Figure A1: Wind roses for C-130 aircraft data in the NFRMA collected between 10-17LT and < 1 km a.g.l. from observations (left), WRF simulations with observational nudging of ADP observations (middle) and WRF simulations with observational nudging of ADP and FRAPPÉ observations (right).

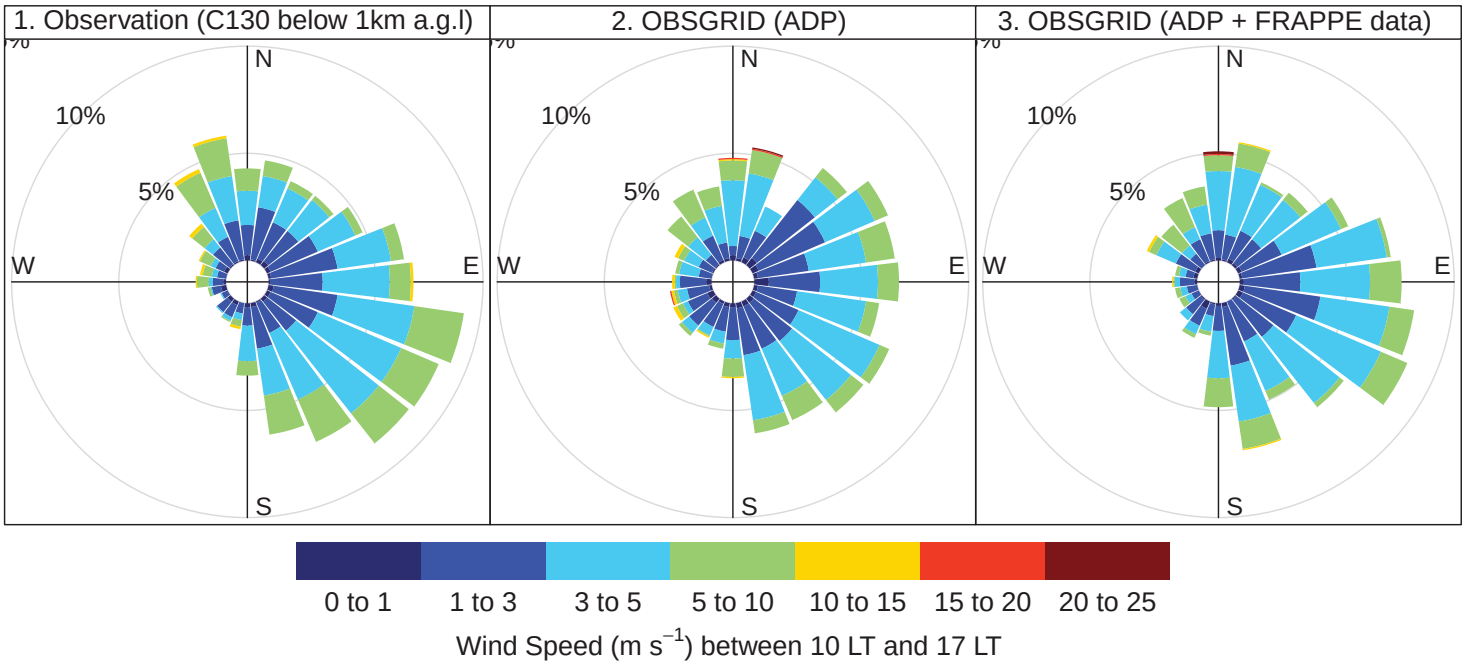
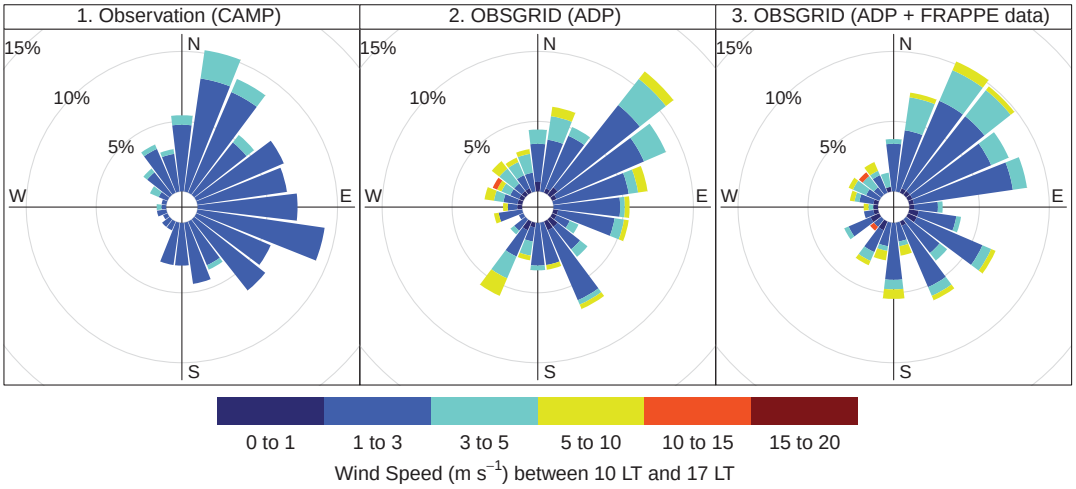
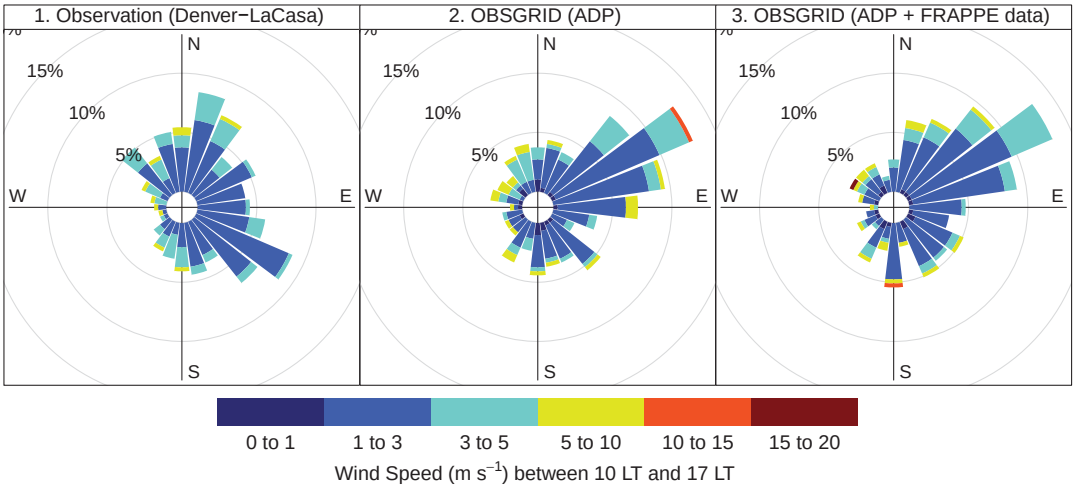
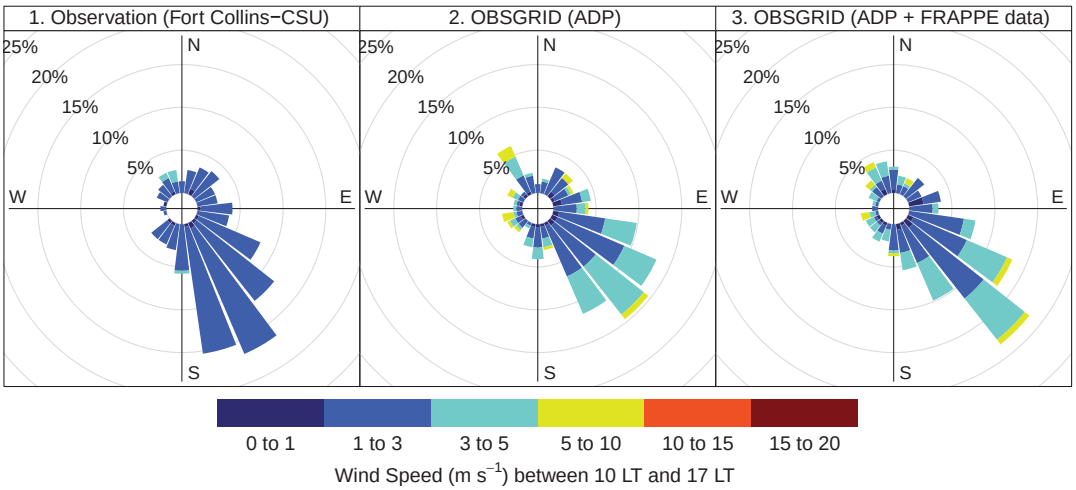
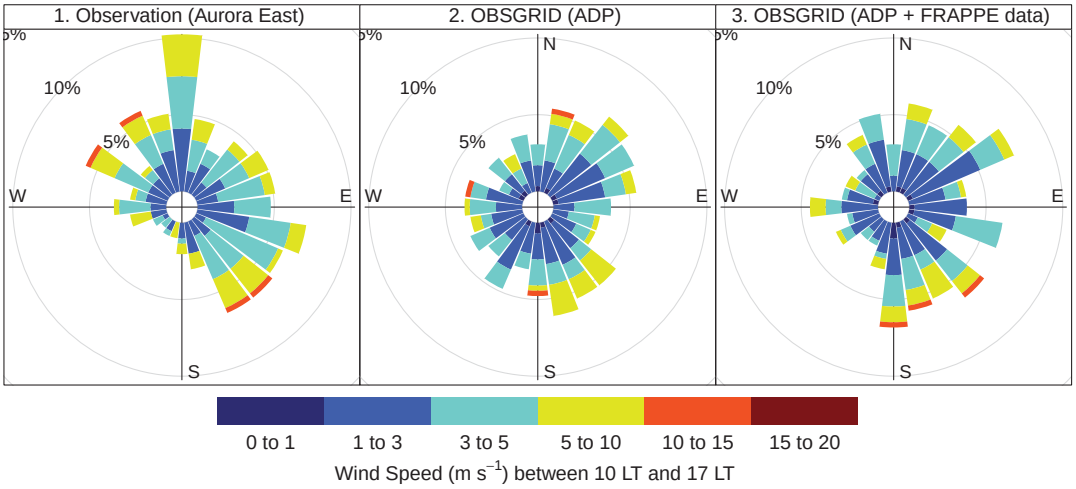


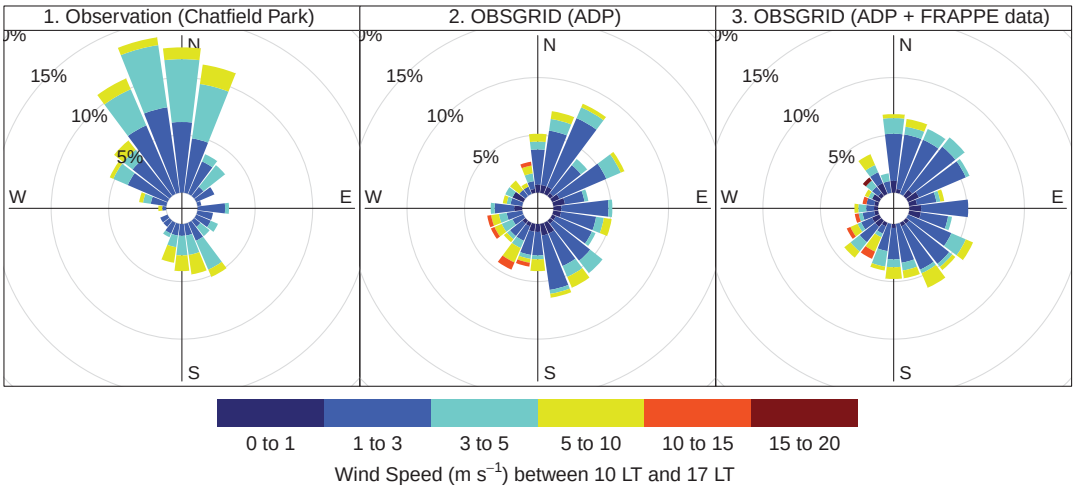
Figure A2: Wind roses for surface sites in the NFRMA for 10-17LT for observations (left), WRF simulations with observational nudging of ADP observations (middle) and WRF simulations with observational nudging of ADP and FRAPPÉ observations (right).

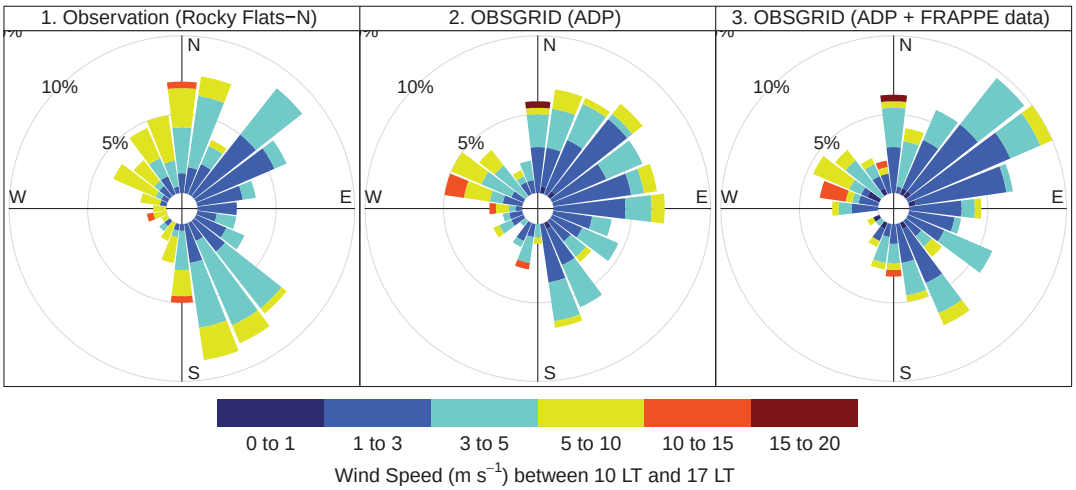


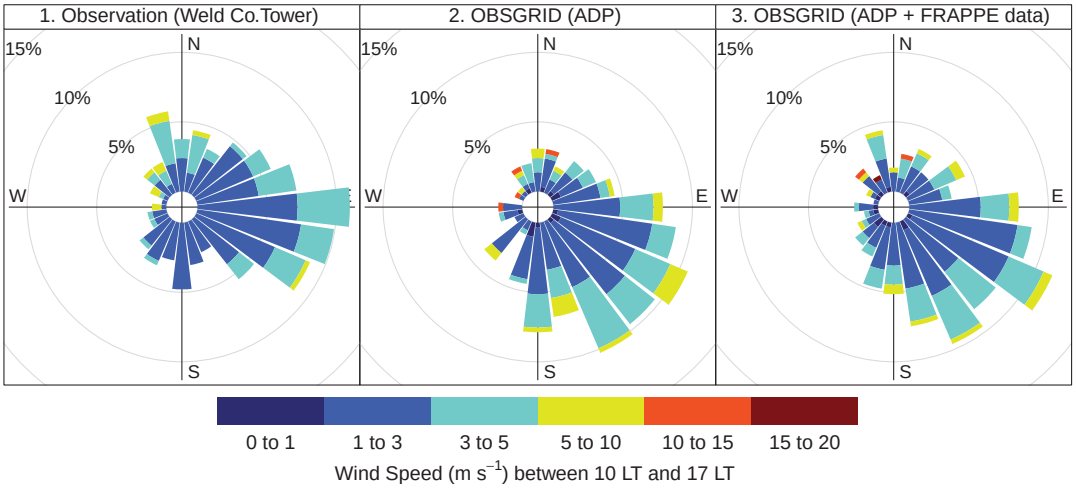


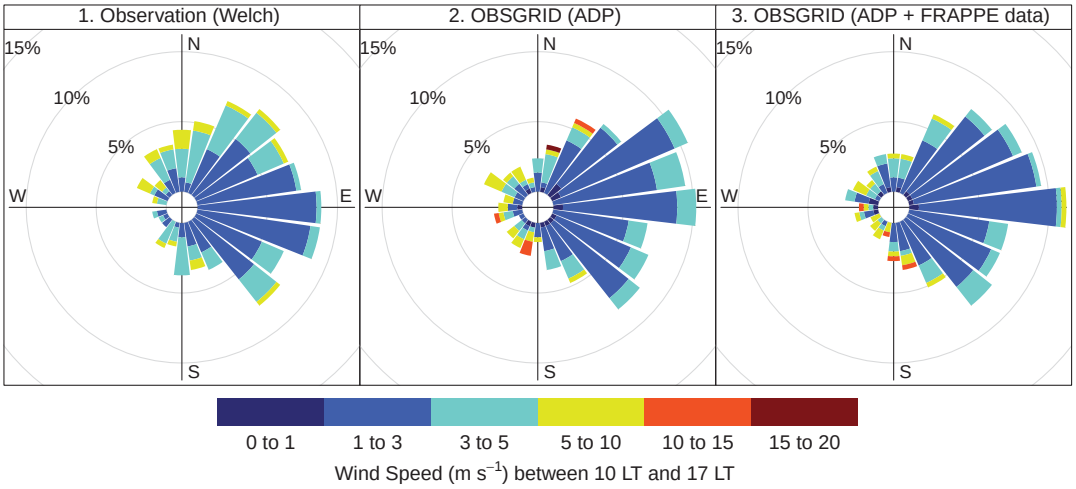


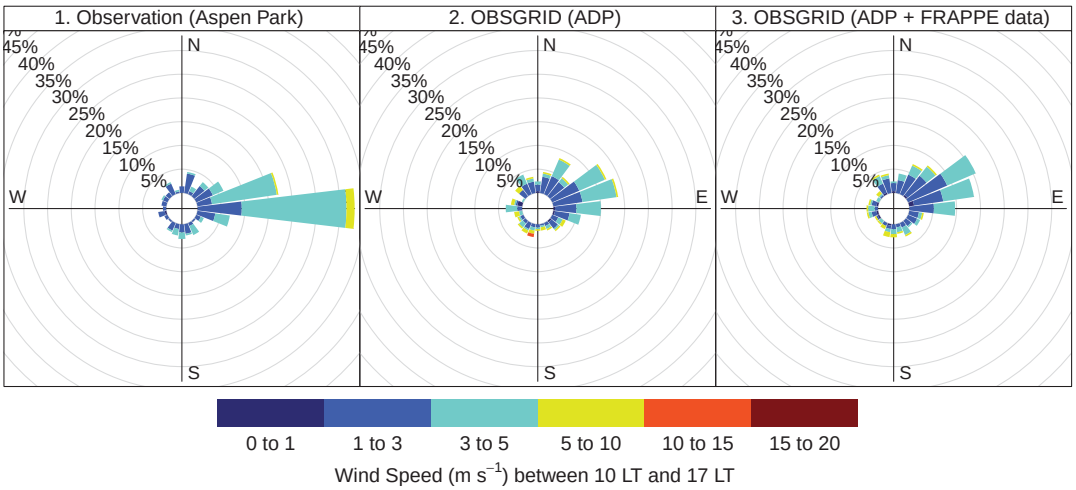

1. Observation (Aurora East)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

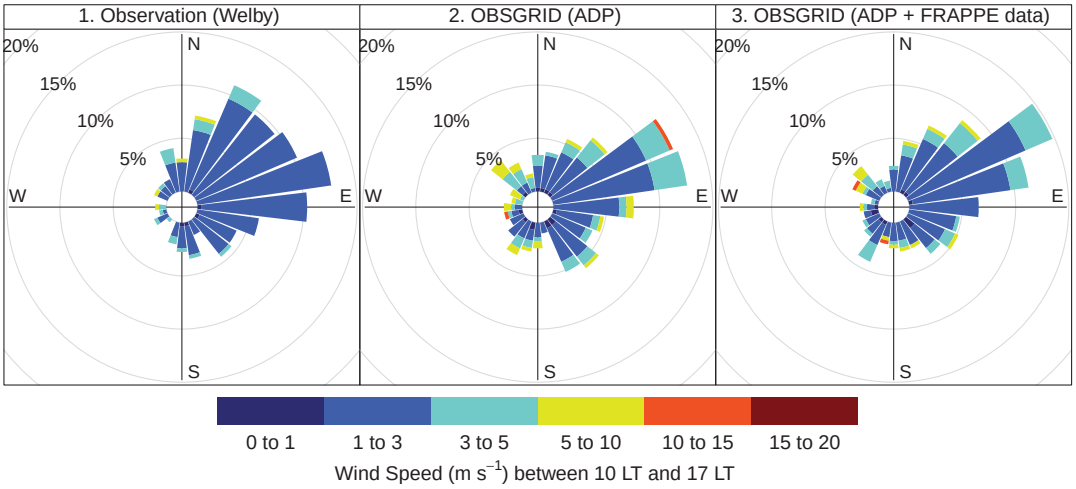

1. Observation (Chatfield Park)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
15%
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

