San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Technical Evaluation of Sensor Technology (TEST) Program

AirBeam Sensor
2020 – 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 AirBeam sensors 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 AirBeam sensors 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

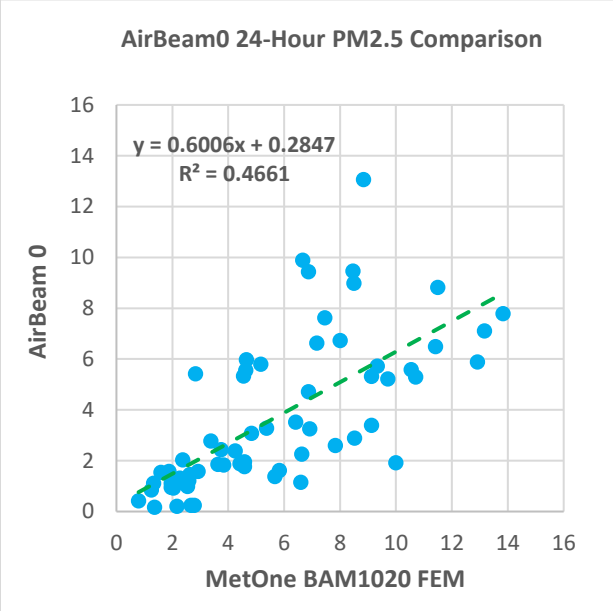
The analysis for this report covers the time period of April 1, 2020 through June 30, 2020 (2020 – 2nd quarter). During this period, hourly data was removed from the calculation of bias when either the AirBeam sensor or regulatory monitor did not have a valid hourly sample. For the 24-hour averages, only days with 18 or more valid hourly samples (75% or greater completeness) are included. Due to a malfunction, the AirBeam 2 sensor stopped reporting after 7:00 AM on May 21, 2020 and remained offline for the rest of the 2nd quarter.

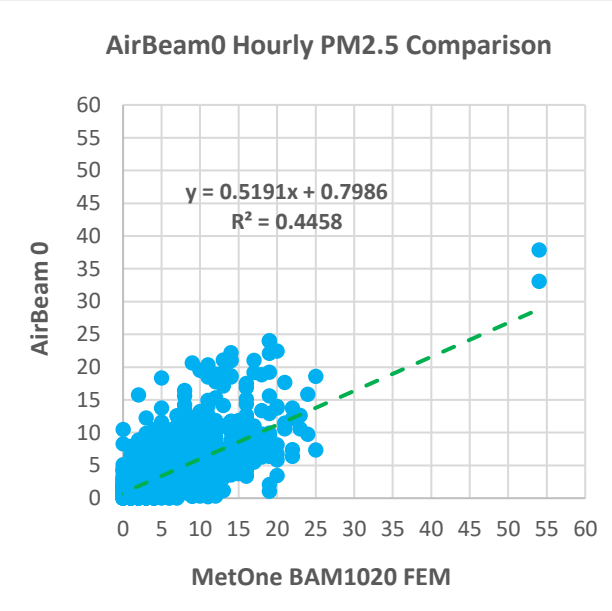
Seasonally, PM2.5 is typically highest during the winter months and lowest during the summer months. Weather systems can also influence PM2.5 levels by either trapping pollutants near the surface or dispersing them. Generally, California's weather pattern is characterized by high pressure systems and low pressure systems that move through the region every two to four days in alternating fashion however low pressure systems tend to be more prevalent during the springtime as the seasons transition from winter to summer. As such, April and May 2020 were characterized by frequent dispersive low pressure systems that also delivered ample precipitation to the Valley before the typical alternating pattern of low and high pressure systems set resumed in June 2020. Thus PM2.5 concentrations remained low during Quarter 2 as a result of good dispersion as well as the seasonal effects of summer.

