San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Technical Evaluation of Sensor Technology (TEST) Program

AirBeam Sensor
2021 – 2nd 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 April 1, 2021, through June 30, 2021, (2021 – 2nd 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.

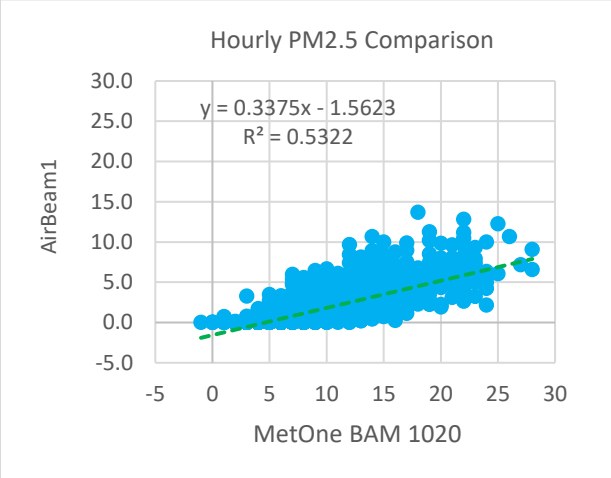
Seasonally, PM2.5 is typically highest during the winter months and lowest during the summer months. Weather systems can influence PM2.5 levels by either trapping pollutants near the surface or dispersing them. Generally, California's weather pattern is characterized by high pressure systems and low pressure systems that move through the region every two to four days in alternating fashion. As the 2021 2nd quarter progressed, temperatures grew warmer and the high pressure systems that built over the region rendered stronger stability, particularly during the end of May-beginning of June and mid-June time frames. The low pressure systems that moved through the region brought good dispersion yet only one of them delivered precipitation to the Valley, and small amounts at that! As such, conditions across the Valley were quite dry by the end of the 2nd quarter.

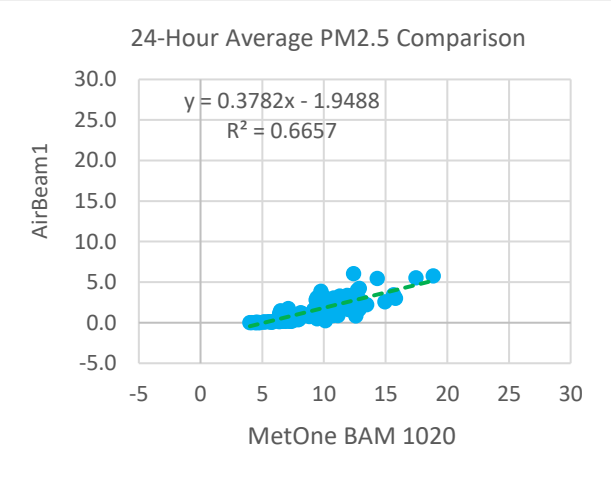
During the 2021 2nd quarter, the Air Beam 1 sensor and the MetOne BAM1020 monitor responded similarly to the fluctuations in concentrations. Although the instruments essentially mirrored each other regarding the fluctuating patterns, the line chart below shows that the AirBeam1 sensor measured lower compared to the MetOne BAM 1020 monitor.

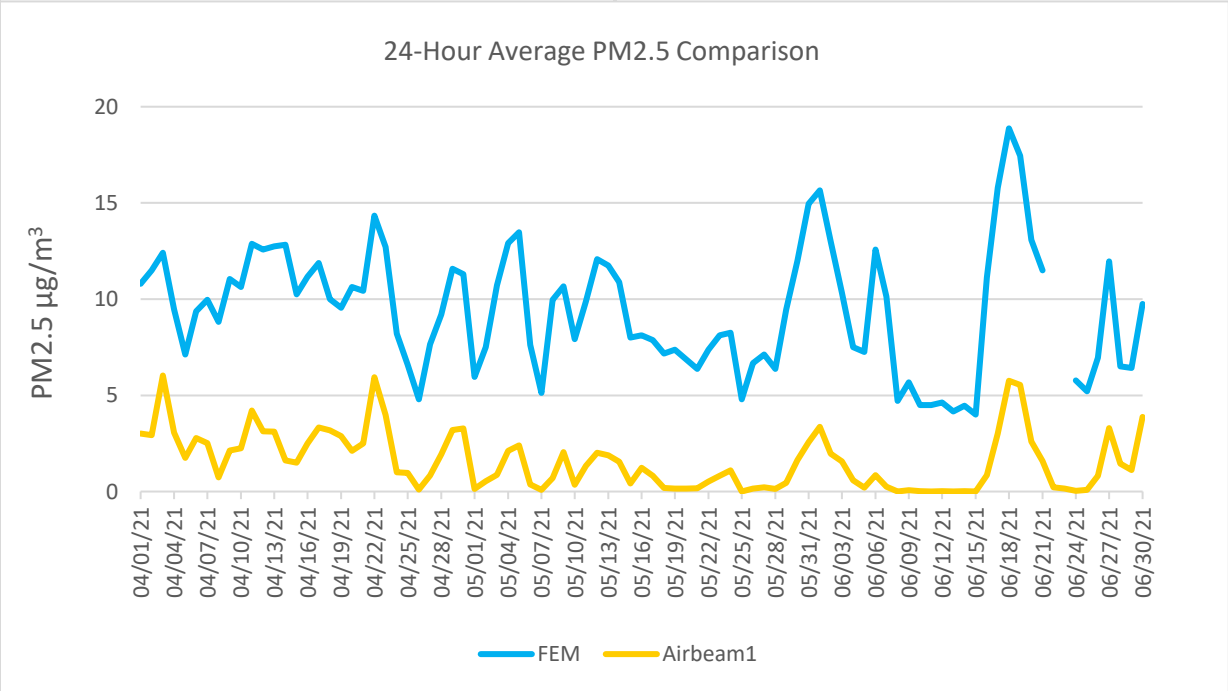
Analysis of AirBeam Sensor Performance

AirBeam1

For the 24-hour average, AirBeam data had a low bias of 7.8 µg/m^3 during the April 1, 2021, through June 30, 2021, period. For the hourly average, AirBeam data had a low bias of 7.6 µg/m^3 over the same period.







Non-Reporting Sites

AirBeam0 and AirBeam2

Data from these sensors was not available for the April 1, 2021, through June 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	1.6	13.7	6.0	0.5322	0.3375	-1.5623	0.6657	0.3782	-1.9488
AirBeam2	---	---	---	---	---	---	---	---	---
FEM	9.4	28	18.9						