Investigating Emission Sources Outside Sub-Saharan Africa Using Ground-Based Measurements

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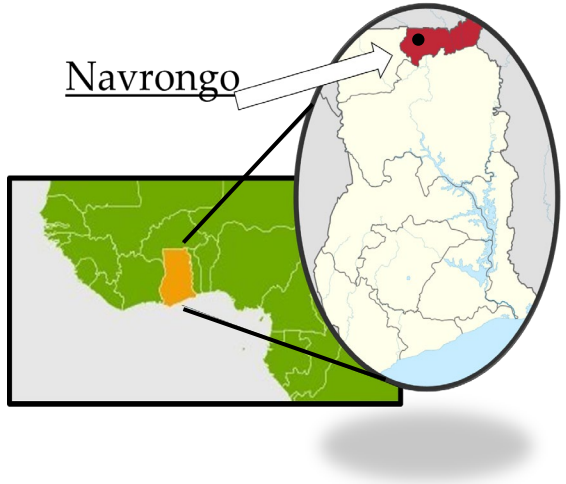
Background on Our Work in Ghana – Context for My Sampling & Research

REACCTING (2013-2015)
Research of Emissions, Air Quality, Climate, and Cooking Technologies in Northern Ghana

NAVRONGO HEALTH RESEARCH CENTRE



200-home cookstove intervention study to study stove use, emissions, and personal exposure

P3 (2015-2017)
Prices, Peers, and Perceptions

More focused on economic factors, still involves emissions sampling and stove usage

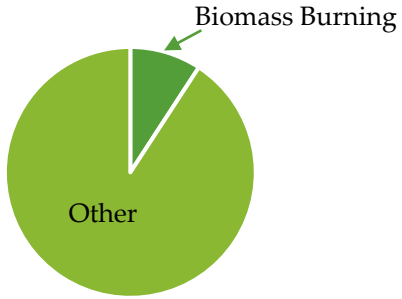
Source Apportionment on Ambient and Personal Exposure Samples

From REACCTING study:
59 Personal & Microenvironment Samples
25 Ambient Samples
Both (10/13 through 10/14)

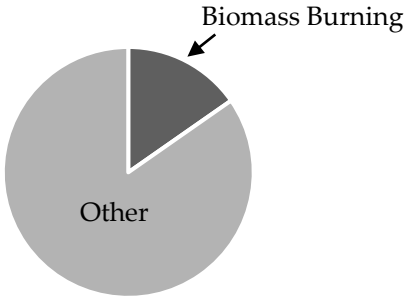
PM2.5 Personal Samples (**42.5 ug/m^3**)
Ambient Concentrations (**4.4 ug/m^3**)

PMF analysis resulted in biomass combustion contributed a median 9.2% OC and 15.3% EC to personal exposure

Organic Carbon



Elemental Carbon



R. Piedrahita et al. - Science of the Total Environment 576 (2017) 178–192

Implications that while cooking is an important, personal exposures are impacted by other sources.

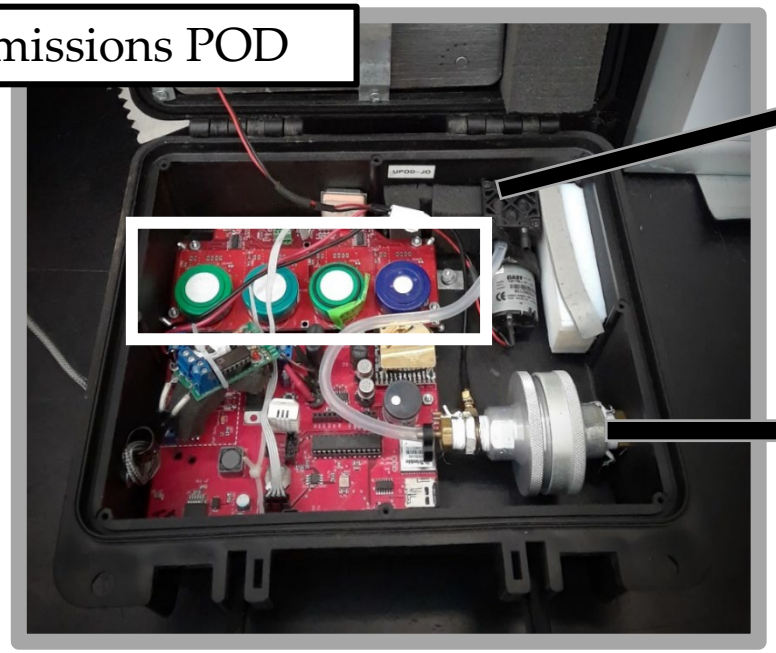
From 2013-2014 we took Samples from Non-Residential Cooking Combustion Sources

Common Emission Sources

- Commercial Cooking
- Residential Cooking
- Trash Burning
- Kerosene Lighting
- Diesel Generators
- Road Traffic
- Agricultural Burning
- Charcoal Production

Sampling Methods and Emission Factors Calculation

Emissions POD



Electrochemical sensors
- Carbon Monoxide
- Carbon Dioxide

Partial Capture Carbon Mass Balance to calculate Emission Factors for:
- Carbon Monoxide
- Carbon Dioxide
- Elemental Carbon (EC)
- Organic Carbon (OC)

