AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Laboratory Evaluation Report for

Gonggam Sensors Co., Ltd. – TAM 1

Report ID: L20250901.0

Published on:
September 5, 2025

Published by:
South Coast Air Quality Management District
21865 Copley Drive
Diamond Bar, CA 91765

Citation:
South Coast Air Quality Management District. (2025). Air Quality Sensor Performance Evaluation Center (AQ-SPEC) Laboratory Evaluation Report for Gonggam Sensors Co., Ltd. – TAM 1 [Revision 0]. Available at http://www.aqmd.gov/aq-spec

Revision History

Version	Date	Note
0	09/05/2025	Original issued report

Disclaimer: All documents, reports, data, and other information provided are for informational and/or educational use only.

The laboratory evaluation was conducted in an AQ-SPEC environmental chamber with simulated pollutant and interferent concentrations that were generated from nebulizer solutions, dust dispensers, and/or gas dilution calibrators. Generated environments may not be able to fully replicate the conditions that may be experienced under ambient settings. The sensor assembly, installation, and use can also impact the reliability of the products evaluated by the AQ-SPEC program.

South Coast AQMD makes no claim, warranty, or guarantee that these devices will or will not work when operated by other users for their specific applications.

South Coast AQMD's AQ-SPEC aims at providing information to and for the benefit of the public to make informed purchasing decisions on air quality sensors. In accordance with this mission, the general policy of the Governing Board of the Agency is to exclude all commercial advertising and promotional material, including links which provide exclusive private or financial benefit to commercial, non-public enterprises and which do not promote or enhance a public benefit to the general public. As a Government Agency, the South Coast AQMD neither endorses nor supports individual private commercial enterprises through testing of products by AQ-SPEC or through providing links to the sites of such commercial enterprises.

Report Role	Name	Date Completed
Tested by	Victor Rocha, Jr.	02/14/2025
Analysis by	Michelle Kuang, Ph.D.	08/08/2025
QC Review by	Wilton Mui, Ph.D.	09/04/2025
Approved by	Wilton Mui, Ph.D.	09/04/2025
Revision by	-----	-----

Table of Contents

Section 1: Background

Three Gonggam Sensors Co., Ltd. – Tiny Aerosol Conditioner inside Air Monitor 1 (TAM 1; hereinafter GGSensors – TAM) units (IDs: 95, 96 and 97) were deployed at the South Coast AQMD stationary ambient monitoring site in Rubidoux from 11/04/2023 to 01/04/2024. Following field testing, the same three units were evaluated in an AQ-SPEC environmental chamber under controlled temperatures, humidities and potassium chloride particle concentrations.

GGSensors - TAM

Teledyne T640x

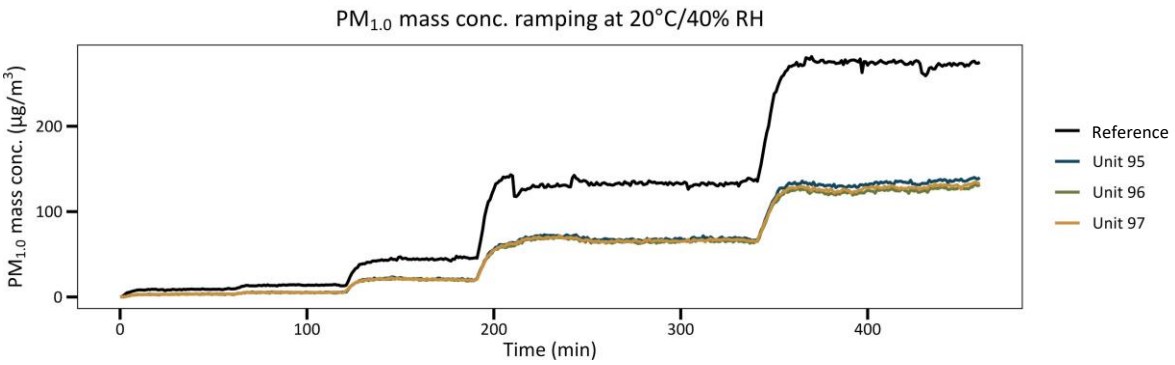
Section 2: Manufacturer Specs

Parameter	Sensor: GGSensors – TAM	Reference Instrument: Teledyne T640x
Pollutant	$PM_{1.0}$, $PM_{2.5}$, $PM_{4.0}$, PM_{10}	$PM_{1.0}$, $PM_{2.5}$ (FEM), PM_{10} (FEM)
Cost	$7,999 (at time of testing)	$21,000
Weight	10 pounds	19 pounds
Dimensions (LxWxD)	8.3 x 8.7 x 5.3 inches	7 x 17 x 14 inches
Power	100-240 VAC (4.7 W max)	100-240 VAC (360 W max)
Battery	No	No
Data transmission	Wi-Fi	Ethernet, USB
Internal memory	Yes; 1 GB (28 years)	Yes; 4 GB (>1 year)
Operating temperature range	-4 – 122 degrees F	32 – 122 degrees F
Operating RH range	0%-100%	0%-100%
Product website	https://ggsensors.com/tam/	https://www.teledyne-api.com/en-us/products/t640
Operating principle	Optical light scattering	Optical light scattering
Time resolution	1 minute	1 minute (as-configured)
Concentration range	0.1-999 µg/m^3	0.1-10,000 µg/m^3

Section 3: $PM_{1.0}$

Section 3.1: Data Overview

Timeseries of $PM_{1.0}$ Concentration Ramp



Section 3.2: Data Recovery

Basic QA/QC procedures such as removal of duplicate records was performed. Nulls, negatives, out of instrument bounds as specified by the manufacturer, and values flagged as invalid by the sensor were considered invalid. Data recovery was calculated as the percent of valid readings through the entire evaluation.

Parameter	Unit 95	Unit 96	Unit 97
$PM_{1.0}$	100%	100%	100%

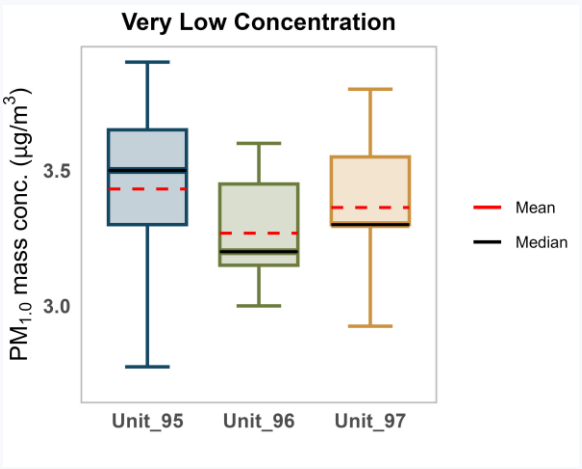
Section 3.3: Intra-Model Variability

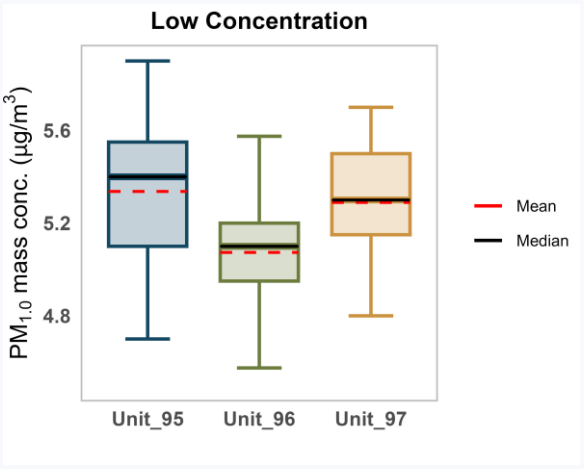
Absolute intra-model variability was calculated as the standard deviation of the mean values of the sensors. Relative intra-model variability was calculated as the absolute intra-model variability divided by the sensor grand mean. Calculations were performed using 20 measurements from each steady-state period.

