Utility of low cost CO sensing: measuring exposure in Ghana to source apportionment of other pollutants

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REACCTING

Research of Emissions, Air Quality, Climate, and Cooking Technologies in Northern Ghana

Intervention Study

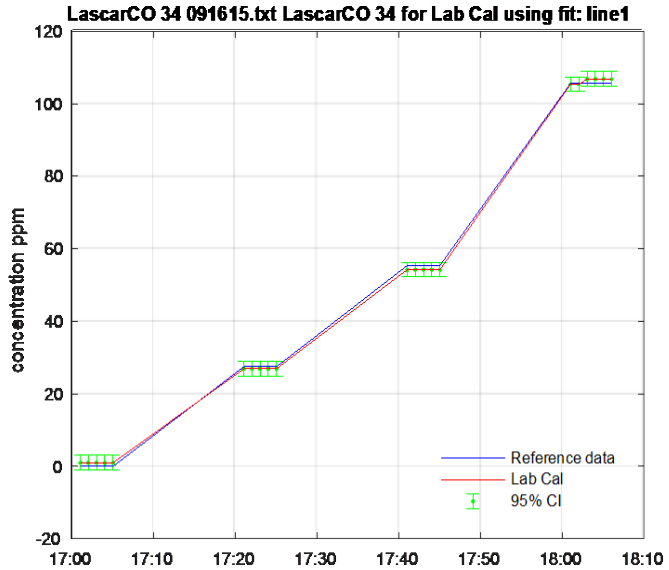
rural households (200)

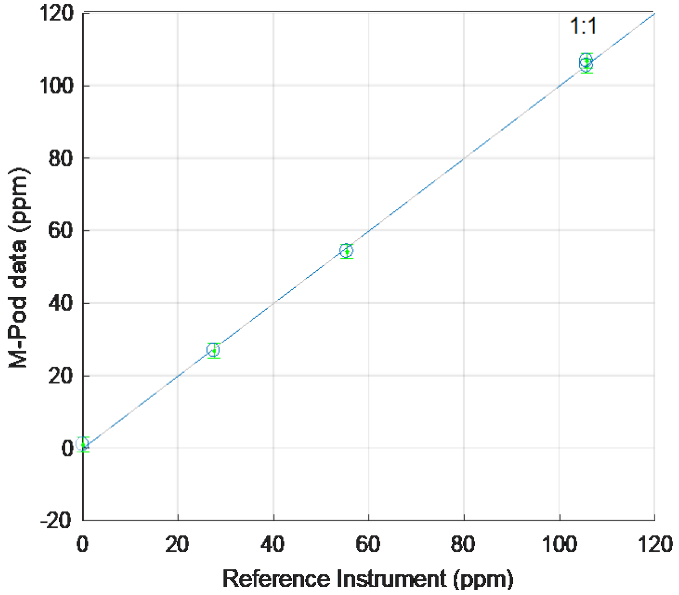
Electrochemical CO sensor

Sources and Exposure Characterization

urban and rural regions
(50 households)

How did calibration go?





Calibration Process

- Pre-deployment lab calibration
- In-field concentration check via colocation
- Post-deployment lab calibration

Pay attention to [CO] scale

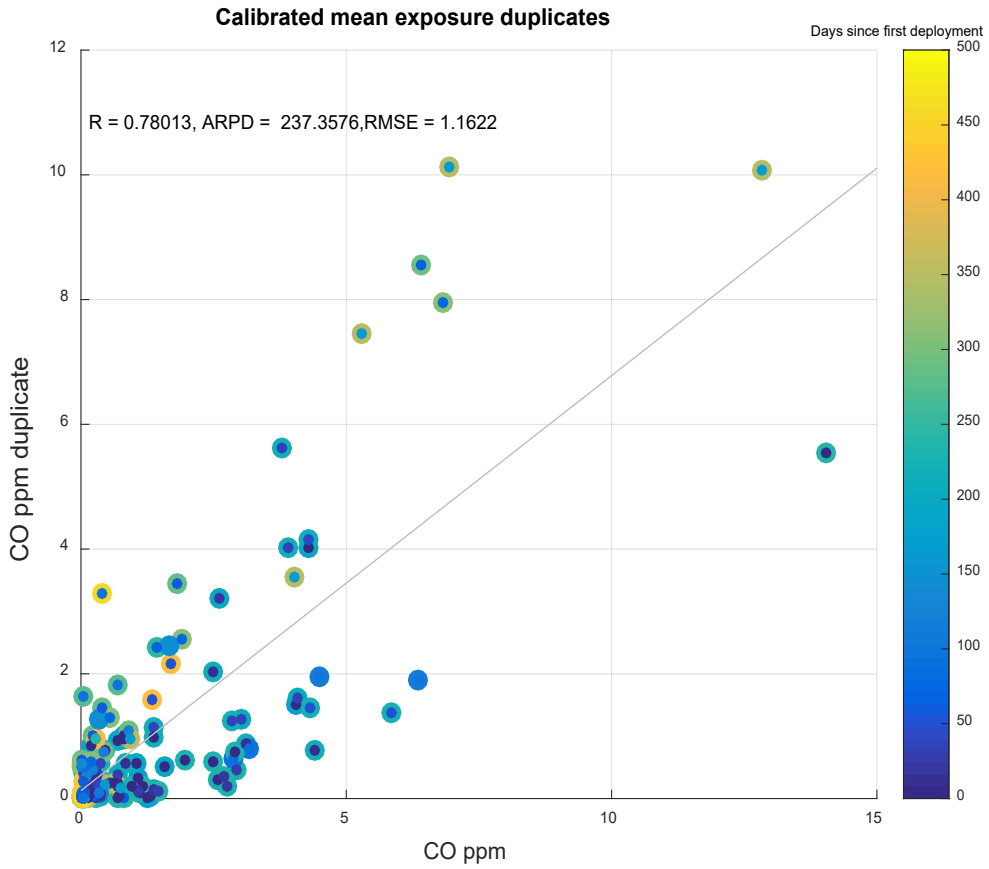
Biggest issue (on average) seen with calibration was the discrepancy between factory and pre-deployment

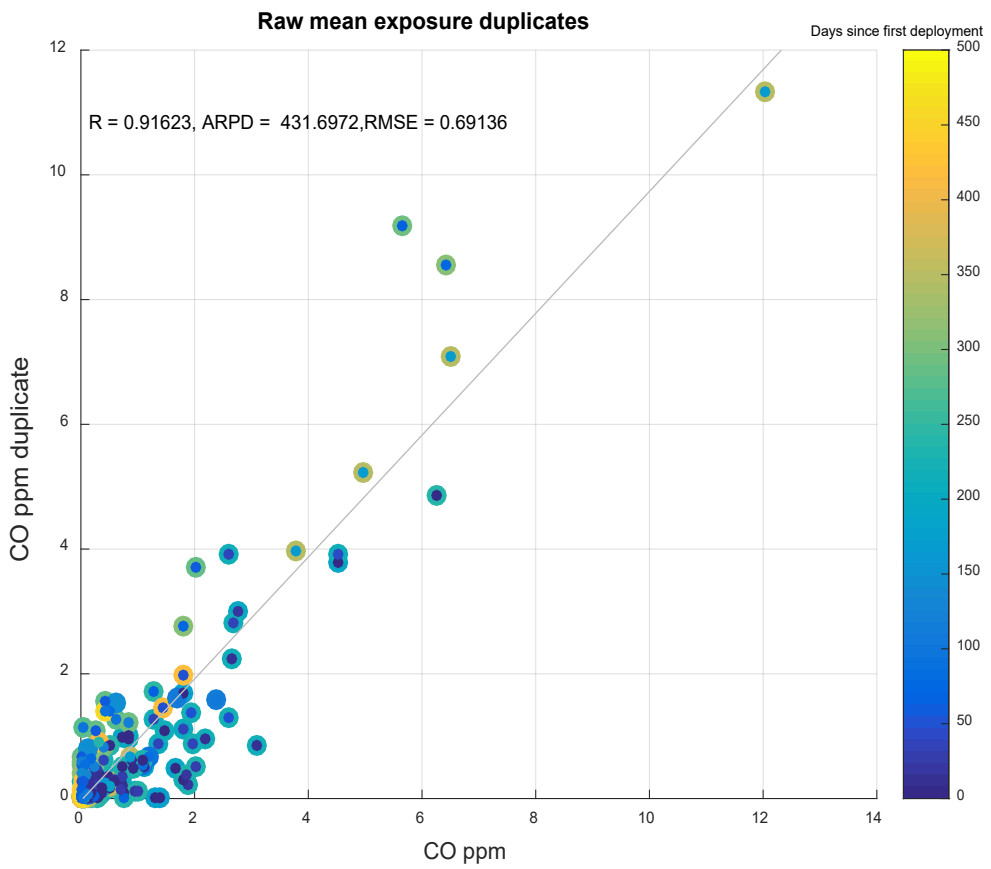
$$LascarSignal = p_1 + p_2(ReferenceConcentration) + \varepsilon$$

The average slope (p_2, sensitivity) was 1.06 ± 0.06 and intercept (p_1) was 0.08 ± 0.13 ppm

Piedrahita et al., Exposures to Carbon Monoxide in a Cookstove Intervention in Northern Ghana, Atmosphere, in press.

