

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

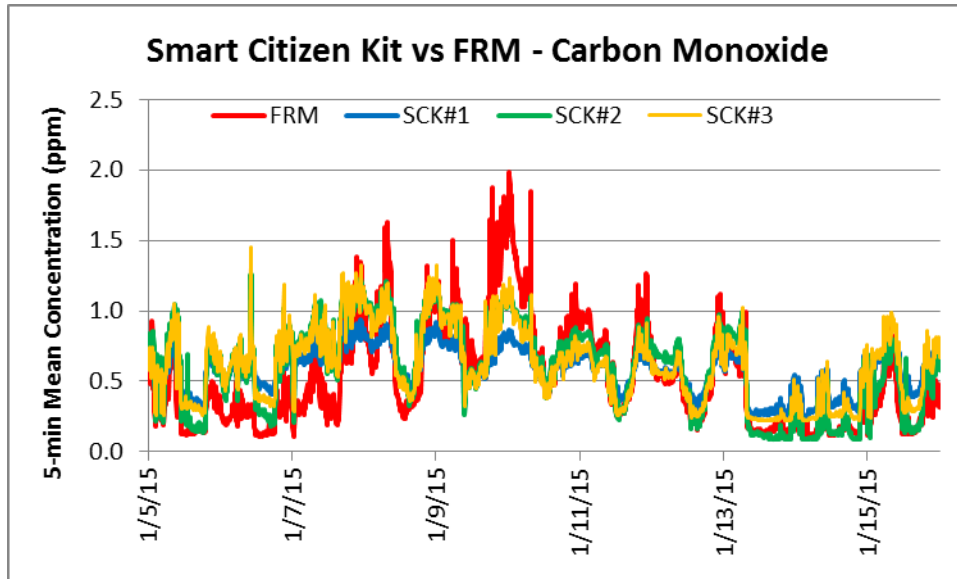
- Basic QA/QC procedures were used to validate the collected data (i.e., obvious outliers, negative values, and invalid data-points were eliminated from the data-set)
- Data recovery for CO, T and RH from all three units was very high (i.e. >96%)
- Many negative, zero and extremely high positive (off-scale) 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

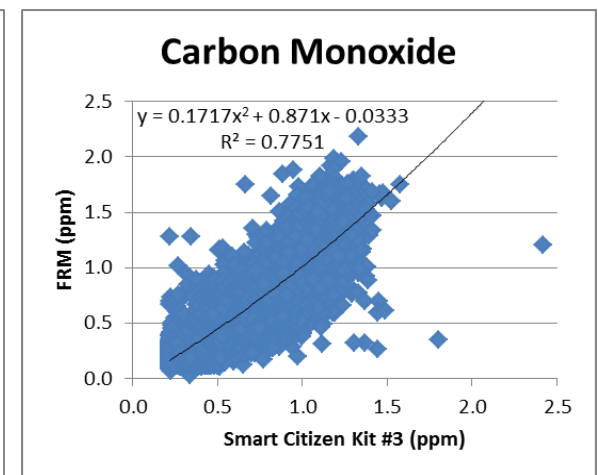
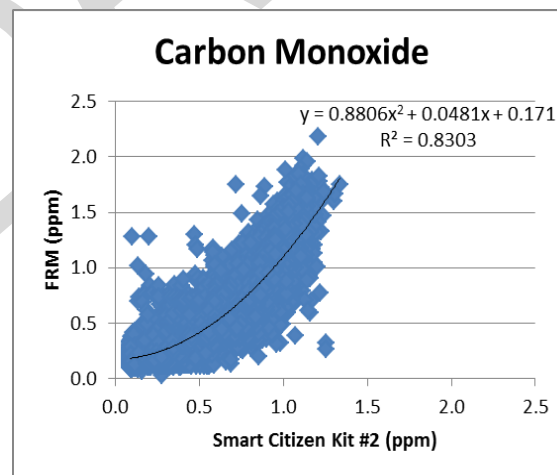
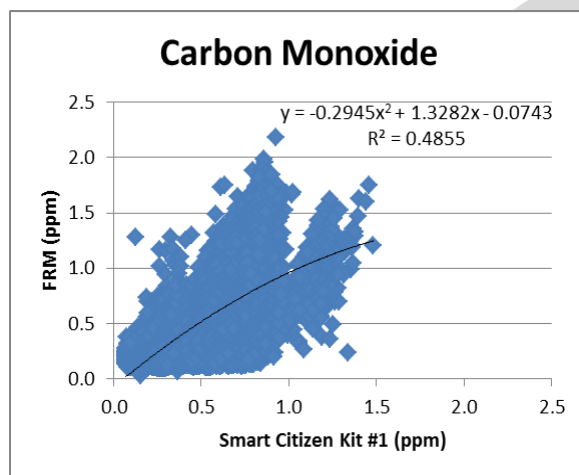
- Minimal measurement variations were observed between the three SCK units and for all measured pollutants/variables except NO₂



