Assessing temporal and spatial variability of ozone in the face of measurement uncertainty

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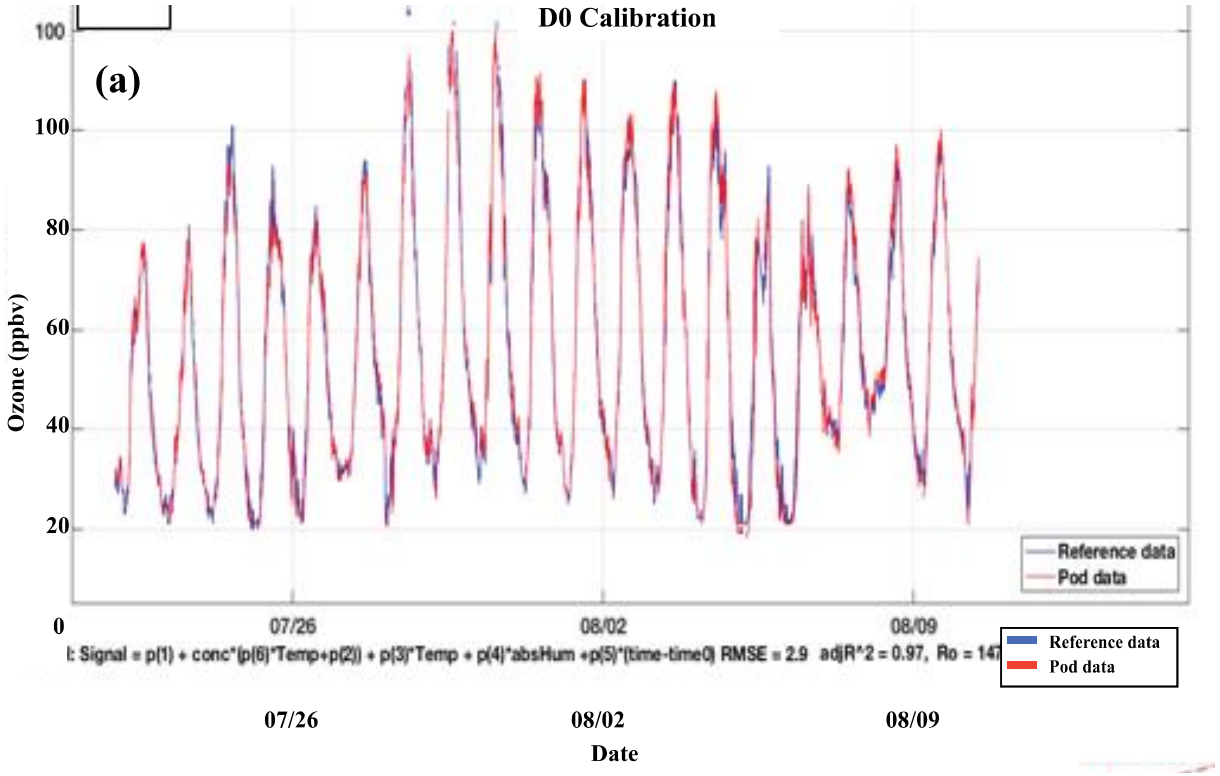
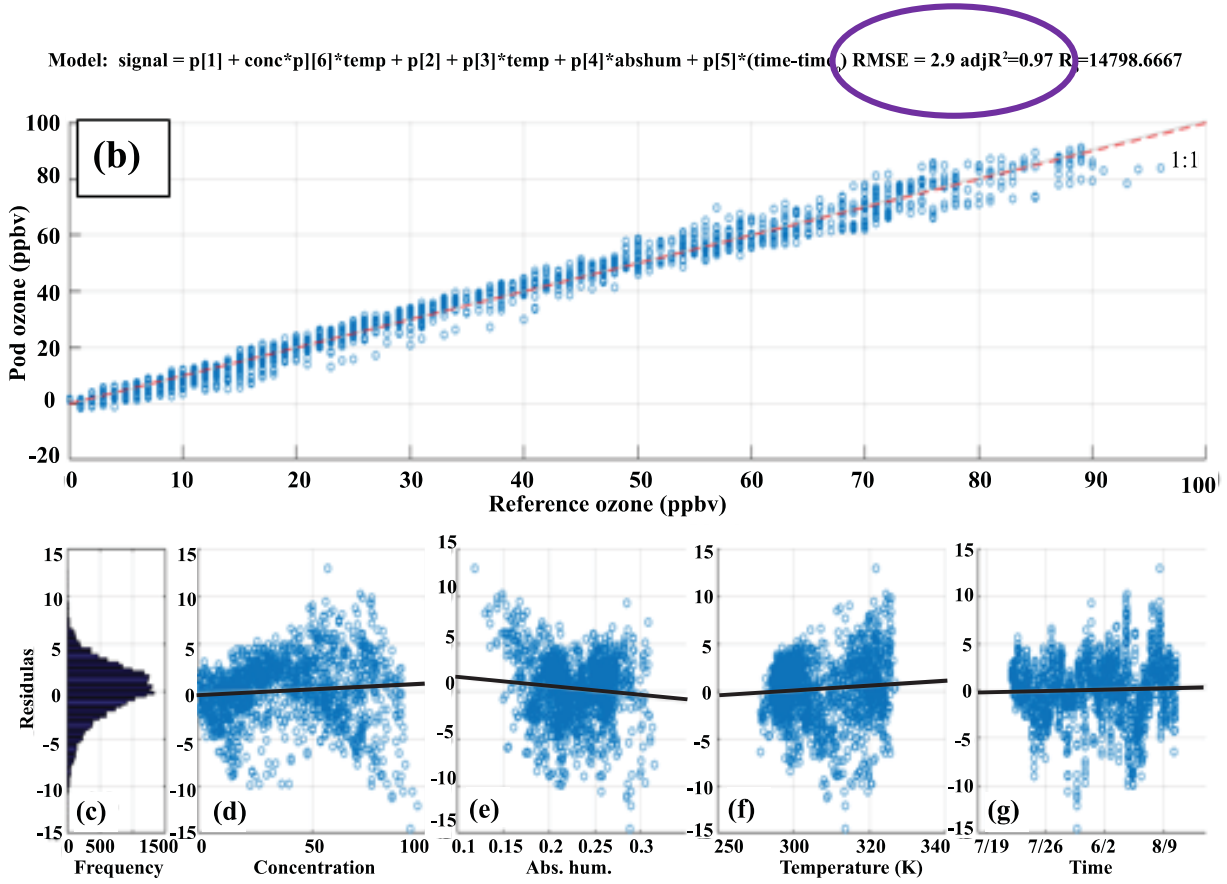
Co-location calibration is a process …
Minimize bias & Extrapolate with extreme caution

