

# Deployment of Low Cost PM Sensors: Aligning Sensor Performance and Data Quality Needs

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# Data Quality Pros and Cons of PM Sensors

- Pros
  - Precision is very easy to evaluate and assess
  - The real time nature of sensors allows direct observations of interventions, micro-environments and process changes
  - Very cost effective to have duplicate measurements
  - Catastrophic failure is easy to diagnose
- Cons
  - Susceptible to drift over time
  - Suffer from systematic bias
  - Accuracy can be dependent sensor aging, PM composition and physical properties, and other environmental factors
  - Difficult to conduct field based calibrations



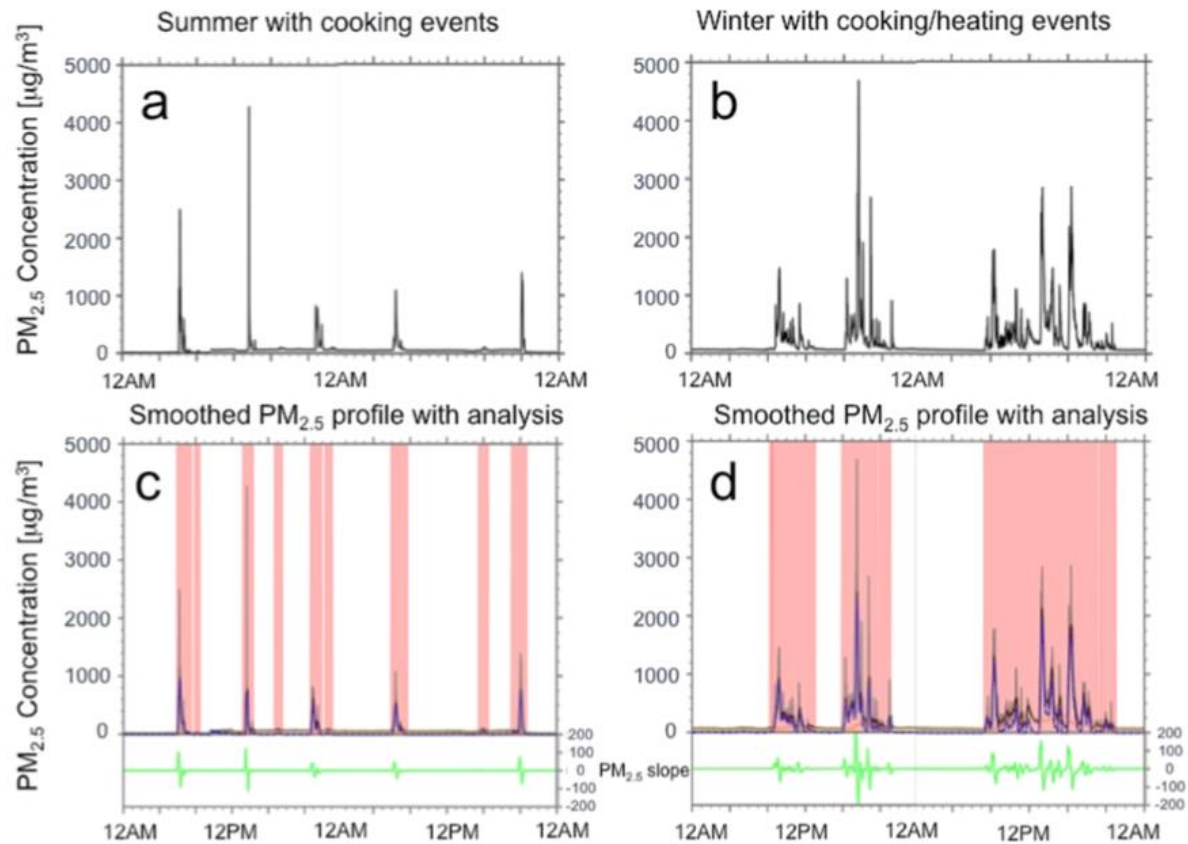
# Ideal Applications for PM Sensors

- Supplementing filter-based measurements to add scaled real time concentration data
- Obtains spatial gradients
- Identifying high exposure micro-environments
- Identifying meteorological conditions that lead to high concentrations
- Source tracking
- Assessment of interventions and the impact of control measures