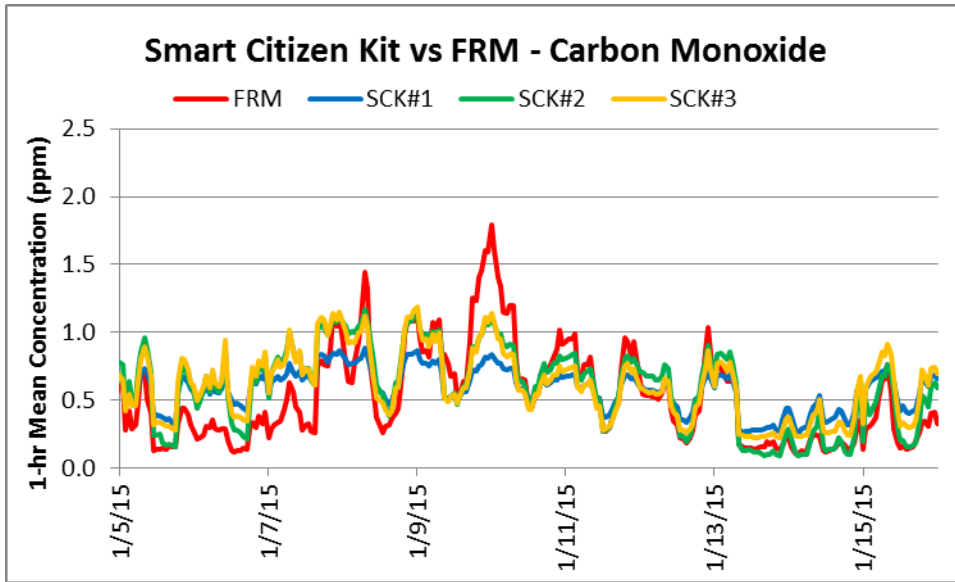
Smart Citizen Kit vs FRM (CO; 5-min mean)