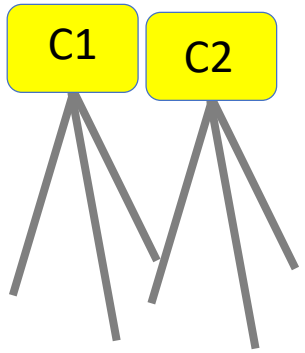


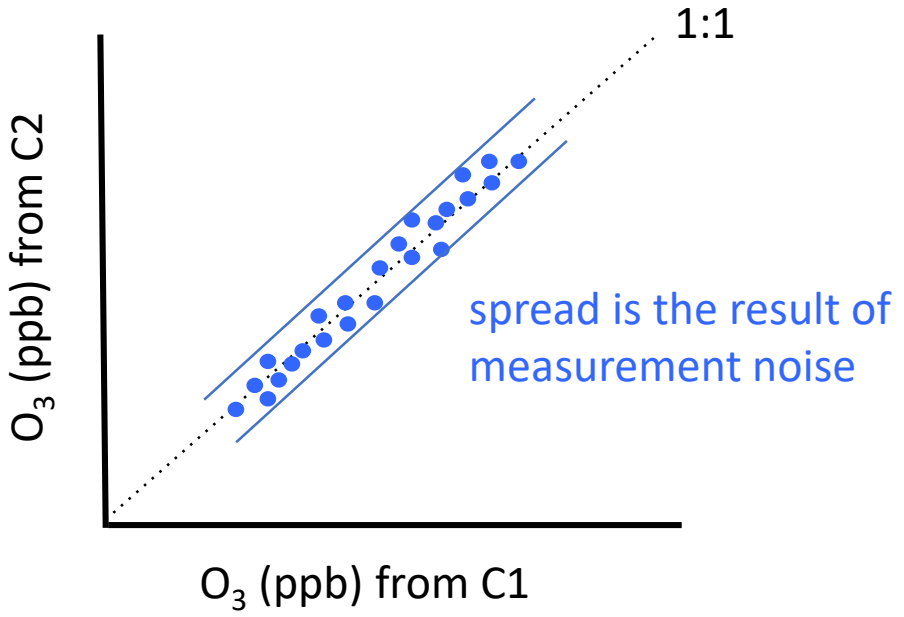


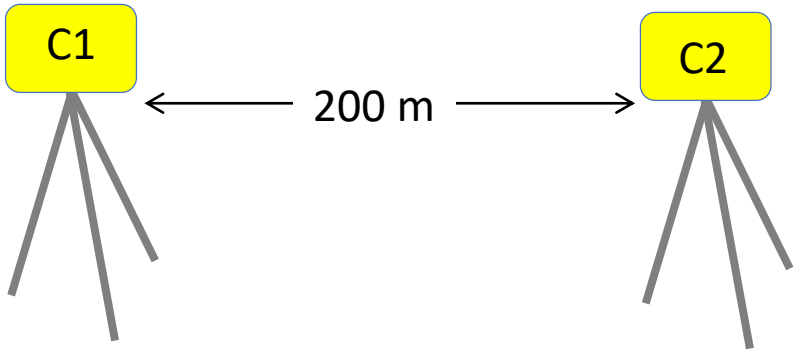
Can O_3 sensors be used to help site regulatory ozone monitors?

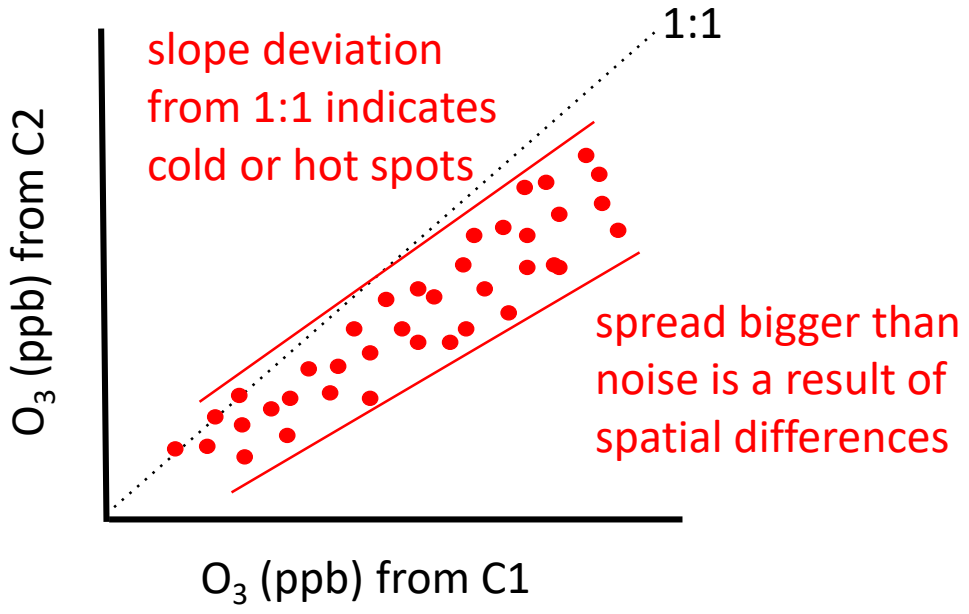
- **Can sensors find hot (or cold) spots for ambient O_3 between regulatory monitoring stations?**
- **What spatial (and temporal) scale do we observe O_3 concentration differences?**
- Do trees impact O_3 concentration?
- How much traffic does it take on a roadway to impact O_3 concentration?
- Does local industry impact O_3 concentration?

How do we design an experiment?



