source         | \( \rho_{OA} \) [g/cm\(^3\)] | MF\( _{OA} \) | MF\( _{BC} \) | MF\( _{SO4} \) | MF\( _{Cl} \) | MF\( _{NH4} \) | \( \rho_{\text{total}} \) [g/cm\(^3\)] | \( D_{va}/D_{ve} \) | \( D_a/D_{va} \) | \( D_a/D_{ve} \) |
|------------------------|-------------------------------|---------------|---------------|---------------|---------------|---------------|---------------------------------|----------------|----------------|----------------|
| Clamp Kiln             | 0.98                          | 0.57          | 0.01          | 0.28          | 0.05          | 0.10          | 1.20                            | 0.83           | 0.91           | 1.09           |
| Zig Zag Kiln           | 1.06                          | 0.16          | 0.26          | 0.52          | 0.00          | 0.06          | 1.60                            | 0.62           | 0.79           | 1.26           |
| Garbage Burning        | 1.02                          | 0.50          | 0.48          | 0.00          | 0.02          | 0.00          | 1.29                            | 0.77           | 0.88           | 1.14           |
| Chip Bags              | 1.03                          | 0.60          | 0.40          | 0.00          | 0.00          | 0.00          | 1.25                            | 0.80           | 0.90           | 1.12           |
| Mixed Plastic          | 1.05                          | 0.84          | 0.14          | 0.00          | 0.03          | 0.00          | 1.12                            | 0.89           | 0.95           | 1.06           |
| Motorcycles            | 0.98                          | 1.00          | 0.00          | 0.00          | 0.00          | 0.00          | 0.98                            | 1.02           | 1.02           | 1.00           |
| Irrigation Pump 1      | 0.99                          | 0.71          | 0.29          | 0.00          | 0.00          | 0.00          | 1.13                            | 0.88           | 0.94           | 1.06           |
| Irrigation Pump 2      | 0.99                          | 0.16          | 0.83          | 0.00          | 0.00          | 0.00          | 1.59                            | 0.63           | 0.80           | 1.26           |
| Hardwood               | 1.08                          | 0.87          | 0.08          | 0.01          | 0.04          | 0.00          | 1.13                            | 0.89           | 0.94           | 1.06           |
| Sticks and Twigs       | 1.06                          | 0.76          | 0.22          | 0.00          | 0.01          | 0.00          | 1.17                            | 0.85           | 0.92           | 1.09           |
| Dung                   | 1.03                          | 0.76          | 0.05          | 0.00          | 0.15          | 0.04          | 1.13                            | 0.89           | 0.94           | 1.06           |
| Dung and Hardwood      | 1.01                          | 0.81          | 0.04          | 0.00          | 0.12          | 0.03          | 1.09                            | 0.92           | 0.96           | 1.04           |
| Mixed Ag. Residue      | 1.08                          | 0.77          | 0.12          | 0.01          | 0.10          | 0.00          | 1.15                            | 0.87           | 0.93           | 1.07           |
| Wheat                  | 1.08                          | 0.73          | 0.14          | 0.01          | 0.10          | 0.01          | 1.17                            | 0.86           | 0.92           | 1.08           |
| Mustard                | 1.08                          | 0.77          | 0.13          | 0.03          | 0.06          | 0.00          | 1.16                            | 0.86           | 0.93           | 1.08           |
| Grass                  | 1.08                          | 0.68          | 0.11          | 0.00          | 0.20          | 0.02          | 1.21                            | 0.83           | 0.91           | 1.10           |
References

Decarlo, P. F., Slowik, J. G., Worsnop, D. R., Davidovits, P., & Jimenez, J. L. (2004). Particle Morphology and Density Characterization by Combined Mobility and Aerodynamic Diameter Measurements. Part 1: Theory. Aerosol Science and Technology, 38, 1185–1205. https://doi.org/10.1080/027868290903903907

Kuwata, M., Zorn, S. R., & Martin, S. T. (2012). Using Elemental Ratios to Predict the Density of Organic Material Composed of Carbon, Hydrogen, and Oxygen. Environmental Science & Technology, 46(2), 787–794. https://doi.org/10.1021/es202525q

