San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Technical Evaluation of Sensor Technology (TEST) Program

AirBeam Sensor
2021 –3rd Quarter

Introduction and Sensor Profile

This analysis report is focused on assessing the performance of the AirBeam sensor as part of the San Joaquin Valley Air Pollution Control District's (District's) Technical Evaluation of Sensor Technology (TEST) Program. The AirBeam sensor measures particulate matter (PM1, PM2.5, and PM10) using a light scattering method. As air is drawn through a sensing chamber, light from a laser scatters off of particles in the air stream. The AirBeam sensor also measures temperature and relative humidity.

Background and Approach of Evaluation Test

As part of the District's effort to evaluate the performance of a variety of low-cost sensors in the Valley, the District installed three AirBeam sensors at the Clovis-Villa air monitoring site in order to compare its performance with that of the regulatory PM2.5 monitor there. The AirBeam1 sensor first began reporting data on May 3, 2019. The datasets analyzed for this report include hourly and 24-hour average PM2.5 data collected from the AirBeam1 sensor and the regulatory Federal Equivalent Method (FEM) MetOne BAM-1020 continuous PM2.5 monitor at the Clovis-Villa site. The scatter plots and time series graphs below show how the datasets compare for both hourly values and the 24-hour average.

Overview of Analysis Findings from Current Period

The analysis for this report covers the time period of July 1, 2021 through September 30, 2021, (2021 – 3rd quarter). During this period, hourly data was removed from the calculation of bias when either the AirBeam sensor or regulatory monitor did not have a valid hourly sample. For the 24-hour averages, only days with 18 or more valid hourly samples (75% or greater completeness) are included.

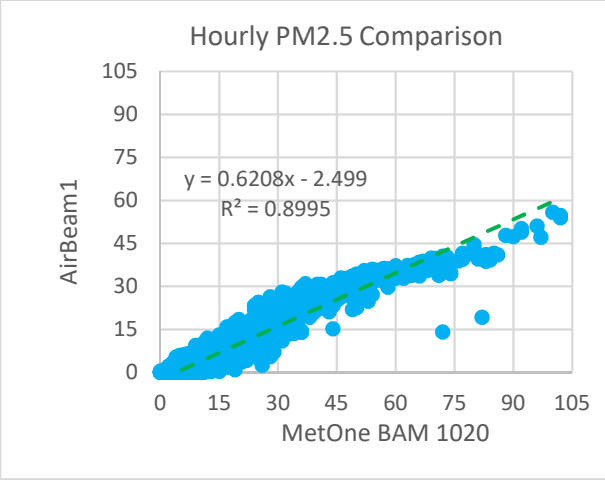
Seasonally, PM2.5 is typically highest during the winter months and lowest during the summer months. Weather systems can influence PM2.5 levels by either trapping pollutants near the surface or dispersing them. Generally, California's weather pattern is characterized by high pressure systems and low pressure systems that move through the region every two to four days in alternating fashion. The 3rd quarter of 2021 was essentially dominated by high pressure systems that produced numerous days of triple digit temperatures, and poor dispersion across the Valley. Monsoonal moisture also streamed into California producing thunderstorms that caused wildfires in the northern California and Sierra Nevada mountains. Wind flow patterns and strong temperature inversions associated with the high pressure systems exacerbated smoke impacts in the Valley. A few low pressure systems did pass through the Pacific Northwest and improved dispersion enough to lift some of the smoke out of the Valley but the respites were short-lived. Indeed poor dispersion and smoke impacts essentially characterized the 3rd quarter and kept PM2.5 concentrations elevated through the most of the period.

