**Supplementary Information for:**
# Contributions to local and regional-scale formaldehyde concentrations

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Notes on units of gas-phase mixing ratios: 1 ppb = 1 nmol/mol; 1 ppt = 1 pmol/mol.

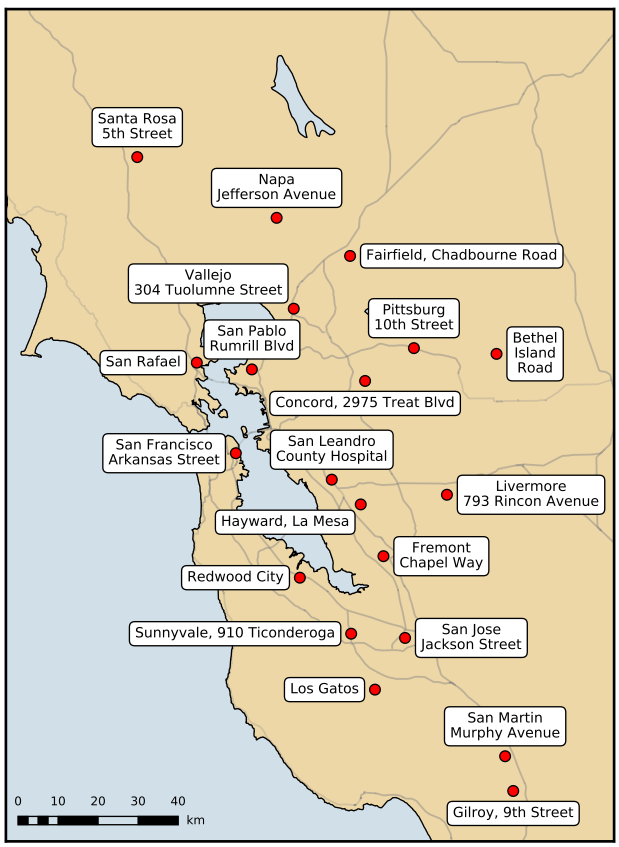


Figure S1: Measurement sites used for the evaluation of the forward model. Sites include ambient air monitoring locations from the air basin- and state-wide regulatory agencies.

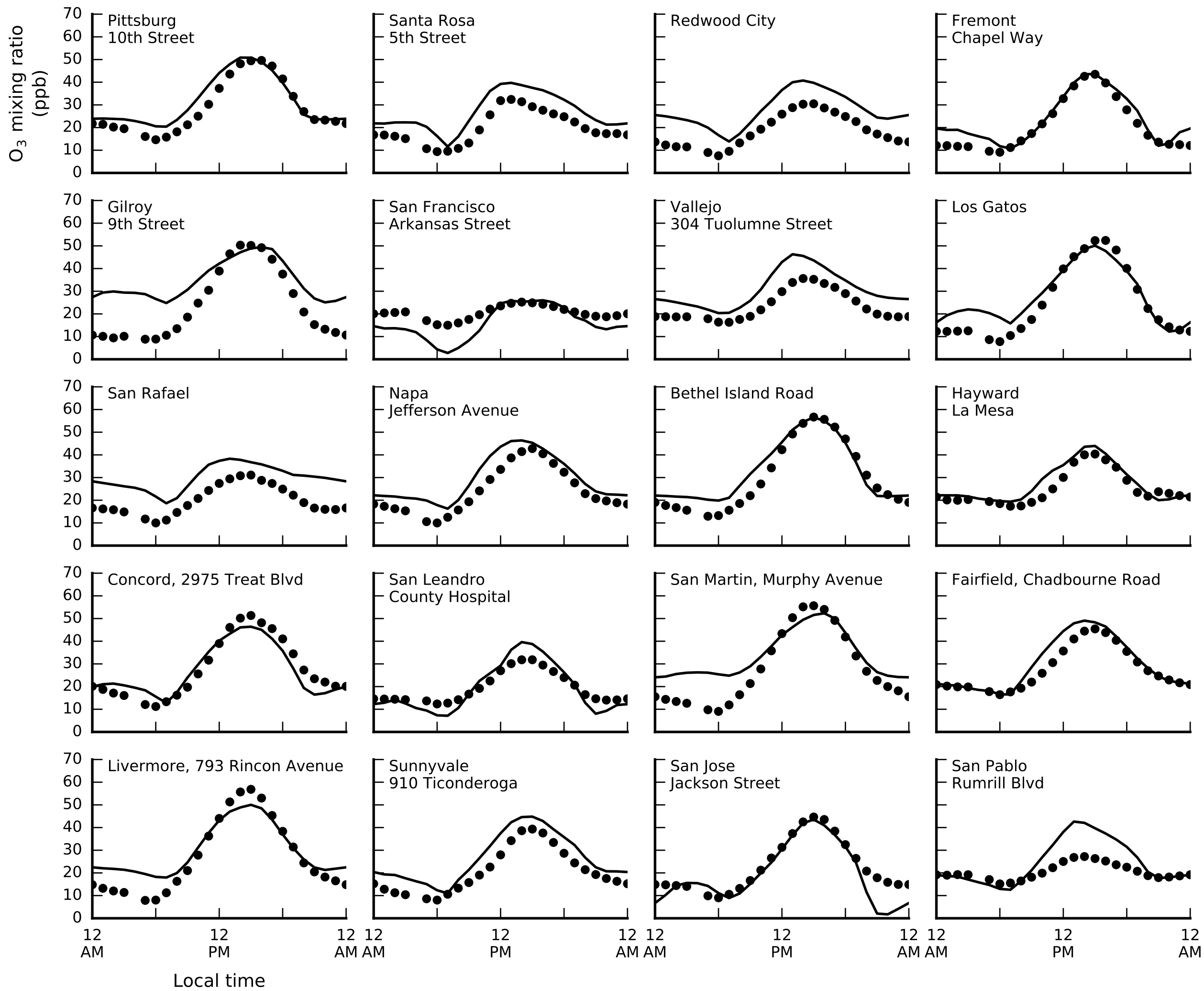


Figure S2: Observed (filled circles) and modeled (solid line) average hourly ozone mixing ratios at twenty different monitoring sites in July. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

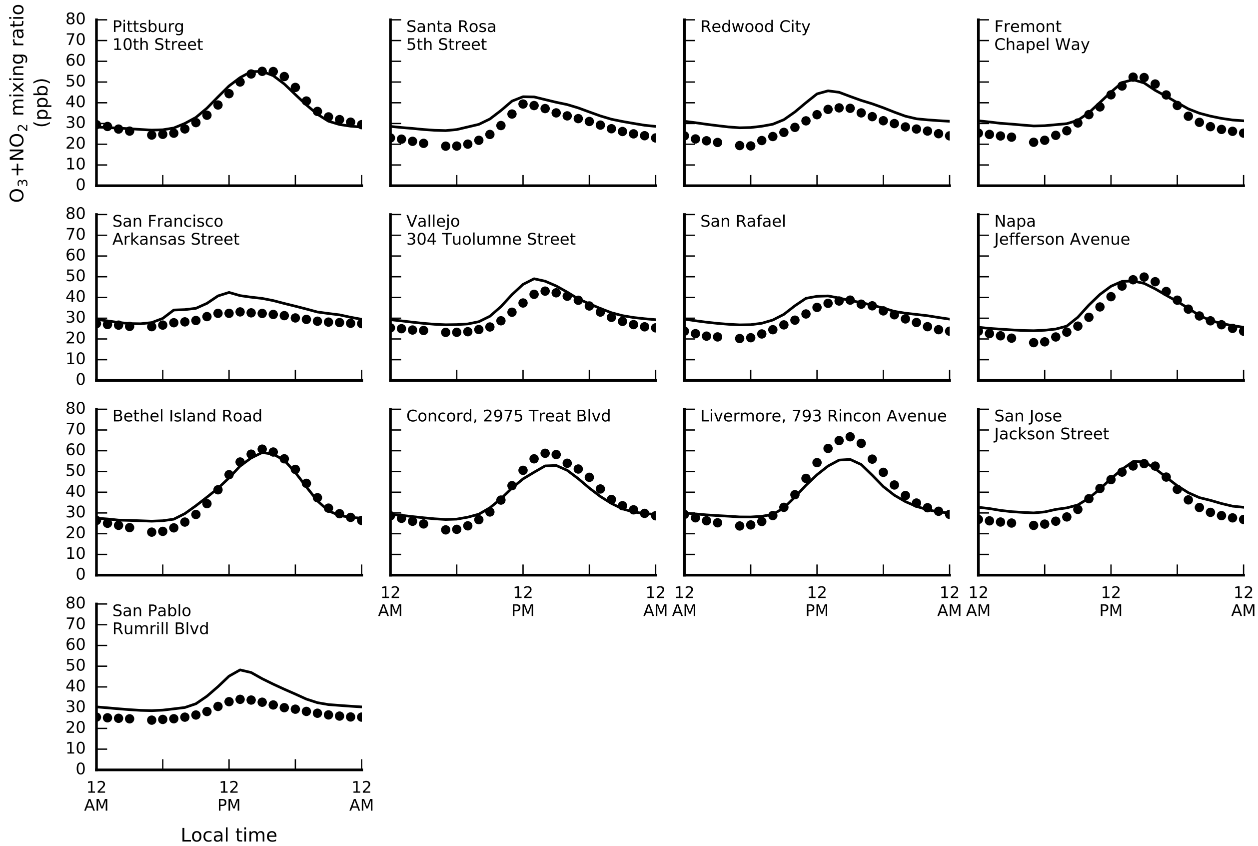


Figure S3: Observed (filled circles) and modeled (solid line) average hourly $O_3 + NO_2$ mixing ratios at thirteen different monitoring sites in July. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

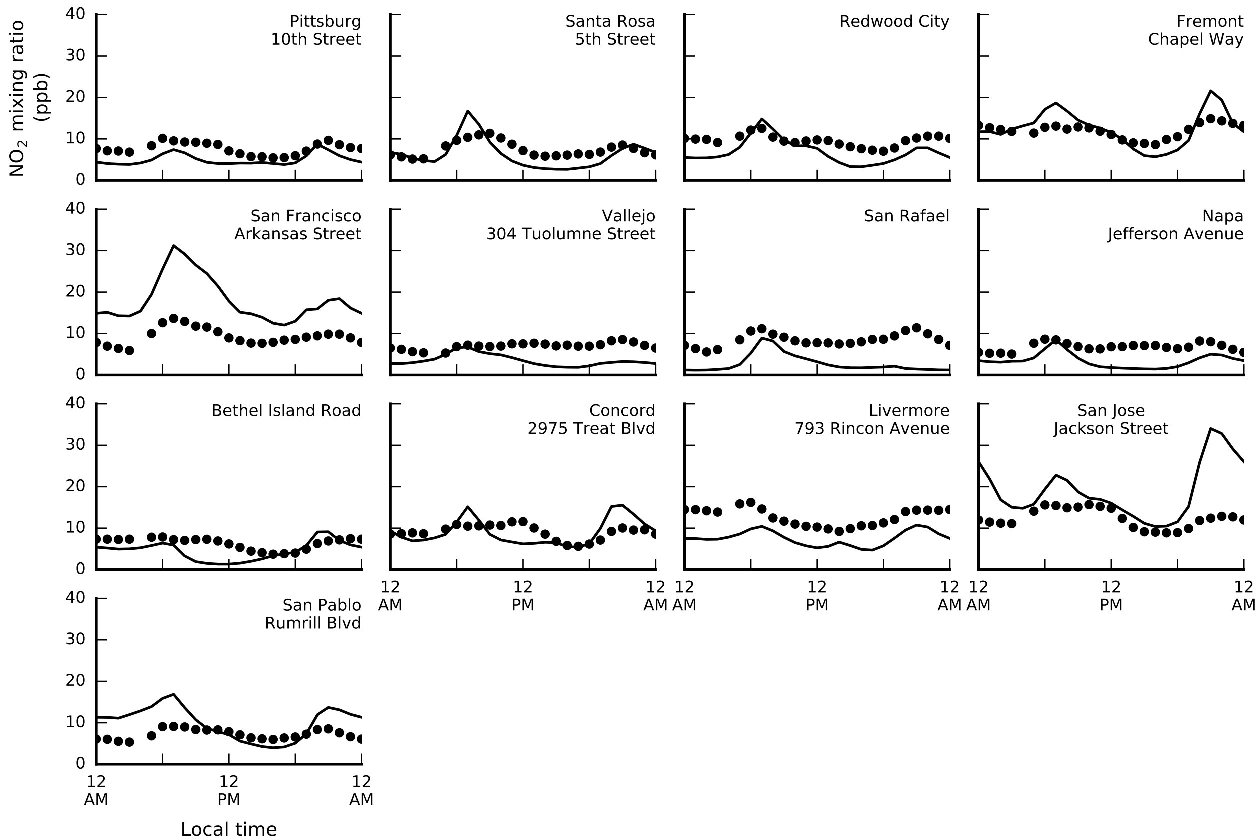


Figure S4: Observed (filled circles) and modeled (solid line) average hourly $NO_2$ mixing ratios at thirteen different monitoring sites in July. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

