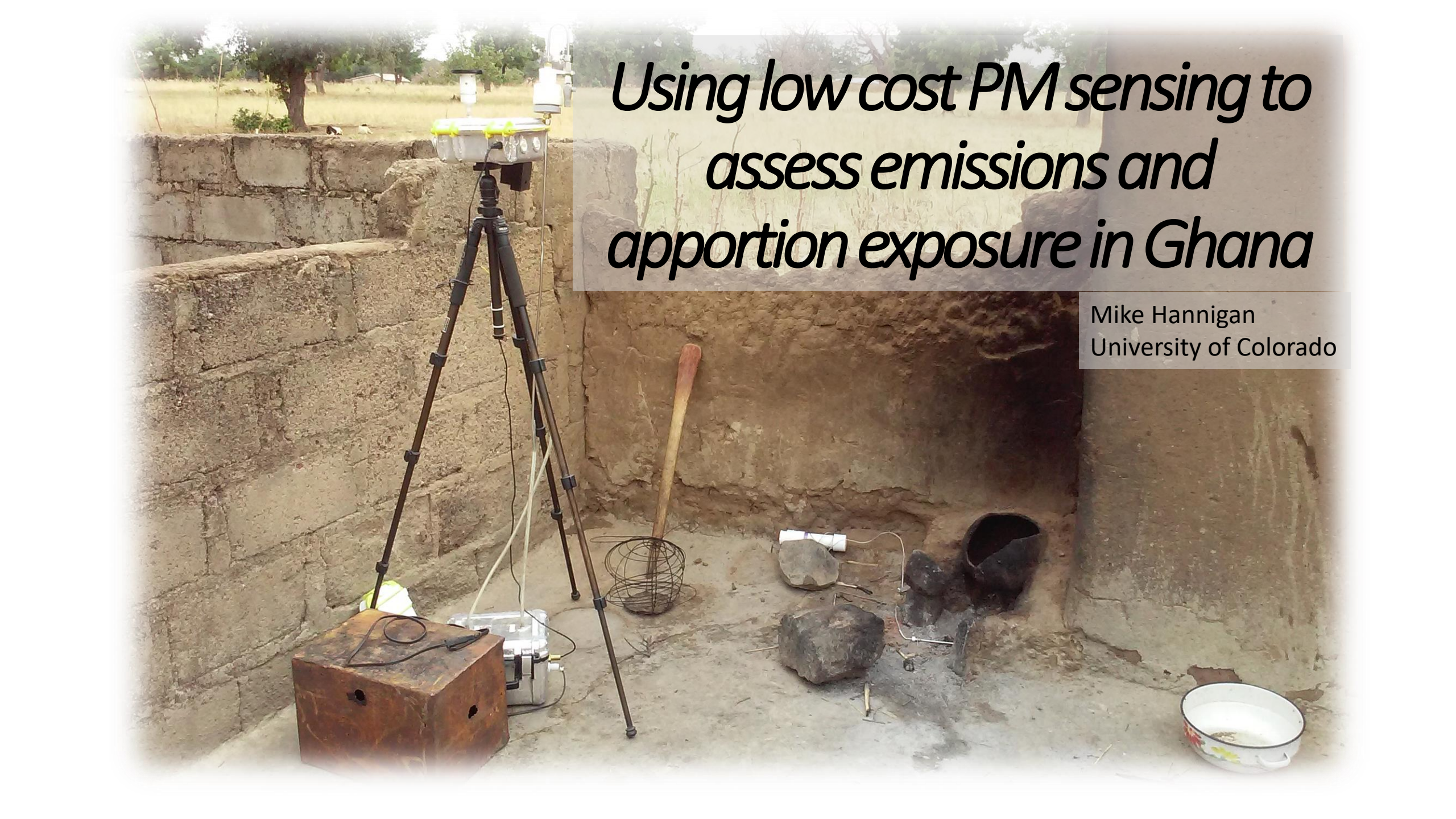
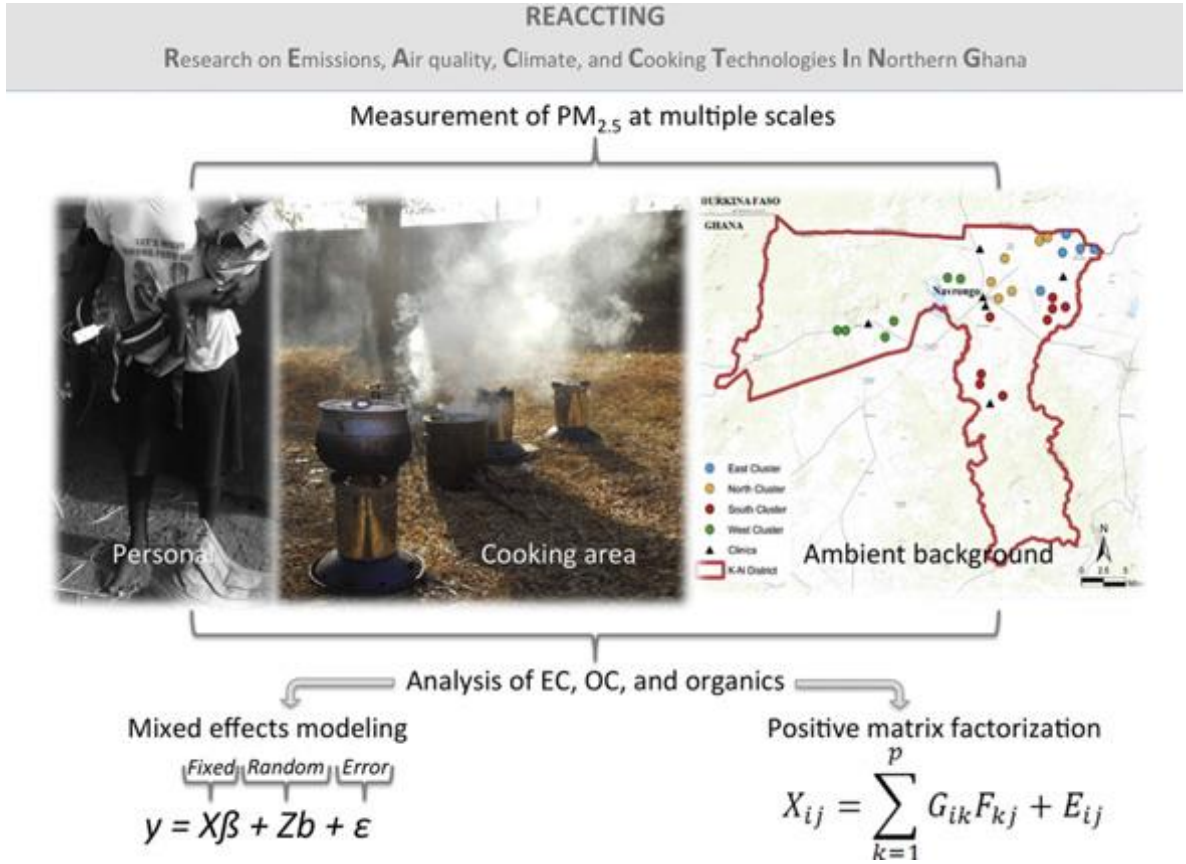
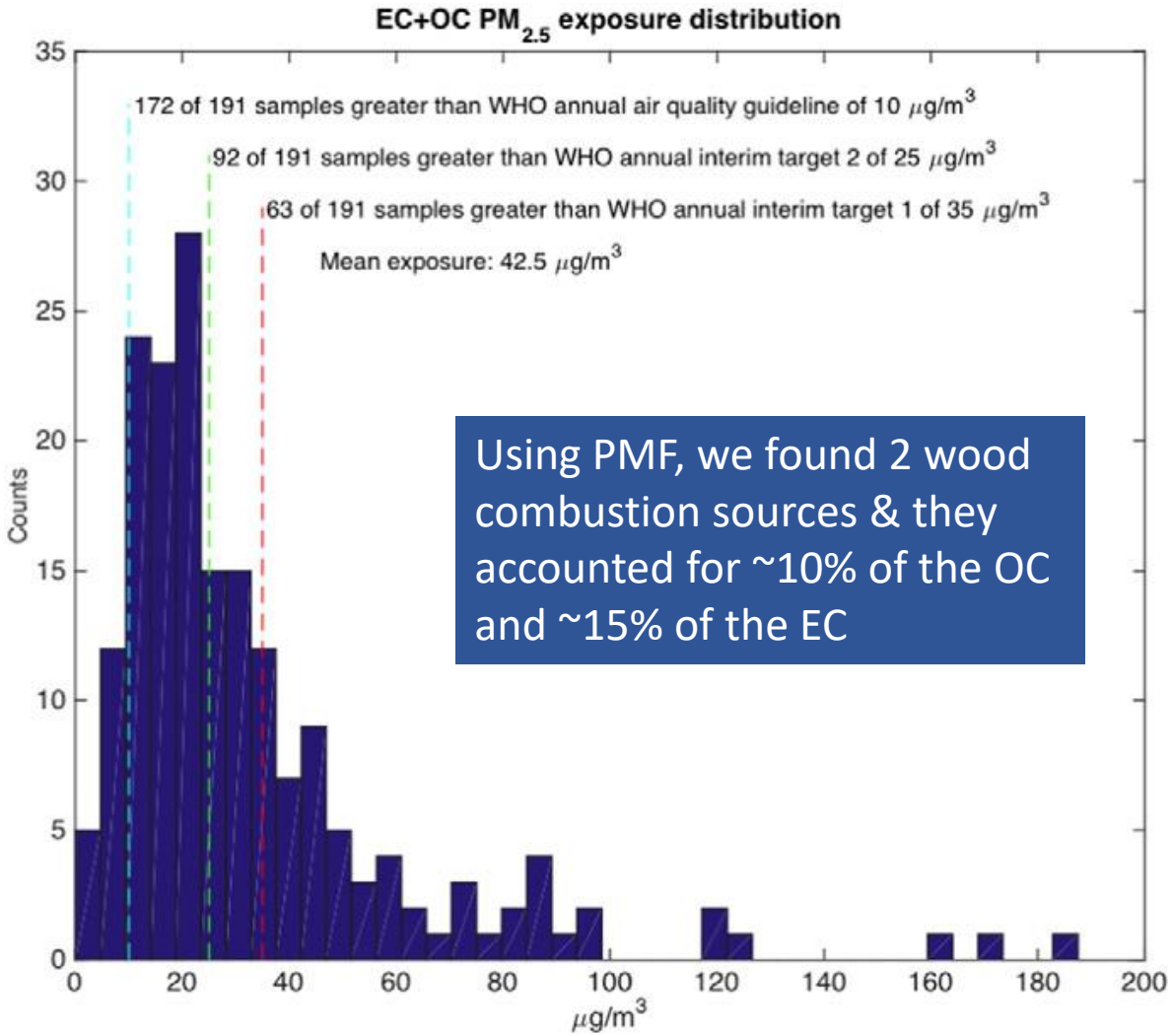