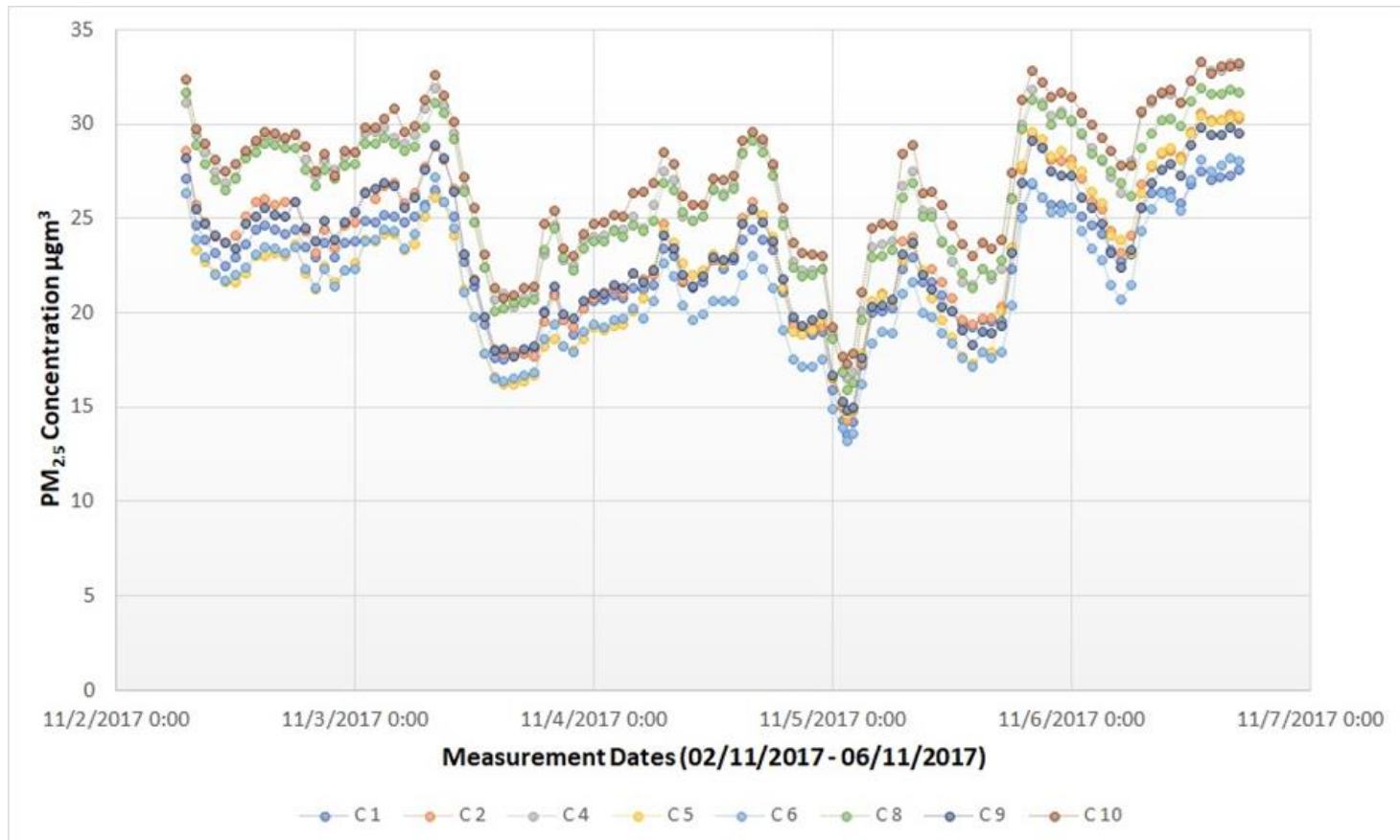


# Scaling Real Time Sensor Data (Carter et al., ES&T 2016)

Environmental Science & Technology

