Supplement of

Direct Measurements of Ozone Response to Emissions Perturbations in California

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1. Configuration of transportable smog chamber system.

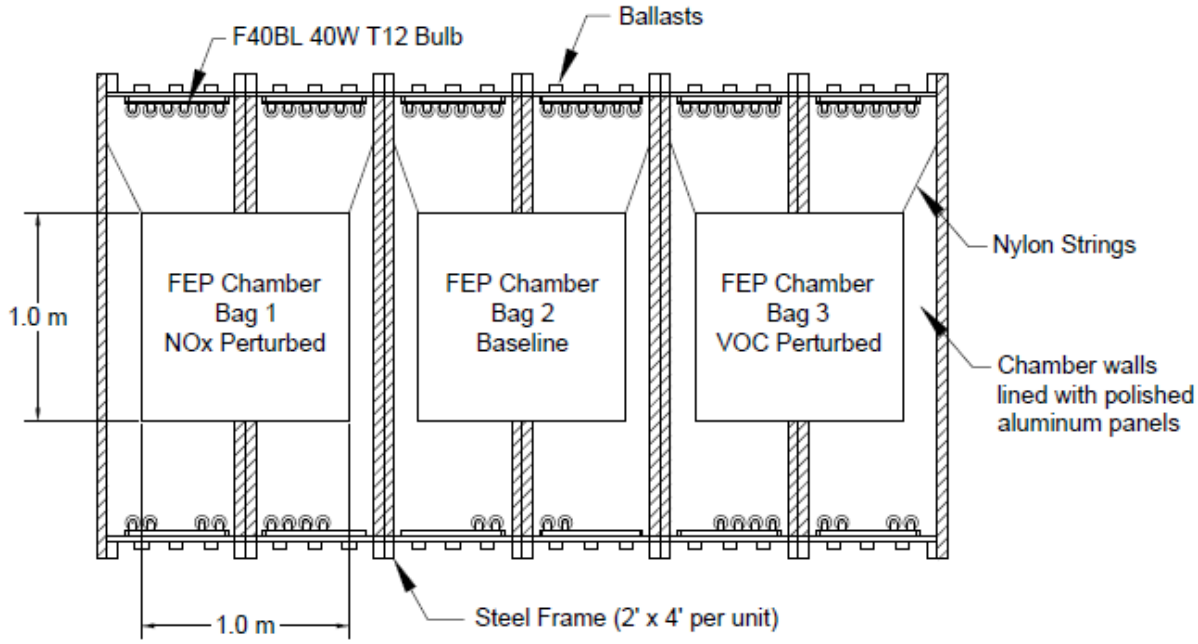

Figure S1. cross-sectional view of the transportable smog chamber system

2. Consistency of O_3 formation in smog chambers

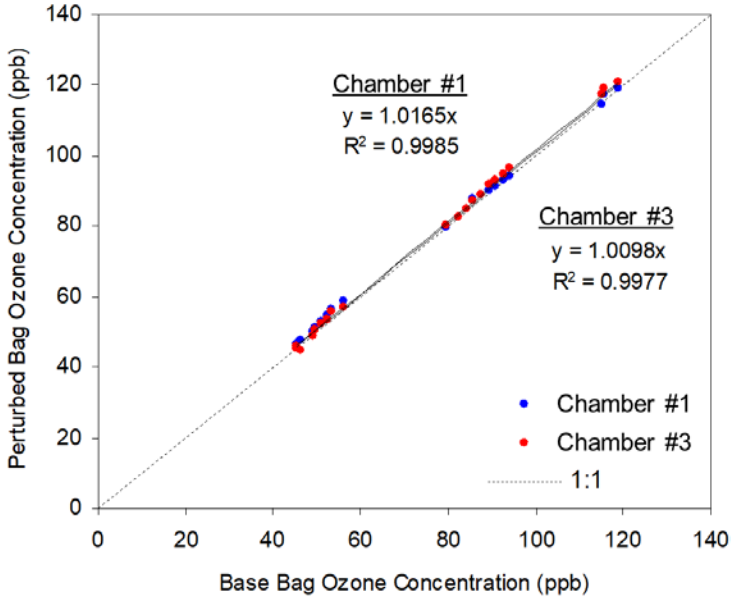

Figure S2. Consistency check of three 1 m^3 FEP bags using equal NO_x-VOC mixture.