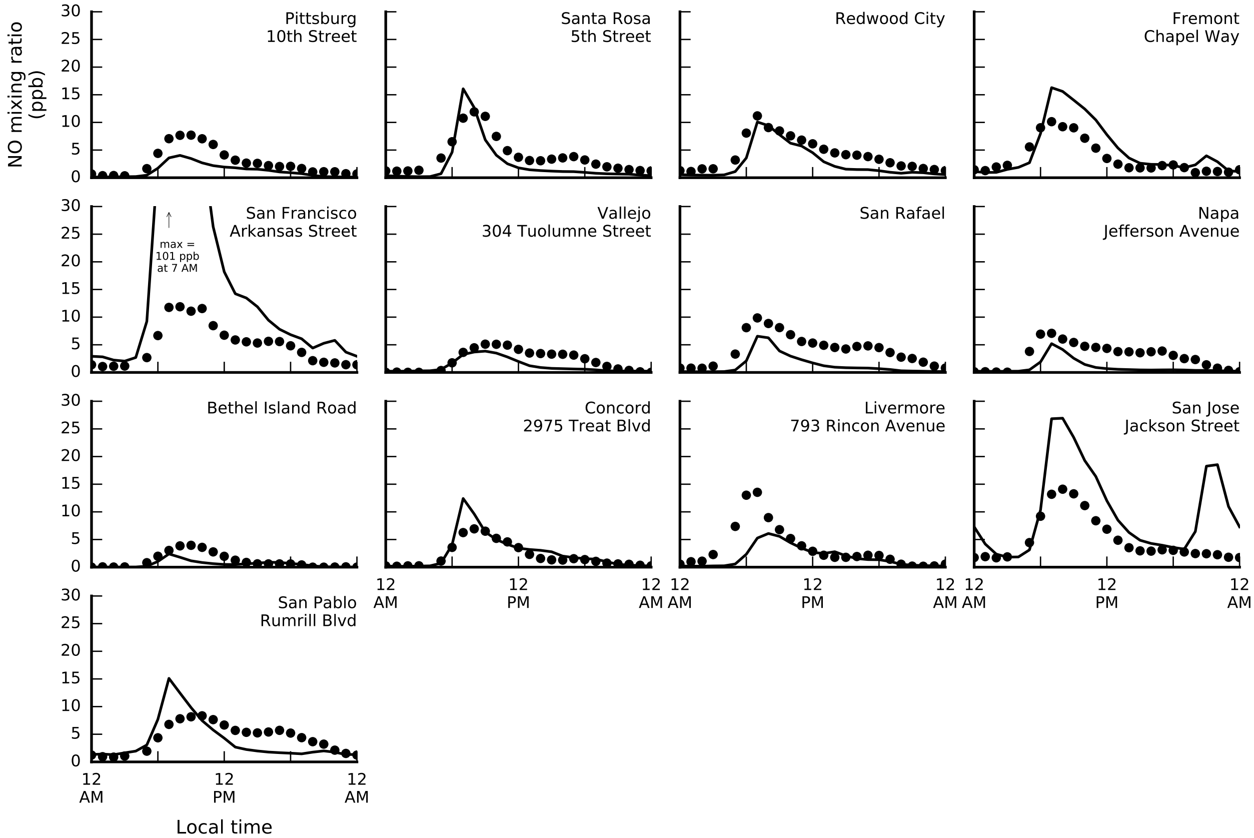


Figure S5: Observed (filled circles) and modeled (solid line) average hourly NO mixing ratios at thirteen different monitoring sites in July. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

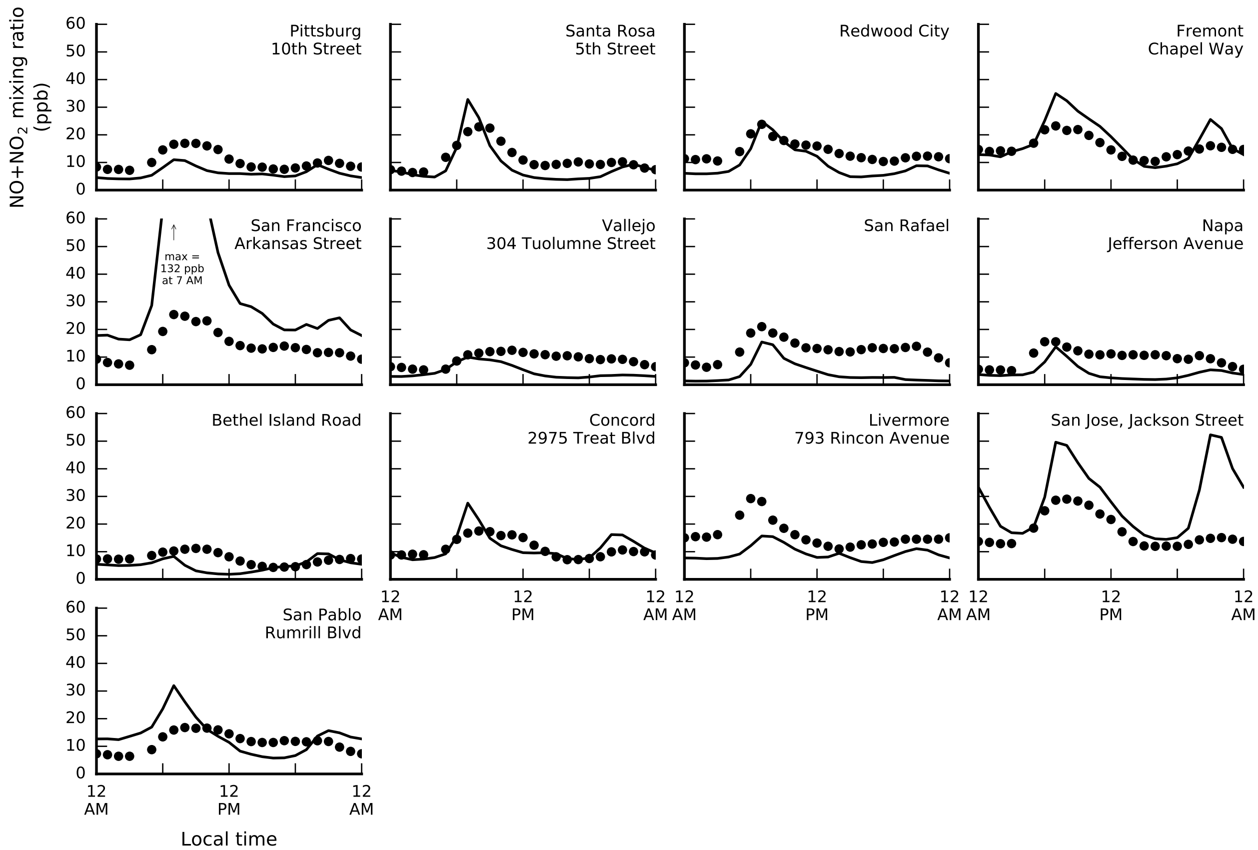


Figure S6: Observed (filled circles) and modeled (solid line) average hourly $NO + NO_2$ mixing ratios at thirteen different monitoring sites in July. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

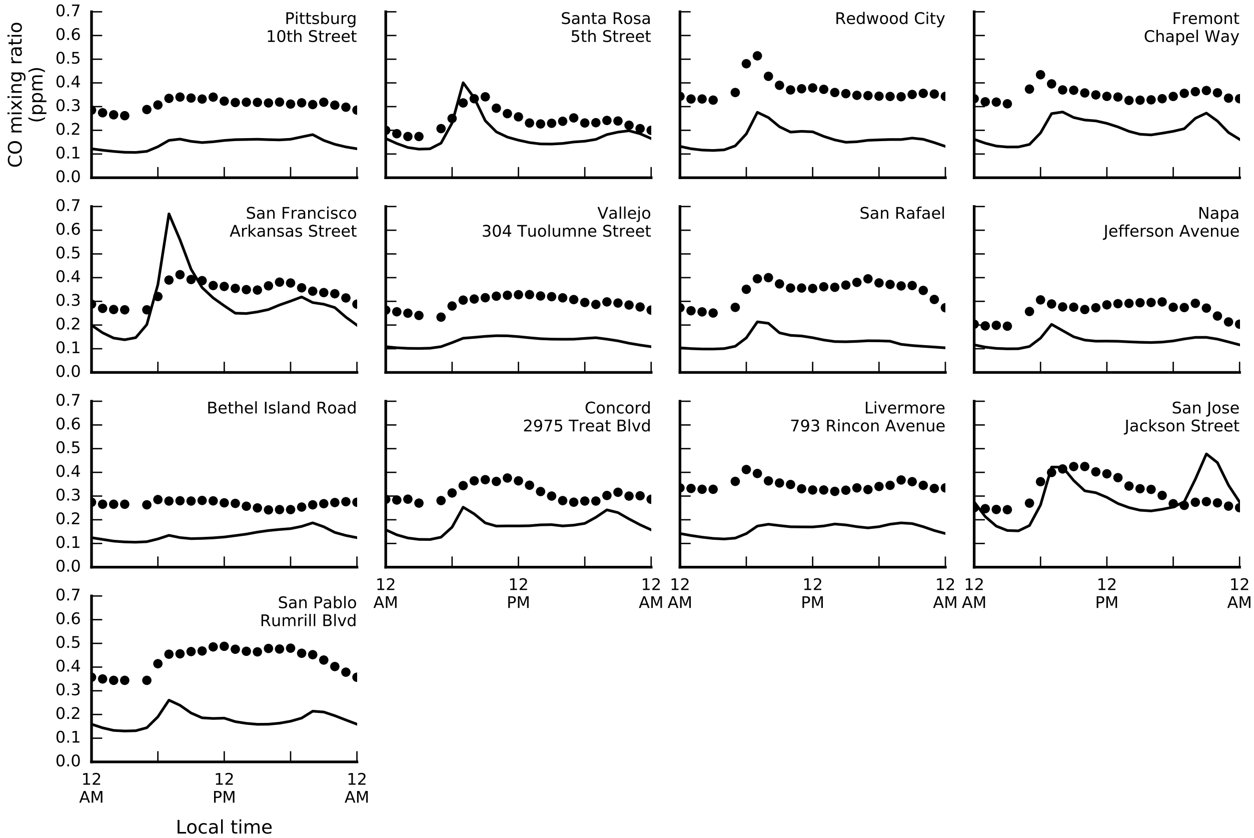


Figure S7: Observed (filled circles) and modeled (solid line) average hourly CO mixing ratios at thirteen different monitoring sites in July. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

