Emission factors for GHGs from small scale combustion

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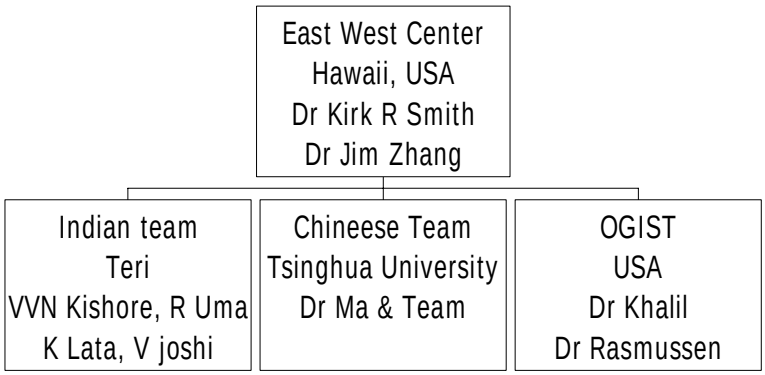
Developing Countries - Small-Scale Combustion Devices- Why is this important to GCC?

- **20-50% of total GHGs from biomass burning**
- **Numerous small scale combustion devices in developing countries**
- **Significant due to PIC**
- **High level of uncertainty**

US-EPA Study



Objectives

- **Develop a common protocol**
- **Emission factor estimation**
- **Fuel use estimation**
- **Greenhouse gas inventory for cookstoves in India**

Experimental design

- **28 stove fuel combinations**
- **In each stove fuel combination three experiments**
- **In each experiment fluegas and indoor sampling**
- **Ambient measurement when no stove was burnt**

Stove fuel combination

Fuel	Stove						
	Ang	TM	IU	IV1	IV2	3R	Hara
CC	✔						
CB	✔						
Fw_1		✔	✔	✔	✔	✔	
Fw_2		✔	✔	✔	✔	✔	
CR_1		✔	✔	✔	✔		
CR_2		✔		✔			
DC		✔		✔	✔		✔

Experimental setup

- **Experiments conducted in Simulated Rural Kitchen at Teri's campus in India**
- **Tested under hood arrangement**
- **Two types of stoves - Stove with flue and with out flue**
- **Height of the hood was adjusted to collect all fluegas**

Parameters measured

- **Airborne parameters - CO_2, CO, CH_4, TNMHC, TSP, SO_2 and NO_2**
- **Fuel parameters - calorific value, moisture content, C, H_2, N_2, S and ash**
- **Ash and char analysis - calorific value, C, H_2, N, S and ash**

Quality Assurance

- **Trial runs before planned experiments**
- **Results from the replicates were <20% RSD**
- **Inter laboratory check**
- **Comparison of local GC analysis with OGIST**
- **Results from teri & OGIST were in good agreement**

Carbon balance model

- **CO+CH4+TNMOC+CO2+AC = FC**
- **1= (FC/CO2) - K**
- **CO2 (as g C) = FC/(1+K)**
- **CO2 (as g CO2)= CO2 as g C × 3.67**
- **CO (as g C) = CO/CO2 × CO2 as C**
- **CO (as CO) = CO as g C × 2.3**

Emission factors

- **CO emission factor is high for charcoal (276 g/Kg) and low for biogas**
- **CO emission factor varies from 15 - 85 g/kg**
- **High emission factor for improved stoves**
- **wood emission factor is lower than dung and crop residues**

Conclusion

- **New comprehensive database of emission factor**
- **National Inventory can be revised by the new emission factors**
- **Biomass cycles are not ghg neutral due to PIC**
- **Energy efficient technology can reduce the emission**

Developing Countries - Small-Scale Combustion Devices - Accomplishments

- Have field tested the various stove/fuel combinations in use in India, China,,and the Philippines
- In Thailand, Kenya, and Brazilwe have conducted measurements of charcoal kilns
- This is the most definitive research to date of this type:
  - Results will be the single most credible, up to date , coherent, complete methodology and data set that will establish baseline emissions and serve as a strong technical basis for evaluating potential policy options.
  - Many of the measurements were quite difficult particularly for N20; QA/QC indicate high quality data even though all sampling occurred in developing countries and often under difficult circumstances.