3. Ambient and chamber O_3 formation comparison

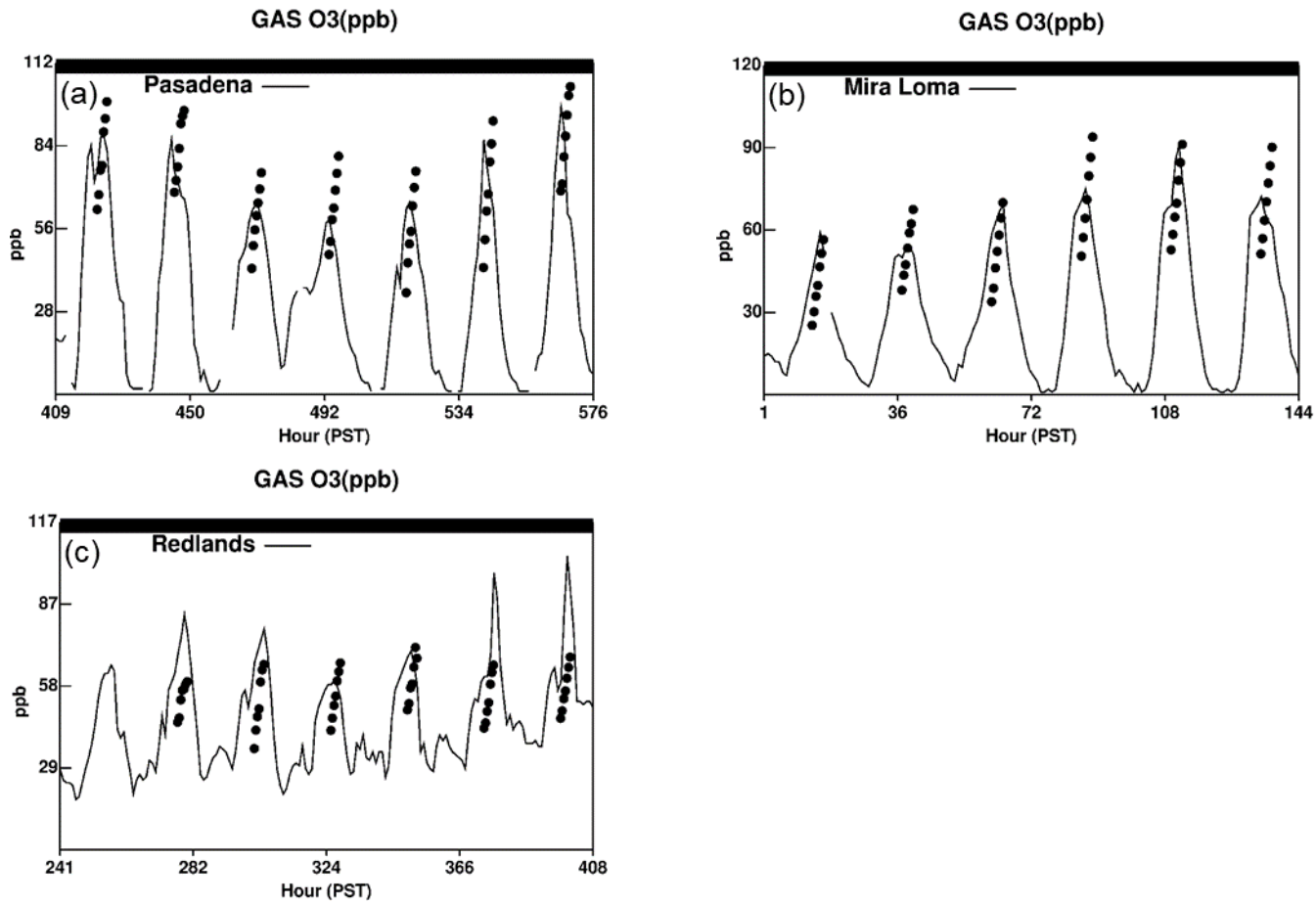

Figure S3. Ambient (solid line) vs. Chamber (solid circles) O_3 concentrations measured at Pasadena (a), Mira Loma (b), and Redlands (c). Chambers were filled over a ~2hr period followed by a 30 min measurement period before UV lights were turned on. Hour is relative to the start of the experiment.