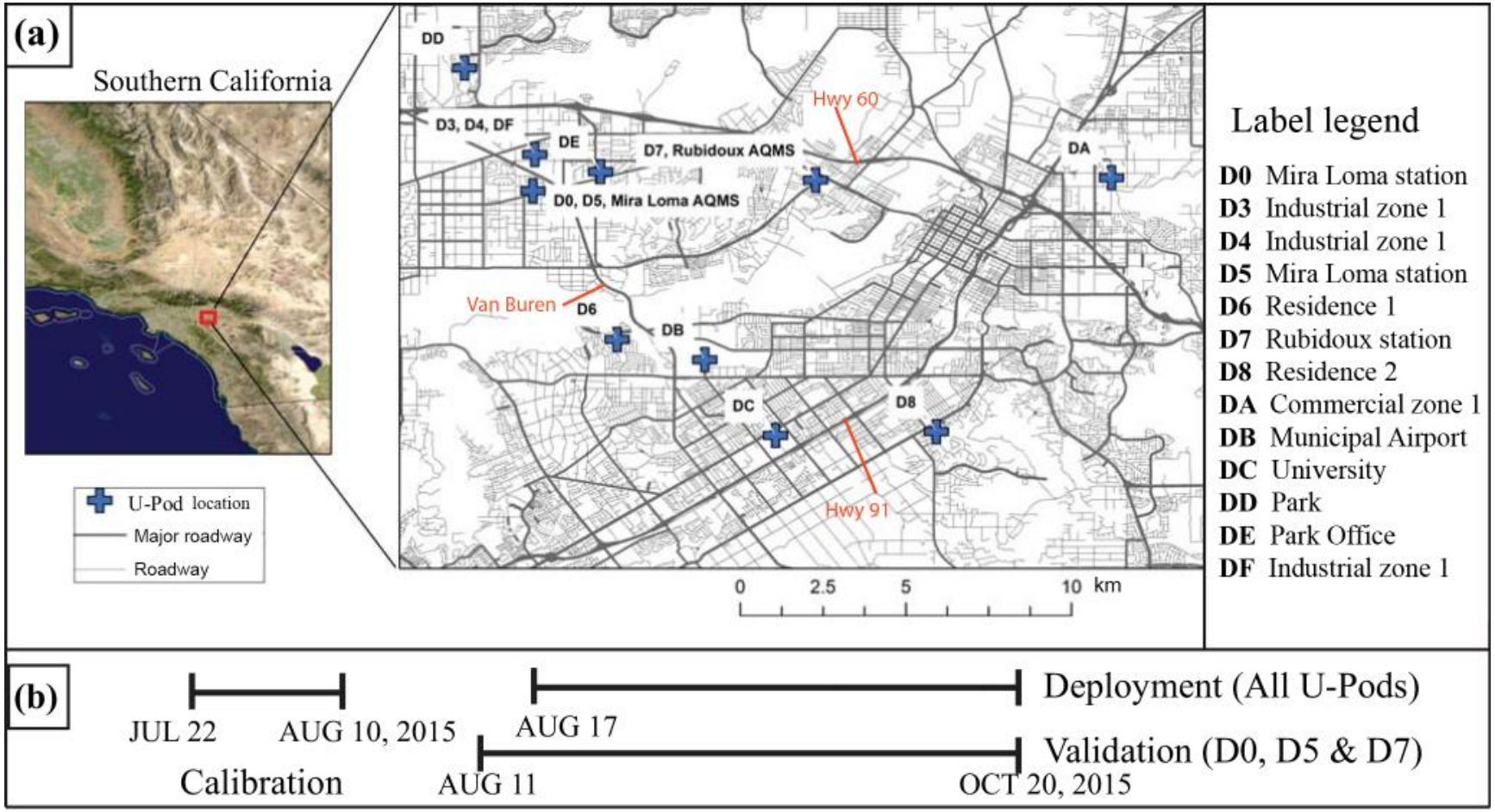




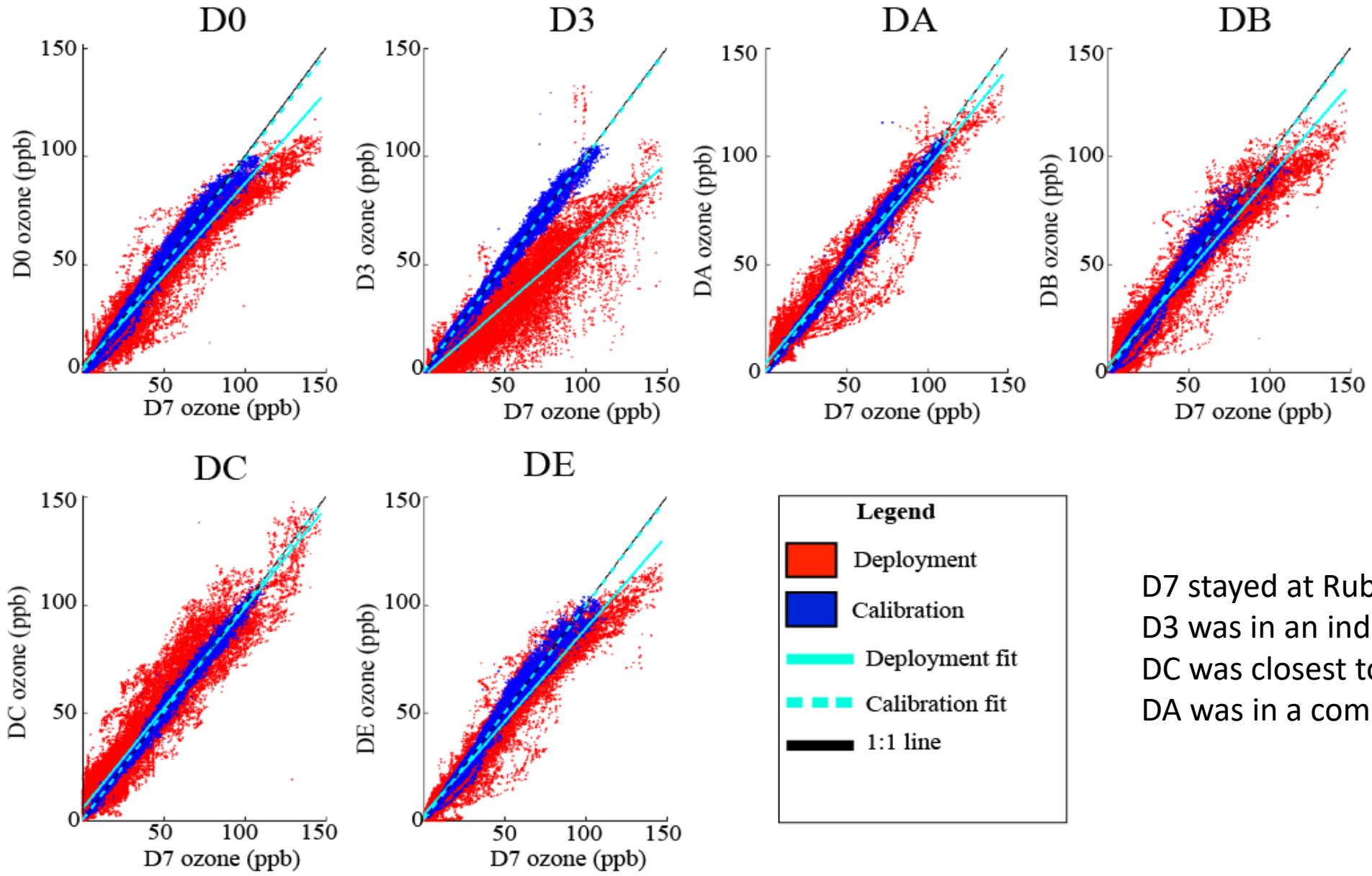


O_3 in Riverside during the summer 2015

spatial scale from 1 to 10 km



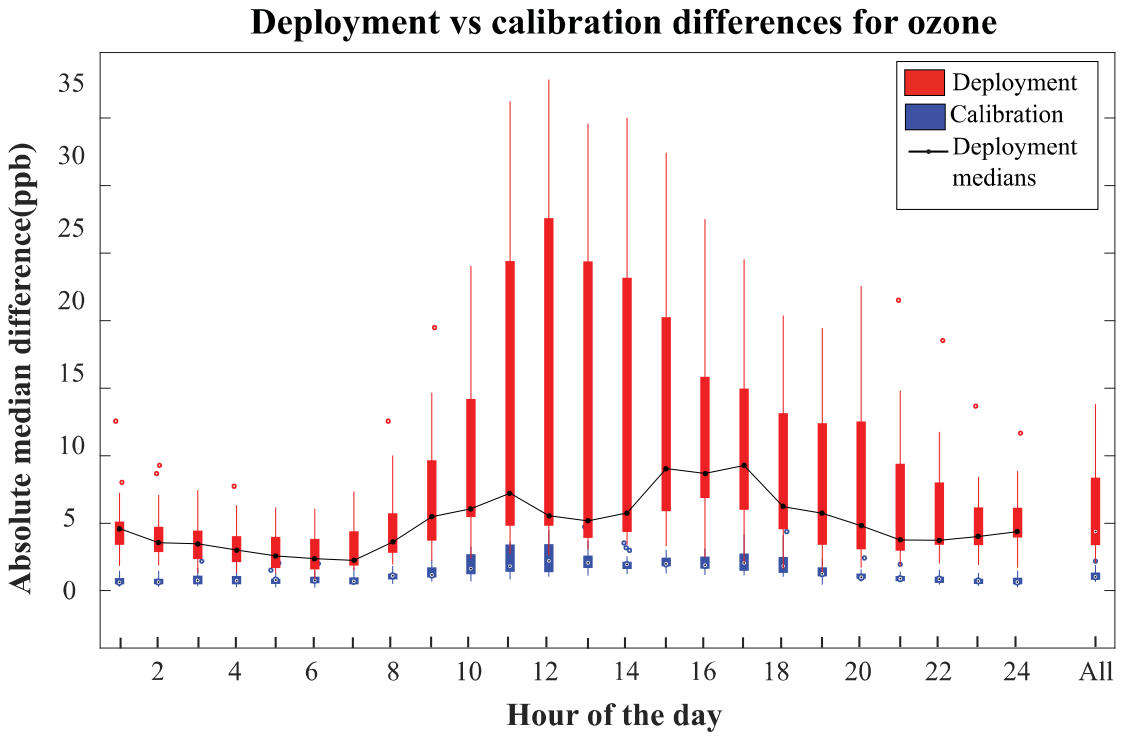
D7, Rubidoux AQMS colocation



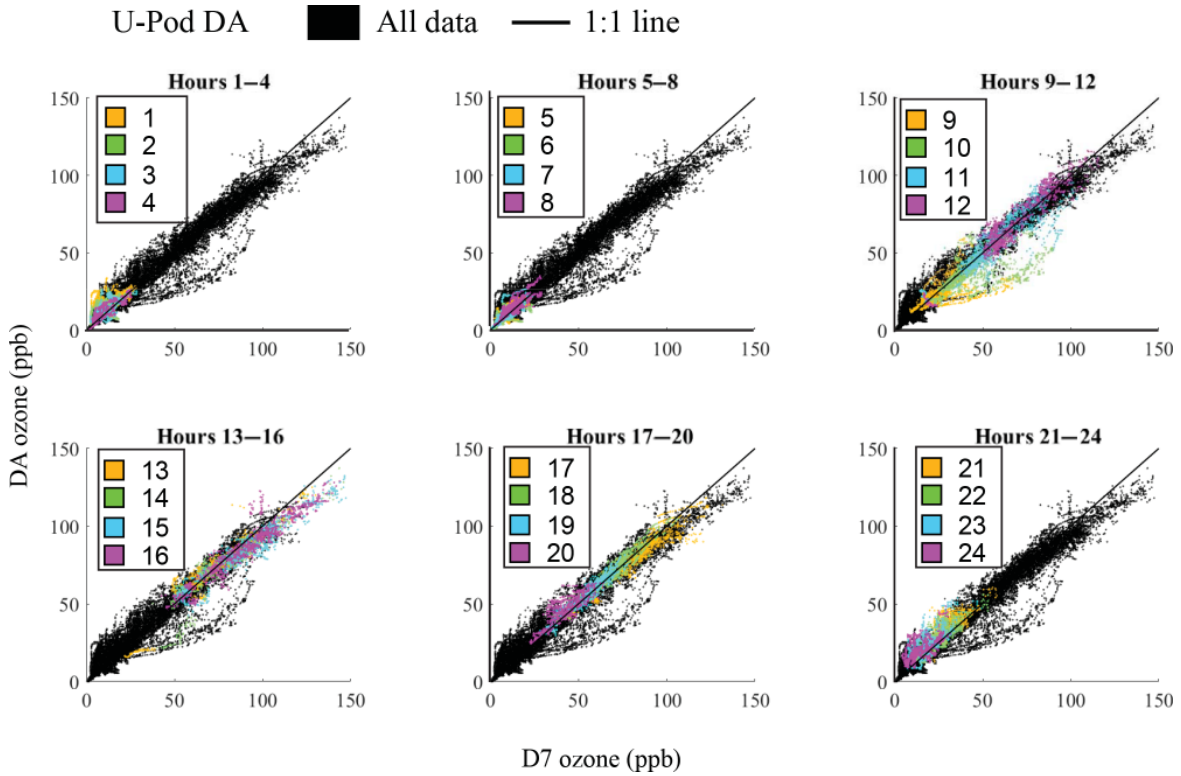
D7 stayed at Rubidoux SCAQMD site
D3 was in an industrial park
DC was closest to Highway 91
DA was in a commercial zone