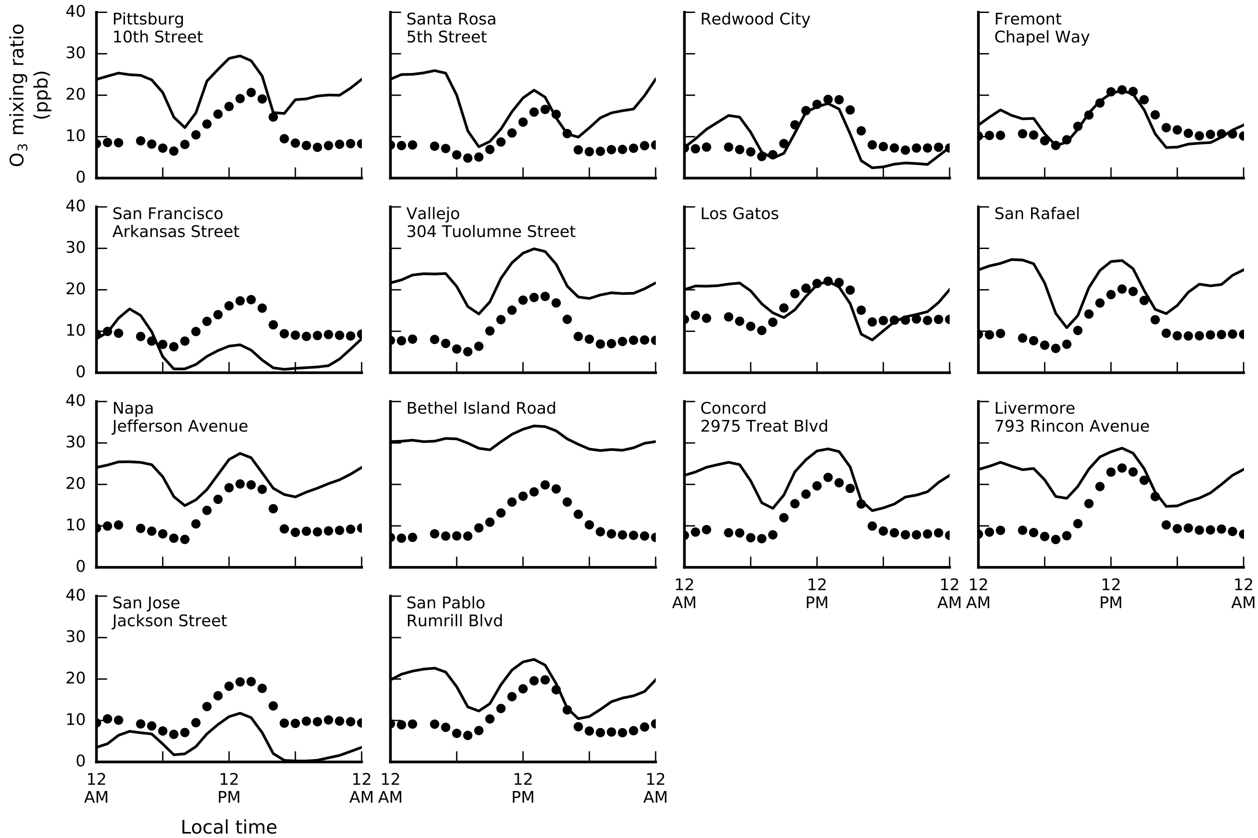


Figure S8: Observed (filled circles) and modeled (solid line) average hourly ozone mixing ratios at fourteen different monitoring sites in December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

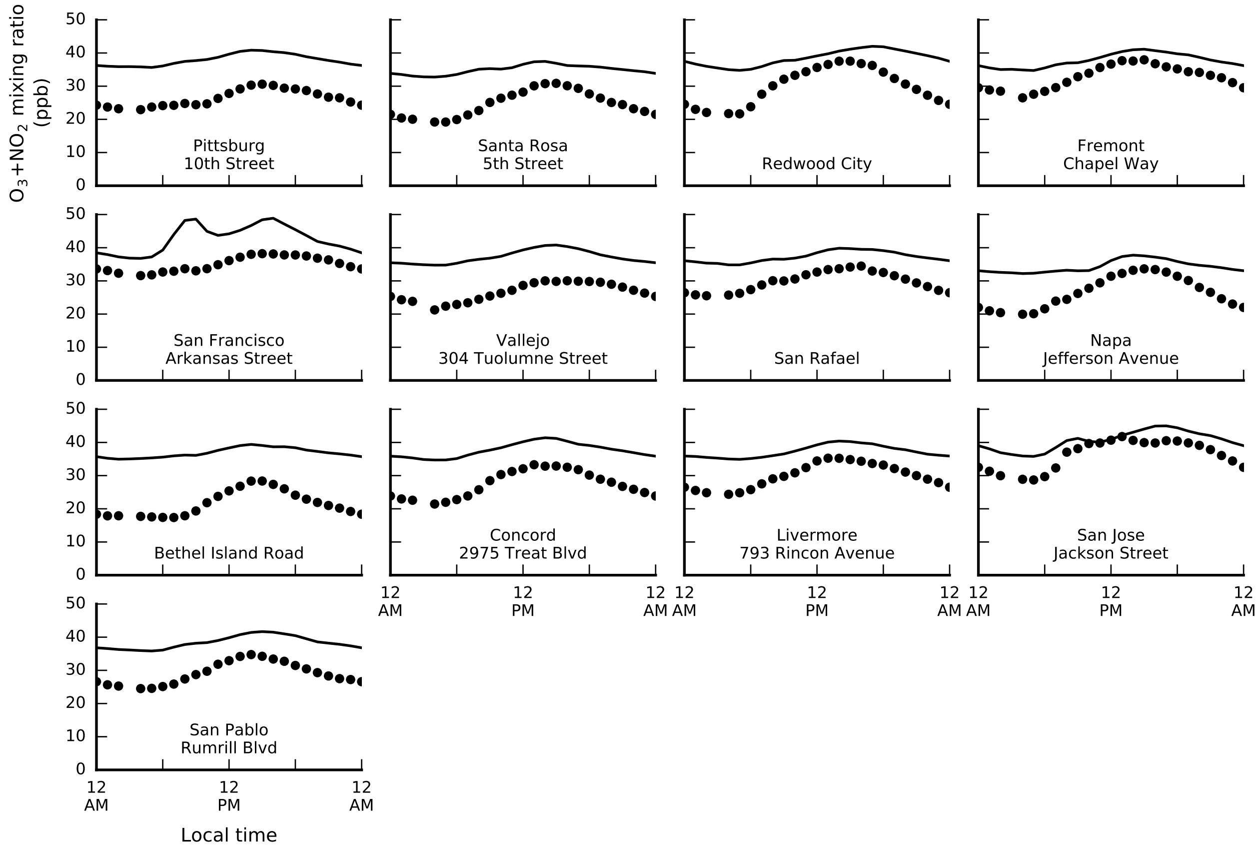


Figure S9: Observed (filled circles) and modeled (solid line) average hourly $O_3 + NO_2$ mixing ratios at thirteen different monitoring sites in December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

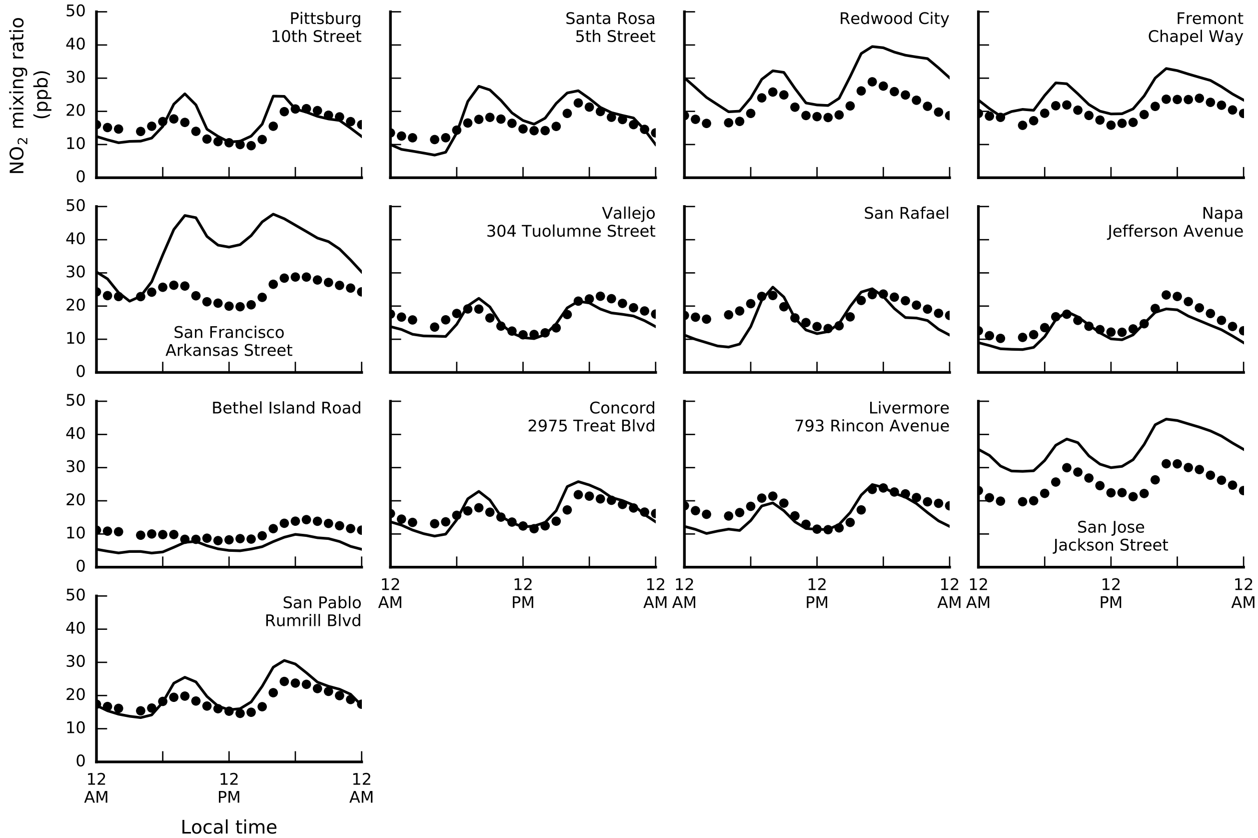


Figure S10: Observed (filled circles) and modeled (solid line) average hourly $NO_2$ mixing ratios at thirteen different monitoring sites in December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

