



## Technical Evaluation of Sensor Technology (TEST) Program

*PurpleAir PA-II Sensor  
2018 – 4<sup>th</sup> 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 analyzers. The study is focused on the conditions in the San Joaquin Valley and is based at the ARB air monitoring sites of Fresno-Garland, Visalia-Church, Modesto-14<sup>th</sup> St., and Bakersfield-California. 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 ARB 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 October 2018 through December 2018 (2018 – 4<sup>th</sup> quarter). There is a noticeable spike in PM2.5 concentrations at all four locations in November. These spikes are associated with the Camp fire in Butte County, California. The rapid expansion of this fire, combined with a very stable atmosphere and light winds, inundated the San Joaquin Valley with smoke. The event only lasted a few weeks with the Modesto sensor being affected the most. This event produced some of the highest PM2.5 readings ever recorded in the District. This is visible on the Modesto monitor with a peak daily reading of 189.8  $\mu\text{g}/\text{m}^3$  on November 16<sup>th</sup>. Another group of fires, named the Alder/Mountaineer/Moses fires collectively, had slight impacts on Tulare County during the month of October and into mid-November.

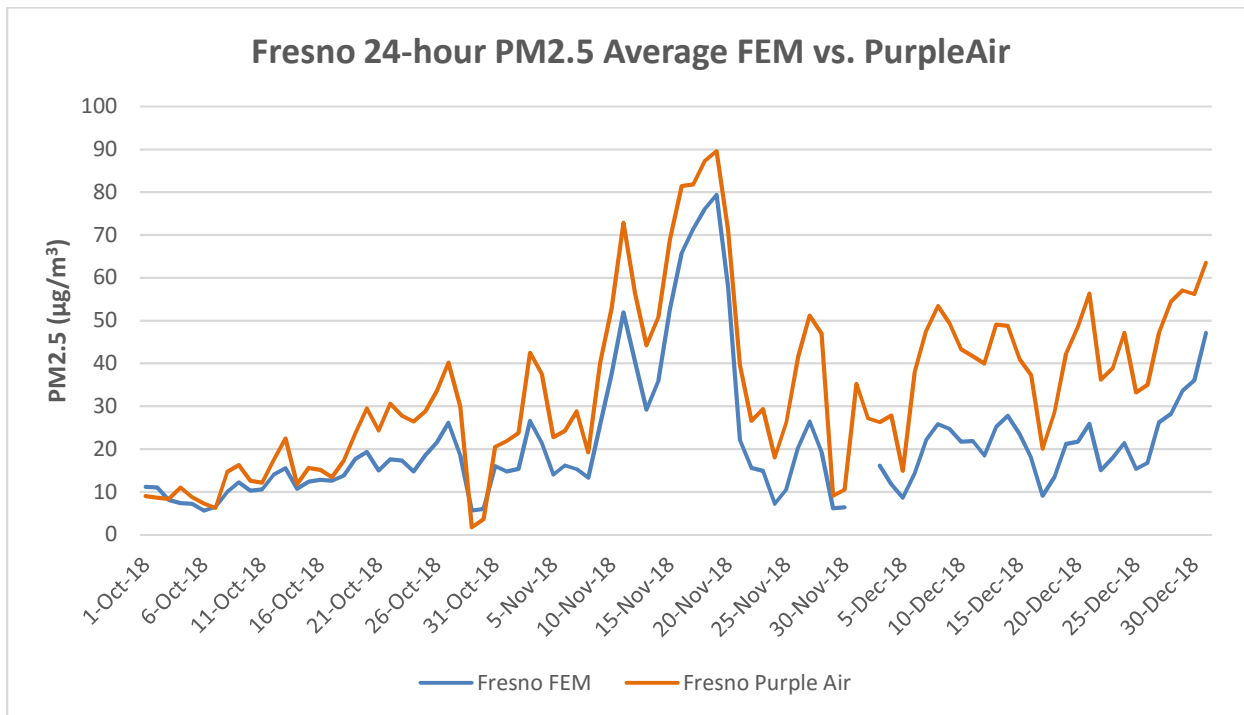
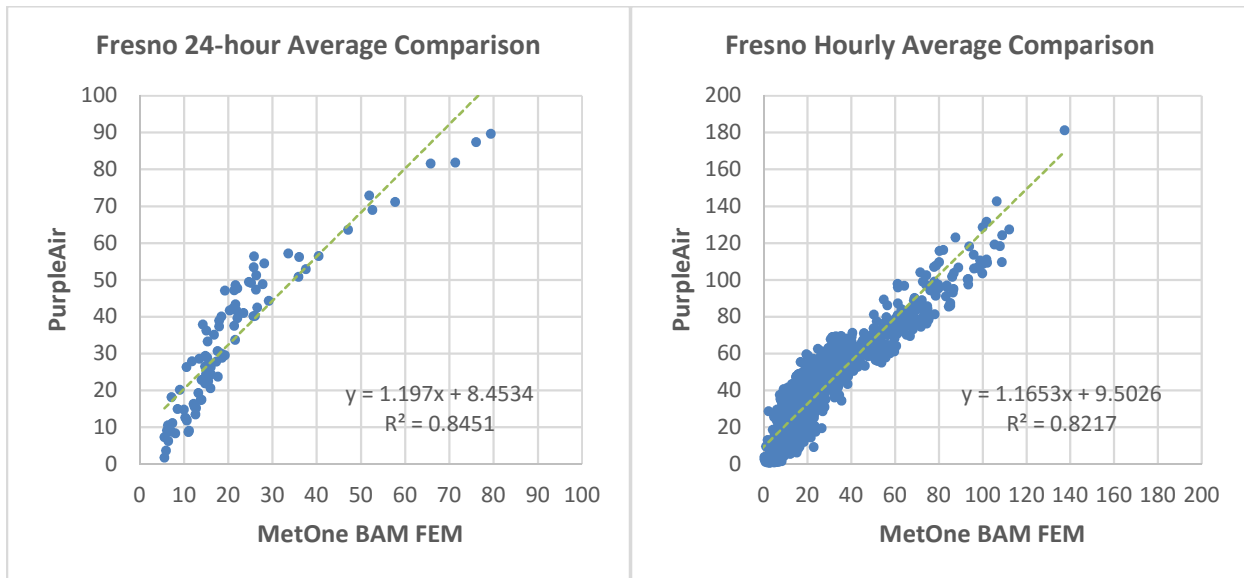
For the FEM sites, all data was available for each of the four sensors except for two days. These two days were on December 1<sup>st</sup> and December 2<sup>nd</sup>. This down time affected the Fresno monitor only.