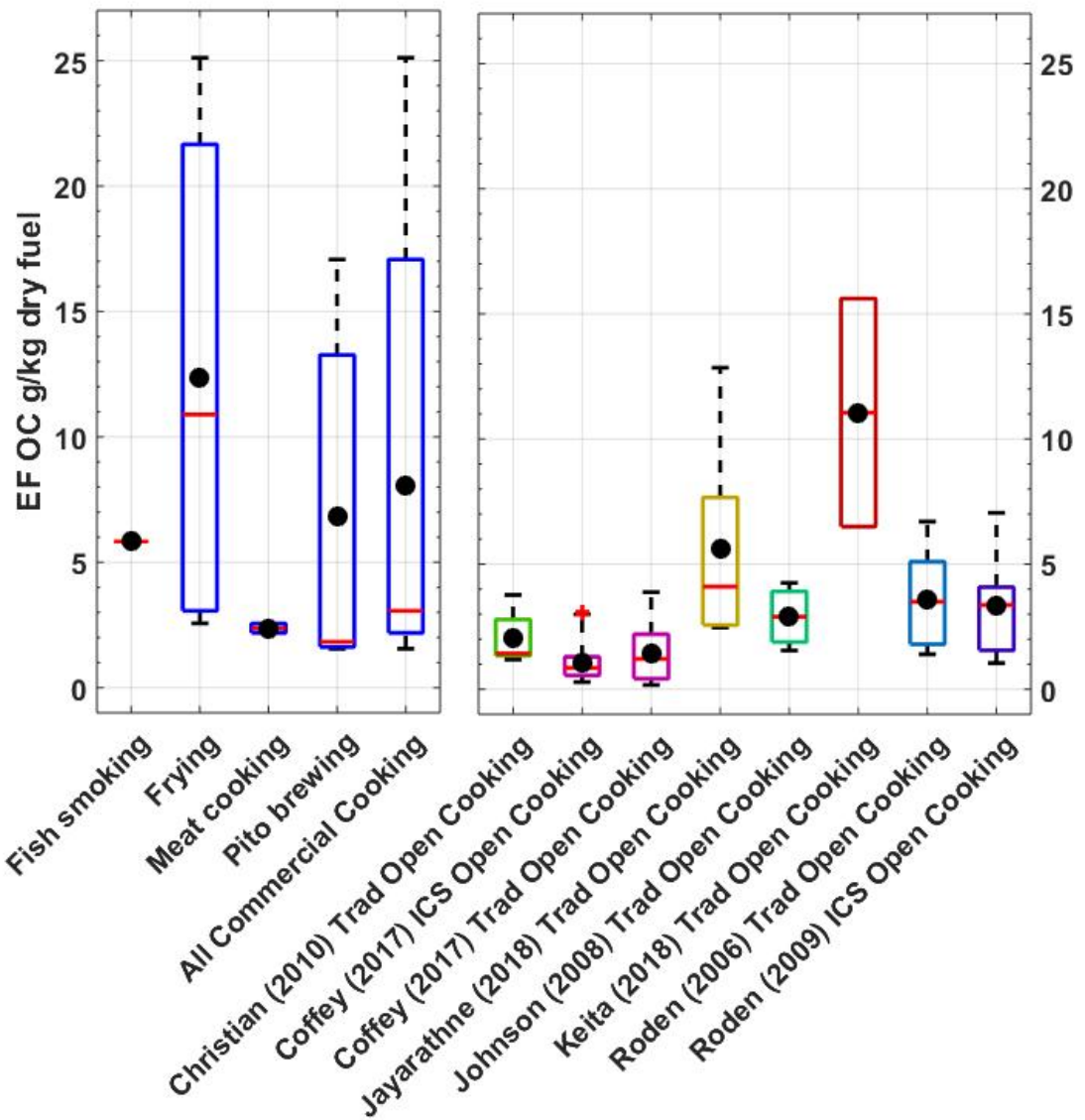
Emission Factors:

