San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Technical Evaluation of Sensor Technology (TEST) Program

PurpleAir PA-II Sensor
2022 –1st Quarter

Introduction and Sensor Profile

This analysis report is focused on assessing the performance of the PurpleAir PA-II sensor as a part of the District's Technical Evaluation of Sensor Technology (TEST) Program. The PurpleAir PA-II sensor uses an optical laser-based particle counting methodology to estimate the mass of varying diameters of particulate matter, including PM1, PM2.5, and PM10. The PA-II sensor also measures temperature, pressure, and relative humidity.

Background and Approach of Evaluation Test

In November of 2017, NASA began an air quality study to compare the performance of PurpleAir sensors to regulatory PM2.5 monitors. The study is focused on the conditions in the San Joaquin Valley and is based at California Air Resources Board (CARB) air monitoring sites of, Fresno-Garland, Modesto-14th St, Visalia-Church, and Bakersfield-California. In 2019, the District began operating PurpleAir sensors at the District's Clovis-Villa air monitoring site and in the Shafter and South Central Fresno AB 617 communities.

The data sets analyzed for this report compare PM2.5 data collected from PurpleAir sensors and Federal Equivalent Method (FEM) monitors that are collocated at the CARB and District air monitoring sites listed above. 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 January 1, 2022, through March 31, 2022 (2022 – 1st quarter). During this period, hourly data was removed from the calculation of bias when either the PurpleAir 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.

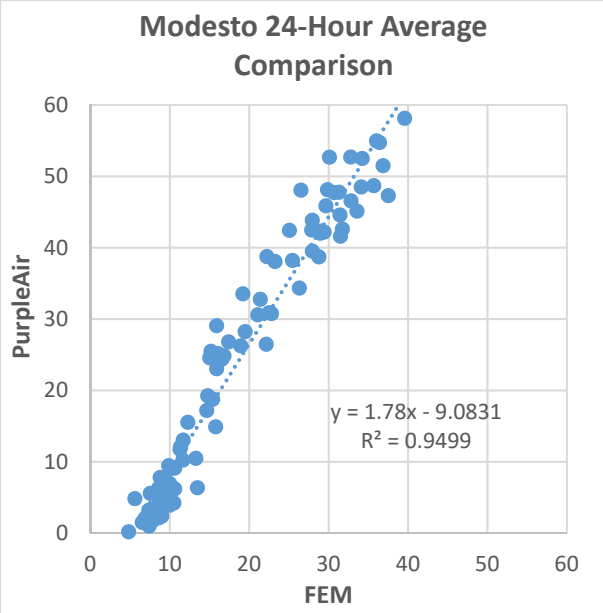
Seasonally, PM2.5 is typically highest during the winter months and lowest during the summer months. Weather systems can influence PM2.5 levels by either trapping pollutants near the surface or dispersing them. Generally, California's weather pattern is characterized by high pressure systems and low pressure systems that move through the region every two to four days in alternating fashion. January 2022 was characterized primarily by stable conditions and poor dispersion as high pressure patterns dominated the region through most of the month. As such, the lack of dispersion contributed to elevated PM2.5 concentrations through the period. With the exception of a low pressure system that brought good dispersion to the northern portion of the District during the first two days of February, stable conditions remained prevalent across most of the Valley through mid-February. The long period of high pressure dominance finally ended on February 15th as alternating weather patterns began traversing the region. This pattern change, characteristic of springtime, led to the more frequent arrival of dispersive low pressure systems and shorter durations of high pressure systems. The better

