

AQ-SPEC

Air Quality Sensor Performance Evaluation Center Evaluation Summary

Sensor Description

Manufacturer/Model:
Kunak/
Air A10

Pollutants:
PM_{1.0}, PM_{2.5} and PM₁₀ mass
concentration

Time Resolution:
5-minute

Type: Optical



Additional Information

Field evaluation report:

<http://www.aqmd.gov/aq-spec/evaluations/field>

Lab evaluation report:

<http://www.aqmd.gov/aq-spec/evaluations/laboratory>

AQ-SPEC website:

<http://www.aqmd.gov/aq-spec>

- Overall, the accuracy of the Kunak sensors decreased as PM_{1.0} mass conc. increased and was fairly constant (66% to 72%) for the PM_{2.5} mass conc. range tested. The accuracy of the Kunak sensors was fairly constant (77% to 88% for GRIMM and 87% to 98% for APS) over the PM₁₀ mass conc. range tested. The Kunak sensors underestimated all PM mass conc. measurements from the reference instruments in the laboratory experiments.
- The Kunak sensors exhibited high precision for all T/RH combinations and all PM_{1.0} and PM_{2.5} concentrations except at 5 °C/65% RH.
- The Kunak sensors (IDs: 0000, 0001 and 0002) showed low and high intra-model variability in the field and in the laboratory evaluations, respectively.
- Data recovery was 100% from all units in the field and in the laboratory.
- For PM_{2.5}, the Kunak sensors showed moderate to strong correlations with the ref. instruments from the field ($0.55 < R^2 < 0.76$) and very strong correlations with GRIMM in the laboratory studies ($R^2 > 0.99$ for PM_{1.0} and PM_{2.5}). For PM₁₀, the Kunak sensors showed moderate to strong correlations with the ref. instruments from the field ($0.56 < R^2 < 0.77$) and very strong correlations with GRIMM and APS in the laboratory studies ($R^2 > 0.99$).
- The same three Kunak units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

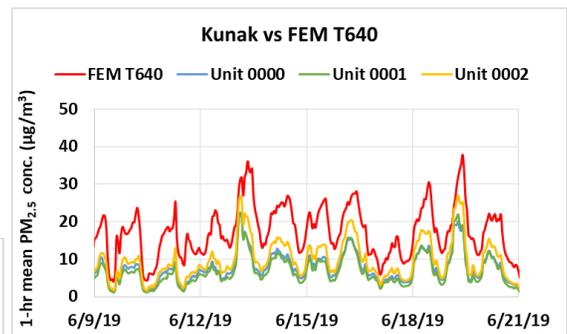
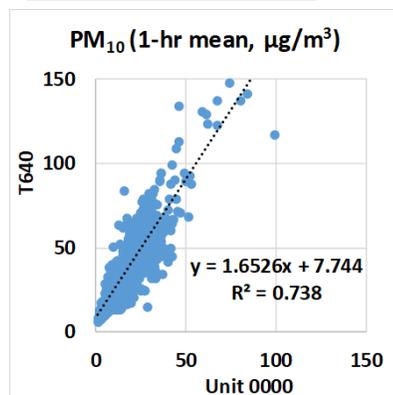
Field Evaluation Highlights

- Deployment period 04/28/2019 - 07/11/2019: the three Kunak sensors showed moderate to strong correlations with the corresponding PM_{2.5} and PM₁₀ mass concentration as monitored by FEM BAM and T640.
- The units showed low intra-model variability and data recovery ~ 100%.

1-hr mean, all ref. inst.

PM_{2.5}: $0.55 < R^2 < 0.76$

PM₁₀: $0.56 < R^2 < 0.77$



Coefficient of Determination (R^2) quantifies how the three sensors followed the PM_{2.5} concentration change by the reference instruments.

An R^2 approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.