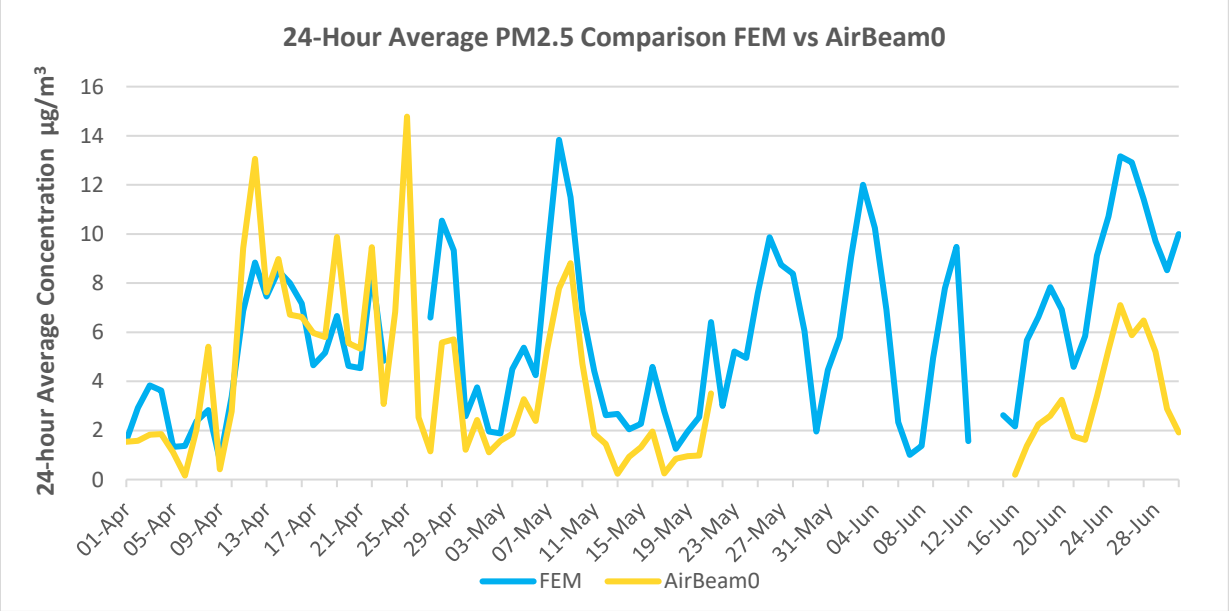
Site Specific Analysis of AirBeam Sensor Performance

AirBeam0

For the 24-hour average, AirBeam data had a low bias of 2.0 µg/m^3 during the April 1, 2020 through June 30, 2020 period. For the hourly average, AirBeam data had a low bias of 2.0 µg/m^3 over the same period.