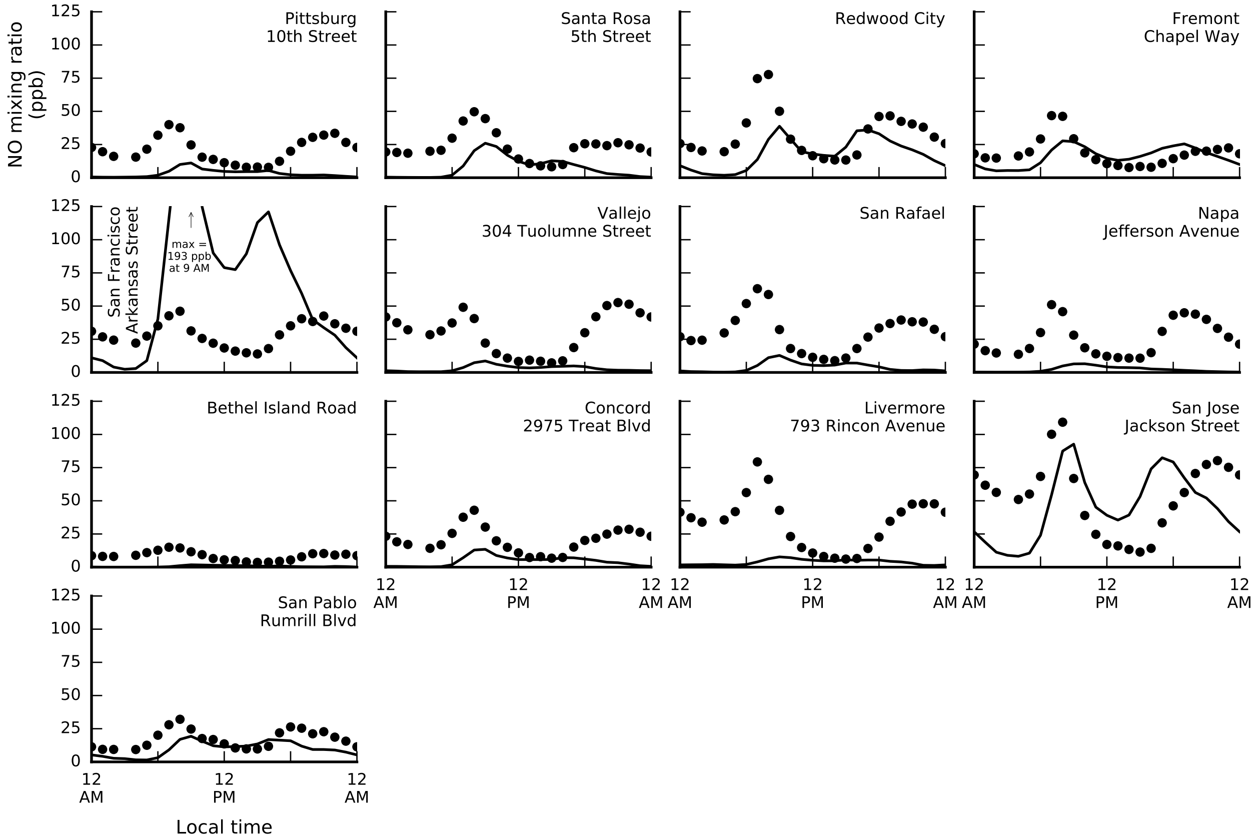


Figure S11: Observed (filled circles) and modeled (solid line) average hourly NO mixing ratios at thirteen different monitoring sites in December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

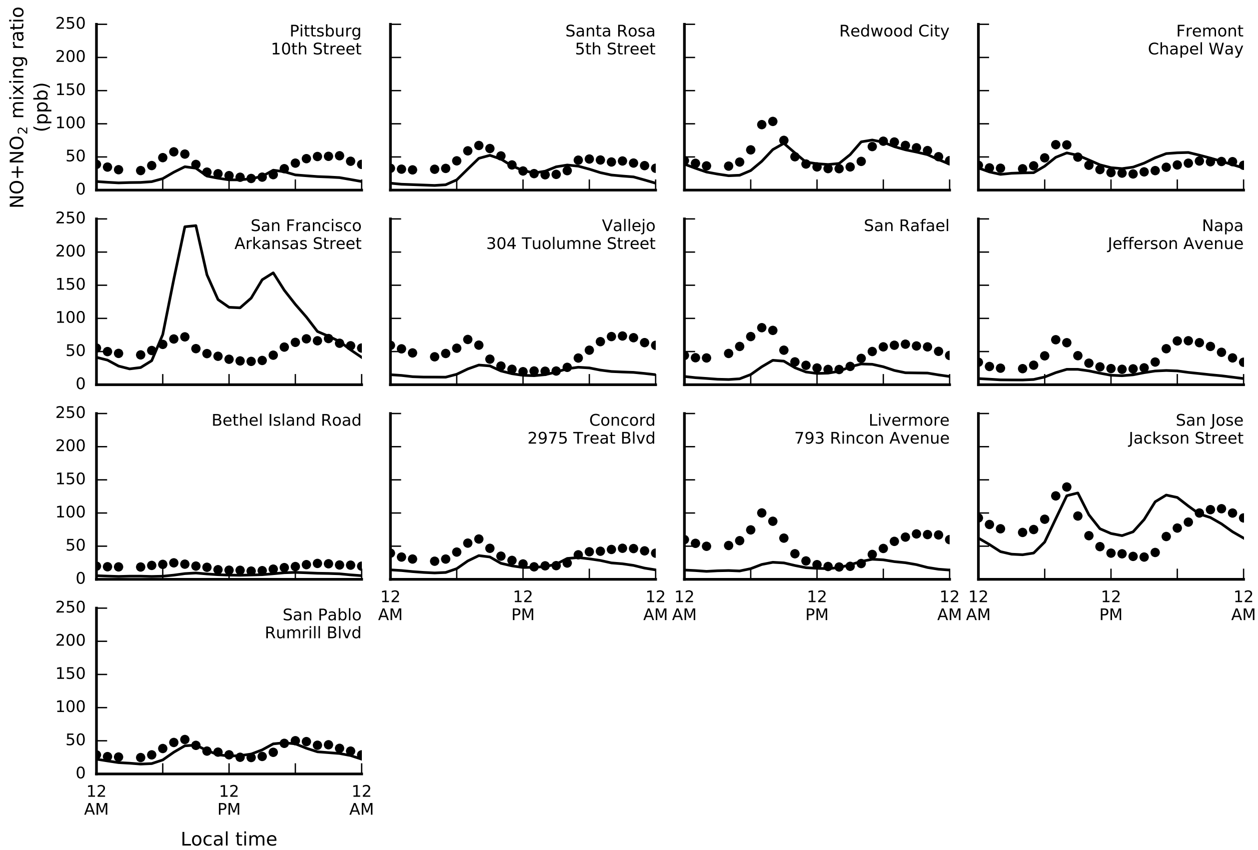


Figure S12: Observed (filled circles) and modeled (solid line) average hourly $NO + NO_2$ mixing ratios at thirteen different monitoring sites in December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

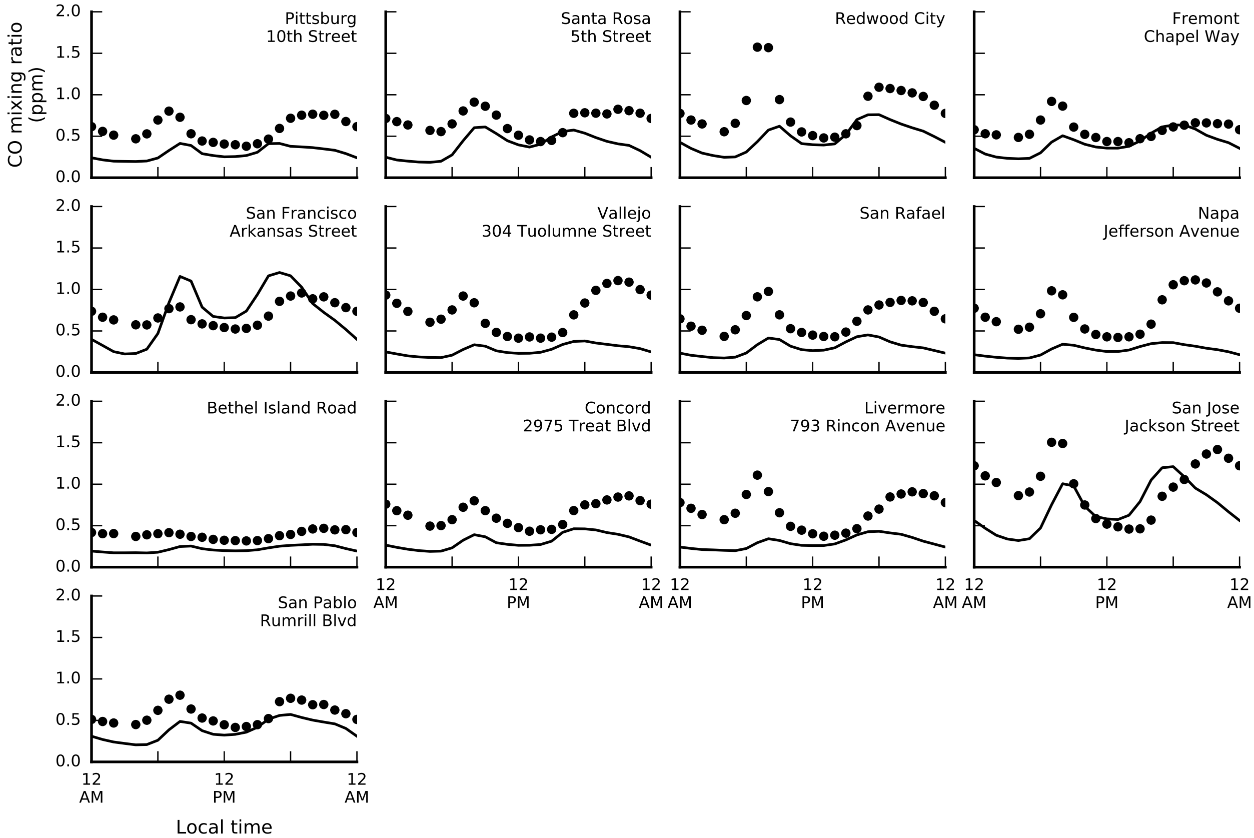


Figure S13: Observed (filled circles) and modeled (solid line) average hourly CO mixing ratios at thirteen different monitoring sites in December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. At each hour, the value is averaged over all the days included in the data set. The locations of the measuring sites are shown on Figure S1.