Using low cost PM sensing to assess emissions and apportion exposure in Ghana

Mike Hannigan
University of Colorado

PM2.5 exposure from REACCTING

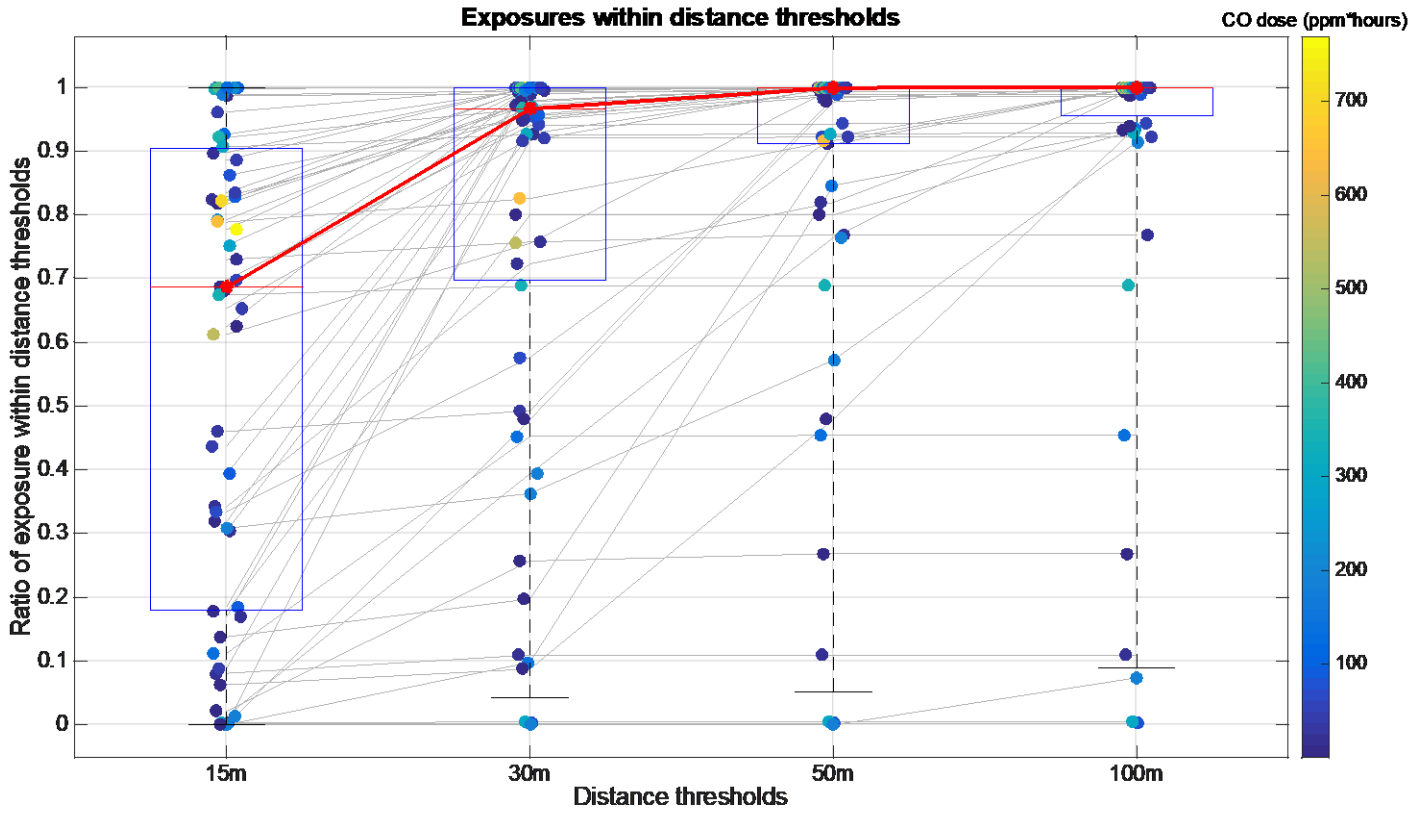




Using PMF, we found 2 wood combustion sources & they accounted for ~10% of the OC and ~15% of the EC

Piedrahita, R, Kanyomse, E, Coffey, E, Xie, M, Hagar, Y, Alirigia, R, Agyei, F, Wiedinmyer, C, Dickinson, KL, Oduro, A, Hannigan, MP. Exposures to and the origins of carbonaceous PM2.5 in a cookstove intervention in Northern Ghana. *Science of the Total Environment*, 2017, 576:178-192.