For the PurpleAir sensors, data was missing for the Visalia location from October 6<sup>th</sup> through December 4<sup>th</sup>. The reason for the extended outage is unknown. There was no secondary sample available for this unit, and the "B" monitor did not report during these same dates.

**Site Specific Analysis of PurpleAir PA-II Sensor Performance**

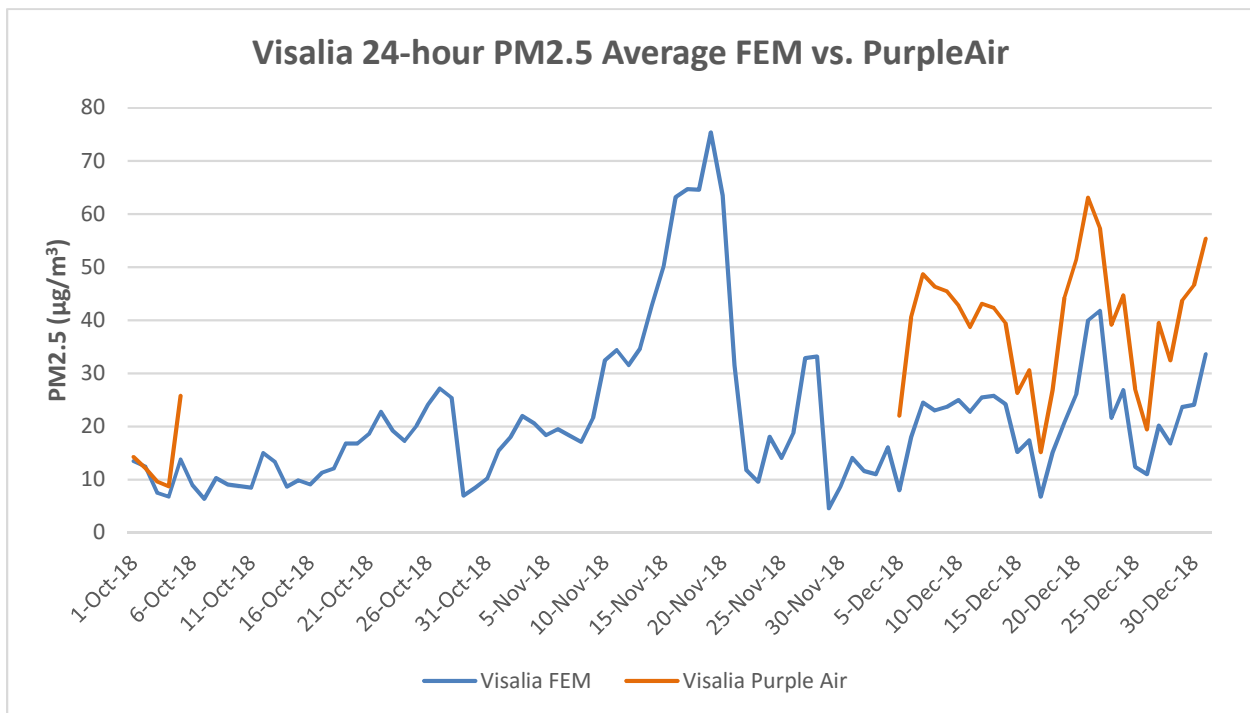
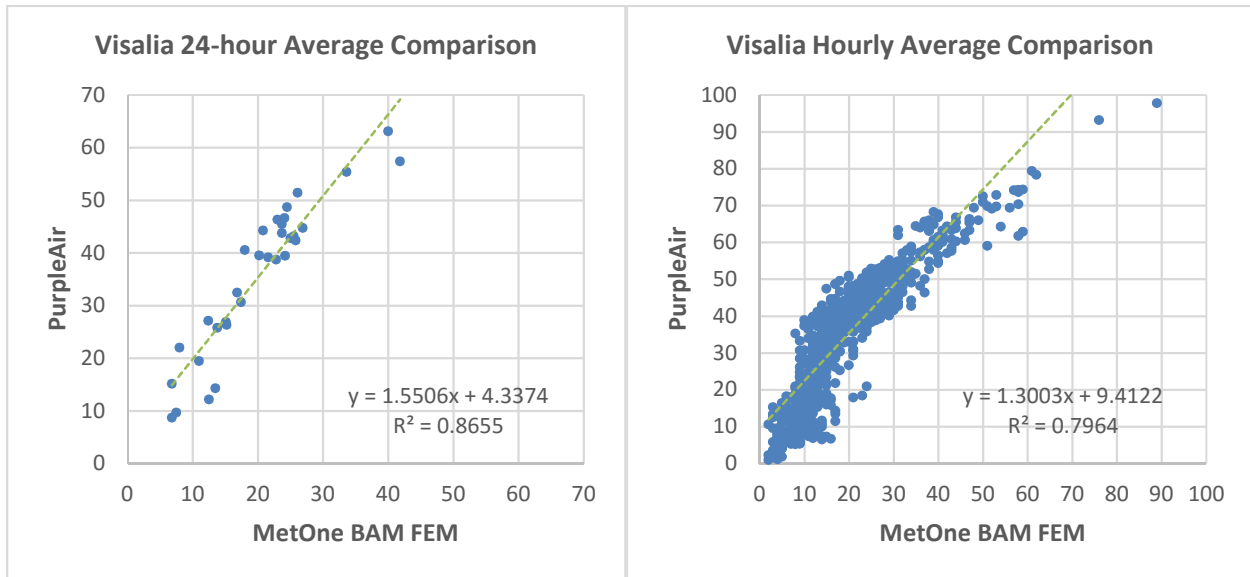
**Fresno-Garland**

For the 24-hour average, PurpleAir data had a 12.7  $\mu\text{g}/\text{m}^3$  high bias during the October 1<sup>st</sup>, 2018 through December 31<sup>st</sup>, 2018 period. For the hourly average, PurpleAir data had a high bias of 13.2  $\mu\text{g}/\text{m}^3$  over the same period.