Table S1: Summary of the comparison between modeled and observed average daily profiles. In each case, the table indicates the average, minimum, and maximum of the mean bias and root mean square error (RMSE) calculated for each of the locations where observations are available. All values are in ppb except for CO (ppm).

| | July | | December | |
|---|---|---|---|---|
| | Mean bias | RMSE | Mean bias | RMSE |
| $O_3$ | 3.8 [−4.4 ; 10.5] | 6.4 [3.5 ; 12.7] | 6.1 [−6.9 ; 19.6] | 9.4 [2.8 ; 19.8] |
| $O_3 + NO_2$ | 3.1 [−2.3 ; 7.0] | 4.7 [2.3 ; 7.6] | 8.9 [4.3 ; 15.4] | 9.2 [4.9 ; 15.6] |
| $NO_2$ | −0.5 [−5.7 ; 8.8] | 4.6 [2.7 ; 9.5] | 2.4 [−4.2 ; 13.5] | 5.7 [2.8 ; 15.1] |
| NO | 0.7 [−2.8 ; 15.0] | 4.6 [1.1 ; 27.5] | −11.8 [−29.7 ; 38.9] | 25.8 [8.5 ; 67.6] |
| $NO + NO_2$ | 0.2 [−8.4 ; 23.8] | 8.6 [3.7 ; 35.5] | −9.5 [−31.8 ; 52.3] | 27.7 [8.8 ; 80.9] |
| CO | −0.14 [−0.25 ; −0.02] | 0.15 [0.07 ; 0.25] | −0.28 [−0.46 ; 0.01] | 0.35 [0.18 ; 0.51] |

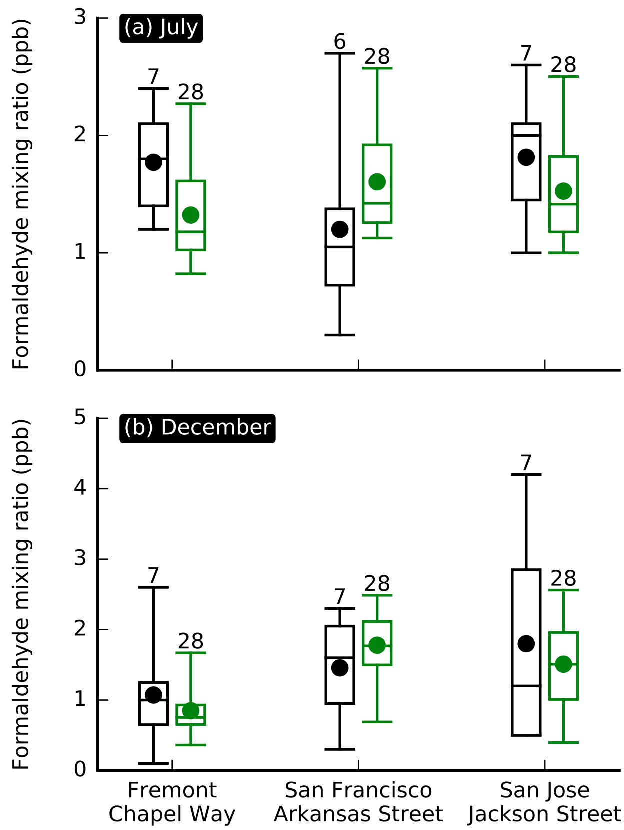


Figure S14: Observed (black, left) and modeled (green, right) 24-hour average formaldehyde mixing ratios at three different monitoring sites in (a) July and (b) December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. Each box-and-whiskers plot represents, for the corresponding data set, the mean (dot), the median (central horizontal line), the first and third quartiles (bottom and top edges of the box), the minimum and maximum values (bottom and top whiskers), and the number of available data points (top number). The locations of the measuring sites are shown on Figure S1.

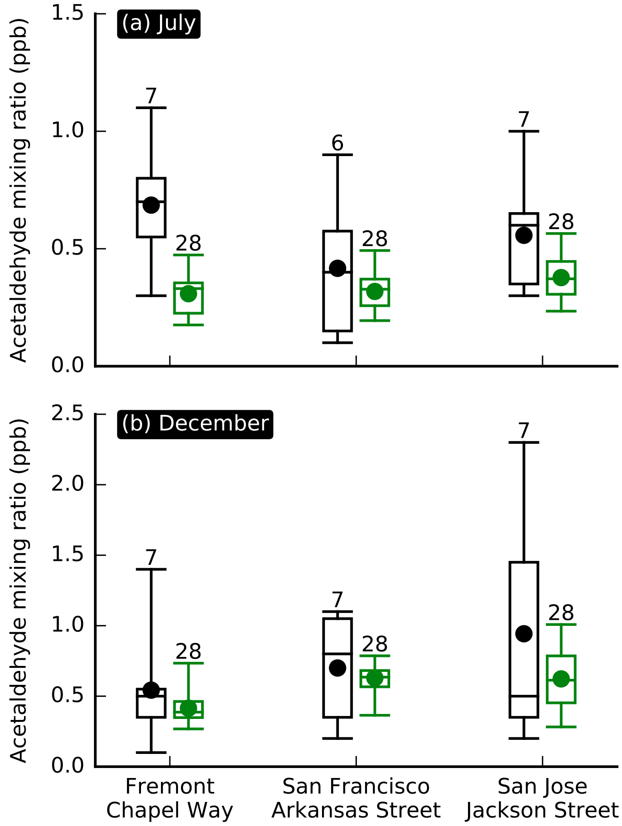


Figure S15: Observed (black, left) and modeled (green, right) 24-hour average acetaldehyde mixing ratios at three different monitoring sites in (a) July and (b) December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. Each box-and-whiskers plot represents, for the corresponding data set, the mean (dot), the median (central horizontal line), the first and third quartiles (bottom and top edges of the box), the minimum and maximum values (bottom and top whiskers), and the number of available data points (top number). The locations of the measuring sites are shown on Figure S1.

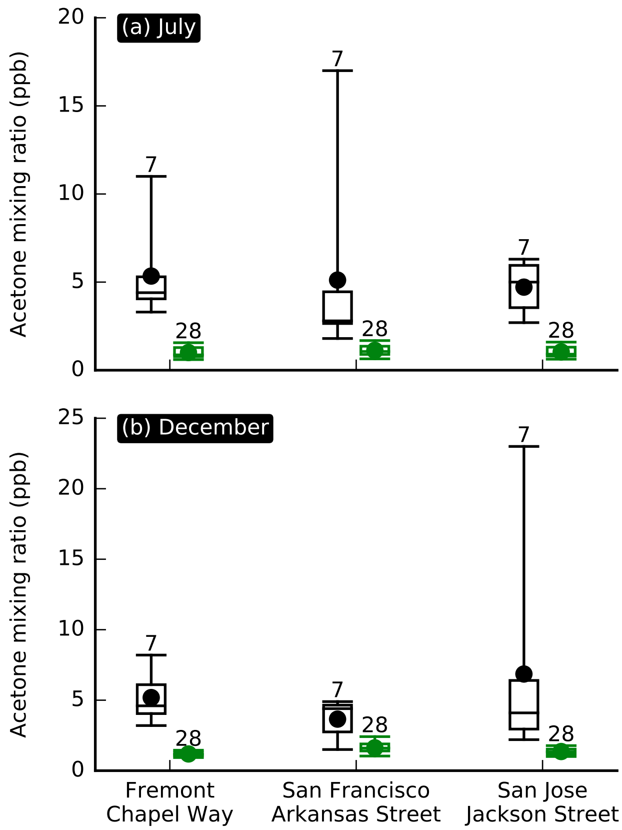


Figure S16: Observed (black, left) and modeled (green, right) 24-hour average acetone mixing ratios at three different monitoring sites in (a) July and (b) December. Observed values combine data from years 2004, 2005, and 2006, by selecting, in each of these years, the days of the year that correspond to the month-long simulation period. Each box-and-whiskers plot represents, for the corresponding data set, the mean (dot), the median (central horizontal line), the first and third quartiles (bottom and top edges of the box), the minimum and maximum values (bottom and top whiskers), and the number of available data points (top number). The locations of the measuring sites are shown on Figure S1.

Table S2: Average surface mixing ratios in the air basin-wide receptor area for each model species, separately for the July and December simulation periods. Surface mixing ratios are mixing ratios in the bottom model layer. Mixing ratios are averaged over the duration of the corresponding simulation period and over the extent of the receptor area. See Carter (2000, Appendix A, Table A-1) for a description of model species.

| Model Species | July Simulation | December Simulation |
|---|---|---|
| NO2 | 3.8 ppb | 10 ppb |
| NO | 1.3 ppb | 4.0 ppb |
| O3P | $2.7 \times 10^{-04}$ ppt | $1.0 \times 10^{-04}$ ppt |
| O3 | 31 ppb | 27 ppb |
| NO3 | 0.66 ppt | 2.2 ppt |
| N2O5 | 6.0 ppt | 55 ppt |
| HNO3 | 510 ppt | 460 ppt |
| O1D2 | $6.1 \times 10^{-10}$ ppt | $4.1 \times 10^{-11}$ ppt |
| HO | 0.13 ppt | 0.010 ppt |
| HONO | 14 ppt | 5.6 ppt |
| HO2 | 5.7 ppt | 0.82 ppt |
| CO | 130 ppb | 240 ppb |
| HNO4 | 4.6 ppt | 10 ppt |
| HO2H | 1.7 ppb | 230 ppt |
| SO2 | 370 ppt | 370 ppt |
| SULF | 340 ppt | 290 ppt |
| C_O2 | 1.8 ppt | 0.43 ppt |
| HCHO | 1.3 ppb | 550 ppt |
| COOH | 53 ppt | 4.8 ppt |
| MEOH | 8.1 ppb | 510 ppt |
| RO2_R | 4.2 ppt | 2.8 ppt |
| ROOH | 100 ppt | 38 ppt |
| R2O2 | 5.2 ppt | 6.1 ppt |
| RO2_N | 1.6 ppt | 1.9 ppt |
| RNO3 | 78 ppt | 82 ppt |
| MEK | 210 ppt | 470 ppt |
| PROD2 | 150 ppt | 430 ppt |
| CCO_O2 | 0.30 ppt | 0.020 ppt |
| PAN | 180 ppt | 170 ppt |
| CCO_OOH | 24 ppt | 0.95 ppt |
| CCO_OH | 25 ppt | 9.7 ppt |
| RCO_O2 | 0.079 ppt | $2.9 \times 10^{-03}$ ppt |
| PAN2 | 44 ppt | 18 ppt |
| CCHO | 220 ppt | 320 ppt |
| RCO_OOH | 10 ppt | 0.19 ppt |
| RCO_OH | 21 ppt | 21 ppt |

| Model Species | July Simulation | December Simulation |
|---|---|---|
| BZCO_O2 | $7.1 \times 10^{-04}$ ppt | $4.1 \times 10^{-05}$ ppt |
| PBZN | 0.73 ppt | 0.46 ppt |
| BZ_O | $4.9 \times 10^{-04}$ ppt | $4.3 \times 10^{-04}$ ppt |
| MA_RCO3 | 0.037 ppt | $6.7 \times 10^{-04}$ ppt |
| MA_PAN | 21 ppt | 5.5 ppt |
| TBU_O | $9.9 \times 10^{-07}$ ppt | $5.2 \times 10^{-07}$ ppt |
| ACET | 1000 ppt | 1.1 ppb |
| NPHE | 5.1 ppt | 7.3 ppt |
| PHEN | 0.83 ppt | 26 ppt |
| BZNO2_O | $2.3 \times 10^{-18}$ ppt | $2.9 \times 10^{-17}$ ppt |
| HOCOO | $1.2 \times 10^{-04}$ ppt | $1.6 \times 10^{-05}$ ppt |
| HCOOH | 14 ppt | 12 ppt |
| RCHO | 160 ppt | 170 ppt |
| GLY | 11 ppt | 15 ppt |
| MGLY | 35 ppt | 25 ppt |
| BACL | 2.1 ppt | 3.5 ppt |
| CRES | 4.8 ppt | 5.9 ppt |
| BALD | 4.3 ppt | 8.3 ppt |
| METHACRO | 150 ppt | 37 ppt |
| MVK | 220 ppt | 44 ppt |
| ISOPROD | 46 ppt | 26 ppt |
| DCB1 | 13 ppt | 30 ppt |
| DCB2 | 0.92 ppt | 1.7 ppt |
| DCB3 | 0.38 ppt | 0.94 ppt |
| ETHENE | 240 ppt | 750 ppt |
| ISOPRENE | 220 ppt | 160 ppt |
| TERP | 75 ppt | 83 ppt |
| ALK1 | 1.1 ppb | 2.3 ppb |
| ALK2 | 360 ppt | 910 ppt |
| ALK3 | 620 ppt | 1.8 ppb |
| ALK4 | 550 ppt | 1.7 ppb |
| ALK5 | 730 ppt | 1.9 ppb |
| ARO1 | 250 ppt | 710 ppt |
| ARO2 | 170 ppt | 810 ppt |
| OLE1 | 88 ppt | 270 ppt |
| OLE2 | 77 ppt | 220 ppt |

Table S3: Average surface mixing ratios in the Pittsburg/Antioch receptor area for each model species, separately for the July and December simulation periods. Surface mixing ratios are mixing ratios in the bottom model layer. Mixing ratios are averaged over the duration of the corresponding simulation period and over the extent of the receptor area. See Carter (2000, Appendix A, Table A-1) for a description of model species.

