

# Field Evaluation of Vaisala Air Quality Transmitter AQT410



# Background

- From 7/14/2017 to 8/22/2017, three **Vaisala** gaseous sensors were deployed in Rubidoux and were run side-by-side SCAQMD Federal Reference Method (FRM) instruments measuring the same pollutants
- Vaisala AQT410 (3 units tested):
  - Gaseous sensor (**electrochemical gas sensor; non-FRM**)
  - Each unit measures NO<sub>2</sub> (ppm), SO<sub>2</sub> (ppm), CO (ppm), Ozone (ppm), ambient air temperature (degree C), relative humidity (%), and pressure (mBar)
  - **Unit cost: ~\$3,700**
  - Time resolution: 1-min
  - Units IDs:
    - COM\_29
    - COM\_30
    - COM\_31
- SCAQMD FRM instruments:
  - CO instrument; **cost: ~\$10,000**
    - Time resolution: 1-min
  - NO<sub>x</sub> instrument; **cost: ~\$11,000**
    - Time resolution: 1-min
  - O<sub>3</sub> instrument; **cost: ~\$7,000**
    - Time resolution: 1-min
  - SO<sub>2</sub> instrument; **cost: ~\$11,000**
    - Time resolution: 1-min
  - Meteorological station (temperature, relative humidity, and pressure); **cost: ~\$5,000**
    - Time resolution: 1-min

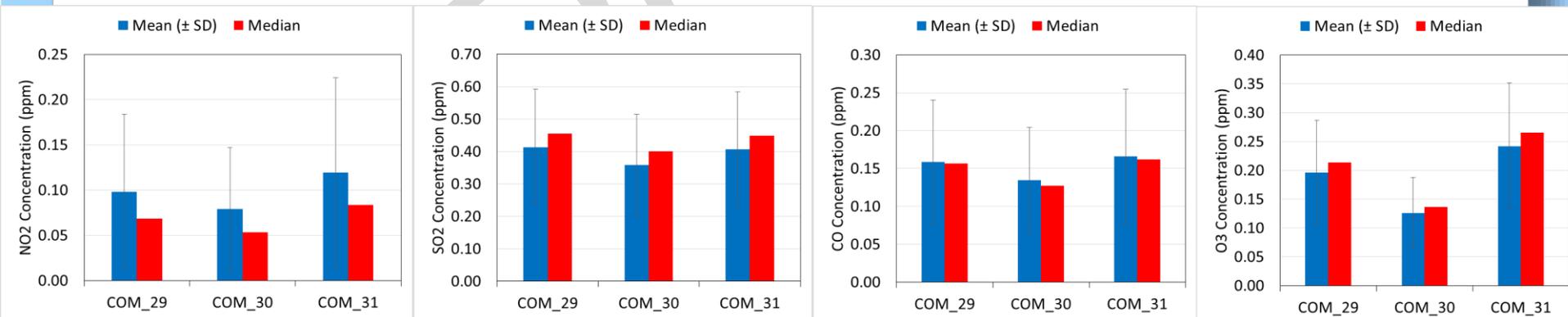


# Data validation & recovery

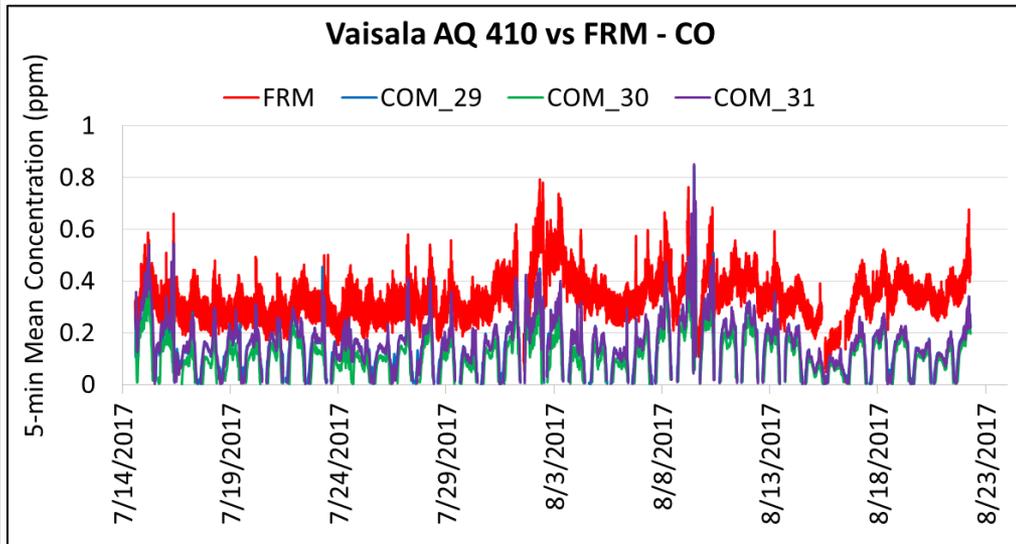
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values, and invalid data-points were eliminated from the data-set)
- Except for CO from COM\_30, data recovery was over 85% for all units/pollutants tested
- For CO from COM\_30, data recovery was 71%, mainly due to a large fraction of the data which was negative