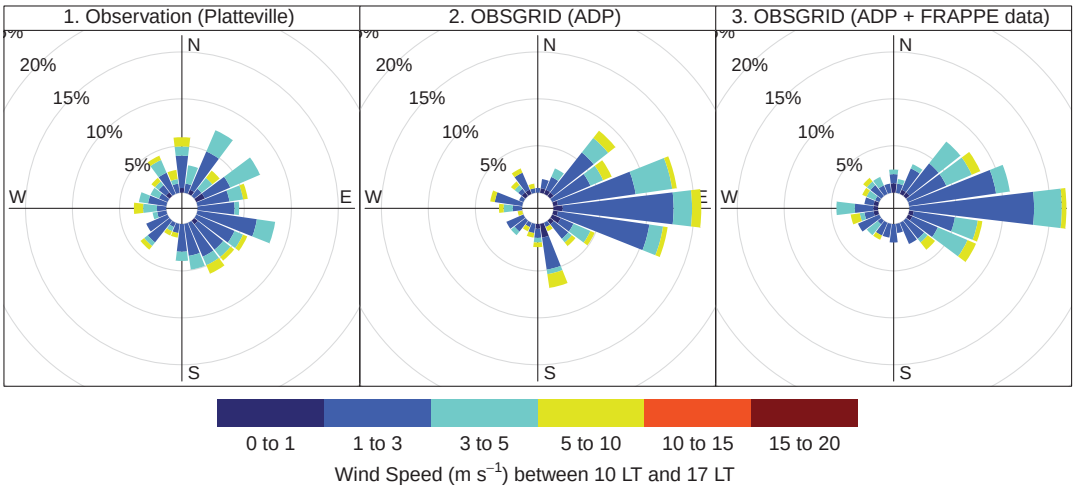

1. Observation (Rocky Flats−N)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

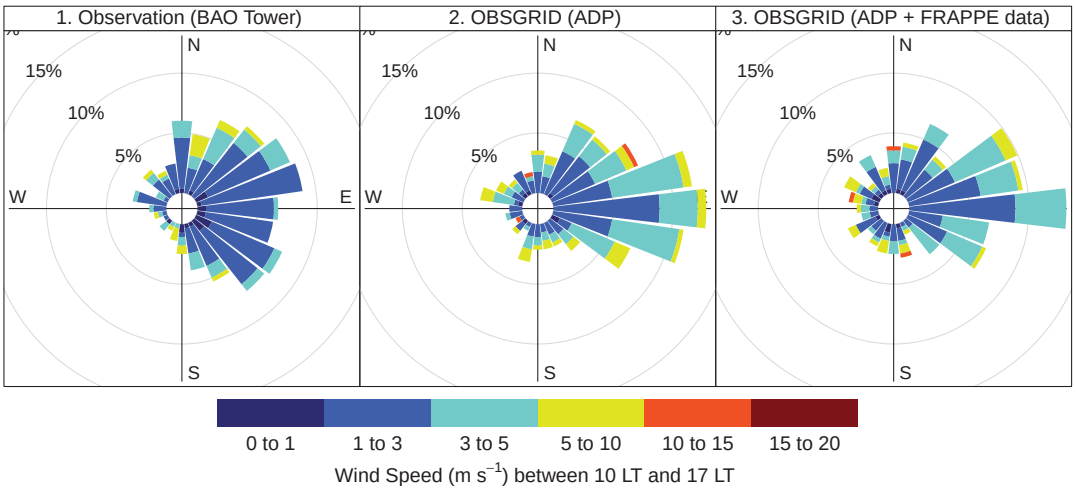

1. Observation (Weld Co.Tower)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
15%
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

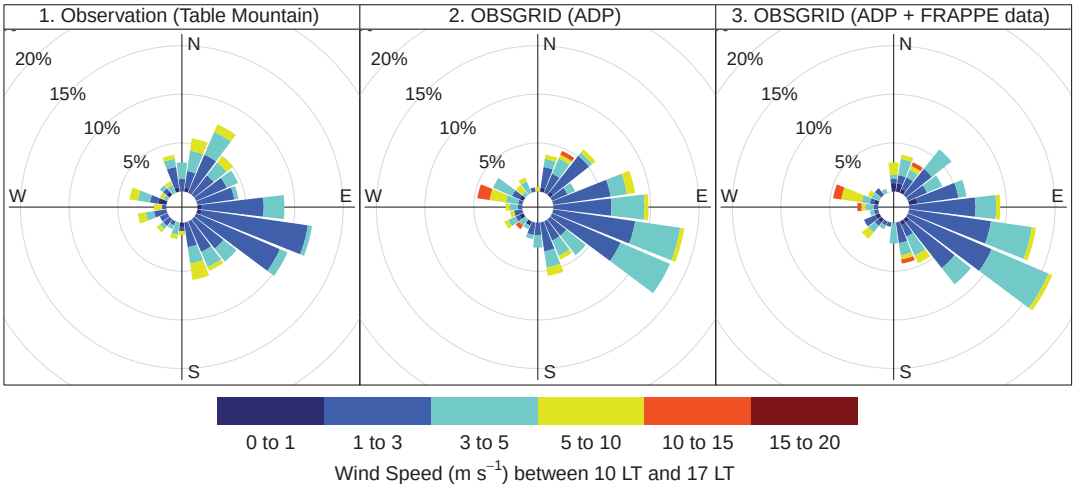

1. Observation (Welch)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
15%
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

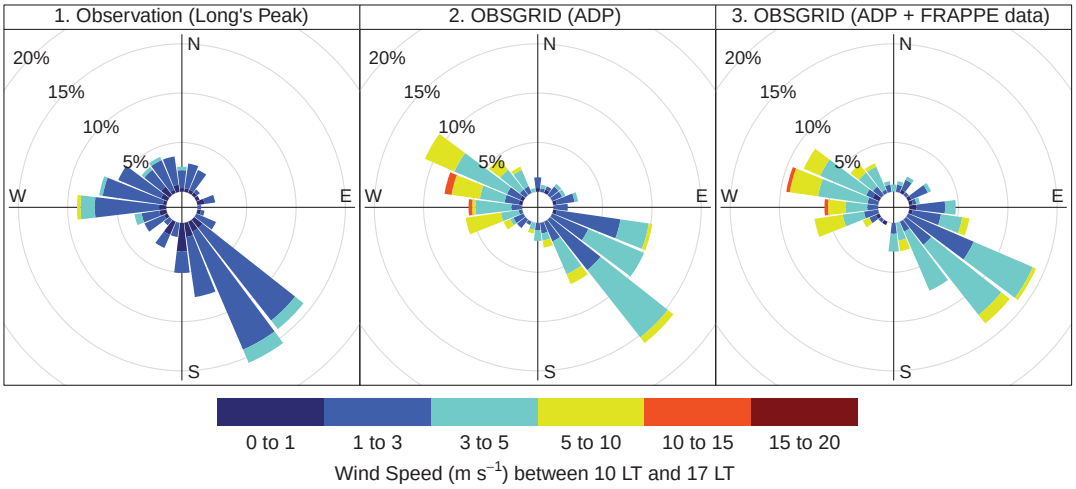

1. Observation (Aspen Park)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
45%
40%
35%
30%
25%
20%
15%
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

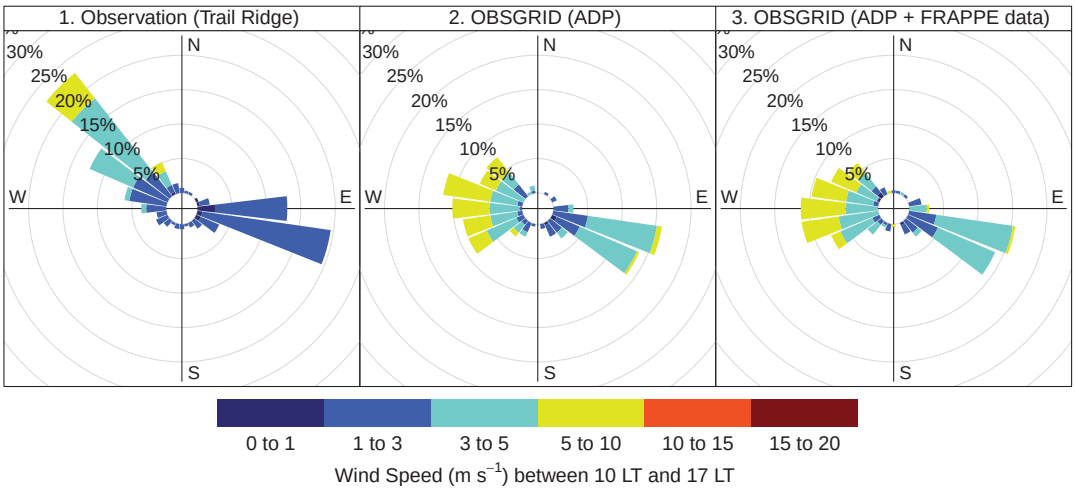

1. Observation (Welby)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
20%
15%
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

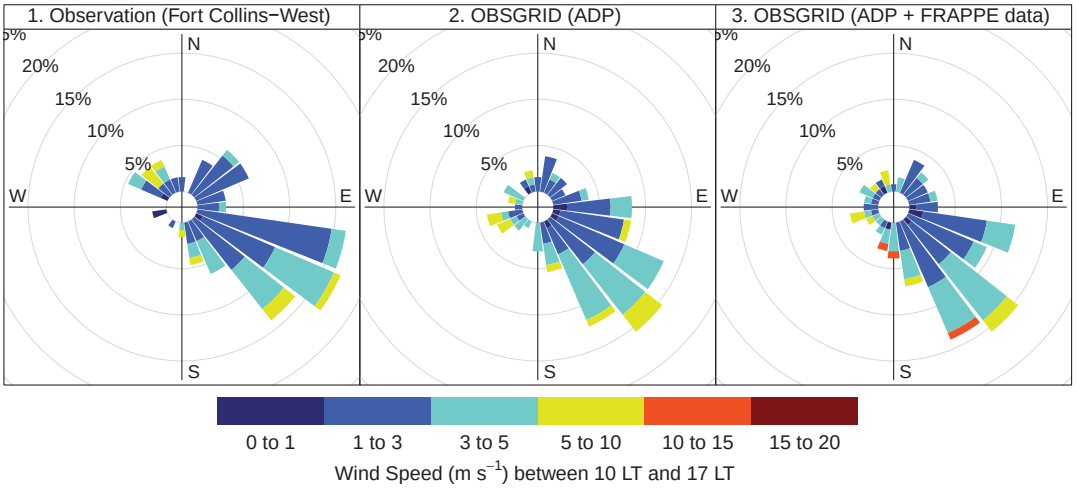

1. Observation (Platteville)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
20%
15%
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT


1. Observation (BAO Tower)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
15%
10%
5%
N
W
E
S
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT


1. Observation (Table Mountain)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
N
E
S
W
20%
15%
10%
5%
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT


1. Observation (Long's Peak)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
N
E
S
W
20%
15%
10%
5%
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT


1. Observation (Trail Ridge)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
N
E
S
W
30%
25%
20%
15%
10%
5%
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT


1. Observation (Fort Collins−West)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
N
S
W
E
5%
10%
15%
20%
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

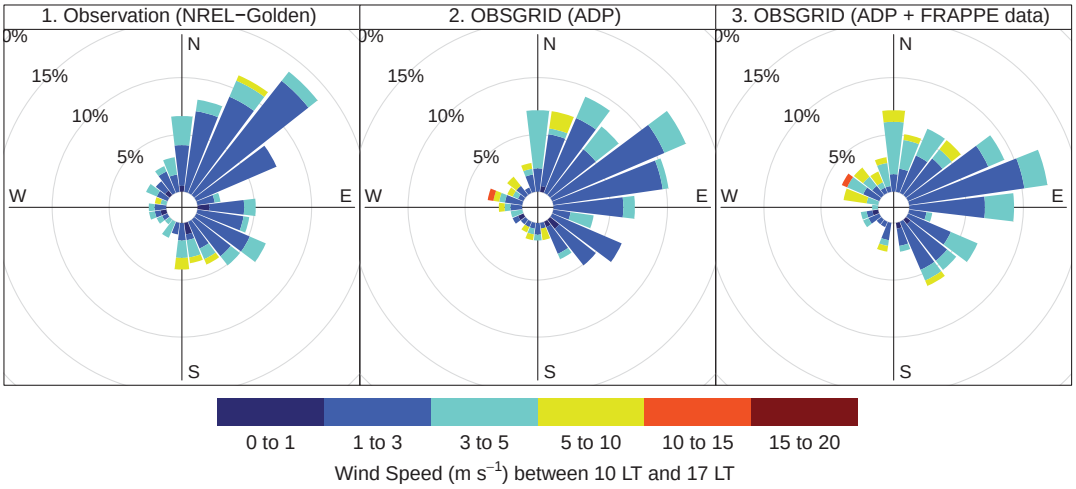
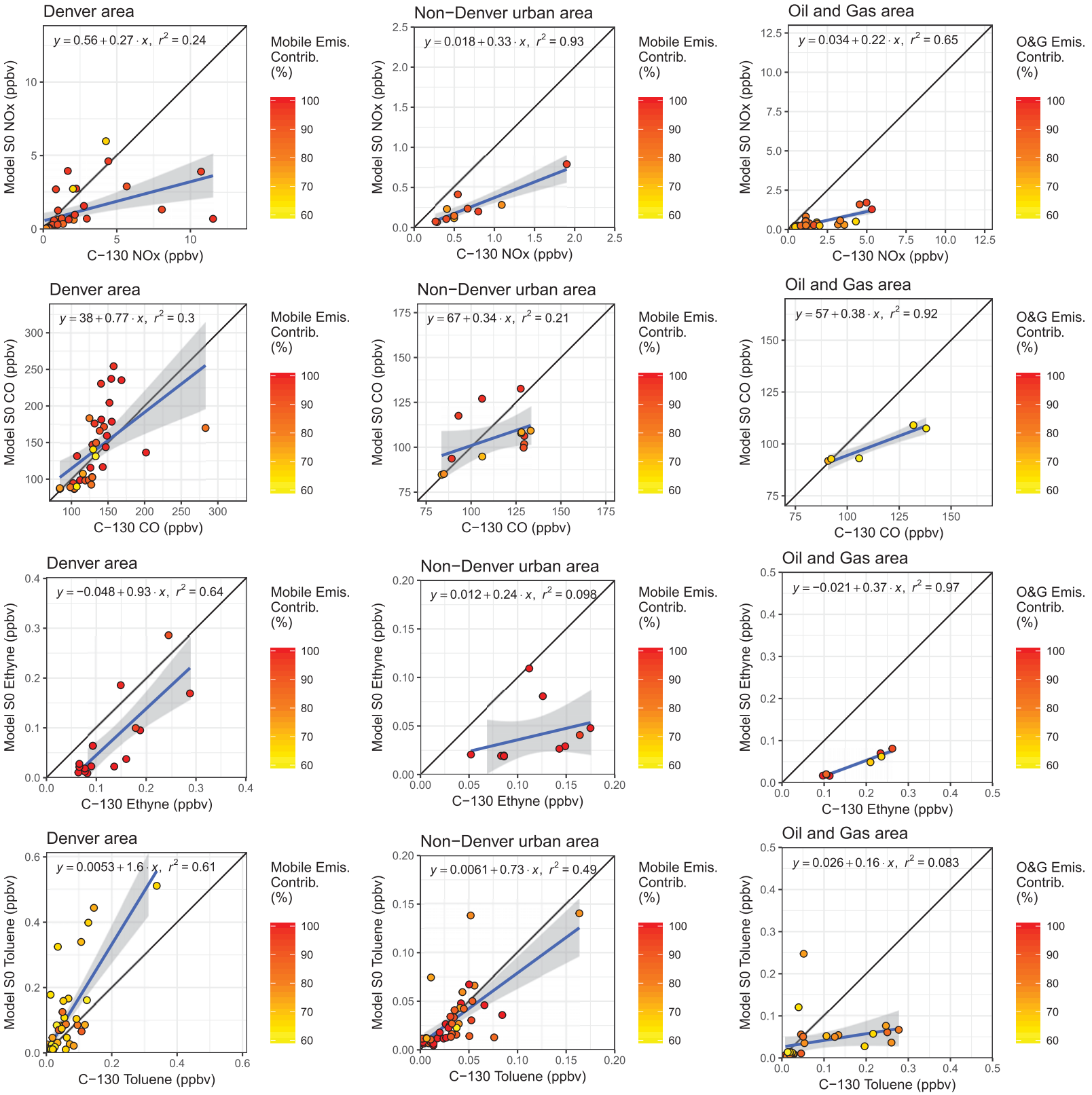

1. Observation (NREL−Golden)
2. OBSGRID (ADP)
3. OBSGRID (ADP + FRAPPE data)
N
S
W
E
5%
10%
15%
0 to 1
1 to 3
3 to 5
5 to 10
10 to 15
15 to 20
Wind Speed (m s−1) between 10 LT and 17 LT

Figure B1: Scatter plots of 1-minute averaged C-130 observed and S0 model concentrations over the Denver (left) and non-Denver (middle) urban areas and the O&G region (right). Only data are used where the contribution of mobile emissions to total emissions for the urban regions and the contribution of O&G emissions to total emissions for the O&G region is larger than 60% following the selection criteria discussed in Section 3. No graphs are shown for areas and species where the criteria were not met.



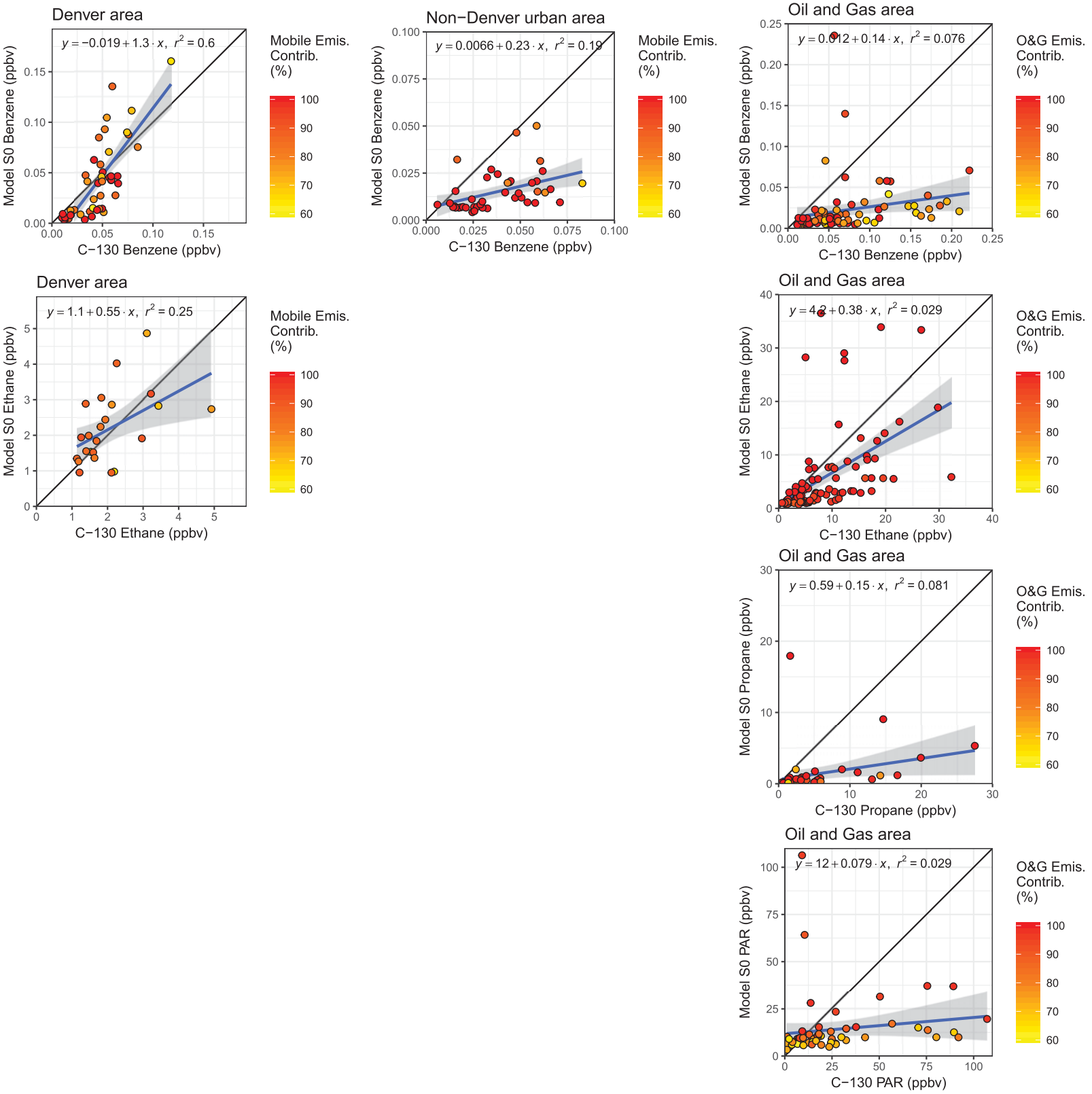
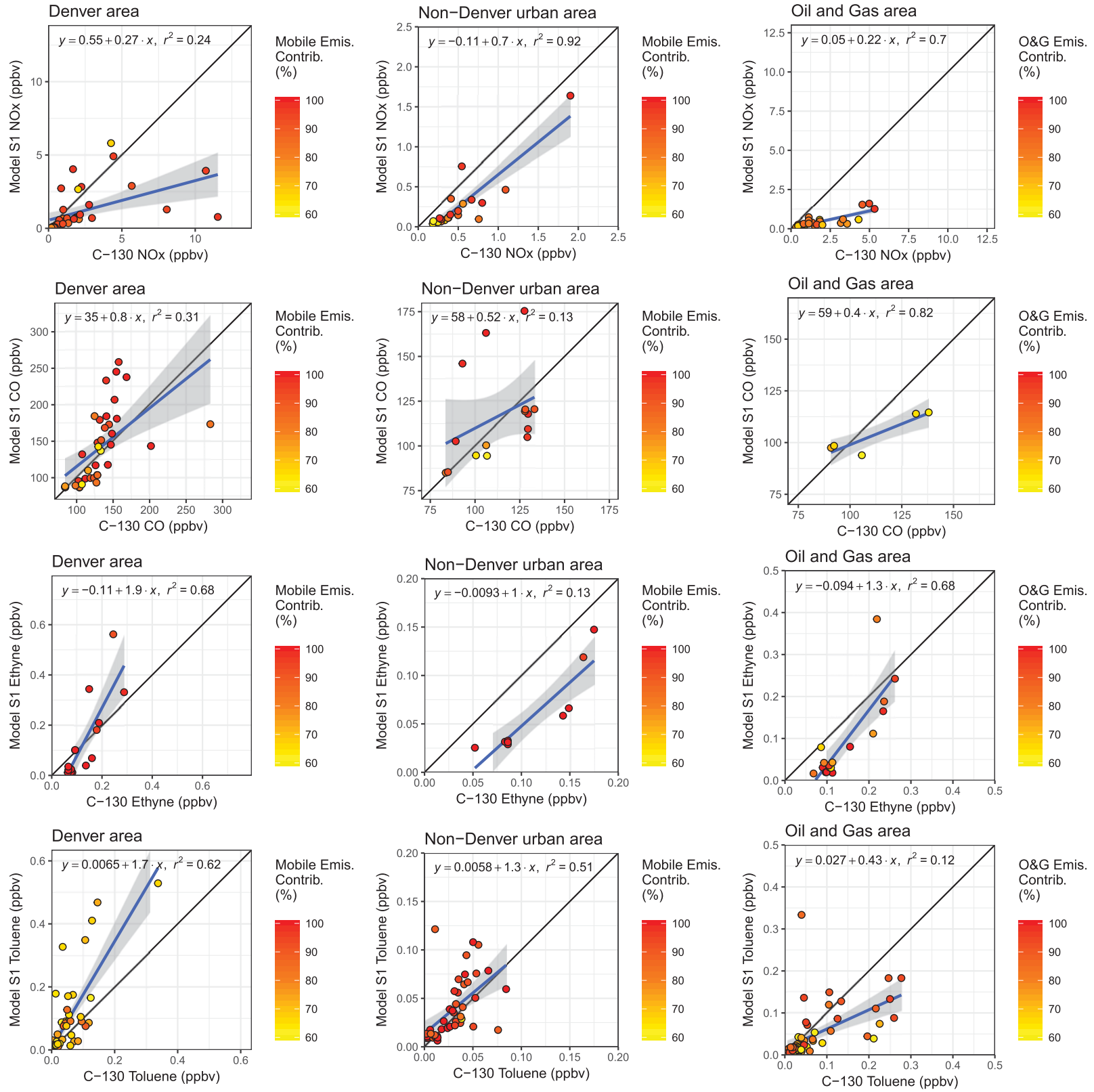