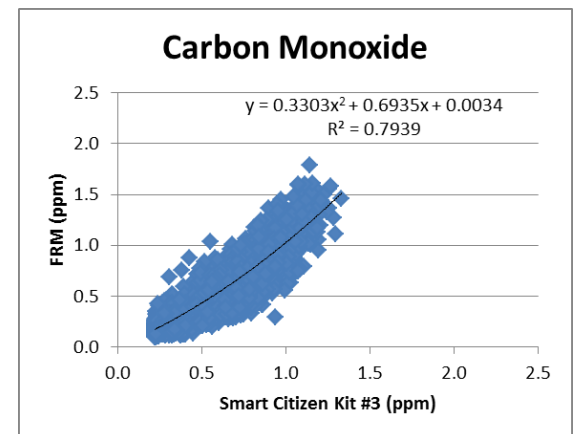
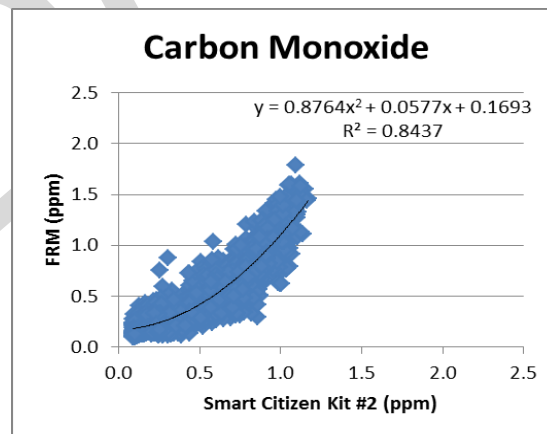
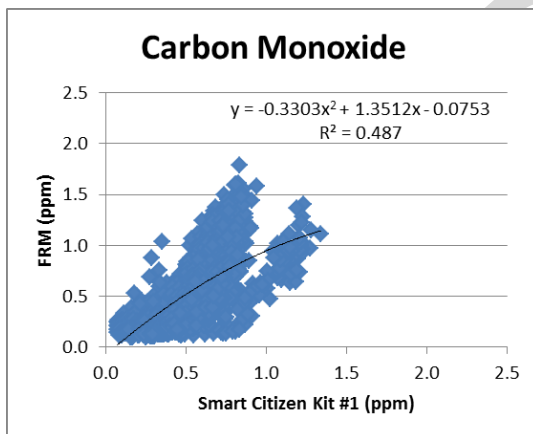
- Overall, all CO measurements correlate well with the corresponding FRM data ($0.48 < R^2 < 0.83$)



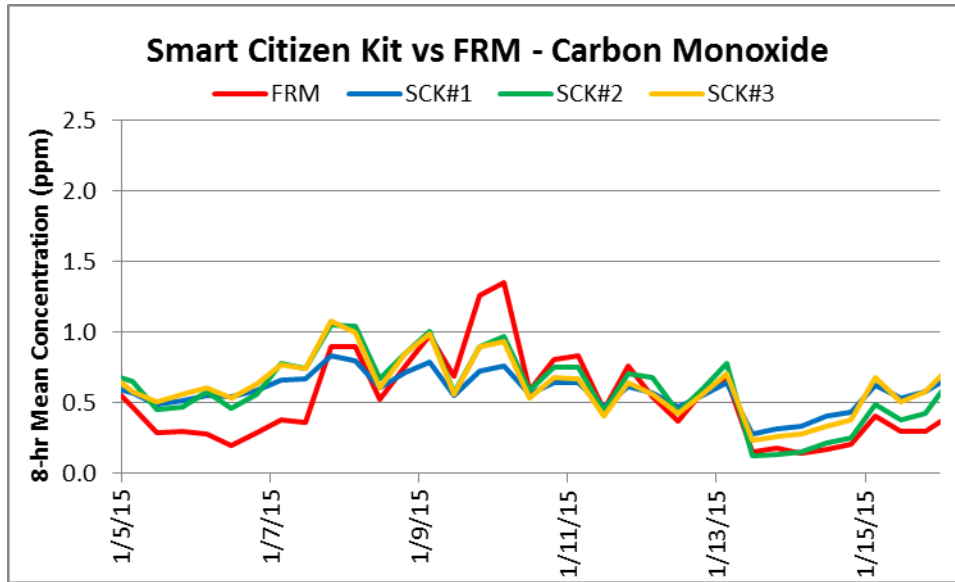
Smart Citizen Kit vs FRM (CO; 1-hr mean)