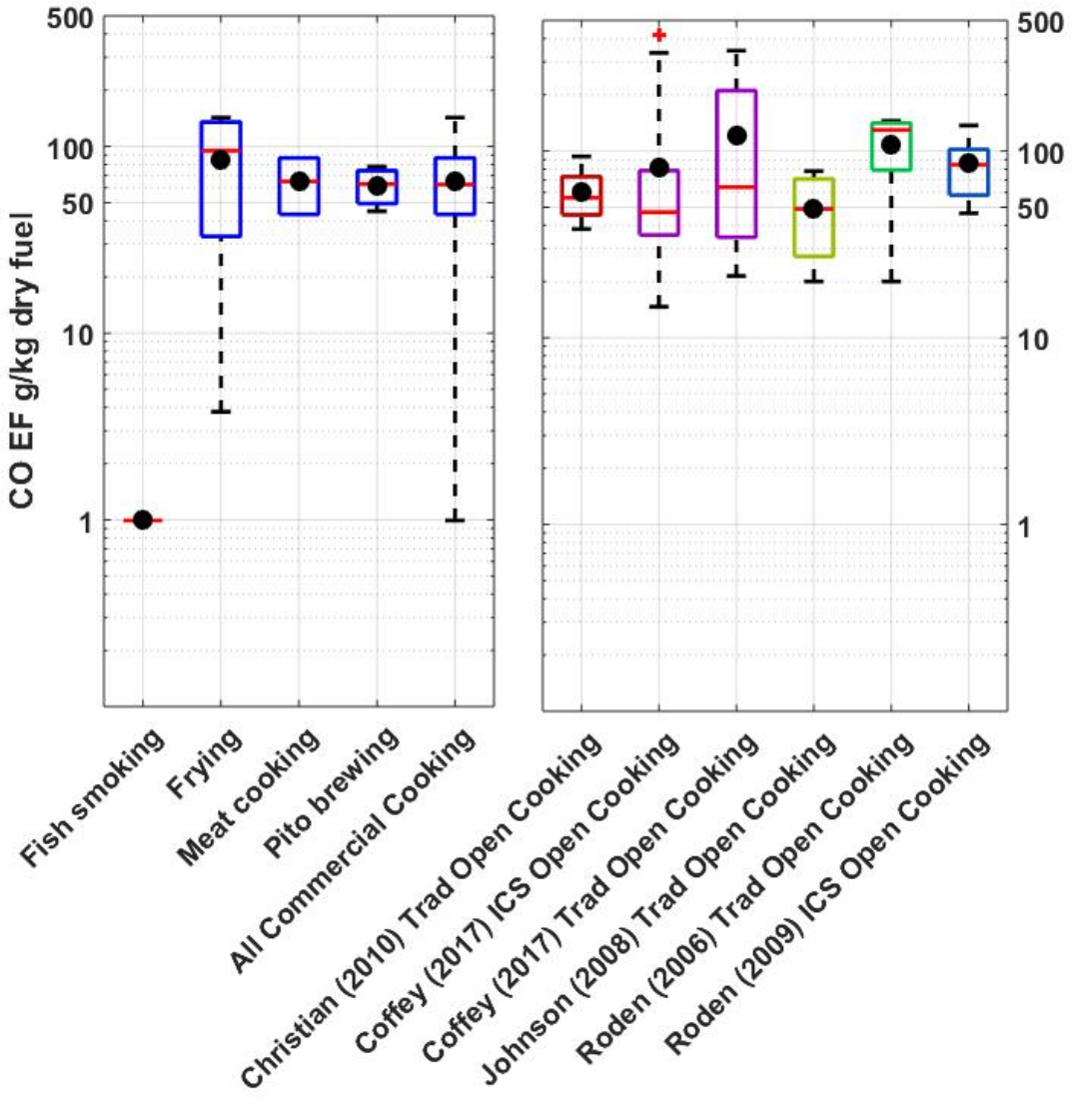
EF_{CO} EF_{CO2} EF_{EC} EF_{OC}

$$\left[\frac{g\ (pollutant)}{kg\ (fuel\ combusted)}\right]$$

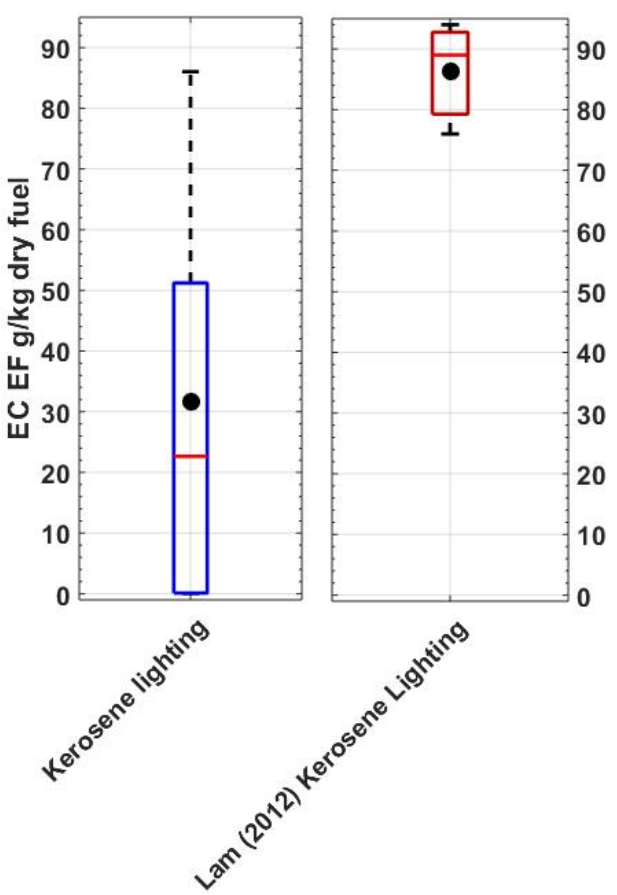
Portable Sampling Device – Equipped with Reliable Sensors and Sampling Ability

