Supplement

This supplement includes maps of monitoring sites and driving routes, data tabulations, and supplemental data analyses.

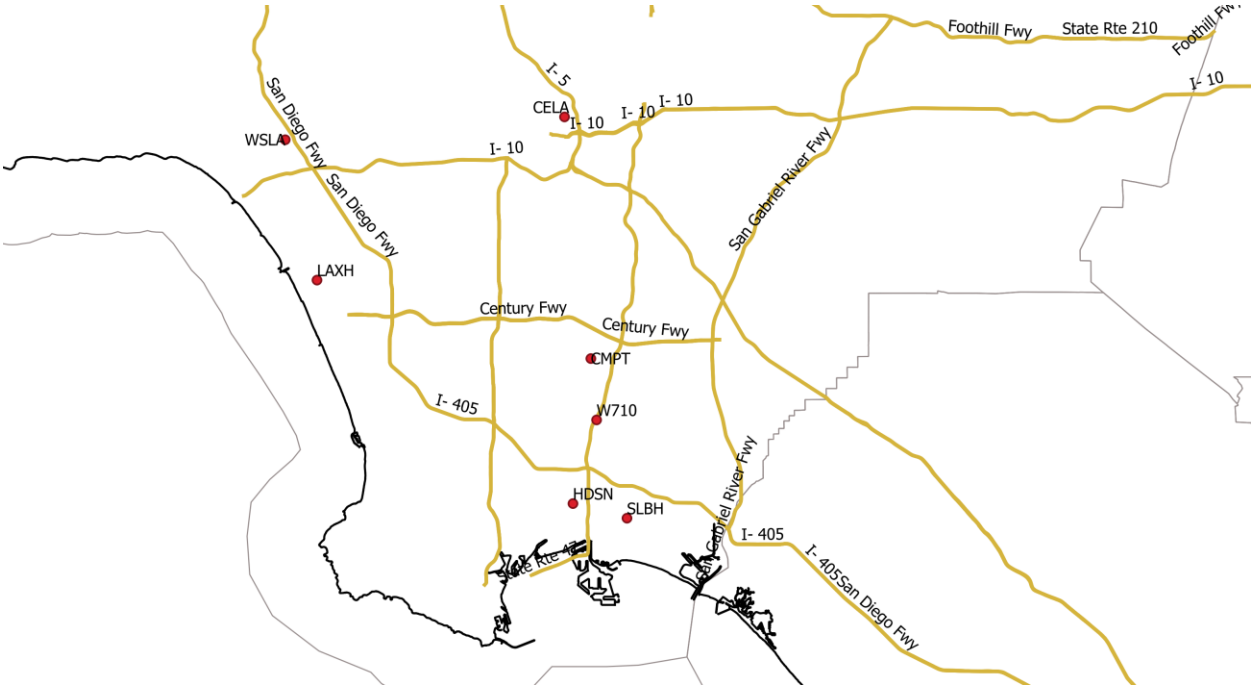


Figure S1. Locations of SCAQMD monitoring sites for which one-minute resolution data were provided by the SCAQMD. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline shapefile obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways shapefile obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

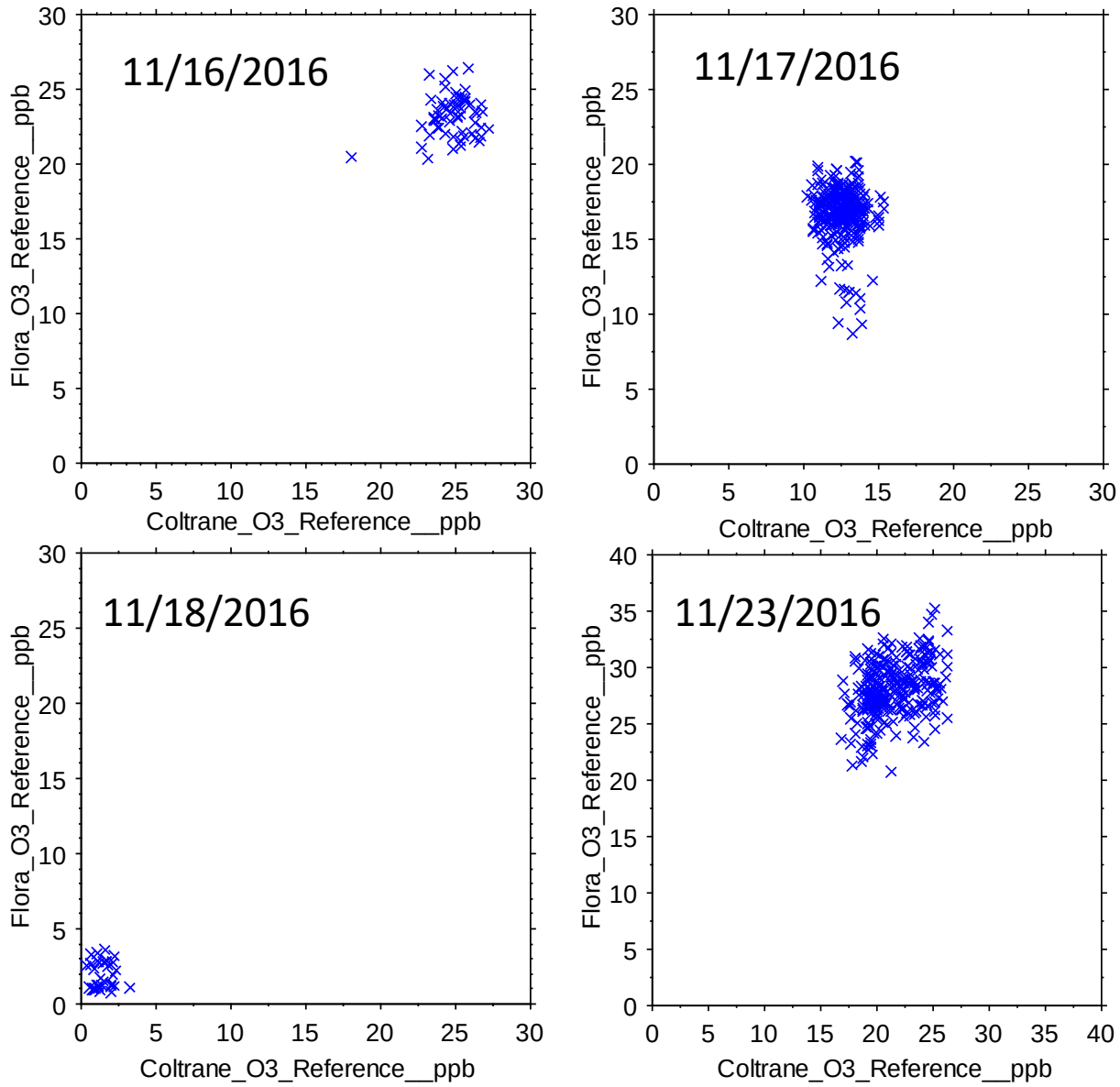
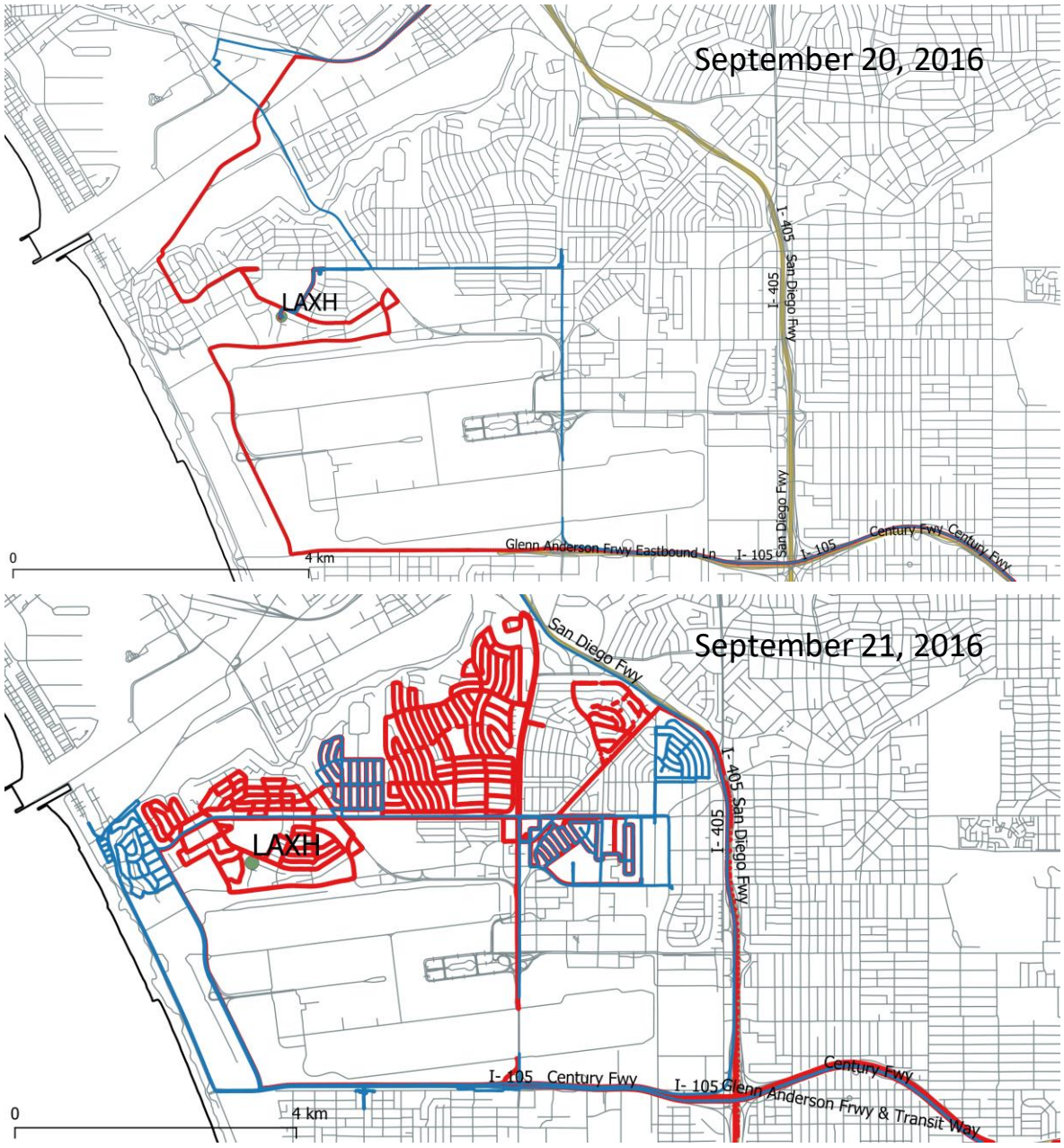