Seinfeld, J. H., Pandis, S. N., & Πανδής, Σ. Ν. 1963-. (2006). Atmospheric chemistry and physics: from air pollution to climate change. J. Wiley.
3. Summary Statistics of Speciated Fuel-based Emission Factors

| Source Type | Fuel | $f^a$ | MCE$^b$ | PM$_i^c$ | OA$^d$ | BC | SO$_i^e$ | NO$_x^f$ | Chloride | NH$_x^i$ | PAH |
|-------------|------|-------|---------|----------|--------|----|---------|---------|----------|---------|-----|
| 1-pot traditional mudstove dung | 0.33 | 0.908 (0.945) | median | 1.039 | 0.064 | 0.007 | 0.002 | 0.250 | 0.068 | 0.003 | |
| | | 25$^{th}$ (10$^{th}$) | 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) |
| | | 75$^{th}$ (90$^{th}$) | 1.576(2.285) | 0.122(0.220) | 0.011(0.017) | 0.004(0.006) | 0.358(0.471) | 0.095(0.120) | 0.006(0.015) |
| | | $\mu$ ($\sigma$) | 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$^g$ | 0.5 | 0.914 (0.962) | median | 1.079 | 0.117 | 0.011 | 0.062 | 0.007 | |
| | | 25$^{th}$ (10$^{th}$) | 0.385(0.174) | 0.009(0.000) | 0.008(0.005) | 0.021(0.009) | 0.002(0.001) | |
| | | 75$^{th}$ (90$^{th}$) | 2.514(4.647) | 0.276(0.476) | 0.017(0.030) | 0.138(0.252) | 0.016(0.027) | |
| | | $\mu$ ($\sigma$) | 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 (0.945) | median | 0.777 | 0.197 | 0.009 | 0.003 | 0.022 | 0.008 | |
| | | 25$^{th}$ (10$^{th}$) | 0.288(0.092) | 0.007(0.000) | 0.005(0.002) | 0.002(0.001) | 0.009(0.004) | 0.003(0.001) | |
| | | 75$^{th}$ (90$^{th}$) | 2.286(7.263) | 0.566(1.201) | 0.015(0.030) | 0.007(0.014) | 0.042(0.073) | 0.020(0.052) | 0.019(0.035) |
| | | $\mu$ ($\sigma$) | 2.444(4.880) | 0.385(0.526) | 0.014(0.020) | 0.006(0.008) | 0.030(0.032) | - | |
| | | 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 (0.965) | median | 2.417 | 0.204 | 0.014 | 0.005 | 0.325 | 0.070 | 0.019 | |
| | | 25$^{th}$ (10$^{th}$) | 1.430(6.020) | 0.092(0.067) | 0.008(0.005) | 0.002(0.001) | 0.246(1.117) | 0.051(0.030) | 0.010(0.007) | |
| | | 75$^{th}$ (90$^{th}$) | 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) | |
| | | $\mu$ ($\sigma$) | 4.836(5.750) | 0.204(0.139) | 0.026(0.031) | 0.006(0.007) | 0.676(7.499) | 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 ($\Delta$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. Baikano (Melia azedarach)
f. Shorea robusta is primary component.
(-) Indicates that the species was not detected above detection limit