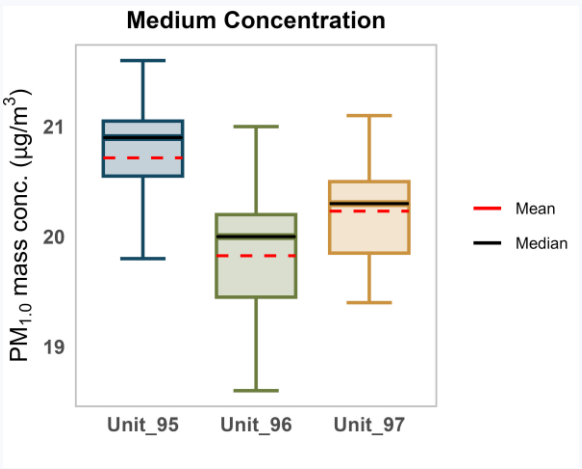
$PM_{1.0}$ Concentration (µg/m³)	Absolute intra-model variability (µg/m³)	Relative intra-model variability (%)
Very Low (9.2)	0.1	2.4
Low (13.9)	0.1	2.7
Medium (45.2)	0.4	2.2
High (134.5)	1.6	2.3
Very High (273.0)	4.7	3.5

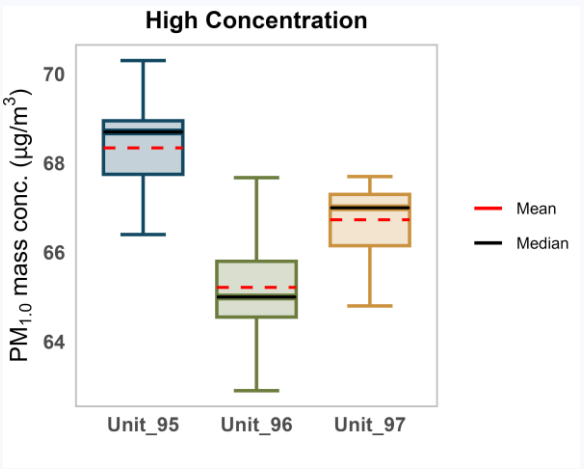
Section 3: $PM_{1.0}$

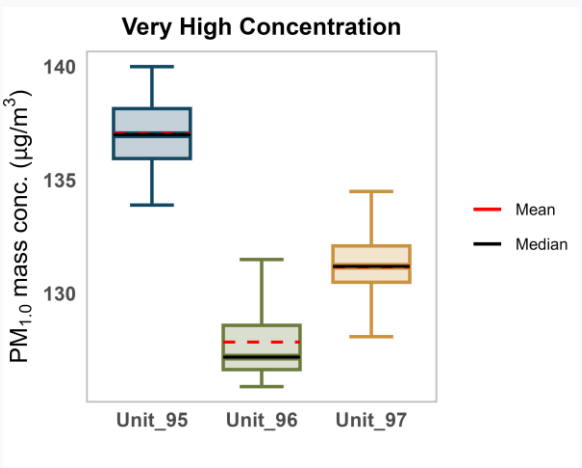
Section 3.3: Intra-Model Variability – Box Plots











Interpretation: The GGSensors – TAM units had similar pollutant distributions at lower concentrations, but different distributions at higher concentrations.

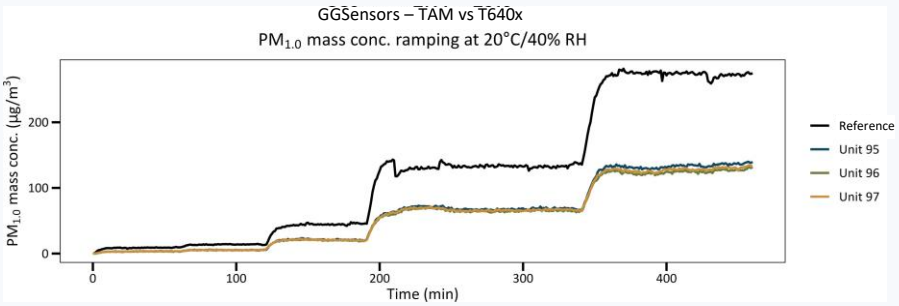
Section 3: $PM_{1.0}$

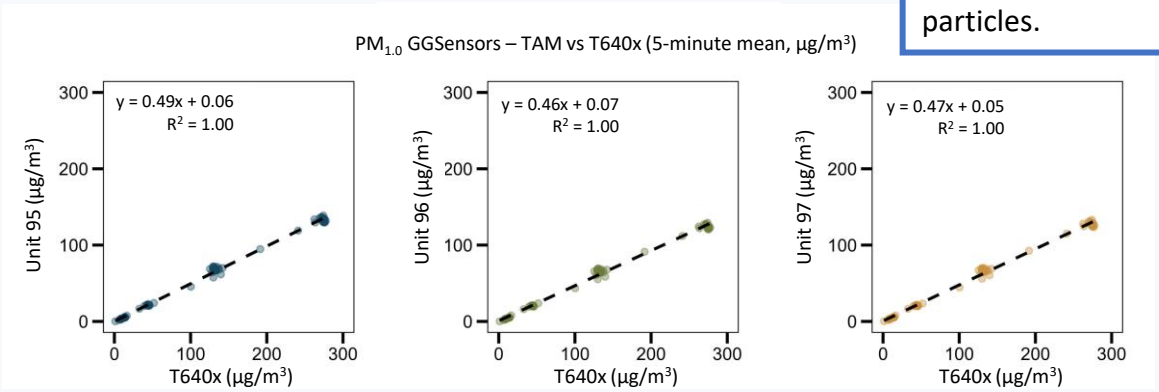
Section 3.4: Linearity (R^2)

Basic QA/QC procedures were used to validate the collected data (i.e., obvious outliers, negative values, readings flagged by the sensor, and invalid data points were eliminated from the data-set.

A summary of the mean R^2 between the sensor and T640x across all units tested.

Parameter	Time Resolution	GGSensor – TAM (mean ± SD)
$PM_{1.0}$	5-minute	1.00 ± 0.00

