

# Portable Dilution Sampling Equipment for Climate-Relevant Emission Source Characterization:

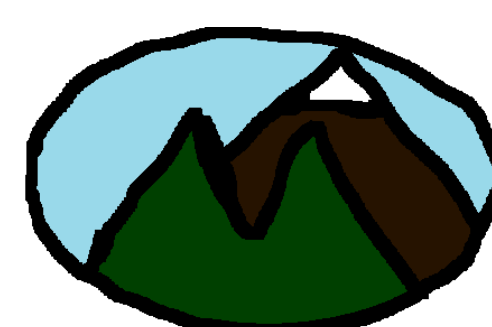
## Ratnoze



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### Problem:

Solid fuel combustion sources are difficult to characterize due to:

- high particle emissions
- large emission fluctuations
- remote locations

### Solution:

The Ratnoze is a versatile sampling system that provides climate-relevant emission characterization.

- Dilution Sampler: The emission sample is mixed with clean, dry dilution air to reduce particle concentrations and humidity for representative partitioning of semi-volatile species.
- A complete sampling kit that includes Probe, Sensor Box, Accessories, and Software
- Open source design



### Sources

- Brick Kilns: Natural draft, Forced Draft, No Chimney



- Charcoal kilns
- Biochar stoves
- Cookstoves
- Space heating stoves
- Engines

### Fuels:

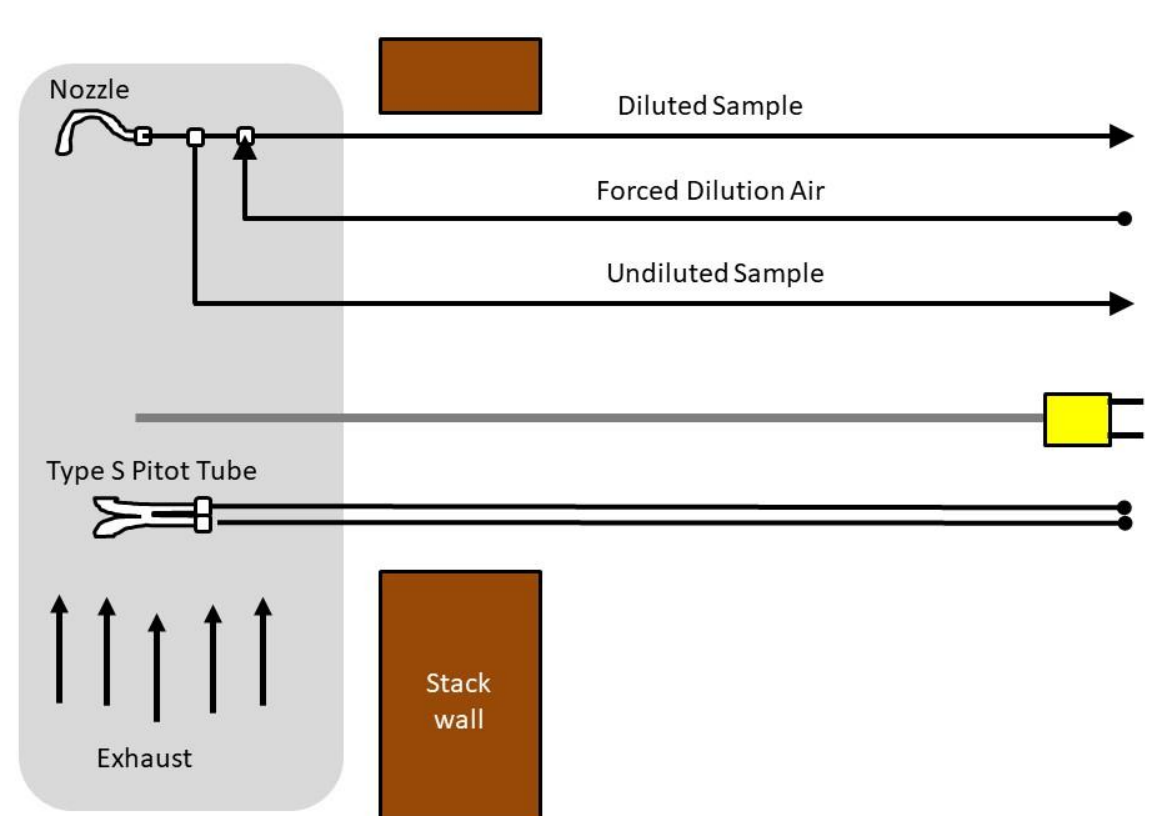
- Biomass
- Coal
- Diesel
- Gas

## Ratnoze4 Sampling System

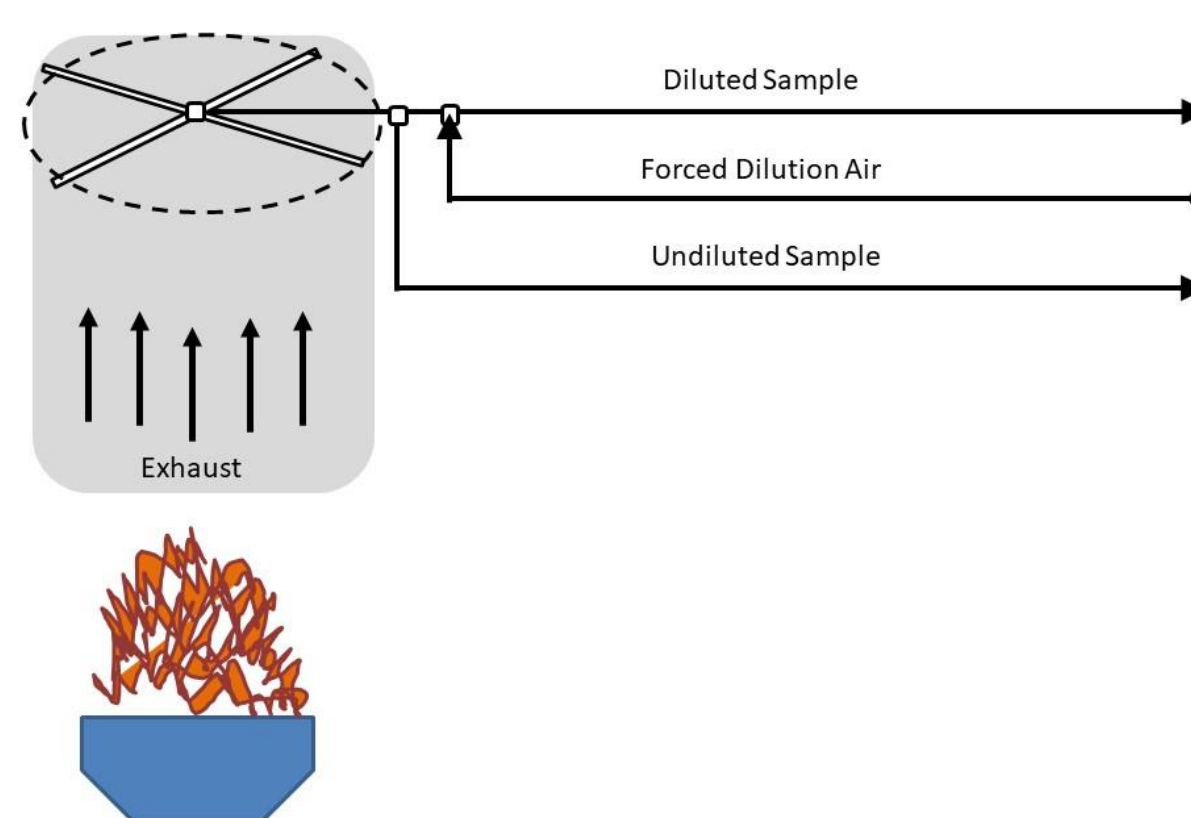
### Probe

Modular probe 0.5-3 m length

#### Isokinetic Nozzle for Stack Sampling

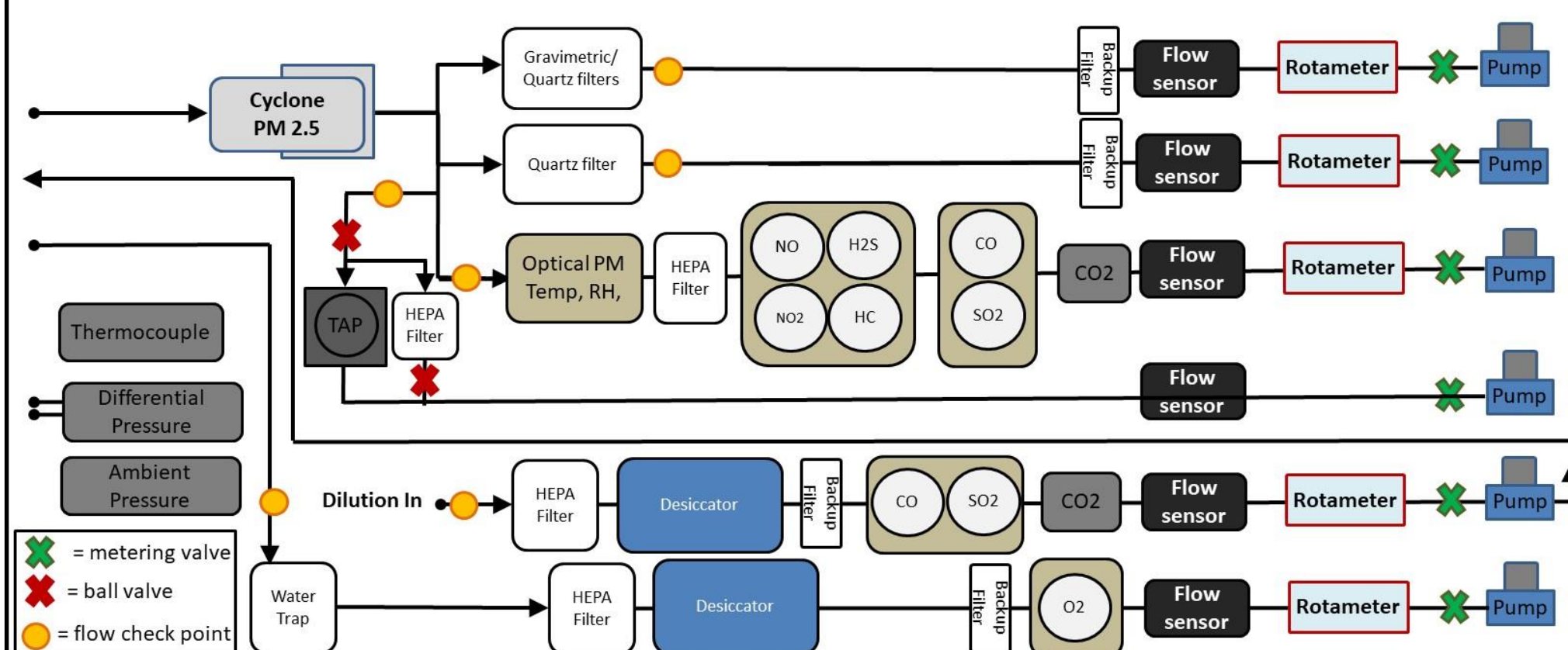


#### Multi-point Area Nozzle for Open Plume Sampling



### Sensor Box

- 2.5  $\mu\text{m}$  cutpoint cyclone (1.5 and 3 lpm)
- Two parallel 47 mm filter holders for PM gravimetric and composition analysis
- On-board data logger



- Forced dilution up to 20:1 DR
- 1 hz sampling rate
- 15 hour battery life

### Measures:

- CO
- CO<sub>2</sub>
- SO<sub>2</sub>
- NO
- NO<sub>2</sub>
- H<sub>2</sub>S
- H<sub>x</sub>C<sub>y</sub>
- O<sub>2</sub>
- Particle Scattering
- Particle Absorption
- Stack Velocity
- Stack Temperature
- Ambient Pressure
- Dilution Ratio
- Filter Flows