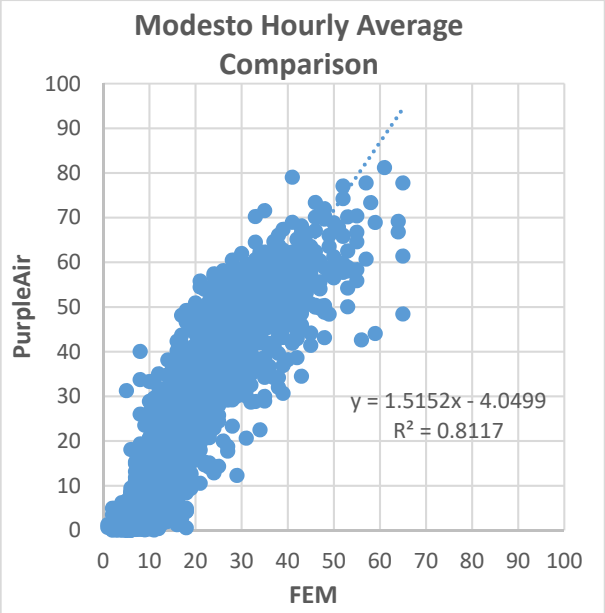
dispersion conditions continued through March and helped PM2.5 concentrations decrease across the Valley through the end of the quarter.

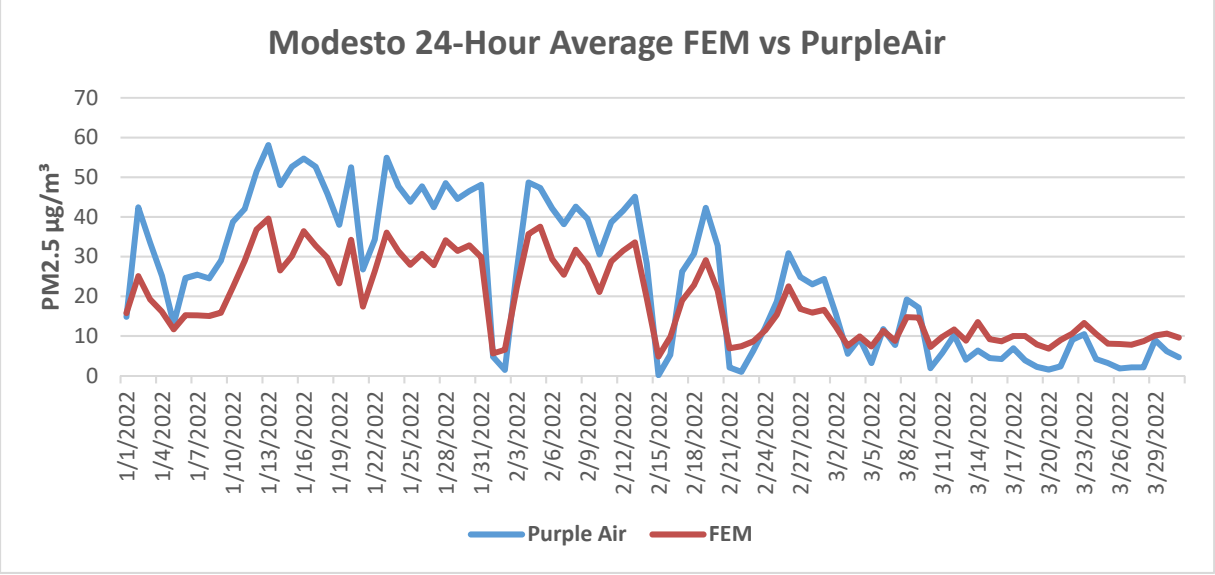
Site Specific Analysis of PurpleAir PA-II Sensor Performance

Modesto-14th St.

For the 24-hour average, PurpleAir data had a 5.6 µg/m^3 high bias during the January 1, 2022, through March 31, 2022, period. For the hourly average, PurpleAir data had a high bias of 5.6 µg/m^3 over the same period.