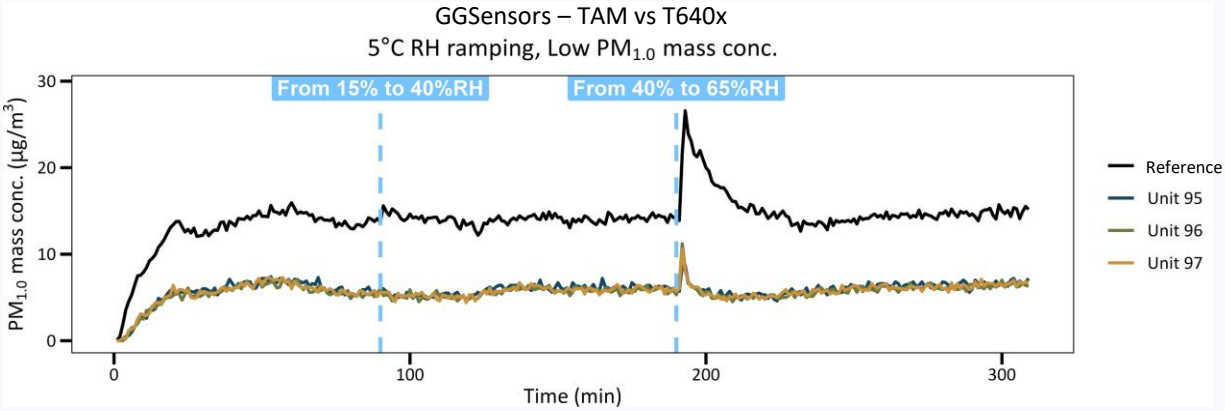


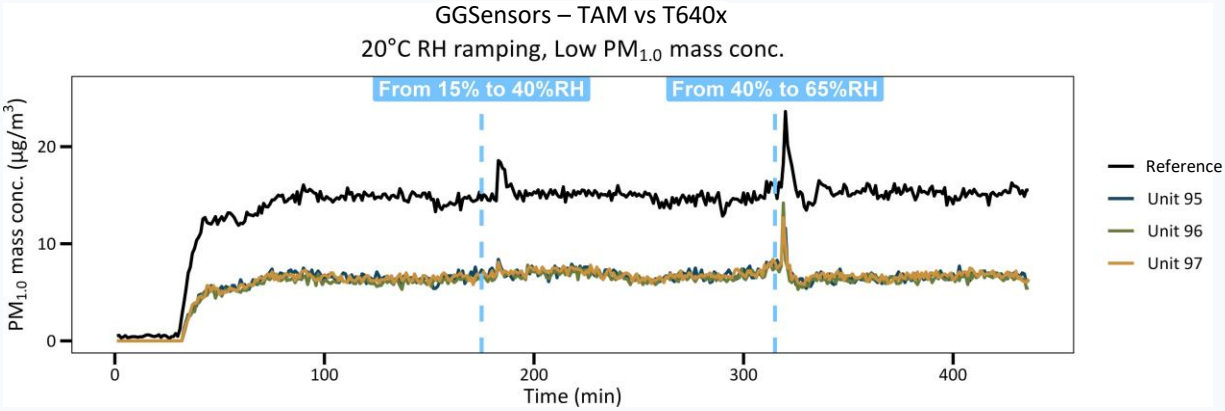


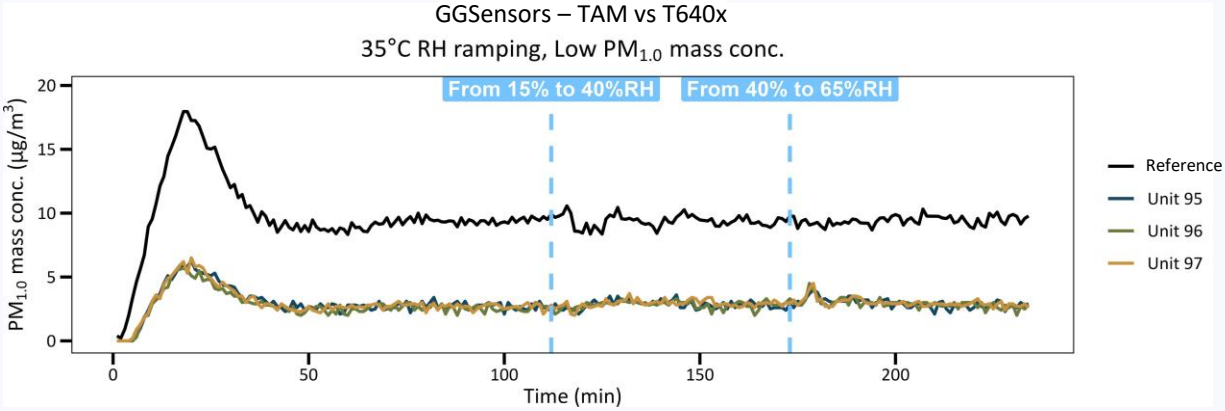
Interpretation: The GGSensors -TAM showed very strong correlation with the corresponding T640x data (R^2 > 0.99) at 5-minute averaging, for potassium chloride particles.