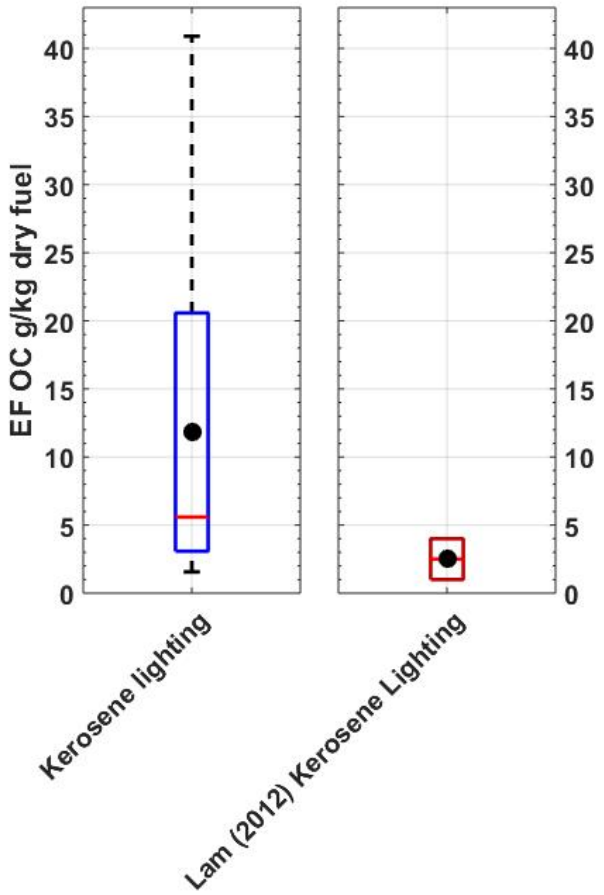
Commercial Cooking

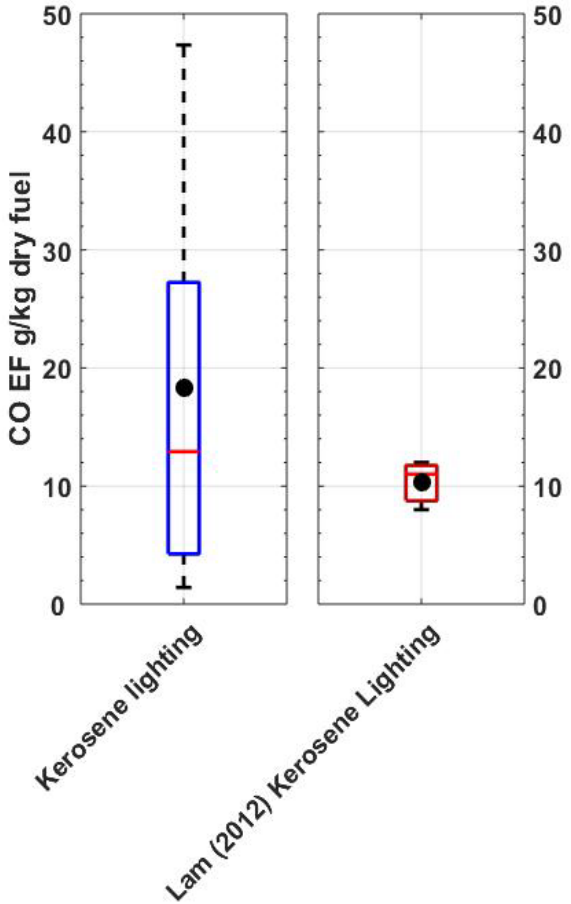




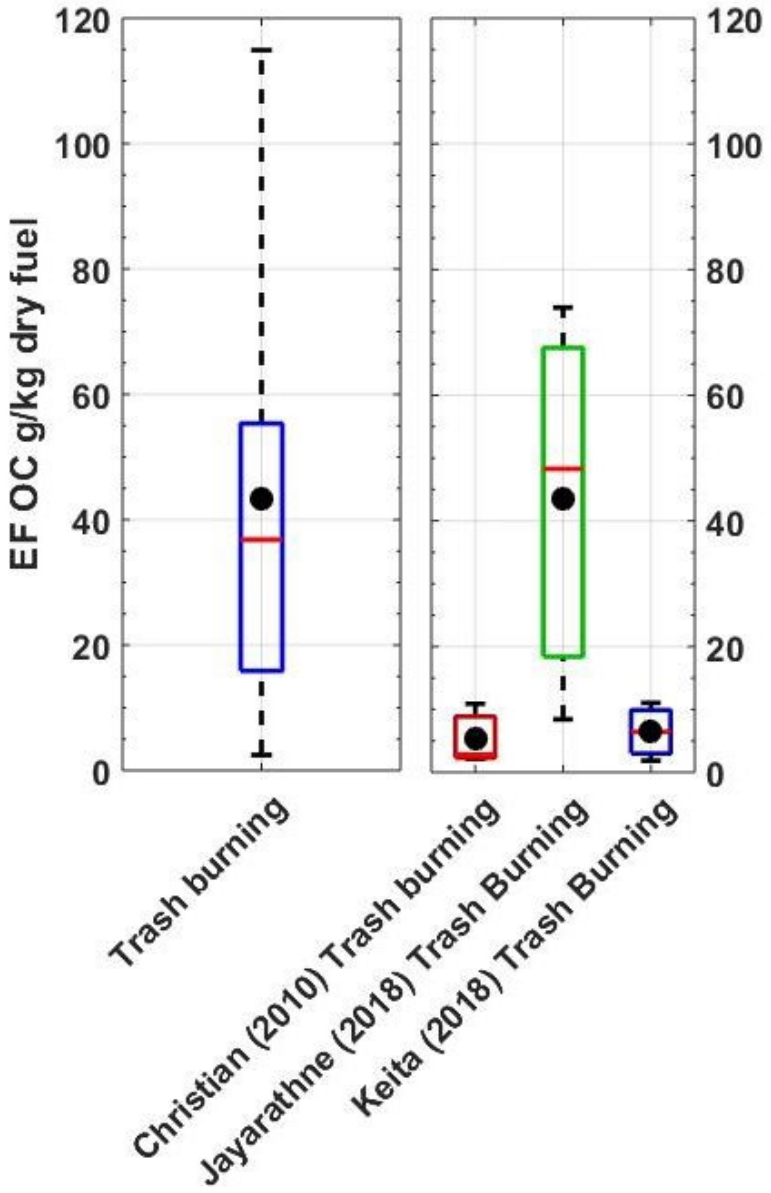
Kerosene Lighting

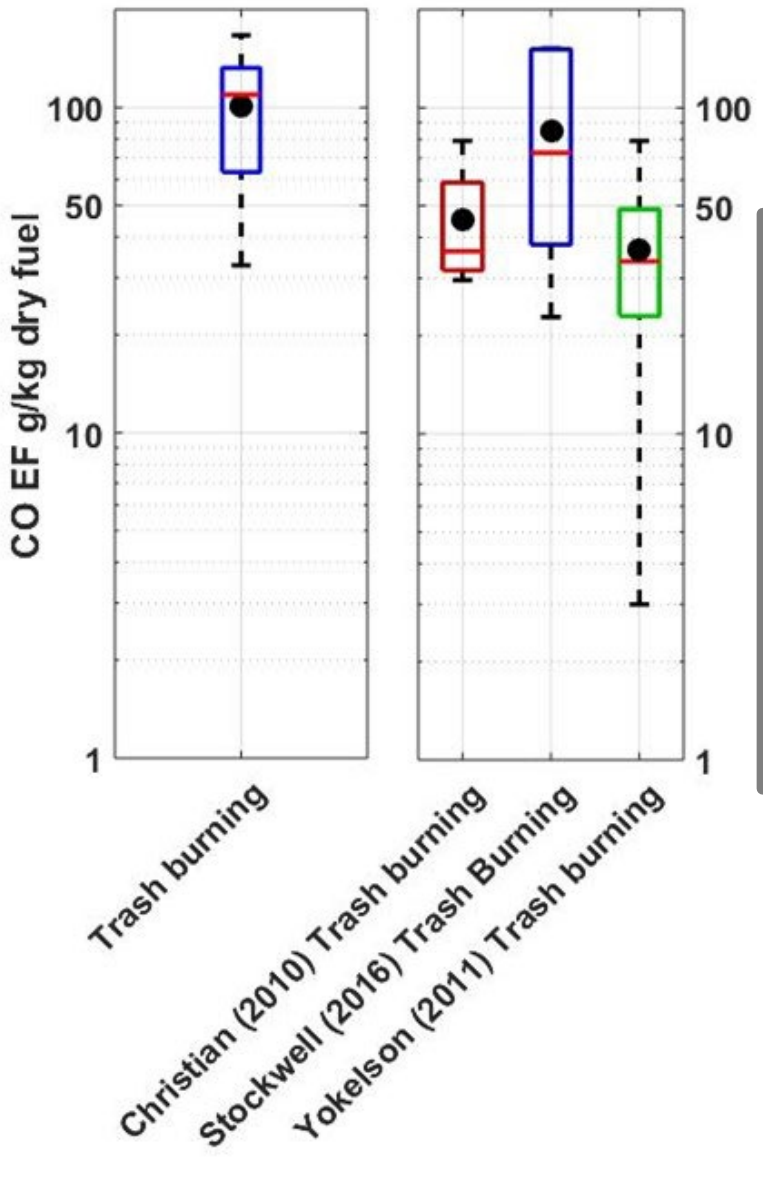






Trash Burning