How well does it work in practice?



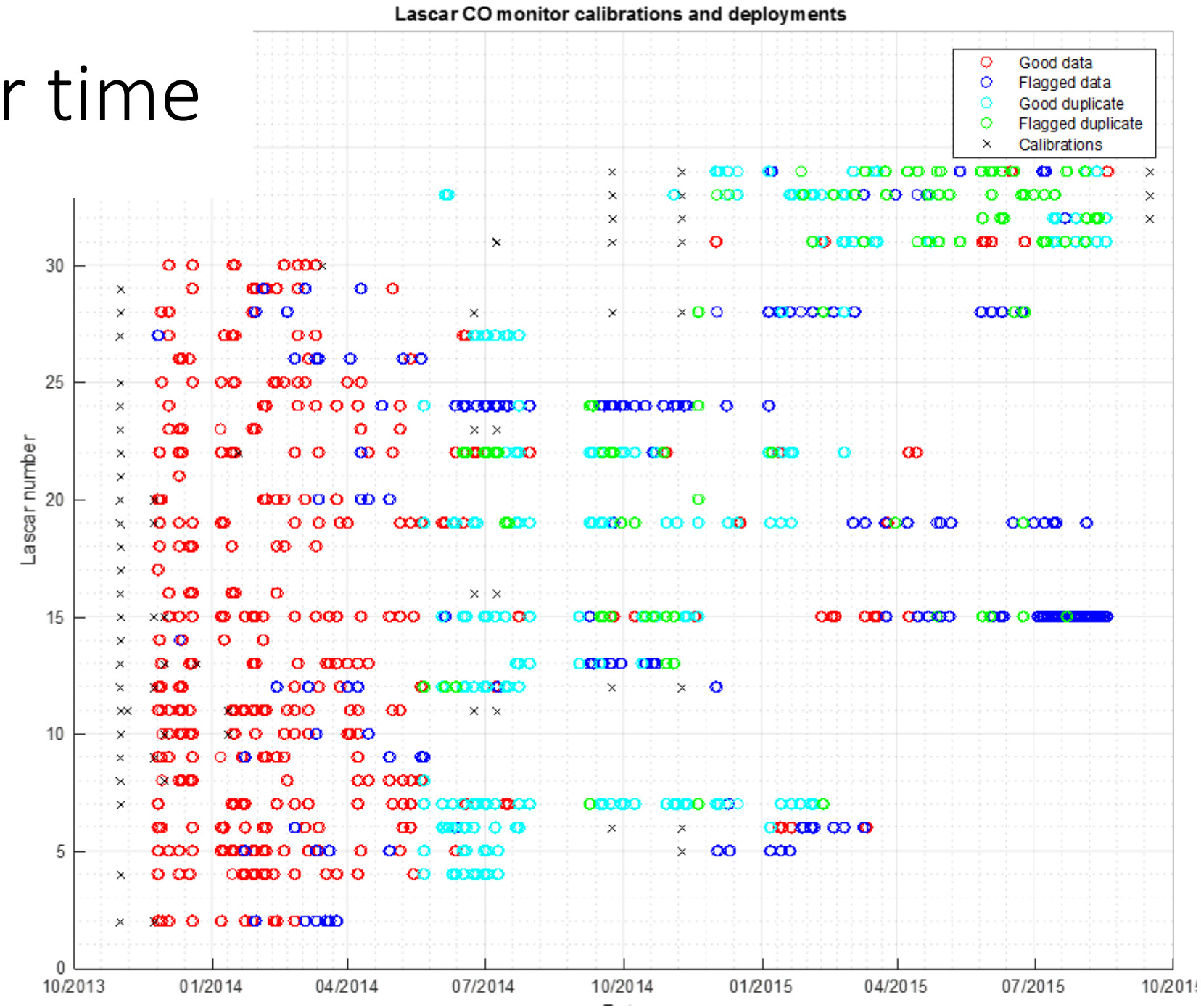


We collected 141 days of duplicate CO exposures.

