

# Field Evaluation CairPol Cairsens NO<sub>2</sub> Sensor

DRAFT



South Coast  
AQMD

**AQ-SPEC**

Air Quality Sensor Performance Evaluation Center

# Background

- From 5/2/2019 to 7/10/2019, three **CairPol Cairsens NO<sub>2</sub>** sensors were deployed at the South Coast AQMD stationary ambient monitoring site in Rubidoux and were run side-by-side with a reference instrument measuring the same pollutant
- **CairPol Cairsens NO<sub>2</sub> (3 units tested):**
  - Gas sensor: NO<sub>2</sub> – Cairsens Gas Sensitive Electrochemical (**non-FRM**)
  - Each unit reports: NO<sub>2</sub> (ppb)
  - **Unit cost: \$1198**
  - Time resolution: 1-min
  - Unit IDs: 5226, 5229, 5231
- **South Coast AQMD Reference instruments:**
  - NO<sub>x</sub> instrument (**FRM**): **cost: ~\$11,000**
    - Time resolution: 1-min
  - Met station (T, RH, P, WS, WD); **cost: ~\$5,000**
    - Time resolution: 1-min

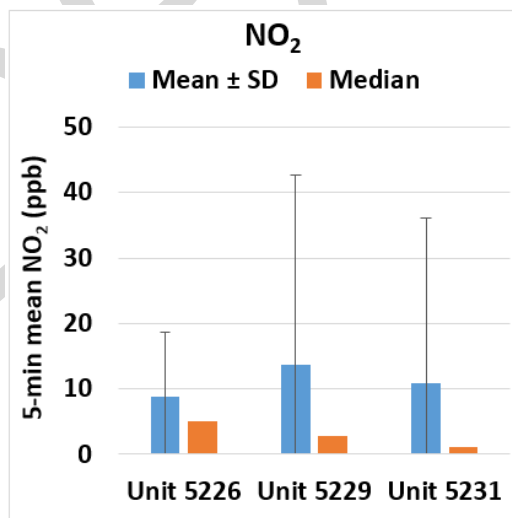


# Data validation & recovery

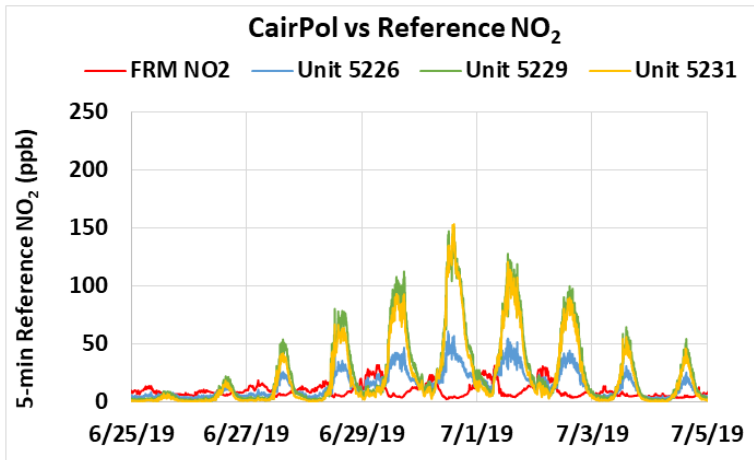
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery for all units was very high (>99.9%) for NO<sub>2</sub> measurements