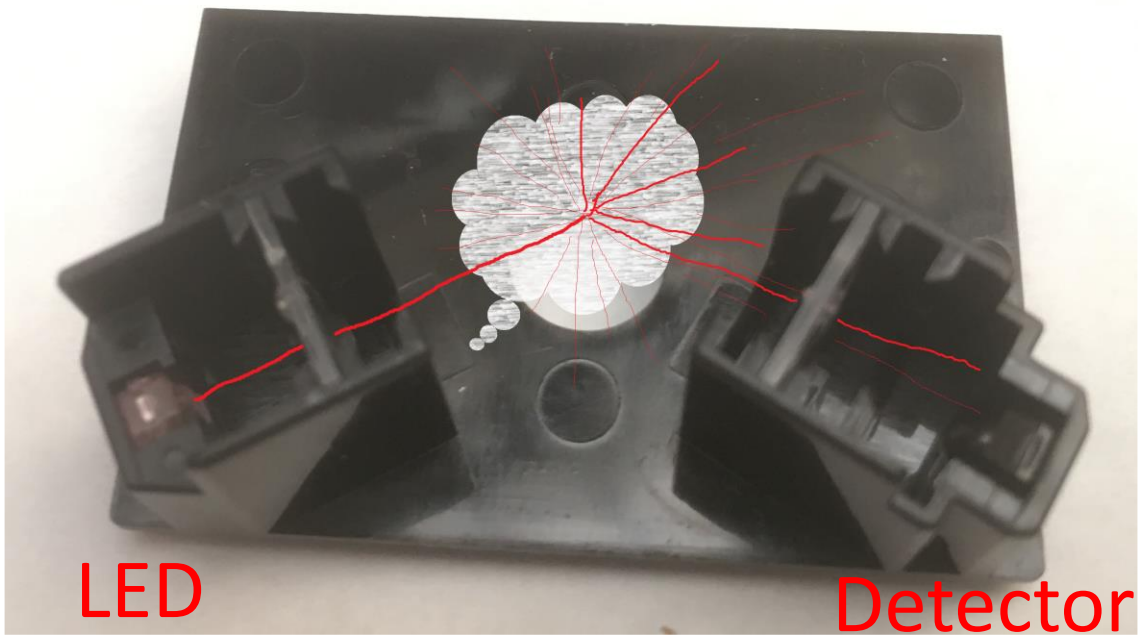
Is there a different way to check this exposure – source link?



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

The PM technology

- HAPEx Nano Monitor (~USD 119)
  - SHARP GP2Y10 sensor with infrared LED and phototransistor
  - Battery powered, 5 year life, 9024 sample storage



PM sensor considerations (crude DQOs)

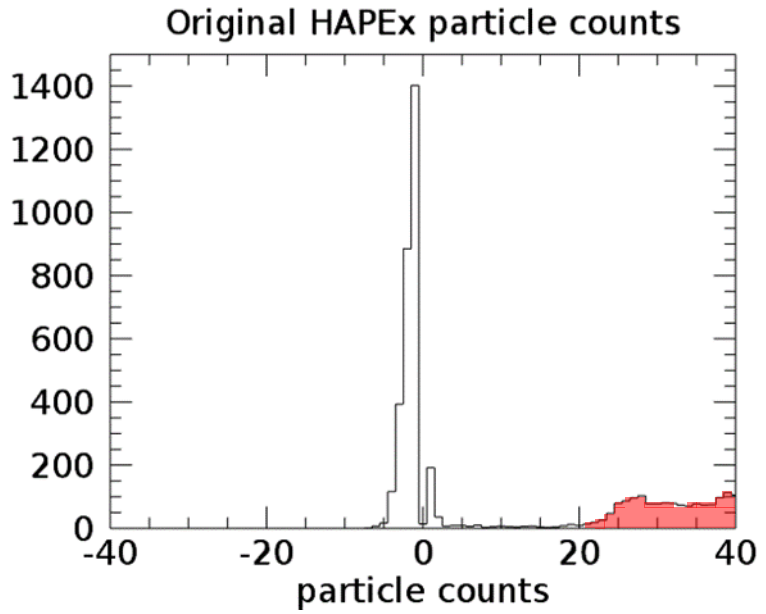
- Relatively high lower-detection limits (8-15 µg/m^3) constraining applications
- Want to constrain bias: (1) between sensors and (2) through time

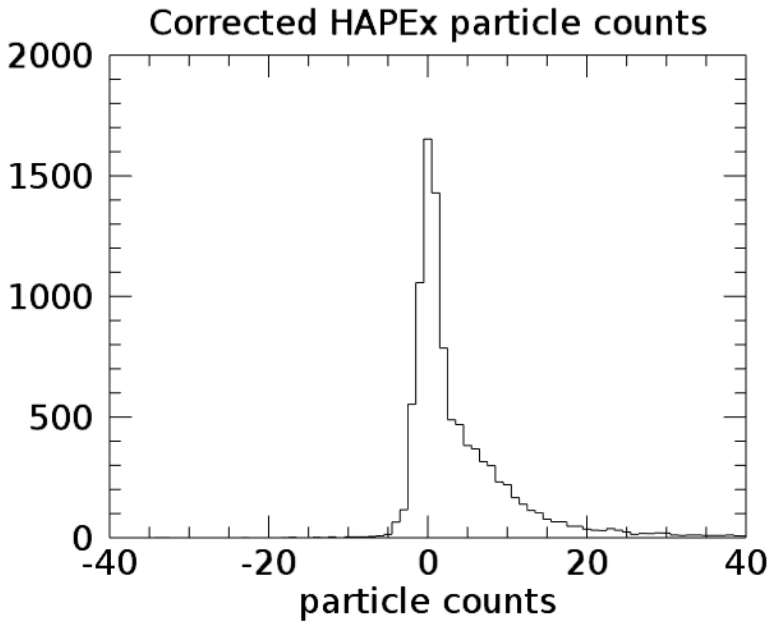
✓Baseline sensor drift from lens fouling and/or artificial light common in field

✓Light-scattering signal a function of many factors

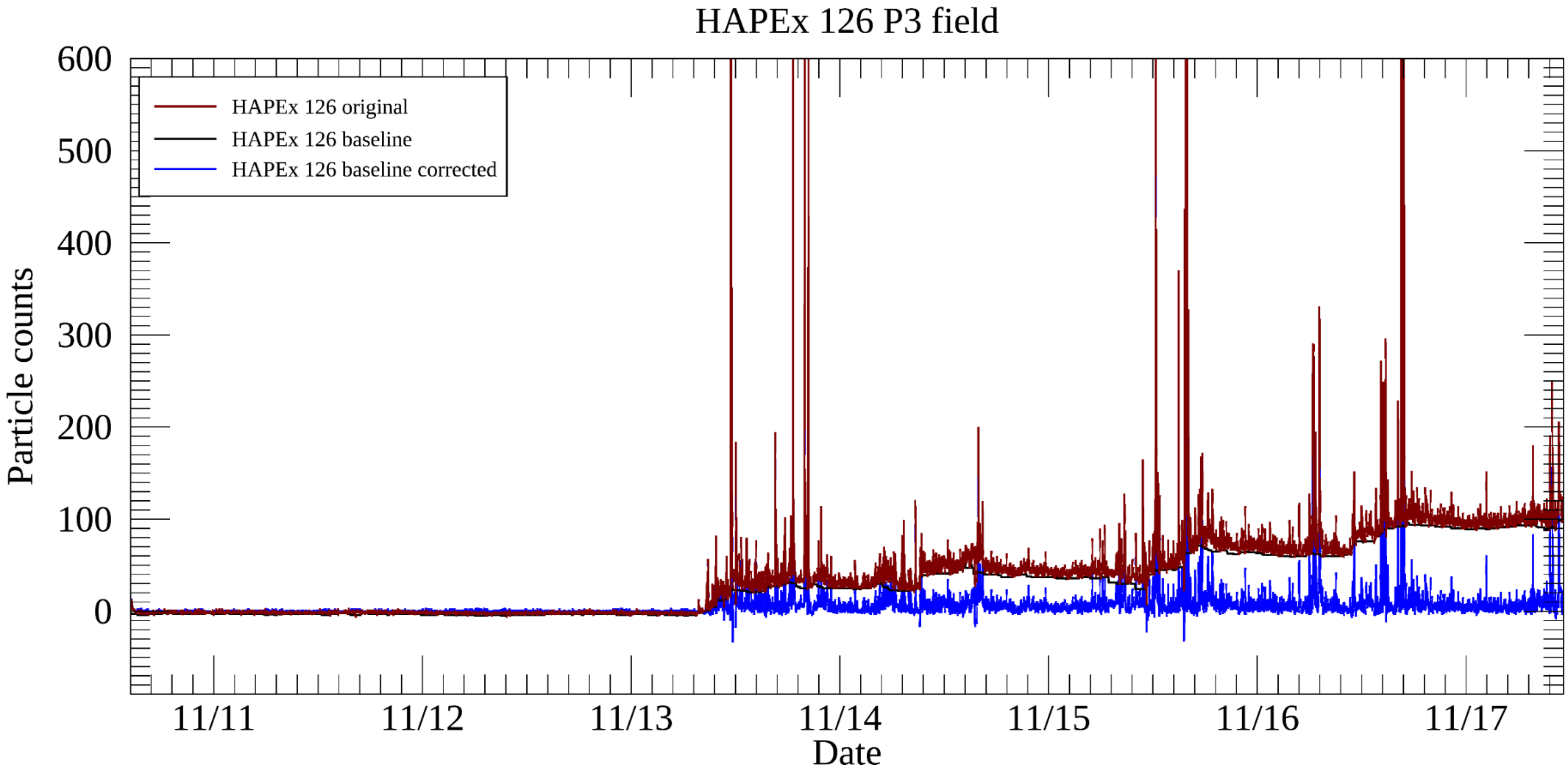
  ✓mass concentration, relative humidity, chemical composition, particle albedo etc.

