Sensor Use for Real-World Applications

Levi Stanton[1], Steven Brown[1], Tim Dye[2], and Clinton MacDonald[1]

[1]Sonoma Technology, Inc. (STI), Petaluma, CA; [2]TD Environmental, Petaluma, CA

Sonoma Technology, Inc.
Innovative Environmental Solutions

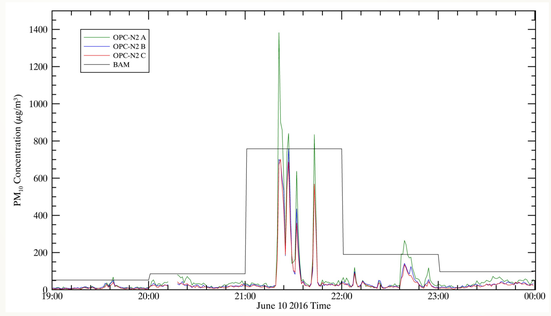
Infrastructure Around Real-World Sensor Use

The usefulness of air quality sensors will be determined by the robustness of the sensor measurements, the reliability of the wireless communications, the security and speed of the cloud service, the ingenuity of the data analytics, and the clarity of the data presentation.

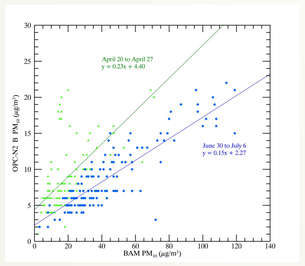
Supported by our Insight data management system, Sonoma Technology, Inc. (STI) has conducted numerous field studies to evaluate the quality of particulate matter (PM) and ozone sensors, and to assess sensor usefulness for various applications. These field studies have demonstrated how to address various sensor performance requirements and produce valuable information for use by the public, government, and industry.

Dust Impacts on a Rural School

We investigated the use of low-cost sensors for monitoring dust by conducting a three-month pilot field study at Cuyama Valley High School in New Cuyama, California. We collocated six low-cost sensors (3 Alphasense OPC-N2s and 3 HabitatMap AirBeams) with a MetOne BAM-1020 federal equivalence method (FEM) monitor. The low-cost sensors had high data recovery rates and high precision. In addition, the low-cost sensors were able to detect windblown dust events and provide alerts for high dust events before the hourly data from the BAM was available.



Hourly PM_{10} concentrations measured by the BAM-1020 and 1-min average PM_{10} concentrations measured by the three OPC-N2s. The OPC-N2s and BAM all measured elevated PM_{10} concentrations during the dust event. The BAM-1020 measurements of the dust event at 21:20 would have been available at 22:00, while the OPC-N2s' would have been available within minutes of the event.

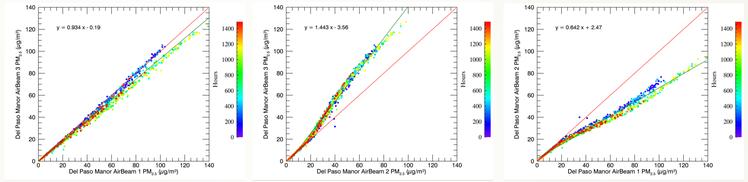


Comparison between hourly PM_{10} concentrations from the BAM-1020 and Alphasense B sensor near the beginning of the study (April 20-27; green) and near the end of the study (June 30–July 6; blue) suggests that the sensor's performance may have degraded over the course of the study.

Funding provided by the Santa Barbara County Air Pollution Control District

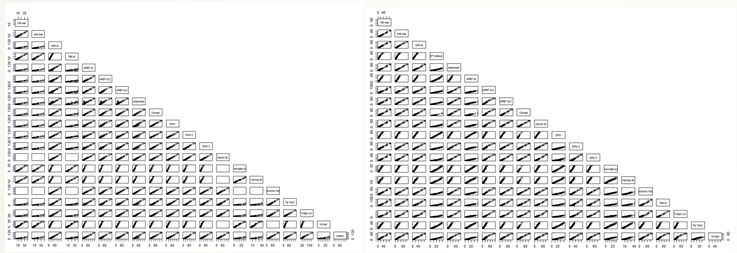
Residential Wood Smoke

To assess sensor accuracy and utility, we collocated AirBeam PM sensors with federal reference method (FRM) monitors for two months at two locations in Sacramento, California. Three collocated AirBeams at the Del Paso Manor site showed very little drift and extremely high precision, but also significant bias.



The AirBeams at Del Paso Manor showed high precision and very little drift.

We performed pre- and post-study collocations of all 19 AirBeams used in the study. These collocations showed that the precision of the AirBeam measurements was very good and drift was minimal. Thus, we were able to correct for sensor-to-sensor bias and use the AirBeams during the study to assess (with high confidence) how PM varied at multiple sites across Sacramento.

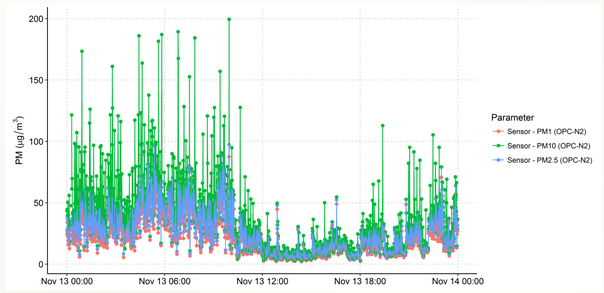


The pre-study (left) and post-study (right) collocations of 19 AirBeams showed very high correlation among all sensors (R^2>0.95).

Funding provided by the Sacramento Metropolitan Air Pollution Control District

Fugitive Coal Dust (Preliminary)

Eight Alphasense OPC-N2 sensors were deployed in a network around an electric power facility that included a Teledyne-API T640X, GRIMM 11-R, and meteorological instruments. The initial deployment was plagued by erratic data with unrealistically high PM_1 concentrations and a high degree of fluctuation in measurements between one minute and the next. Initially, it was thought that there may be a source of electromagnetic interference, but sensor performance improved dramatically during the summer months, suggesting that the problems may have been caused by low temperatures.



Sensor measurements were highly erratic in the beginning of the study.

After sensor performance improved, the collocated sensors showed reasonable agreement (sensor-to-sensor R^2>0.85) and reasonable agreement with the T640X reference instrument (R^2 of 0.45 for PM_{10}, R^2 of 0.58 for $PM_{2.5}$). Thus, the sensor data could be used to identify when dust mitigation procedures are needed.

Funding provided by The Electric Power Research Institute

Contact Us

707.665.9900 | sonomatech.com
Levi Stanton (lstanton@sonomatech.com)
2017 Making Sense of Sensors Conference
September 27-28, 2017, Diamond Bar, CA (STI-6783).