## Vaisala AQT410; intra-model variability

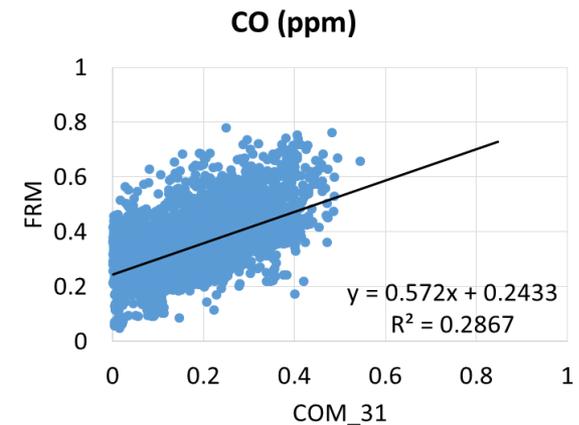
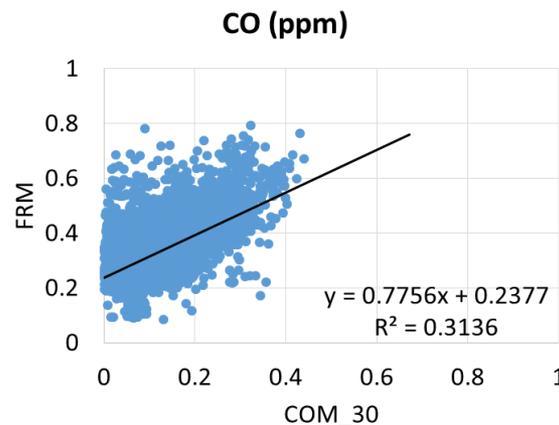
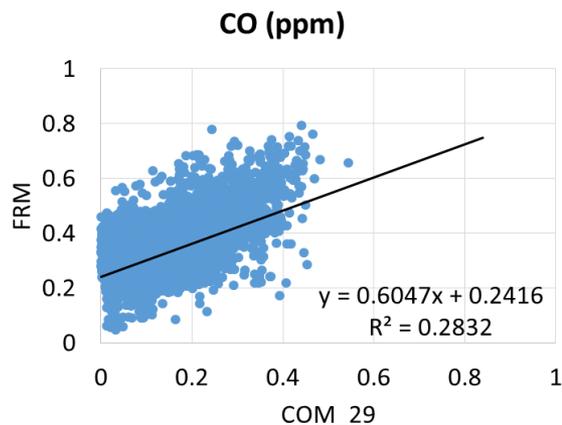
- Relatively low intra-model variability was observed for NO<sub>2</sub>, SO<sub>2</sub>, and CO from all Vaisala AQT410 sensors
- O<sub>3</sub> levels showed a relatively high variation among the tested AQT410 devices