Section 3: $PM_{1.0}$

Section 3.5: Climate Susceptibility – Low Concentrations

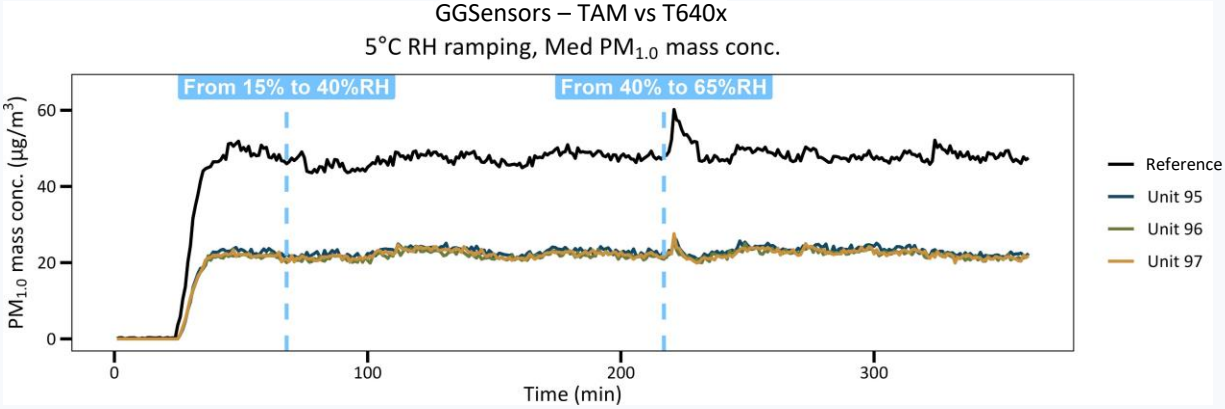


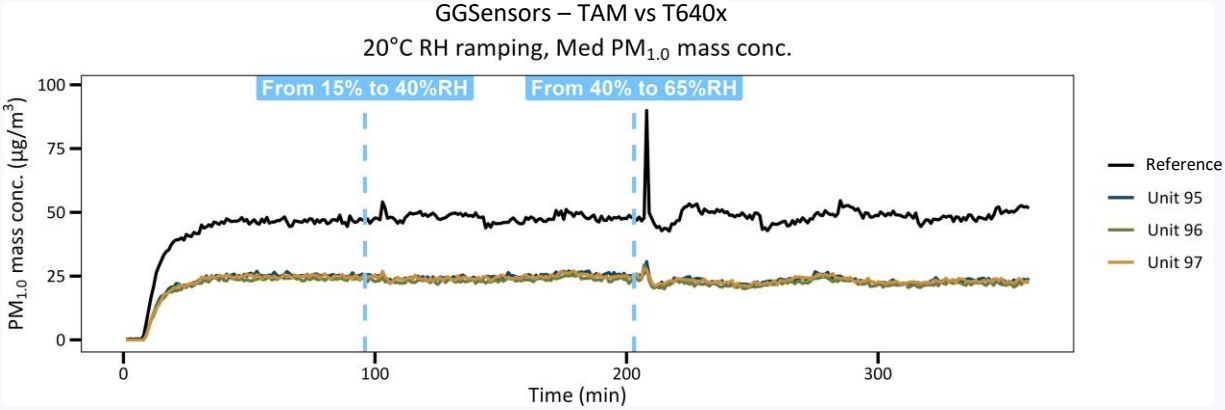


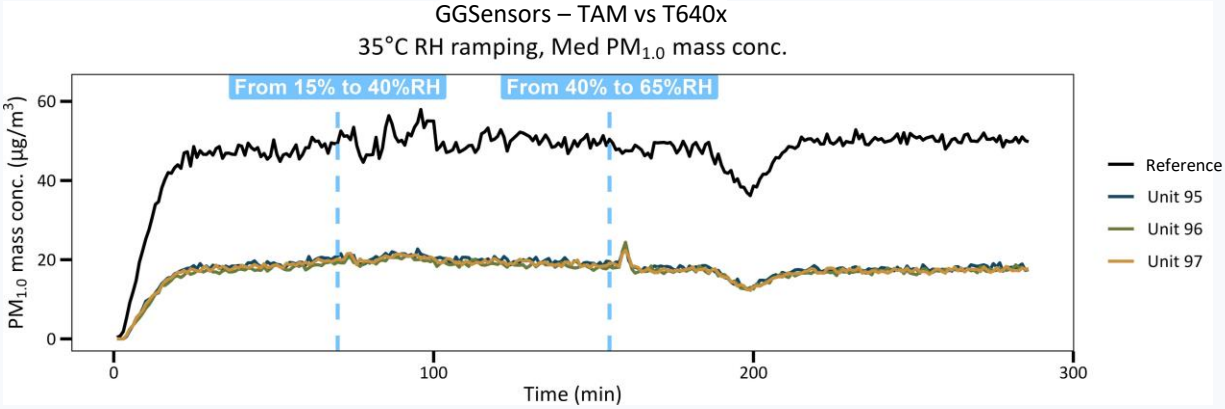


Section 3: $PM_{1.0}$

Section 3.5: Climate Susceptibility – Med. Concentrations

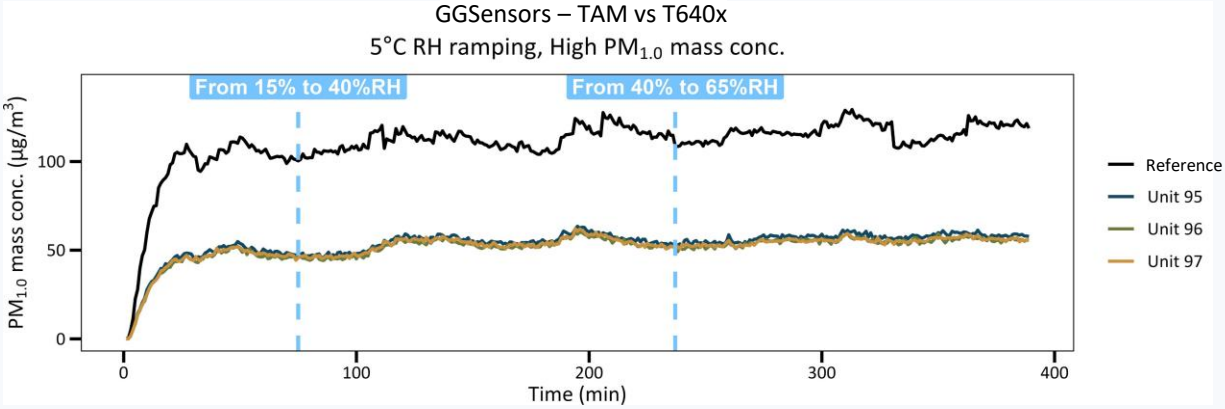


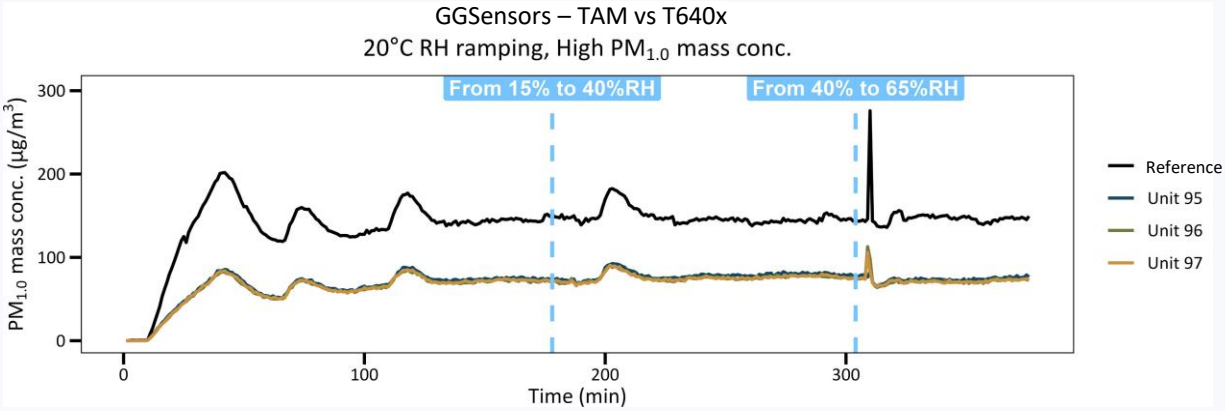


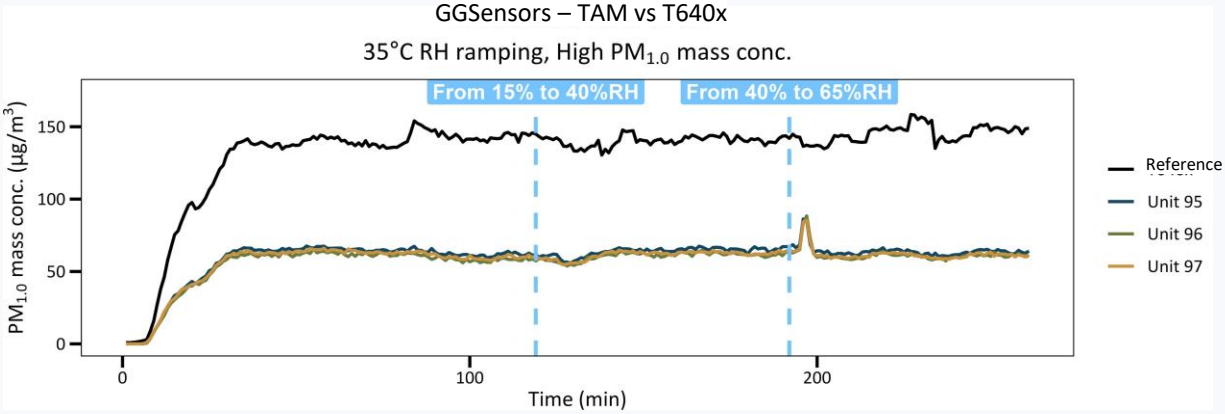


Section 3: $PM_{1.0}$

Section 3.5: Climate Susceptibility – High Concentrations



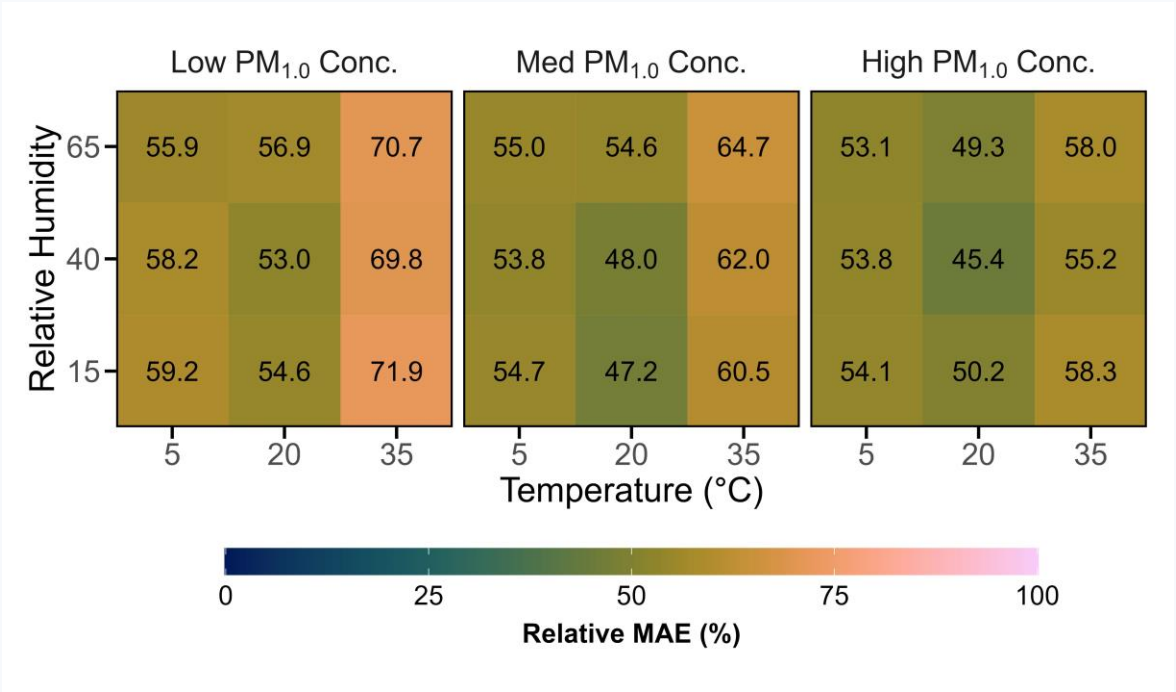




Section 3: $PM_{1.0}$

Section 3.5: Climate Susceptibility – Heat Maps

Relative MAE: effect of $PM_{1.0}$ concentration, temperature and RH

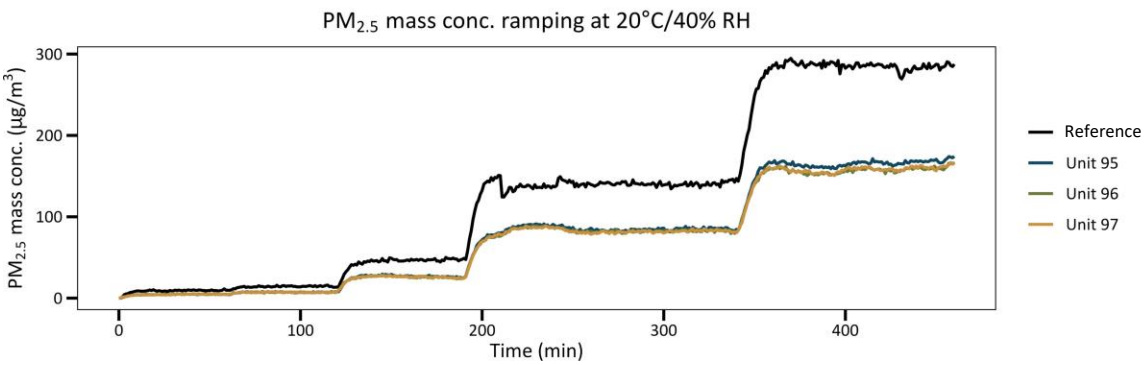


Interpretation: The GGSensors – TAM units generally showed higher relative MAE values at 35°C and at low $PM_{1.0}$ concentrations, for potassium chloride particles.

Section 4: $PM_{2.5}$

Section 4.1: Data Overview

Timeseries of $PM_{2.5}$ Concentration Ramp



Section 4.2: Data Recovery

Basic QA/QC procedures such as removal of duplicate records was performed. Nulls, negatives, out of instrument bounds as specified by the manufacturer, and values flagged as invalid by the sensor were considered invalid. Data recovery was calculated as the percent of valid readings through the entire evaluation.

