Field Evaluation
Smart Citizen Kit
Background

- From 11/25/2014 to 01/28/2015, three Smart Citizen Kit (SCK) gaseous sensors were deployed at one of our monitoring stations in Rubidoux, CA, and run side-by-side with Federal Reference Method (FRM) instruments measuring the same pollutants.

- **Smart Citizen Kit (3 units tested):**
  - Gaseous sensors (non-FEM)
  - Each unit measures: CO (kOhm), NO₂ (kOhm), Temperature (°C) and Relative Humidity (%)
  - Unit cost: ~$200
  - Time resolution: 1-min
  - Units IDs: SCK#1, SCK #2, SCK #3

- **SCAQMD FRM instruments:**
  - CO instrument; cost: ~$10,000
    - Time resolution: 1-min
  - NOx instrument; cost: ~$11,000
    - Time resolution: 1-min
  - Meteorological station (wind speed, wind direction 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)
- Data recovery for CO, T and RH from all three units was very high (i.e. >96%)
- Many negative, zero and extremely high positive (off-scale) NO₂ values were recorded. No correlation between these extreme NO₂ data-points and RH (or T) was found. Further analysis is needed to validate the SCK NO₂ data

Smart Citizen Kit; intra-model variability

- Minimal measurement variations were observed between the three SCK units and for all measured pollutants/variables except NO₂
Overall, all CO measurements correlate well with the corresponding FRM data ($0.48 < R^2 < 0.83$)
Smart Citizen Kit vs FRM (CO; 1-hr mean)

- Overall, all CO measurements correlate well with the corresponding FRM data (0.49<\(R^2<0.84\))

![Graph showing correlation between Smart Citizen Kit and FRM data for CO](image)

\[
y = -0.3303x^2 + 1.3512x - 0.0753 \\
R^2 = 0.487
\]

\[
y = 0.8764x^2 + 0.0577x + 0.1693 \\
R^2 = 0.8437
\]

\[
y = 0.3303x + 0.6935x + 0.0034 \\
R^2 = 0.7939
\]
Smart Citizen Kit vs FRM (CO; 8-hr mean)

Overall, all CO measurements correlate well with the corresponding FRM data (0.45<R²<0.82)
Smart Citizen Kit vs FRM (Temp; 1-hr mean)

- All SCK Temperature measurements correlate very well with the corresponding reference (station) temperature data ($R^2>0.94$)
Smart Citizen Kit vs FRM (RH; 1-hr mean)

- All SCK RH measurements correlate very well with the corresponding reference (station) RH data ($R^2 > 0.97$)
Discussion

• Overall, the CO data measured using the SCK sensors correlate well with the corresponding FRM data.
• The intra-model variability between the three SCK devices tested was moderate.
• The current version of the SCK does not provide reliable NO\textsubscript{2} concentrations. A more thorough data analysis will be conducted to elucidate this problem.
• Chamber testing is necessary to fully evaluate the performance of the three SCKs over different environmental conditions.
• SmartCitizen is currently working on a new version of their SCK sensor. Testing of this improved model will begin in 2016.

• All results are still preliminary.