Figure S2. Comparison of paired 1-sec O_3 measurements recorded by two mobile platforms while parked in the San Francisco garage during the first two weeks of the San Joaquin Valley sampling period. One vehicle did not record O_3 measurements while parked on two days.



Red = Flora Blue = Coltrane

Figure S3. Los Angeles driving routes on September 20 and 21, 2016 (red = Flora, blue = Coltrane). Each 1-s measurement is marked by a point; because the points are closely spaced, the routes appear as smooth lines. The air quality monitor (LAXH) is shown. On September 20, the cars parked next to the monitor for an audit check. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline shapefile obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways shapefile obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

Figure S4. Satellite view showing location of LAXH and surrounding areas (courtesy GoogleEarth).

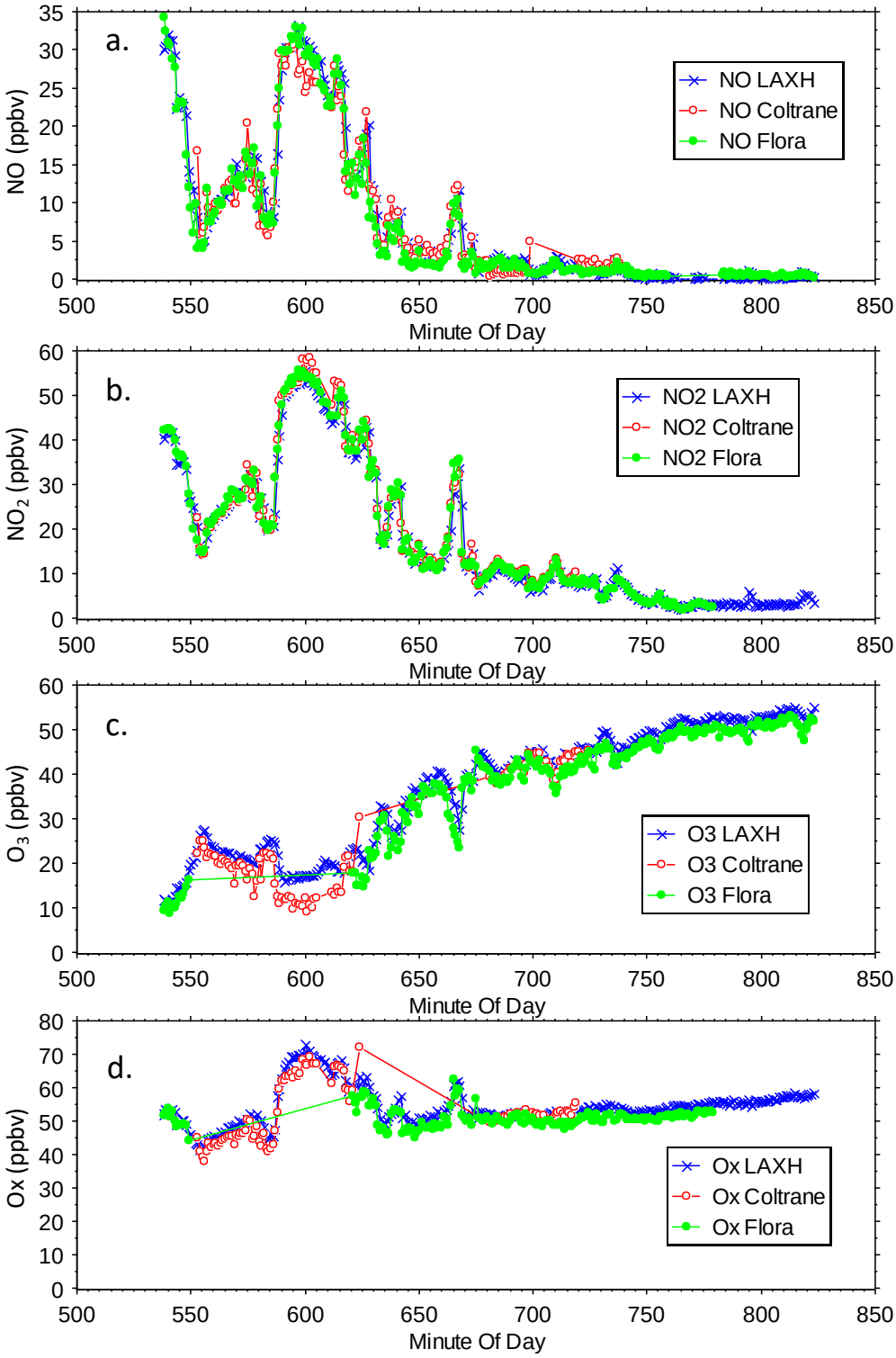


Figure S5. NO, NO_2, O_3, and O_x on September 20, 2016 at LAXH as measured by a fixed-site monitor and the mobile platforms.