| Source Type | fuel | $f^a$ | MCEb | PMc, \( \mu (\sigma) \) | OAe, \( \mu (\sigma) \) | BC | SOf | NOg | Chl | NHh | PAHi |
|-------------|------|-------|------|----------------|----------------|----|-----|-----|-----|-----|------|
| Crop Residue Burning | mixed | 0.42 | 0.957 (0.943) | median | 1.244 | 0.375 | 0.020 | 0.008 | 0.170 | 0.004 |
| | 25th (10th) | 0.439 (0.153) | 0.079 (0.002) | 0.08 (0.004) | 0.003 (0.001) | 0.064 (0.030) | 0.002 (0.001) |
| | 75th (90th) | 3.039 (7.424) | 0.552 (0.852) | 0.068 (0.168) | 0.014 (0.027) | 0.374 (0.865) | 0.010 (0.018) |
| | \( \mu (\sigma) \) | 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 |
| | 25th (10th) | 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) |
| | 75th (90th) | 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) |
| | \( \mu (\sigma) \) | 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 |
| | 25th (10th) | 0.230 (0.107) | 0.132 (0.024) | 0.025 (0.014) | 0.002 (0.001) | 0.009 (0.002) | 0.001 (0.000) |
| | 75th (90th) | 5.599 (8.602) | 1.083 (2.316) | 0.326 (0.523) | 0.041 (0.094) | 0.262 (0.955) | 0.011 (0.020) |
| | \( \mu (\sigma) \) | 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 |
| | 25th (10th) | 0.404 (0.175) | 0.106 (0.014) | 0.002 (0.000) | 0.147 (0.022) | 0.024 (0.010) | 0.001 (0.001) |
| | 75th (90th) | 3.147 (14.533) | 0.443 (0.949) | 0.009 (0.023) | 1.290 (2.540) | 0.222 (0.337) | 0.008 (0.029) |
| | \( \mu (\sigma) \) | 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 (\( \Delta \text{CO}_2/(\Delta \text{CO}+\Delta \text{CO}_2) \)) 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$^b$ | PM$_i^c$ | OA$^d$ | SO$_4$ | NO$_3$ | Chl | NH$_4$ | PAH |
|-------------|------|-------|--------|---------|--------|-------|-------|-----|-------|-----|
| Open Garbage Burning | Mixed Refuse 1 | 0.5 | 0.937 (0.990) | 1.574 | 0.002 | 0.003 | 0.047 | 0.003 | - | - |
| | | | | | | | | | | |
| | Mixed Refuse 2 | 0.5 | 0.980 (0.957) | 1.024 | - | 0.003 | 0.002 | 0.045 | 0.011 | 0.004 |
| | | | | | | | | | | |
| | Mixed Refuse (1 and 2) | 0.5 | 0.923 (0.976) | 1.148 | 0.003 | 0.002 | 0.045 | 0.003 | - | - |
| | | | | | | | | | | |
| | Mixed Plastic | 0.74 | 0.962 (0.987) | 11.047 | 0.014 | 0.331 | 0.017 | - | - | - |
| | | | | | | | | | | |
| | Chip Bags | 0.63 | 0.989 (0.986) | 2.456 | 0.004 | 0.002 | 0.004 | 0.004 | - | - |