Denver area
y = −0.019 + 1.3 · x, r² = 0.6
Model S0 Benzene (ppbv)
C−130 Benzene (ppbv)
Mobile Emis. Contrib. (%)
Non−Denver urban area
y = 0.0066 + 0.23 · x, r² = 0.19
Oil and Gas area
y = 0.012 + 0.14 · x, r² = 0.076
O&G Emis. Contrib. (%)
Denver area
y = 1.1 + 0.55 · x, r² = 0.25
Model S0 Ethane (ppbv)
C−130 Ethane (ppbv)
Oil and Gas area
y = 4.2 + 0.38 · x, r² = 0.029
Oil and Gas area
y = 0.59 + 0.15 · x, r² = 0.081
Model S0 Propane (ppbv)
C−130 Propane (ppbv)
Oil and Gas area
y = 12 + 0.079 · x, r² = 0.029
Model S0 PAR (ppbv)
C−130 PAR (ppbv)

Figure B2: Scatter plots of 1-minute averaged C-130 observed and S1 model concentrations over the Denver (left) and non-Denver (middle) urban areas and the O&G region (right). Only data are used where the contribution of mobile emissions to total emissions for the urban regions and the contribution of O&G emissions to total emissions for the O&G region is larger than 60% following the selection criteria discussed in Section 3. No graphs are shown for areas and species where the criteria were not met.



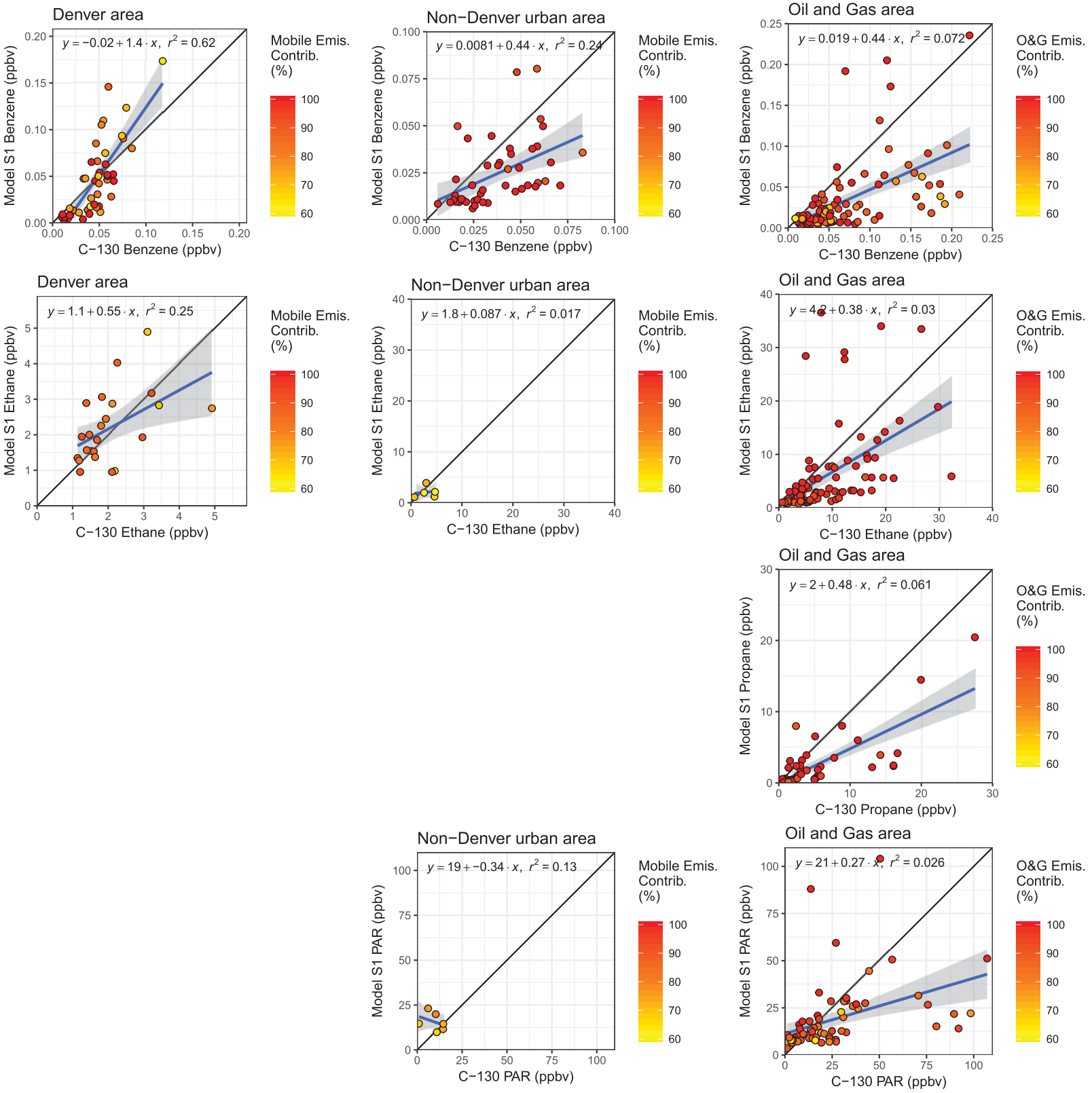
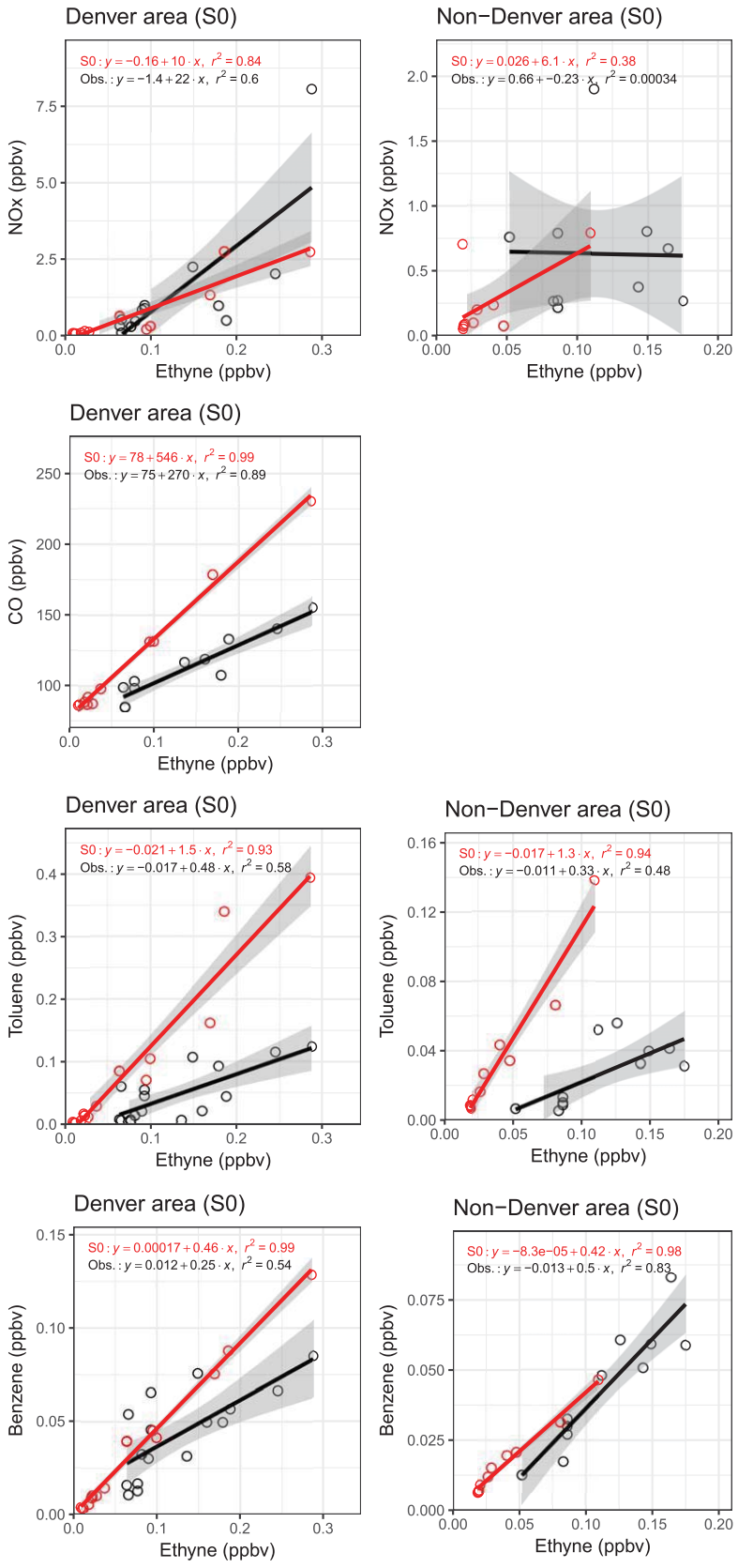

Denver area
y = −0.02 + 1.4 · x, r² = 0.62
Model S1 Benzene (ppbv)
C−130 Benzene (ppbv)
Non−Denver urban area
y = 0.0081 + 0.44 · x, r² = 0.24
Model S1 Benzene (ppbv)
C−130 Benzene (ppbv)
Oil and Gas area
y = 0.019 + 0.44 · x, r² = 0.072
Model S1 Benzene (ppbv)
C−130 Benzene (ppbv)
Mobile Emis. Contrib. (%)
O&G Emis. Contrib. (%)
100
90
80
70
60
Denver area
y = 1.1 + 0.55 · x, r² = 0.25
Model S1 Ethane (ppbv)
C−130 Ethane (ppbv)
Non−Denver urban area
y = 1.8 + 0.087 · x, r² = 0.017
Model S1 Ethane (ppbv)
C−130 Ethane (ppbv)
Oil and Gas area
y = 4.2 + 0.38 · x, r² = 0.03
Model S1 Ethane (ppbv)
C−130 Ethane (ppbv)
Oil and Gas area
y = 2 + 0.48 · x, r² = 0.061
Model S1 Propane (ppbv)
C−130 Propane (ppbv)
Non−Denver urban area
y = 19 + −0.34 · x, r² = 0.13
Model S1 PAR (ppbv)
C−130 PAR (ppbv)
Oil and Gas area
y = 21 + 0.27 · x, r² = 0.026
Model S1 PAR (ppbv)
C−130 PAR (ppbv)

Figure B3:Tracer ratios of urban tracers versus ethyne over the Denver and non-Denver area and O&G tracers versus propane. Results for 1-minute averaged C-130 observed and S0 modeled concentrations are shown. The same data selection is used as for Figure B1.



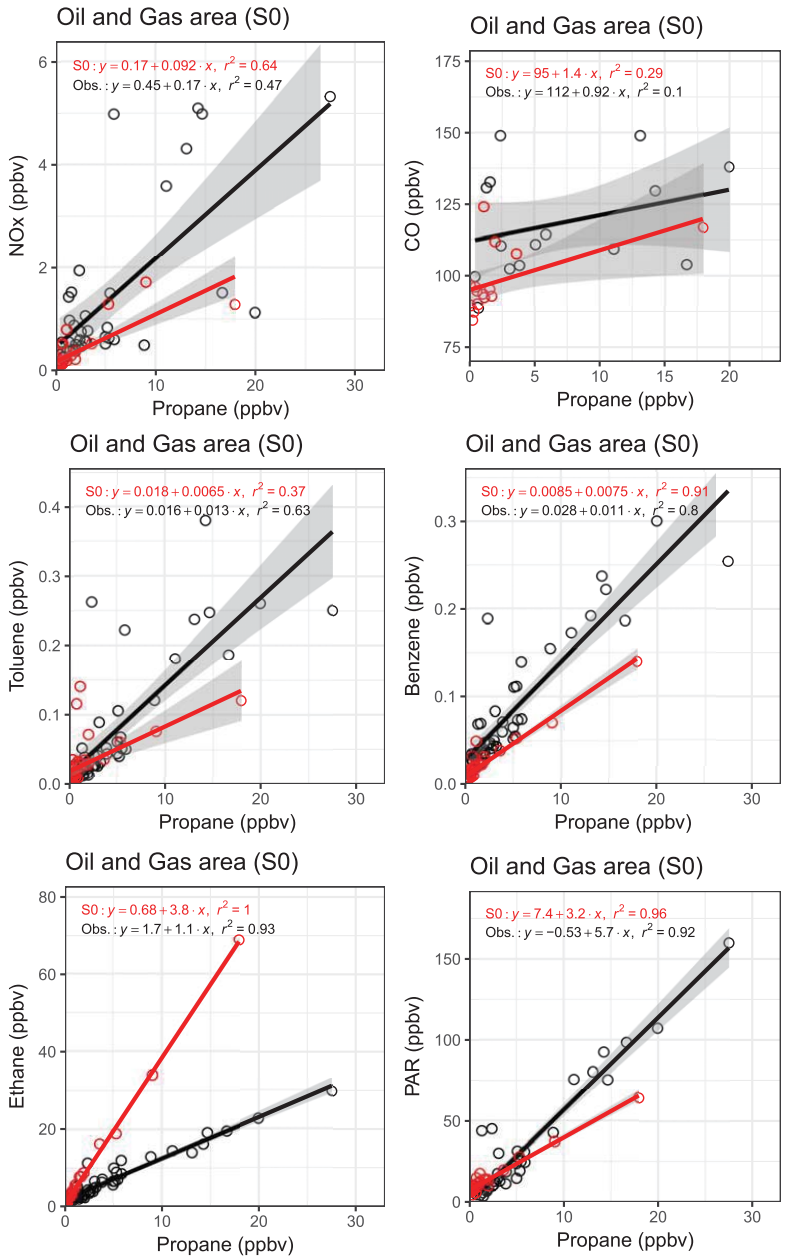
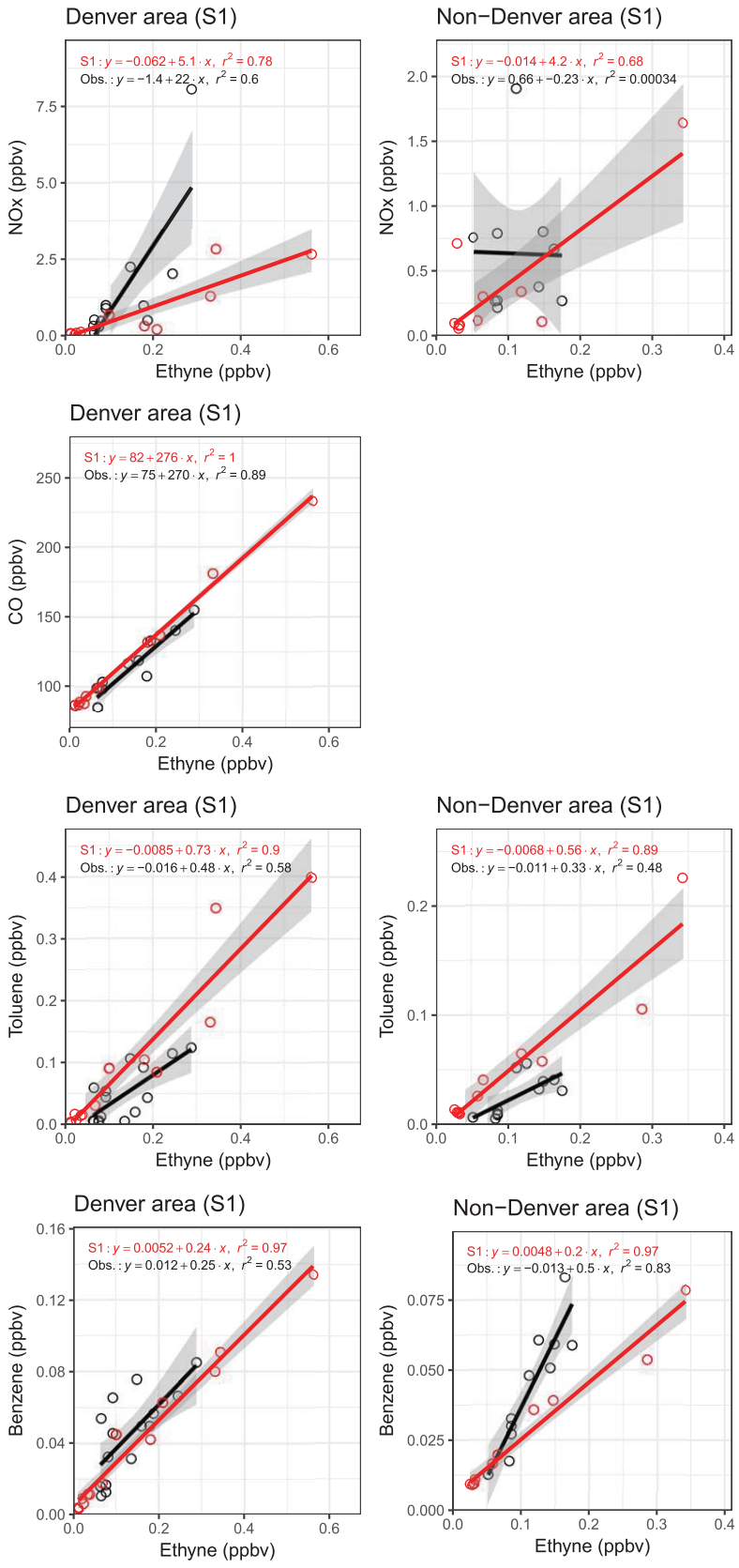

Oil and Gas area (S0)
S0 : y = 0.17 + 0.092 · x, r² = 0.64
Obs. : y = 0.45 + 0.17 · x, r² = 0.47
NOx (ppbv)
Propane (ppbv)
Oil and Gas area (S0)
S0 : y = 95 + 1.4 · x, r² = 0.29
Obs. : y = 112 + 0.92 · x, r² = 0.1
CO (ppbv)
Propane (ppbv)
Oil and Gas area (S0)
S0 : y = 0.018 + 0.0065 · x, r² = 0.37
Obs. : y = 0.016 + 0.013 · x, r² = 0.63
Toluene (ppbv)
Propane (ppbv)
Oil and Gas area (S0)
S0 : y = 0.0085 + 0.0075 · x, r² = 0.91
Obs. : y = 0.028 + 0.011 · x, r² = 0.8
Benzene (ppbv)
Propane (ppbv)
Oil and Gas area (S0)
S0 : y = 0.68 + 3.8 · x, r² = 1
Obs. : y = 1.7 + 1.1 · x, r² = 0.93
Ethane (ppbv)
Propane (ppbv)
Oil and Gas area (S0)
S0 : y = 7.4 + 3.2 · x, r² = 0.96
Obs. : y = −0.53 + 5.7 · x, r² = 0.92
PAR (ppbv)
Propane (ppbv)

Figure B4: Tracer ratios of urban tracers versus ethyne over the Denver and non-Denver area and O&G tracers versus propane. Results for 1-minute averaged C-130 observed and S1 modeled concentrations are shown. The same data selection is used as for Figure B2.