| Model Species | July Simulation | December Simulation |
|---|---|---|
| NO2 | 5.1 ppb | 11 ppb |
| NO | 1.0 ppb | 1.9 ppb |
| O3P | $3.0 \times 10^{-04}$ ppt | $8.4 \times 10^{-05}$ ppt |
| O3 | 32 ppb | 26 ppb |
| NO3 | 0.71 ppt | 1.1 ppt |
| N2O5 | 5.6 ppt | 46 ppt |
| HNO3 | 660 ppt | 510 ppt |
| O1D2 | $6.8 \times 10^{-10}$ ppt | $3.8 \times 10^{-11}$ ppt |
| HO | 0.17 ppt | $9.1 \times 10^{-03}$ ppt |
| HONO | 18 ppt | 3.8 ppt |
| HO2 | 4.7 ppt | 0.42 ppt |
| CO | 140 ppb | 250 ppb |
| HNO4 | 5.5 ppt | 9.0 ppt |
| HO2H | 1.7 ppb | 220 ppt |
| SO2 | 360 ppt | 350 ppt |
| SULF | 320 ppt | 310 ppt |
| C_O2 | 1.2 ppt | 0.099 ppt |
| HCHO | 1.5 ppb | 520 ppt |
| COOH | 61 ppt | 5.0 ppt |
| MEOH | 8.3 ppb | 520 ppt |
| RO2_R | 1.5 ppt | 0.21 ppt |
| ROOH | 96 ppt | 29 ppt |
| R2O2 | 0.98 ppt | 0.18 ppt |
| RO2_N | 0.31 ppt | 0.045 ppt |
| RNO3 | 110 ppt | 63 ppt |
| MEK | 240 ppt | 470 ppt |
| PROD2 | 150 ppt | 420 ppt |
| CCO_O2 | 0.20 ppt | $8.6 \times 10^{-03}$ ppt |
| PAN | 200 ppt | 180 ppt |
| CCO_OOH | 32 ppt | 1.0 ppt |
| CCO_OH | 33 ppt | 9.2 ppt |
| RCO_O2 | 0.074 ppt | $1.2 \times 10^{-03}$ ppt |
| PAN2 | 67 ppt | 17 ppt |
| CCHO | 280 ppt | 310 ppt |
| RCO_OOH | 14 ppt | 0.19 ppt |
| RCO_OH | 27 ppt | 18 ppt |

| Model Species | July Simulation | December Simulation |
|---|---|---|
| BZCO_O2 | $8.4 \times 10^{-04}$ ppt | $2.6 \times 10^{-05}$ ppt |
| PBZN | 1.2 ppt | 0.50 ppt |
| BZ_O | $4.6 \times 10^{-04}$ ppt | $6.5 \times 10^{-04}$ ppt |
| MA_RCO3 | 0.014 ppt | $2.0 \times 10^{-04}$ ppt |
| MA_PAN | 25 ppt | 5.0 ppt |
| TBU_O | $1.2 \times 10^{-06}$ ppt | $6.1 \times 10^{-07}$ ppt |
| ACET | 1.0 ppb | 1.1 ppb |
| NPHE | 8.3 ppt | 13 ppt |
| PHEN | 1.5 ppt | 68 ppt |
| BZNO2_O | $2.5 \times 10^{-18}$ ppt | $3.7 \times 10^{-17}$ ppt |
| HOCOO | $9.5 \times 10^{-05}$ ppt | $1.0 \times 10^{-05}$ ppt |
| HCOOH | 19 ppt | 10 ppt |
| RCHO | 210 ppt | 180 ppt |
| GLY | 13 ppt | 13 ppt |
| MGLY | 40 ppt | 25 ppt |
| BACL | 2.7 ppt | 3.5 ppt |
| CRES | 5.4 ppt | 5.9 ppt |
| BALD | 5.7 ppt | 8.4 ppt |
| METHACRO | 140 ppt | 32 ppt |
| MVK | 200 ppt | 38 ppt |
| ISOPROD | 57 ppt | 18 ppt |
| DCB1 | 15 ppt | 31 ppt |
| DCB2 | 1.2 ppt | 1.8 ppt |
| DCB3 | 0.54 ppt | 1.1 ppt |
| ETHENE | 280 ppt | 670 ppt |
| ISOPRENE | 140 ppt | 36 ppt |
| TERP | 83 ppt | 20 ppt |
| ALK1 | 1.2 ppb | 2.4 ppb |
| ALK2 | 590 ppt | 1.2 ppb |
| ALK3 | 810 ppt | 1.8 ppb |
| ALK4 | 830 ppt | 2.0 ppb |
| ALK5 | 970 ppt | 2.0 ppb |
| ARO1 | 300 ppt | 690 ppt |
| ARO2 | 210 ppt | 1.2 ppb |
| OLE1 | 110 ppt | 240 ppt |
| OLE2 | 86 ppt | 190 ppt |

Table S4: Average surface mixing ratios in the San Jose receptor area for each model species, separately for the July and December simulation periods. Surface mixing ratios are mixing ratios in the bottom model layer. Mixing ratios are averaged over the duration of the corresponding simulation period and over the extent of the receptor area. See Carter (2000, Appendix A, Table A-1) for a description of model species.

| Model Species | July Simulation | December Simulation |
|---|---|---|
| NO2 | 14 ppb | 32 ppb |
| NO | 5.4 ppb | 31 ppb |
| O3P | $6.0 \times 10^{-04}$ ppt | $2.7 \times 10^{-04}$ ppt |
| O3 | 24 ppb | 7.7 ppb |
| NO3 | 0.32 ppt | 0.15 ppt |
| N2O5 | 7.5 ppt | 12 ppt |
| HNO3 | 880 ppt | 670 ppt |
| O1D2 | $5.4 \times 10^{-10}$ ppt | $1.9 \times 10^{-11}$ ppt |
| HO | 0.075 ppt | $3.4 \times 10^{-03}$ ppt |
| HONO | 34 ppt | 23 ppt |
| HO2 | 0.82 ppt | 0.068 ppt |
| CO | 230 ppb | 610 ppb |
| HNO4 | 4.3 ppt | 3.1 ppt |
| HO2H | 1.6 ppb | 210 ppt |
| SO2 | 490 ppt | 740 ppt |
| SULF | 360 ppt | 270 ppt |
| C_O2 | 0.17 ppt | 0.014 ppt |
| HCHO | 1.5 ppb | 1.3 ppb |
| COOH | 47 ppt | 5.9 ppt |
| MEOH | 7.3 ppb | 720 ppt |
| RO2_R | 0.33 ppt | 0.042 ppt |
| ROOH | 76 ppt | 49 ppt |
| R2O2 | 0.19 ppt | 0.050 ppt |
| RO2_N | 0.061 ppt | 0.015 ppt |
| RNO3 | 130 ppt | 140 ppt |
| MEK | 250 ppt | 530 ppt |
| PROD2 | 180 ppt | 440 ppt |
| CCO_O2 | 0.033 ppt | $1.6 \times 10^{-03}$ ppt |
| PAN | 190 ppt | 150 ppt |
| CCO_OOH | 23 ppt | 1.1 ppt |
| CCO_OH | 28 ppt | 19 ppt |
| RCO_O2 | 0.011 ppt | $2.1 \times 10^{-04}$ ppt |
| PAN2 | 54 ppt | 21 ppt |
| CCHO | 370 ppt | 570 ppt |
| RCO_OOH | 10 ppt | 0.24 ppt |
| RCO_OH | 30 ppt | 41 ppt |

| Model Species | July Simulation | December Simulation |
|---|---|---|
| BZCO_O2 | $1.6 \times 10^{-04}$ ppt | $3.7 \times 10^{-06}$ ppt |
| PBZN | 1.1 ppt | 0.61 ppt |
| BZ_O | $1.4 \times 10^{-04}$ ppt | $3.6 \times 10^{-05}$ ppt |
| MA_RCO3 | $2.2 \times 10^{-03}$ ppt | $4.9 \times 10^{-05}$ ppt |
| MA_PAN | 20 ppt | 6.2 ppt |
| TBU_O | $1.5 \times 10^{-06}$ ppt | $5.4 \times 10^{-07}$ ppt |
| ACET | 1.0 ppb | 1.3 ppb |
| NPHE | 8.7 ppt | 11 ppt |
| PHEN | 1.7 ppt | 86 ppt |
| BZNO2_O | $7.9 \times 10^{-19}$ ppt | $1.2 \times 10^{-18}$ ppt |
| HOCOO | $2.0 \times 10^{-05}$ ppt | $1.7 \times 10^{-06}$ ppt |
| HCOOH | 19 ppt | 22 ppt |
| RCHO | 260 ppt | 380 ppt |
| GLY | 20 ppt | 31 ppt |
| MGLY | 45 ppt | 42 ppt |
| BACL | 3.5 ppt | 5.2 ppt |
| CRES | 11 ppt | 15 ppt |
| BALD | 9.2 ppt | 16 ppt |
| METHACRO | 110 ppt | 39 ppt |
| MVK | 170 ppt | 47 ppt |
| ISOPROD | 49 ppt | 40 ppt |
| DCB1 | 26 ppt | 52 ppt |
| DCB2 | 1.9 ppt | 2.7 ppt |
| DCB3 | 0.84 ppt | 1.6 ppt |
| ETHENE | 790 ppt | 2.7 ppb |
| ISOPRENE | 190 ppt | 390 ppt |
| TERP | 87 ppt | 150 ppt |
| ALK1 | 1.1 ppb | 3.2 ppb |
| ALK2 | 670 ppt | 2.1 ppb |
| ALK3 | 1.9 ppb | 6.1 ppb |
| ALK4 | 1.7 ppb | 5.7 ppb |
| ALK5 | 2.2 ppb | 6.4 ppb |
| ARO1 | 810 ppt | 2.6 ppb |
| ARO2 | 550 ppt | 2.5 ppb |
| OLE1 | 360 ppt | 1.2 ppb |
| OLE2 | 310 ppt | 1.1 ppb |

Table S5: Average surface mixing ratios in the East Bay receptor area for each model species, separately for the July and December simulation periods. Surface mixing ratios are mixing ratios in the bottom model layer. Mixing ratios are averaged over the duration of the corresponding simulation period and over the extent of the receptor area. See Carter (2000, Appendix A, Table A-1) for a description of model species.