Parameter	Unit 95	Unit 96	Unit 97
$PM_{2.5}$	100%	100%	100%

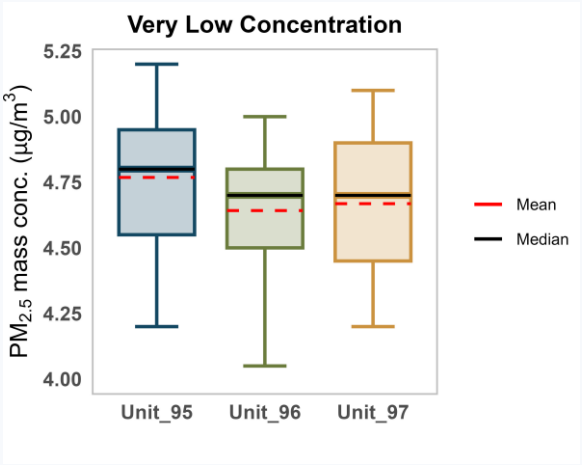
Section 4.3: Intra-Model Variability

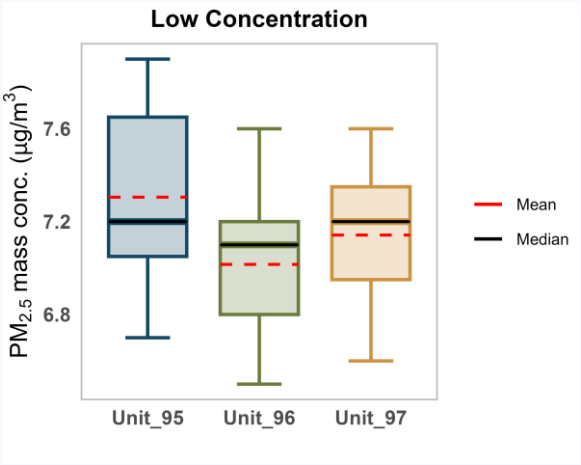
Absolute intra-model variability was calculated as the standard deviation of the mean values of the sensors. Relative intra-model variability was calculated as the absolute intra-model variability divided by the sensor grand mean. Calculations were performed using 20 measurements from each steady-state period.

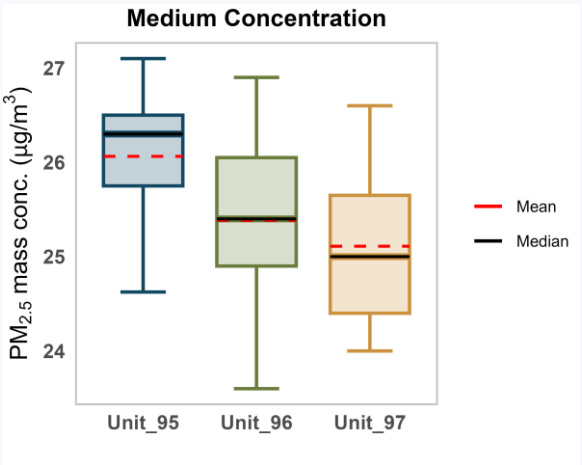
$PM_{2.5}$ Concentration (µg/m³)	Absolute intra-model variability (µg/m³)	Relative intra-model variability (%)
Very Low (9.6)	0.1	1.4
Low (14.6)	0.1	2.0
Medium (47.5)	0.5	1.9
High (142.1)	1.5	1.8
Very High (285.3)	4.8	3.0

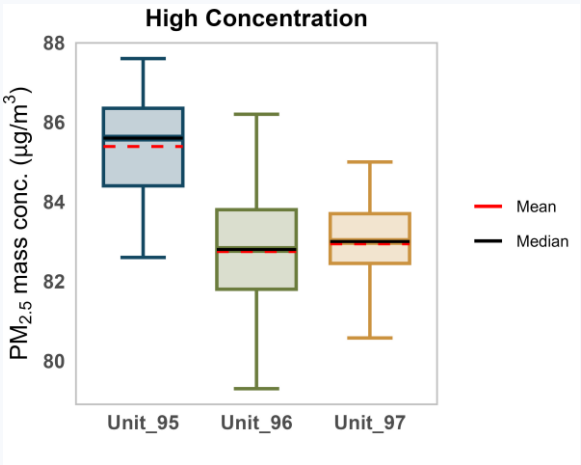
Section 4: $PM_{2.5}$

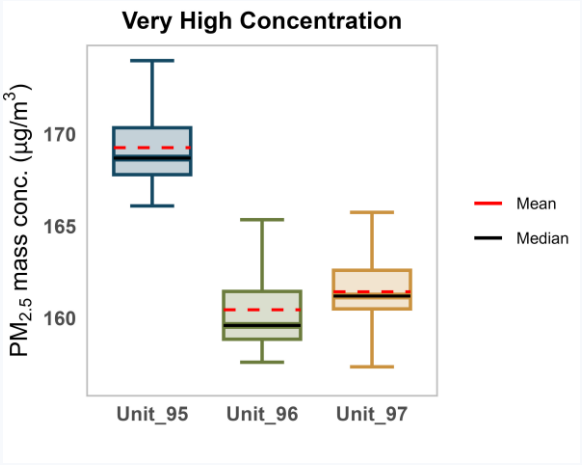
Section 4.3: Intra-Model Variability











Interpretation: The GGSensors – TAM units had similar pollutant distributions at lower concentrations, but different distributions at higher concentrations.