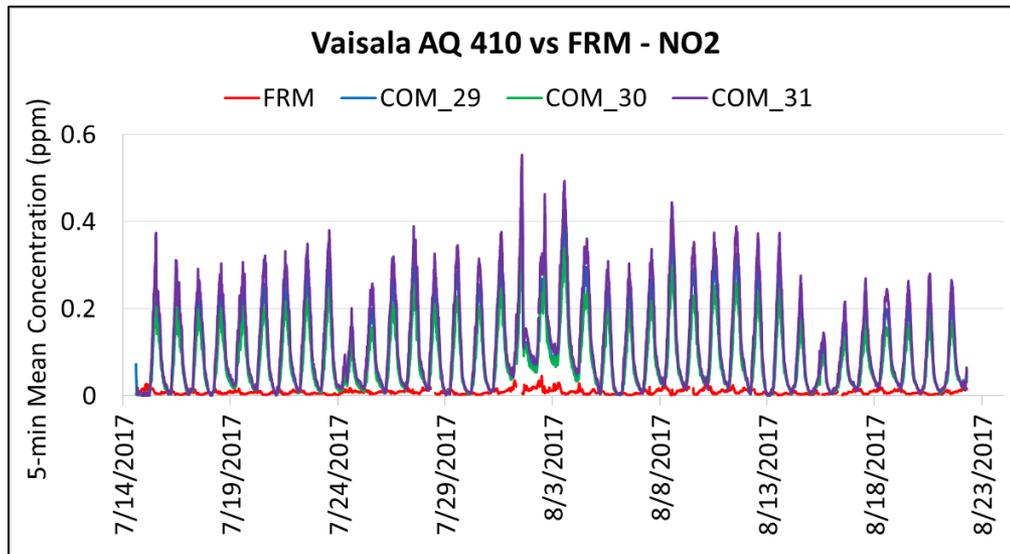
# AQT410 vs FRM (CO; 5-min mean)



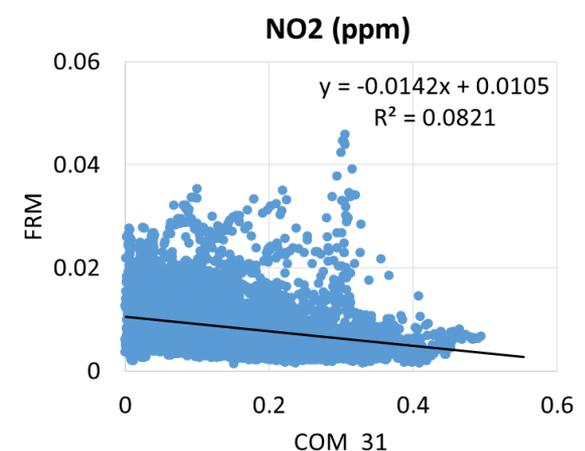
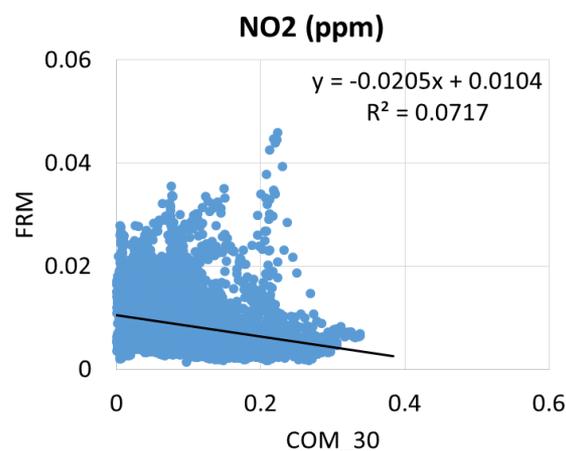
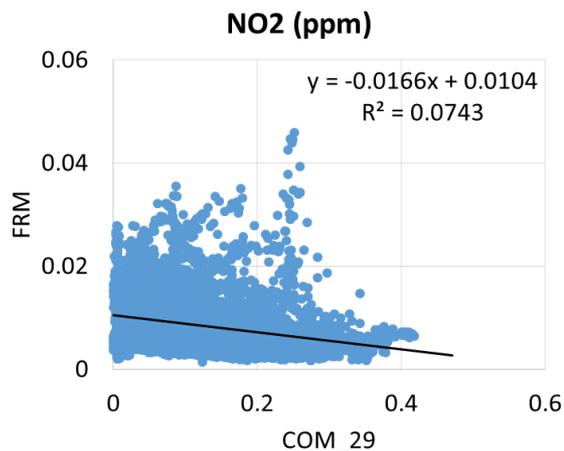
- AQT410 sensors show modest correlations with the corresponding FRM CO data ( $0.28 < R^2 < 0.31$ )