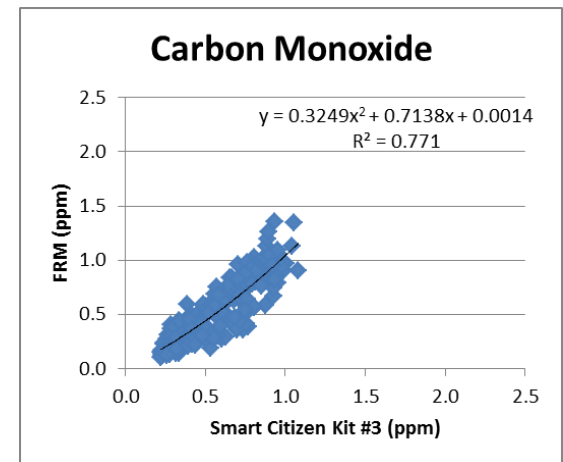
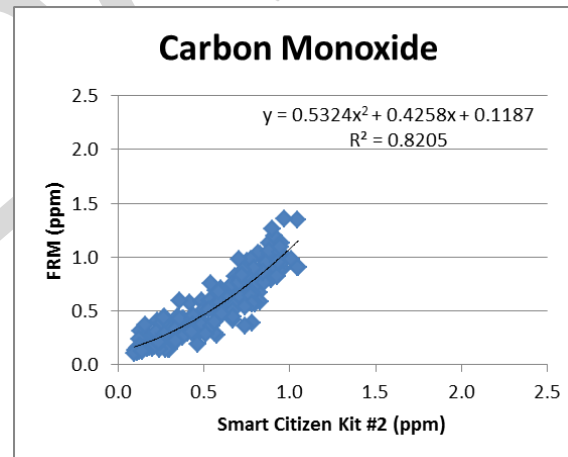
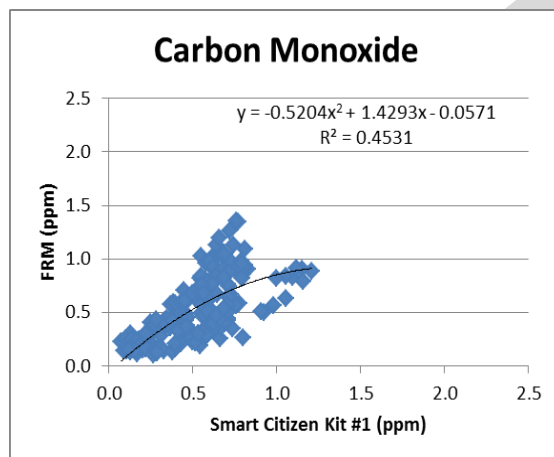
- Overall, all CO measurements correlate well with the corresponding FRM data ($0.49 < R^2 < 0.84$)



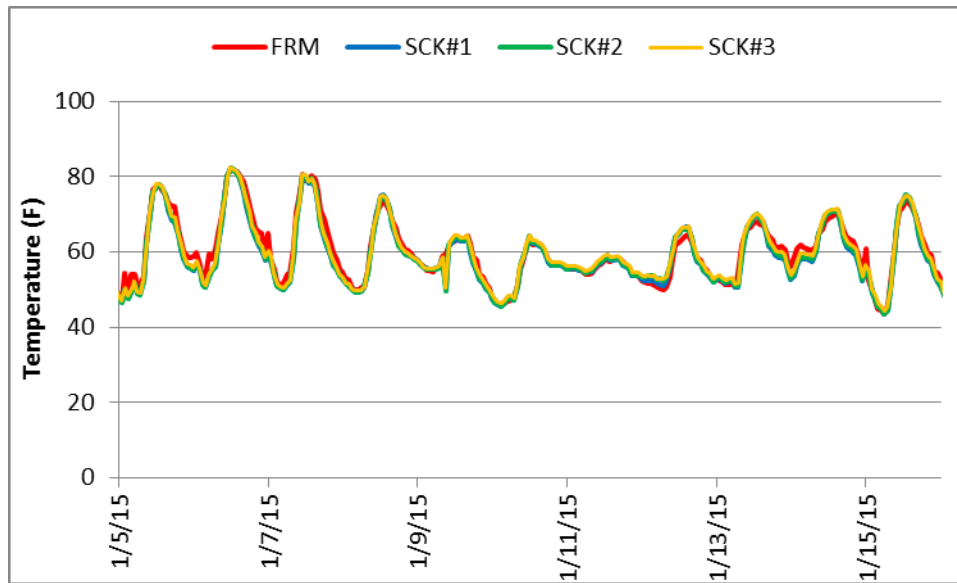
Smart Citizen Kit vs FRM (CO; 8-hr mean)