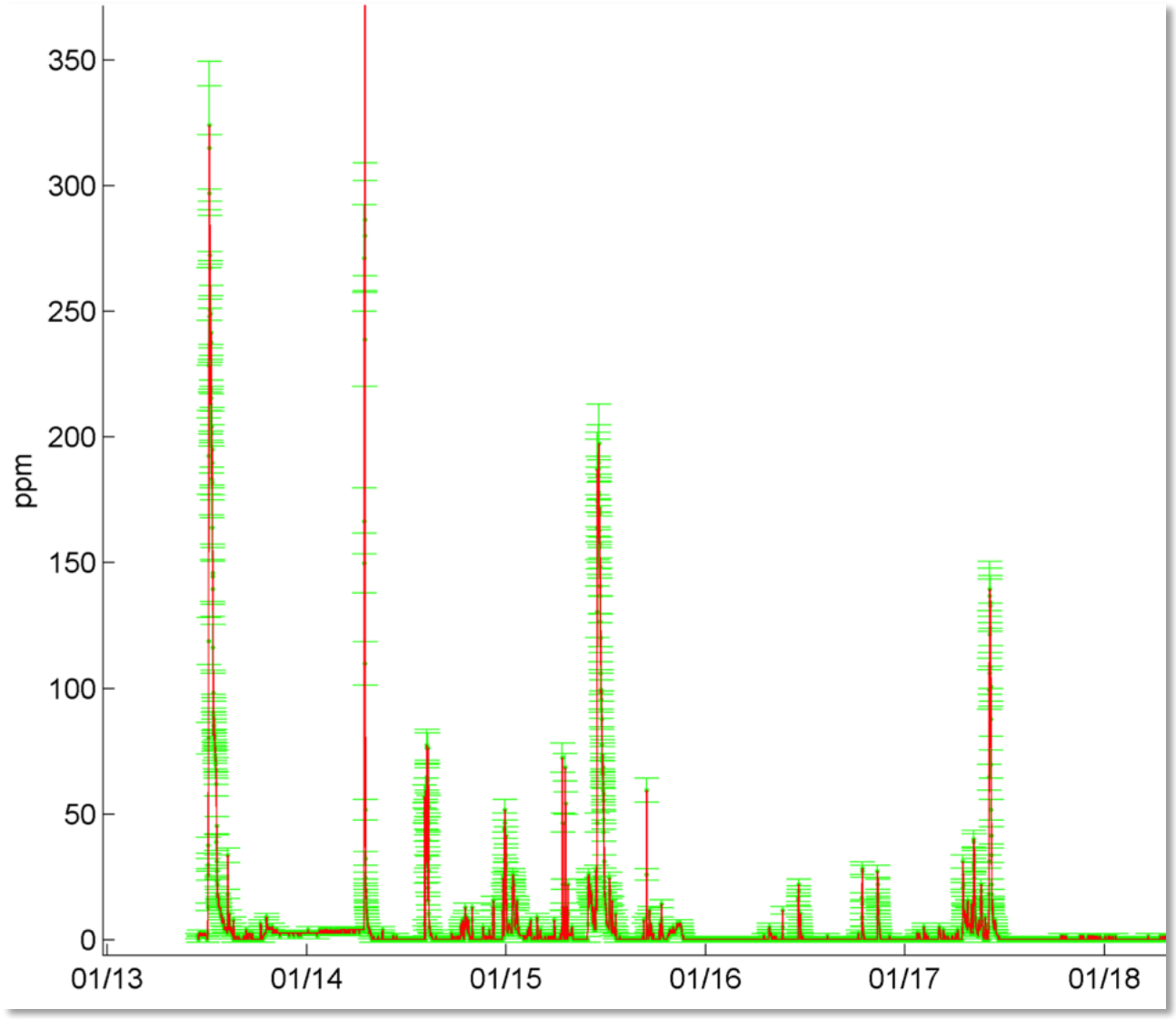
Performance over time

We used 34 units.
Goals was 2 years of use.
Issues …

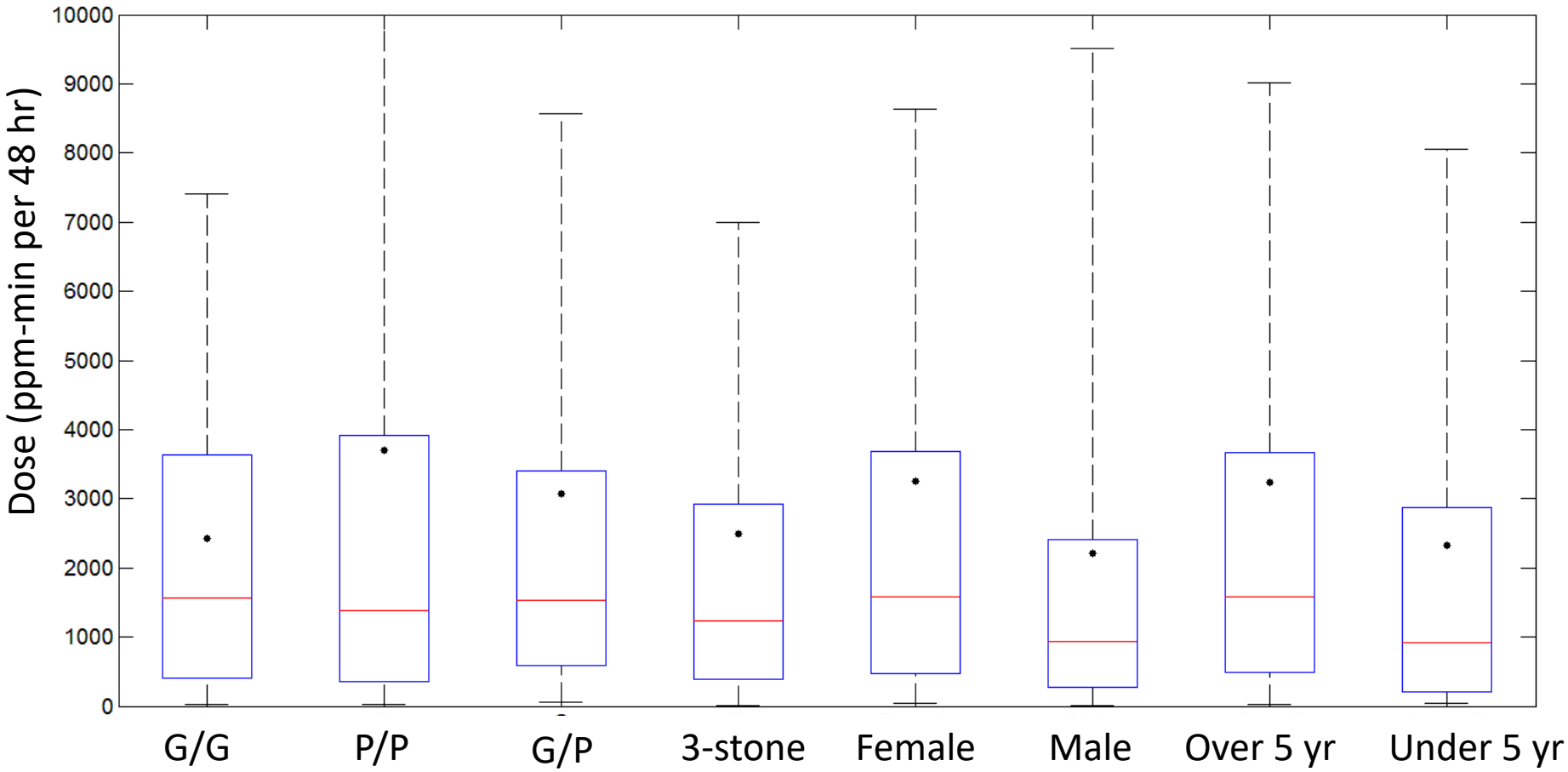
- Batteries
- Sensors



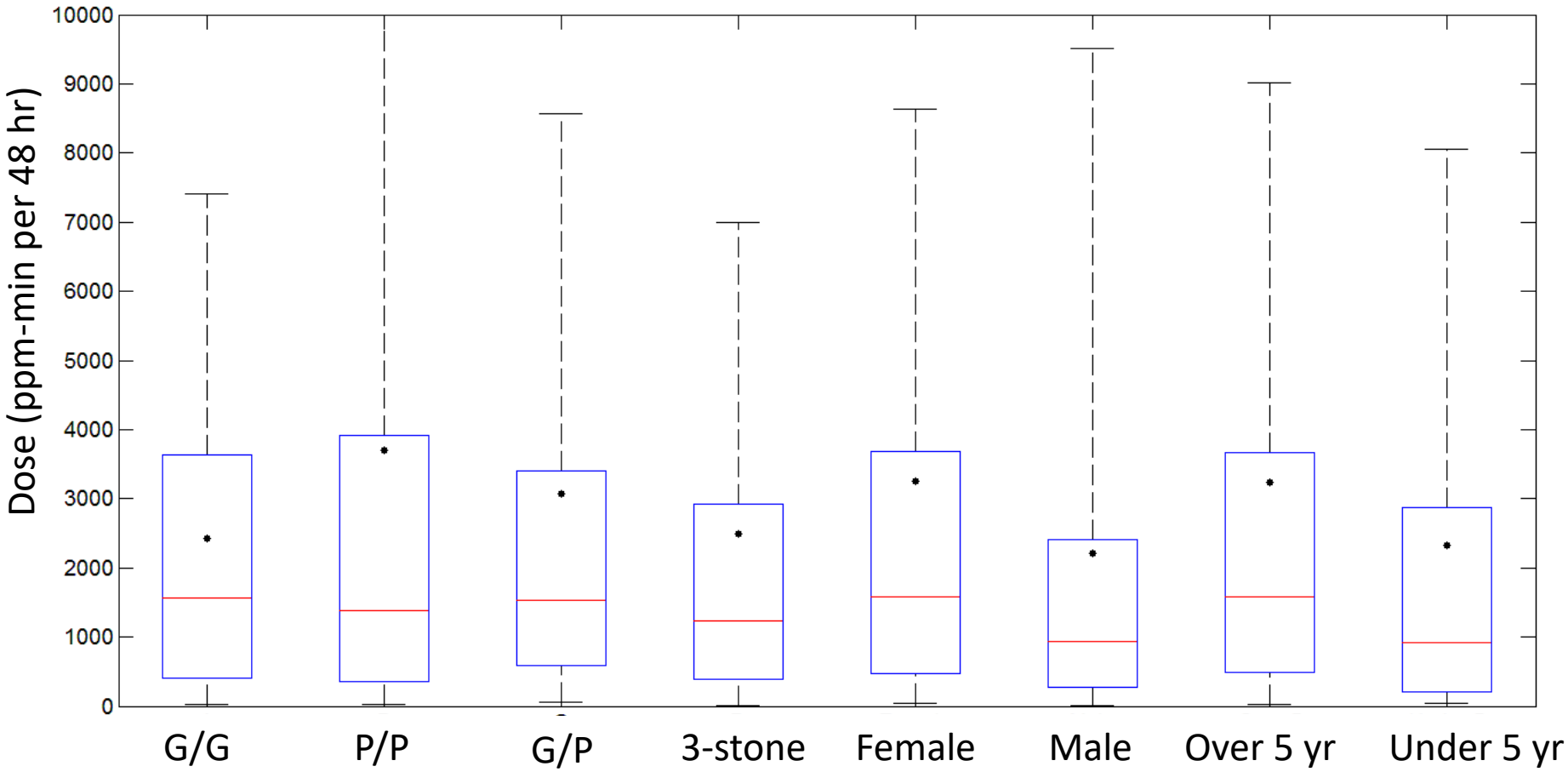
Example CO personal exposure



Personal CO Doses

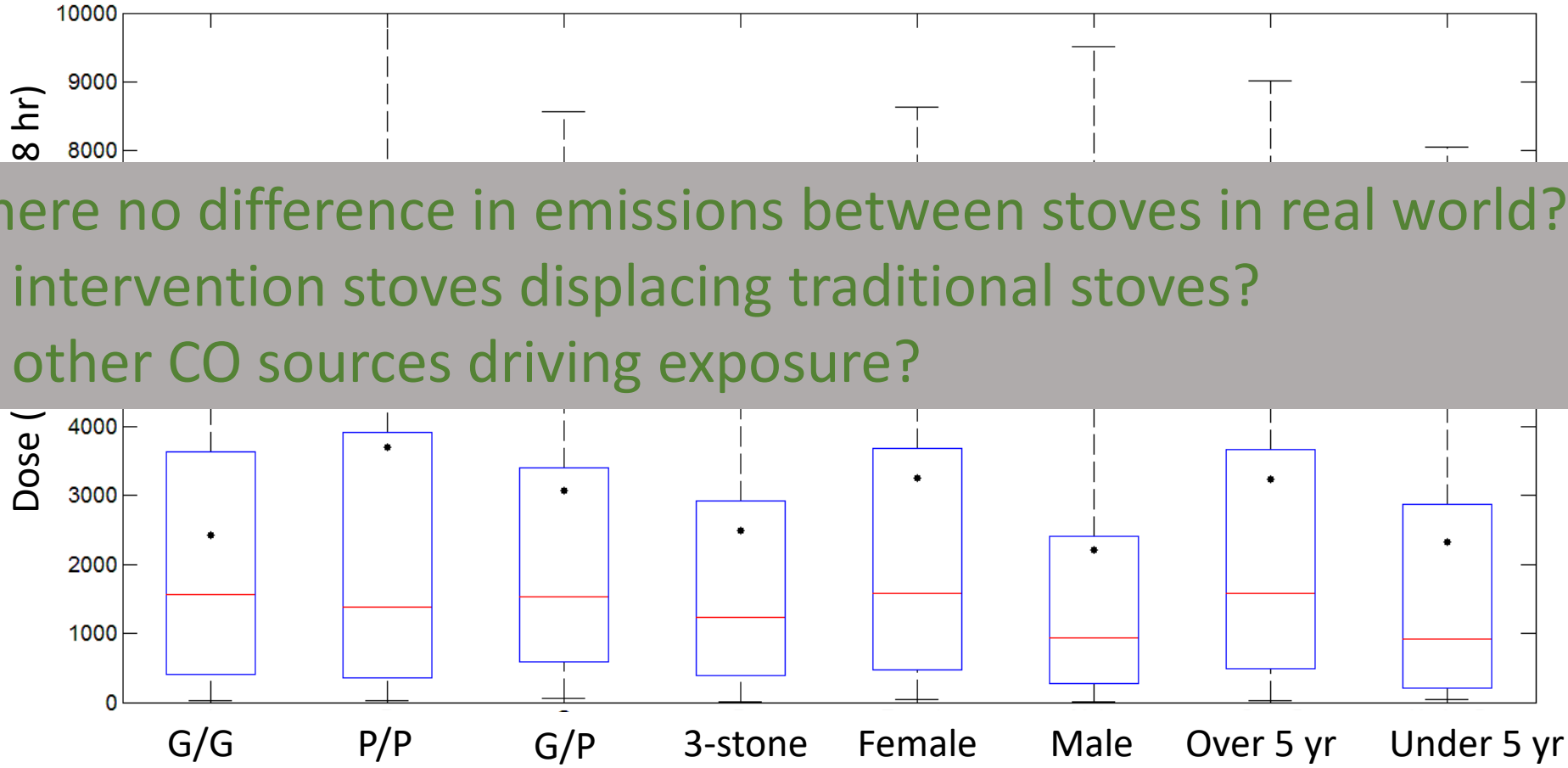