4. CO*Biogenic calculation

Temperature and relative humidity-induced enhancement factor for isoprene emissions

$$T = \frac{\exp[T_1(T_L - T_s)/RT_LT_S]}{1 + \exp[T_1(T_L - T_3)/RT_LT_S]}$$

Where T_L is the ambient temperature (kelvins), T_S is the normalizing temperature (301 k), R is the gas constant (8.314 $J\,K^{-1}mol^{-1}$), and T_1 (= 95100 $J\,mol^{-1}$), T_2 (= 231000 $J\,mol^{-1}$), T_3 (= 311.83 k) are empirical coefficient.

$$H = RH \cdot H_1 + H_2$$

Where RH is relative humidity (%) and H_1 (=0.00236) and H_2 (=0.8495) are empirical coefficients.

$$CO * Biogenic = [CO] \times T \times H$$

Where [CO] is CO concentration (ppb) measured in the nearby monitoring station.

5. VOC reactivity (VOCR) and CO*Biogenic correlation

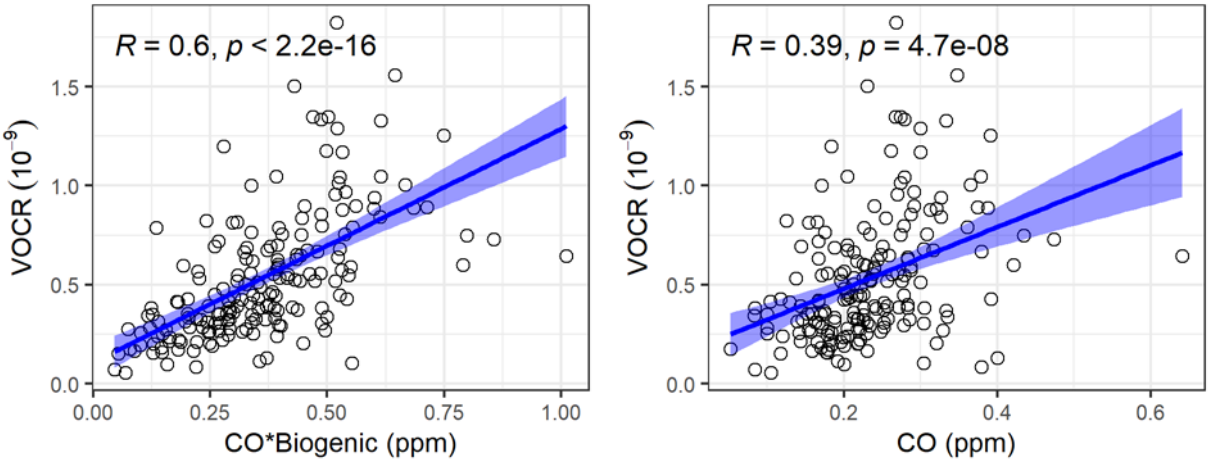

Figure S 4. Scatter plot of VOC reactivity vs CO concentration (right) and CO*Biogenic (left) in Sacramento during the years 2010-2019.