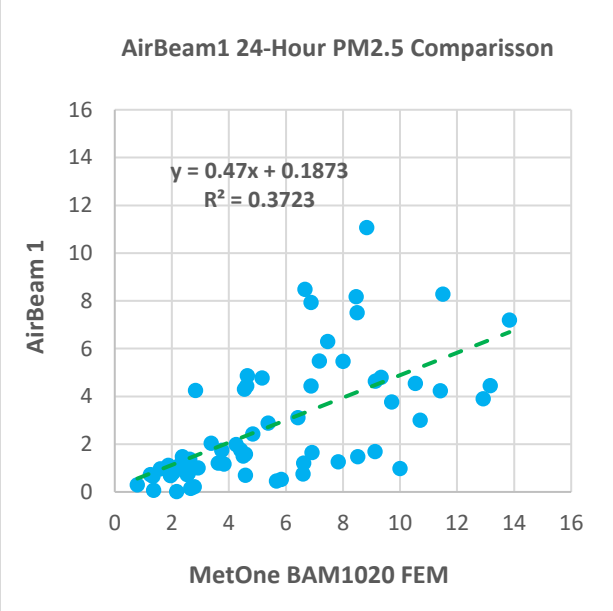


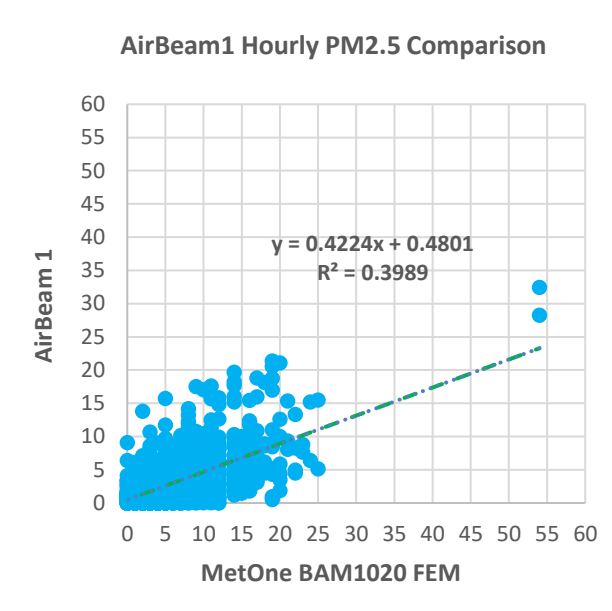


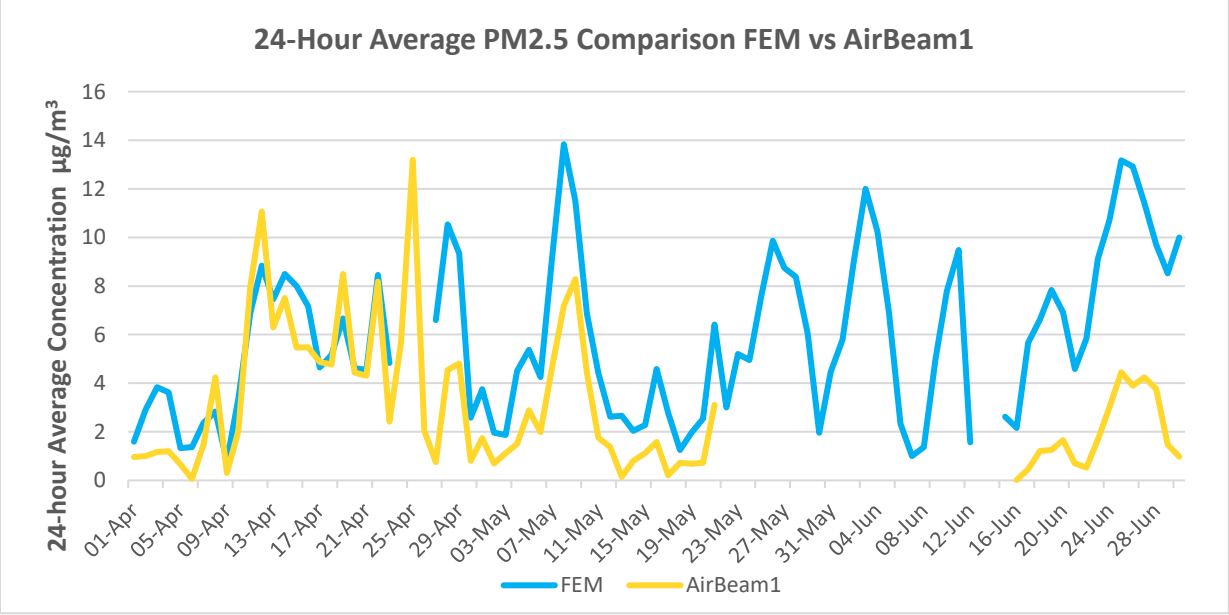


AirBeam1

For the 24-hour average, AirBeam data had a low bias of 2.8 µg/m^3 during the April 1, 2020 through June 30, 2020 period. For the hourly average, AirBeam data had a low bias of 2.8 µg/m^3 over the same period.