## CairPol Cairsens NO<sub>2</sub> ; intra-model variability

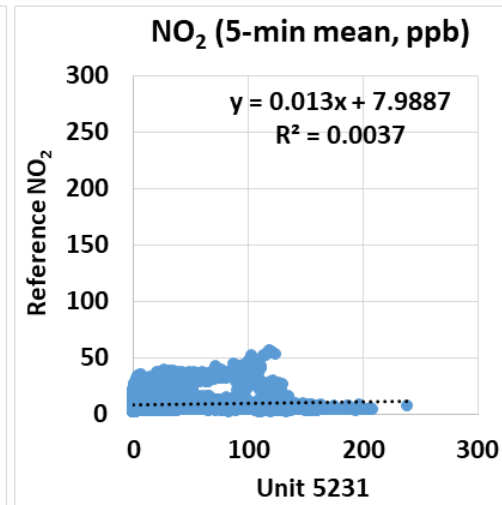
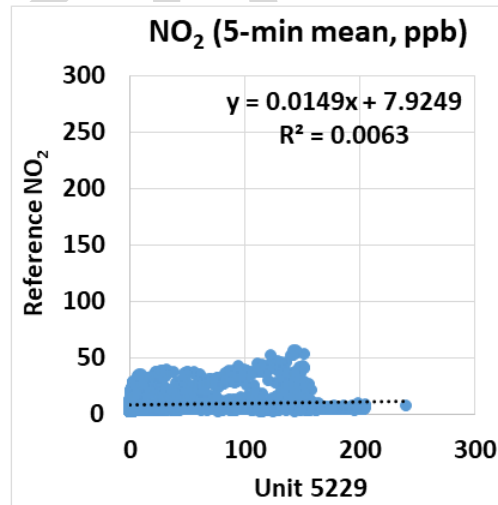
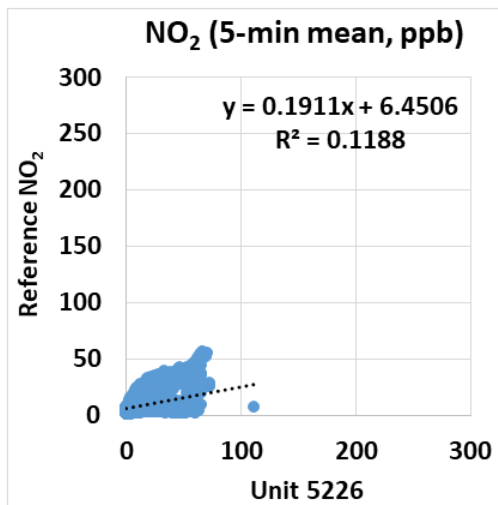
- Absolute intra-model variability was 3 ppb  
(calculated as the standard deviation of the three sensor means)
- Relative intra-model variability was 23%  
(calculated as the absolute intra-model variability relative to the mean of the three sensor means)



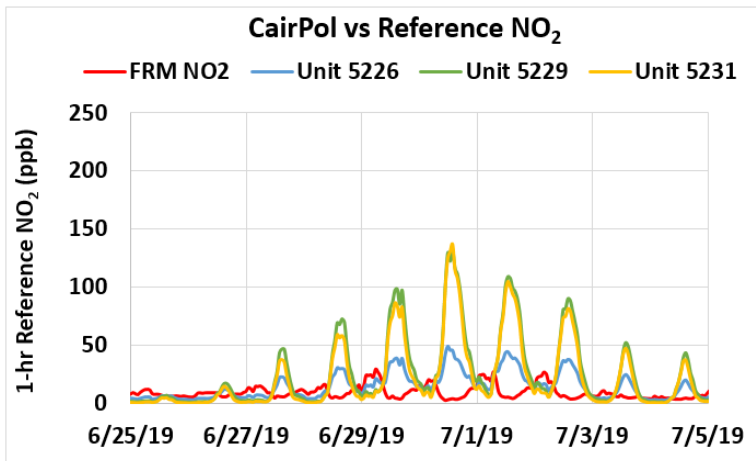
# CairPol Cairsens NO<sub>2</sub> vs FRM (NO<sub>2</sub>; 5-min mean)