6. Location of chamber measurement site in Sacramento

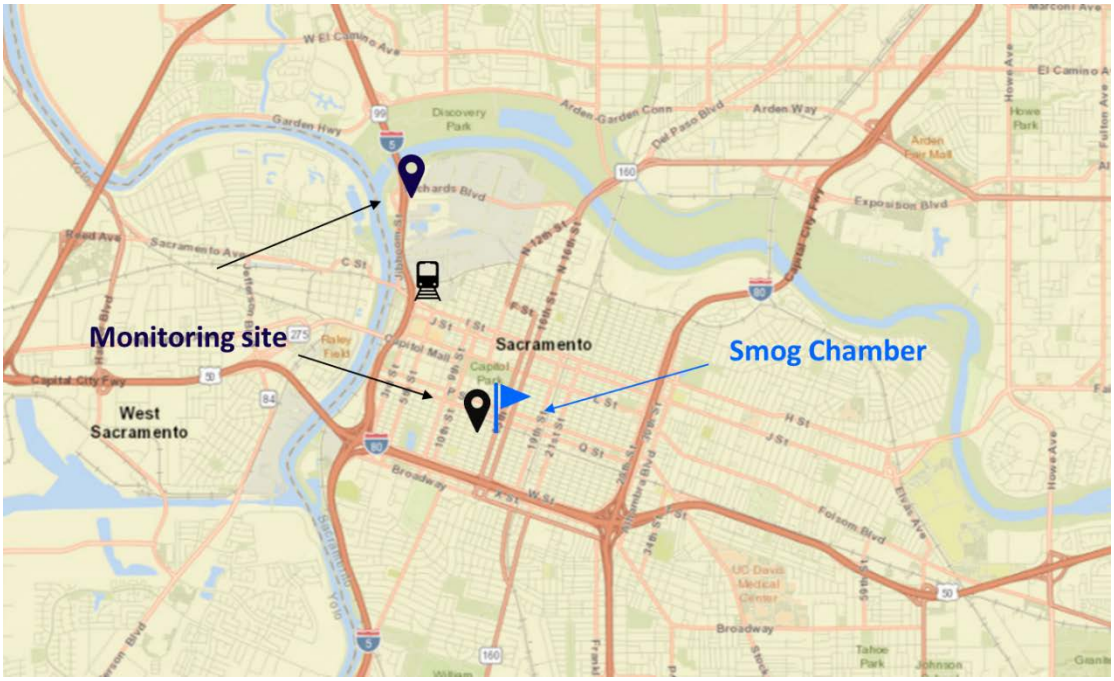

Figure S5. Map shows the location of the sampling site in Sacramento and surrounding facilities. Powered by ESRI.

7. Chamber and satellite O_3 sensitivity correlation

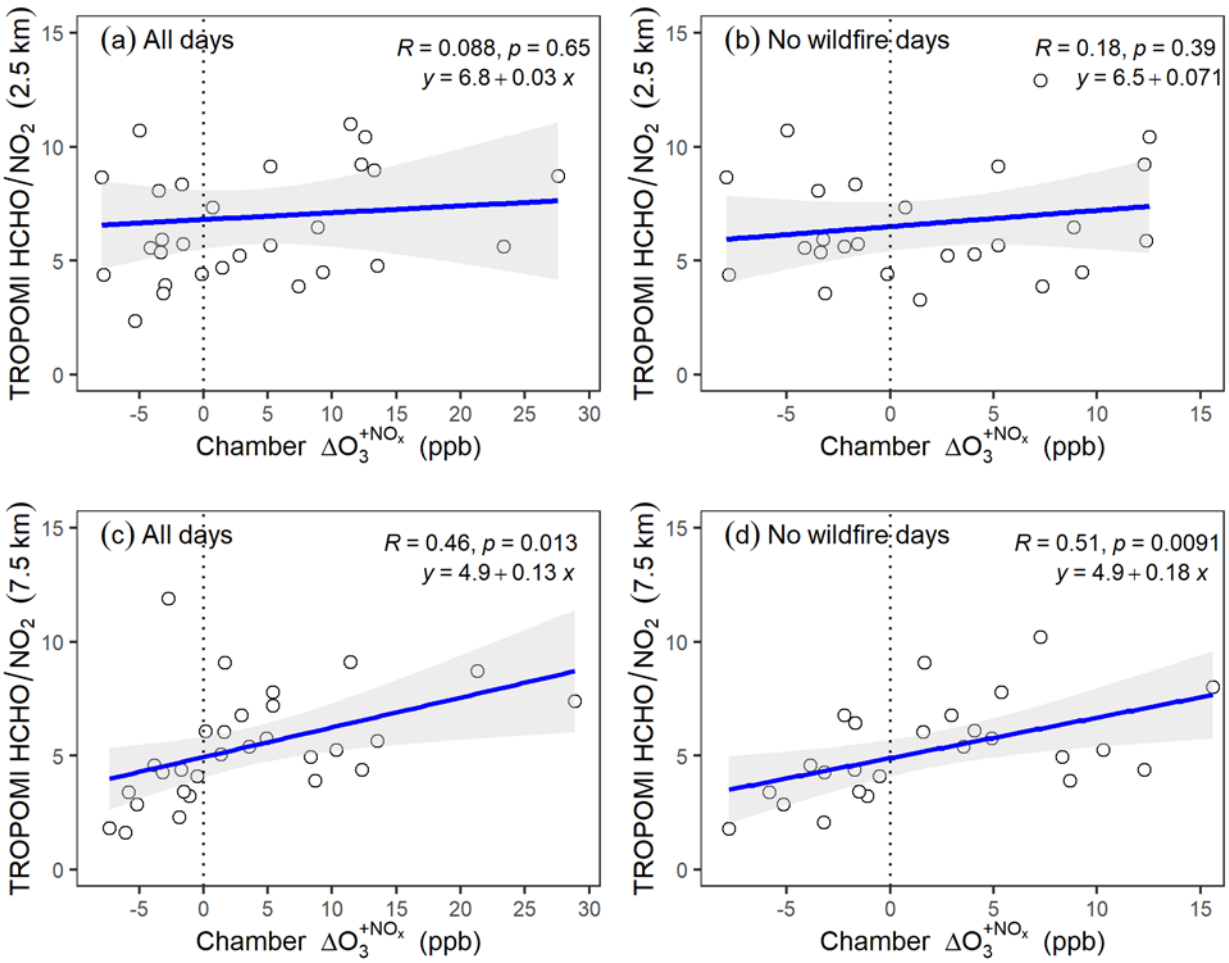

Figure S6. Correlation between weekly averaged TROPOMI satellite HCHO/NO2 at other two circular buffers (2.5 km (top) and 7.5 km (bottom)) and the weekly averaged chamber $\Delta O_3^{+NO_x}$ from ground-based measurement.

