Supplement of

Aerosol emission factors from traditional biomass cookstoves in India: Insights from field measurements

Apoorva Pandey et al.

Correspondence to: Rajan K. Chakrabarty (chakrabarty@wustl.edu) and Apoorva Pandey (apoorva@wustl.edu)

Wireless sensor data

Measurements from Sharp GP2Y sensors attached to the sampling probe (Sensor 1) and to the Minivol sampler (Sensor 2), from day 9 of the study, are shown in Figure S1. These sensors include an infrared emitting diode, the emission from which is scattered by the particles, and a phototransistor converts the scattered light to a voltage output proportional to the PM concentration. Linear regression analysis of the sensor data (Sensor 2 vs Sensor 1) yields a slope of 0.96 with an R^2 of 0.85. Therefore, the concentration measured by the Minivol sampler was adjusted upwards by a factor of 1.04 (=1/0.97).

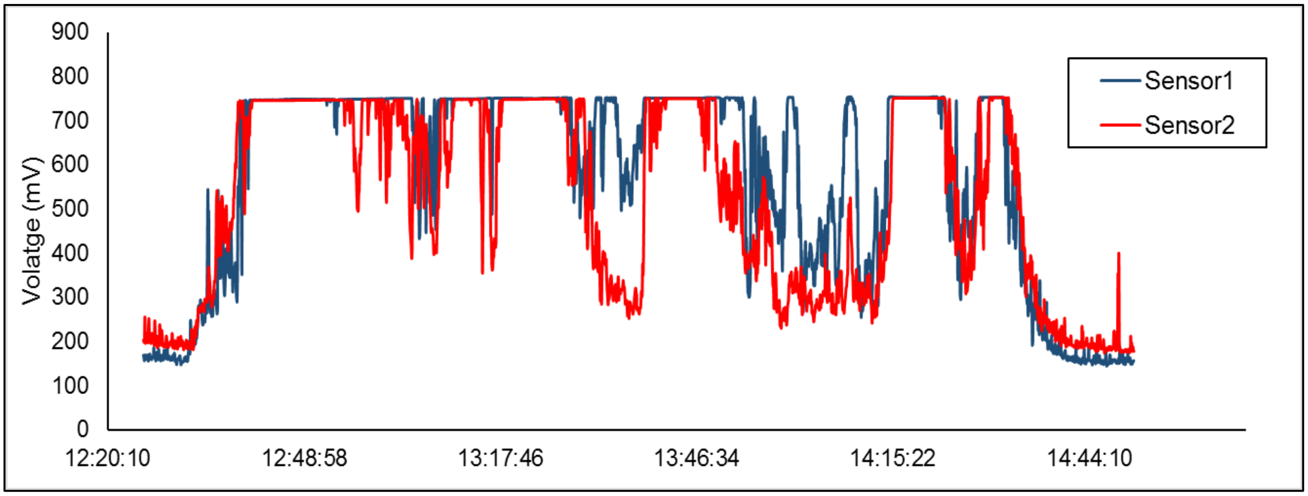

Figure S1: Raw signals from the PM sensors located at the sampling probe (Sensor1) and the Minivol $PM_{2.5}$ sampler (Sensor2).

Carbon Monoxide (CO) emission factors

Emission factors of CO were calculated using the equation below:

$$EF_{CO} = CMF_{fuel} \frac{C_{Co}}{\Delta C_{CO_2}\left(\frac{M_C}{M_{CO_2}}\right) + \Delta C_{CO}\left(\frac{M_C}{M_{CO}}\right)}$$

where EF_{CO} is the CO emission factor (g of CO released per kg of fuel burnt), CMF_{fuel} is the carbon mass fraction of the fuel, which ranged from 33% to 50% for the tested fuels. C_{CO} is the concentration of CO in g m^{-3}. ΔC_{CO2} and ΔC_{CO} are the concentrations above ambient levels of CO_2 and CO in g $m^{-3,}$ respectively. M_C, M_{CO2}, and M_{CO} are the atomic or molecular weights of C, CO_2, and CO in g $mole^{-1}$.

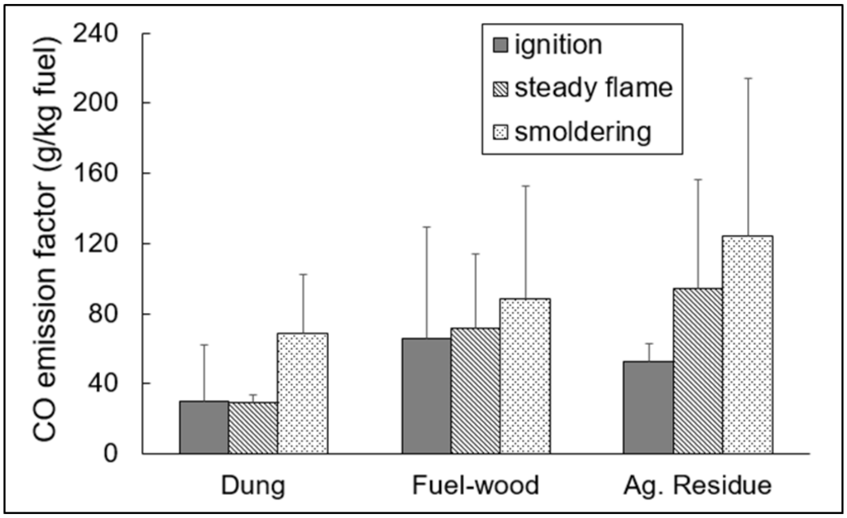

Figure S2: Fuel-wise average values of CO emission factors, categorized by observed combustion phases. One-sided error bars are shown to denote one standard deviation from the mean.