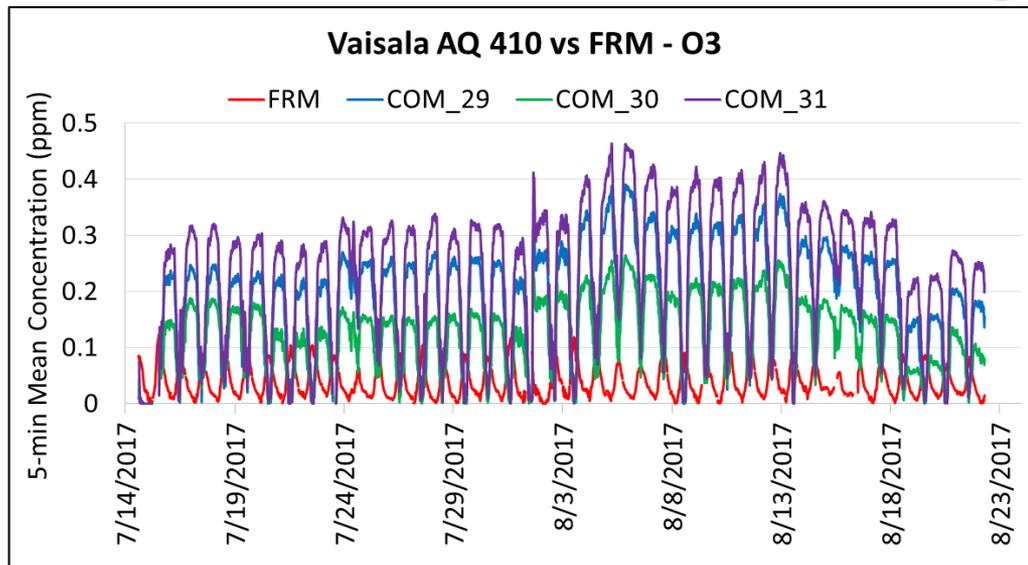
# AQT410 vs FRM (NO<sub>2</sub>; 5-min mean)



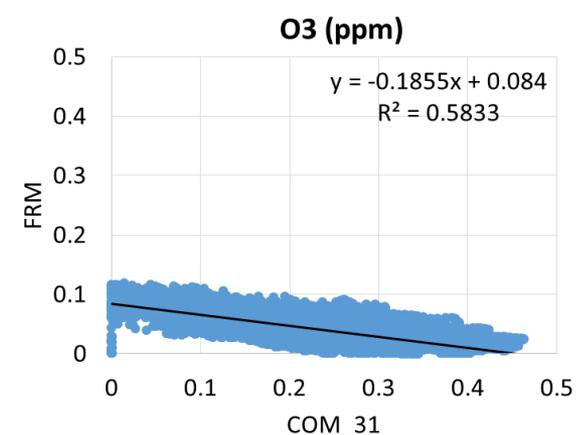
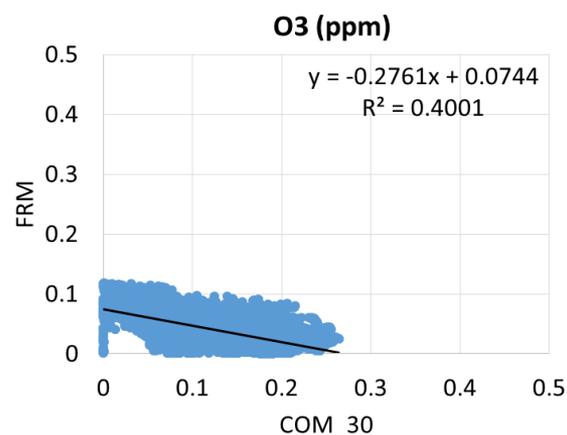
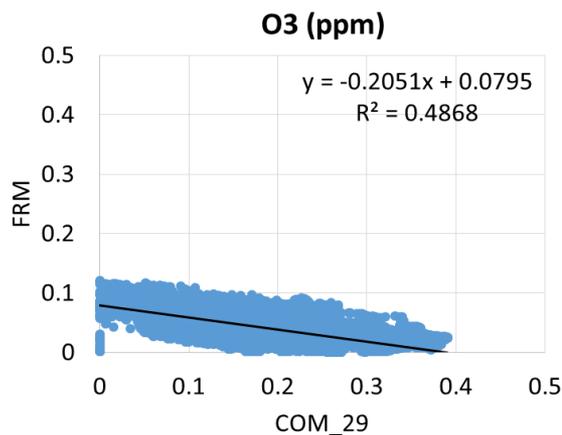
- NO<sub>2</sub> measurements from all three AQT410 sensors correlate poorly with the corresponding FRM data ( $0.07 < R^2 < 0.08$ ) and overall, they largely overestimate measured NO<sub>2</sub> concentrations