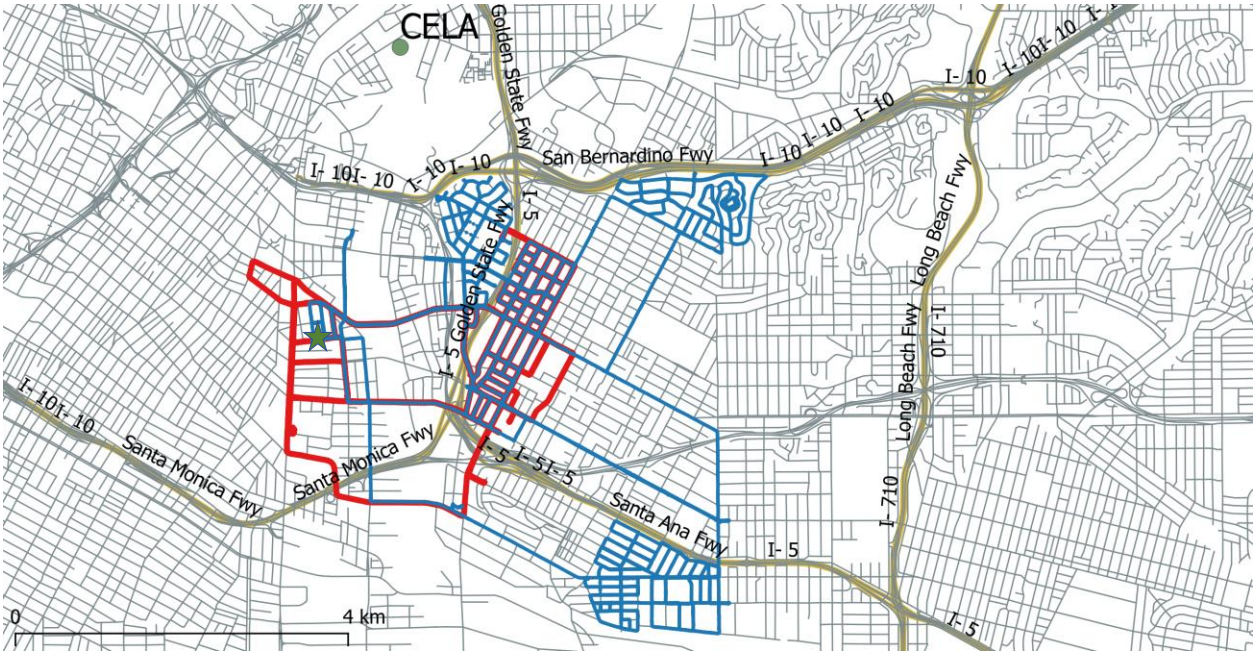


Figure S6. Los Angeles driving routes on August 3, 2016 (red = Flora, blue = Coltrane). Each 1-s measurement is marked by a point; because the points are closely spaced, the routes appear as smooth lines. The air quality monitor in downtown Los Angeles (CELA) is shown. The parking garage is located at the star. The garage is 3.0 km from CELA (direct distance). Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

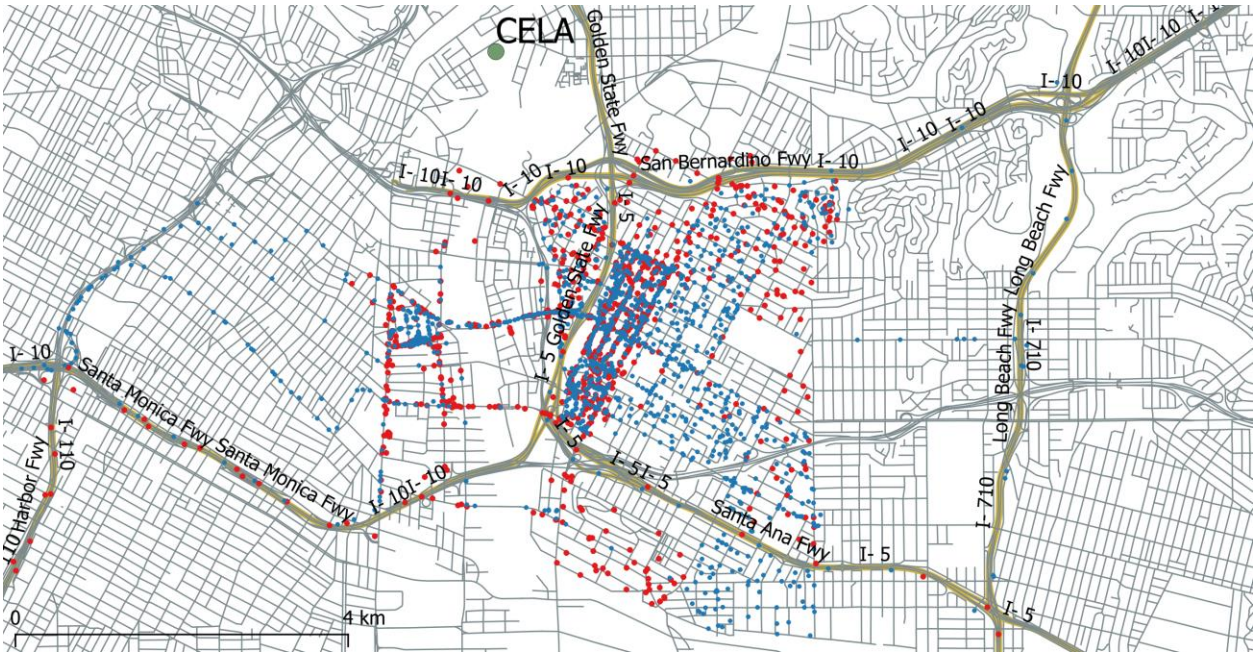


Figure S7. Locations of cars based on 1-minute averages during August 3 – 12, 2016 (red = Flora, blue = Coltrane). The air quality monitor in downtown Los Angeles (CELA) is shown. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