Sadighi, K, Coffey, E, Polidori, A, Feenstra, B, Lv, Q, Henze, D, Hannigan, MP. Intra-urban spatial variability of surface ozone in Riverside, CA: viability and validation of low-cost sensors, Atmos. Meas. Tech., 11, 1777–1792, 2018

Since O_3 has a nice daily cycle, we should look at the data thru the time of day lens …



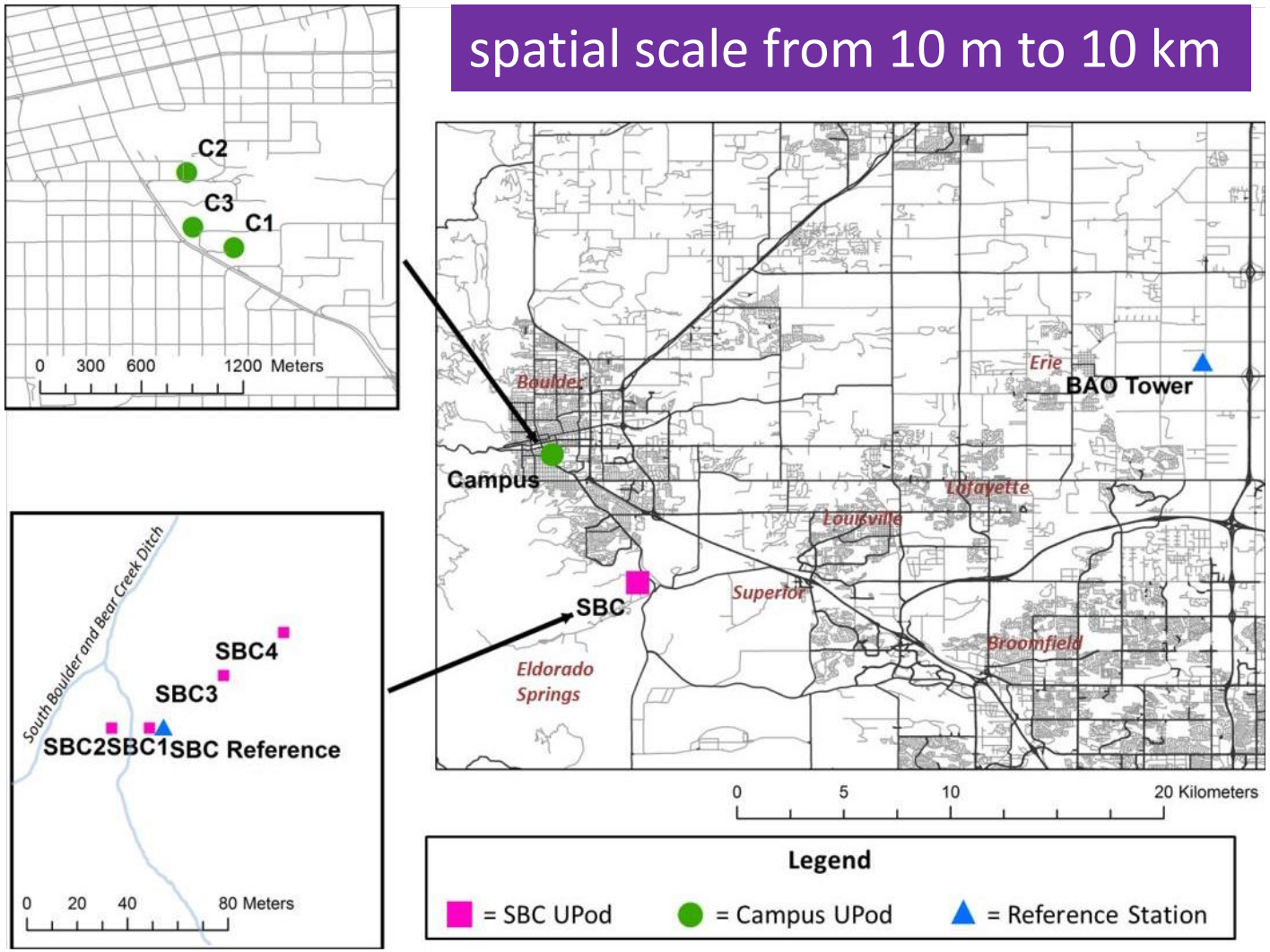
Distributions of medians of absolute differences between all pairs of pods for each hour of the day. Whiskers show 95 % intervals. The black line connects the medians of the deployment. The “all” category includes all hours of the day.



Data from DA, located at Commercial Zone 1, plotted against D7 (Rubidoux). Each scatterplot represents 4 h of the day, with the black data representing the complete deployment dataset (all hours). The black line is a 1 : 1 line.