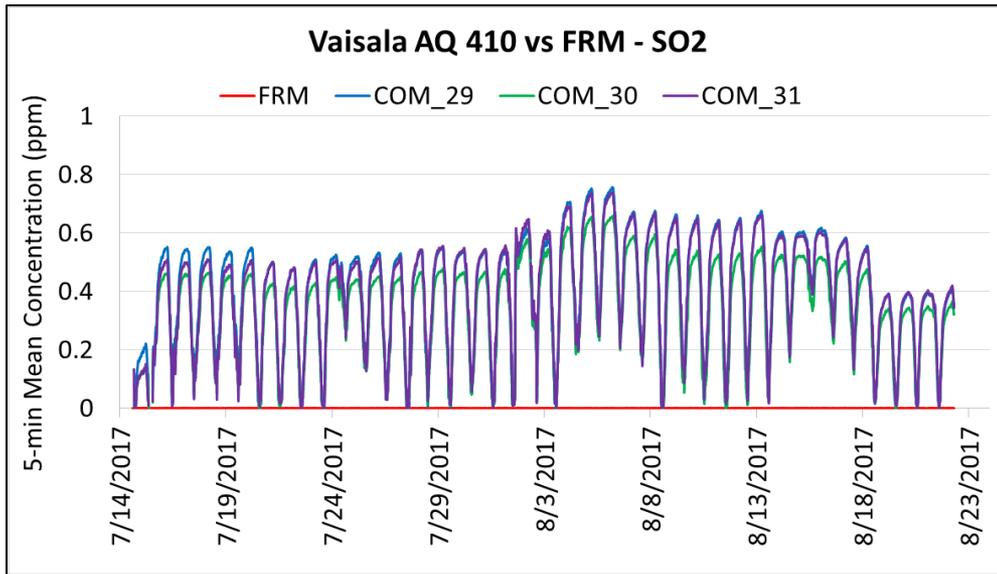
# AQT410 vs FRM (O<sub>3</sub>; 5-min mean)



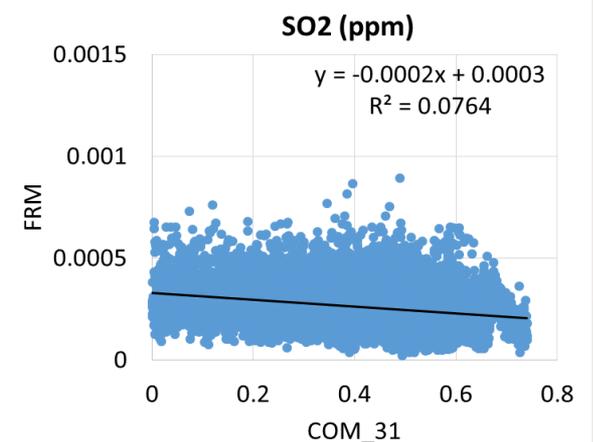
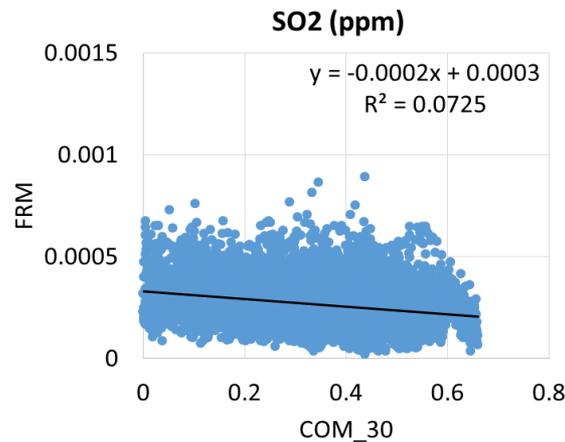
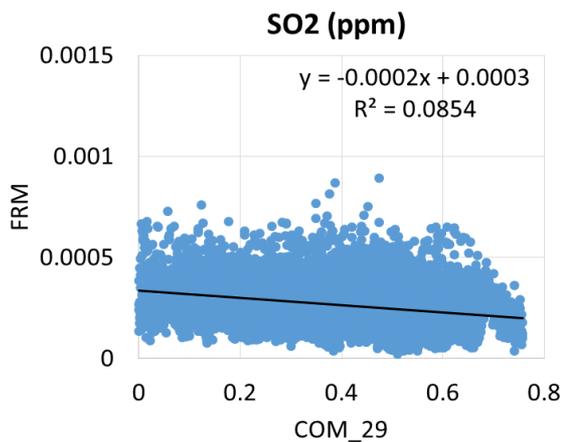
- AQT410 O<sub>3</sub> measurements show moderate negative correlation with the corresponding FRM data and they largely overestimate the O<sub>3</sub> concentrations