✓Long term sensitivity drift in highly polluted environments

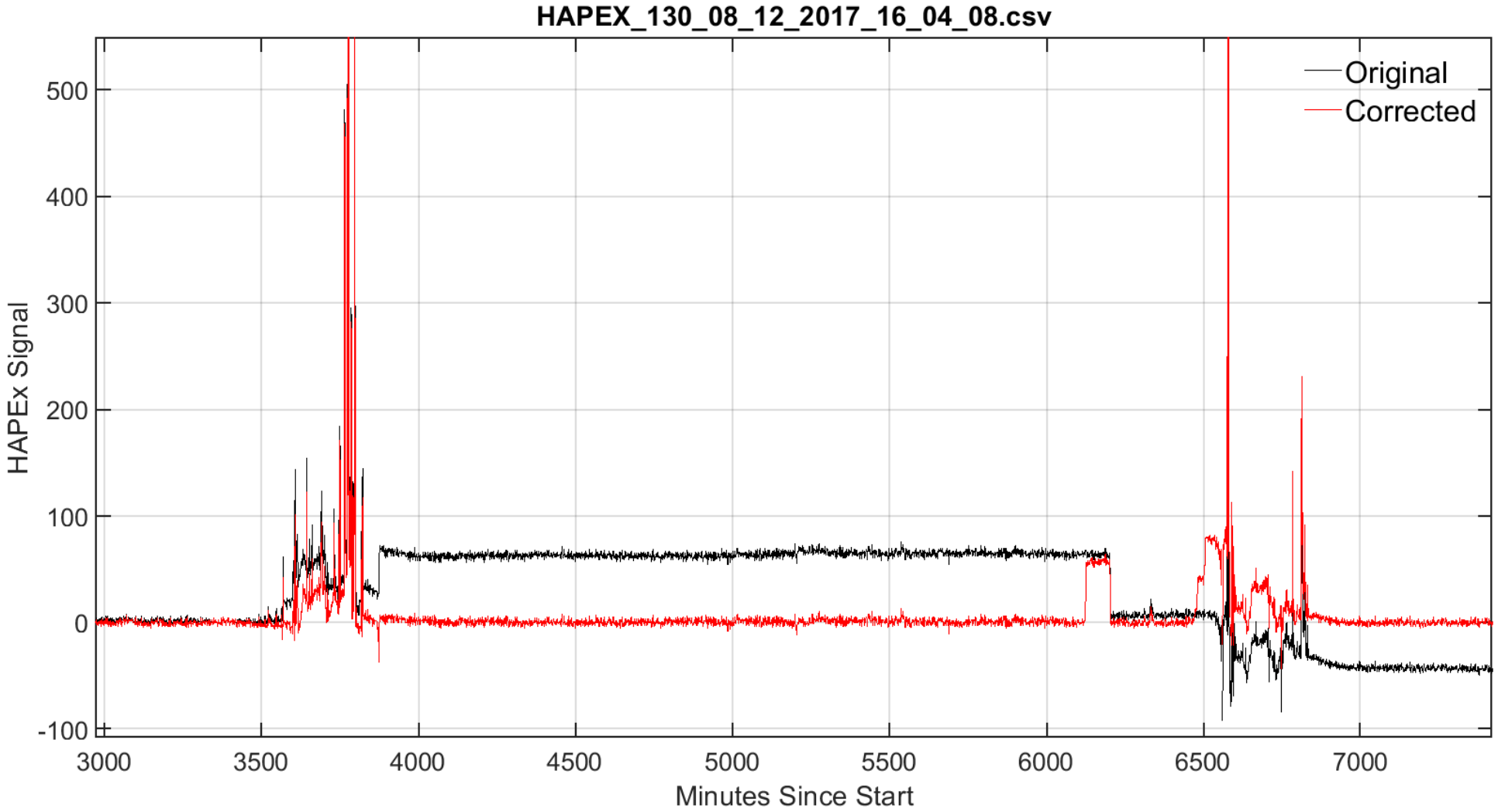


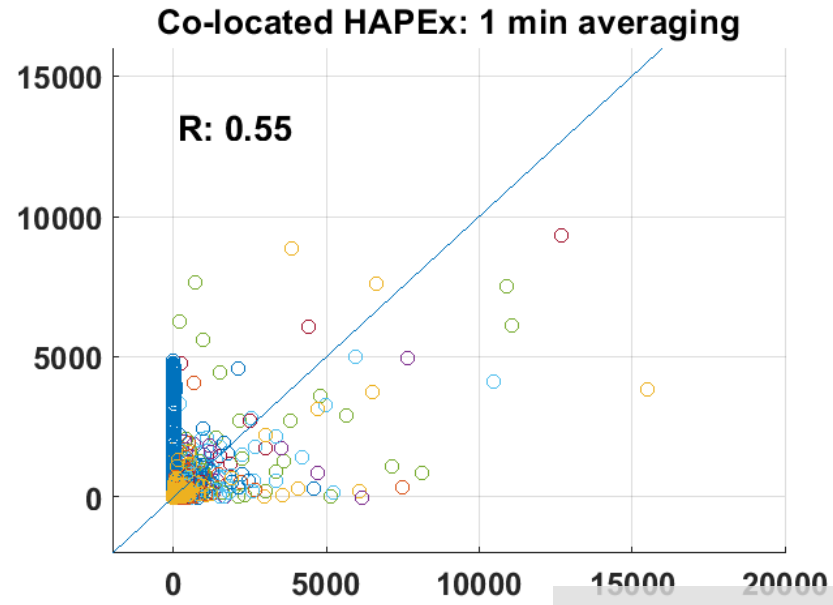


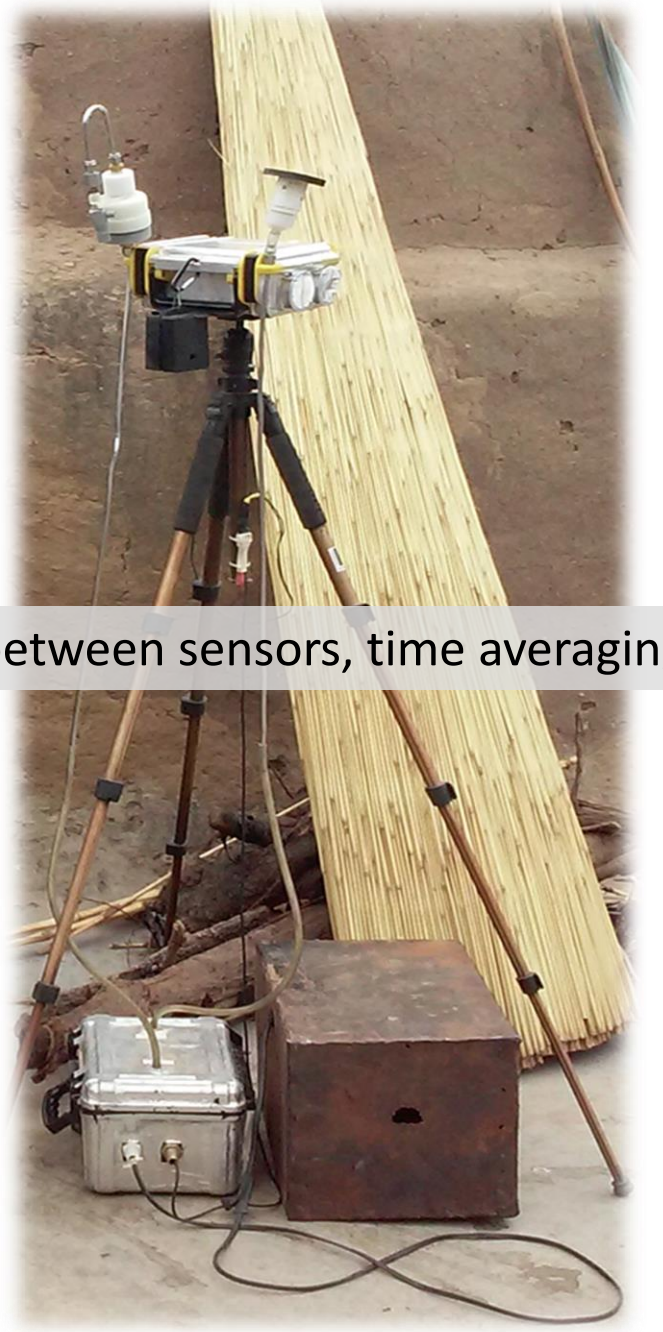
Baseline drift needs to be eliminated (homemade code)