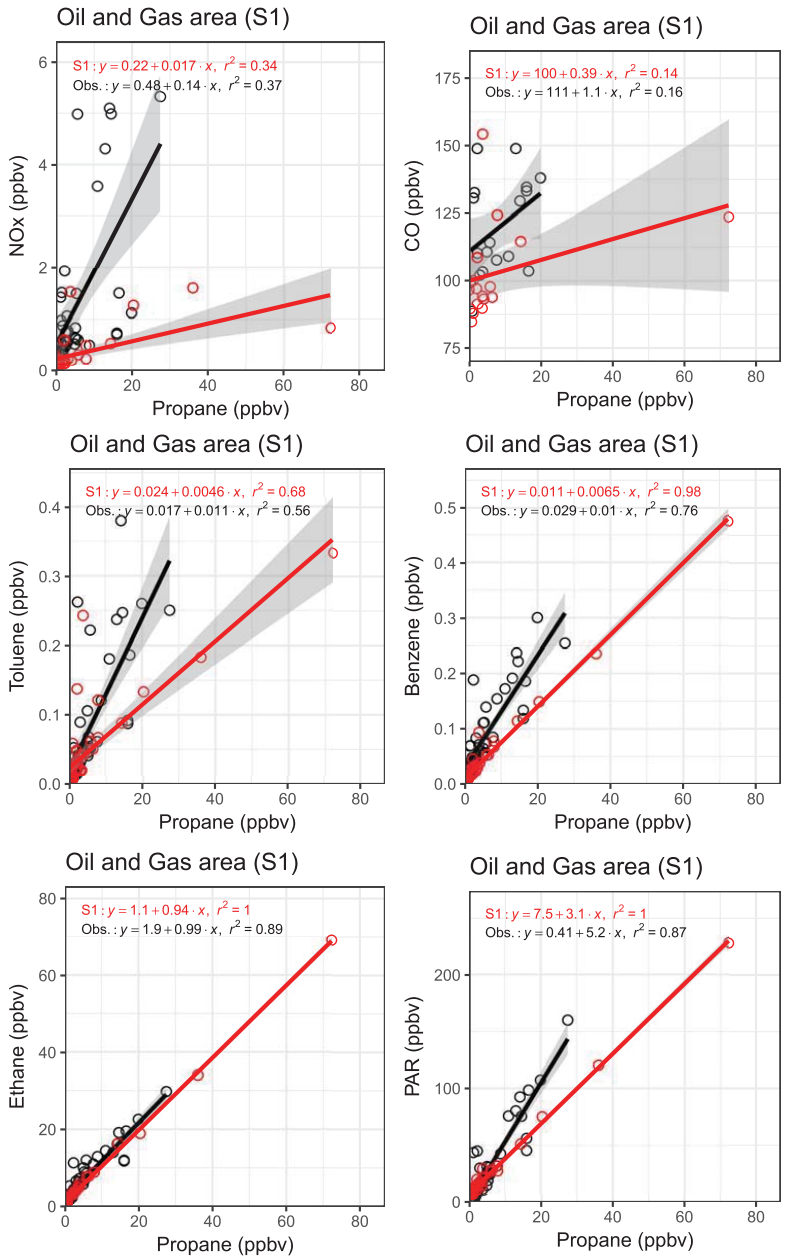
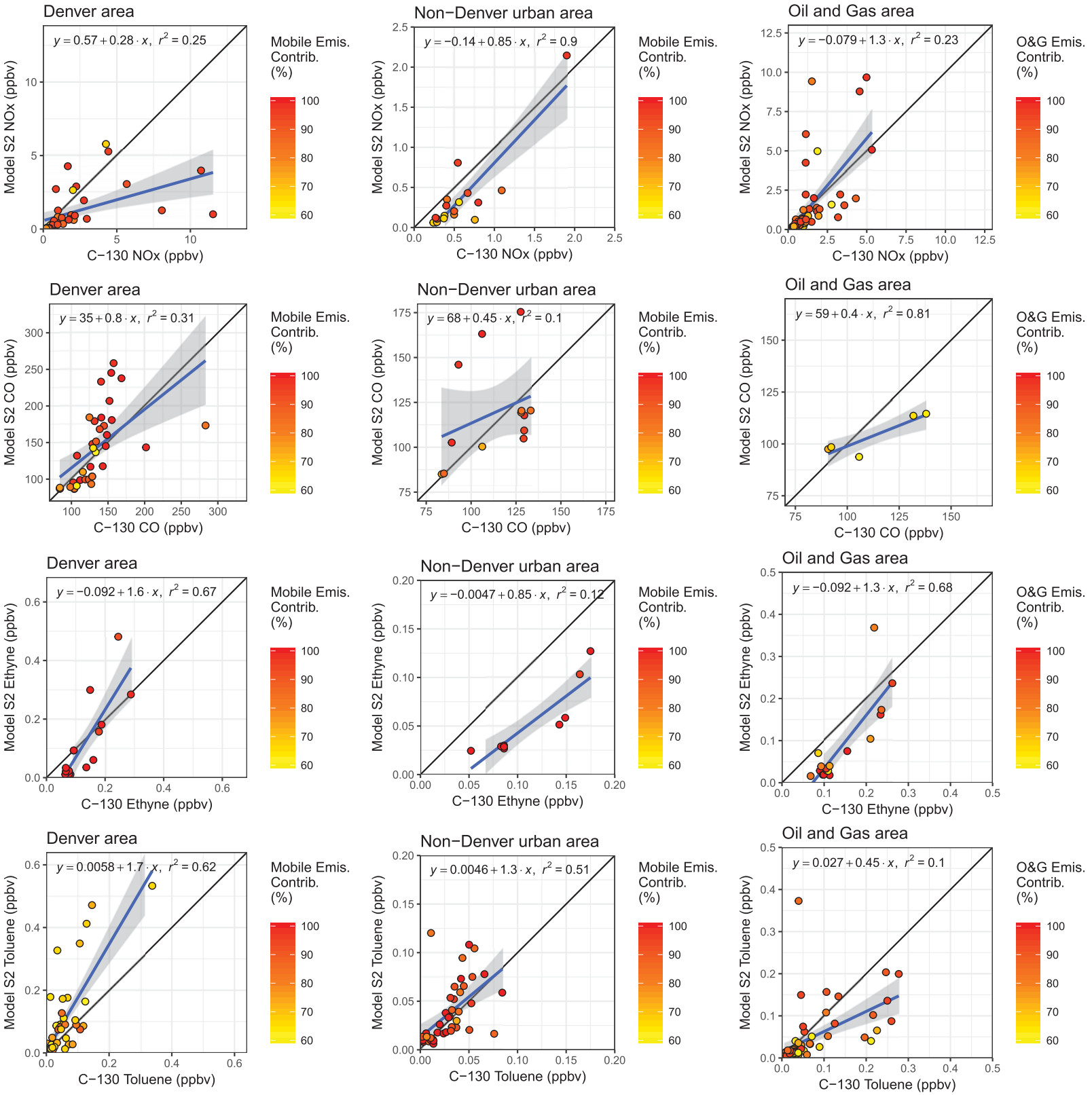

Oil and Gas area (S1)
S1 : y = 0.22 + 0.017 · x, r² = 0.34
Obs. : y = 0.48 + 0.14 · x, r² = 0.37
NOx (ppbv)
Propane (ppbv)
Oil and Gas area (S1)
S1 : y = 100 + 0.39 · x, r² = 0.14
Obs. : y = 111 + 1.1 · x, r² = 0.16
CO (ppbv)
Propane (ppbv)
Oil and Gas area (S1)
S1 : y = 0.024 + 0.0046 · x, r² = 0.68
Obs. : y = 0.017 + 0.011 · x, r² = 0.56
Toluene (ppbv)
Propane (ppbv)
Oil and Gas area (S1)
S1 : y = 0.011 + 0.0065 · x, r² = 0.98
Obs. : y = 0.029 + 0.01 · x, r² = 0.76
Benzene (ppbv)
Propane (ppbv)
Oil and Gas area (S1)
S1 : y = 1.1 + 0.94 · x, r² = 1
Obs. : y = 1.9 + 0.99 · x, r² = 0.89
Ethane (ppbv)
Propane (ppbv)
Oil and Gas area (S1)
S1 : y = 7.5 + 3.1 · x, r² = 1
Obs. : y = 0.41 + 5.2 · x, r² = 0.87
PAR (ppbv)
Propane (ppbv)

Figure B5: Scatter plots of 1-minute averaged C-130 observed and S2 model concentrations over the Denver (left) and non-Denver (middle) urban areas and the O&G region (right). Only data are used where the contribution of mobile emissions to total emissions for the urban regions and the contribution of O&G emissions to total emissions for the O&G region is larger than 60% following the selection criteria discussed in Section 3. No graphs are shown for areas and species where the criteria were not met.



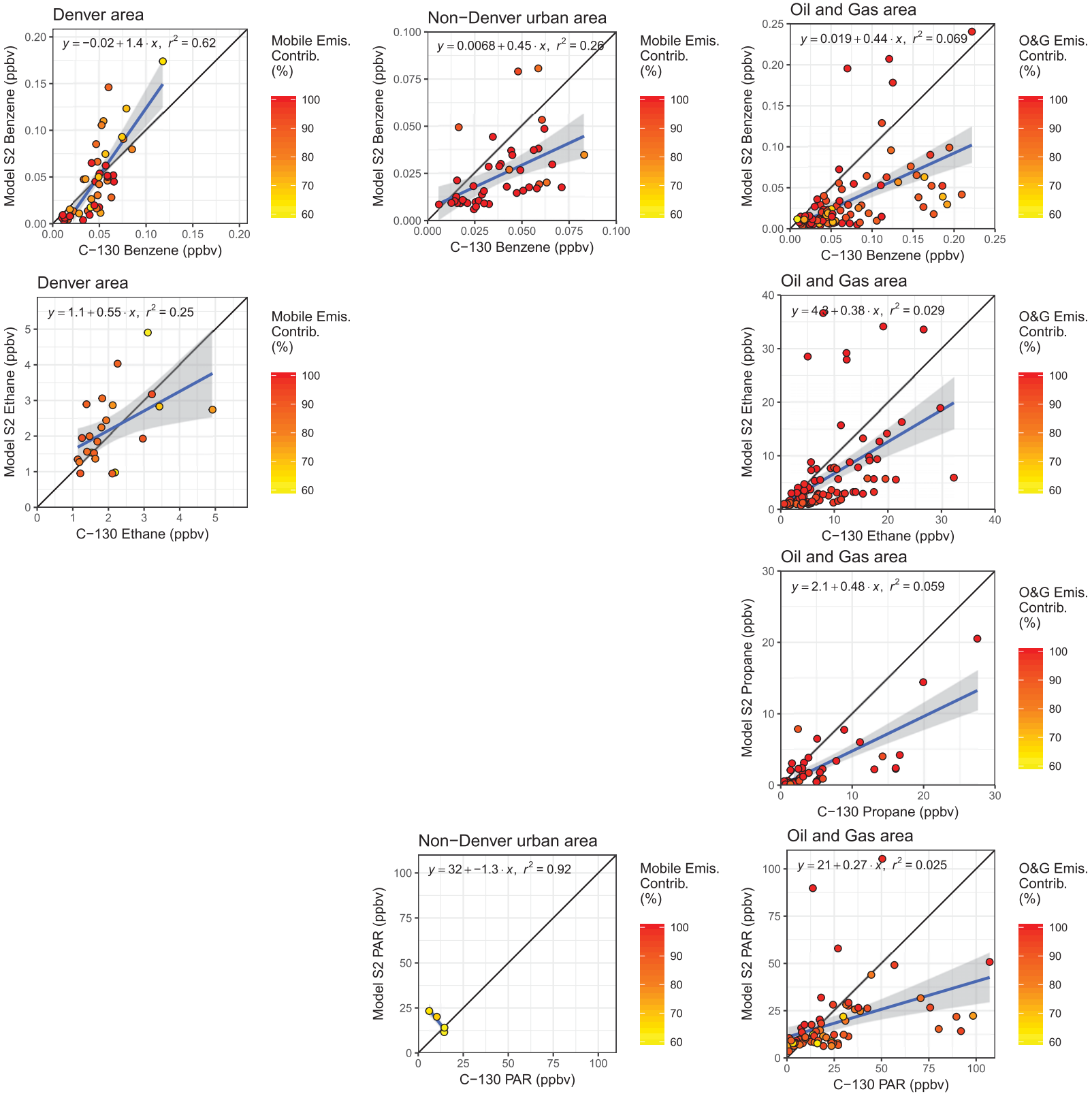
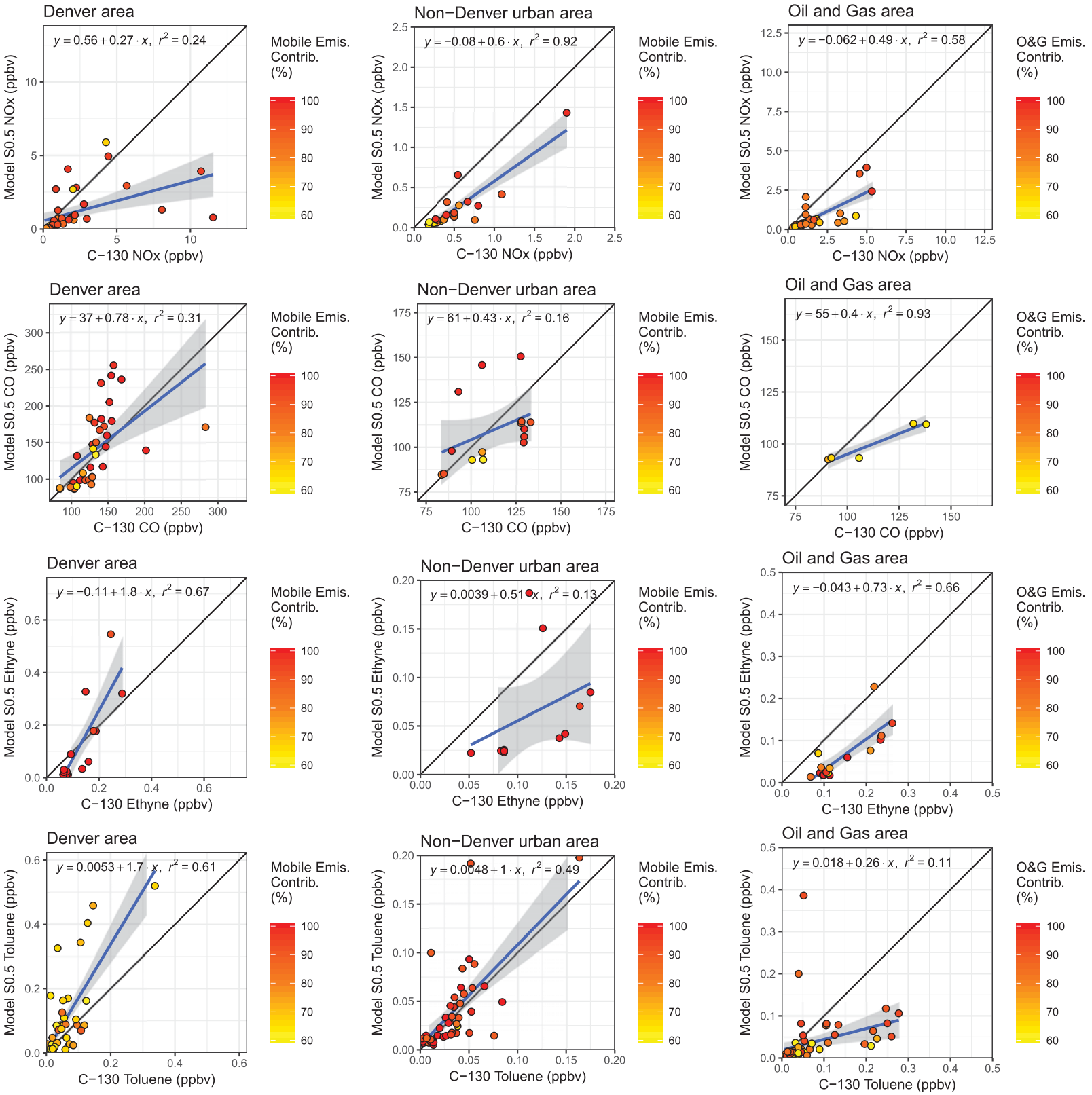

Denver area
y = −0.02 + 1.4 · x, r² = 0.62
Model S2 Benzene (ppbv)
C−130 Benzene (ppbv)
Mobile Emis. Contrib. (%)
Non−Denver urban area
y = 0.0068 + 0.45 · x, r² = 0.26
Oil and Gas area
y = 0.019 + 0.44 · x, r² = 0.069
O&G Emis. Contrib. (%)
Denver area
y = 1.1 + 0.55 · x, r² = 0.25
Model S2 Ethane (ppbv)
C−130 Ethane (ppbv)
Oil and Gas area
y = 4.3 + 0.38 · x, r² = 0.029
Oil and Gas area
y = 2.1 + 0.48 · x, r² = 0.059
Model S2 Propane (ppbv)
C−130 Propane (ppbv)
Non−Denver urban area
y = 32 + −1.3 · x, r² = 0.92
Model S2 PAR (ppbv)
C−130 PAR (ppbv)
Oil and Gas area
y = 21 + 0.27 · x, r² = 0.025

Figure B6: Scatter plots of 1-minute averaged C-130 observed and S05 model concentrations over the Denver (left) and non-Denver (middle) urban areas and the O&G region (right). Only data are used where the contribution of mobile emissions to total emissions for the urban regions and the contribution of O&G emissions to total emissions for the O&G region is larger than 60% following the selection criteria discussed in Section 3. No graphs are shown for areas and species where the criteria were not met.