Personal CO Doses



Why aren't we seeing differences in CO exposure?

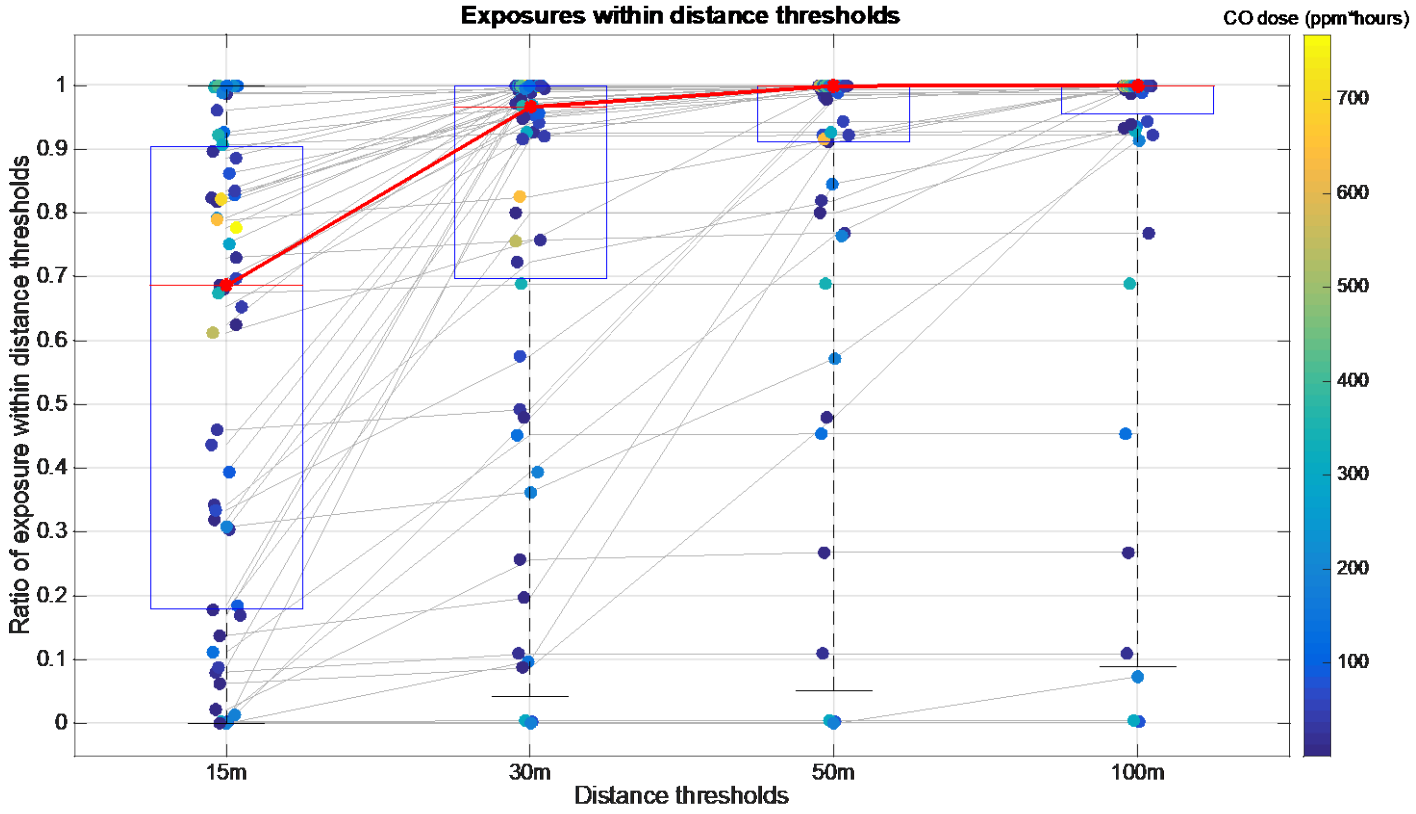
Personal CO Doses



- ✓Is there no difference in emissions between stoves in real world?
- ✓Are intervention stoves displacing traditional stoves?
- ✓Are other CO sources driving exposure?