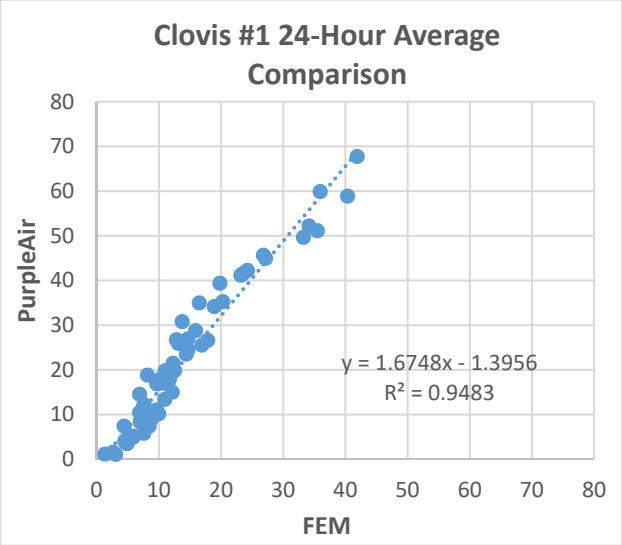


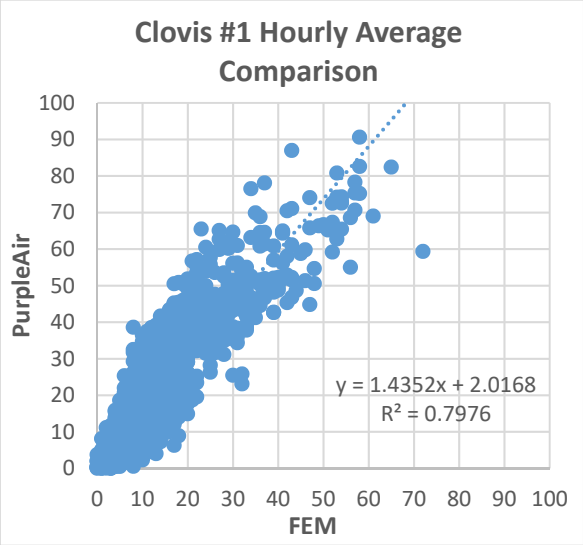


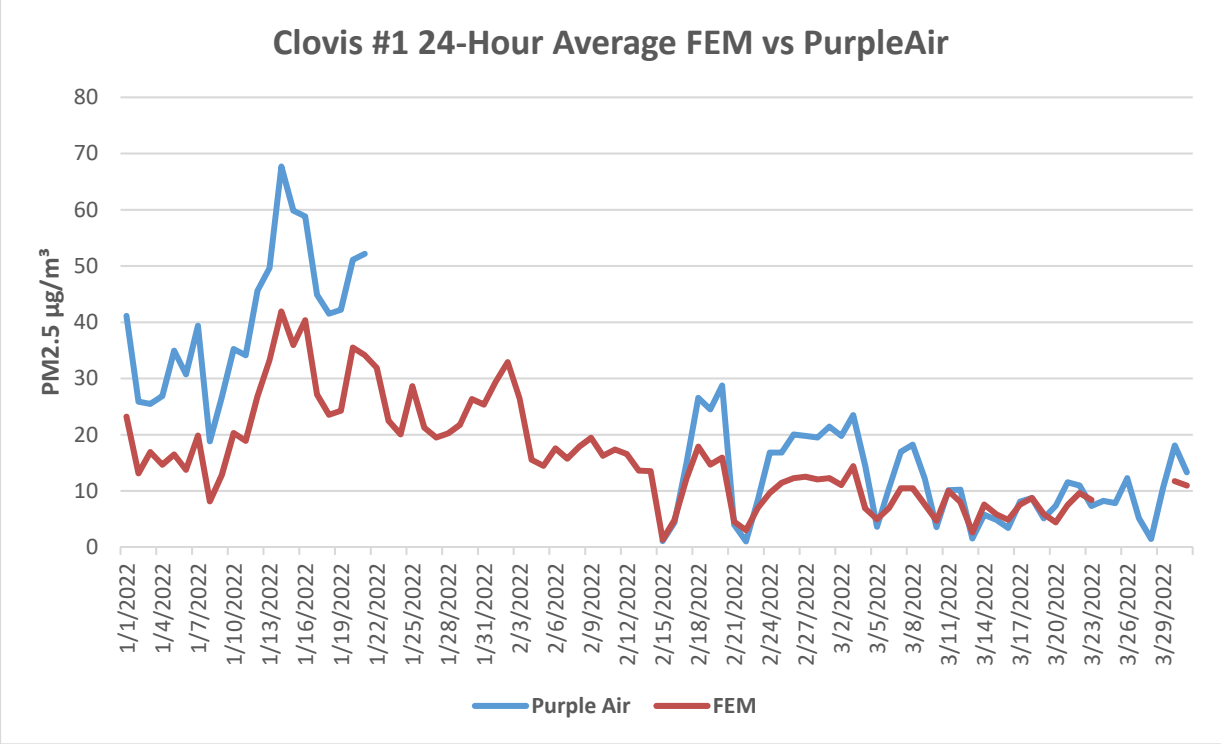


Clovis-Villa #1

For the 24-hour average, PurpleAir data had a 4.8 µg/m^3 high bias during the January 1, 2022, through March 31, 2022, period. For the hourly average, PurpleAir data had a high bias of 4.8 µg/m^3 over the same period.