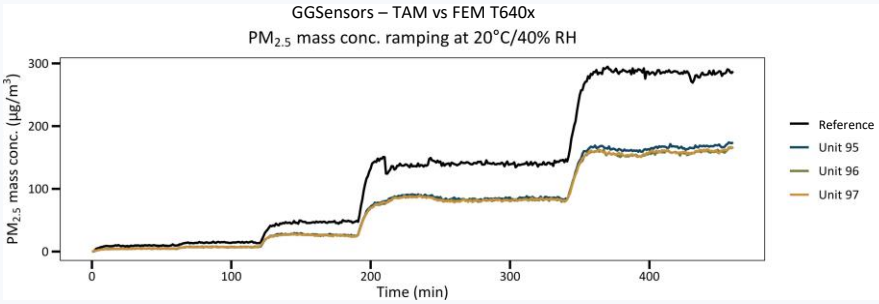
Section 4: $PM_{2.5}$

Section 4.4: Linearity (R^2)

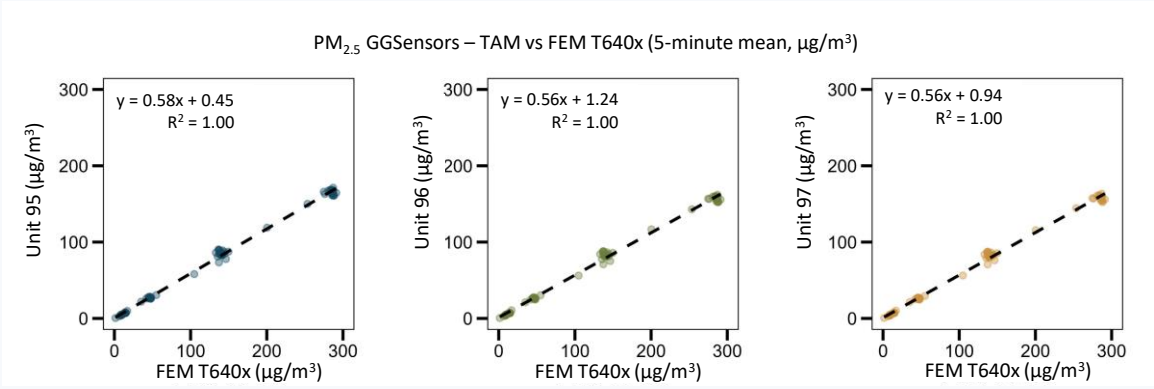
Basic QA/QC procedures were used to validate the collected data (i.e., obvious outliers, negative values, readings flagged by the sensor, and invalid data points were eliminated from the data-set.

A summary of the mean R^2 between the sensor and FEM T640x across all units tested.

Parameter	Time Resolution	GGSensor – TAM (mean ± SD)
$PM_{2.5}$	5-minute	1.00 ± 0.00

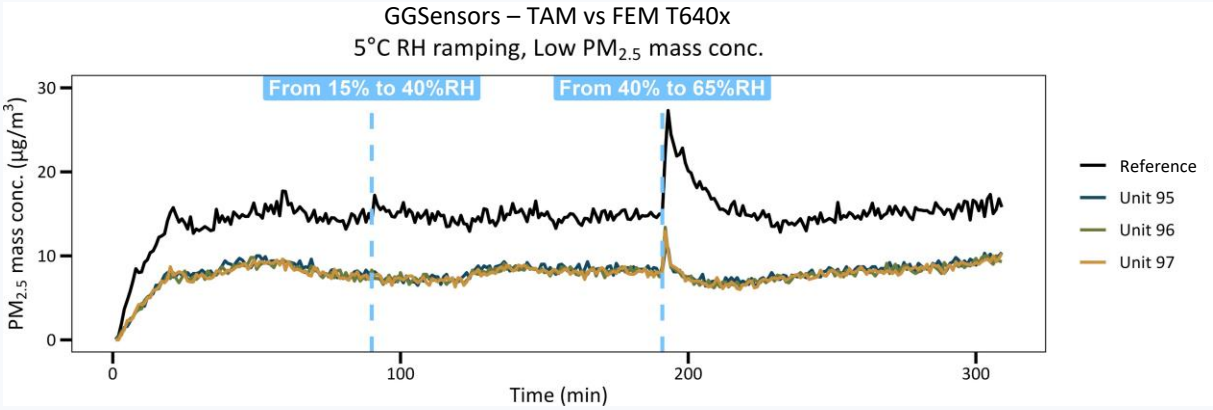


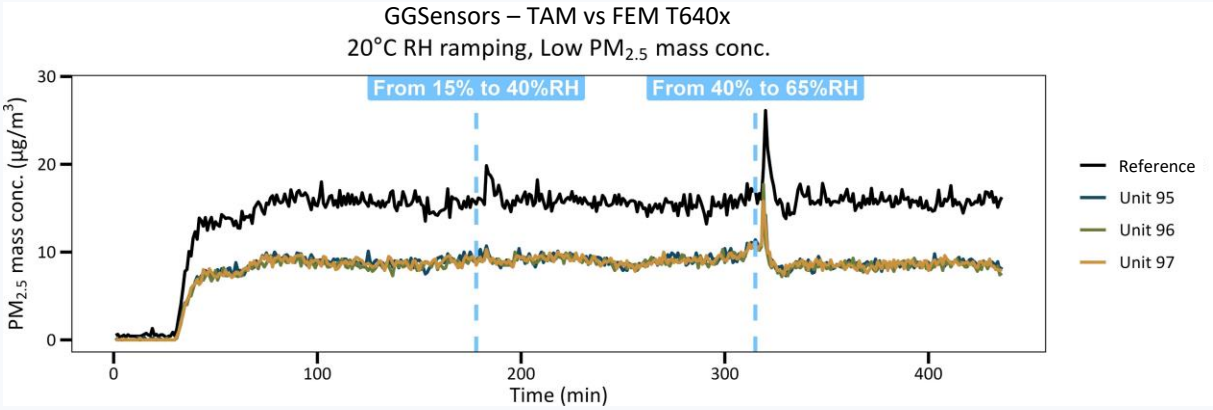
Interpretation: The GGSensors -TAM showed very strong correlation with the corresponding FEM T640x data (R^2 > 0.99) at 5-minute averaging, for potassium chloride particles.