Laboratory Evaluation Highlights

Accuracy (PM_{2.5})

$$A (\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

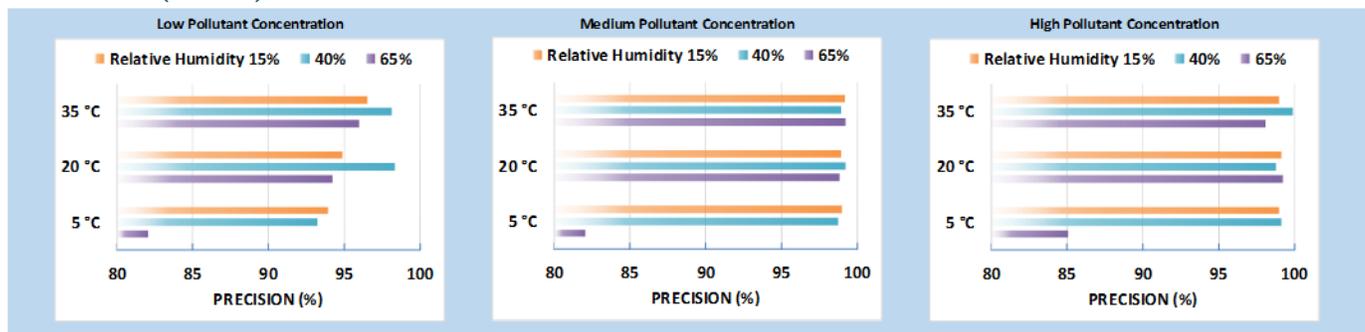
Steady state #	Sensor Mean (µg/m ³)	FEM GRIMM (µg/m ³)	Accuracy (%)
1	4.4	6.6	66.7
2	7.7	11.5	66.6
3	24.0	36.3	66.2
4	72.9	109.8	66.3
5	131.4	193.4	67.9
6	218.2	301.7	72.3

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40%. The sensor's readings at each ramping steady state are compared to the reference instrument.

A negative % means sensors' overestimation by more than two fold. The higher the positive value (close to 100%), the higher the sensor's accuracy.



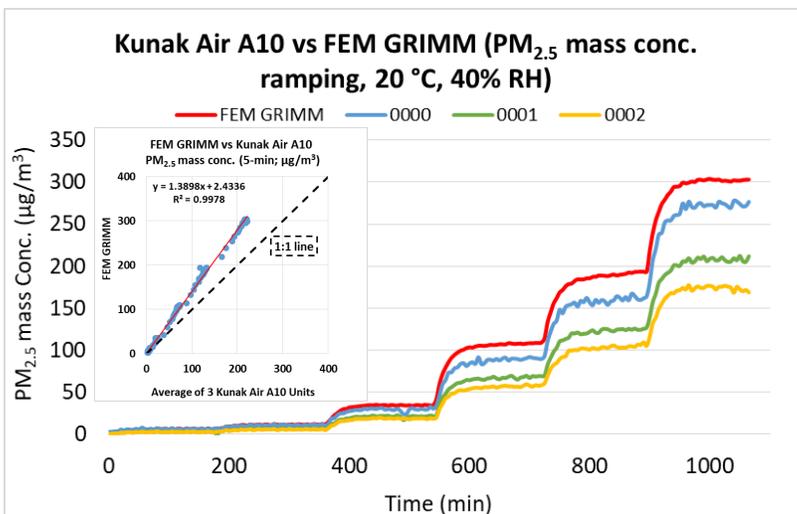
Precision (PM_{2.5})



100% represents high precision.

Sensor's ability to generate precise measurements of PM_{2.5} concentration at low, medium, and high pollutant levels were evaluated under 9 combinations of T and RH, including extreme weather conditions like cold and dry (5 °C and 15%) cold and humid (5 °C and 65%), hot and humid (35 °C and 65%), or hot and dry (35 °C and 15%).

Coefficient of Determination



The Kunak sensors showed very strong correlations with the corresponding FEM PM_{2.5} data ($R^2 > 0.99$) at 20 °C and 40% RH. For conc. ramping experiments of PM_{1.0} and PM₁₀, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Kunak sensor performance. At the set-points of RH changes, the Kunak sensors reported spiked changes in concentrations and showed significant conc. variation at 5 °C/65% RH.

Observed Interferents

N/A



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