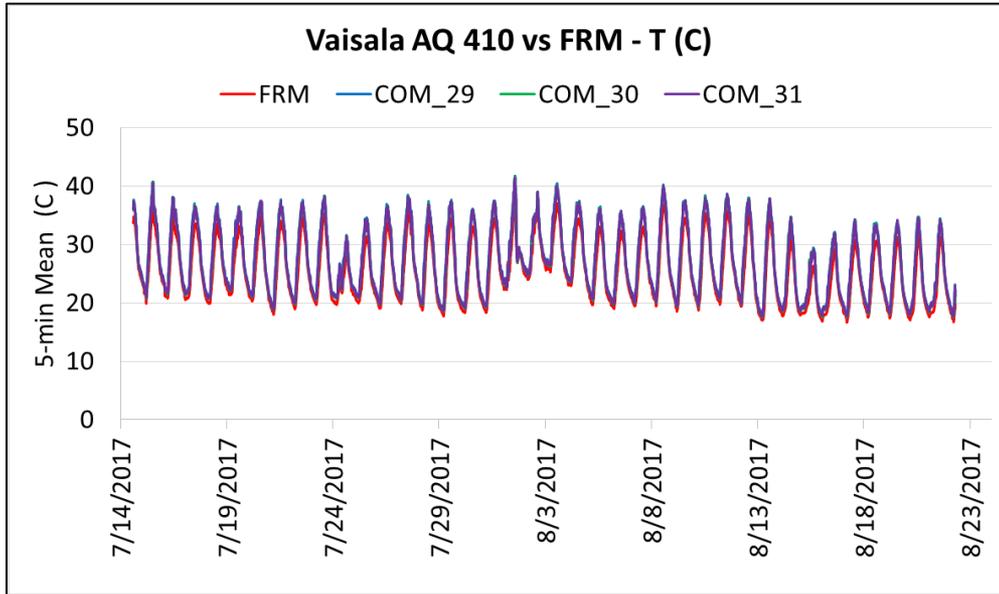
# AQT410 vs FRM (SO<sub>2</sub>; 5-min mean)