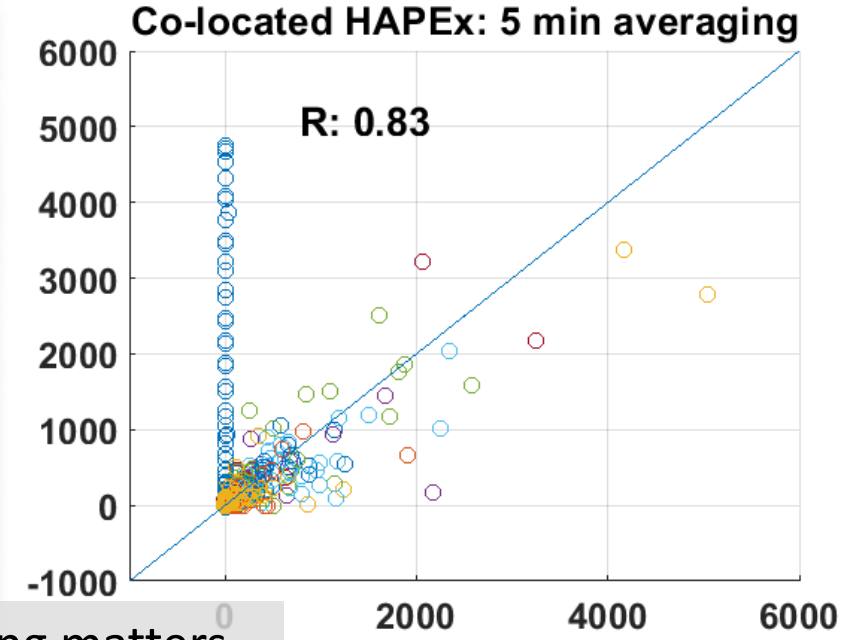


It is messy sometimes …

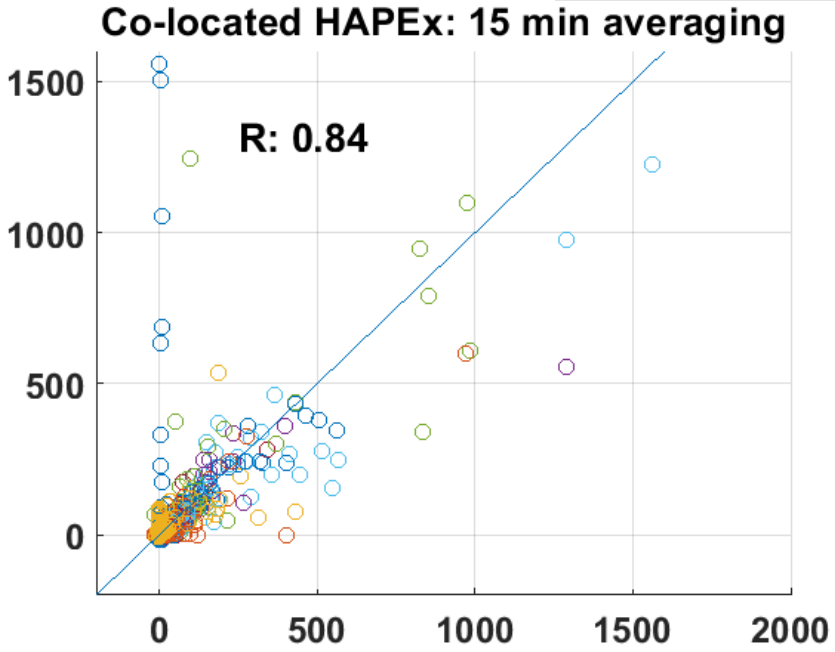


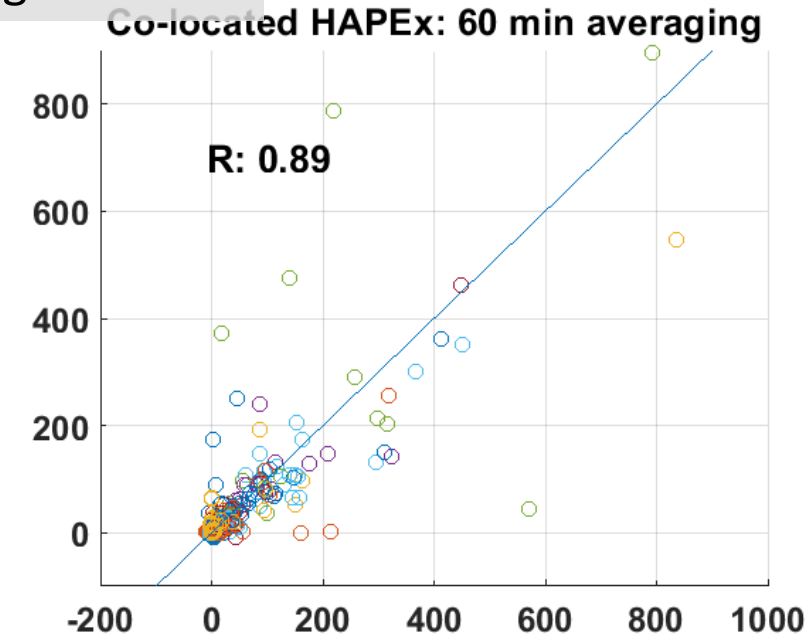






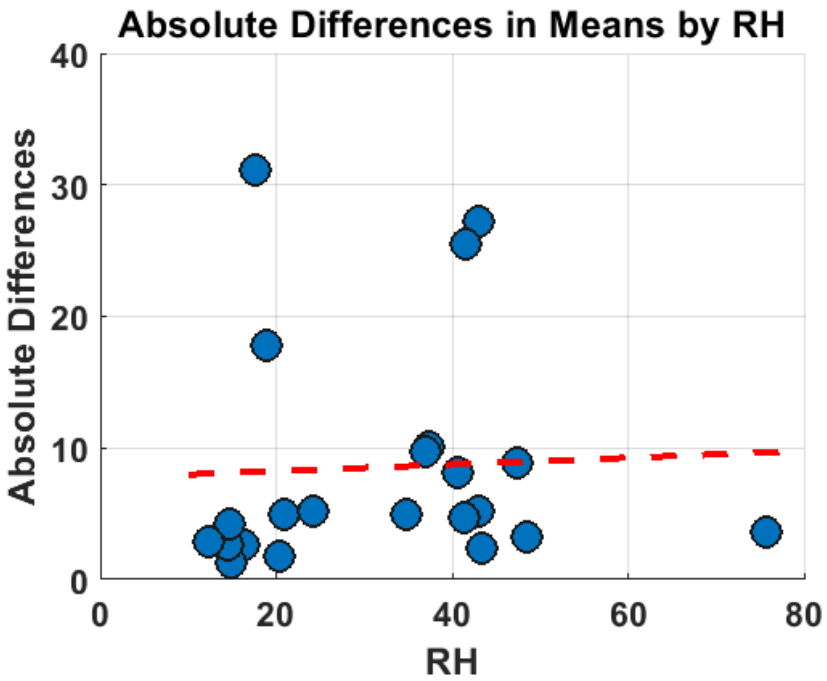
To compare between sensors, time averaging matters.