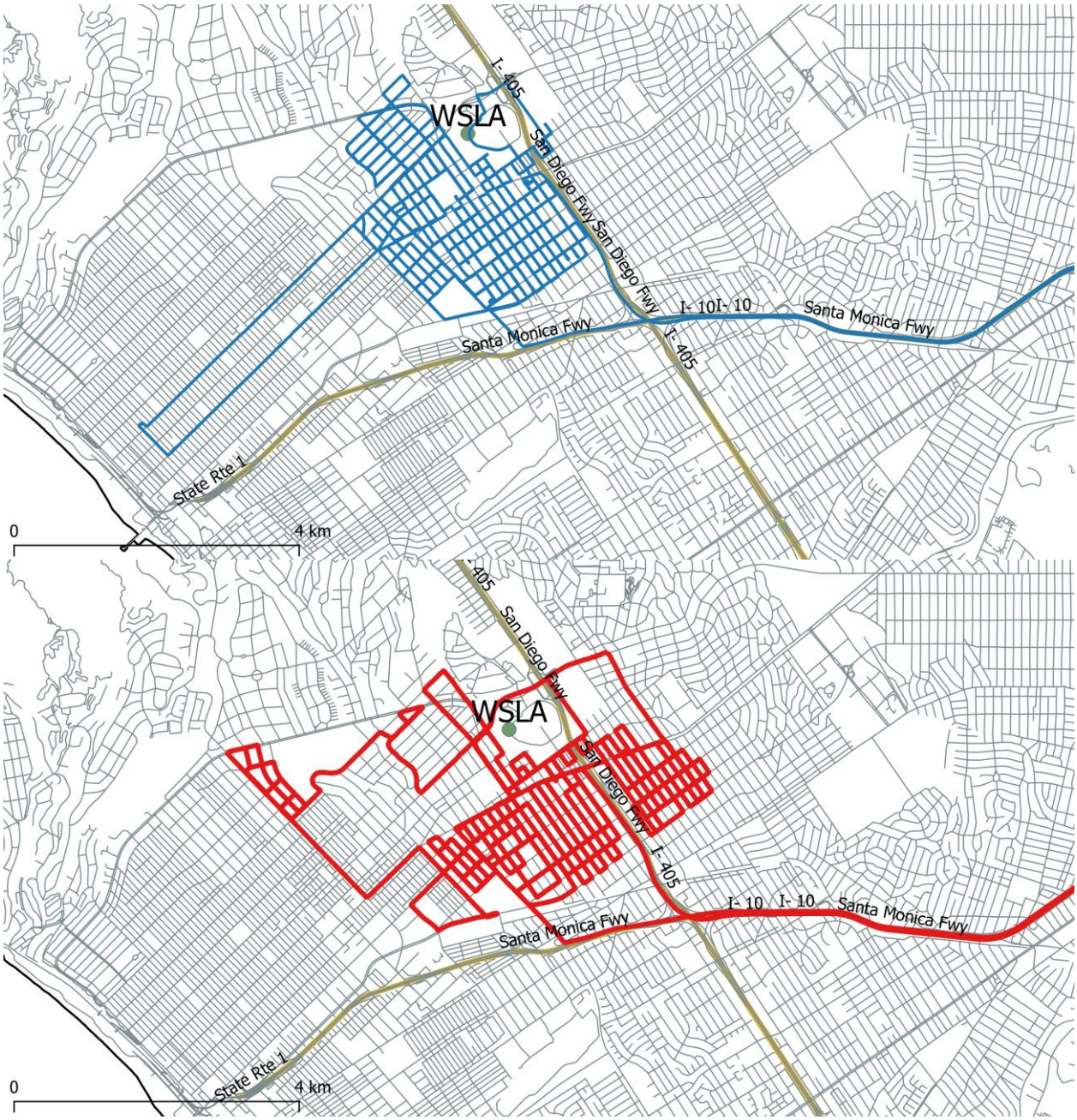


Figure S8. Los Angeles driving routes on September 13 (blue, Coltrane) and September 19 (red, Flora). Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

Figure S9. Satellite view of WSLA and surrounding areas (courtesy GoogleEarth).

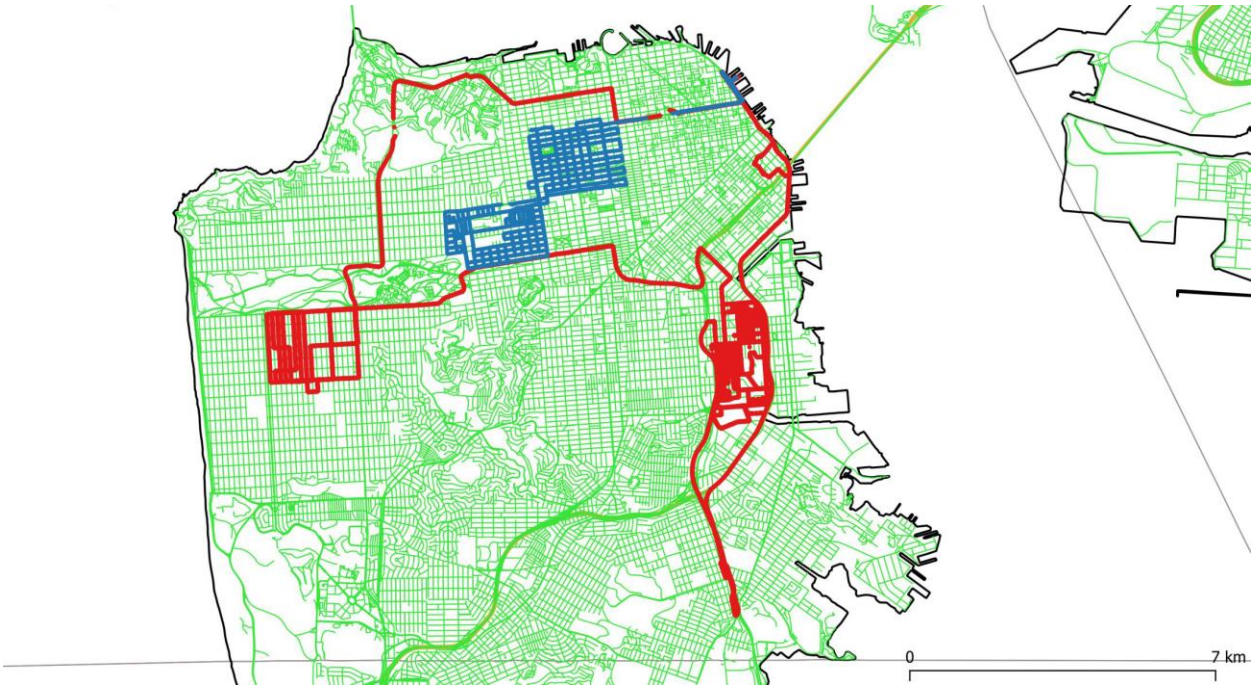


Figure S10. San Francisco driving routes on May 11, 2017. Red = Flora, blue = Coltrane. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

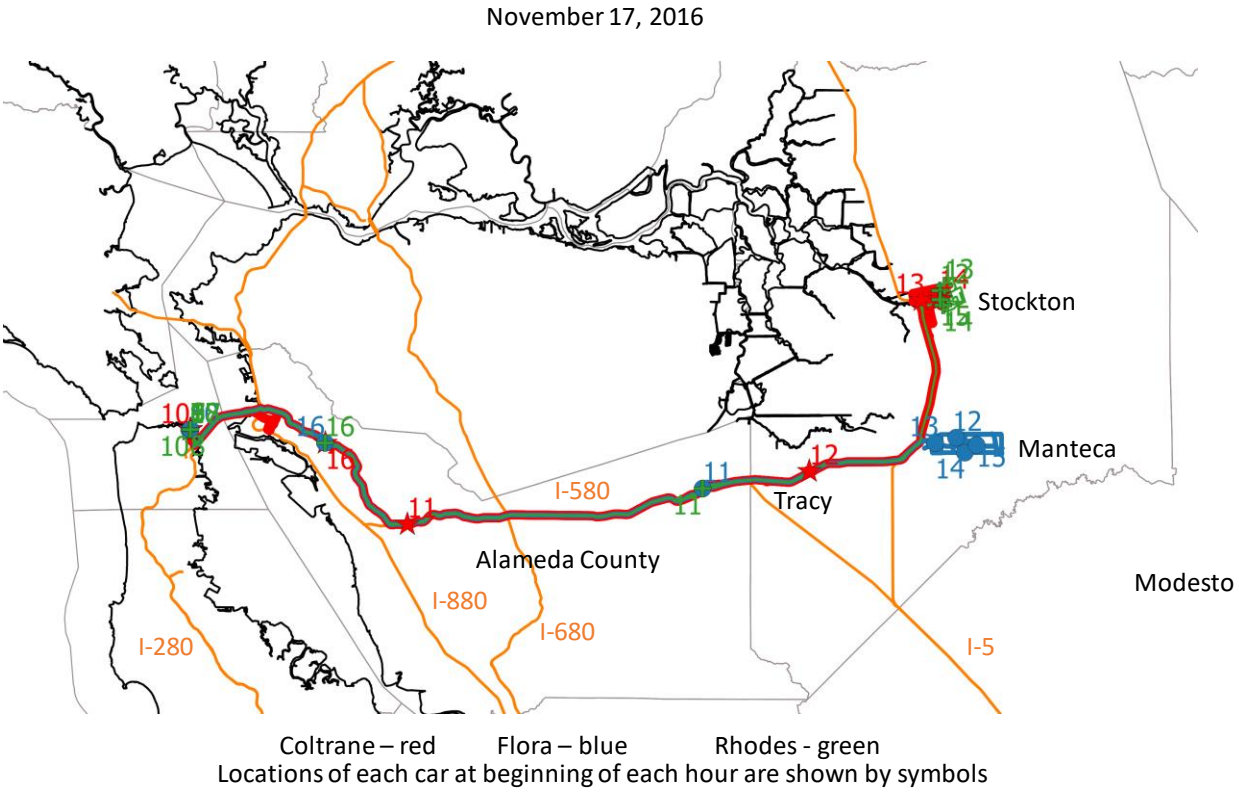


Figure S11. San Joaquin Valley driving routes on November 17, 2016. The positions of each car at the beginning of each hour are marked. The drives began and ended at the parking garage in San Francisco. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