O_3 in and around Boulder during summer 2015

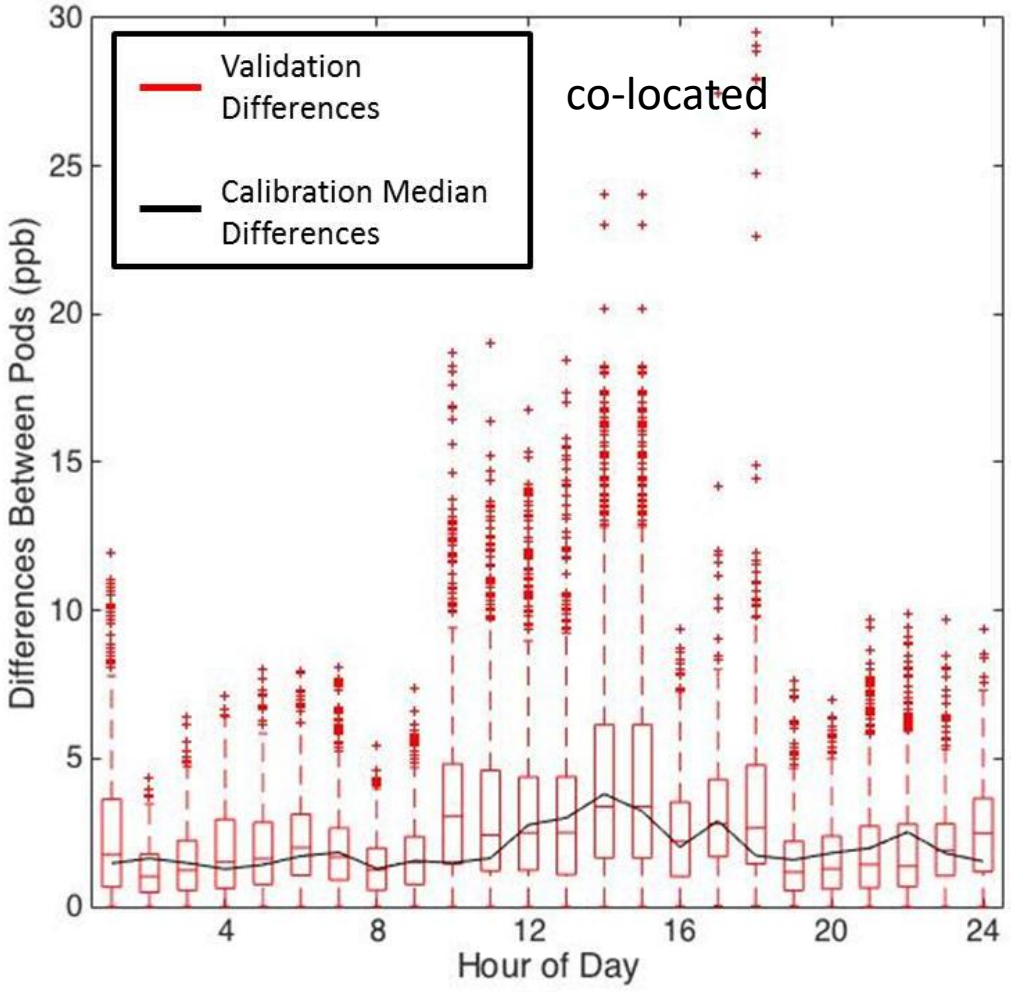
spatial scale from 10 m to 10 km

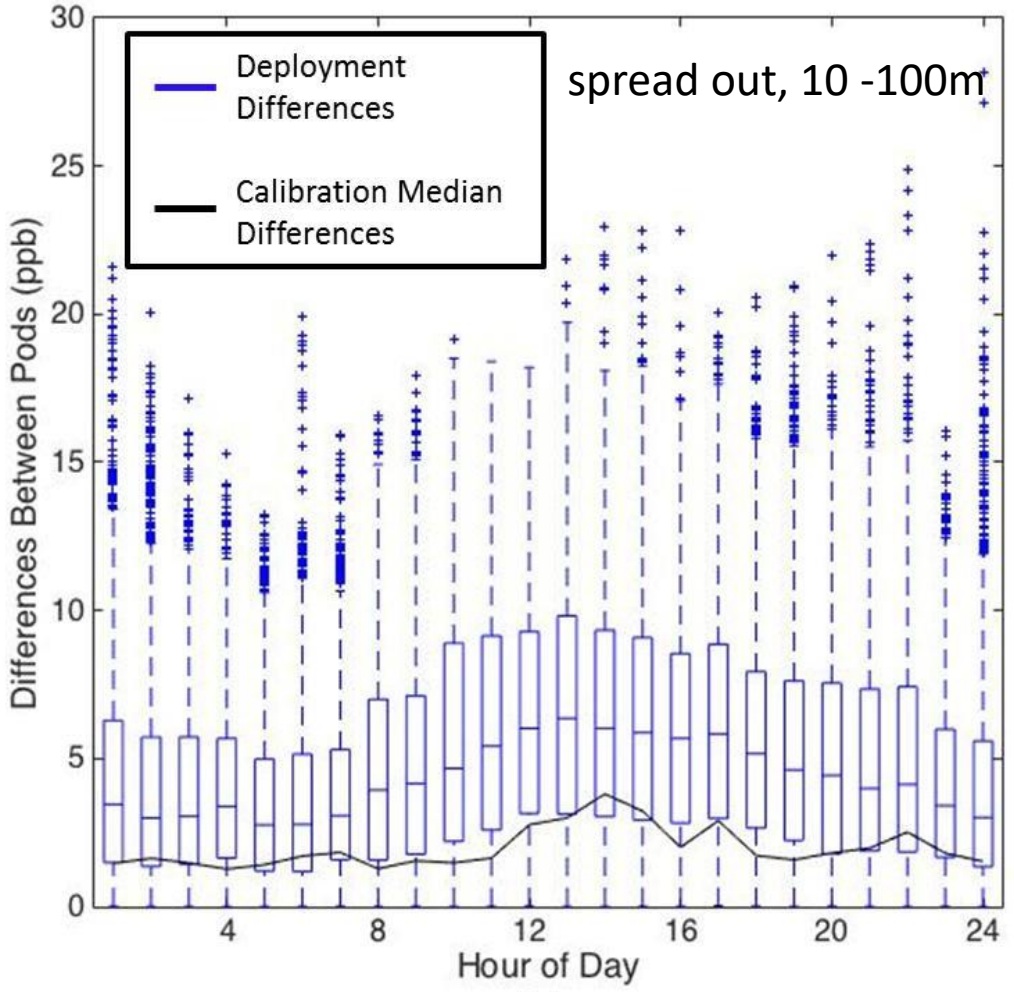


South Boulder Creek & CU campus

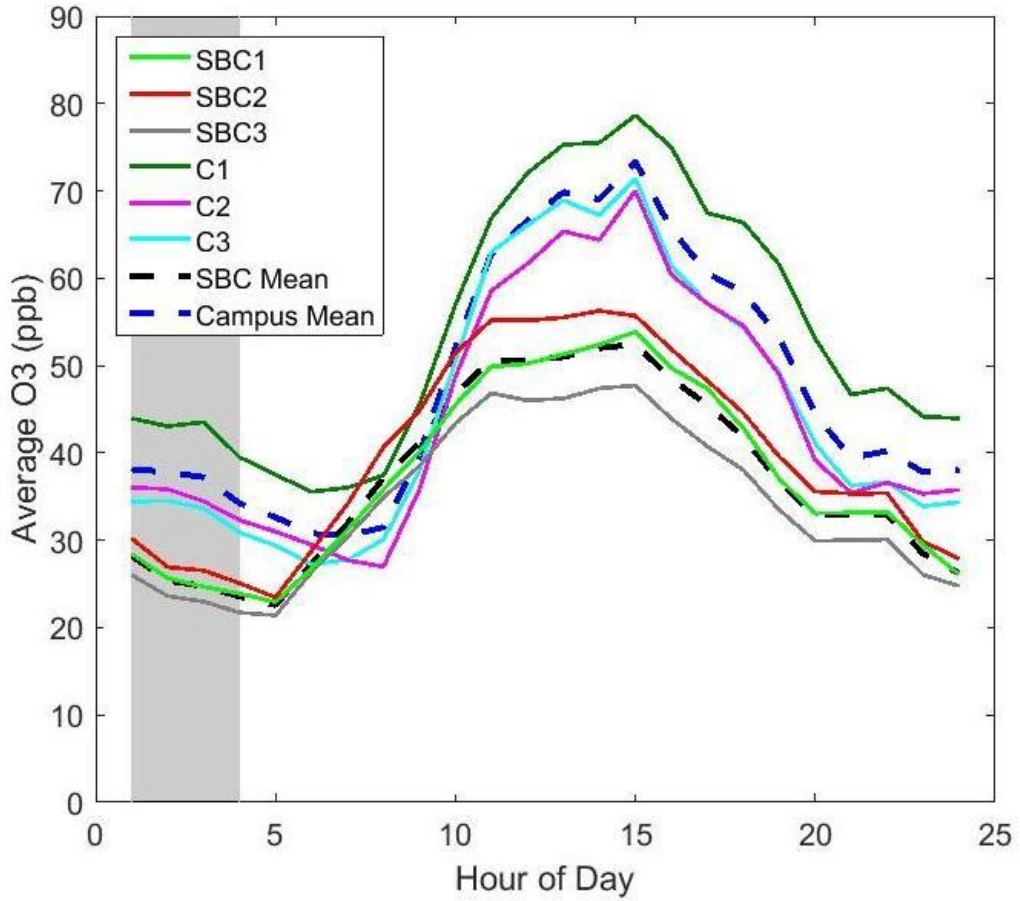
Cheadle L, Deanes, L, Sadighi, K, Casey, J, Collier-Oxandale, A, Hannigan, MP. Quantifying Neighborhood-Scale Spatial Variations of Ozone at Open Space and Urban Sites in Boulder, Colorado Using Low-Cost Sensor Technology , Sensors, 17, 2072, 2017.