### Accessories

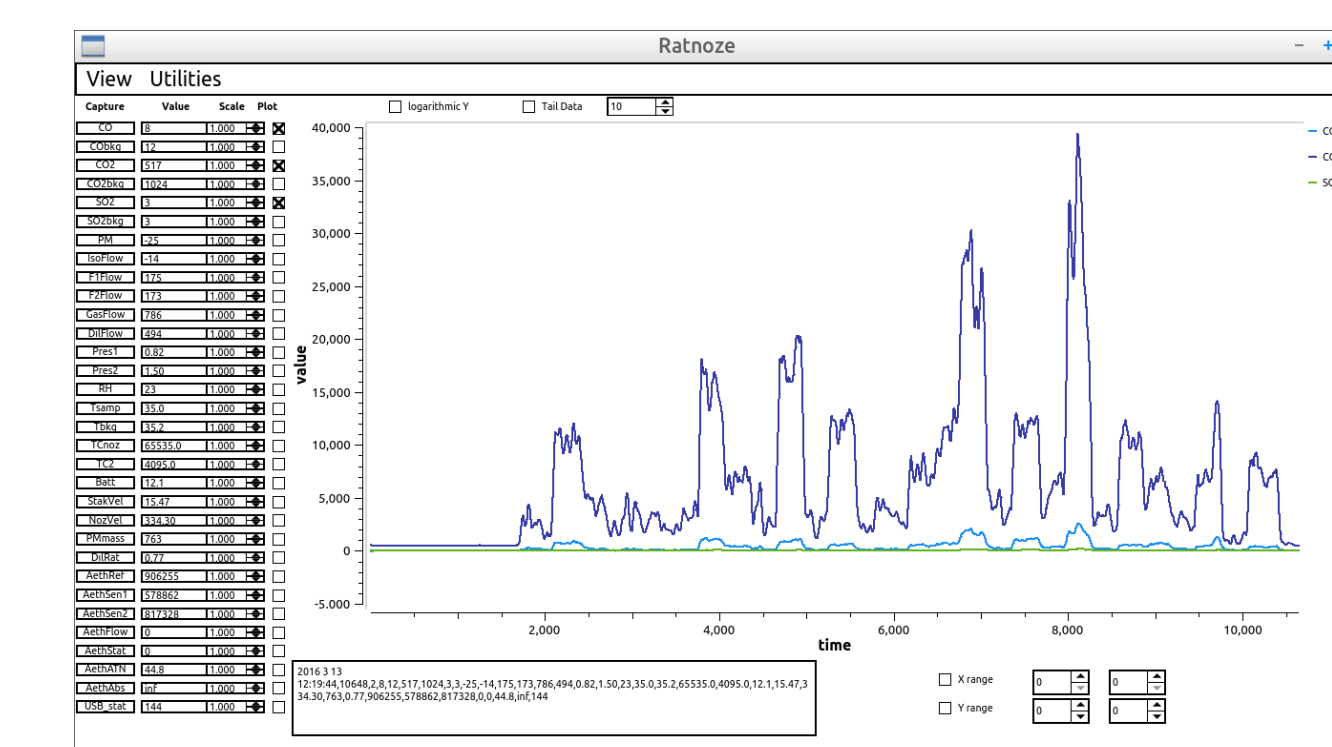
- Wireless Transmitter
- Computer
- Tools
- Bubble Meter
- Safety Masks
- Travel Cases



Case	dimensions (cm)	weight (kg)
Sensor box case	38 x 51 x 64	24
Accessory case	25 x 36 x 56	16
Probe case	18 x 43 x 102	12