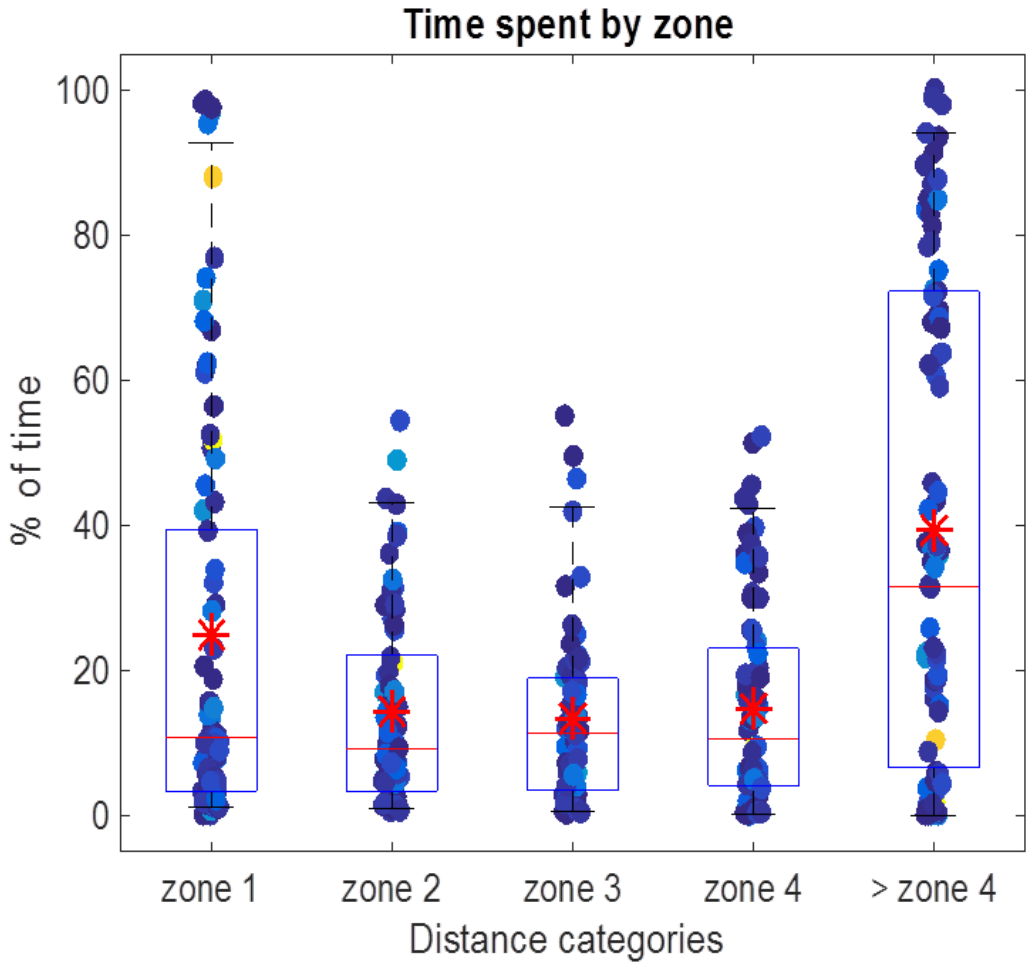
Why aren't we seeing differences in CO exposure?

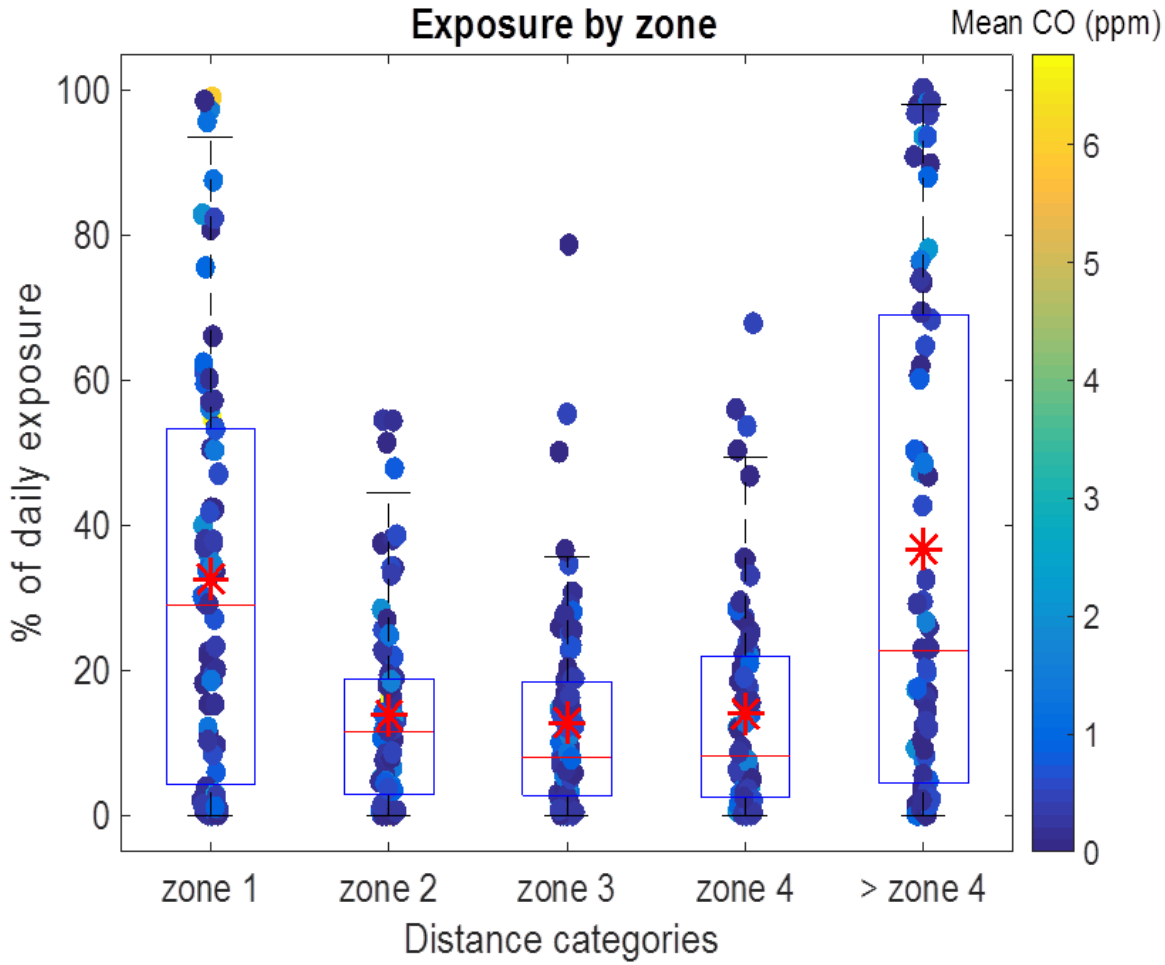
Is there a different way to check this exposure – source link?



Use real-time exposure data with proximity & location data.

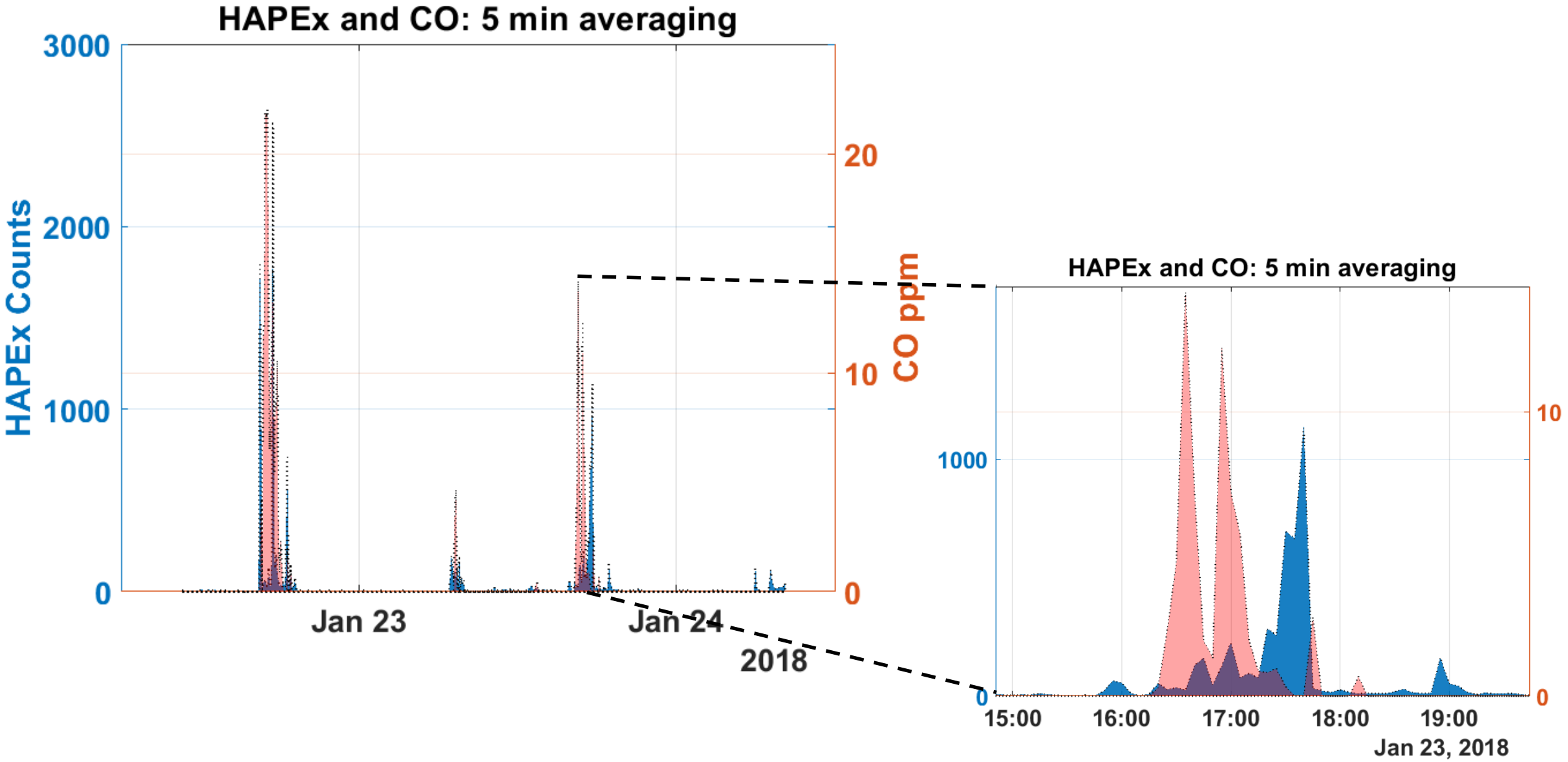
Low-cost real-time sensing can provide unique opportunities for analysis.