Both CO and $PM_{2.5}$ are products of incomplete combustion are their mass emission rates measured during lab cookstove tests are found to correlate (Roden et al., 2009). In this study, no correlation was observed between the estimated CO emission factors and corresponding $PM_{2.5}$ emission factors. Further, we plotted modified combustion efficiencies (MCE), calculated as the ratio of CO_2 concentration to $CO+CO_2$ concentration, against OC-to-EC ratios. MCE is typically treated as an identifier of combustion phase, with values greater than 0.9 associated with (Reid et al., 2005; Zhang et al., 2008). We found estimated MCE values above 0.9 for roughly 90% of all run time, even when no flaming phase was visibly observed. They showed no correlation with OC-to-EC ratios.

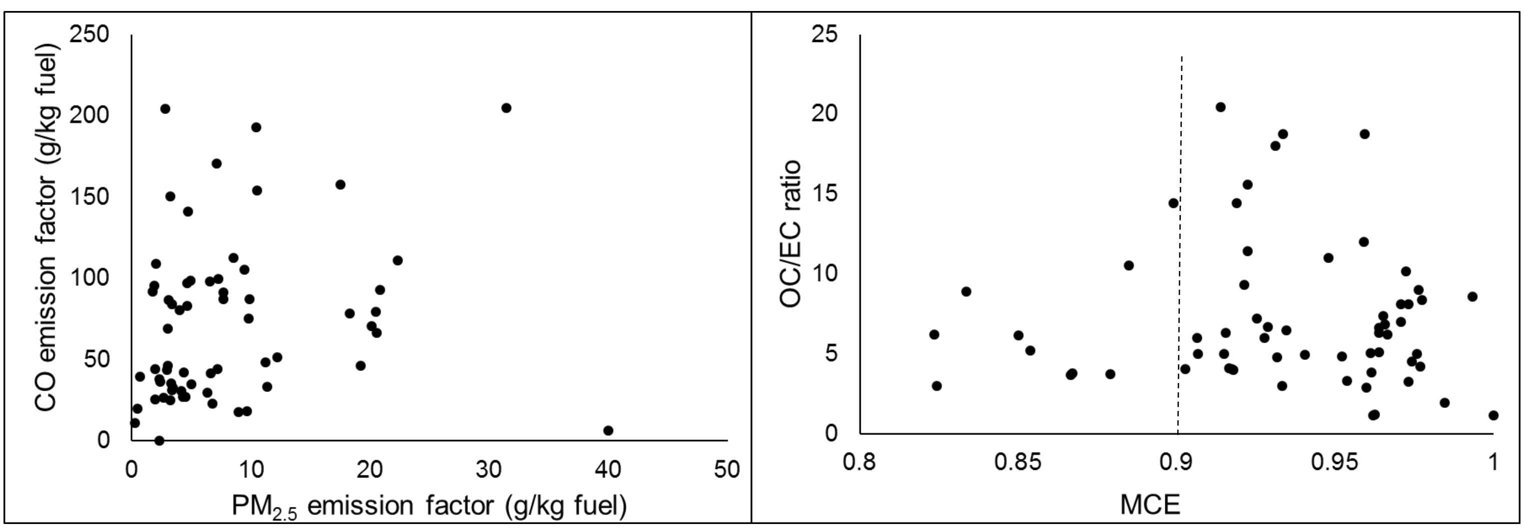

Figure S2: Comparisons of (a) CO vs $PM_{2.5}$, EFs and (b) OC/EC ratios vs modified combustion efficiency (MCE) values.

References

Reid, J., Koppmann, R., Eck, T. and Eleuterio, D. (2005). A review of biomass burning emissions part II: intensive physical properties of biomass burning particles. *Atmospheric Chemistry and Physics,* 5, 799-825.

Roden, C. A., Bond, T. C., Conway, S., Pinel, A. B. O., MacCarty, N. and Still, D. (2009). Laboratory and field investigations of particulate and carbon monoxide emissions from traditional and improved cookstoves. *Atmospheric Environment,* 43, 1170-1181.

Zhang, H., Ye, X., Cheng, T., Chen, J., Yang, X., Wang, L. and Zhang, R. (2008). A laboratory study of agricultural crop residue combustion in China: emission factors and emission inventory. *Atmospheric Environment,* 42, 8432-8441.