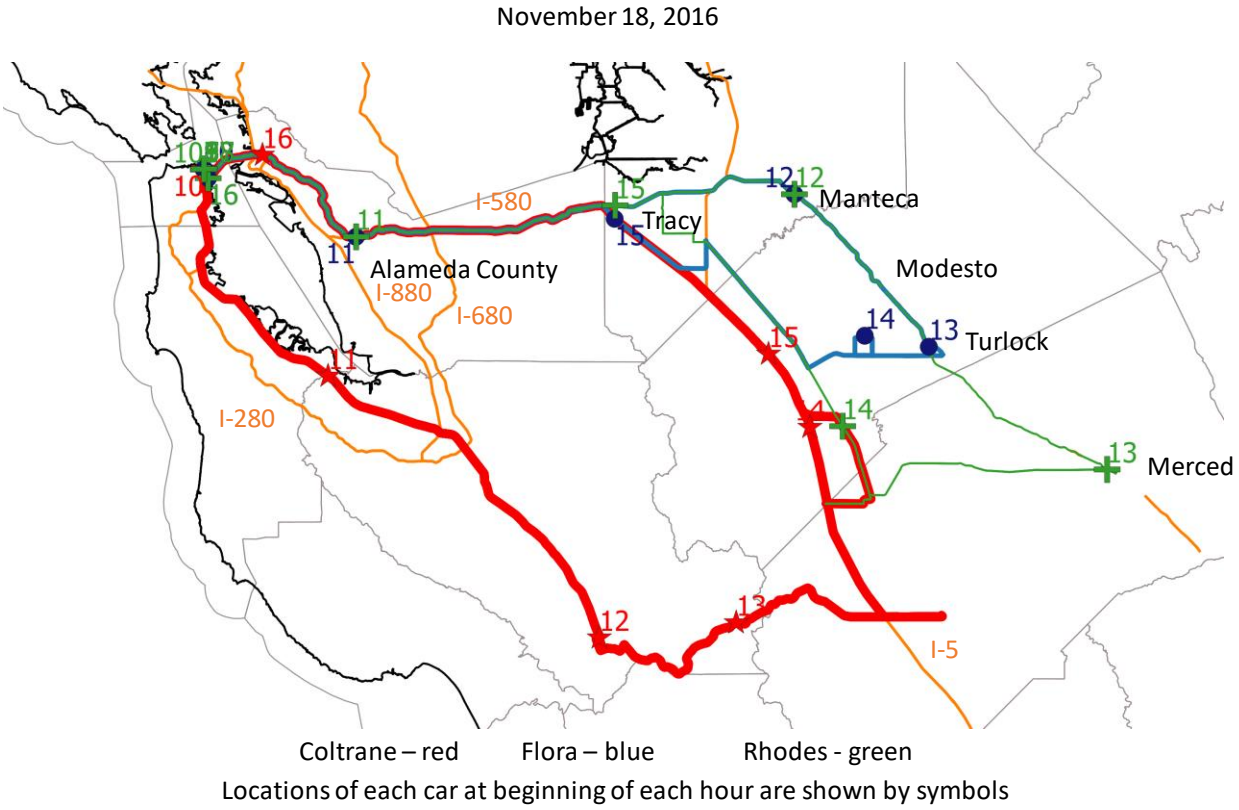


Figure S12. San Joaquin Valley driving routes on November 18, 2016. The positions of each car at the beginning of each hour are marked. The drives began and ended at the parking garage in San Francisco. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

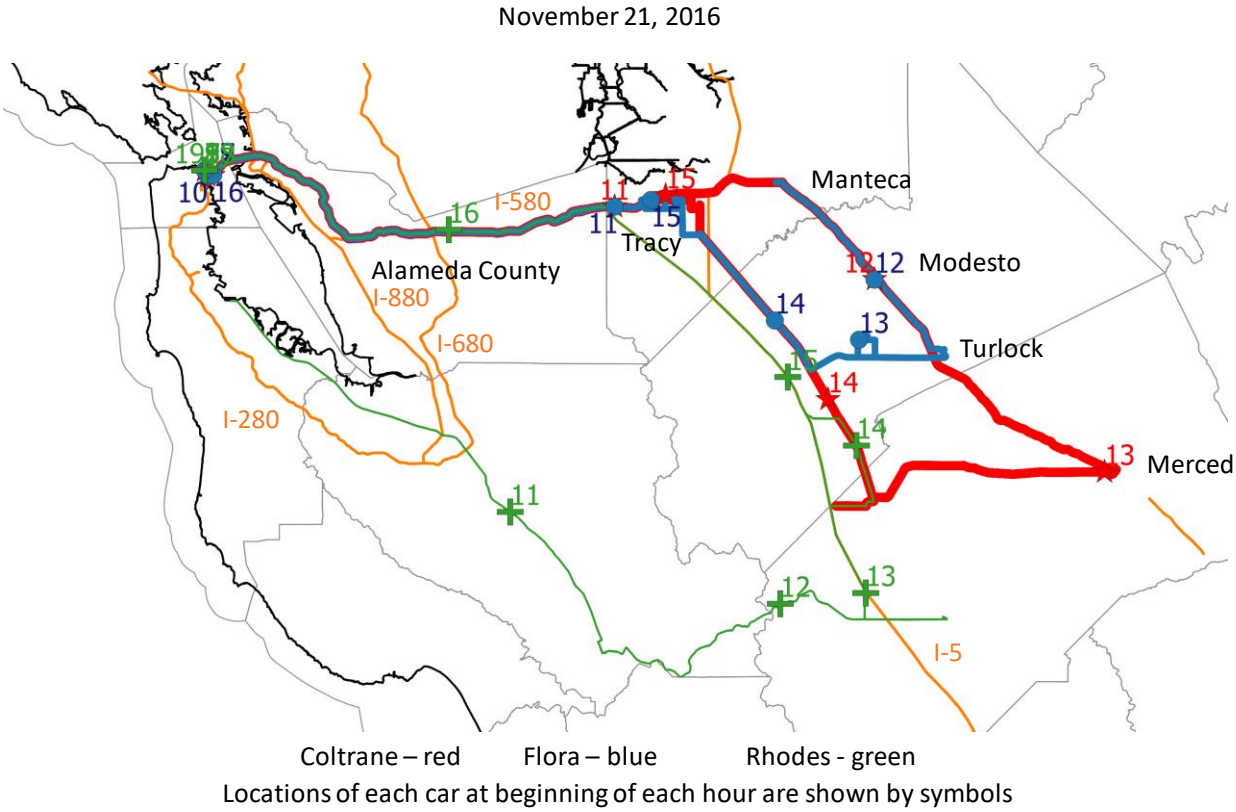


Figure S13. San Joaquin Valley driving routes on November 21, 2016. The positions of each car at the beginning of each hour are marked. The drives began and ended at the parking garage in San Francisco. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