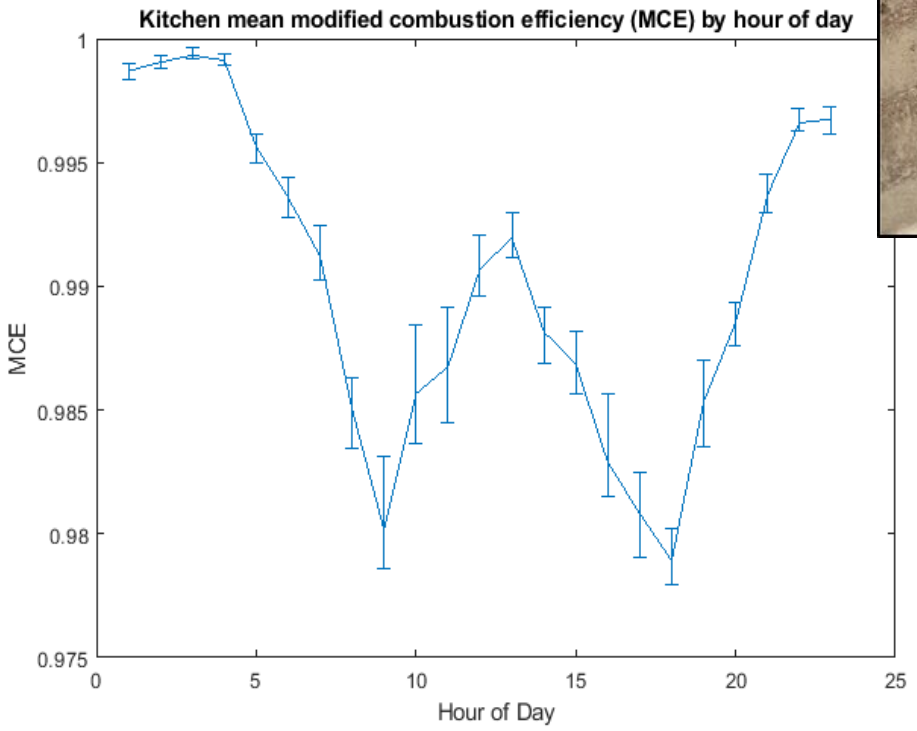


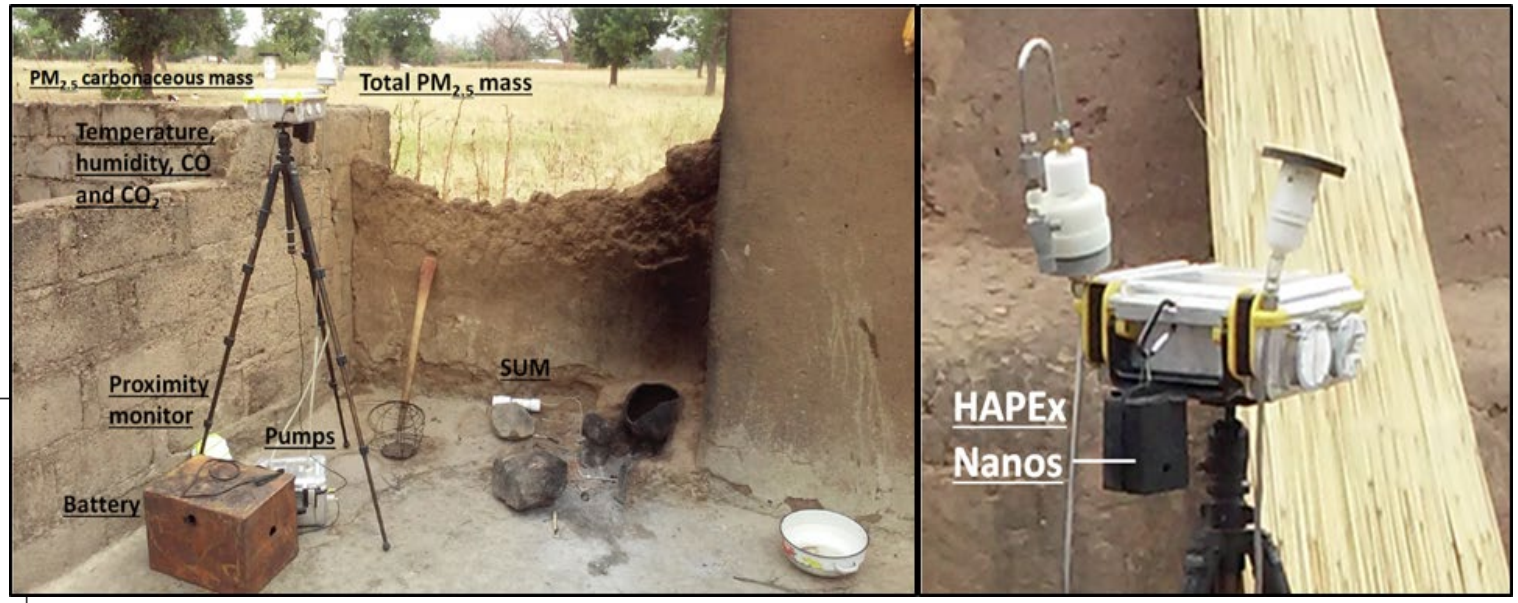
Piedrahita, et al., Attributing Air Pollutant Exposure to Emission Sources with Proximity Sensing, Atmosphere, in press.

Sensor time resolution helps find links with sources and activities …



Can the CO sensor help with PM measurements?