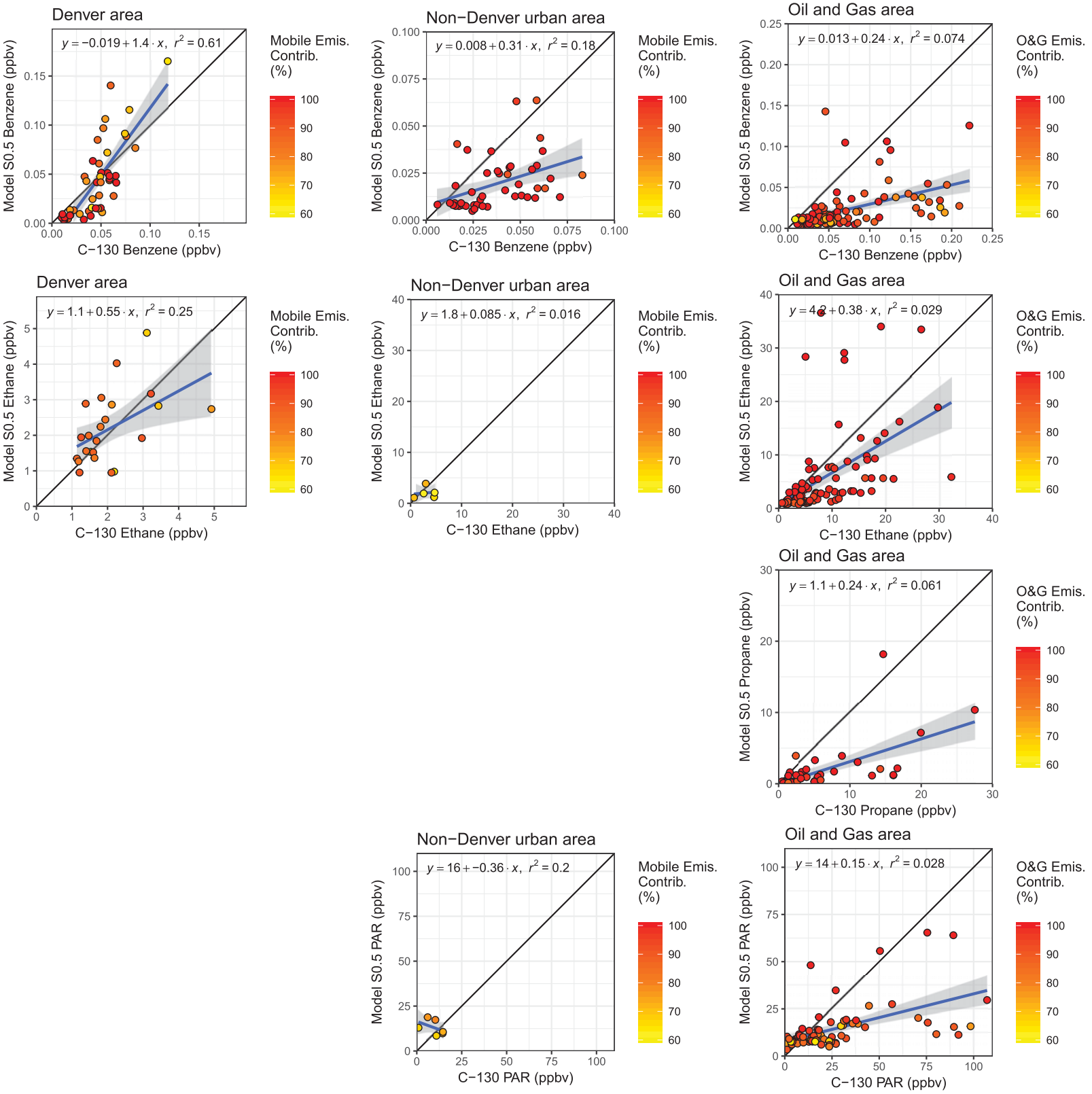
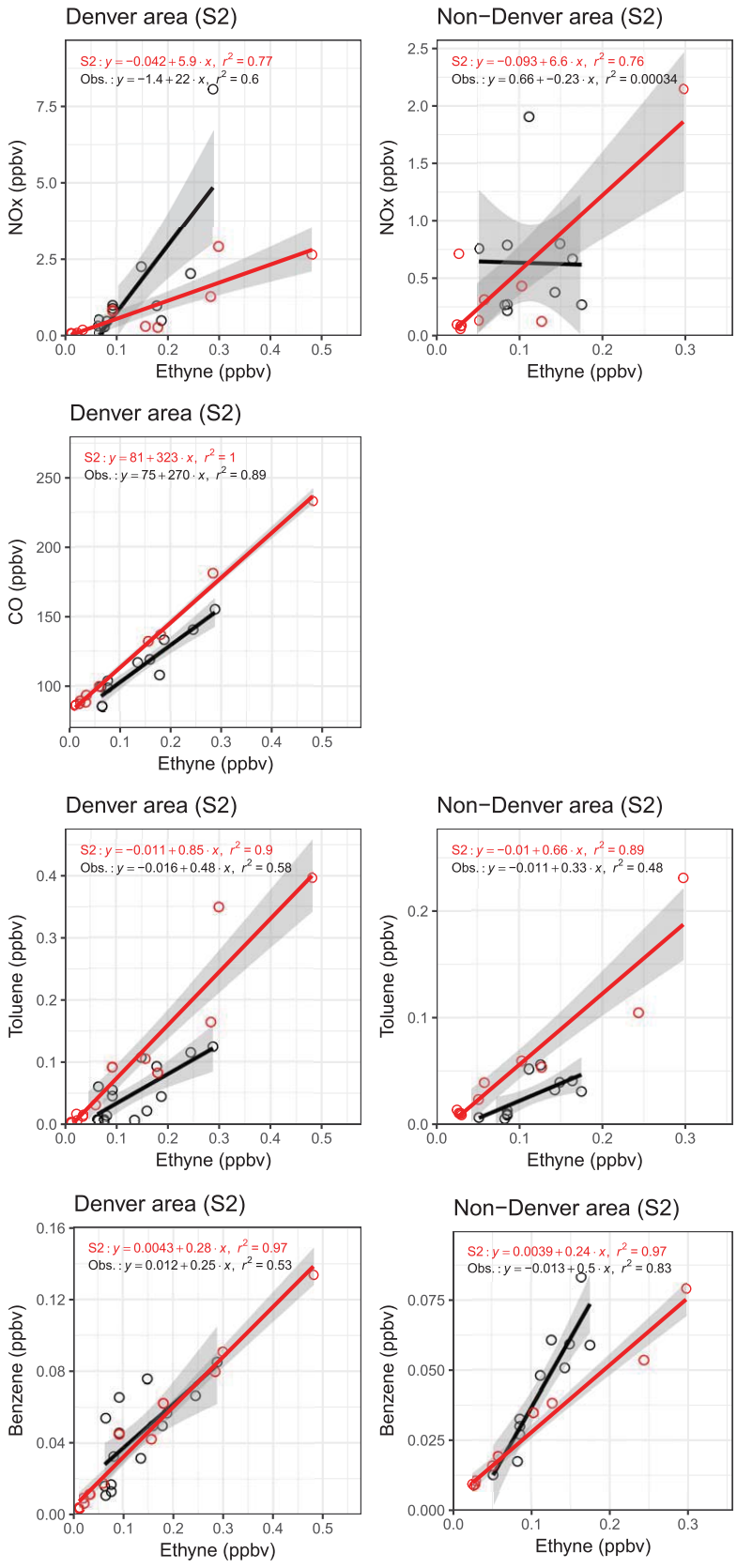

Denver area
y = −0.019 + 1.4 · x, r² = 0.61
Model S0.5 Benzene (ppbv)
C−130 Benzene (ppbv)
Non−Denver urban area
y = 0.008 + 0.31 · x, r² = 0.18
Model S0.5 Benzene (ppbv)
C−130 Benzene (ppbv)
Oil and Gas area
y = 0.013 + 0.24 · x, r² = 0.074
Model S0.5 Benzene (ppbv)
C−130 Benzene (ppbv)
Mobile Emis. Contrib. (%)
O&G Emis. Contrib. (%)
100
90
80
70
60
Denver area
y = 1.1 + 0.55 · x, r² = 0.25
Model S0.5 Ethane (ppbv)
C−130 Ethane (ppbv)
Non−Denver urban area
y = 1.8 + 0.085 · x, r² = 0.016
Model S0.5 Ethane (ppbv)
C−130 Ethane (ppbv)
Oil and Gas area
y = 4.2 + 0.38 · x, r² = 0.029
Model S0.5 Ethane (ppbv)
C−130 Ethane (ppbv)
Oil and Gas area
y = 1.1 + 0.24 · x, r² = 0.061
Model S0.5 Propane (ppbv)
C−130 Propane (ppbv)
Non−Denver urban area
y = 16 + −0.36 · x, r² = 0.2
Model S0.5 PAR (ppbv)
C−130 PAR (ppbv)
Oil and Gas area
y = 14 + 0.15 · x, r² = 0.028
Model S0.5 PAR (ppbv)
C−130 PAR (ppbv)

Figure B7: Tracer ratios of urban tracers versus ethyne over the Denver and non-Denver area and O&G tracers versus propane. Results for 1-minute averaged C-130 observed and S2 modeled concentrations are shown. The same data selection is used as for Figure B1.



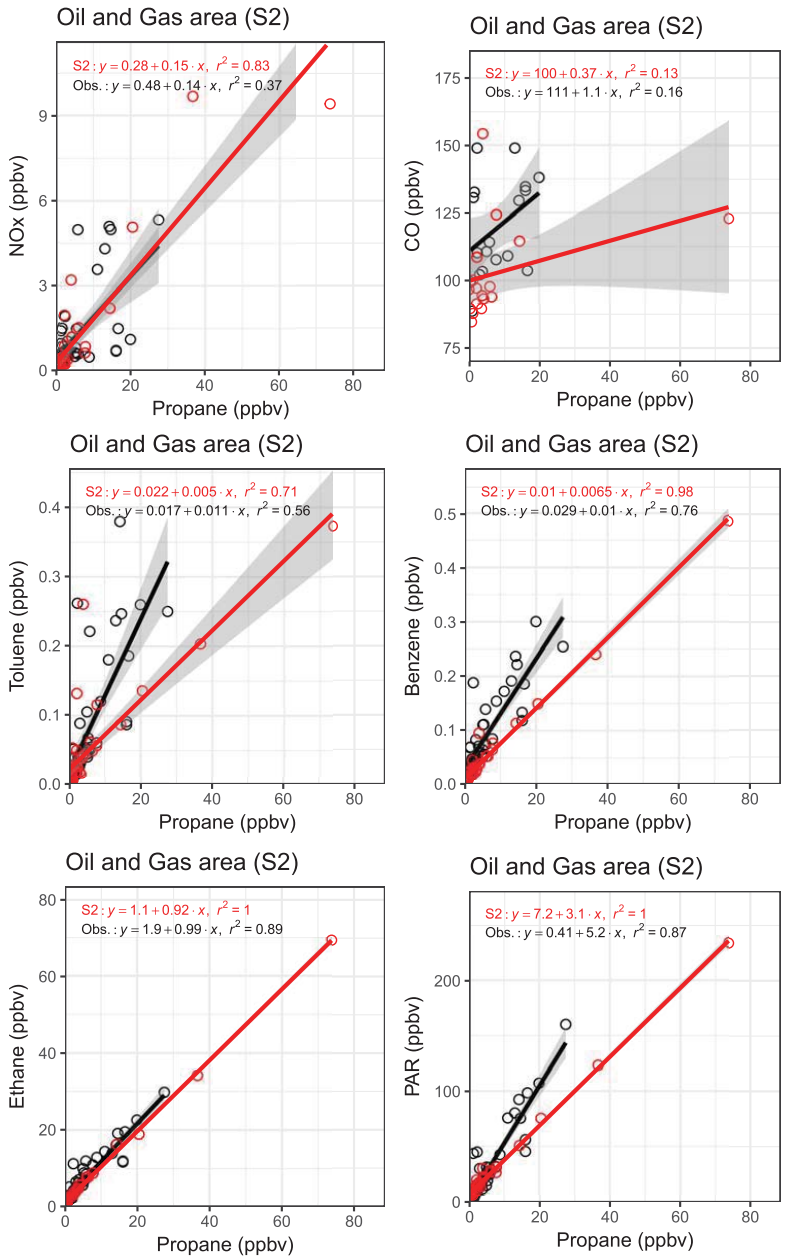
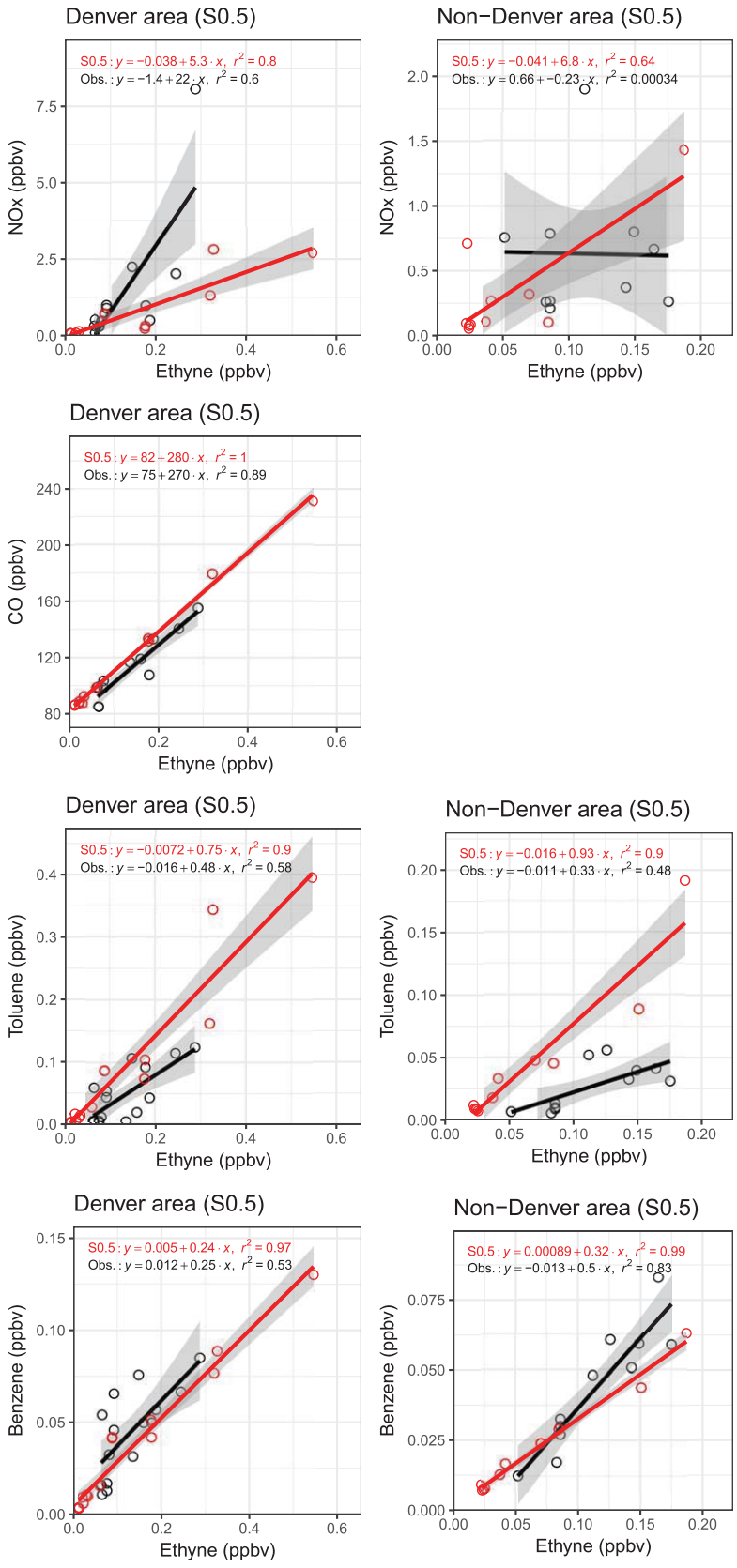

Oil and Gas area (S2)
S2 : y = 0.28 + 0.15 · x, r² = 0.83
Obs. : y = 0.48 + 0.14 · x, r² = 0.37
NOx (ppbv)
Propane (ppbv)
Oil and Gas area (S2)
S2 : y = 100 + 0.37 · x, r² = 0.13
Obs. : y = 111 + 1.1 · x, r² = 0.16
CO (ppbv)
Propane (ppbv)
Oil and Gas area (S2)
S2 : y = 0.022 + 0.005 · x, r² = 0.71
Obs. : y = 0.017 + 0.011 · x, r² = 0.56
Toluene (ppbv)
Propane (ppbv)
Oil and Gas area (S2)
S2 : y = 0.01 + 0.0065 · x, r² = 0.98
Obs. : y = 0.029 + 0.01 · x, r² = 0.76
Benzene (ppbv)
Propane (ppbv)
Oil and Gas area (S2)
S2 : y = 1.1 + 0.92 · x, r² = 1
Obs. : y = 1.9 + 0.99 · x, r² = 0.89
Ethane (ppbv)
Propane (ppbv)
Oil and Gas area (S2)
S2 : y = 7.2 + 3.1 · x, r² = 1
Obs. : y = 0.41 + 5.2 · x, r² = 0.87
PAR (ppbv)
Propane (ppbv)

Figure B8: Tracer ratios of urban tracers versus ethyne over the Denver and non-Denver area and O&G tracers versus propane. Results for 1-minute averaged C-130 observed and S05 modeled concentrations are shown. The same data selection is used as for Figure B2.