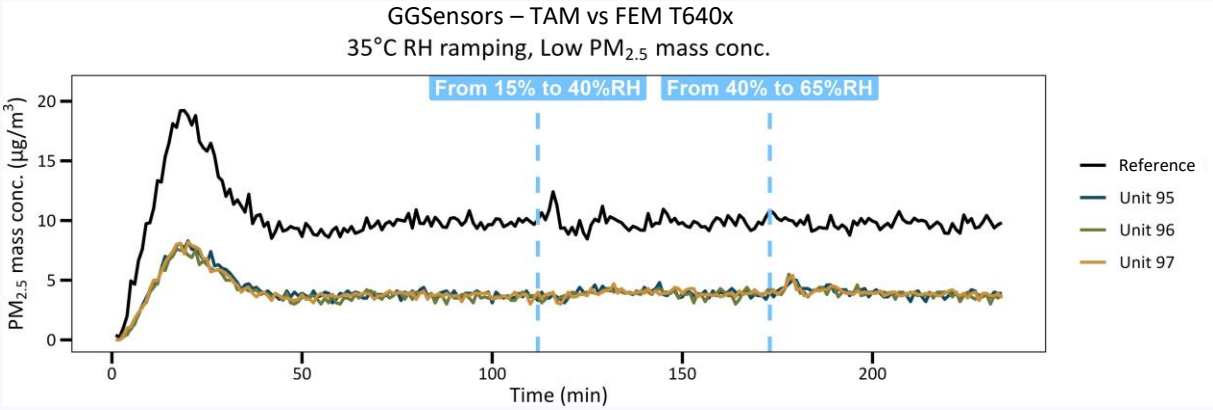


Section 4: $PM_{2.5}$

Section 4.5: Climate Susceptibility – Low Concentrations

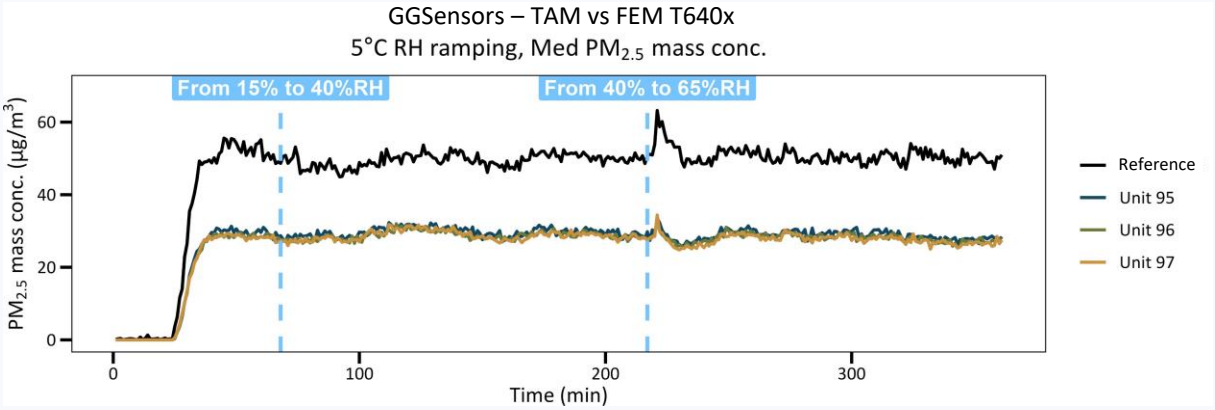


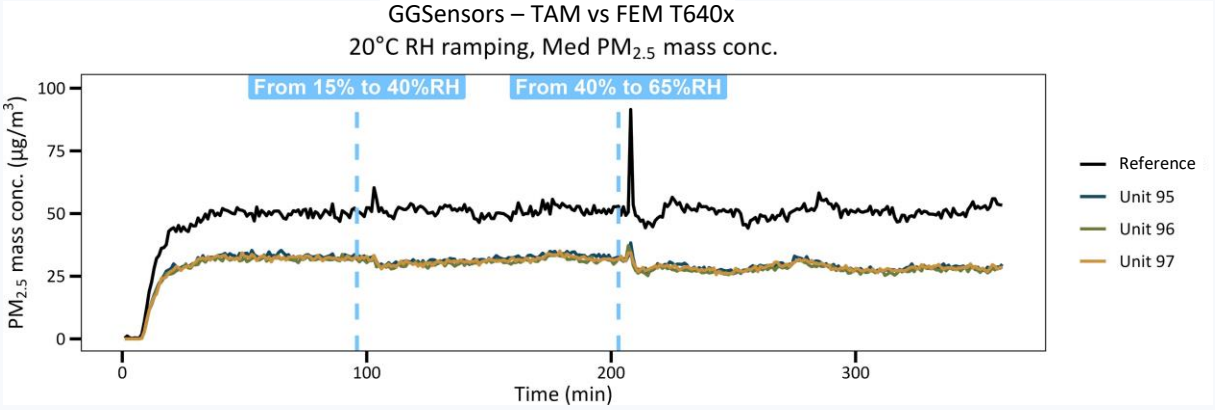


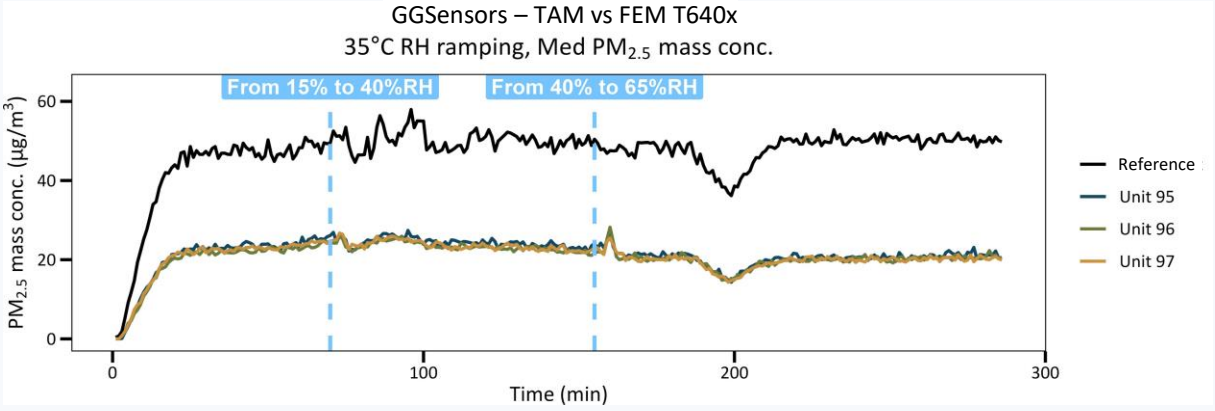


Section 4: $PM_{2.5}$

Section 4.5: Climate Susceptibility – Med. Concentrations

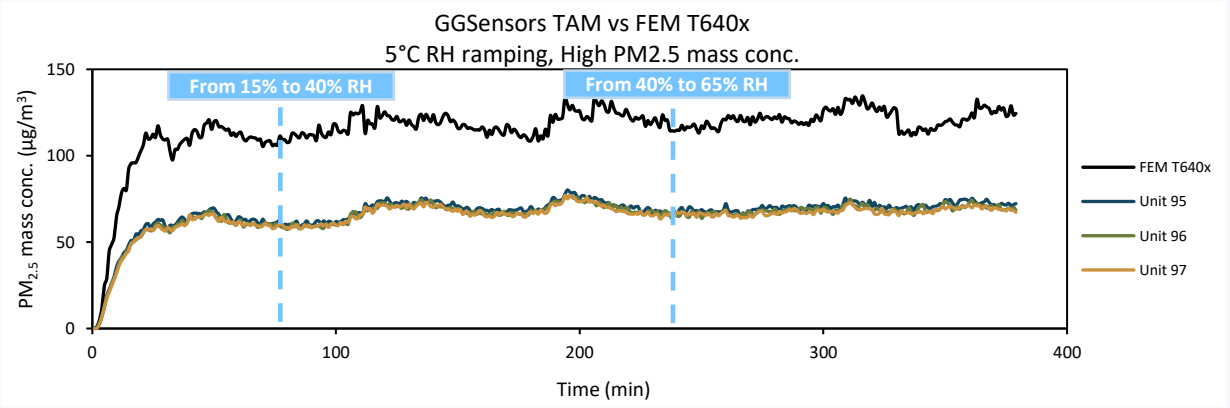


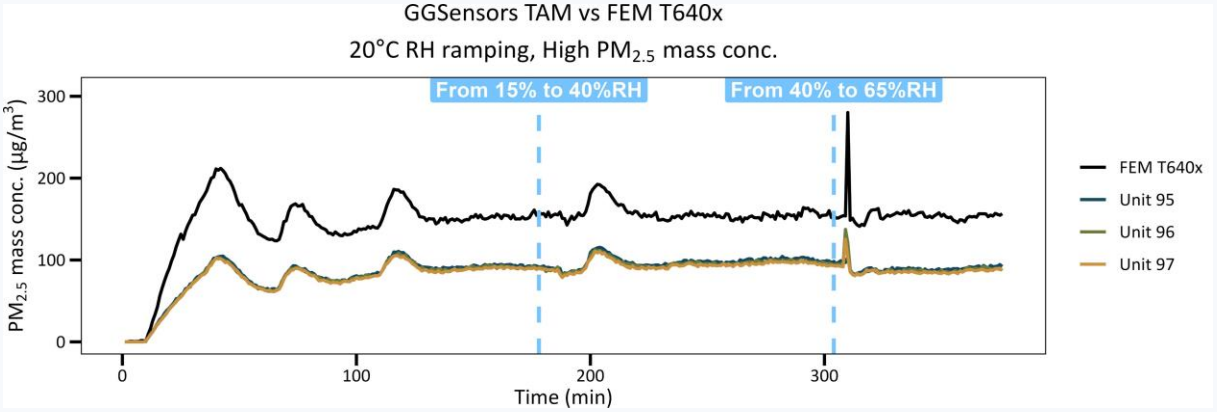


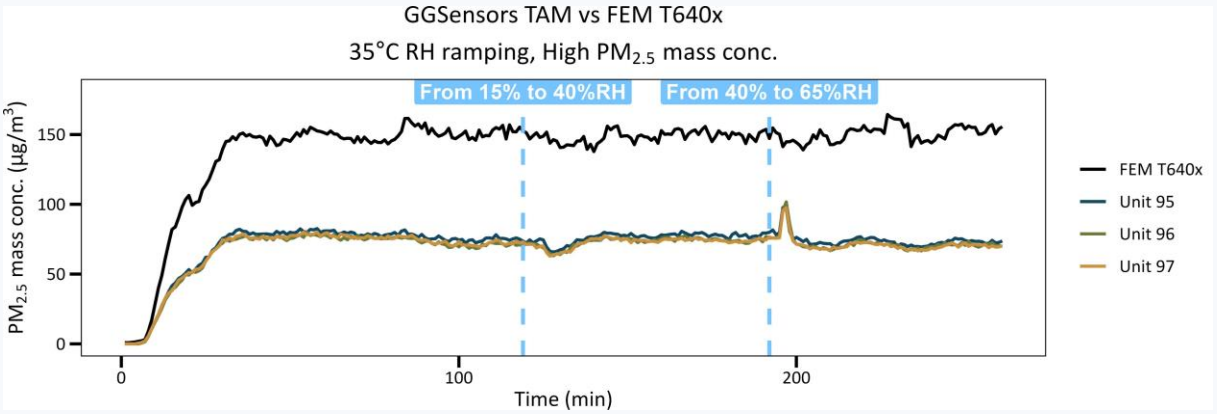


Section 4: $PM_{2.5}$

Section 4.5: Climate Susceptibility – High Concentrations



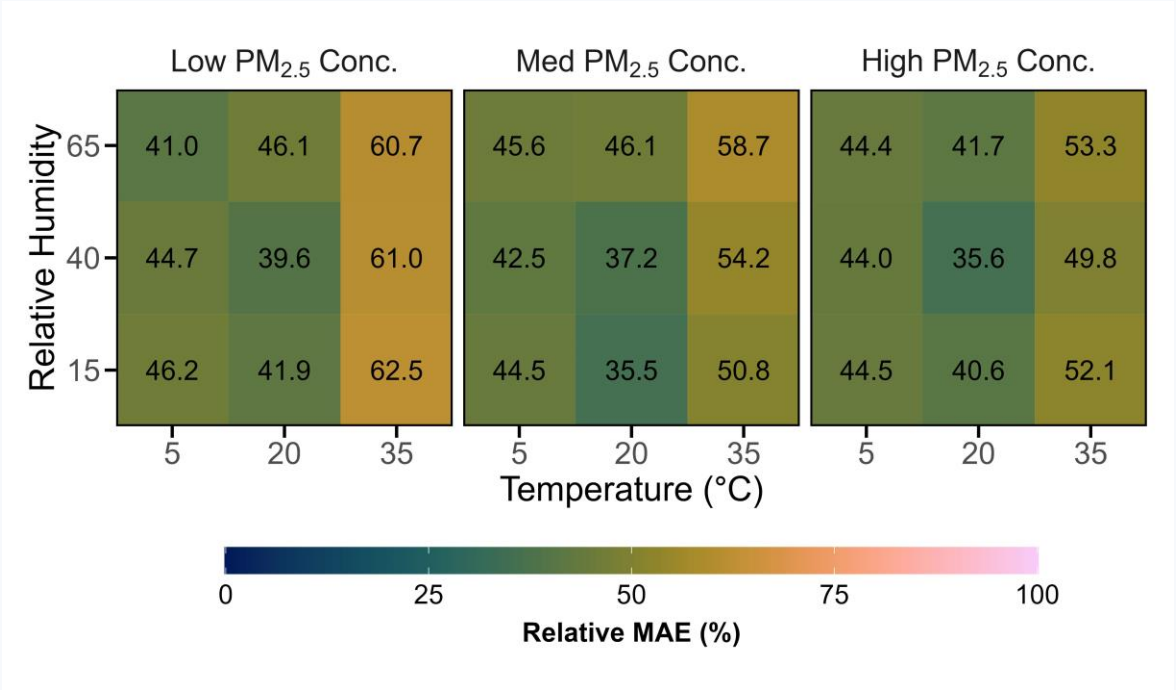




Section 4: $PM_{2.5}$

Section 4.5: Climate Susceptibility – Heat Maps

Relative MAE: effect of $PM_{2.5}$ concentration, temperature and RH



Interpretation: The GGSensors – TAM units generally showed higher relative MAE values at 35°C and at low $PM_{2.5}$ concentrations, for potassium chloride particles.

Section 5: Summary Metrics