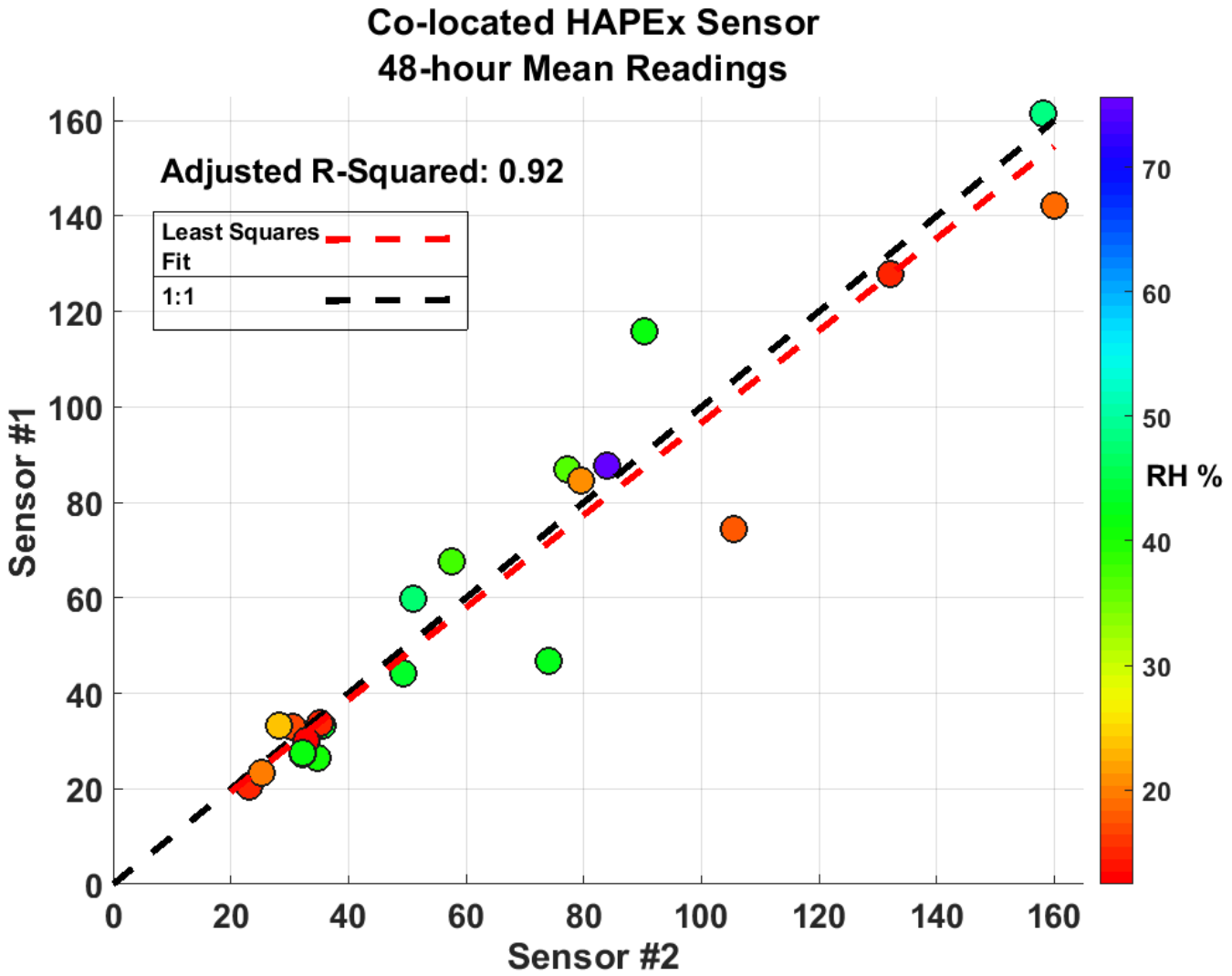




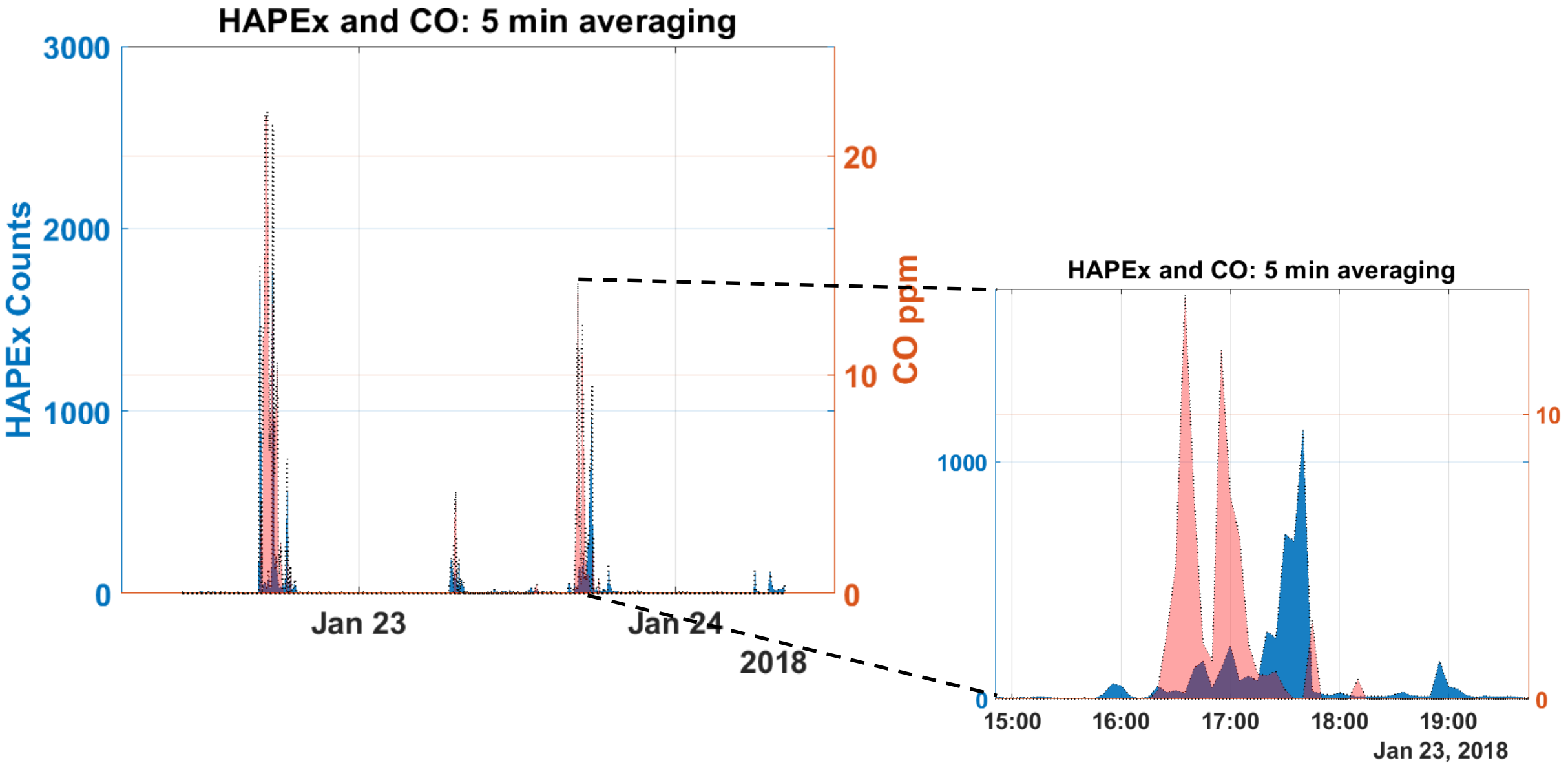
More thoughts about comparing between two sensors … Kitchen Area Measurements: Preliminary Data