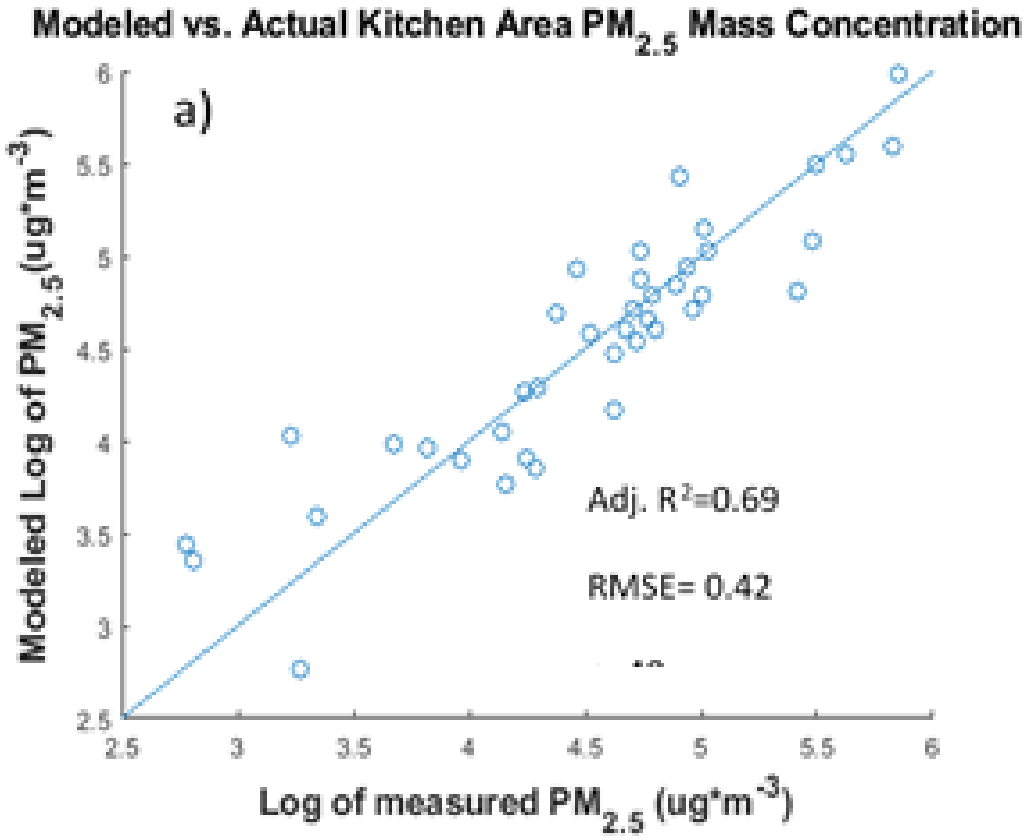


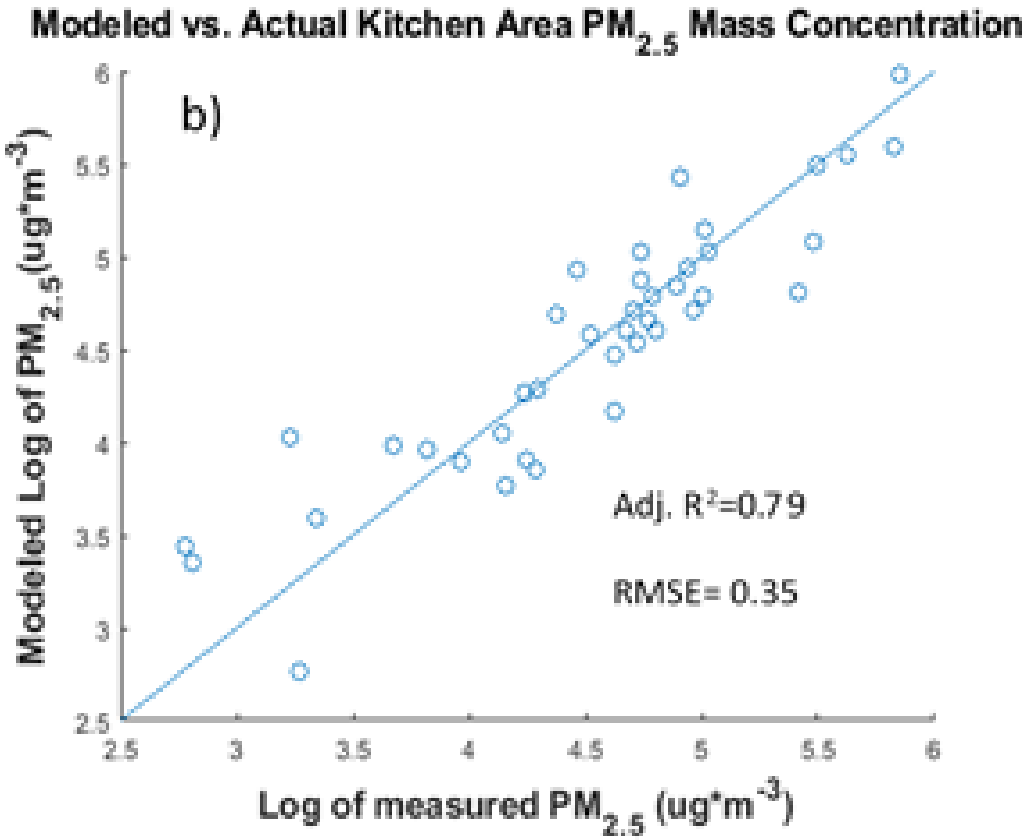


E. Coffey et al., “Kitchen Area Air Quality Measurements in Northern Ghana: Evaluating the Performance of a Low-Cost Particulate Sensor within a Household Energy Study”, *Atmosphere*, in press.

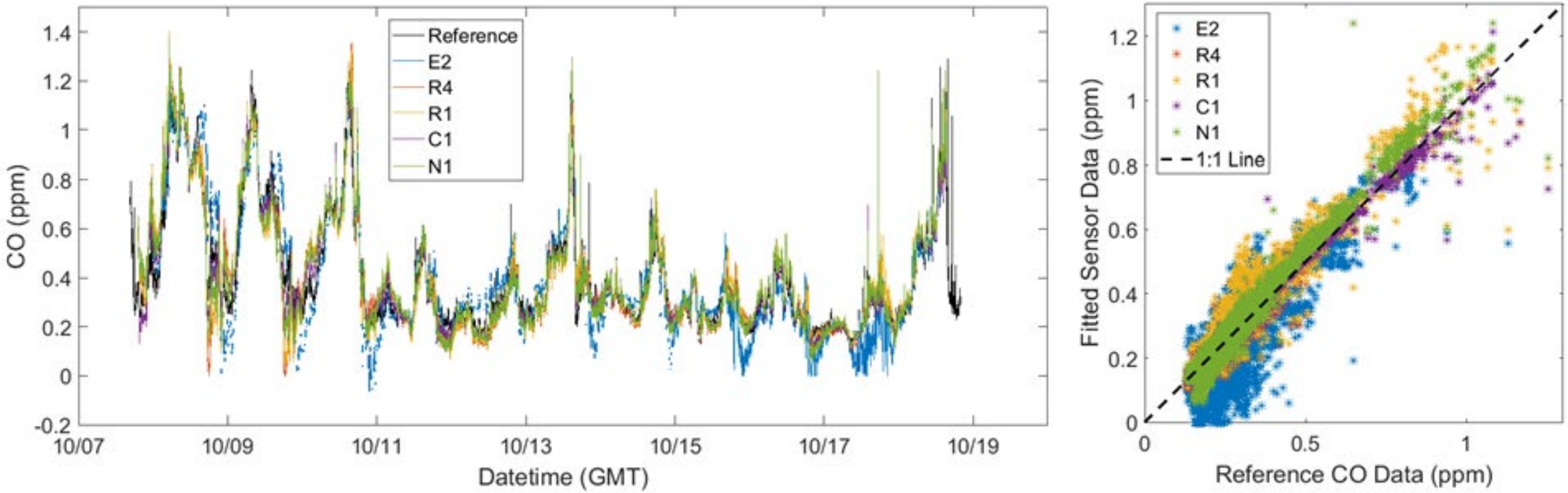
MCE to improves PM sensor quantification