		$PM_{1.0}$				
		Very low	Low	Medium	High	Very High
GGSensor-TAM	Average*	3.4	5.3	20.3	66.7	132.2
	SD*	0.1	0.1	0.4	1.5	4.6
T640x	Average*	9.2	13.9	45.2	134.5	273.0
	SD*	0.4	0.4	1.4	2.6	1.6
GGSensor TAM vs. T640x	MBE*	-5.9 to -5.7	-8.7 to -8.5	-25.4 to -24.5	-69.3 to -66.2	-144.9 to -135.8
	MAE*	5.7 to 5.9	8.5 to 8.7	24.5 to 25.4	66.2 to 69.3	135.8 to 144.9
	RMSE*	5.8 to 5.9	8.5 to 8.8	24.5 to 25.4	66.3 to 69.4	135.8 to 144.9

*Units in $\mu g/m^3$

Section 5: Summary Metrics

		$PM_{2.5}$				
		Very low	Low	Medium	High	Very High
GGSensor-TAM	Average*	4.7	7.2	25.6	83.7	164.0
	SD*	0.1	0.1	0.5	1.4	4.8
T640x	Average*	9.6	14.6	47.5	142.1	285.3
	SD*	0.6	0.7	1.4	2.9	2.8
GGSensor TAM vs. T640x	MBE*	-4.9 to -4.8	-7.5 to -7.3	-22.3 to -21.4	-59.3 to -56.8	-124.5 to -115.8
	MAE*	4.8 to 4.9	7.3 to 7.5	21.4 to 22.3	56.8 to 59.3	115.8 to 124.5
	RMSE*	4.9 to 5.0	7.4 to 7.6	21.4 to 22.4	56.9 to 59.4	115.8 to 124.5

*Units in $\mu g/m^3$