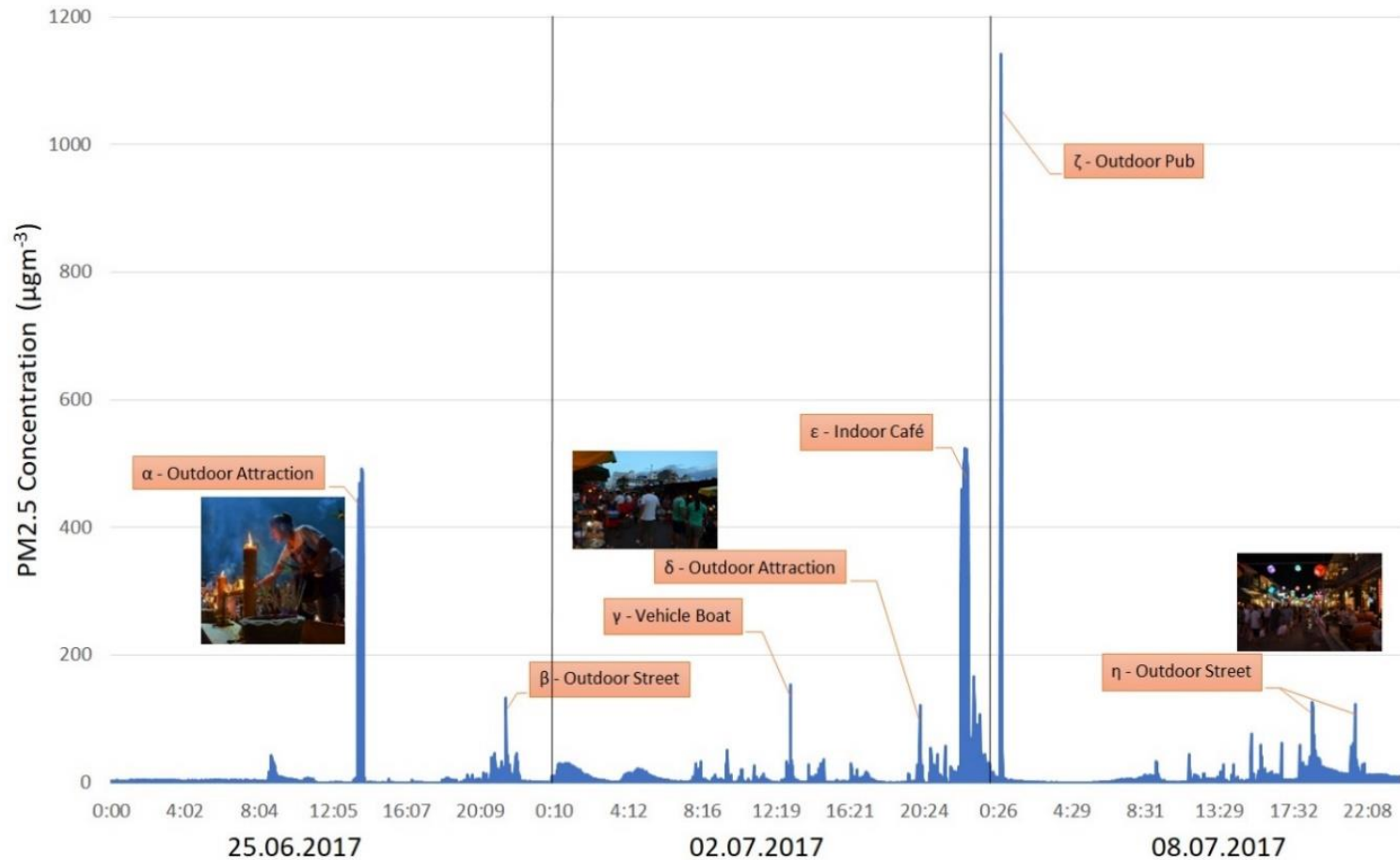


# Colocation of Low Cost Sensors after Urban Spatial Gradient Study (Ozler MS