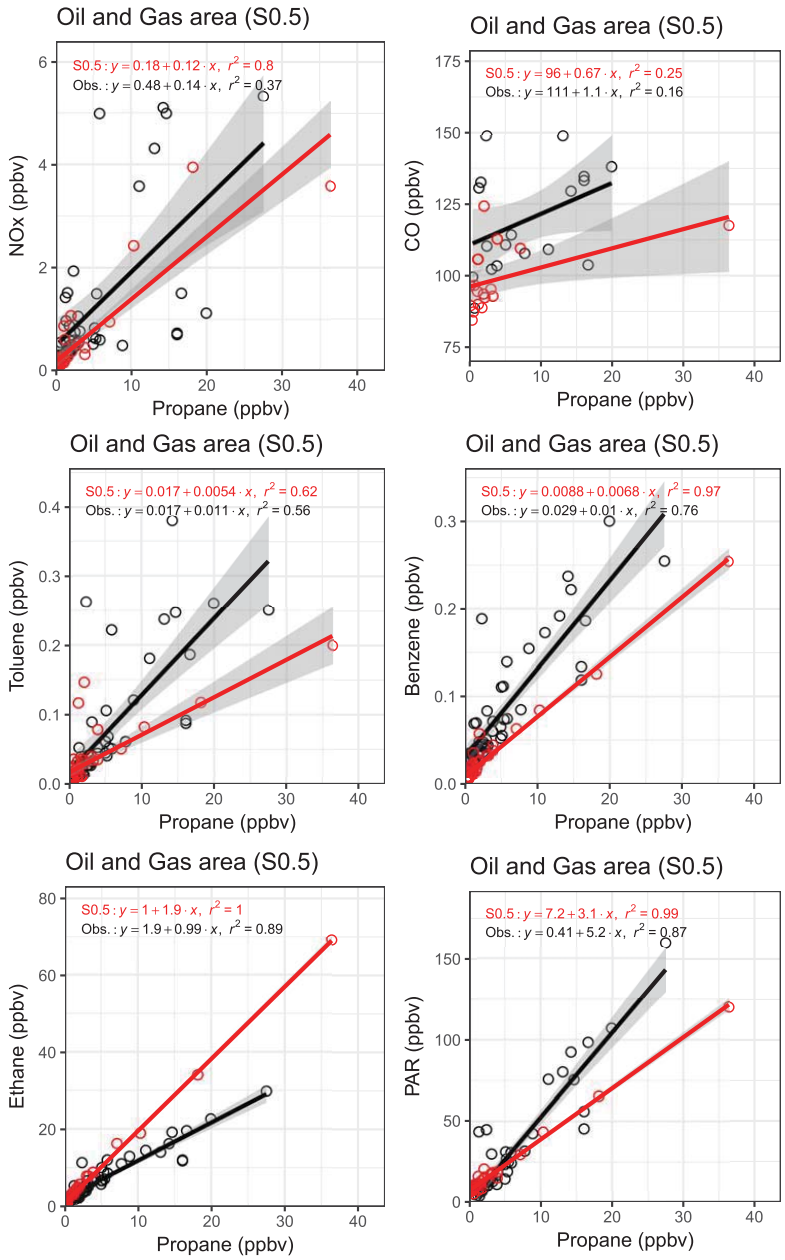
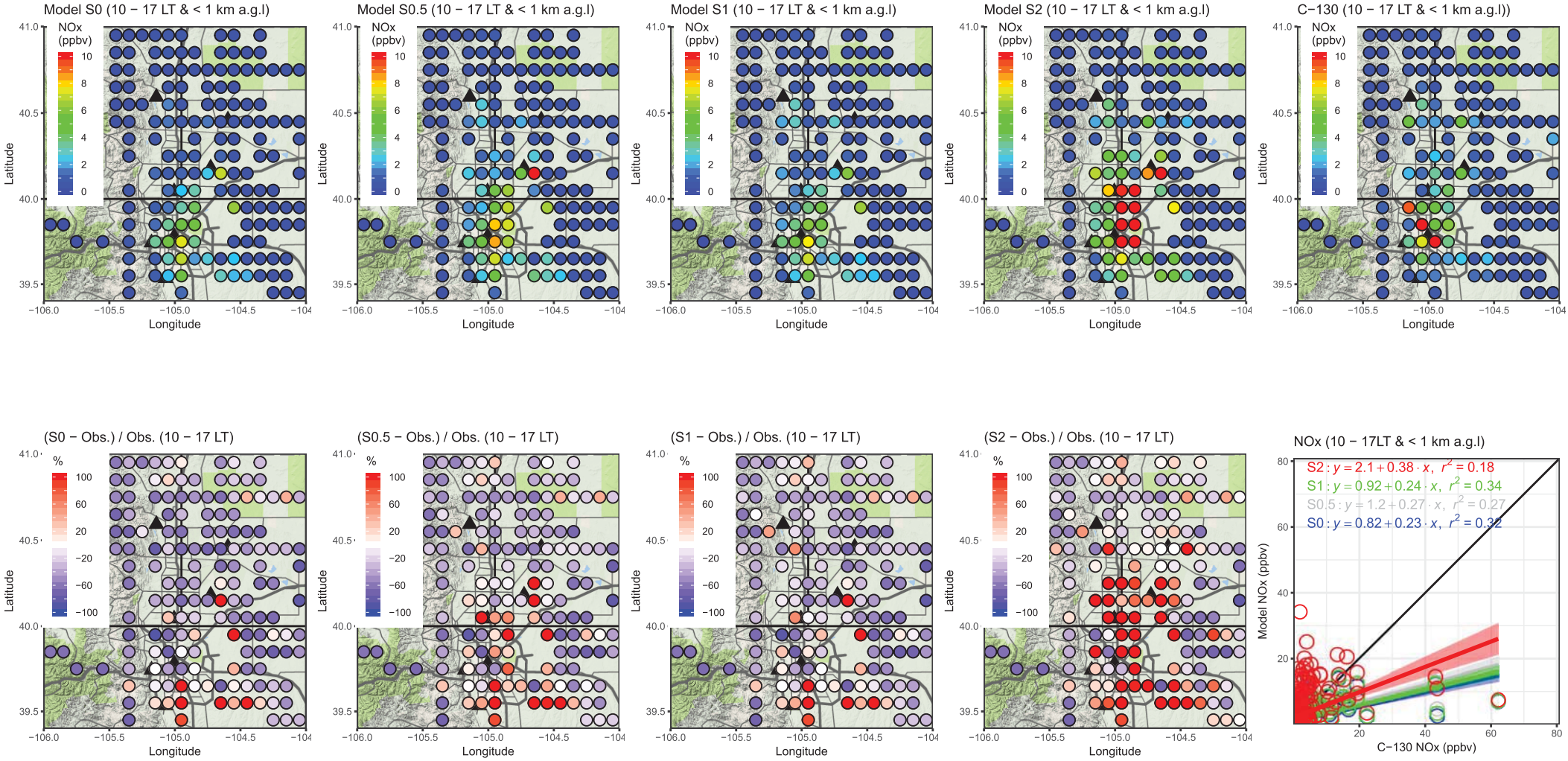
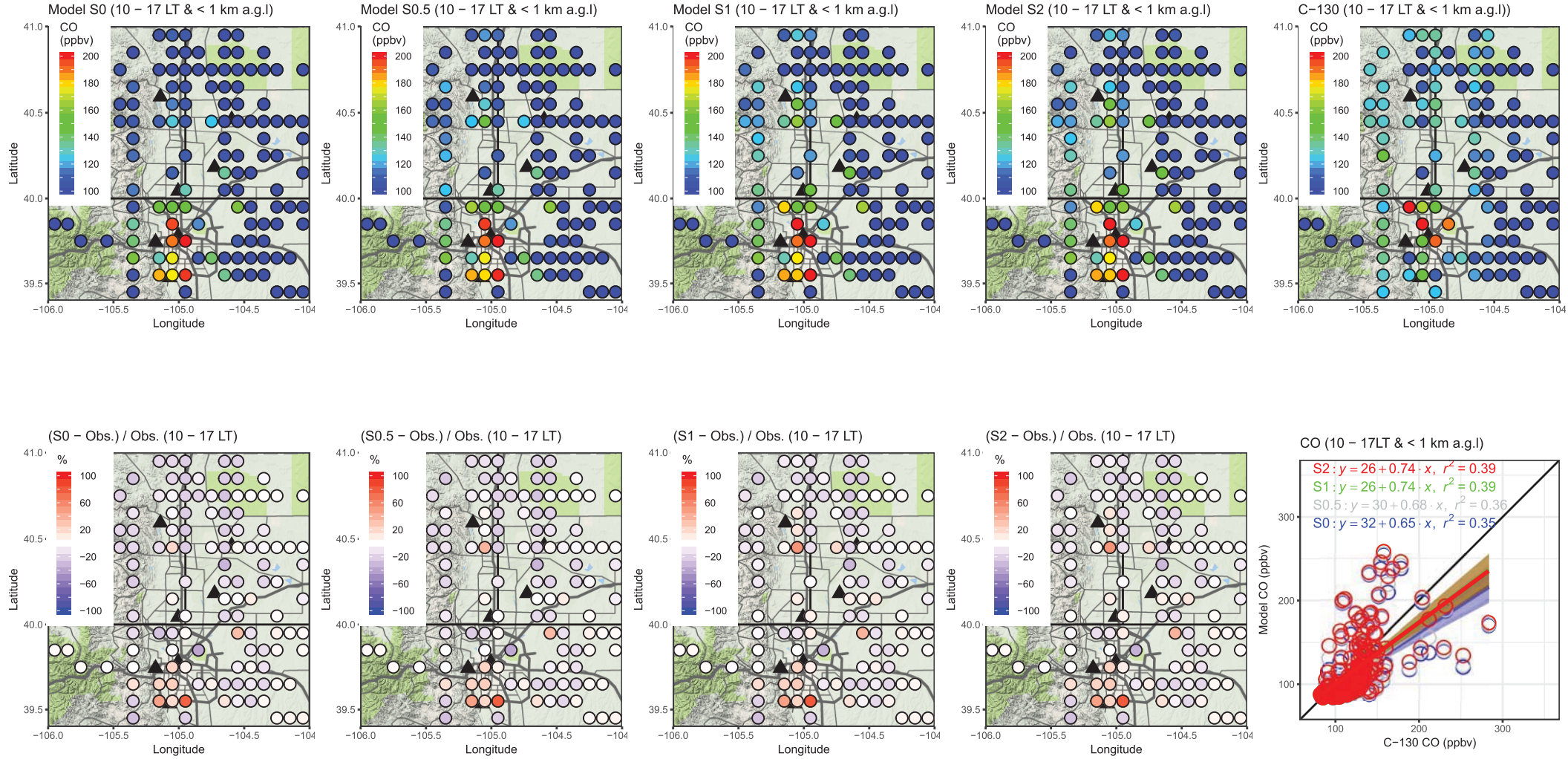
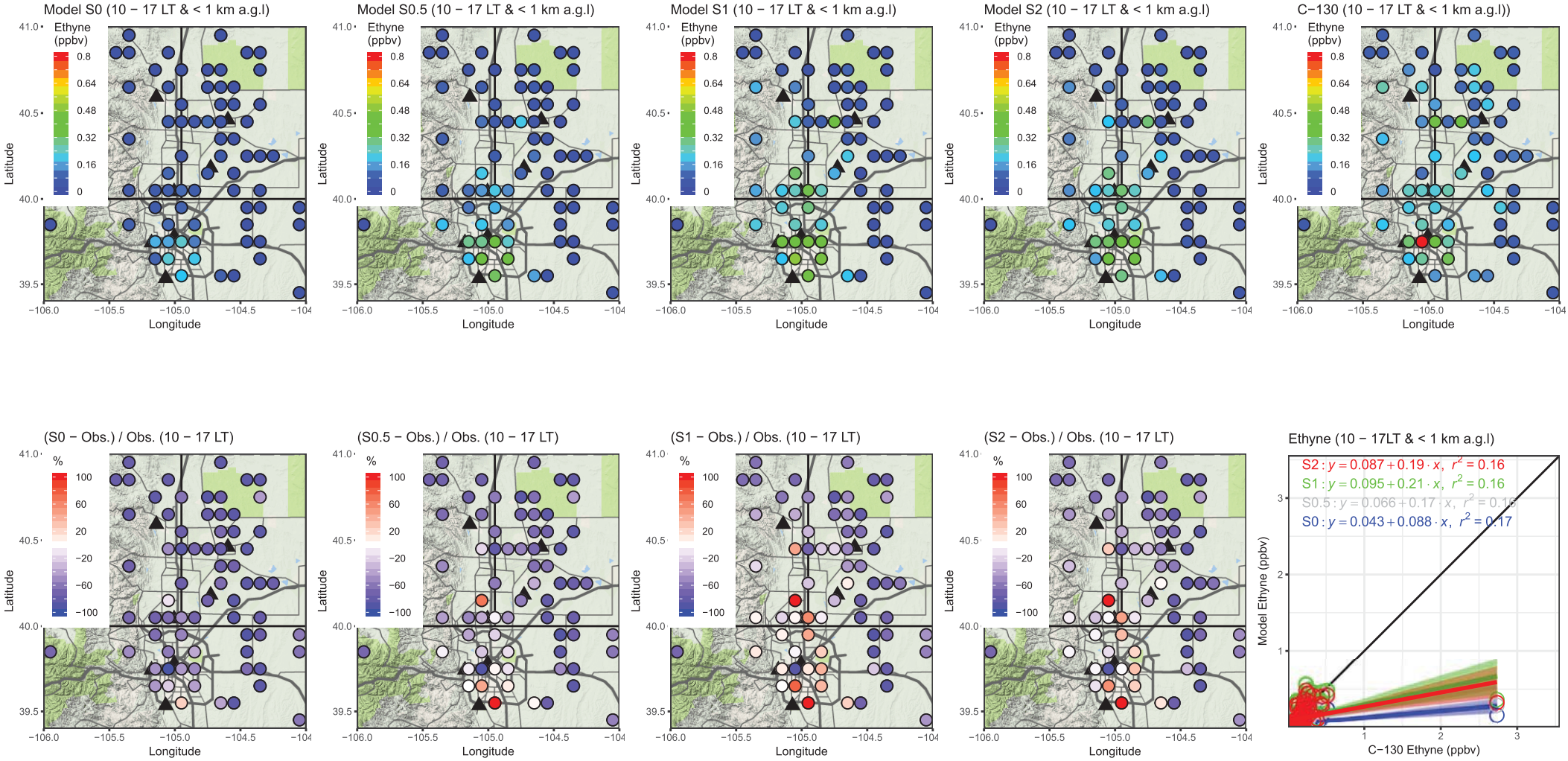
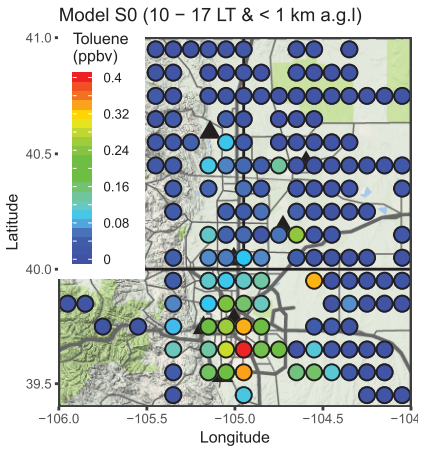

Oil and Gas area (S0.5)
S0.5 : y = 0.18 + 0.12 · x, r² = 0.8
Obs. : y = 0.48 + 0.14 · x, r² = 0.37
NOx (ppbv)
Propane (ppbv)
Oil and Gas area (S0.5)
S0.5 : y = 96 + 0.67 · x, r² = 0.25
Obs. : y = 111 + 1.1 · x, r² = 0.16
CO (ppbv)
Propane (ppbv)
Oil and Gas area (S0.5)
S0.5 : y = 0.017 + 0.0054 · x, r² = 0.62
Obs. : y = 0.017 + 0.011 · x, r² = 0.56
Toluene (ppbv)
Propane (ppbv)
Oil and Gas area (S0.5)
S0.5 : y = 0.0088 + 0.0068 · x, r² = 0.97
Obs. : y = 0.029 + 0.01 · x, r² = 0.76
Benzene (ppbv)
Propane (ppbv)
Oil and Gas area (S0.5)
S0.5 : y = 1 + 1.9 · x, r² = 1
Obs. : y = 1.9 + 0.99 · x, r² = 0.89
Ethane (ppbv)
Propane (ppbv)
Oil and Gas area (S0.5)
S0.5 : y = 7.2 + 3.1 · x, r² = 0.99
Obs. : y = 0.41 + 5.2 · x, r² = 0.87
PAR (ppbv)
Propane (ppbv)

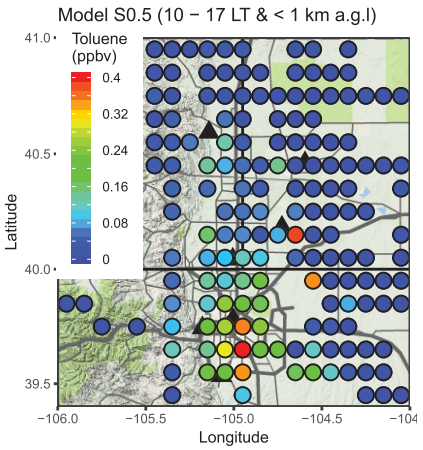
Figure B9: Comparisons of S0, S05, S1 and S2 model results to 1-minute C-130 aircraft measurements of NOx, CO, Ethyne, Toluene, Benzene, Ethane, Propane and PAR. All data were sampled below 1km a.g.l. and averaged over 0.1° × 0.1° except for the scatter plots for which we use 1-minute average measurements compared with interpolated 1-hour instantaneous model data for each measurement location.

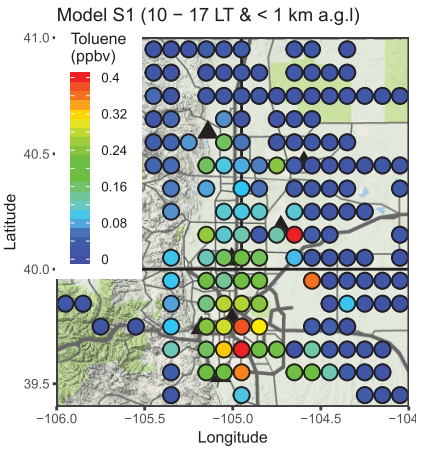


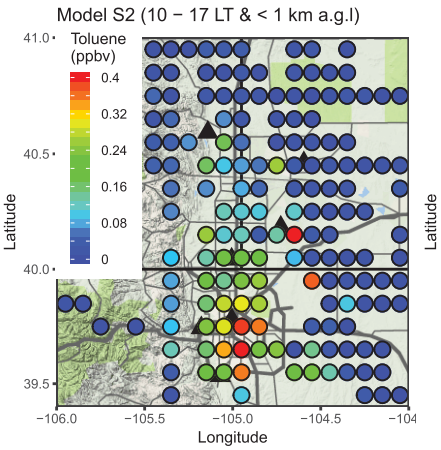

Model S0 (10 − 17 LT & < 1 km a.g.l)
Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Model S1 (10 − 17 LT & < 1 km a.g.l)
Model S2 (10 − 17 LT & < 1 km a.g.l)
C−130 (10 − 17 LT & < 1 km a.g.l))
CO (ppbv)
200
180
160
140
120
100
Latitude
Longitude
41.0
40.5
40.0
39.5
−106.0
−105.5
−105.0
−104.5
(S0 − Obs.) / Obs. (10 − 17 LT)
(S0.5 − Obs.) / Obs. (10 − 17 LT)
(S1 − Obs.) / Obs. (10 − 17 LT)
(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
CO (10 − 17LT & < 1 km a.g.l)
S2 : y = 26 + 0.74 · x, r² = 0.39
S1 : y = 26 + 0.74 · x, r² = 0.39
S0.5 : y = 30 + 0.68 · x, r² = 0.36
S0 : y = 32 + 0.65 · x, r² = 0.35
Model CO (ppbv)
C−130 CO (ppbv)
100
200
300

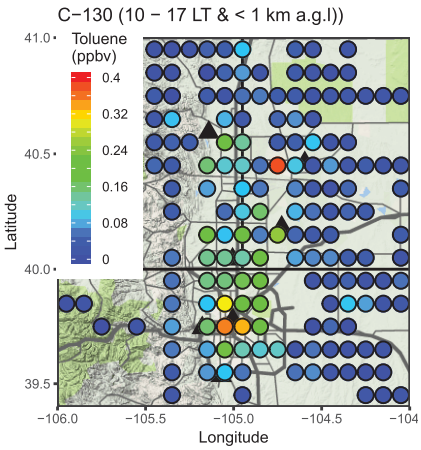

Model S0 (10 − 17 LT & < 1 km a.g.l)
Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Model S1 (10 − 17 LT & < 1 km a.g.l)
Model S2 (10 − 17 LT & < 1 km a.g.l)
C−130 (10 − 17 LT & < 1 km a.g.l))
Ethyne (ppbv)
0.8
0.64
0.48
0.32
0.16
0
Latitude
Longitude
41.0
40.5
40.0
39.5
−106.0
−105.5
−105.0
−104.5
(S0 − Obs.) / Obs. (10 − 17 LT)
(S0.5 − Obs.) / Obs. (10 − 17 LT)
(S1 − Obs.) / Obs. (10 − 17 LT)
(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
Ethyne (10 − 17LT & < 1 km a.g.l)
S2 : y = 0.087 + 0.19 · x, r² = 0.16
S1 : y = 0.095 + 0.21 · x, r² = 0.16
S0.5 : y = 0.066 + 0.17 · x, r² = 0.15
S0 : y = 0.043 + 0.088 · x, r² = 0.17
Model Ethyne (ppbv)
C−130 Ethyne (ppbv)
1
2
3

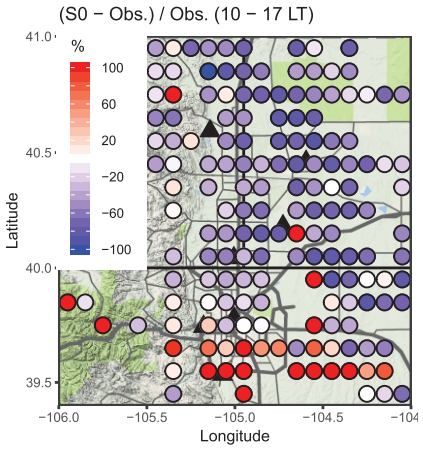

Model S0 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

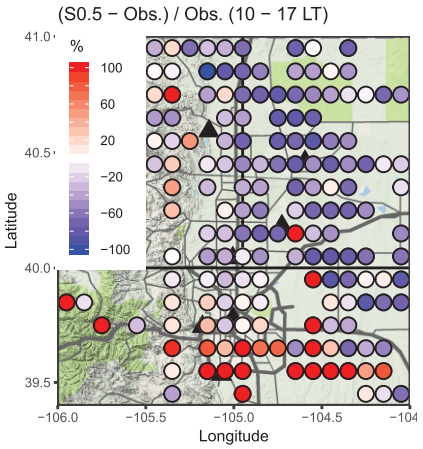

Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

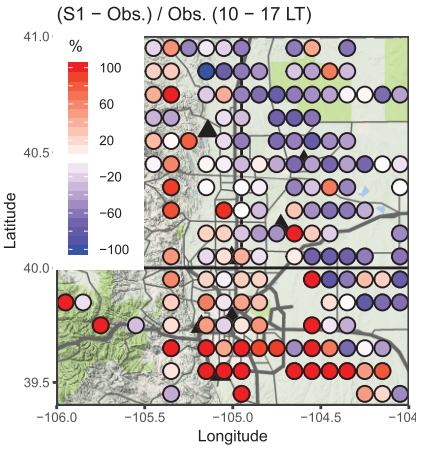

Model S1 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

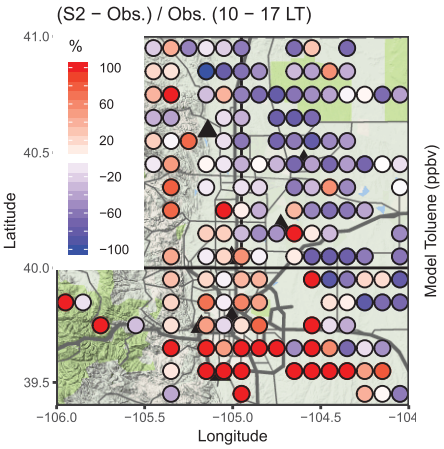

Model S2 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

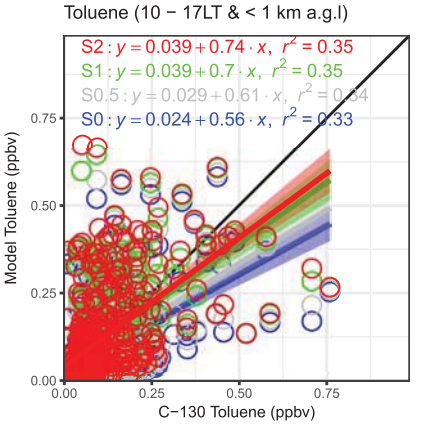

C−130 (10 − 17 LT & < 1 km a.g.l))
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