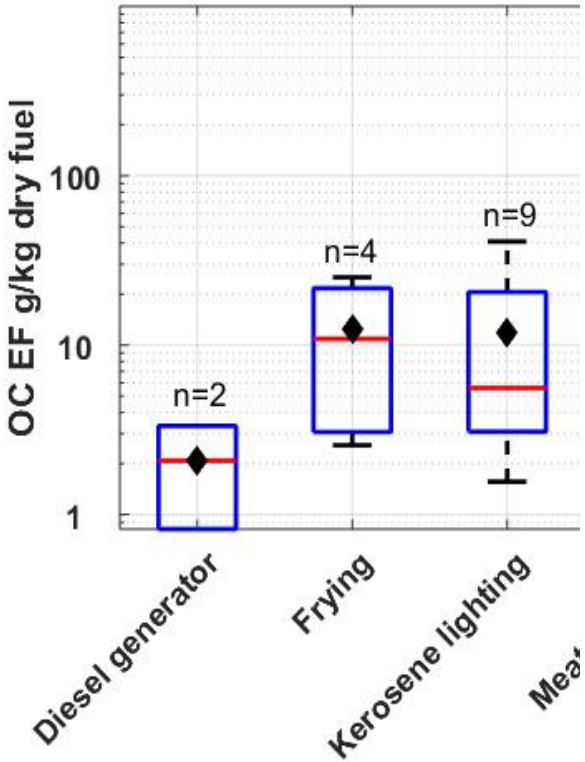


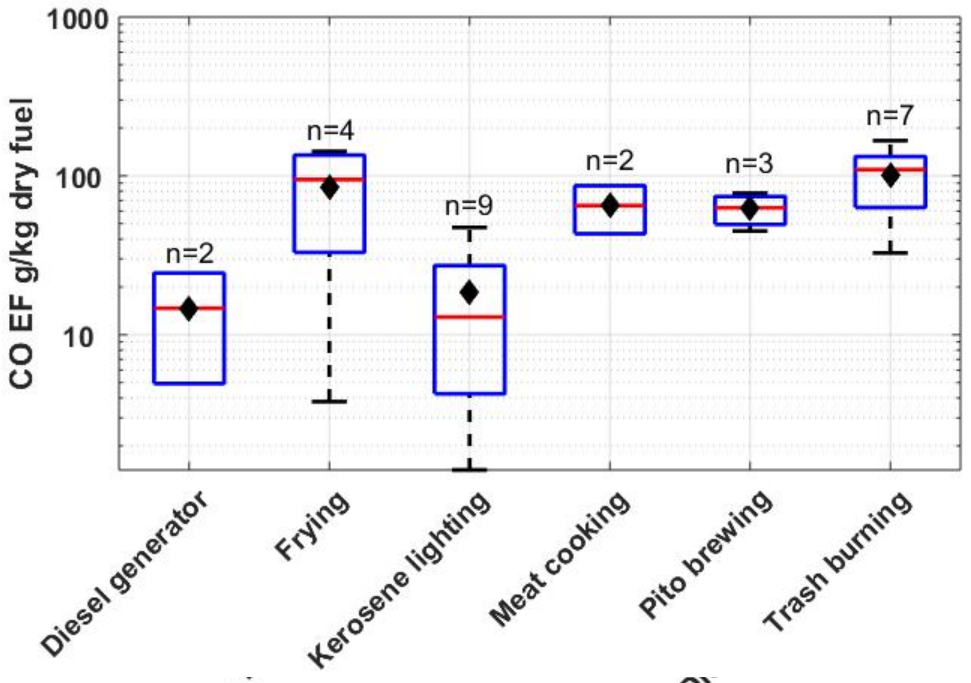


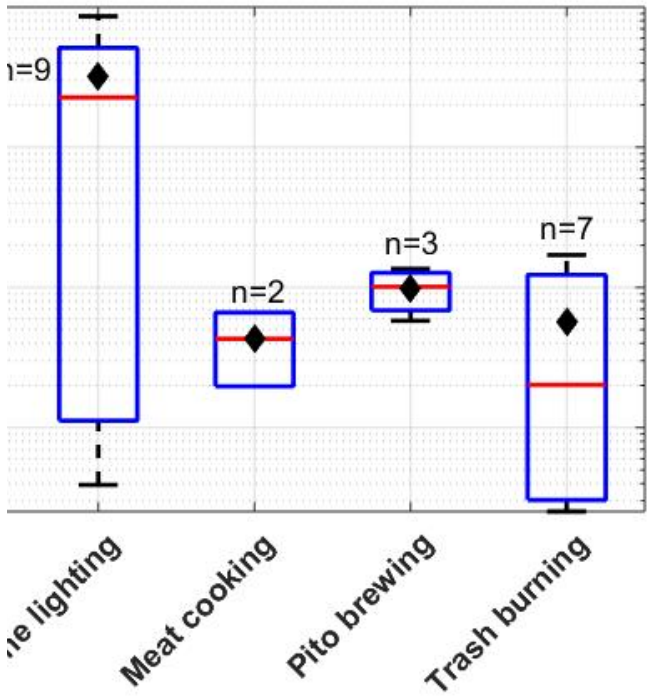
Variances Across Samples and Source Types

Comparing Carbonaceous PM factors
- Trash Burning OC
- Kerosene Lighting EC

Significant variance within individual samples
- Fuel composition used in combustion (Trash Burning)
- Combustion environment and parameters
- Bias from combustion phase sampling imbalance