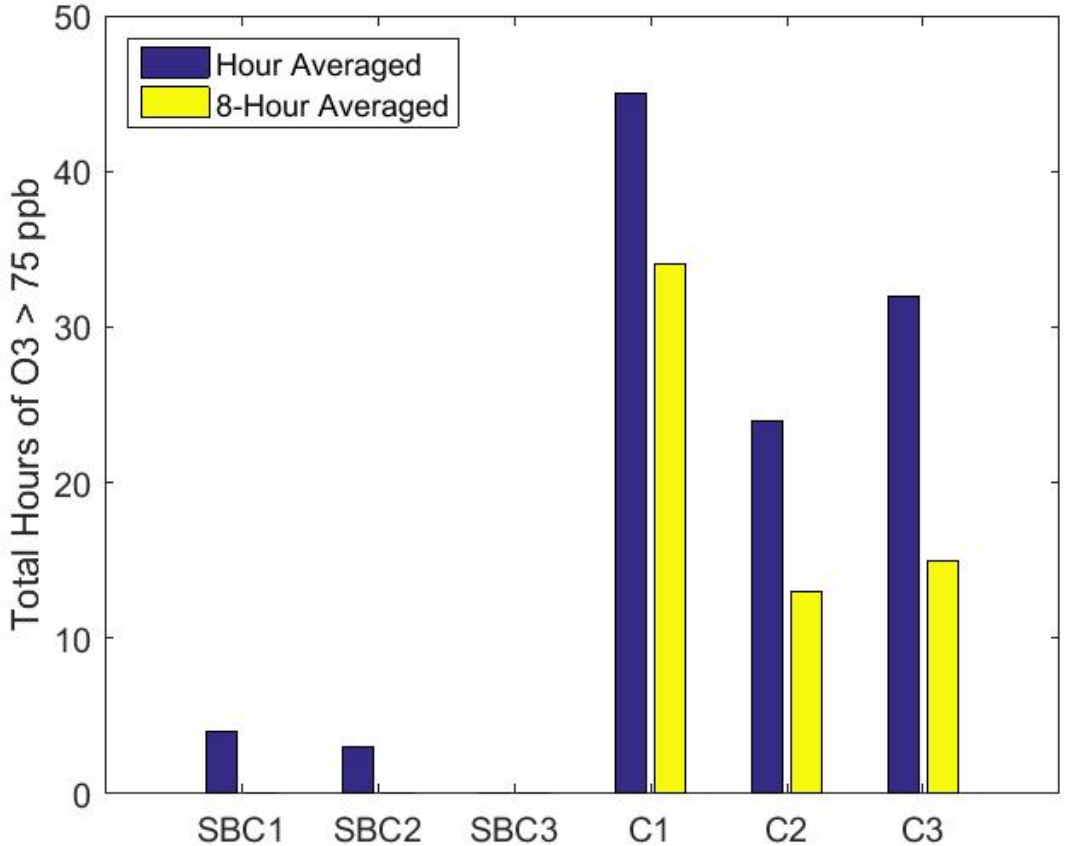
Still observe diurnal differences at South Boulder Creek on scale of 10s of meters





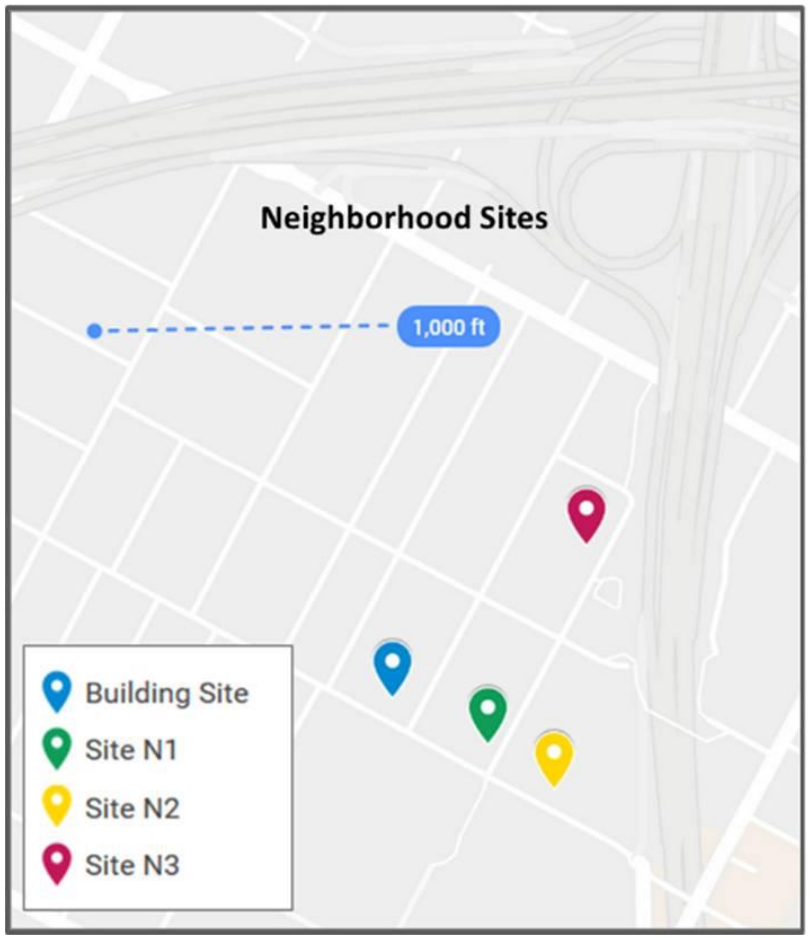
Depending on site and time averaging, O_3 statistics can be different

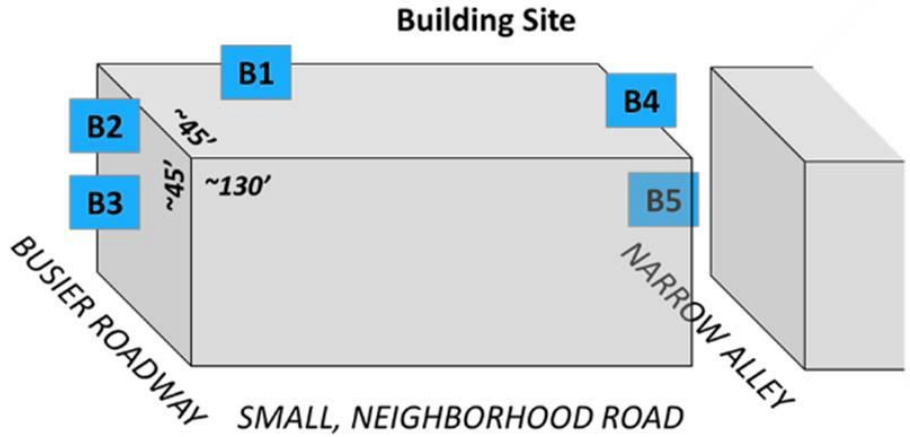




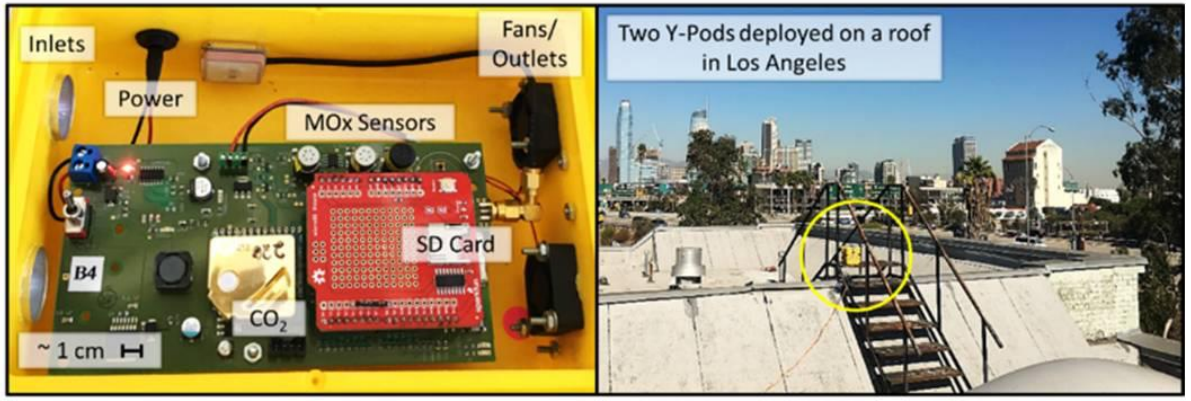
Back to SoCal (South LA) during summer 2017