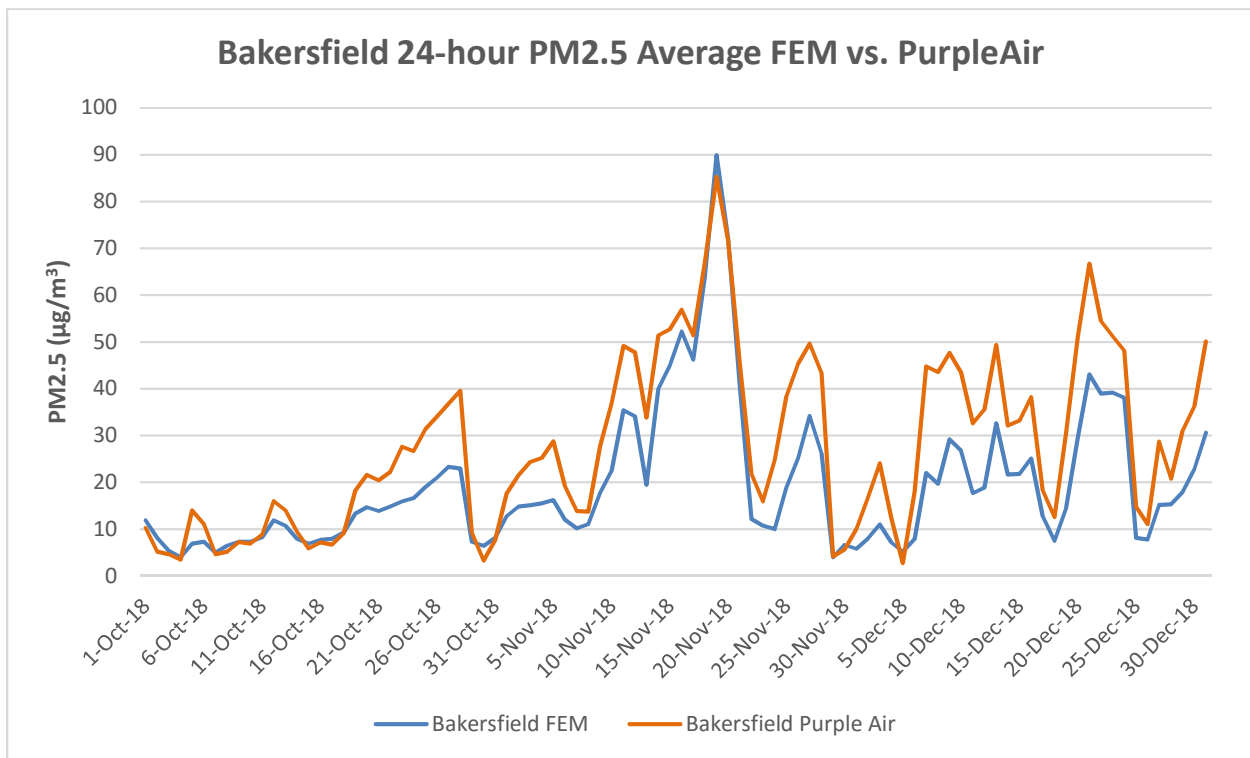
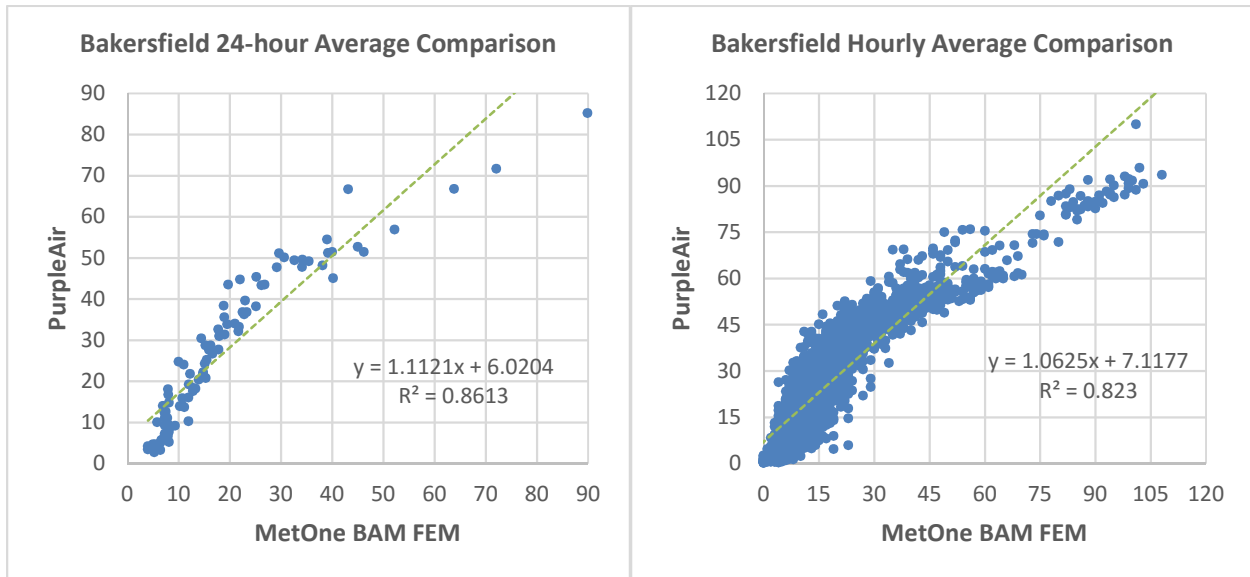
**Visalia-Church**