| Model Species | July Simulation | December Simulation |
|---|---|---|
| NO2 | 14 ppb | 27 ppb |
| NO | 8.2 ppb | 23 ppb |
| O3P | $6.6 \times 10^{-04}$ ppt | $2.1 \times 10^{-04}$ ppt |
| O3 | 21 ppb | 12 ppb |
| NO3 | 0.32 ppt | 0.27 ppt |
| N2O5 | 6.4 ppt | 21 ppt |
| HNO3 | 630 ppt | 490 ppt |
| O1D2 | $4.2 \times 10^{-10}$ ppt | $2.1 \times 10^{-11}$ ppt |
| HO | 0.055 ppt | $3.9 \times 10^{-03}$ ppt |
| HONO | 37 ppt | 13 ppt |
| HO2 | 0.46 ppt | 0.099 ppt |
| CO | 210 ppb | 420 ppb |
| HNO4 | 3.5 ppt | 4.8 ppt |
| HO2H | 1.6 ppb | 210 ppt |
| SO2 | 1.0 ppb | 1.1 ppb |
| SULF | 350 ppt | 280 ppt |
| C_O2 | 0.097 ppt | 0.021 ppt |
| HCHO | 1.3 ppb | 980 ppt |
| COOH | 35 ppt | 4.9 ppt |
| MEOH | 7.2 ppb | 590 ppt |
| RO2_R | 0.23 ppt | 0.068 ppt |
| ROOH | 68 ppt | 34 ppt |
| R2O2 | 0.21 ppt | 0.097 ppt |
| RO2_N | 0.064 ppt | 0.028 ppt |
| RNO3 | 89 ppt | 93 ppt |
| MEK | 210 ppt | 480 ppt |
| PROD2 | 160 ppt | 420 ppt |
| CCO_O2 | 0.015 ppt | $1.8 \times 10^{-03}$ ppt |
| PAN | 170 ppt | 170 ppt |
| CCO_OOH | 16 ppt | 0.97 ppt |
| CCO_OH | 20 ppt | 13 ppt |
| RCO_O2 | $4.2 \times 10^{-03}$ ppt | $2.3 \times 10^{-04}$ ppt |
| PAN2 | 36 ppt | 18 ppt |
| CCHO | 300 ppt | 440 ppt |
| RCO_OOH | 6.5 ppt | 0.18 ppt |
| RCO_OH | 21 ppt | 27 ppt |
| BZCO_O2 | $6.4 \times 10^{-05}$ ppt | $3.2 \times 10^{-06}$ ppt |
| PBZN | 0.68 ppt | 0.50 ppt |
| BZ_O | $8.9 \times 10^{-05}$ ppt | $5.1 \times 10^{-05}$ ppt |
| MA_RCO3 | $1.1 \times 10^{-03}$ ppt | $4.8 \times 10^{-05}$ ppt |
| MA_PAN | 18 ppt | 5.3 ppt |
| TBU_O | $1.3 \times 10^{-06}$ ppt | $4.4 \times 10^{-07}$ ppt |
| ACET | 990 ppt | 1.1 ppb |
| NPHE | 5.2 ppt | 9.9 ppt |
| PHEN | 1.6 ppt | 62 ppt |
| BZNO2_O | $6.2 \times 10^{-19}$ ppt | $2.7 \times 10^{-18}$ ppt |
| HOCOO | $1.3 \times 10^{-05}$ ppt | $2.7 \times 10^{-06}$ ppt |
| HCOOH | 14 ppt | 15 ppt |
| RCHO | 210 ppt | 260 ppt |
| GLY | 16 ppt | 21 ppt |
| MGLY | 39 ppt | 31 ppt |
| BACL | 3.1 ppt | 4.0 ppt |
| CRES | 10 ppt | 9.4 ppt |
| BALD | 7.6 ppt | 11 ppt |
| METHACRO | 130 ppt | 36 ppt |
| MVK | 190 ppt | 42 ppt |
| ISOPROD | 40 ppt | 25 ppt |
| DCB1 | 24 ppt | 36 ppt |
| DCB2 | 1.6 ppt | 2.1 ppt |
| DCB3 | 0.66 ppt | 1.2 ppt |
| ETHENE | 860 ppt | 2.0 ppb |
| ISOPRENE | 130 ppt | 240 ppt |
| TERP | 68 ppt | 120 ppt |
| ALK1 | 1.1 ppb | 2.6 ppb |
| ALK2 | 570 ppt | 1.5 ppb |
| ALK3 | 1.6 ppb | 3.8 ppb |
| ALK4 | 1.4 ppb | 3.5 ppb |
| ALK5 | 2.0 ppb | 4.2 ppb |
| ARO1 | 690 ppt | 1.5 ppb |
| ARO2 | 500 ppt | 1.7 ppb |
| OLE1 | 290 ppt | 710 ppt |
| OLE2 | 270 ppt | 660 ppt |

Table S6: Overall semi-normalized sensitivities (ppt) of formaldehyde model responses to emissions, by model species. Sensitivities are summed over the entire modeling domain and duration of the simulation period. Species are omitted if the corresponding sensitivities to emissions are negligible for all model responses. For each sensitivity $S^{\times}$, the number in parentheses is $S^{\times}/|S^{\times}_{\mathrm{tot}}|$ where $S^{\times}_{\mathrm{tot}}$ is the overall semi-normalized emissions sensitivity of the corresponding response, summed across all model species. See Carter (2000, Appendix A, Table A-1) for a description of model species.

| Model species | Sensitivity of the Air Basin response | | Sensitivity of the Pittsburg/Antioch response | | Sensitivity of the San Jose response | | Sensitivity of the East Bay response | |
|---|---|---|---|---|---|---|---|---|
| | July / | December | July / | December | July / | December | July / | December |
| NO2 | -3.3 (-1.1%) / | -2.4 (-0.39%) | -2.4 (-0.75%) / | -0.93 (-0.32%) | -6.4 (-1.4%) / | -4.6 (-0.44%) | -5.0 (-1.3%) / | -1.9 (-0.31%) |
| NO | -55 (-18%) / | -77 (-13%) | -36 (-12%) / | -28 (-9.7%) | -120 (-26%) / | -150 (-14%) | -87 (-23%) / | -60 (-10%) |
| CO | -0.91 (-0.30%) / | 0.0 (0.0%) | -1.7 (-0.54%) / | 0.0 (0.0%) | -0.78 (-0.17%) / | 0.0 (0.0%) | -0.84 (-0.22%) / | 0.0 (0.0%) |
| HCHO | 170 (54%) / | 540 (88%) | 86 (27%) / | 250 (85%) | 270 (58%) / | 920 (90%) | 280 (75%) / | 540 (90%) |
| MEOH | 0.0 (0.0%) / | 0.0 (0.0%) | 0.39 (0.12%) / | 0.0 (0.0%) | 0.47 (0.10%) / | 0.0 (0.0%) | 0.0 (0.0%) / | 0.0 (0.0%) |
| CCHO | 1.7 (0.56%) / | 0.92 (0.15%) | 1.9 (0.61%) / | 0.0 (0.0%) | 2.8 (0.62%) / | 2.2 (0.21%) | 2.5 (0.65%) / | 0.64 (0.11%) |
| ACET | 0.0 (0.0%) / | 0.0 (0.0%) | 0.34 (0.11%) / | 0.0 (0.0%) | 0.51 (0.11%) / | 0.0 (0.0%) | 0.0 (0.0%) / | 0.0 (0.0%) |
| RCHO | 0.0 (0.0%) / | 0.0 (0.0%) | 0.39 (0.12%) / | 0.0 (0.0%) | 0.54 (0.12%) / | 0.0 (0.0%) | 0.0 (0.0%) / | 0.0 (0.0%) |
| ETHENE | 34 (11%) / | 20 (3.4%) | 41 (13%) / | 10 (3.6%) | 54 (12%) / | 36 (3.5%) | 44 (12%) / | 16 (2.7%) |
| ISOPRENE | 72 (23%) / | 29 (4.8%) | 120 (37%) / | 10 (3.6%) | 100 (22%) / | 45 (4.4%) | 44 (11%) / | 23 (3.8%) |
| TERP | 14 (4.7%) / | 12 (1.9%) | 17 (5.3%) / | 3.8 (1.3%) | 21 (4.6%) / | 19 (1.8%) | 12 (3.1%) / | 9.6 (1.6%) |
| ALK1 | 0.50 (0.16%) / | 0.0 (0.0%) | 1.0 (0.32%) / | 0.0 (0.0%) | 0.99 (0.22%) / | 0.0 (0.0%) | 0.0 (0.0%) / | 0.0 (0.0%) |
| ALK2 | 0.61 (0.20%) / | 0.0 (0.0%) | 0.80 (0.25%) / | 0.0 (0.0%) | 1.5 (0.33%) / | 0.0 (0.0%) | 0.0 (0.0%) / | 0.0 (0.0%) |
| ALK3 | 5.2 (1.7%) / | 1.2 (0.20%) | 8.3 (2.6%) / | 0.59 (0.20%) | 9.3 (2.0%) / | 2.3 (0.22%) | 4.4 (1.2%) / | 0.97 (0.16%) |
| ALK4 | 3.9 (1.3%) / | 0.0 (0.0%) | 7.4 (2.4%) / | 0.0 (0.0%) | 7.7 (1.7%) / | 0.0 (0.0%) | 2.4 (0.63%) / | 0.0 (0.0%) |
| ALK5 | 3.3 (1.1%) / | -1.7 (-0.28%) | 7.9 (2.5%) / | -0.69 (-0.24%) | 8.7 (1.9%) / | -3.1 (-0.30%) | 0.0 (0.0%) / | -1.3 (-0.21%) |
| ARO1 | 3.1 (1.0%) / | 1.0 (0.17%) | 4.3 (1.4%) / | 0.0 (0.0%) | 6.2 (1.4%) / | 2.3 (0.23%) | 2.7 (0.72%) / | 0.65 (0.11%) |
| ARO2 | 9.9 (3.2%) / | 8.5 (1.4%) | 12 (3.8%) / | 3.1 (1.1%) | 17 (3.8%) / | 18 (1.7%) | 11 (3.0%) / | 6.1 (1.0%) |
| OLE1 | 18 (5.9%) / | 17 (2.8%) | 19 (6.1%) / | 8.7 (3.0%) | 31 (6.7%) / | 30 (2.9%) | 22 (5.9%) / | 13 (2.2%) |
| OLE2 | 33 (11%) / | 62 (10%) | 32 (10%) / | 34 (12%) | 56 (12%) / | 110 (10%) | 40 (11%) / | 50 (8.3%) |
| Total | 310 / | 610 | 310 / | 290 | 460 / | 1000 | 380 / | 600 |
| Categories: | | | | | | | | |
| $NO_x$ | -59 (-19%) / | -79 (-13%) | -39 (-12%) / | -29 (-10%) | -130 (-28%) / | -150 (-15%) | -92 (-24%) / | -62 (-10%) |
| VOCs (all) | 370 (120%) / | 690 (110%) | 360 (110%) / | 320 (110%) | 590 (130%) / | 1200 (110%) | 470 (120%) / | 660 (110%) |
| VOCs (antropogenic) | 280 (90%) / | 640 (110%) | 220 (70%) / | 300 (100%) | 460 (100%) / | 1100 (110%) | 410 (110%) / | 630 (100%) |
| VOCs (biogenic) | 89 (29%) / | 43 (7.1%) | 140 (43%) / | 16 (5.4%) | 130 (28%) / | 67 (6.5%) | 57 (15%) / | 34 (5.7%) |
| VOCs (on-road) | 110 (35%) / | 220 (35%) | 92 (29%) / | 86 (30%) | 190 (40%) / | 400 (39%) | 150 (41%) / | 230 (39%) |

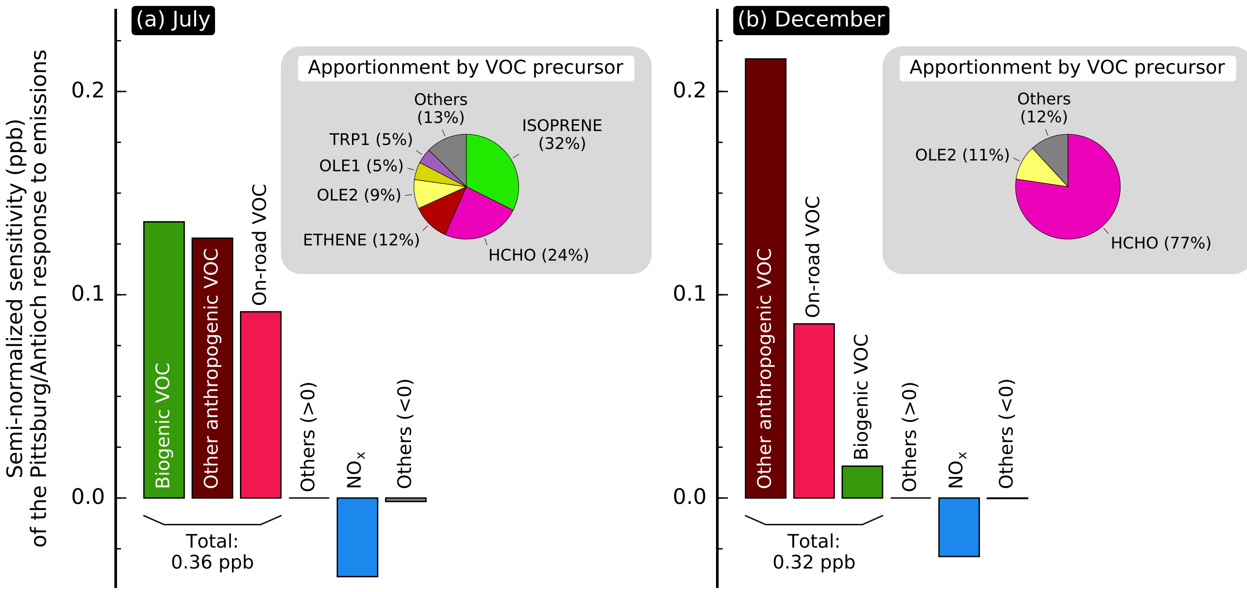


Figure S17: Semi-normalized sensitivity of the Pittsburg/Antioch population-weighted formaldehyde mixing ratio to emissions, in (a) July and (b) December. An apportionment by precursor species of the sensitivity to overall VOC emissions is shown in the pie chart insets.