8. Monthly variance of TROPOMI HCHO/NO2 in California

Table S1. Monthly averaged TROPOMI satellite HCHO/NO2 for all air basins in California

Air Basin	N	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
Northeast Plateau	1701	4.7 (1.9)	3.5 (1.3)	3.4 (1.2)	5.7 (1.2)	9.8 (1.5)	12.4 (2.4)	10.9 (2.2)	11.0 (1.7)	6.8 (0.9)
North Coast	1349	5.0 (1.6)	4.1 (1.1)	4.1 (1.5)	5.2 (1.1)	9.2 (1.7)	12.6 (2.8)	11.5 (2.2)	9.4 (2.7)	6.5 (1.1)
Sacramento	1643	3.9 (1.6)	3.2 (1.1)	3.4 (1.1)	4.7 (1.2)	8.8 (2.0)	11.3 (3.3)	9.8 (2.7)	10.7 (2.2)	5.9 (1.5)
Mountain Counties	1329	3.6 (1.4)	3.5 (1.4)	3.3 (1.3)	4.5 (0.9)	9.9 (1.7)	11.9 (2.3)	9.8 (1.8)	10.8 (2.4)	7.0 (1.7)
Lake County	144	4.5 (1.1)	4.0 (1.2)	4.5 (1.1)	5.0 (1.0)	10.2 (0.8)	12.1 (1.4)	10.3 (2.0)	10.3 (2.2)	5.9 (0.7)
Lake Tahoe	40	2.4 (0.9)	2.8 (1.7)	2.6 (1.1)	3.5 (1.0)	9.0 (1.2)	11.2 (1.3)	8.9 (0.9)	11.7 (0.9)	6.2 (0.7)
Great Basin Valleys	1492	3.4 (1.2)	2.7 (1.2)	3.3 (1.4)	5.0 (1.0)	10.2 (1.7)	10.6 (2.6)	8.3 (1.9)	9.9 (2.2)	7.7 (1.7)
San Francisco Bay	583	1.8 (0.9)	2.4 (0.8)	2.6 (0.9)	3.6 (0.8)	6.2 (1.5)	6.5 (1.6)	6.0 (1.5)	7.4 (1.6)	3.8 (1.1)
San Joaquin Valley	2473	2.6 (1.4)	2.6 (1.3)	3.3 (1.4)	4.3 (1.2)	8.2 (3.4)	8.7 (3.4)	7.5 (2.1)	7.7 (1.6)	6.4 (2.2)
North Central Coast	542	2.8 (0.7)	2.9 (1.0)	3.7 (1.0)	4.9 (0.8)	7.4 (1.1)	8.4 (1.2)	7.4 (1.1)	8.2 (1.2)	5.6 (1.2)
Mojave Desert	2766	2.6 (0.6)	2.6 (0.7)	3.7 (0.9)	4.5 (0.7)	7.8 (1.2)	7.7 (1.3)	6.8 (1.2)	7.2 (1.2)	5.3 (1.0)
South Central Coast	791	2.7 (0.7)	2.6 (0.9)	3.9 (0.9)	5.2 (0.7)	8.8 (1.2)	9.4 (1.4)	8.5 (1.1)	9.6 (1.3)	6.7 (1.2)
South Coast	689	1.1 (0.6)	1.5 (0.7)	2.5 (0.8)	3.4 (1.1)	5.1 (1.9)	5.1 (2.1)	4.5 (1.6)	4.2 (1.9)	3.0 (1.5)
Salton Sea	663	2.5 (0.6)	3.1 (0.6)	3.9 (0.6)	4.8 (0.6)	7.2 (1.0)	7.7 (1.2)	7.1 (1.2)	6.5 (1.1)	4.8 (0.9)
San Diego County	429	2.1 (0.9)	2.4 (0.8)	3.3 (0.8)	4.5 (0.9)	7.4 (1.6)	7.5 (1.9)	7.4 (1.6)	6.9 (1.7)	4.8 (1.5)

Note: Mean (SD) of TROPOMI ($HCHO/NO_2$) shown.