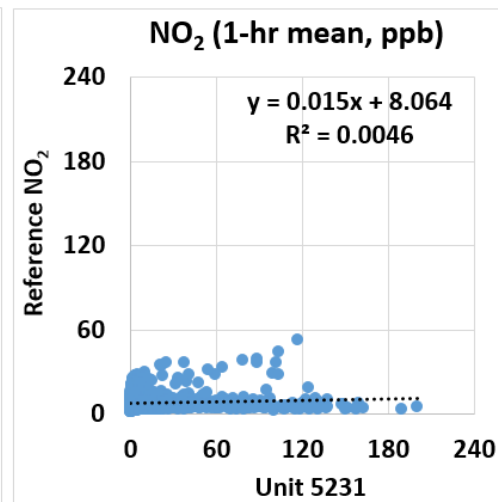
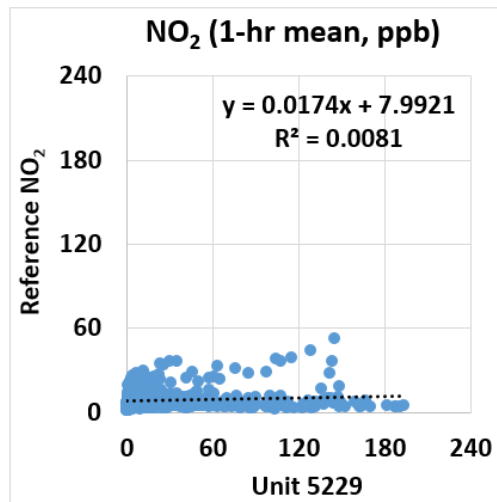
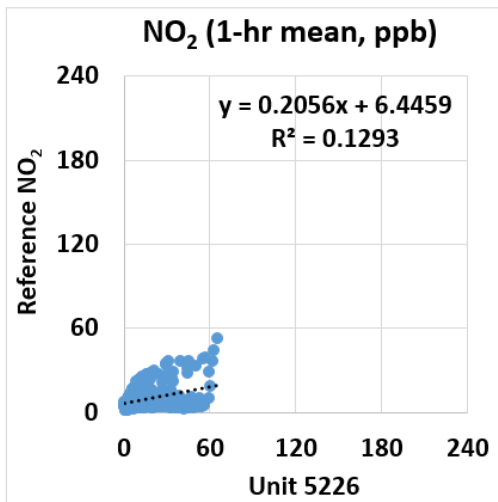
- One CairPol Cairsens sensor showed very weak correlation ( $R^2 = 0.12$ ), while two sensors showed no correlation with the corresponding FRM NO<sub>2</sub> data ( $R^2 < 0.0063$ )
- The CairPol Cairsens sensors overestimated NO<sub>2</sub> concentration as measured by the FRM instrument
- The CairPol Cairsens sensors do not seem to track the NO<sub>2</sub> diurnal variations compared to the FRM



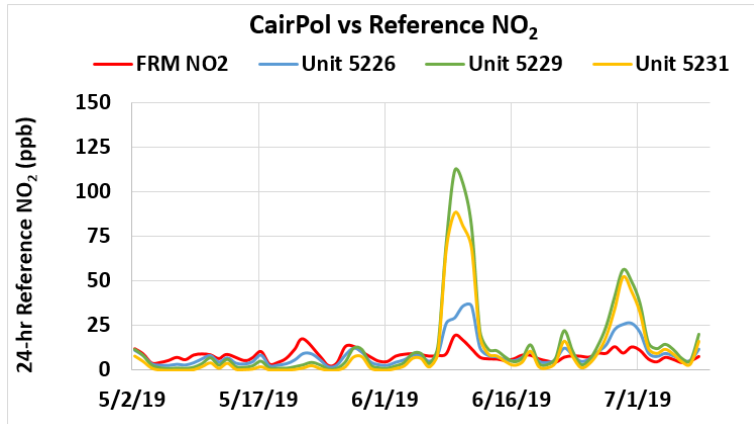
# CairPol Cairsens NO<sub>2</sub> vs FRM (NO<sub>2</sub>; 1-hr mean)