- High precision among sensors for 48-hour mean readings with R^2 of 0.92

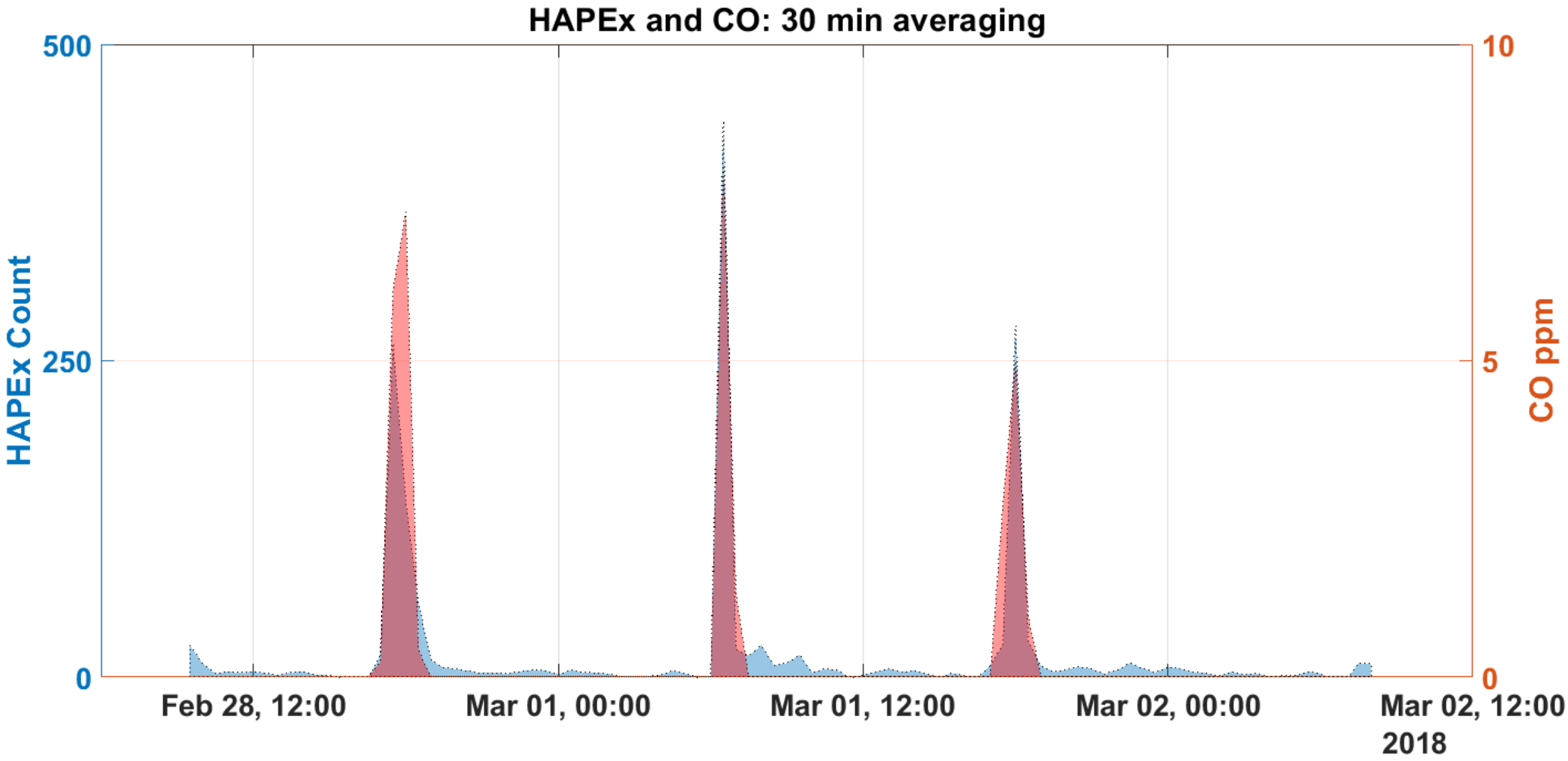




But high time resolution helps find links with sources and activities …

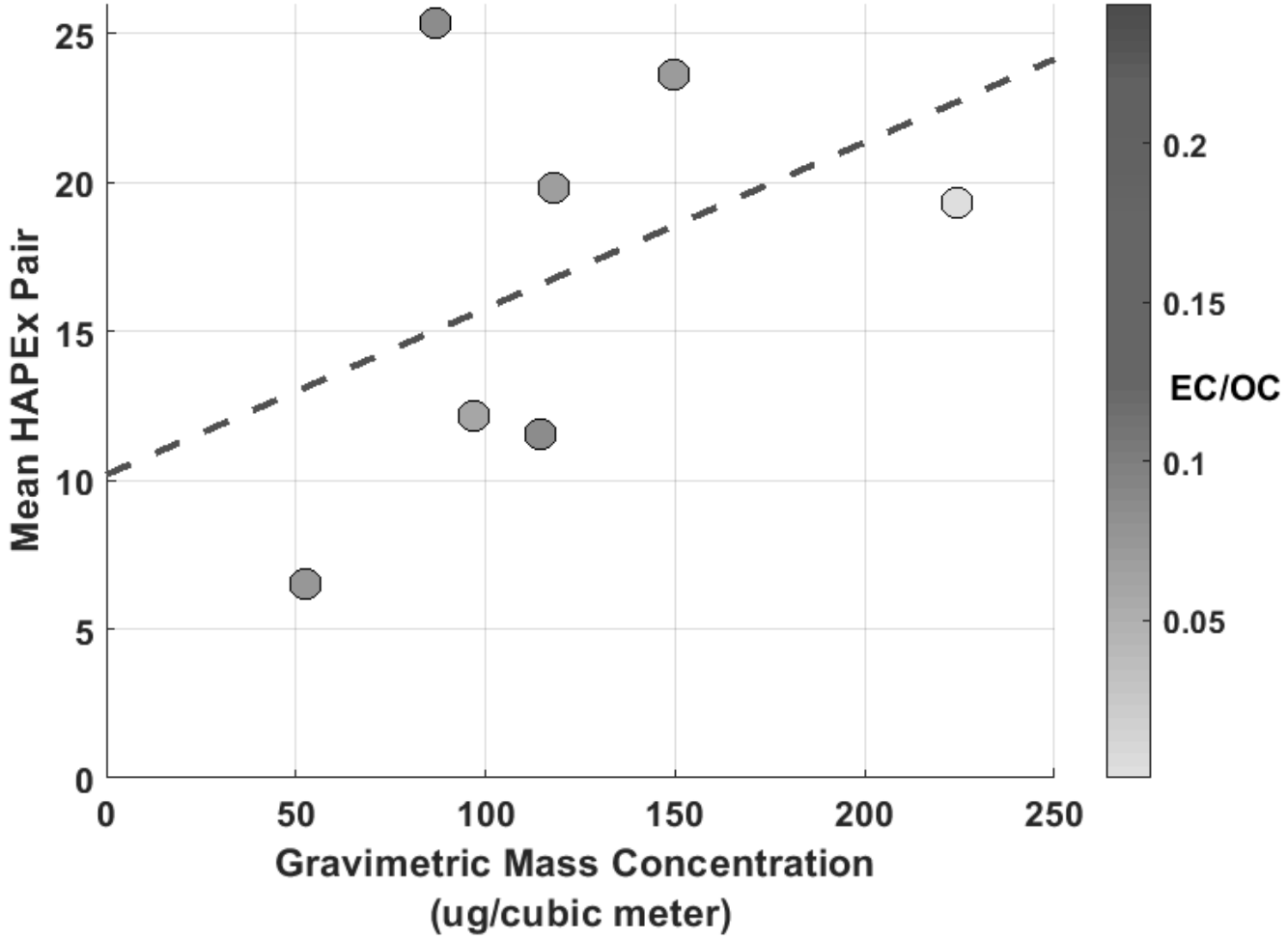


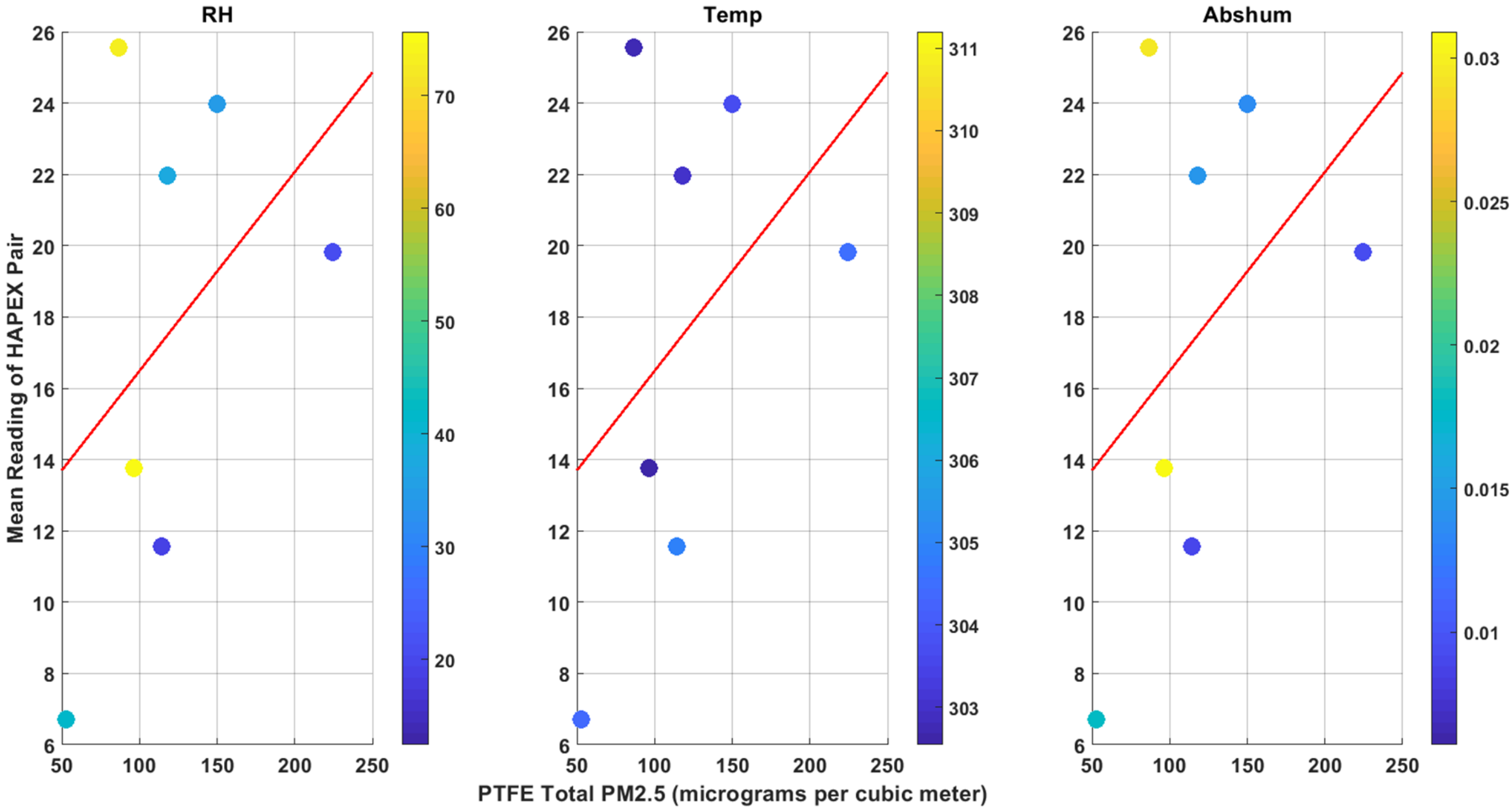
If you average, then you lose some information



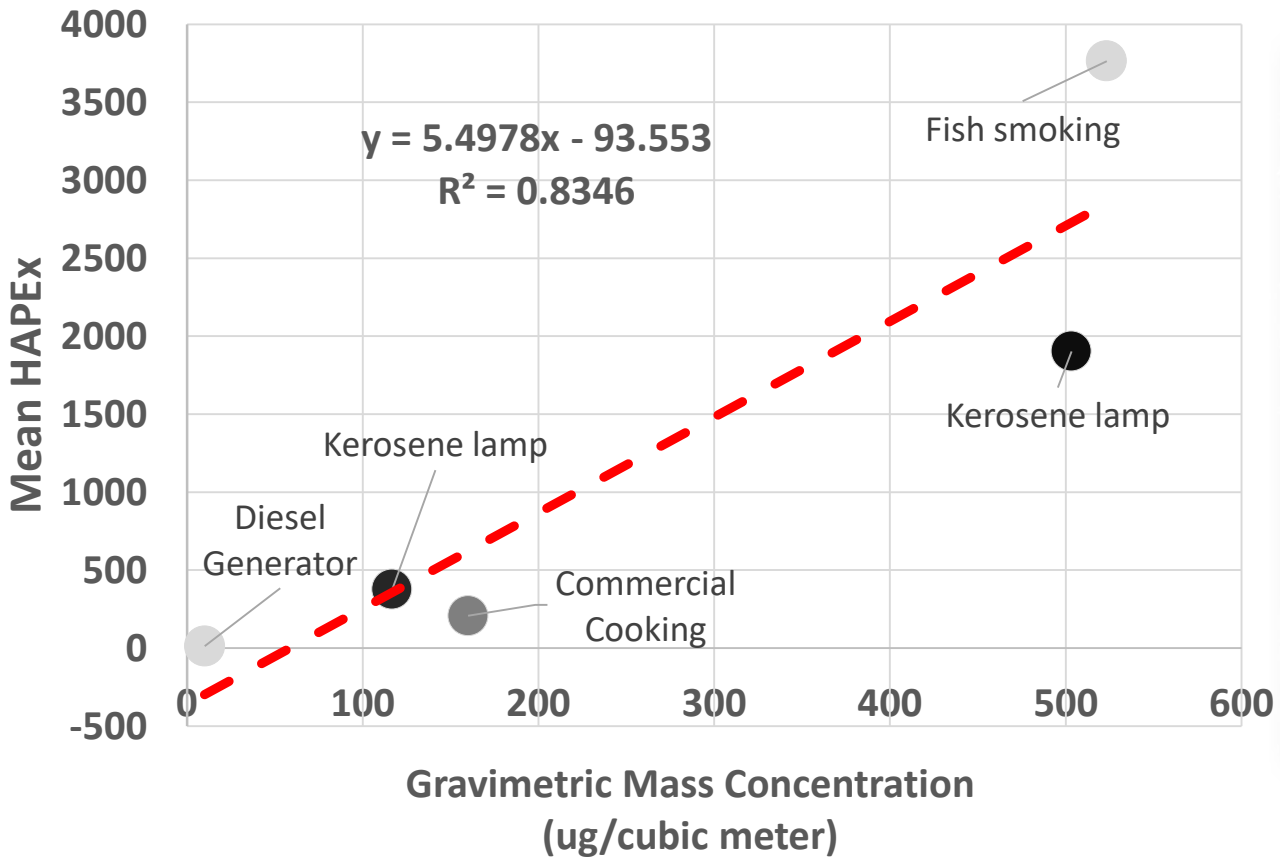
Calibration of sensor signal to PM2.5 mass concentration … Kitchen Area Measurements: Preliminary data

- Correlation between 48-hr gravimetric mass and mean HAPEx readings low (adj. R^2~0.04)
- Other factors explain additional HAPEx variation
  - Particle albedo, EC/OC (adj. R^2~0.79)
  - Temp
  - RH
  - CO, CO2 (modified combustion efficiency)




RH
Temp
Abshum
Mean Reading of HAPEX Pair
PTFE Total PM2.5 (micrograms per cubic meter)
26
24
22
20
18
16
14
12
10
8
6
50
100
150
200
250
70
60
50
40
30
20
311
310
309
308
307
306
305
304
303
0.03
0.025
0.02
0.015
0.01

Direct emission measurements might be useful in a dynamic calibration, depends on DQO

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P3 Prices, Peers, and Perceptions: Improved Cookstove Research in Northern Ghana

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Funding:

Environmental Protection Agency STAR Program
National Science Foundation Coupled Natural Human Systems
National Science Foundation Economics Program
National Institutes of Health Clean Cooking Implementation Science Network (ISN)
Rathmann Family Foundation