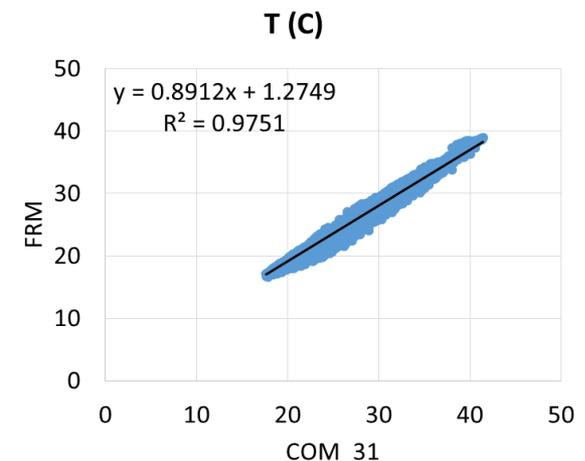
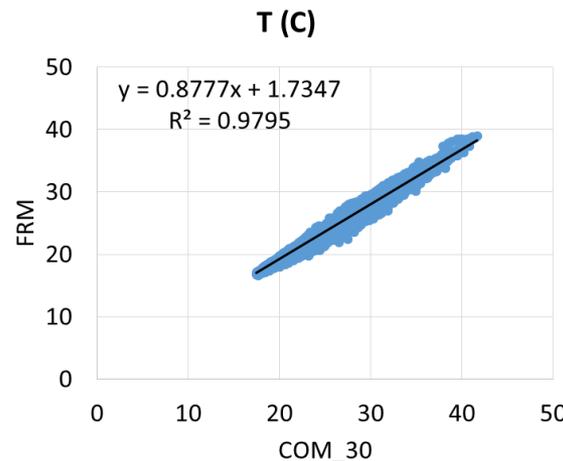
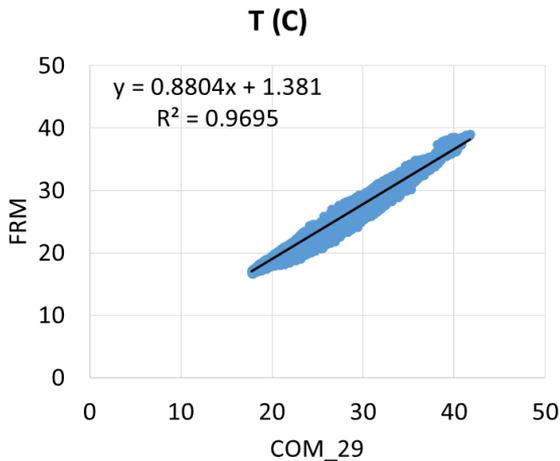
- SO<sub>2</sub> sensor data correlate poorly with the corresponding FRM measurements ( $0.07 < R^2 < 0.08$ ) and overall, AQT410 sensors overestimate measured SO<sub>2</sub> concentrations to a great extent



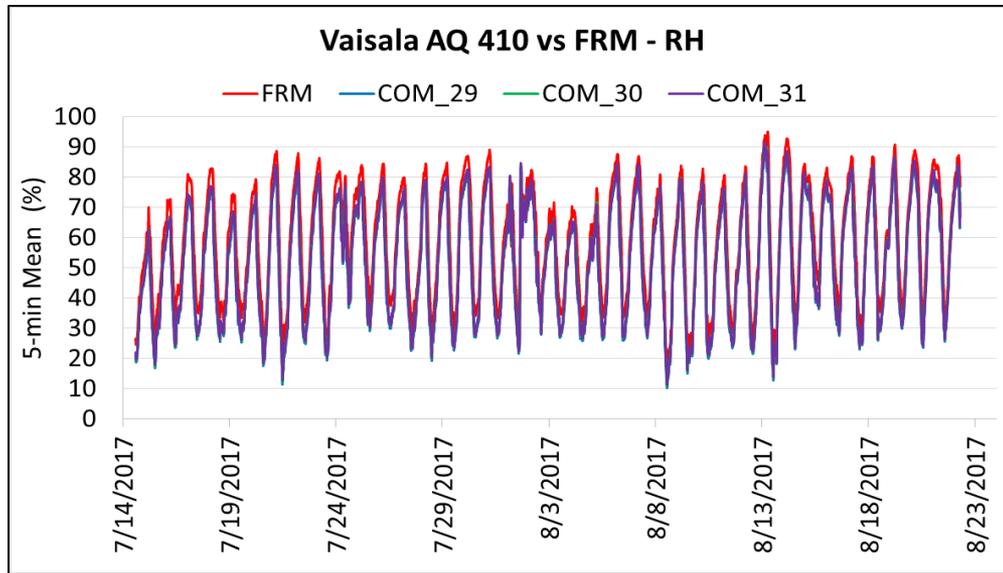
# AQT410 vs FRM (Temp; 5-min mean)