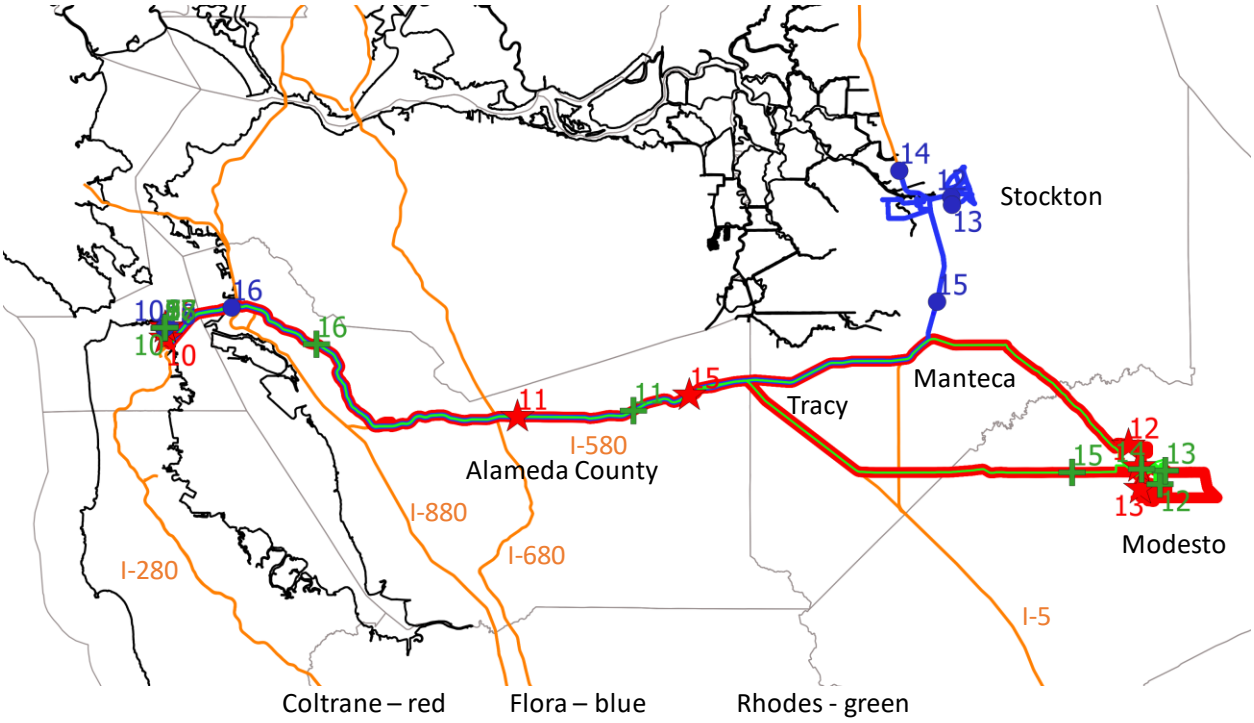


Figure S14. San Joaquin Valley driving routes on November 22, 2016. The positions of each car at the beginning of each hour are marked. The drives began and ended at the parking garage in San Francisco. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

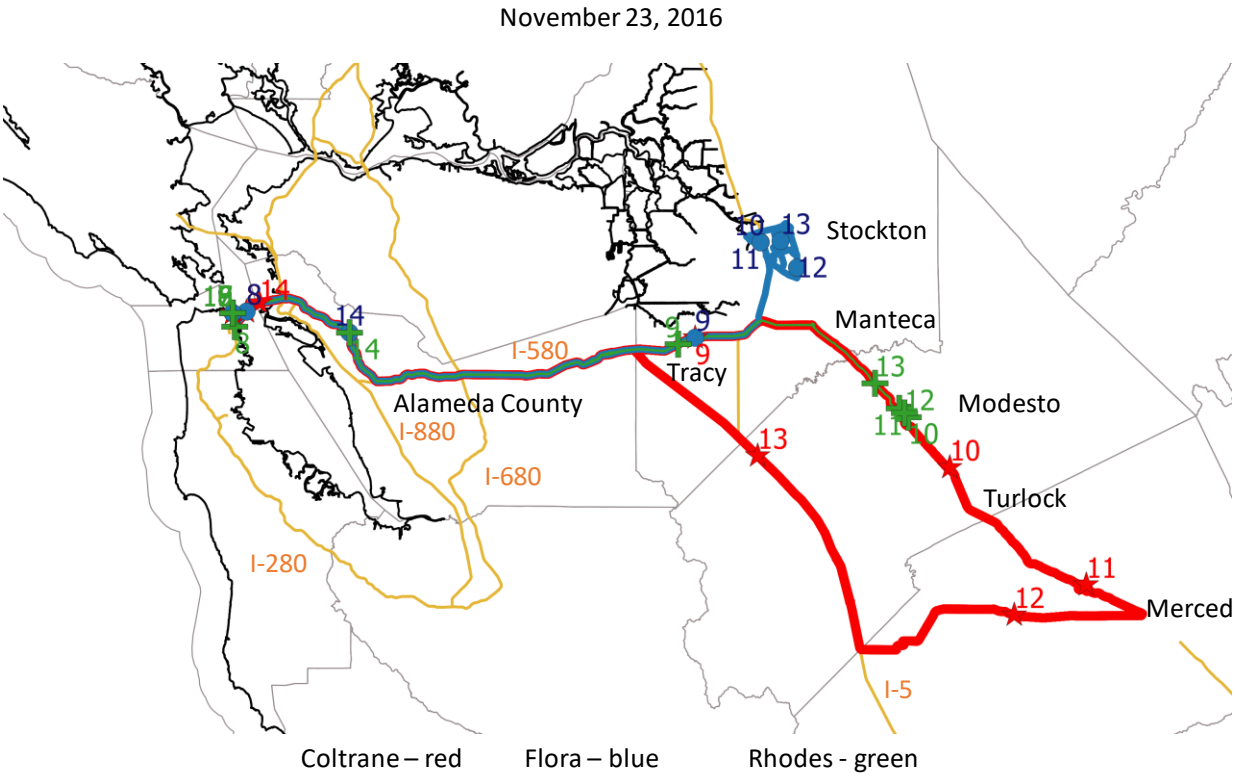


Figure S15. San Joaquin Valley driving routes on November 23, 2016. The positions of each car at the beginning of each hour are marked. The drives began and ended at the parking garage in San Francisco. Map generated with QGIS version 3.2.2 (https://qgis.org/en/site/) open-source software licensed under the GNU General Public License (http://www.gnu.org.licenses). California coastline and state highway shapefiles obtained from the OpenStreetMap community (www.openstreetmap.org) and MapCruzin (www.mapcruzin.com), licensed under the Creative Commons Attribution Share-Alike 2.0 license. U.S. highways and California county boundary shapefiles obtained from U.S. Bureau of the Census TIGER/Line shapefiles public data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html).