Thesis, UW-Madison, 2018)



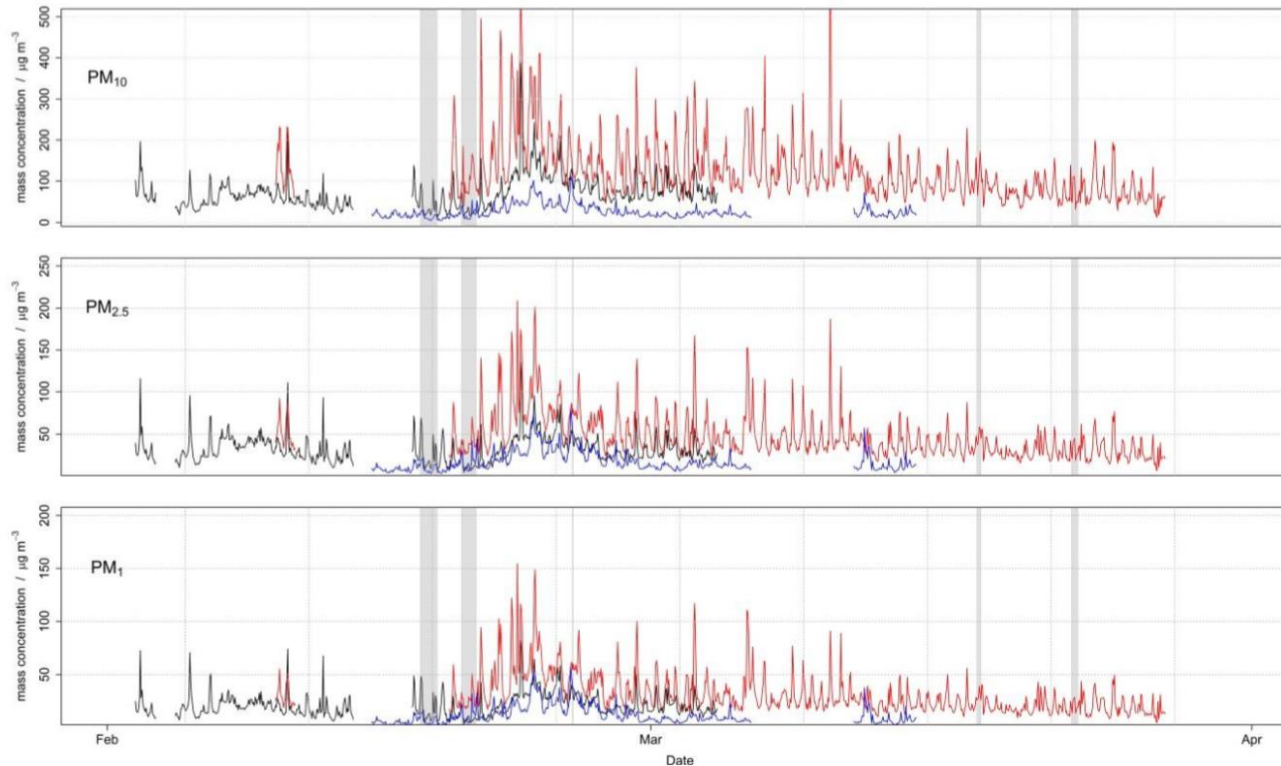
# Person Exposure PM Hotspots

(Ozler MS Thesis, UW-Madison, 2018)