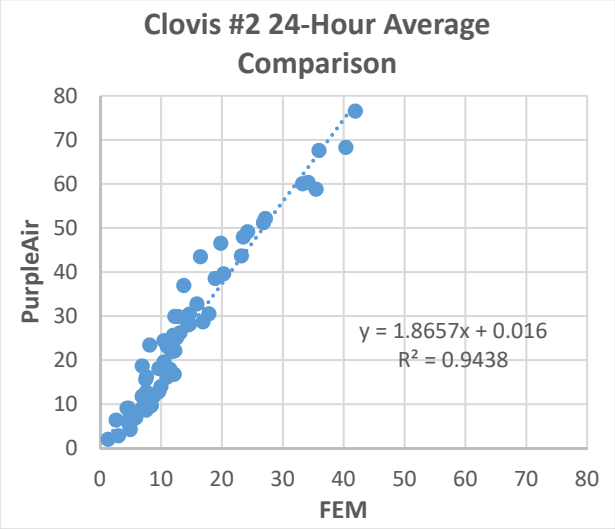


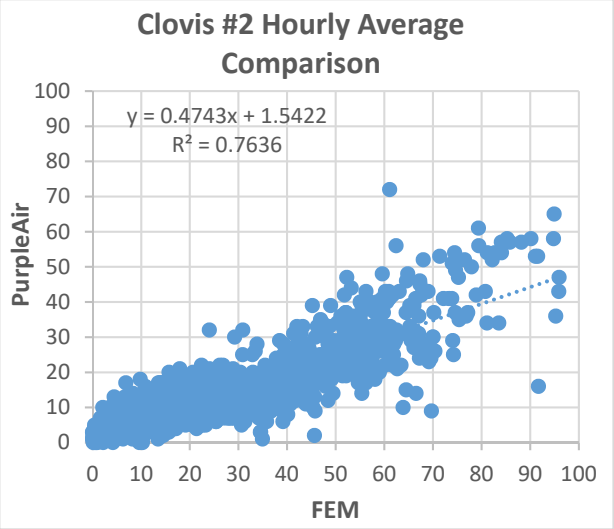


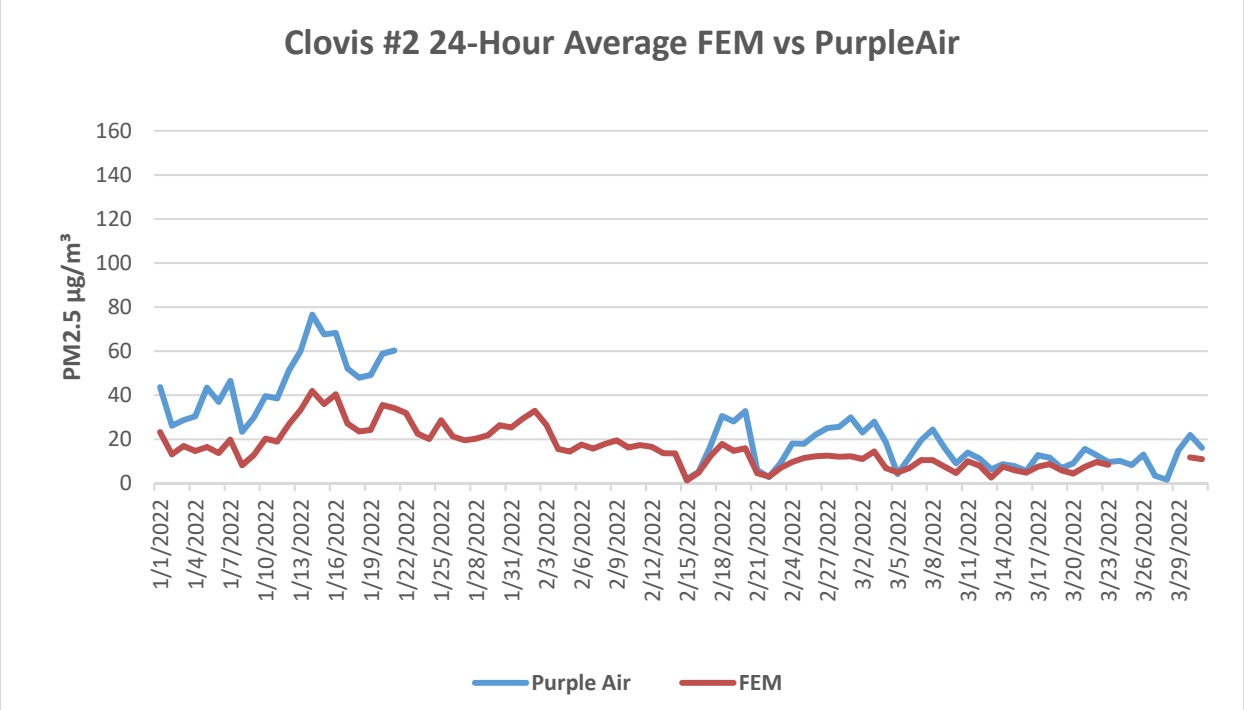


Clovis-Villa #2

For the 24-hour average, PurpleAir data had an 8.6 µg/m³ high bias during the January 1, 2022, through March 31, 2022, period. For the hourly average, PurpleAir data had a high bias of 8.6 µg/m³ over the same period.