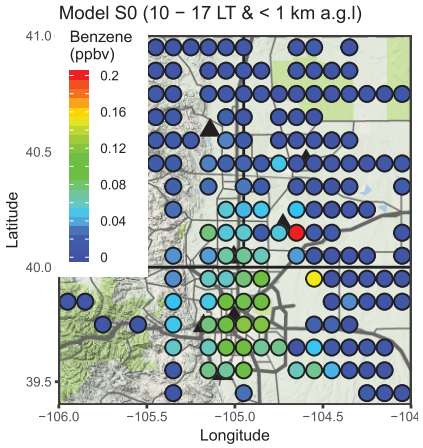

(S0 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

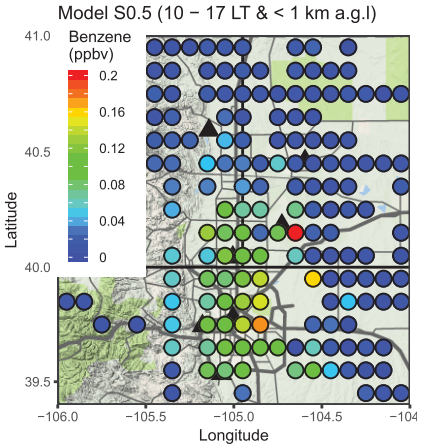

(S0.5 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

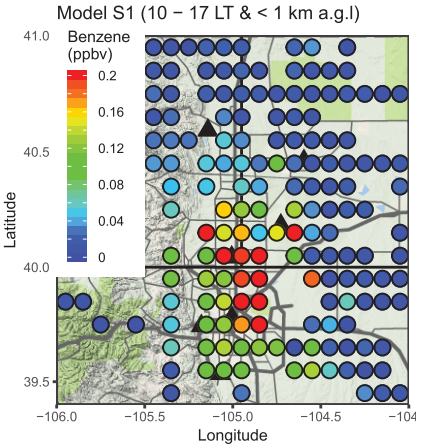

(S1 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

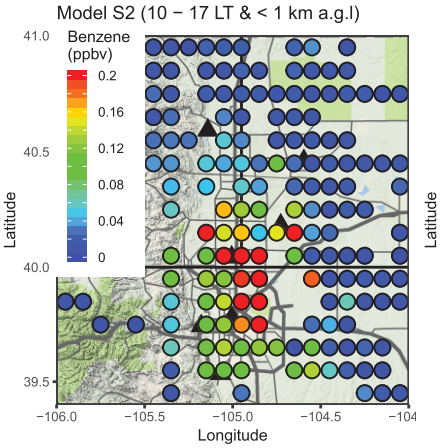

(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

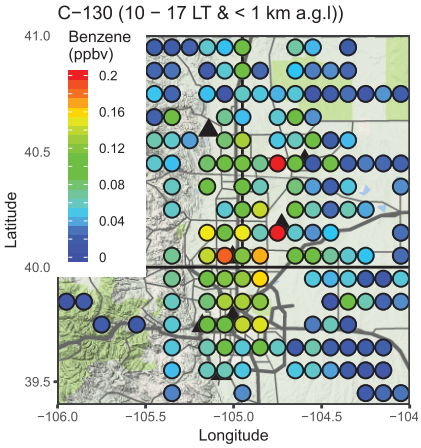

Toluene (10 − 17LT & < 1 km a.g.l)
S2 : y = 0.039 + 0.74 · x, r² = 0.35
S1 : y = 0.039 + 0.7 · x, r² = 0.35
S0.5 : y = 0.029 + 0.61 · x, r² = 0.34
S0 : y = 0.024 + 0.56 · x, r² = 0.33
Model Toluene (ppbv)
0.00
0.25
0.50
0.75
C−130 Toluene (ppbv)

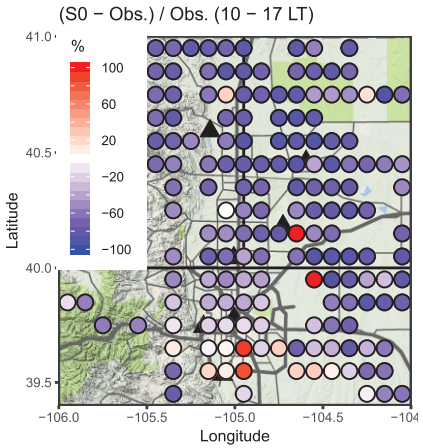

Model S0 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

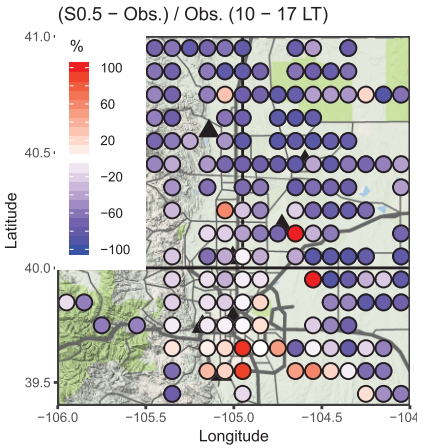

Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

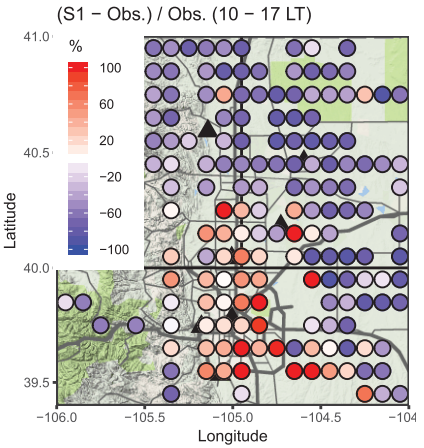

Model S1 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

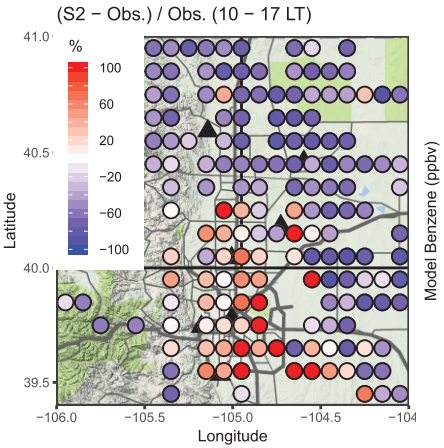

Model S2 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

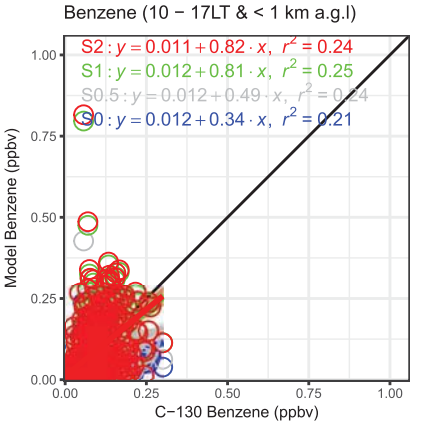

C−130 (10 − 17 LT & < 1 km a.g.l))
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

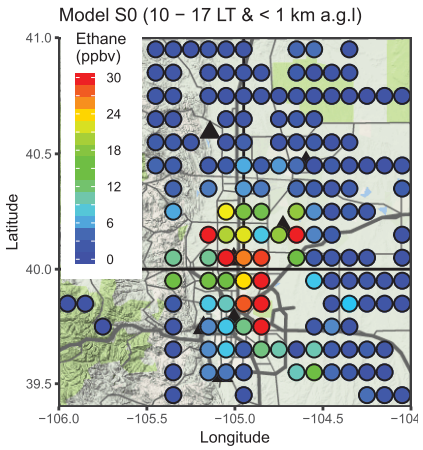

(S0 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

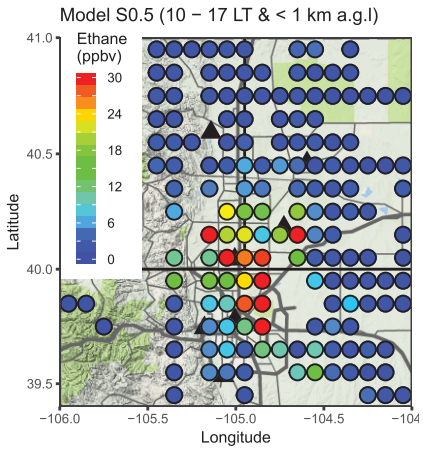

(S0.5 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

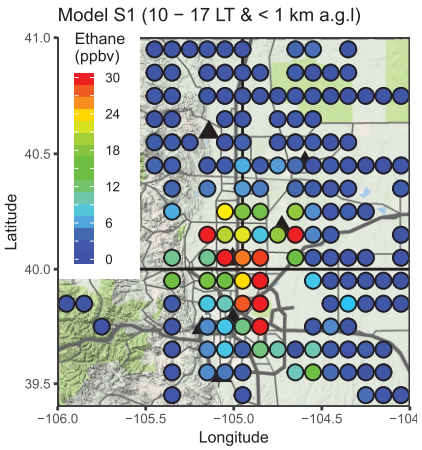

(S1 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

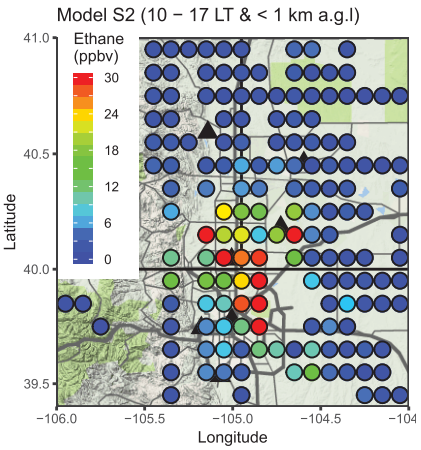

(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

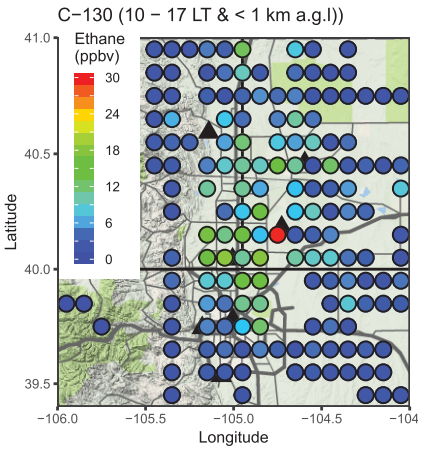

Benzene (10 − 17LT & < 1 km a.g.l)
S2 : y = 0.011 + 0.82 · x, r² = 0.24
S1 : y = 0.012 + 0.81 · x, r² = 0.25
S0.5 : y = 0.012 + 0.49 · x, r² = 0.24
S0 : y = 0.012 + 0.34 · x, r² = 0.21
Model Benzene (ppbv)
1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00
C−130 Benzene (ppbv)

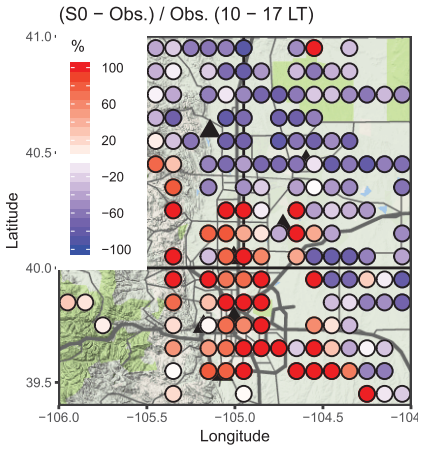

Model S0 (10 − 17 LT & < 1 km a.g.l)
Ethane (ppbv)
30
24
18
12
6
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

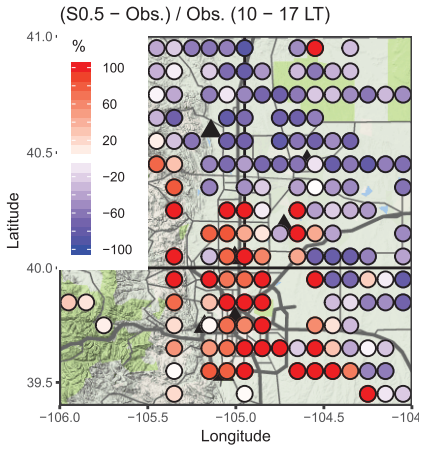

Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Ethane (ppbv)
30
24
18
12
6
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

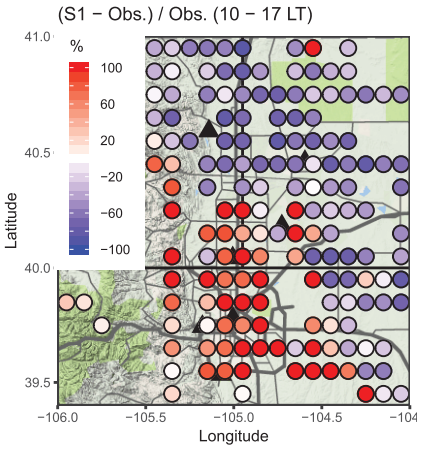

Model S1 (10 − 17 LT & < 1 km a.g.l)
Ethane (ppbv)
30
24
18
12
6
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

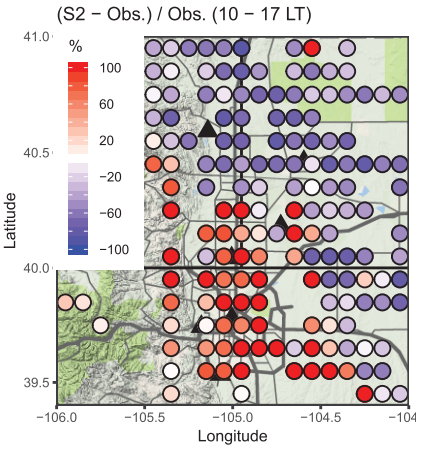

Model S2 (10 − 17 LT & < 1 km a.g.l)
Ethane (ppbv)
30
24
18
12
6
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

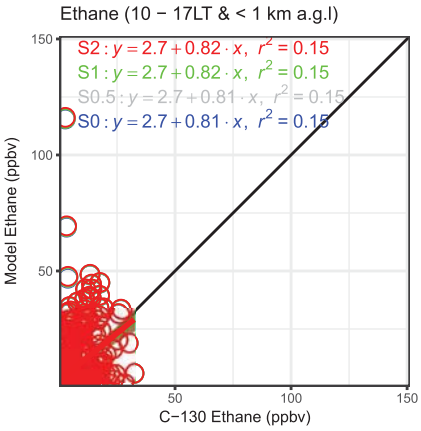

C−130 (10 − 17 LT & < 1 km a.g.l))
Ethane (ppbv)
30
24
18
12
6
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

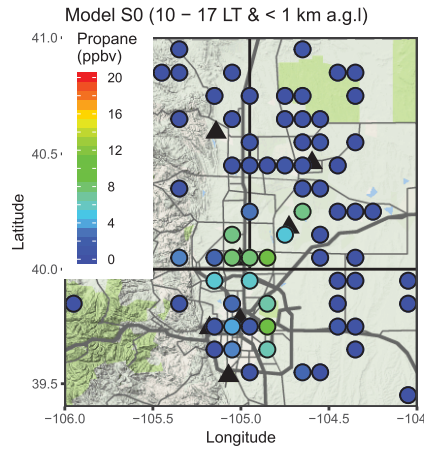

(S0 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

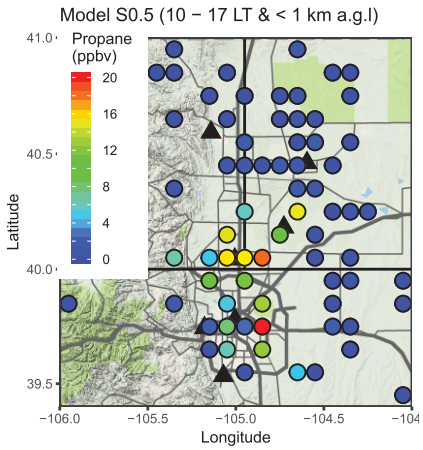

(S0.5 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

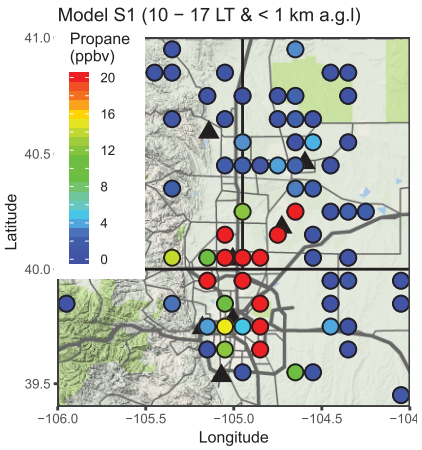

(S1 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

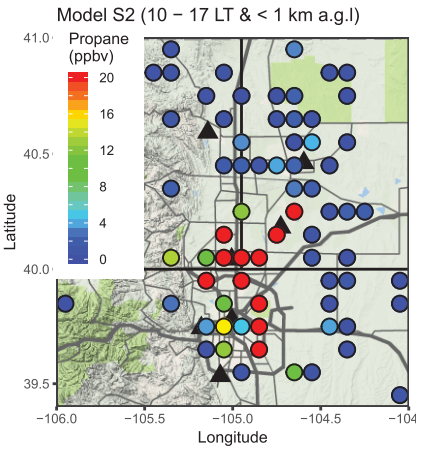

(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

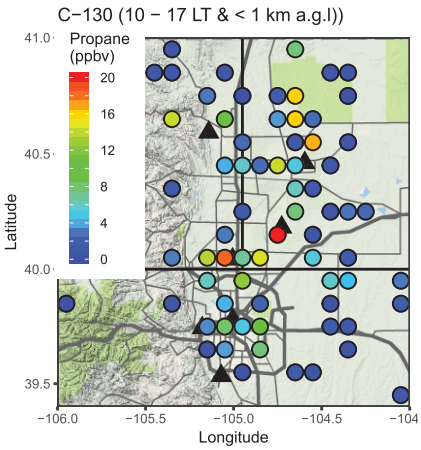

Ethane (10 − 17LT & < 1 km a.g.l)
S2 : y = 2.7 + 0.82 · x, r² = 0.15
S1 : y = 2.7 + 0.82 · x, r² = 0.15
S0.5 : y = 2.7 + 0.81 · x, r² = 0.15
S0 : y = 2.7 + 0.81 · x, r² = 0.15
150
100
50
Model Ethane (ppbv)
50
100
150
C−130 Ethane (ppbv)

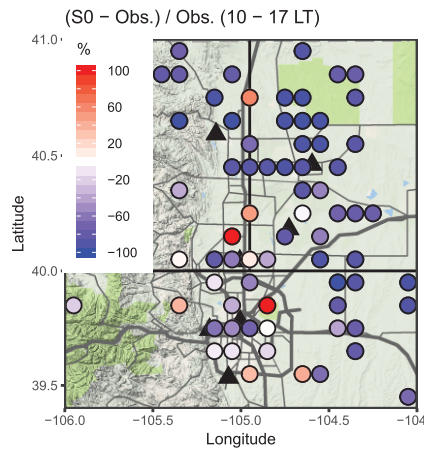

Model S0 (10 − 17 LT & < 1 km a.g.l)
Propane (ppbv)
20
16
12
8
4
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

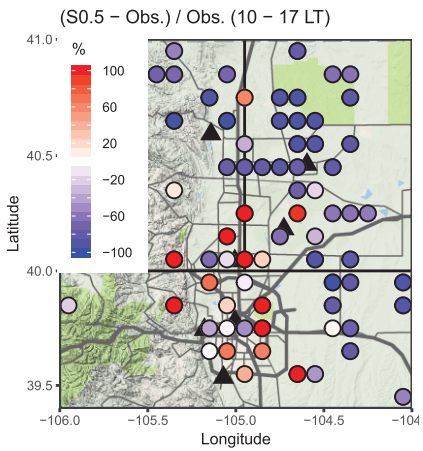

Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Propane (ppbv)
20
16
12
8
4
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

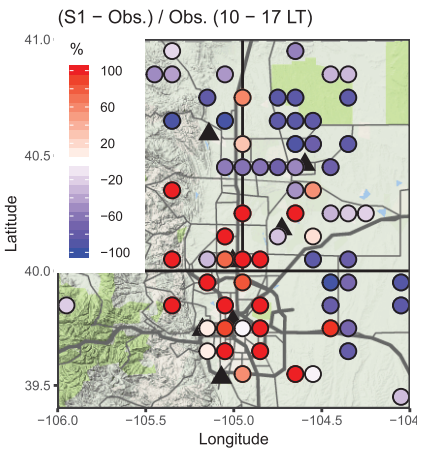

Model S1 (10 − 17 LT & < 1 km a.g.l)
Propane (ppbv)
20
16
12
8
4
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

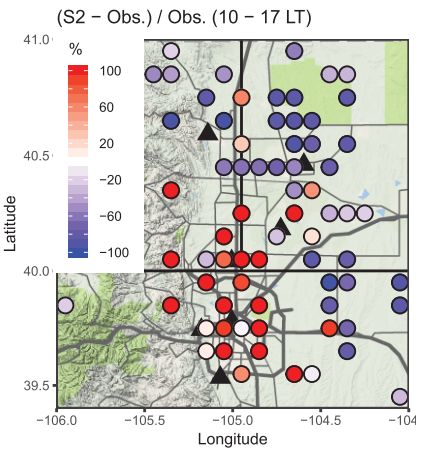

Model S2 (10 − 17 LT & < 1 km a.g.l)
Propane (ppbv)
20
16
12
8
4
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