spatial scale from a building to 0.5 km



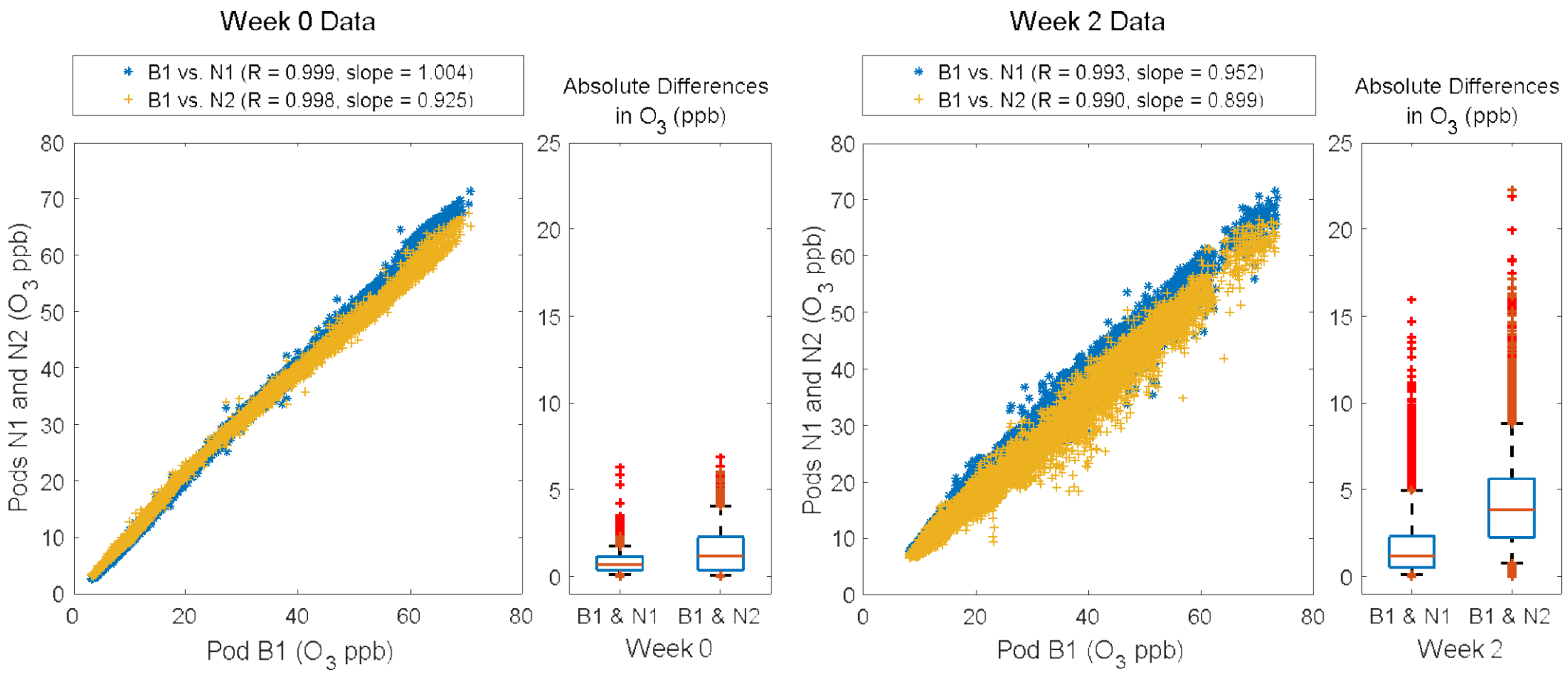


Sensors & Deployment Example

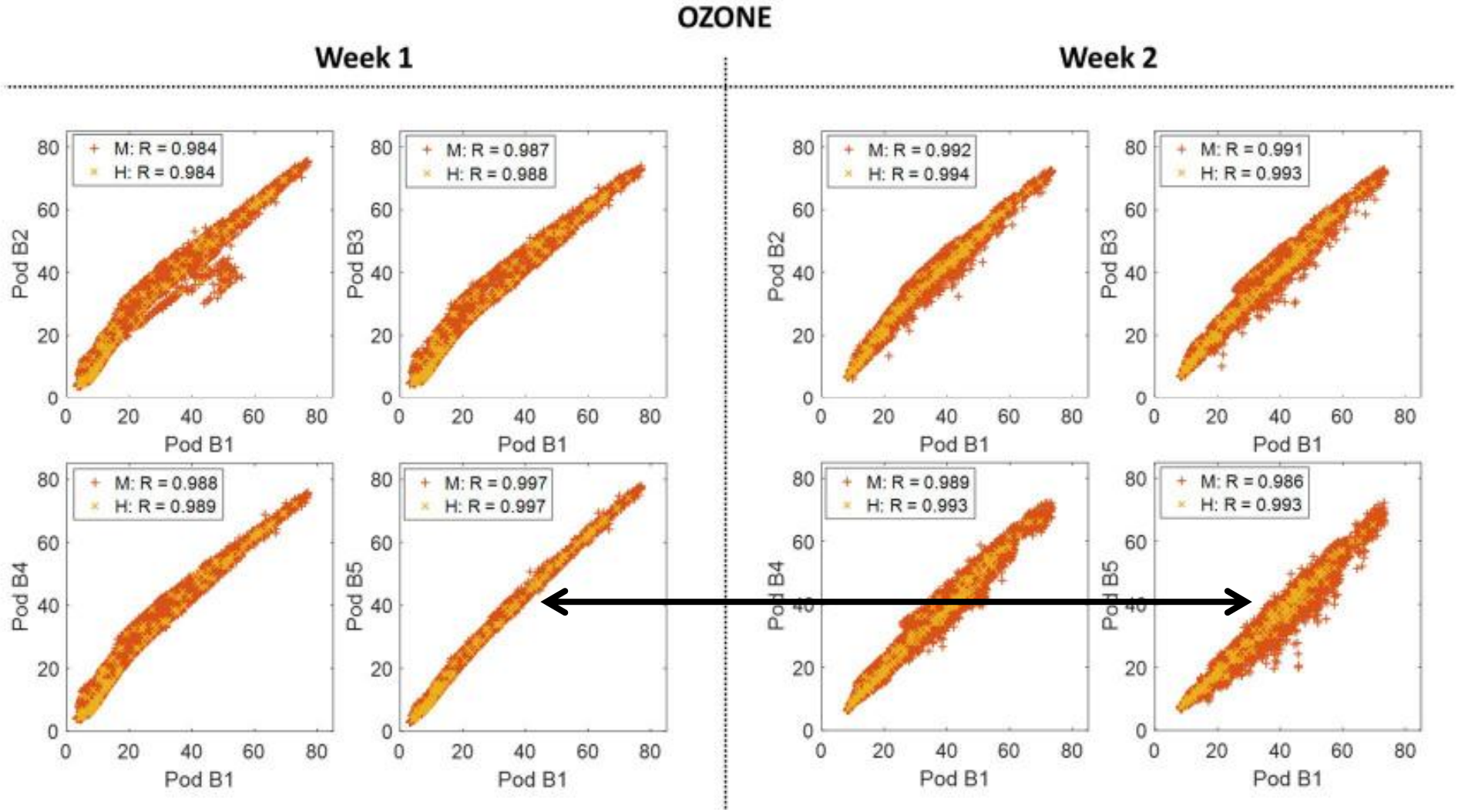


Collier-Oxandale, A, Coffey, E, Thorson, J, Johnston, J, Hannigan, MP. Comparing Building and Neighborhood-Scale Variability of CO2 and O3 to Inform Deployment Considerations for Low-Cost Sensor System Use, Sensors, 18, 1349, 2018.

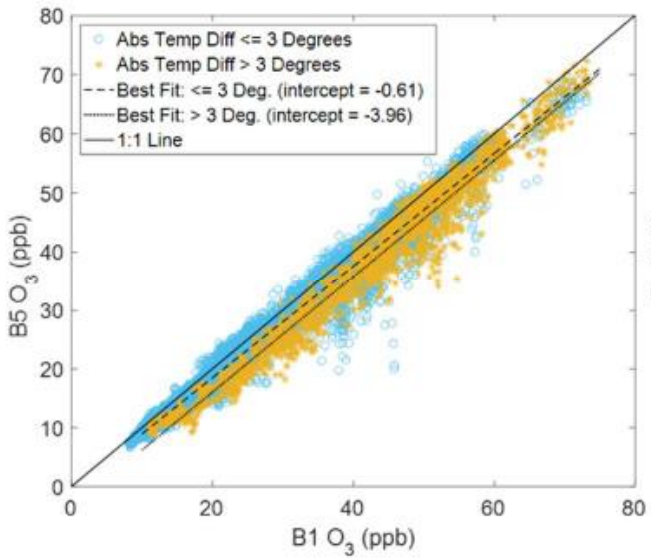
Sensors can see neighborhood scale variability