For the 24-hour average, PurpleAir data had a 14.2  $\mu\text{g}/\text{m}^3$  high bias during the October 1<sup>st</sup>, 2018 through December 31<sup>st</sup>, 2018 period. For the hourly average, PurpleAir data had a 15.6  $\mu\text{g}/\text{m}^3$  high bias over the same period.



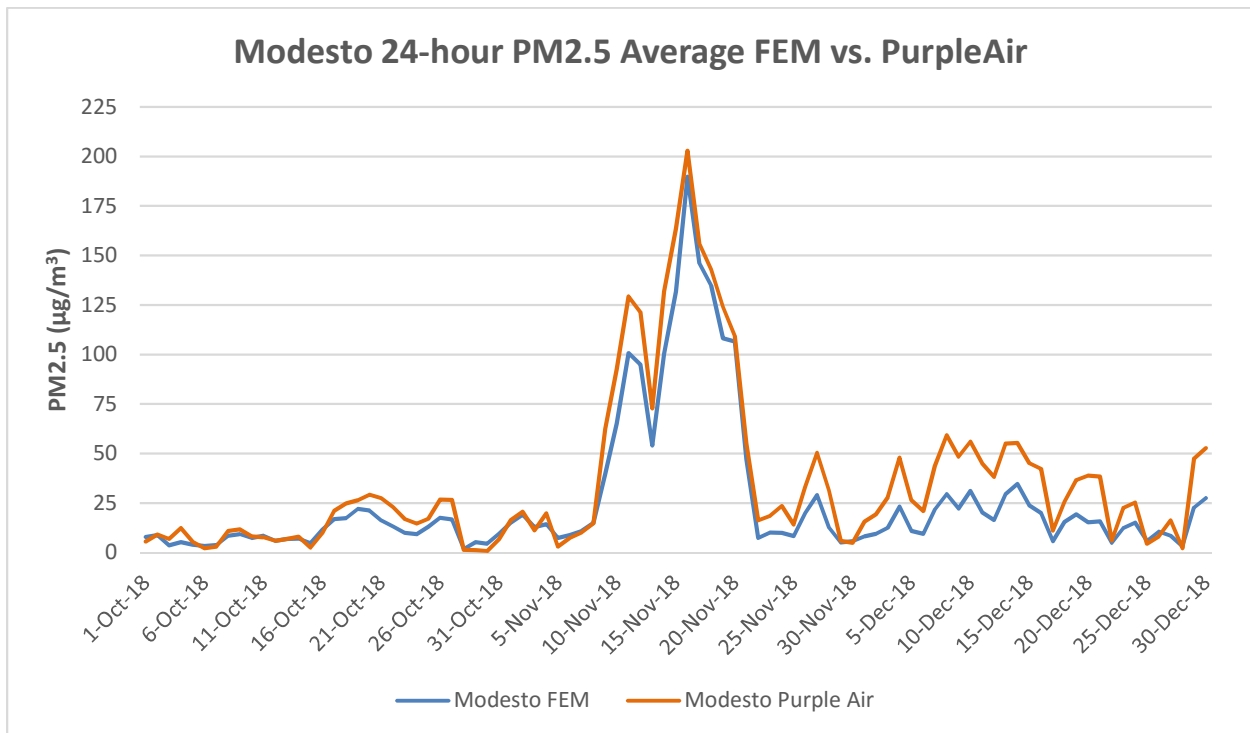
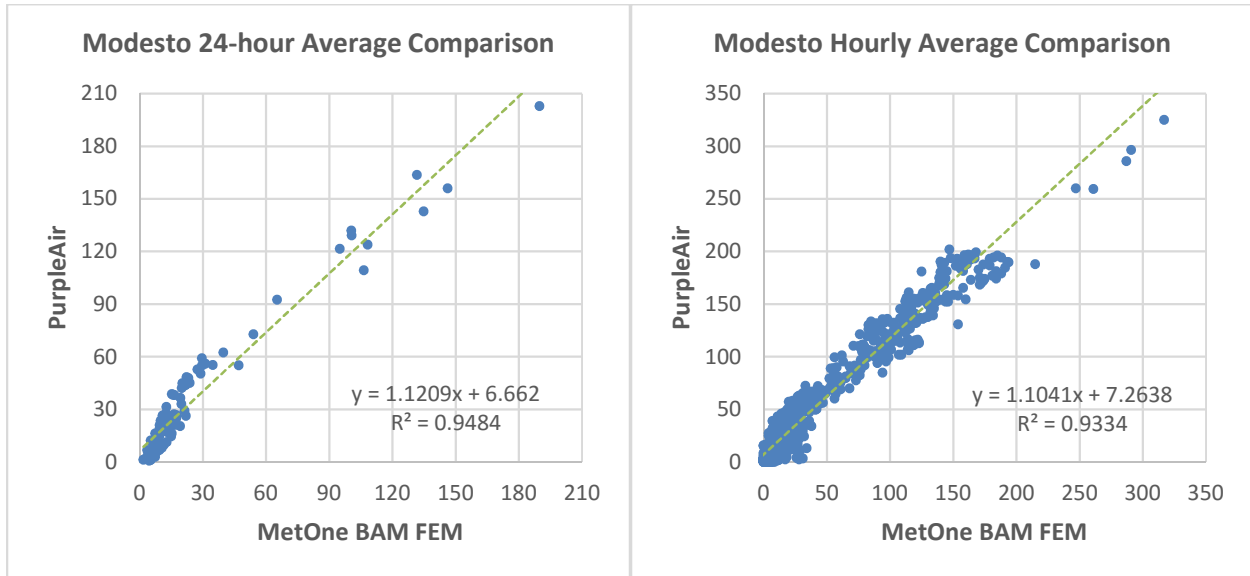
**Bakersfield-California**