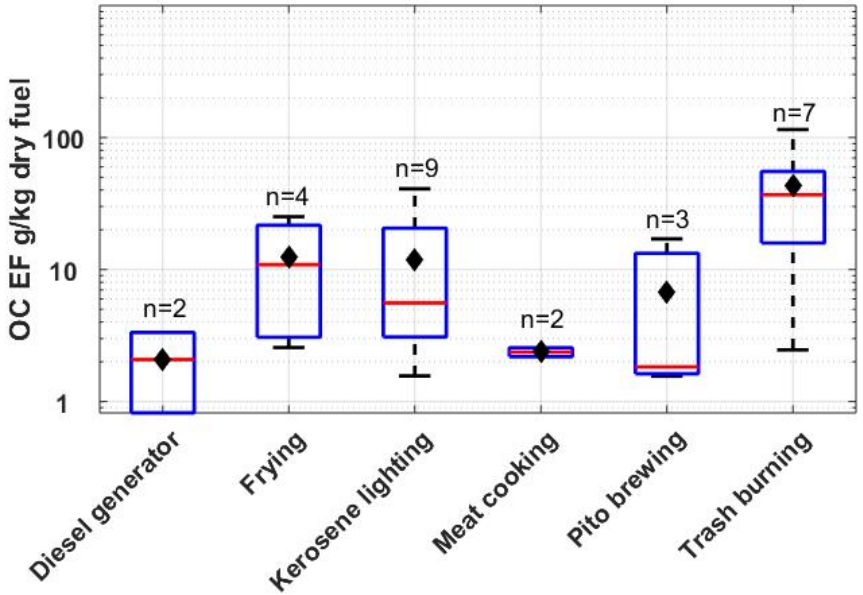


Conclusions

In-Field emissions often differ from lab measured emission factors

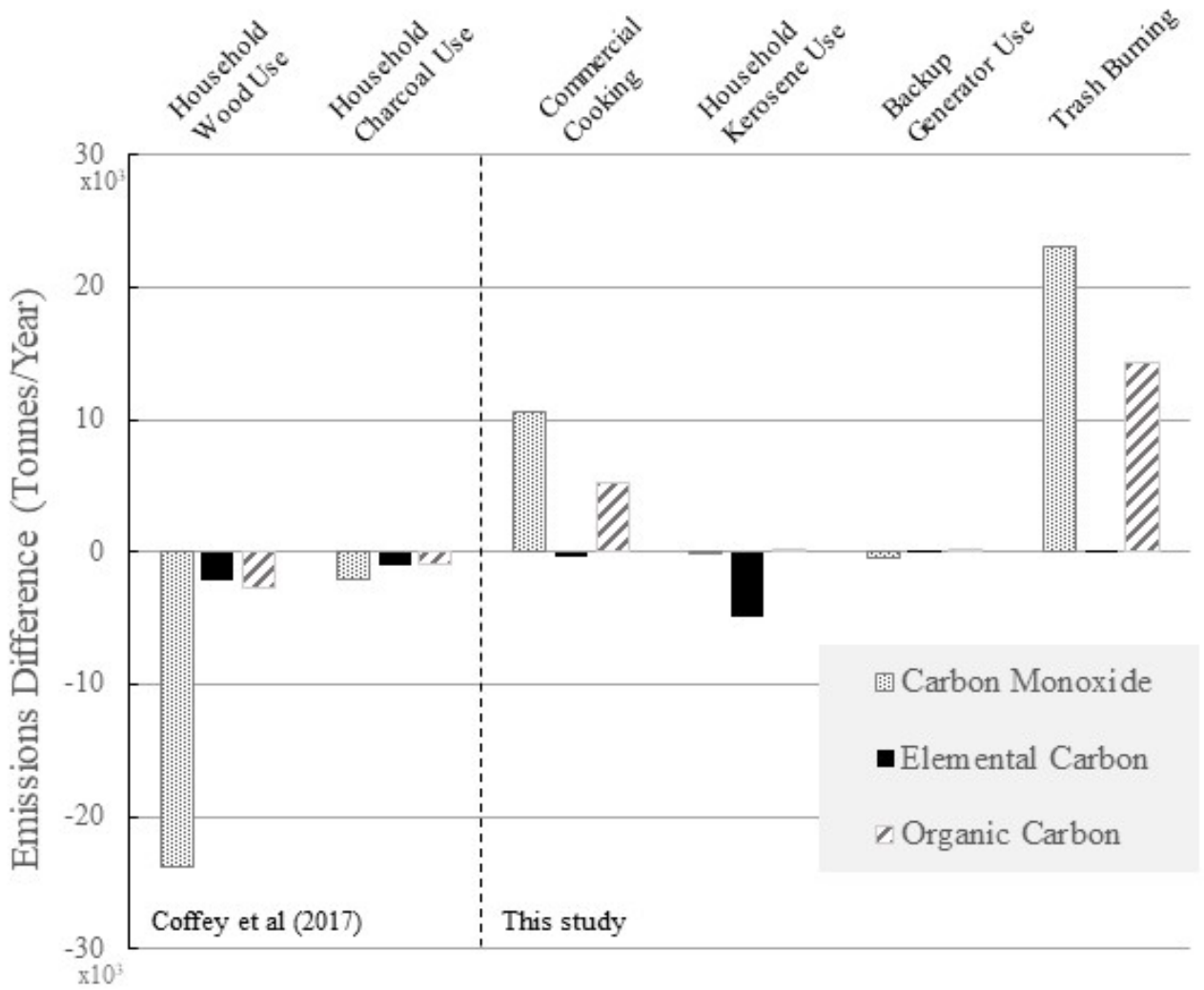
These small variations, when scaled via activity data, can greatly affect country or regional estimates

Important to study the variability between and within source types



Questions?