a. Carbon mass fraction of fuel from Stockwell et al. (2016)
b. Average modified combustion efficiency ($\Delta$CO2/(\DeltaCO+\DeltaCO2)) 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
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. 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

| Source          | Type (fuel) | \( f^a \) | MCE\(^b \) | \( PM_1^c \) | OA\(^d \) | BC | SO\(_2^e \) | NO\(_3^f \) | Chl | NH\(_3^g \) | PAH |
|-----------------|-------------|-----------|------------|-------------|---------|----|-------------|---------|-----|-----------|-----|
| Motorcycles     | idling      | 0.85      | 0.6        | 0.067       | 0.024(0.010) |    | 0.218(1.329) |        |     |           |     |
|                 | (gasoline)  |           | (0.678)    |             |         |    |             |         |     |           |     |
|                 |             |           | 25\(^{a}\) (10th) |             |         |    |             |         |     |           |     |
|                 |             |           | 75\(^{a}\) (90\(^{a}\)) |             |         |    |             |         |     |           |     |
|                 |             |           | \( \mu \) (\( \sigma \)) |             |         |    |             |         |     |           |     |
|                 |             |           | integrated | 0.127      | 0.127   |    |             |         |     |           |     |
| Irrigation      | Pump 1      | 0.87      | 0.987 (0.978) | 5.892      | 2.342   |    | 4.654(4.024) | 2.038(1.794) |    |           |     |
| pumps           | (diesel)    |           |             | 7.304(10.284) | 2.698(3.490) |    |             |         |     |           |     |
|                 |             |           | \( \mu \) (\( \sigma \)) |             |         |    |             |         |     |           |     |
|                 |             |           | integrated | 7.245      | 5.178   | 2.067 |             |         |     |           |     |
|                 | Pump 2      | 0.87      | 0.996 (0.997) | 0.419      | 3.402   | 0.06 | 0.309(0.203) | 2.643(2.329) | 0.003(0.002) |       | 0.003 |
|                 | (diesel)    |           |             | 0.583(0.759) | 4.840(5.912) |    | 0.452(0.223) | 3.685(1.458) | 0.005(0.003) |       | 0.005(0.015) |
|                 |             |           | \( \mu \) (\( \sigma \)) |             |         |    |             |         |     |           |     |
|                 |             |           | integrated | 2.713      | 0.445   | 2.264 |             |         |     |           |     |
| Brick Kilns     | Batch Style | 0.64      | 0.950 (0.961) | 0.604      | 0.111   | 0.353| 0.231(0.113) | 0.003(0.000) | 0.158(0.059) | 0.015(0.004) | 0.055(0.022) |
|                 | Clamp Kiln  |           |             | 1.341(2.587) | 0.024(0.043) |    | 0.977(1.110) | 0.022(0.056) | 0.504(0.564) | 0.082(0.113) | 0.179(0.202) |
|                 | (coal and   |           |             |             |         |    |             |         |     |           |     |
|                 | hardwood\(^i\)) |           |             |             |         |    |             |         |     |           |     |
|                 |             |           | \( \mu \) (\( \sigma \)) |             |         |    |             |         |     |           |     |
|                 |             |           | integrated | 1.759      | 0.999   | 0.014 | 0.484 |             |         |     |           |     |
|                 | Forced-draft| 0.72      | 0.994 (0.991) | 0.317      | 0.191   | 1.009| 0.136(0.077) | 0.113(0.033) | 0.582(0.229) | 0.066(0.055) | 0.142(0.179) |
| Kiln            | Zig-zag     |           |             | 0.474(0.561) | 0.871(1.111) |    | 0.295(0.183) | 0.381(0.386) | 0.912(0.528) | 0.106(0.045) |       |
|                 | (coal and   |           |             |             |         |    |             |         |     |           |     |
|                 | bagasse\(^i\)) |           |             |             |         |    |             |         |     |           |     |
|                 |             |           | \( \mu \) (\( \sigma \)) |             |         |    |             |         |     |           |     |
|                 |             |           | integrated | 1.823      | 0.294   | 0.466 | 0.955 |             |         |     |           |     |

\( f^a \): Carbon mass fraction of fuel from Stockwell et al. (2016)

\( MCE^b \): Average modified combustion efficiency (\( \Delta CO_2/(\Delta CO+\Delta CO_2) \)) from Stockwell et al. (2016)

\( PM_1^c \): Primary organic aerosol measured with the mAMS

\( OA^d \): Kiln estimated to be co-fired with 10% hardwood

\( BC \): Used as a starter fuel

\( \mu \) (\( \sigma \)): Indicates that the species was not detected above detection limit
### 4. AE33 Scattering Corrected Absorption Coefficient Emission Factors of Field Tested Emission Sources

| Source Type         | Type (Fuel)        | 370 nm | 880 nm |
|---------------------|--------------------|--------|--------|
| 1-pot traditional   | dung               | 16.385 | 0.659  |
| mudstove            | hardwood           | 19.245 | 1.619  |
|                     | sticks and twigs   | 24.652 | 4.045  |
| 2-pot traditional   | dung and           | 13.824 | 1.251  |
| mudstove            | hardwood           |        |        |
| Crop residue        | mixed residue      | 21.219 | 3.189  |
| burning             | wheat              | 32.140 | 4.962  |
|                     | mustard            | 35.462 | 4.345  |
|                     | grass              | 17.254 | 2.201  |
| Open garbage        | mix 1              | 3.165  | 1.443  |
| burning             | 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