### Software (Python)

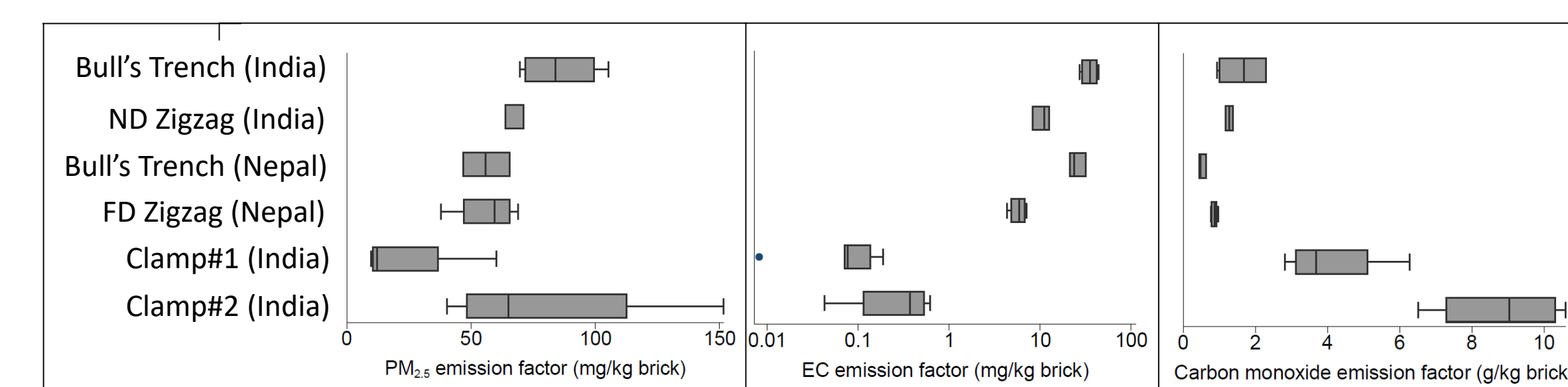
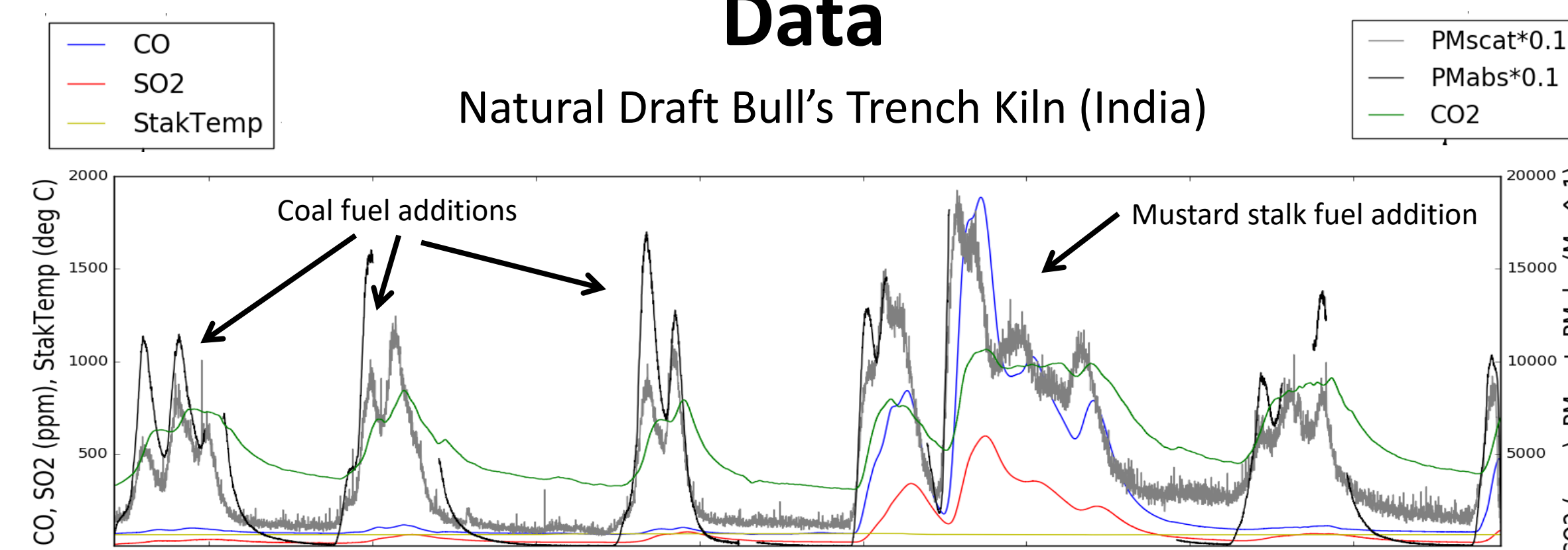
#### Real-time data plotting software:



#### Data Post-Processing Software:

- Calculates emission factors, emission rates, and other reporting metrics using Carbon Balance and Stack Flow methods
- Includes uncertainty propagation

### Data



### Locations:

- Ratnoze1: ICIMOD, Nepal
- Ratnoze2: Corporation Ambiental Empresarial, Colombia
- Ratnoze3: Beijing University of Business and Technology, China
- Ratnoze4: Mountain Air Engineering, USA

### More Information

Contact: ryan@mtnaireng.com  
Equipment Documentation:  
www.mtnaireng.com/Emissions-Equipment/

### Measurement Reports:

[https://www.dropbox.com/s/2riyci9z70modnj/SAsia\\_BKemissions\\_Final.pdf?dl=0](https://www.dropbox.com/s/2riyci9z70modnj/SAsia_BKemissions_Final.pdf?dl=0)  
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