Effect of In-Field Emission Factors on Emissions Estimates for Ghana



DICE-Africa Emission Inventory – We replaced Emission Factors with ones calculated from sources we sampled

Relative Changes:

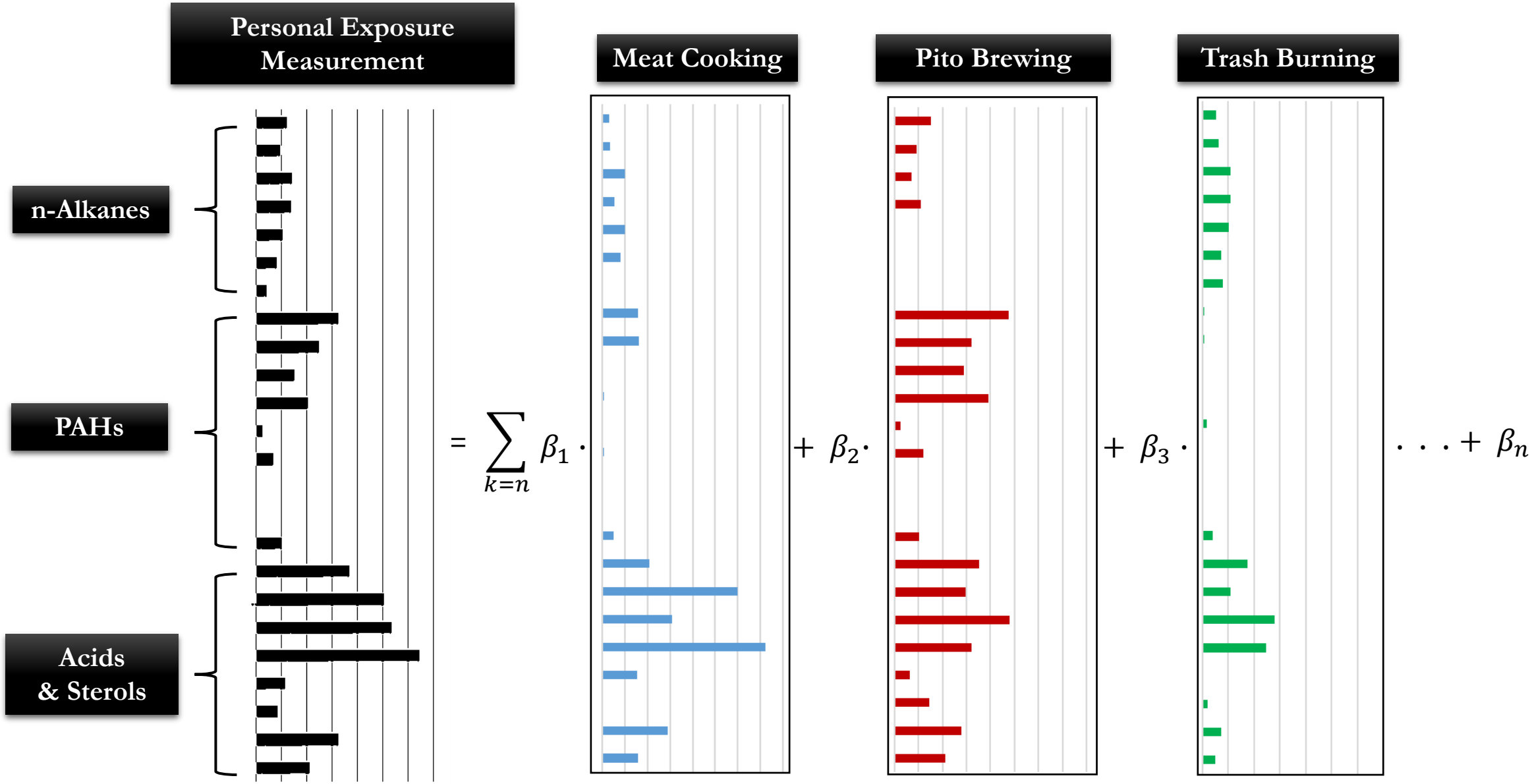
Household Cooking
- CO 9% Decrease
- EC 76% Decrease
- OC 27% Decrease

Commercial Cooking
- CO 11% Increase
- OC 146% Increase

Trash Burning
- CO 167% Increase
- OC 743% Increase

Marais, Eloise A., and Christine Wiedinmyer. *Environmental science & technology*50.19 (2016): 10739-10745.

Future Work – Source Apportionment Using Organic Speciation



Future Work – In Depth Investigation of Trash Burning

- Attempt assessment of trash composition
- Isolate emissions and organic tracers from individual components

- Use ambient filter samples from rural and urban sites to attempt apportionment of Trash Burning contribution to ambient PM

Moisture in Trash Burning Fuel