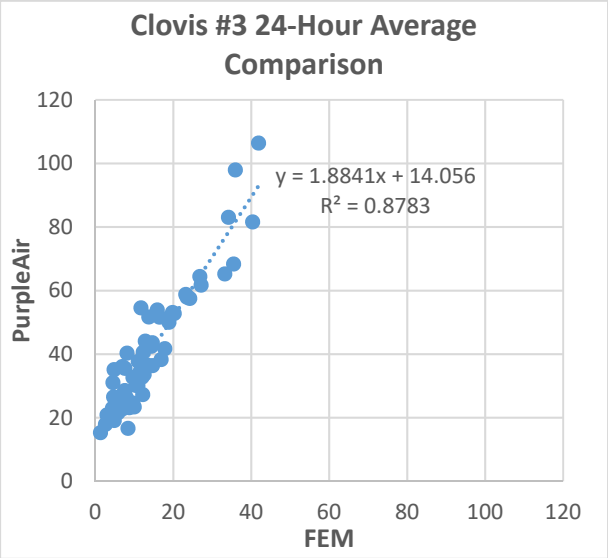


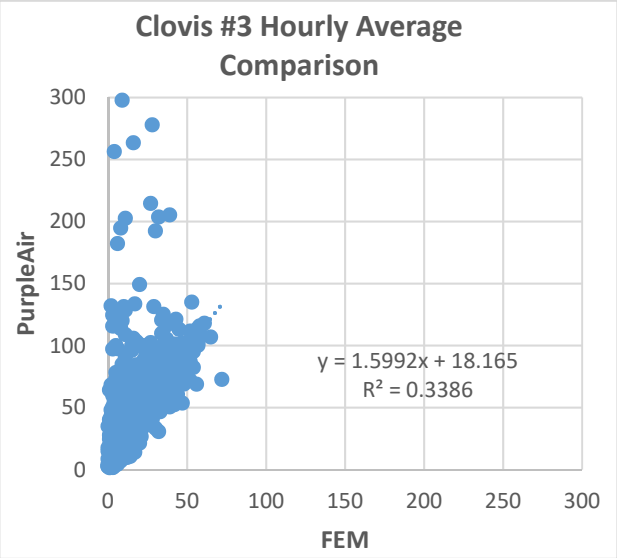


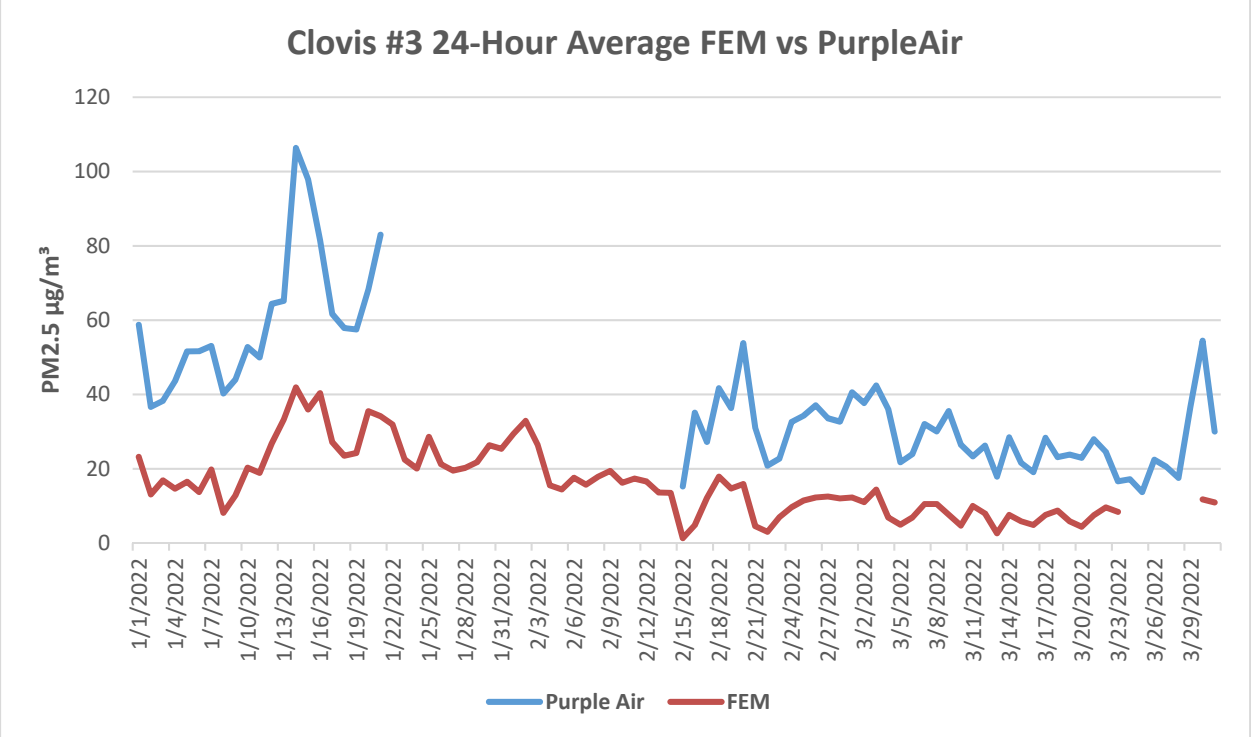


Clovis-Villa #3

For the 24-hour average, PurpleAir data had a 22.8 µg/m^3 high bias during the January 1, 2022, through March 31, 2022, period. For the hourly average, PurpleAir data had a high bias of 22.7 µg/m^3 over the same period.