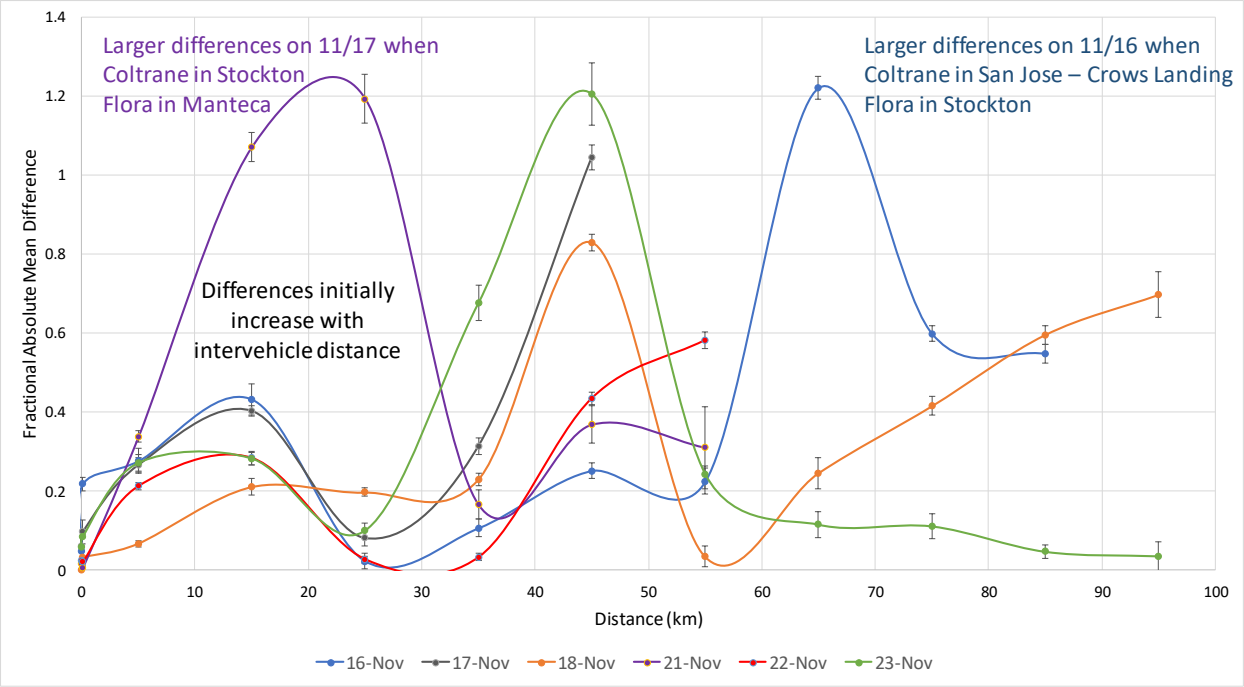


Figure S16. FAMD of NO_2 measurements versus distance between vehicles on six sampling days in the San Joaquin Valley.

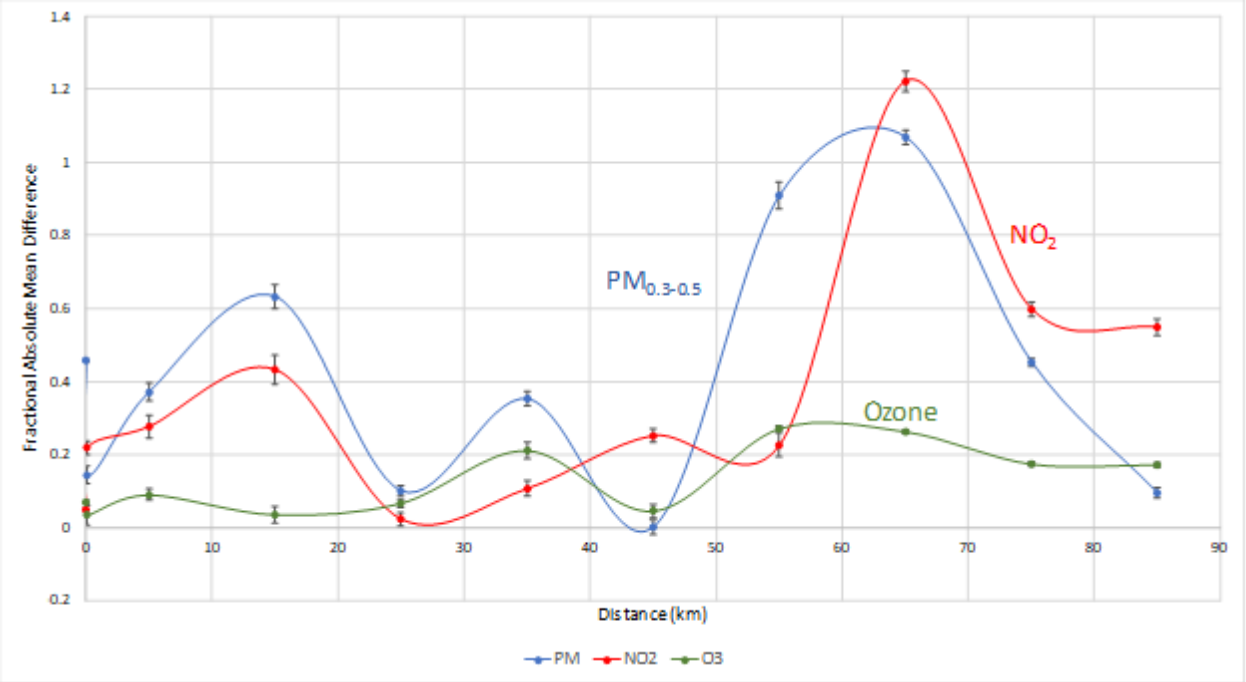


Figure S17. Fractional absolute mean differences (FAMD) for NO_2, O_3, and particle number (0.3 – 0.5 μm) versus distance between mobile platforms (Coltrane and Flora) during sampling in the San Joaquin Valley on Nov 16, 2016.

Table S1. Mean NO_2 concentrations and differences when vehicle pairs sampled different areas within the northern San Joaquin Valley. Vehicles A and B correspond to the first and second areas sampled, respectively. Sample sizes differ for the two vehicles. Mean concentrations were determined from all available data for each vehicle. Mean and fractional mean differences were determined from paired 1-s measurements reported by both vehicles. Uncertainties are one standard error.

Date	Areas Sampled	Car[1] A–B	N[2]	Mean NO_2 Vehicle A (ppbv)[3]	Mean NO_2 Vehicle B (ppbv)[3]	Mean NO_2 Difference (ppbv)[3]	Fractional Mean Difference
Nov 16	Stockton – Rural	F–C	6724	11.3 ± 0.09	8.3 ± 0.2	2.9 ± 0.2	0.30 ± 0.02
Nov 16	Stockton – Tracy	F–R	8753	11.3 ± 0.09	7.1 ± 0.1	4.2 ± 0.1	0.46 ± 0.02
Nov 17	Stockton – Manteca	C–F	10982	6.9 ± 0.06	8.0 ± 0.09	-1.2 ± 0.1	-0.16 ± 0.01
Nov 17	Stockton – Stockton	C–R	10457	6.9 ± 0.06	6.8 ± 0.06	0.05 ± 0.08	0.007 ± 0.01
Nov 17	Stockton – Manteca	R–F	11168	6.8 ± 0.06	8.0 ± 0.09	-1.3 ± 0.1	-0.18 ± 0.01
Nov 18	East – West SJV	F–C	7826	11.0 ± 0.2	13.8 ± 0.2	-3.7 ± 0.2	-0.30 ± 0.02
Nov 18	East – West SJV	R–C	7220	12.8 ± 0.1	13.8 ± 0.2	-3.1 ± 0.1	-0.23 ± 0.02
Nov 21	East – West SJV	F–R	8554	5.8 ± 0.07	7.6 ± 0.08	-2.0 ± 0.1	-0.30 ± 0.02
Nov 21	East – West SJV	C–R	7914	10.6 ± 0.1	7.6 ± 0.08	2.7 ± 0.2	0.30 ± 0.02
Nov 22	Stockton – Modesto	F–C	9368	16.1 ± 0.1	9.9 ± 0.1	6.1 ± 0.1	0.49 ± 0.01
Nov 22	Stockton – Modesto	F–R	9063	16.1 ± 0.1	7.7 ± 0.06	8.3 ± 0.1	0.70 ± 0.01
Nov 23	Stockton – Modesto	F–R	11638	12.3 ± 0.1	12.8 ± 0.09	-1.1 ± 0.1	-0.09 ± 0.01
Nov 23	Stockton – Highway	F–C	9898	12.3 ± 0.1	13.9 ± 0.1	-1.2 ± 0.1	-0.09 ± 0.01

[1] C = Coltrane, F = Flora, R = Rhodes

[2] Number of paired samples

[3] Vehicle means determined from all measurements made by the vehicle; mean difference determined from paired measurements made by both vehicles

Table S2. Mean NO concentrations and differences when vehicle pairs sampled different areas within the northern San Joaquin Valley. Vehicles A and B correspond to the first and second areas sampled, respectively. Sample sizes differ for the two vehicles. Mean concentrations were determined from all available data for each vehicle. Mean and fractional mean differences were determined from paired 1-s measurements reported by both vehicles. Uncertainties are one standard error.