# Source Tracking in Kenya

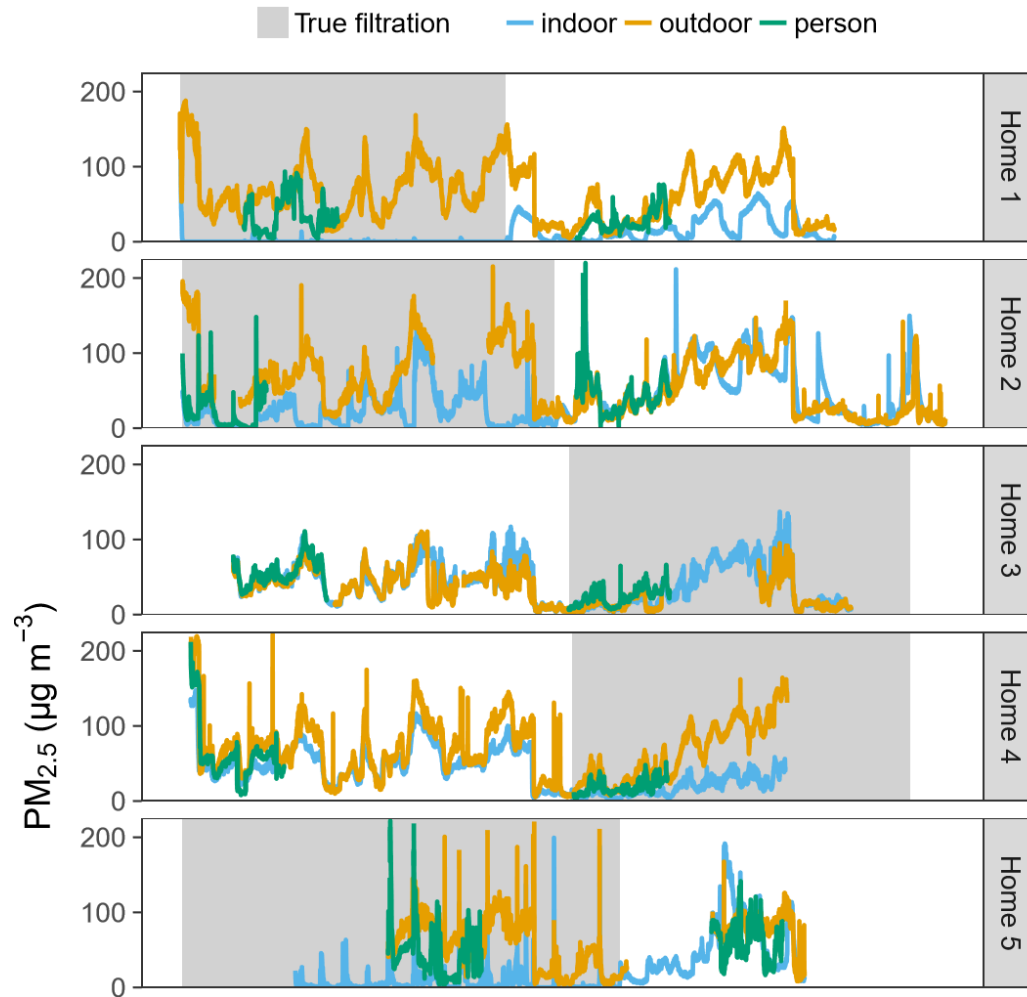
(Pope et al., ACPD-2018-327)



**Figure 2** Hourly time series data showing  $PM_{10}$ ,  $PM_{2.5}$  and  $PM_1$  mass concentrations at the three study locations. Red line = urban roadside, black line = urban background and blue line = rural background. Where multiple OPC-N2 devices were measuring in the same location at the same time,

# Assessing Interventions and Control Measures

(Karolyn Johnson et al., in review)





# Nominal Targets for Precision and Accuracy for Low Cost Sensors

Application	Precision	Accuracy
Comparison to Standards	$\pm 10\%$	$\pm 10\%$
Scaling Filter Based Measurements	$\pm 50\%$	$\pm 50\%$
Spatial Gradients	$\pm 10\%$	$\pm 25\%$
Microenvironmental Monitoring	$\pm 25\%$	$\pm 25\%$
Meteorological Drives	$\pm 10\%$	$\pm 25\%$
Source Tracking	$\pm 50\%$	$\pm 50\%$
Intervention and Control Measures	$\pm 25\%$	$\pm 25\%$