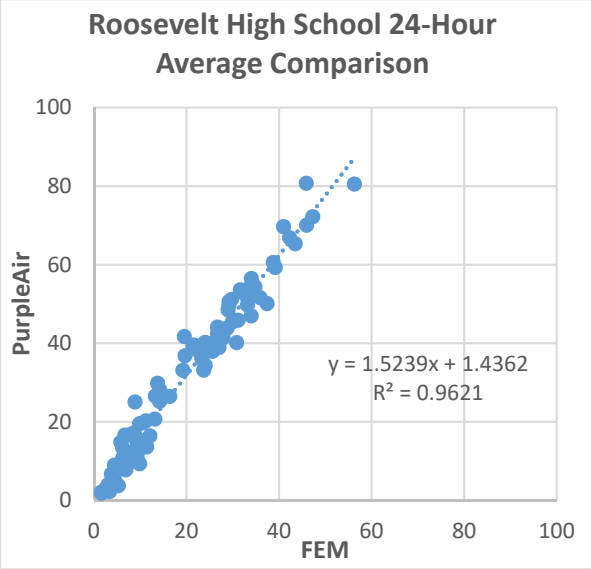


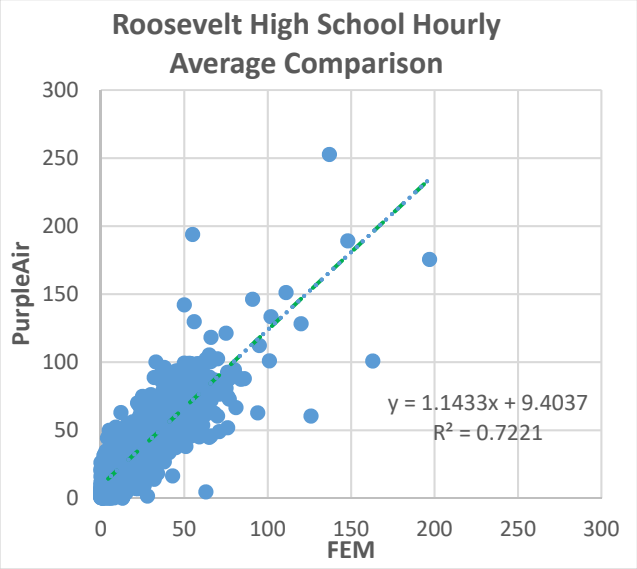


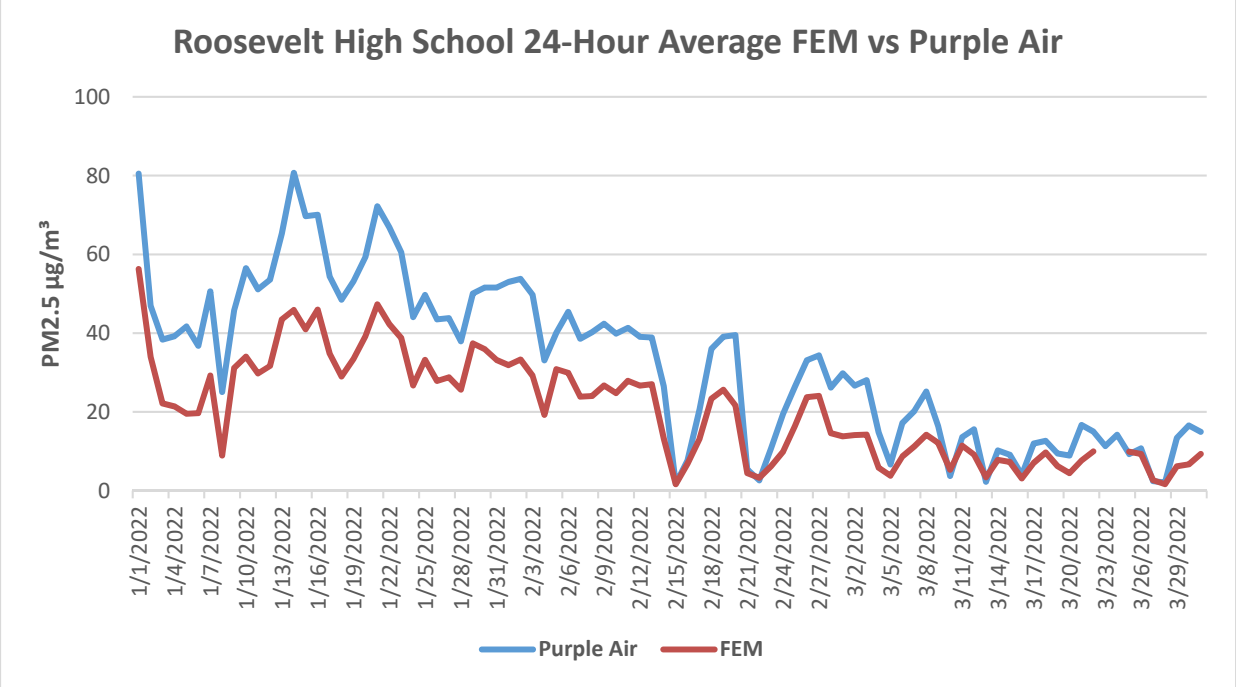


South Central Fresno – Roosevelt High School

For the 24-hour average, PurpleAir data had an 11.9 µg/m^3 low bias during the January 1, 2022, through March 31, 2022, period. For the hourly average, PurpleAir data had a high bias of 11.8 µg/m^3 over the same period.







Non-Reporting Sites

Bakersfield-California
Data from this sensor was not available for the January 1, 2022, through March 31, 2022 period. This sensor will be included in future analysis reports if the data becomes available.

Visalia-Church
Data from this sensor was not available for the January 1, 2022, through March 31, 2022 period. This sensor will be included in future analysis reports if the data becomes available.

Shafter #2
Data from this sensor was not available for the January 1, 2022, through March 31, 2022 period. This sensor will be included in future analysis reports if the data becomes available.

Fresno-Garland
Data from this sensor was not available for the January 1, 2022, through March 31, 2022 period. Data from this sensor is not expected to resume.

Statistical Summary

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

Table A – Fresno-Garland, Visalia-Church, Bakersfield-California, and Modesto-14th Sites

Statistic	Fresno-Garland	Visalia-Church	Bakersfield-CA	Modesto-14th