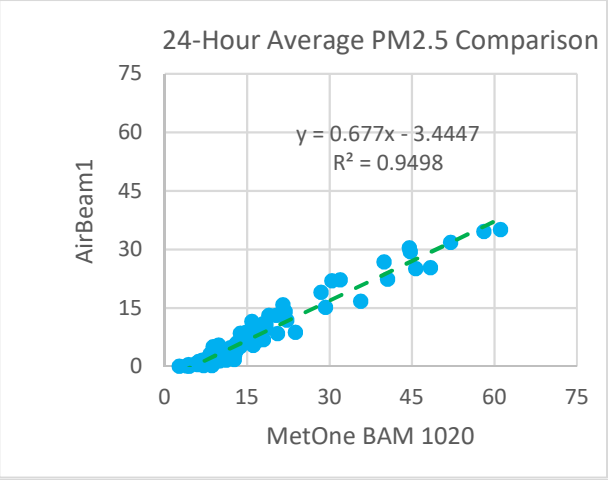
During the 2021 3rd quarter, the Air Beam 1 sensor and the MetOne BAM1020 monitor responded similarly to the fluctuations in concentrations. Although the instruments essentially mirrored each other regarding the fluctuating patterns, the line chart below shows that the AirBeam1 sensor measured higher compared to the MetOne BAM 1020 monitor.

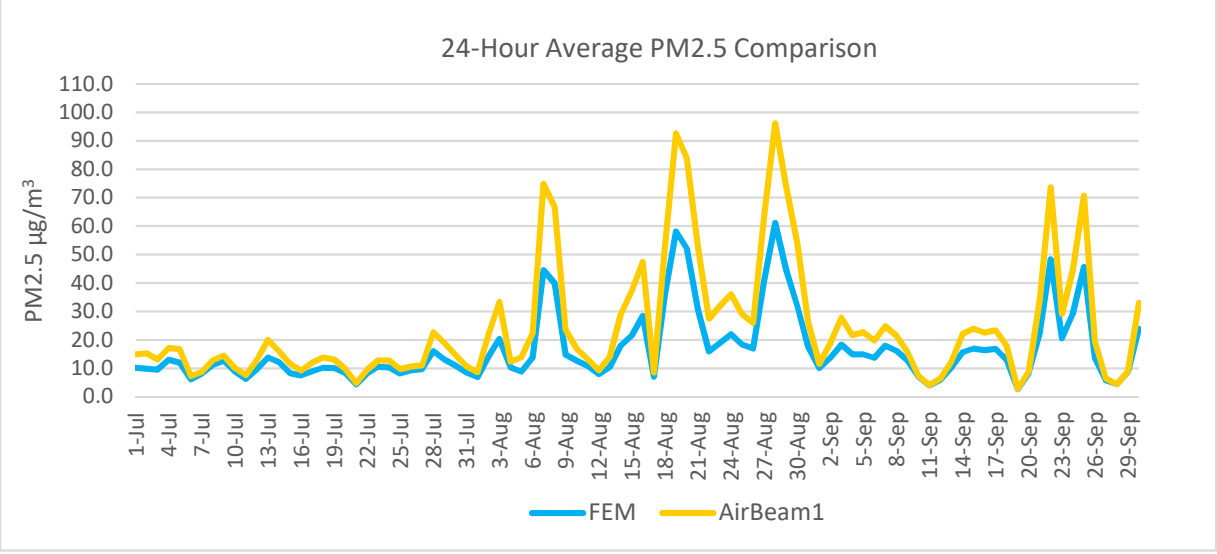
Analysis of AirBeam Sensor Performance

AirBeam1

For the 24-hour average, AirBeam data had a low bias of -8.8 µg/m^3 during the July 1, 2021, through September 30, 2021, period. For the hourly average, AirBeam data had a low bias of -8.8 µg/m^3 over the same period.







Non-Reporting Sites

AirBeam0 and AirBeam2

Data from these sensors was not available for the July 1, 2021, through September 30, 2021, period. These sensors sustained a hardware failure and are no longer operating.

Statistical Summary

The following table provides a statistical summary of the PM2.5 data collected during the analysis period of this report.

Clovis-Villa	Average 24-hr	Max 1-hr	Max 24-hr	1-hr R2	1-hr Slope	1-hr Intercept	24-hr R2	24-hr Slope	24-hr Intercept
AirBeam0	---	---	---	---	---	---	---	---	---
AirBeam1	7.8	55.9	35.1	0.8995	0.6208	-2.499	0.9498	0.677	-3.4447
AirBeam2	---	---	---	---	---	---	---	---	---
FEM	16.7	102	61.1						