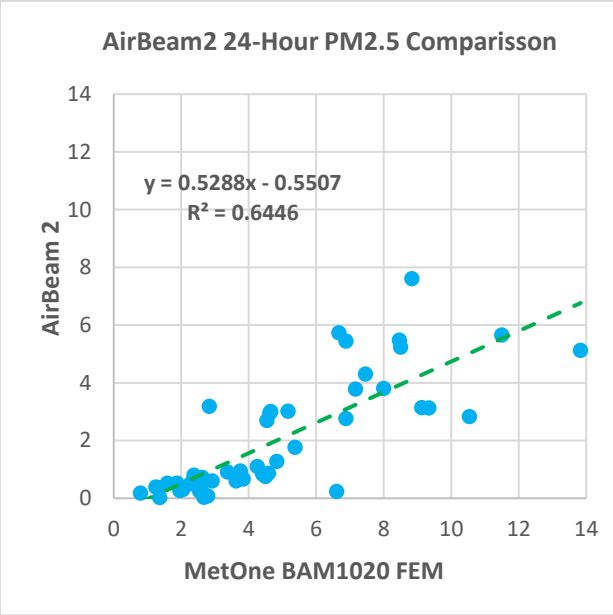


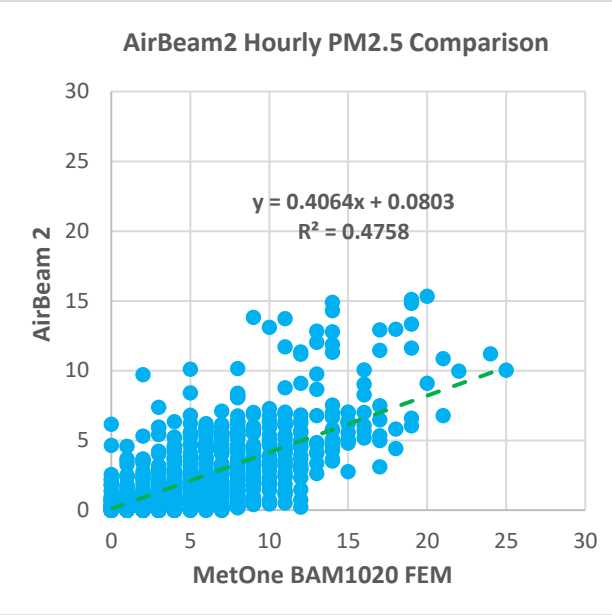


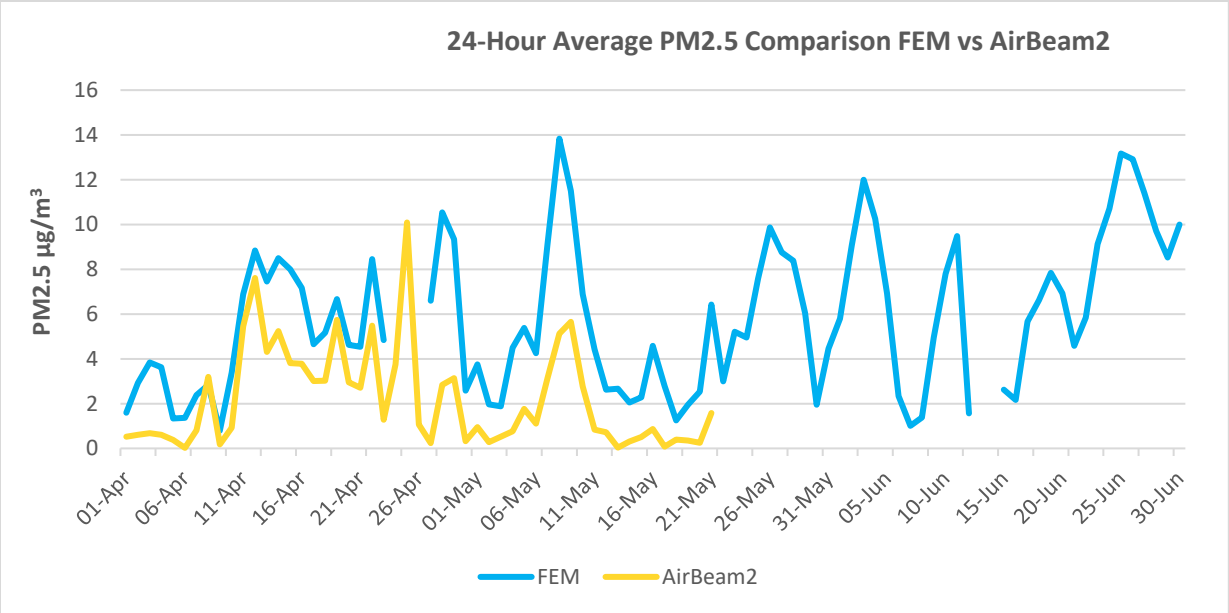


AirBeam2

As mentioned previously, due to a malfunction, the AirBeam 2 sensor stopped reporting on the morning of May 21, 2020, and remained offline for the remainder of the 2nd quarter. Thus, for the 24-hour average, AirBeam data had a low bias of 2.9 µg/m^3 during the April 1, 2020 through May 20, 2020 period. For the hourly average, AirBeam2 data had a low bias of 2.8 µg/m^3 over the same period.







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	3.7	37.9	14.8	0.4458	0.5191	0.7986	0.4661	0.6006	0.2847
AirBeam1	2.9	32.4	13.2	0.3989	0.4224	0.4801	0.3723	0.47	0.1873
AirBeam2*	2.0	15.3	10.1	0.4758	0.4064	0.0803	0.6446	0.5288	-0.5507
FEM	5.7	54	13.8						

*Analysis period for the AirBeam 2 sensor is April 1, 2020 through May 20, 2020 due to a malfunction that caused the sensor to stop reporting.