For the 24-hour average, PurpleAir data had an 8.2  $\mu\text{g}/\text{m}^3$  high bias during the October 1<sup>st</sup>, 2018 through December 31<sup>st</sup>, 2018 period. For the hourly average, PurpleAir data had an 8.3  $\mu\text{g}/\text{m}^3$  high bias over the same period.



**Modesto-14<sup>th</sup> St.**

For the 24-hour average, PurpleAir data had a 9.8 µg/m<sup>3</sup> high bias during the October 1<sup>st</sup>, 2018 through December 31<sup>st</sup>, 2018 period. For the hourly average, PurpleAir data had a 9.9 µg/m<sup>3</sup> high bias over the same period.



### **Statistical Summary**

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

<b>Statistic</b>	<b>Fresno-Garland</b>	<b>Visalia-Church</b>	<b>Bakersfield-Cal</b>	<b>Modesto</b>
FEM Avg	21.6	21.5	19.5	25.7
Sensor Avg	34.3	35.7	27.7	35.5
FEM 1-hr Max	137.4	89	121	317
Sensor 1-hr Max	181	97.8	110	325.1
FEM 24-hr Max	79.4	75.4	89.9	189.8
Sensor 24-hr Max	89.6	63.1	85.3	202.9
1-hr R <sup>2</sup>	0.8217	0.7964	0.823	0.9334
1-hr Slope	1.1653	1.3003	1.0625	1.1041
1-hr Intercept	9.5026	9.4122	7.1177	7.2638
24-hr R <sup>2</sup>	0.8451	0.8655	0.8613	0.9484
24-hr Slope	1.197	1.5506	1.1121	1.1209
24-hr Intercept	8.4534	4.3374	6.0204	6.662