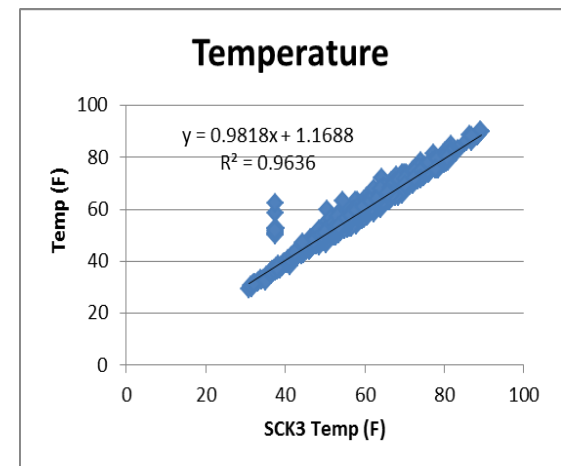
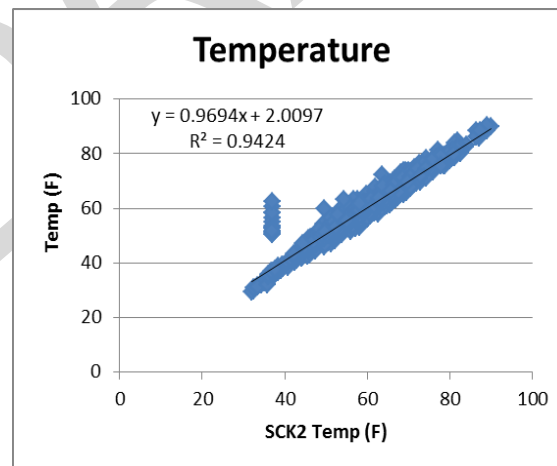
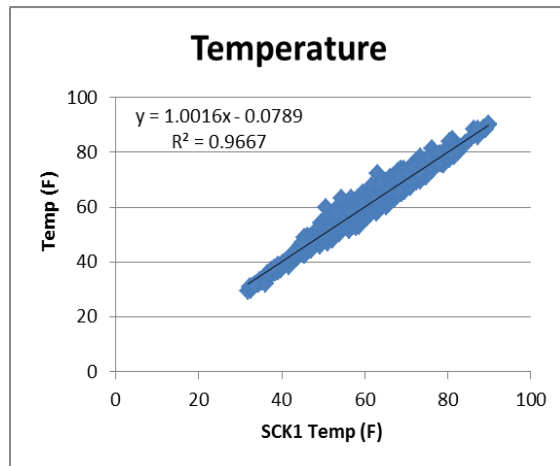
- Overall, all CO measurements correlate well with the corresponding FRM data ($0.45 < R^2 < 0.82$)