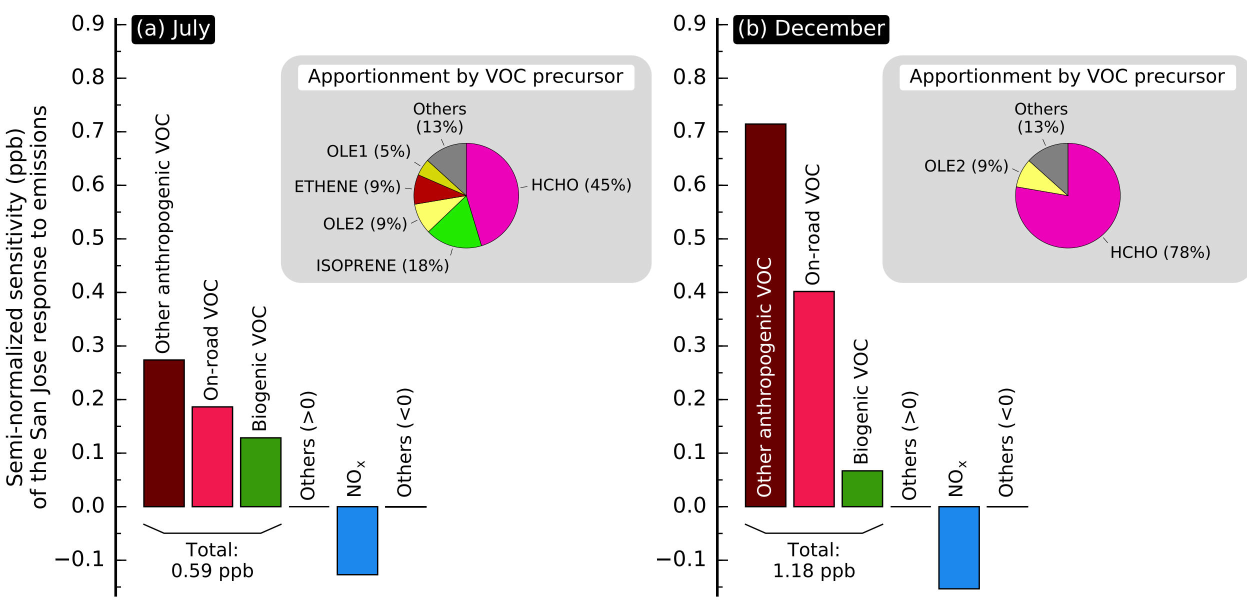


Figure S18: Semi-normalized sensitivity of the San Jose population-weighted formaldehyde mixing ratio to emissions, in (a) July and (b) December. An apportionment by precursor species of the sensitivity to overall VOC emissions is shown in the pie chart insets.

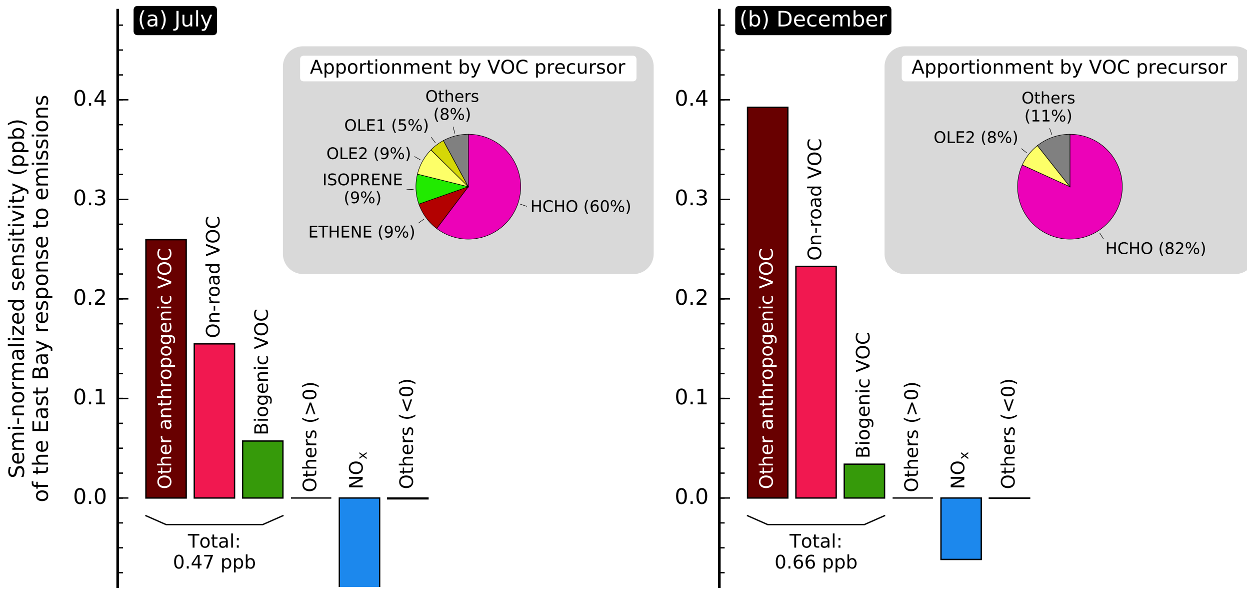


Figure S19: Semi-normalized sensitivity of the East Bay population-weighted formaldehyde mixing ratio to emissions, in (a) July and (b) December. An apportionment by precursor species of the sensitivity to overall VOC emissions is shown in the pie chart insets.

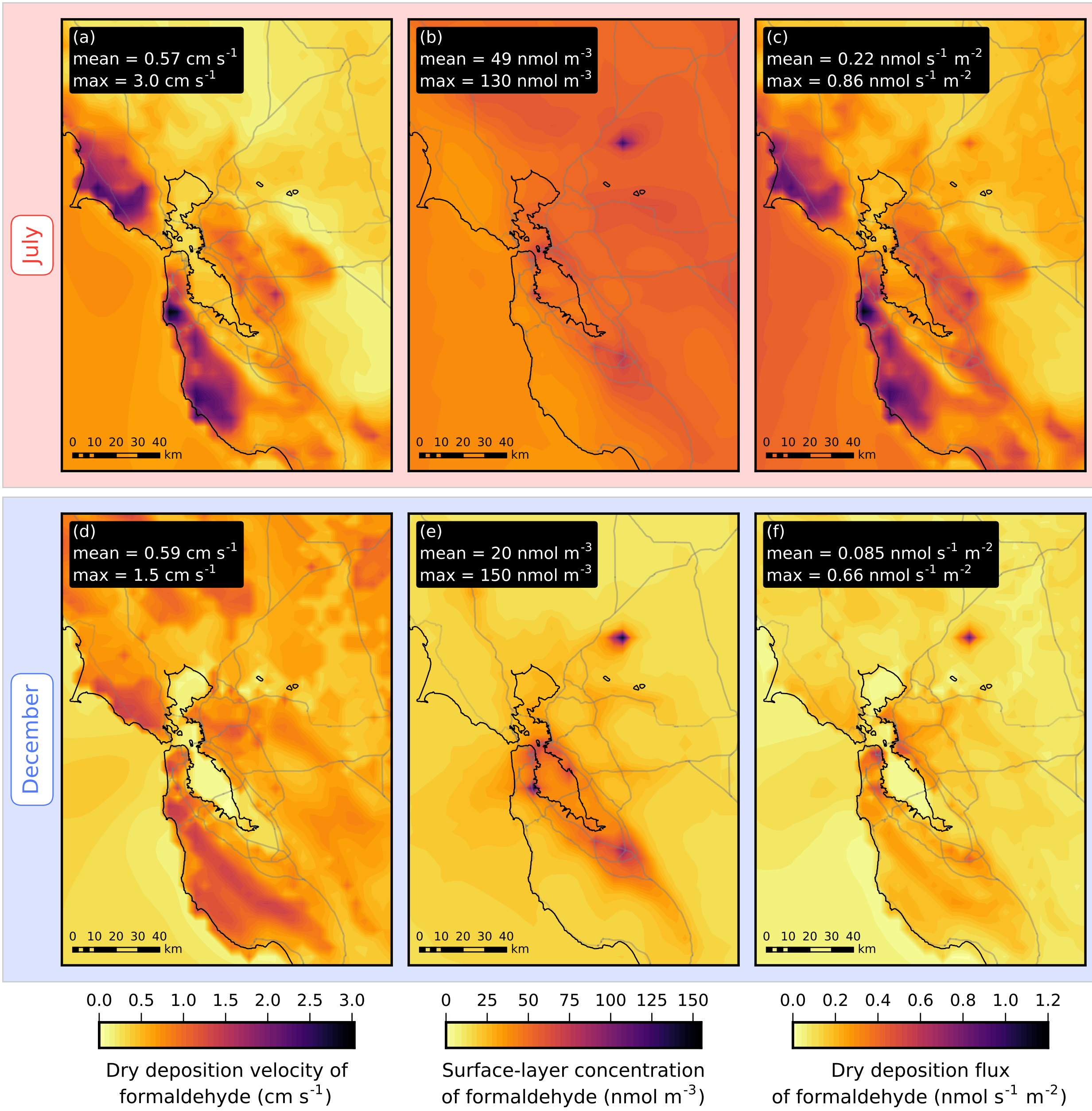


Figure S20: Dry deposition velocity ($v_d$), surface-layer concentration ($C$), and dry deposition flux ($F$) of formaldehyde, where $F = v_d \times C$. Dry deposition velocities were calculated by the MM5 model (BAAQMD, 2009).

# References

BAAQMD (Bay Area Air Quality Management District): Toxics Modeling to Support the Community Air Risk Evaluation (CARE) Program, Research and Modeling Section Publication No. 200906-002-TX. San Francisco, CA. June 2009, 2009.

Carter, W. P. L.: Documentation of the SAPRC-99 Chemical Mechanism for VOC reactivity assessment. Volume 1 of 2. Documentation Text, Final Report to California Air Resources Board. Contract 92-329 and Contract 95-308. Report number 00-AP-RT17-001-FR, May 8th 2000, 2000.