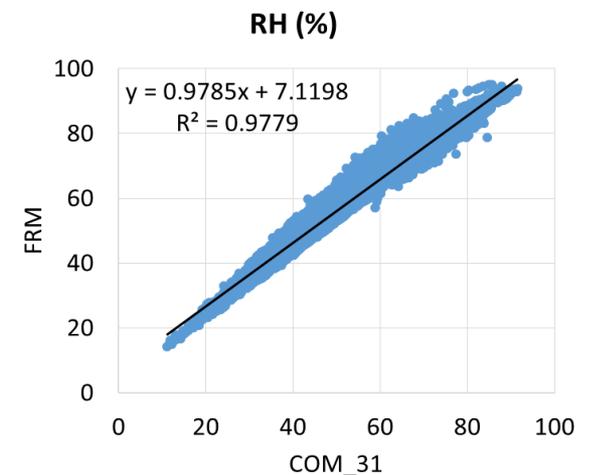
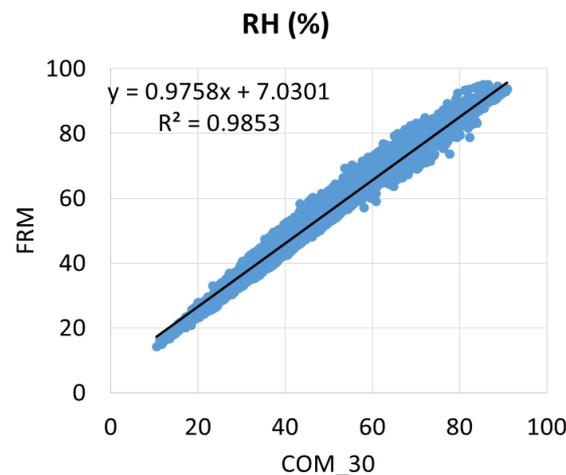
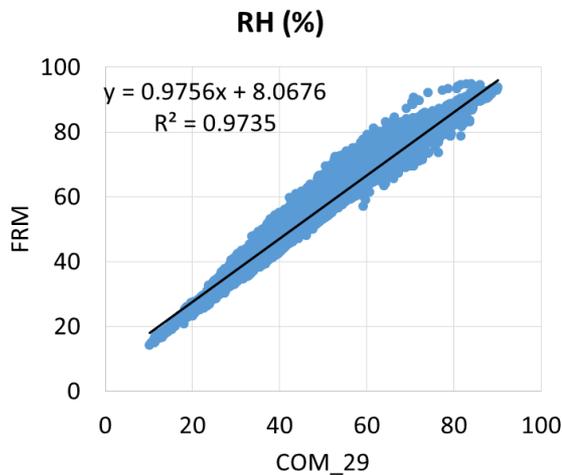
- Temperature measurements from all three AQT410 sensors correlate very well with the corresponding FRM data ( $R^2 > 0.96$ ), but they slightly overestimate the FRM measured temperature



# AQT410 vs FRM (RH; 5-min mean)



- AQT410 Relative Humidity measurements correlate very well with the corresponding FRM data ( $R^2 > 0.97$ )



# Discussion

- Overall, the three tested Vaisala AQT410 devices, each measuring CO, NO<sub>2</sub>, SO<sub>2</sub>, and O<sub>3</sub>, were reliable (i.e. no down time over a period of about two months) with a relatively high data recovery (>85%), except for CO measurement from one AQT410 unit which showed 71% data recovery
- Except for O<sub>3</sub>, AQT410 sensors showed low intra-model variability for CO, NO<sub>2</sub>, and SO<sub>2</sub>
- CO concentrations measured by AQT410 sensors demonstrated modest correlation with the corresponding FRM data ( $0.28 < R^2 < 0.31$ )
- Other gaseous pollutants (i.e. NO<sub>2</sub>, SO<sub>2</sub>, and O<sub>3</sub>) showed very low and even negative correlations with the FRM instrument and were largely overestimated by the AQT410 sensors
- Temperature and relative humidity measured by AQT410 sensors correlated very well ( $R^2 > 0.97$ ) with the corresponding values collected using a substantially more expensive meteorological instrument and were quite accurate
- It should be noted that no sensor calibration had been performed by SCAQMD Staff prior to the beginning of this field testing
- Laboratory chamber testing under temperature- and relative humidity- controlled conditions, known individual gas concentrations and known concentrations of interferent gas mixtures may be necessary to fully evaluate the performance of the Vaisala AQT410 sensors
- All results are still preliminary