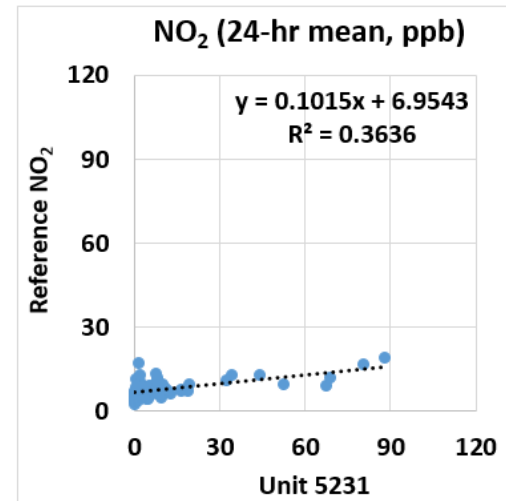
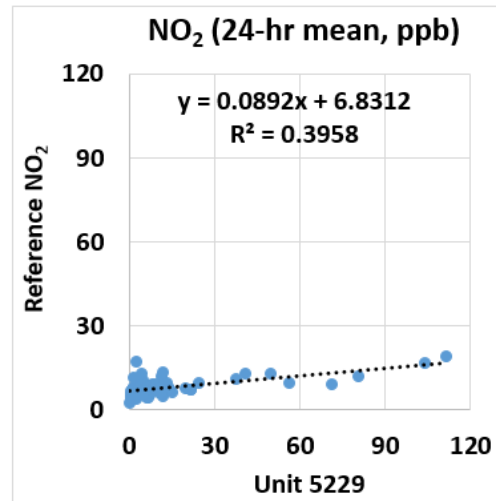
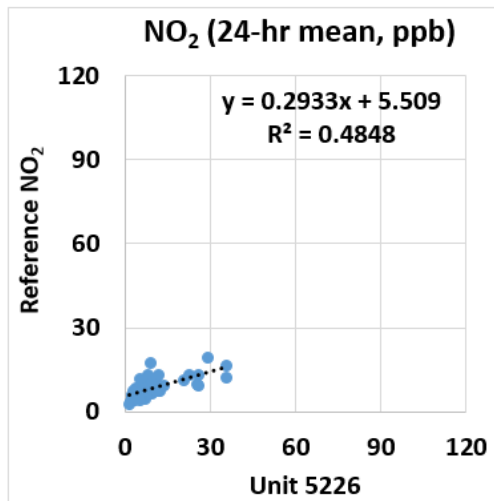
- One CairPol Cairsens sensor showed very weak correlation ( $R^2 = 0.13$ ), while two sensors showed no correlation with the corresponding FRM NO<sub>2</sub> data ( $R^2 < 0.0081$ )
- The CairPol Cairsens sensors overestimated NO<sub>2</sub> concentration as measured by the FRM instrument
- The CairPol Cairsens sensors do not seem to track the NO<sub>2</sub> diurnal variations compared to the FRM



# CairPol Cairsens NO<sub>2</sub> vs FRM (NO<sub>2</sub>; 24-hr mean)



- CairPol Cairsens sensors showed weak correlation with the corresponding FRM NO<sub>2</sub> data ( $0.36 < R^2 < 0.48$ )
- The CairPol Cairsens sensors overestimated NO<sub>2</sub> concentration as measured by the FRM instrument
- The CairPol Cairsens sensors do not seem to track the NO<sub>2</sub> diurnal variations compared to the FRM



# Discussion

- The three **CairPol Cairsens NO<sub>2</sub>** sensors' data recovery for NO<sub>2</sub> measurements from all units was very high at >99.9%.
- The three sensors showed an absolute intra-model variability of 3 ppb for NO<sub>2</sub> measurements.
- The three sensors showed a relative intra-model variability of 23% for NO<sub>2</sub> measurements.
- During the field deployment testing period:
  - The CairPol Cairsens NO<sub>2</sub> sensors showed no-to-very weak correlation for 5-min and 1-hr averaging time ( $0.0037 < R^2 < 0.12$  and  $0.0046 < R^2 < 0.13$ , respectively) and weak correlation ( $0.36 < R^2 < 0.48$ ) at the 24-hr averaging time with the reference instrument and overestimated the corresponding FRM NO<sub>2</sub> data.
- No sensor calibration was performed by South Coast AQMD Staff prior to the beginning of this test
- All results are still preliminary