FEM Avg. 24-hr	PurpleAir sensor at this site did not report during this period	PurpleAir sensor at this site did not report during this period	PurpleAir sensor at this site did not report during this period	18.9
Sensor Avg. 24-hr				24.5
FEM Max 1-hr				65
Sensor Max 1-hr				81.17
FEM Max 24-hr				39.6
Sensor Max 24-hr				58.1
1-hr R^2				0.8117
1-hr Slope				1.5152
1-hr Intercept				-4.0499
24-hr R^2				0.9499
24-hr Slope				1.7800
24-hr Intercept				-9.0831

Table B – Clovis-Villa Site

Statistic	Clovis-Villa PurpleAir #1	Clovis-Villa PurpleAir #2	Clovis-Villa PurpleAir #3
FEM Avg. 24-hr	16.1	16.1	16.1
Sensor Avg. 24-hr	20.8	24.7	38.8
FEM Max 1-hr	72	72	72
Sensor Max 1-hr	90.6	95.98	297.72
FEM Max 24-hr	41.9	41.9	41.9
Sensor Max 24-hr	67.7	76.5	106.4
1-hr R^2	0.7976	0.7636	0.3386
1-hr Slope	1.4352	0.4743	1.5992
1-hr Intercept	2.0168	1.5422	18.165
24-hr R^2	0.9483	0.9438	0.8783
24-hr Slope	1.6748	1.8657	1.8841
24-hr Intercept	-1.3956	0.0160	14.056

Table C – South Central Fresno and Shafter Sites

Statistic	South Central Fresno	Shafter
FEM Avg. 24-hr	20.8	PurpleAir sensor at this site did not report during this period
Sensor Avg. 24-hr	32.6	
FEM Max 1-hr	197	
Sensor Max 1-hr	252.60	
FEM Max 24-hr	56.3	
Sensor Max 24-hr	80.7	
1-hr R^2	0.7221	
1-hr Slope	1.1433	
1-hr Intercept	9.4037	
24-hr R^2	0.9621	
24-hr Slope	1.5239	
24-hr Intercept	1.4362	