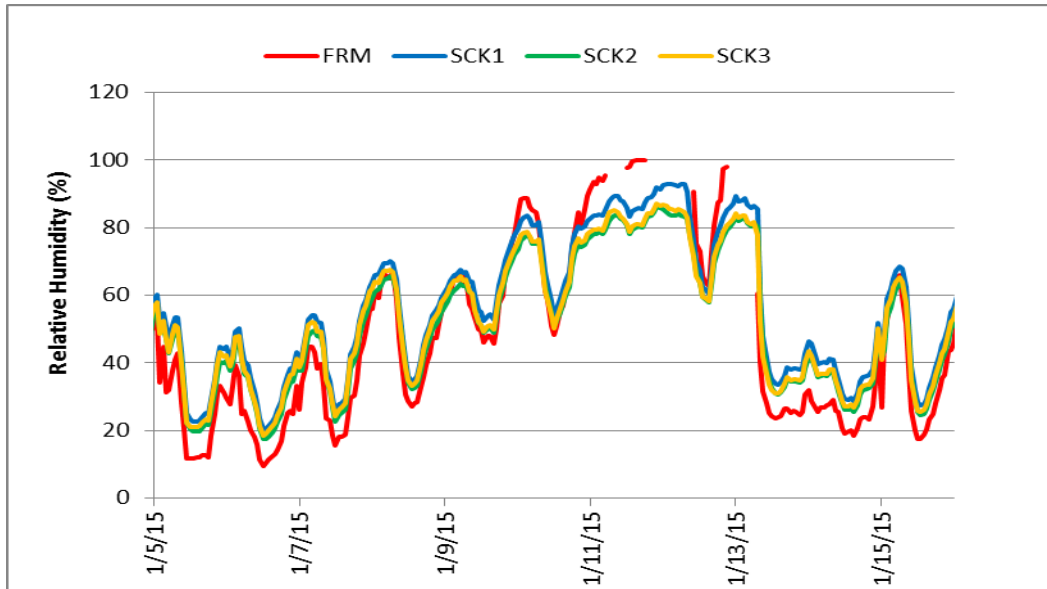
Smart Citizen Kit vs FRM (Temp; 1-hr mean)



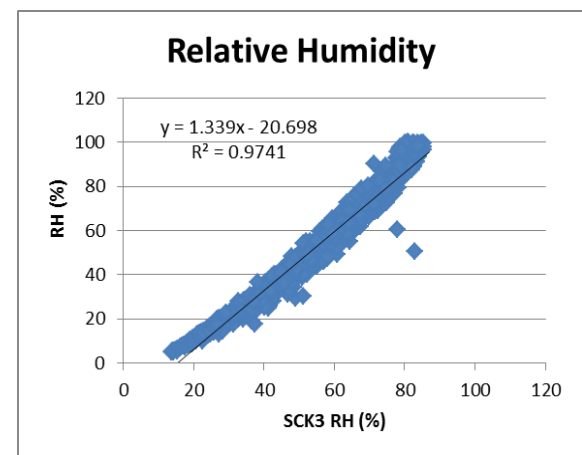
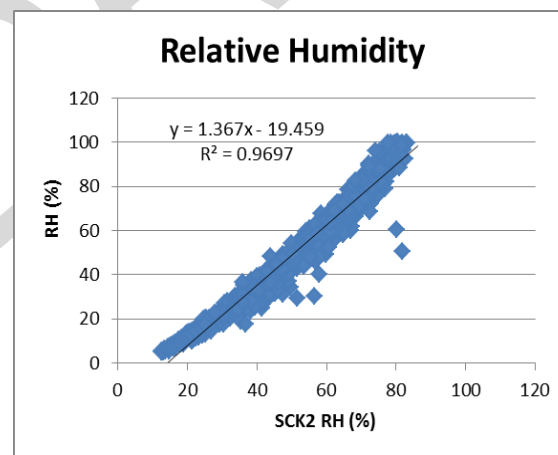
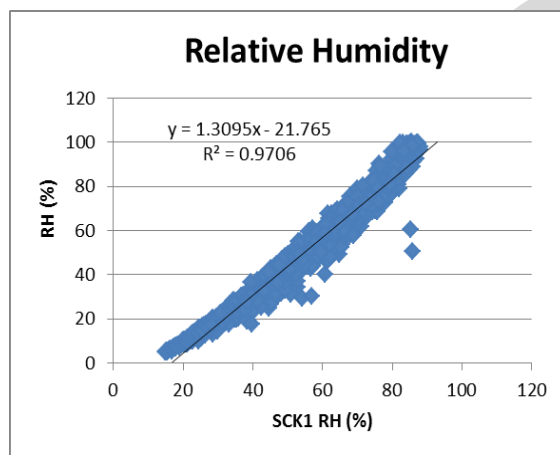
- All SCK Temperature measurements correlate very well with the corresponding reference (station) temperature data ($R^2 > 0.94$)



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 NO₂ 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