So does temperature, RH, season, urban/rural classification



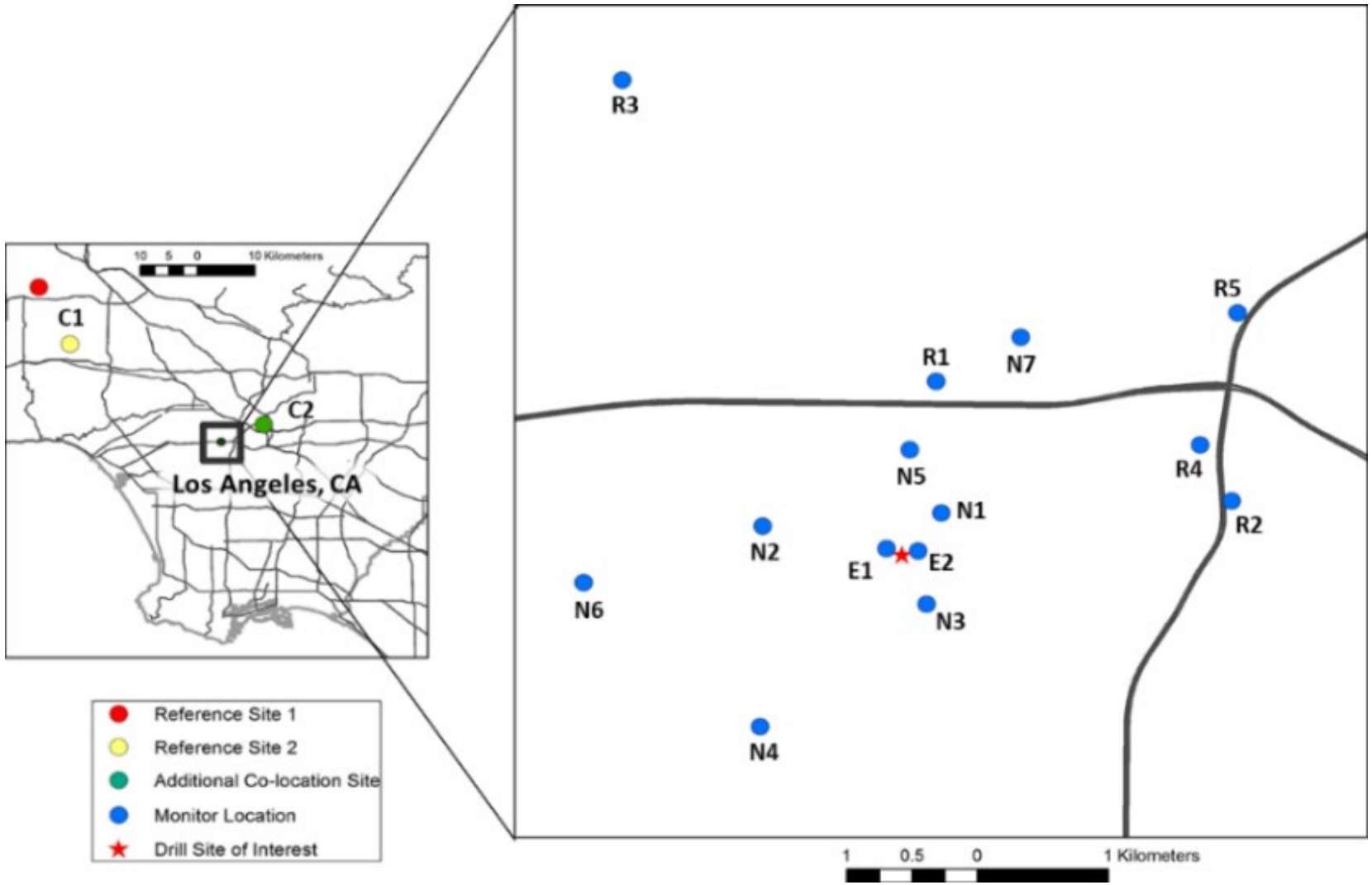


How useful is this type of CO sensor at lower US ambient concentrations?



Here is a co-location of 5 Pods (equipped with electrochemical CO) in LA

You can use them to explore source links…



Collier-Oxandale, A, et al. “Using Gas-Phase Air Quality Sensors to Disentangle Potential Sources in a Los Angeles Neighborhood”
Submitted to Atmospheric Environment

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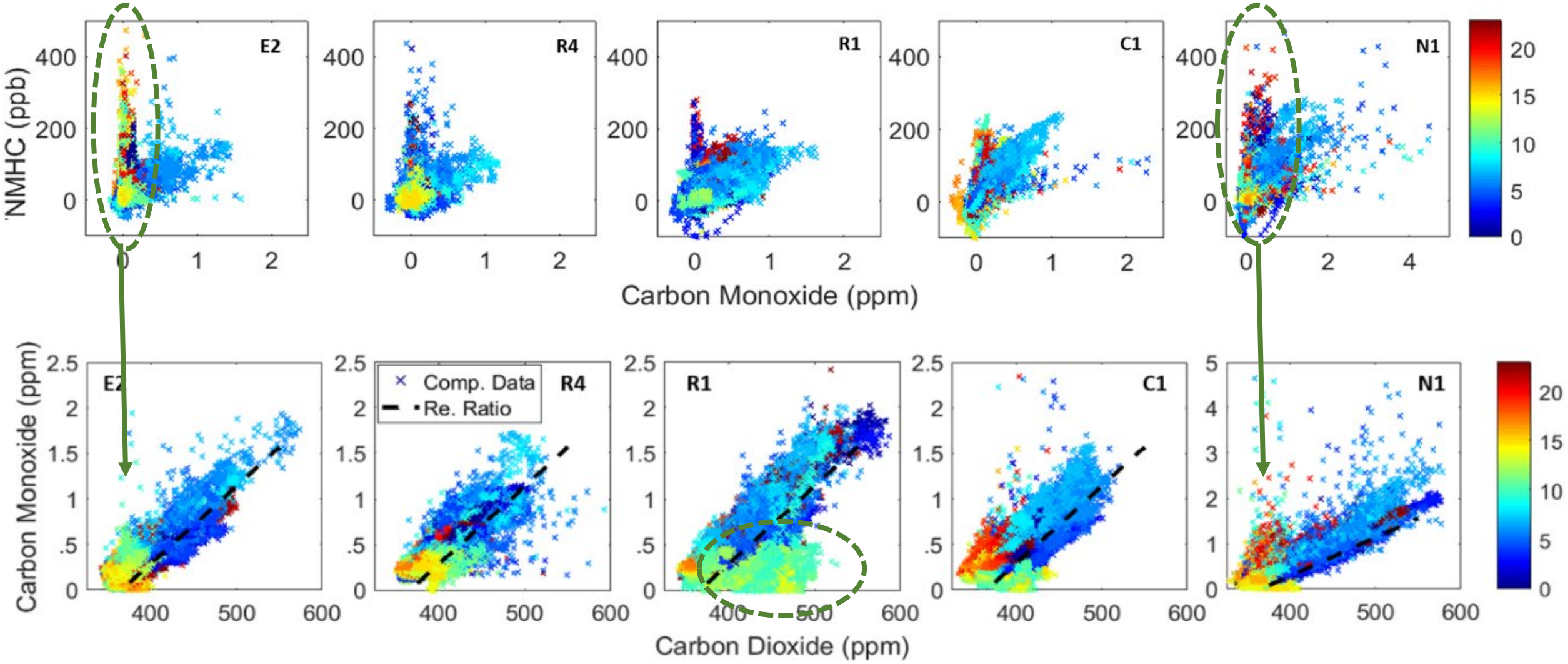
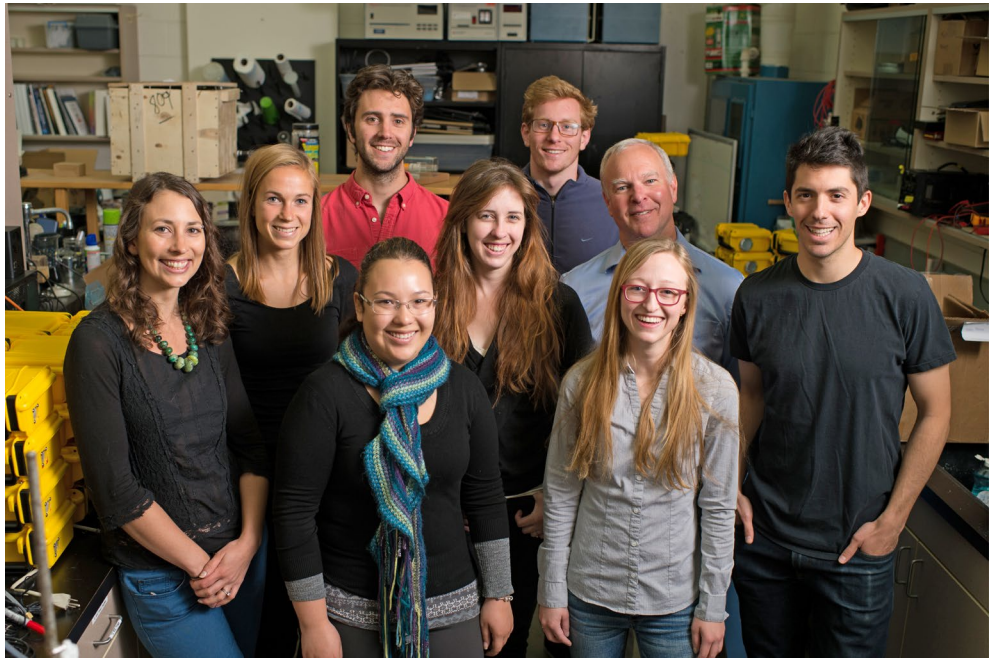


This work was done by many people …

My group:
Evan Coffey, Ashley Collier-Oxandale, Joanna Casey, Jake Thorson, Ricardo Piedrahita, Drew Meyers, Nick Masson



Collaborators in SoCal:
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<u>REACCTING team</u>
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