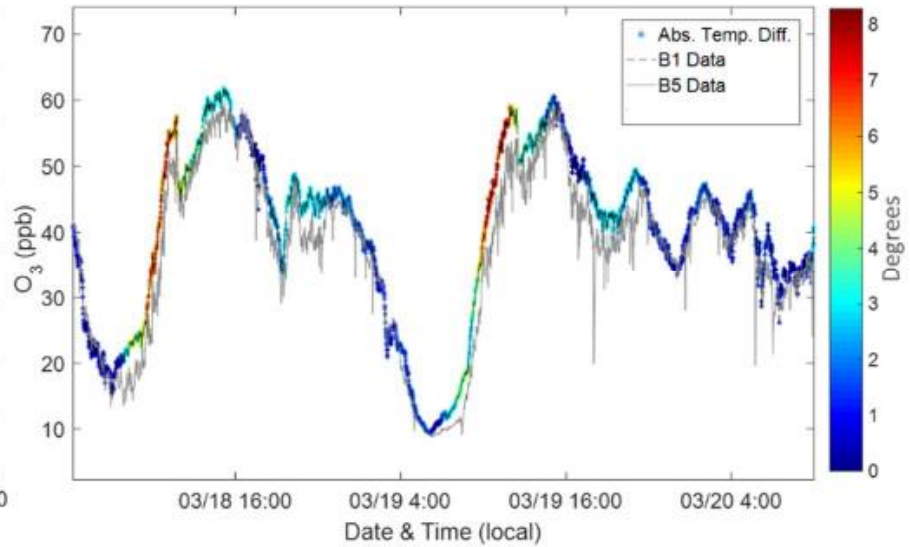


Can sensors see building scale spatial variability?

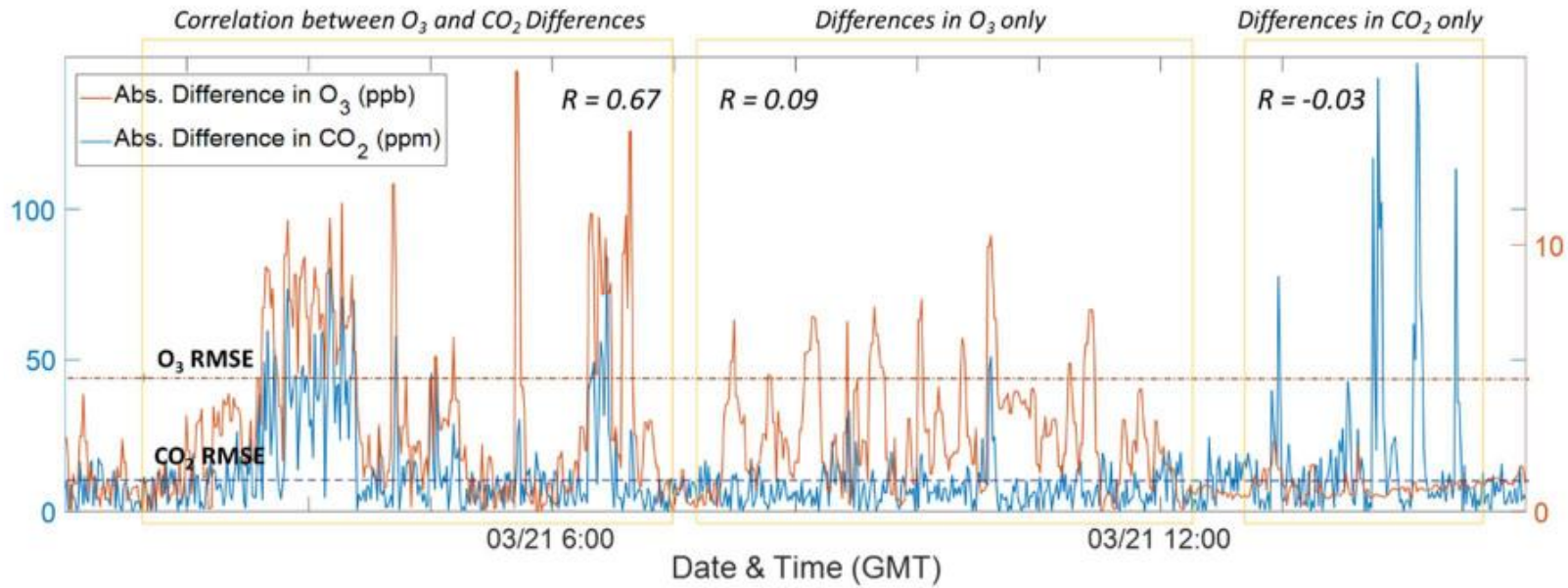


What's driving this small scale variability?





- ✓ Temperature at the sensor
- ✓ Very close sources



This work was done by many people …

My group:
Evan Coffey, Ashley Collier-Oxandale, Joanna Casey, Kira Sadighi, Lucy Cheadle, Jake Thorson, Ricardo Piedrahita, Lauren Deanes, Drew Meyers, Nick Masson

Collaborators:
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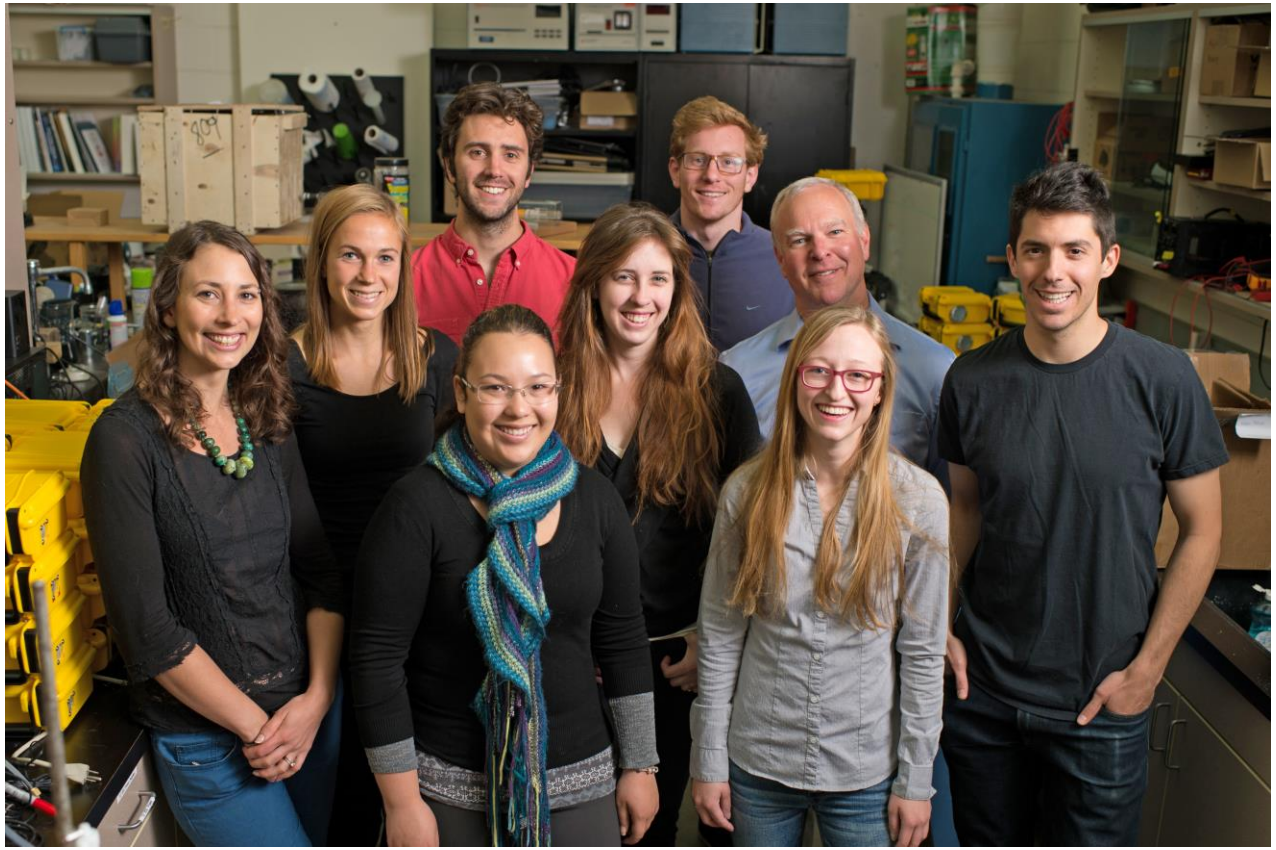
Bill Griswold (UCSD)
Jill Johnston (USC)
Rob Dick (U Mich)
Sandy Navarro (Esperanza Community Housing)
Many people at CDPHE, SCAQMD, SJVAPCD, CARB



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