Date	Areas Sampled	Car[1] A–B	N[2]	Mean NO Vehicle A (ppbv)[3]	Mean NO Vehicle B (ppbv)[3]	Mean NO Difference (ppbv)[3]	Fractional Mean Difference
Nov 16	Stockton – Rural	F–C	6783	20.0 ± 0.5	23.5 ± 1.0	-3.7 ± 1.2	-0.30 ± 0.02
Nov 16	Stockton – Tracy	F–R	8470	20.0 ± 0.5	NA	NA	NA
Nov 17	Stockton – Manteca	C–F	10152	26.8 ± 0.5	14.4 ± 0.3	12.6 ± 0.6	0.61 ± 0.03
Nov 17	Stockton – Stockton	C–R	10990	26.8 ± 0.5	NA	NA	NA
Nov 17	Stockton – Manteca	R–F	10815	NA	14.4 ± 0.3	NA	NA
Nov 18	East – West SJV	F–C	7621	13.0 ± 0.3	25.0 ± 0.7	-11.7 ± 0.8	-0.61 ± 0.05
Nov 18	East – West SJV	R–C	8262	NA	25.0 ± 0.7	NA	NA
Nov 21	East – West SJV	F–R	8144	8.6 ± 0.3	NA	NA	NA
Nov 21	East – West SJV	C–R	8298	23.7 ± 0.6	NA	NA	NA
Nov 22	Stockton – Modesto	F–C	8632	23.4 ± 0.4	16.3 ± 0.4	7.1 ± 0.7	0.36 ± 0.03
Nov 22	Stockton – Modesto	F–R	9143	23.4 ± 0.4	NA	NA	NA
Nov 23	Stockton – Modesto	F–R	11959	25.5 ± 0.5	NA	NA	NA
Nov 23	Stockton – Highway	F–C	10820	25.5 ± 0.5	16.9 ± 0.4	8.4 ± 0.7	0.40 ± 0.03

[1] C = Coltrane, F = Flora, R = Rhodes

[2] Number of paired samples if two vehicles made measurements; single vehicle count otherwise

[3] Vehicle means determined from all measurements made by the vehicle; mean difference determined from paired measurements made by both vehicles

Table S3. Mean O_3 concentrations and differences when vehicle pairs sampled different areas within the northern San Joaquin Valley. Vehicles A and B correspond to the first and second areas sampled, respectively. Sample sizes differ for the two vehicles. Mean concentrations were determined from all available data for each vehicle. Mean and fractional mean differences were determined from paired 1-s measurements reported by both vehicles. Uncertainties are one standard error.

Date	Areas Sampled	Car[1] A–B	N[2]	Mean O_3 Vehicle A (ppbv)[3]	Mean O_3 Vehicle B (ppbv)[3]	Mean O_3 Difference (ppbv)[3]	Fractional Mean Difference
Nov 16	Stockton – Rural	F–C	3034	33.1 ± 0.08	40.6 ± 0.1	-8.8 ± 0.1	-0.24 ± 0.004
Nov 16	Stockton – Tracy	F–R	4276	33.1 ± 0.08	NA	NA	NA
Nov 17	Stockton – Manteca	C–F	3795	25.7 ± 0.09	26.5 ± 0.08	-0.3 ± 0.1	0.01 ± 0.004
Nov 17	Stockton – Stockton	C–R	5866	25.7 ± 0.09	NA	NA	NA
Nov 17	Stockton – Manteca	R–F	5820	NA	26.5 ± 0.08	NA	NA
Nov 18	East – West SJV	F–C	3957	40.8 ± 0.09	NA	NA	NA
Nov 18	East – West SJV	R–C	0	NA	NA	NA	NA
Nov 21	East – West SJV	F–R	3782	31.6 ± 0.06	NA	NA	NA
Nov 21	East – West SJV	C–R	4520	28.4 ± 0.09	NA	NA	NA
Nov 22	Stockton – Modesto	F–C	1020	17.8 ± 0.1	26.0 ± 0.08	-9.3 ± 0.2	-0.42 ± 0.01
Nov 22	Stockton – Modesto	F–R	2339	17.8 ± 0.1	NA	NA	NA
Nov 23	Stockton – Modesto	F–R	1370	36.6 ± 0.08	NA	NA	NA
Nov 23	Stockton – Highway	F–C	665	36.6 ± 0.08	33.0 ± 0.08	8.4 ± 0.7	0.18 ± 0.006

[1] C = Coltrane, F = Flora, R = Rhodes

[2] Number of paired samples if two vehicles made measurements; single vehicle count otherwise

[3] Vehicle means determined from all measurements made by the vehicle; mean difference determined from paired measurements made by both vehicles

Table S4. Mean $PM_{0.3-0.5}$ number counts and differences when vehicle pairs sampled different areas within the northern San Joaquin Valley. Vehicles A and B correspond to the first and second areas sampled, respectively. Sample sizes differ for the two vehicles. Mean concentrations were determined from all available data for each vehicle. Mean and fractional mean differences were determined from paired 1-s measurements reported by both vehicles. Uncertainties are one standard error.

Date	Areas Sampled	Car[1] A–B	N[2]	Mean PM Vehicle A $(L^{-1})^3$	Mean PM Vehicle B $(L^{-1})^3$	Mean PM Difference $(L^{-1})^3$	Fractional Mean Difference
Nov 16	Stockton – Rural	F–C	9026	9708 ± 80	3413 ± 18	6310 ± 84	0.96 ± 0.01
Nov 16	Stockton – Tracy	F–R	8981	9708 ± 80	8405 ± 87	1283 ± 120	0.14 ± 0.01
Nov 17	Stockton – Manteca	C–F	11483	23676 ± 62	23276 ± 91	427 ± 98	0.02 ± 0.004
Nov 17	Stockton – Stockton	C–R	11282	23676 ± 62	26340 ± 74	-2665 ± 72	0.11 ± 0.003
Nov 17	Stockton – Manteca	R–F	11506	26340 ± 74	23276 ± 91	3070 ± 106	0.12 ± 0.004
Nov 18	East – West SJV	F–C	8791	86607 ± 99	68678 ± 303	17775 ± 317	0.23 ± 0.004
Nov 18	East – West SJV	R–C	8499	81074 ± 207	68678 ± 303	10511 ± 313	0.14 ± 0.004
Nov 21	East – West SJV	F–R	8832	15457 ± 118	17691 ± 104	-2125 ± 129	-0.13 ± 0.008
Nov 21	East – West SJV	C–R	8603	21982 ± 128	17691 ± 104	4552 ± 126	0.23 ± 0.006
Nov 22	Stockton – Modesto	F–C	9635	46883 ± 203	42176 ± 168	4512 ± 230	0.10 ± 0.005
Nov 22	Stockton – Modesto	F–R	9563	46883 ± 203	52864 ± 168	-5788 ± 300	-0.12 ± 0.006
Nov 23	Stockton – Modesto	F–R	12642	6675 ± 114	13070 ± 77	-6384 ± 144	-0.65 ± 0.02
Nov 23	Stockton – Highway	F–C	12621	6675 ± 114	11954 ± 71	-5267 ± 140	-0.57 ± 0.02

[1] C = Coltrane, F = Flora, R = Rhodes

[2] Number of paired samples

[3] Vehicle means determined from all measurements made by the vehicle; mean difference determined from paired measurements made by both vehicles