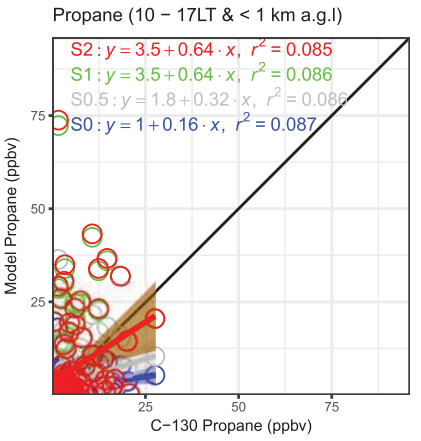

C−130 (10 − 17 LT & < 1 km a.g.l))
Propane (ppbv)
20
16
12
8
4
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S0 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S0.5 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S1 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


Propane (10 − 17LT & < 1 km a.g.l)
S2 : y = 3.5 + 0.64 · x, r² = 0.085
S1 : y = 3.5 + 0.64 · x, r² = 0.086
S0.5 : y = 1.8 + 0.32 · x, r² = 0.086
S0 : y = 1 + 0.16 · x, r² = 0.087
75
50
25
Model Propane (ppbv)
25
50
75
C−130 Propane (ppbv)

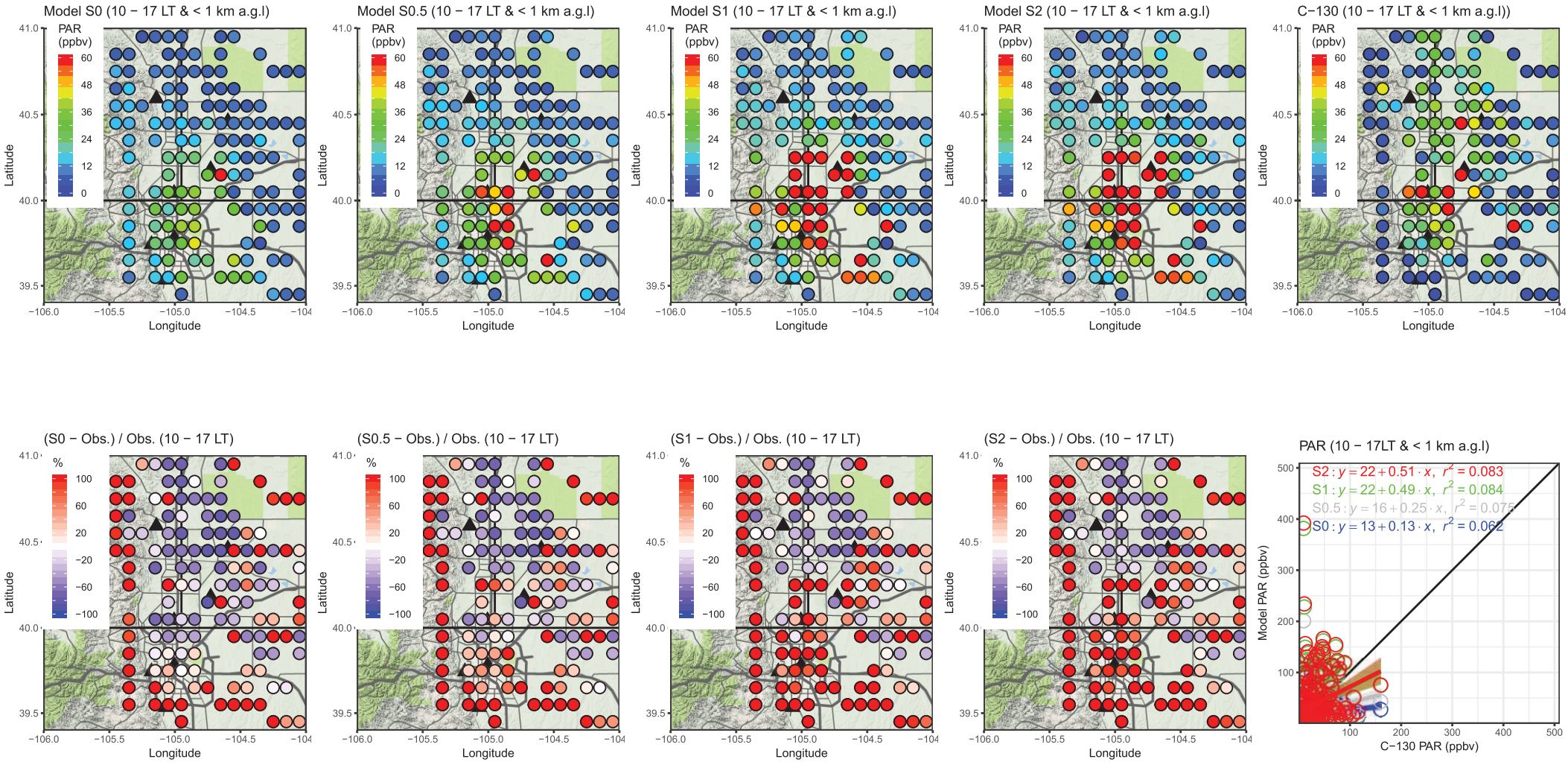
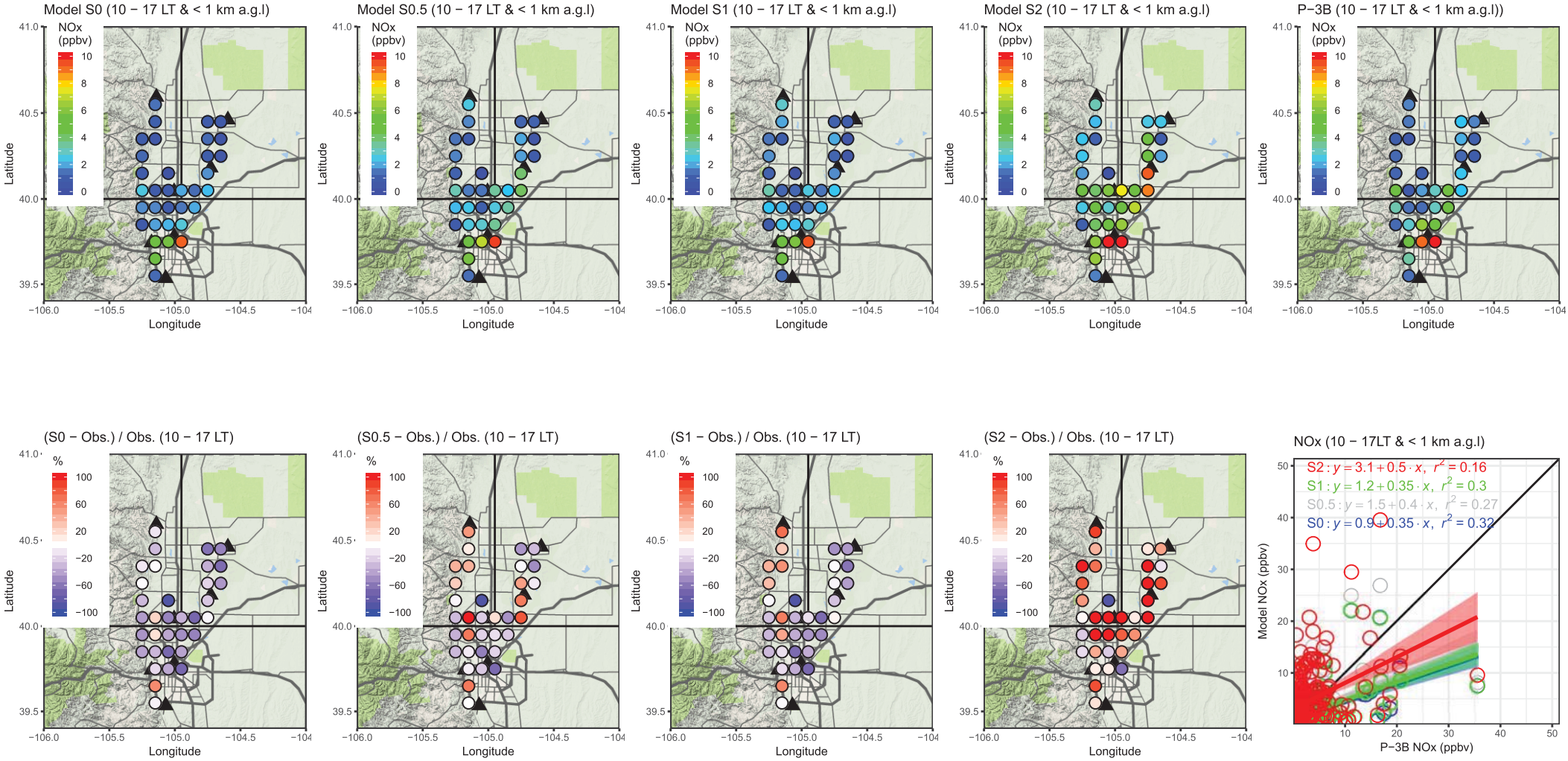
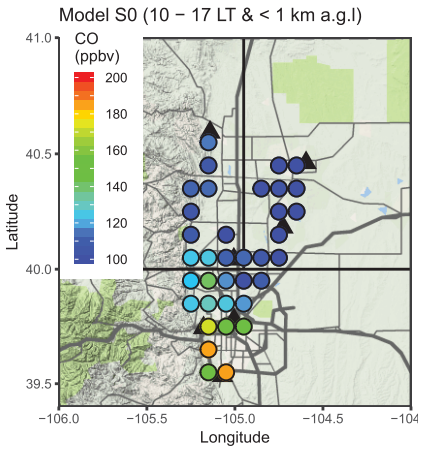
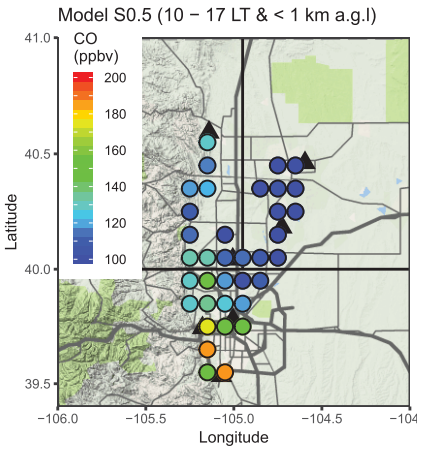
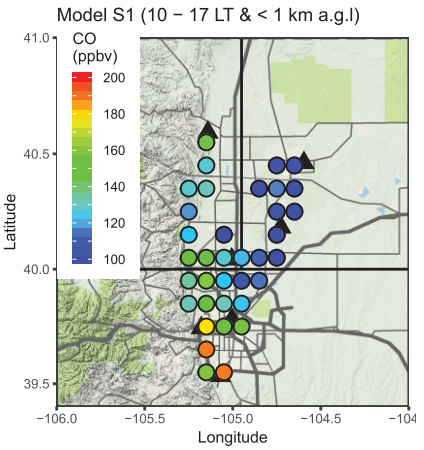

Model S0 (10 − 17 LT & < 1 km a.g.l)
Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Model S1 (10 − 17 LT & < 1 km a.g.l)
Model S2 (10 − 17 LT & < 1 km a.g.l)
C−130 (10 − 17 LT & < 1 km a.g.l))
PAR (ppbv)
60
48
36
24
12
0
Latitude
Longitude
41.0
40.5
40.0
39.5
−106.0
−105.5
−105.0
−104.5
(S0 − Obs.) / Obs. (10 − 17 LT)
(S0.5 − Obs.) / Obs. (10 − 17 LT)
(S1 − Obs.) / Obs. (10 − 17 LT)
(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
PAR (10 − 17LT & < 1 km a.g.l)
S2 : y = 22 + 0.51 · x, r2 = 0.083
S1 : y = 22 + 0.49 · x, r2 = 0.084
S0.5 : y = 16 + 0.25 · x, r2 = 0.075
S0 : y = 13 + 0.13 · x, r2 = 0.062
Model PAR (ppbv)
C−130 PAR (ppbv)
500
400
300
200
100

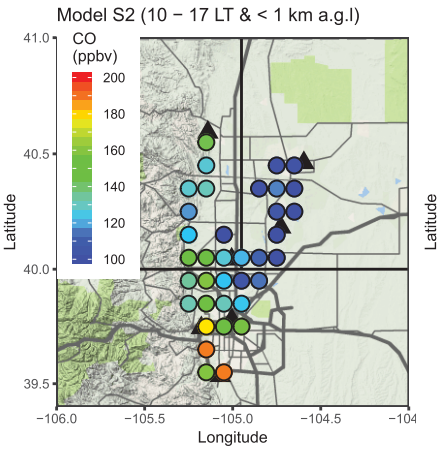
Figure C1. Comparisons of S0, S05, S1 and S2 model results to 1-minute P-3 aircraft measurements of NOx, CO, Ethane, Toluene, and Benzene. All data were sampled below 1km a.g.l. and averaged over 0.1° × 0.1° except for the scatter plots for which we use 1-minute average measurements compared with interpolated 1-hour instantaneous model data for each measurement location.

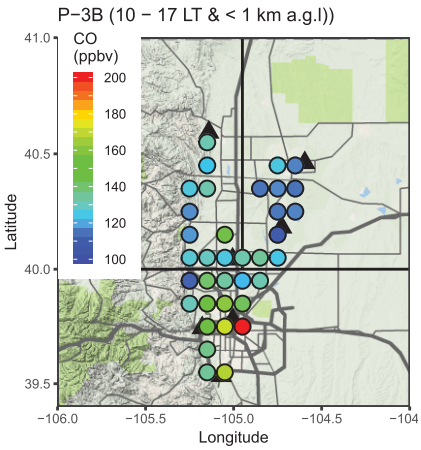


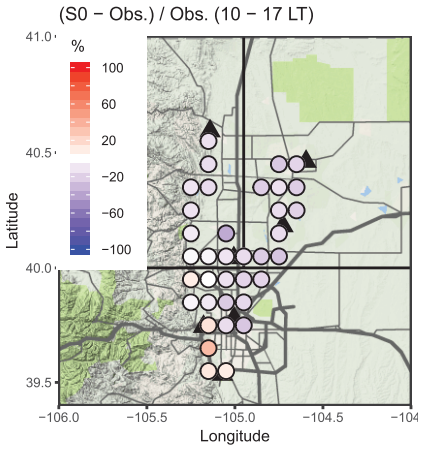

Model S0 (10 − 17 LT & < 1 km a.g.l)
CO (ppbv)
200
180
160
140
120
100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

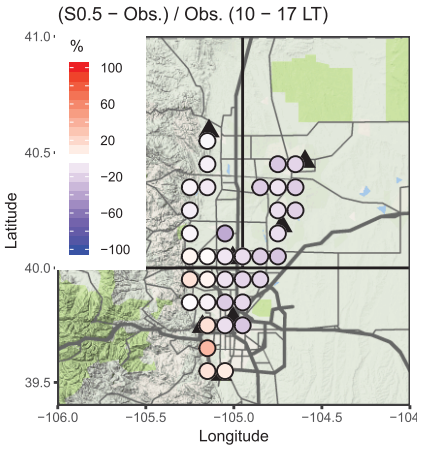

Model S0.5 (10 − 17 LT & < 1 km a.g.l)
CO (ppbv)
200
180
160
140
120
100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

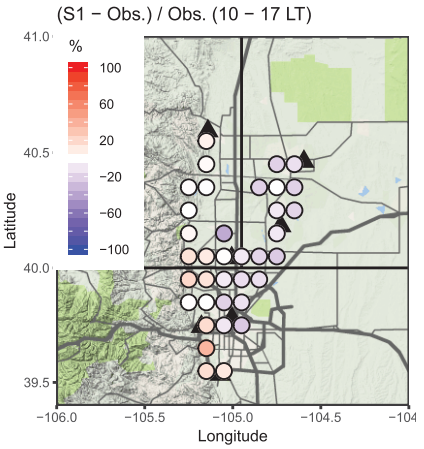

Model S1 (10 − 17 LT & < 1 km a.g.l)
CO (ppbv)
200
180
160
140
120
100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

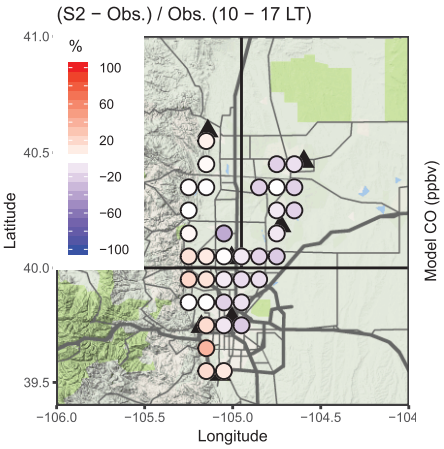

Model S2 (10 − 17 LT & < 1 km a.g.l)
CO (ppbv)
200
180
160
140
120
100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

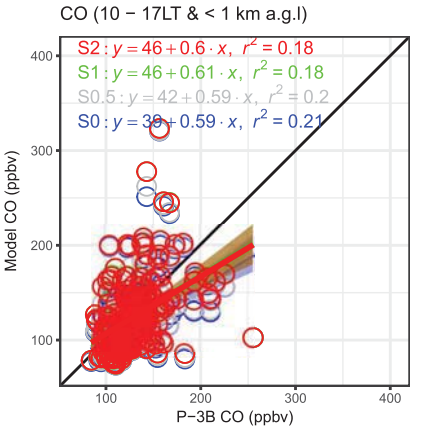

P−3B (10 − 17 LT & < 1 km a.g.l))
CO (ppbv)
200
180
160
140
120
100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

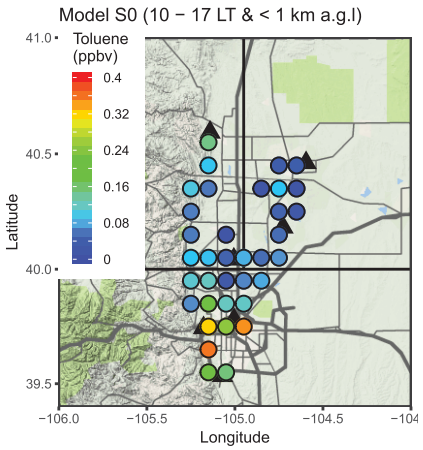

(S0 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

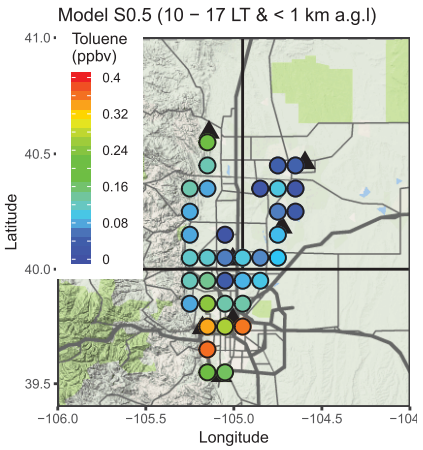

(S0.5 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

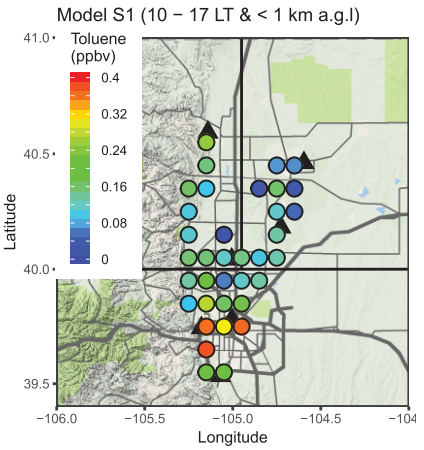

(S1 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

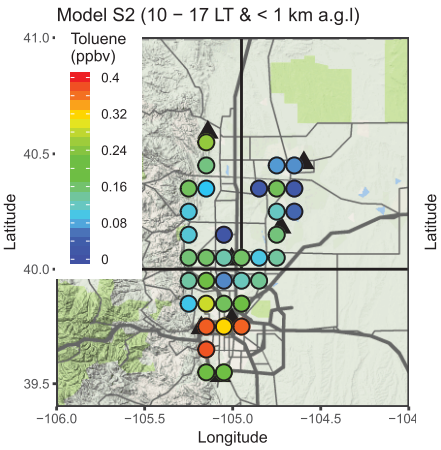

(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

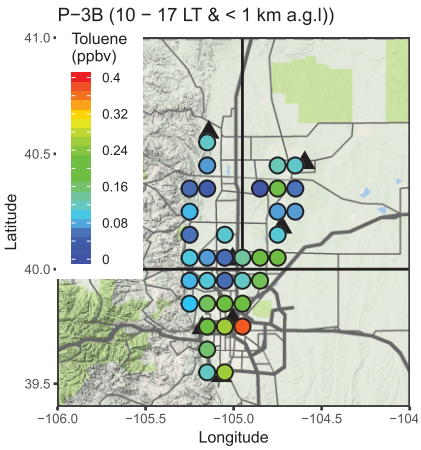

CO (10 − 17LT & < 1 km a.g.l)
S2 : y = 46 + 0.6 · x, r² = 0.18
S1 : y = 46 + 0.61 · x, r² = 0.18
S0.5 : y = 42 + 0.59 · x, r² = 0.2
S0 : y = 36 + 0.59 · x, r² = 0.21
400
300
200
100
Model CO (ppbv)
100
200
300
400
P−3B CO (ppbv)

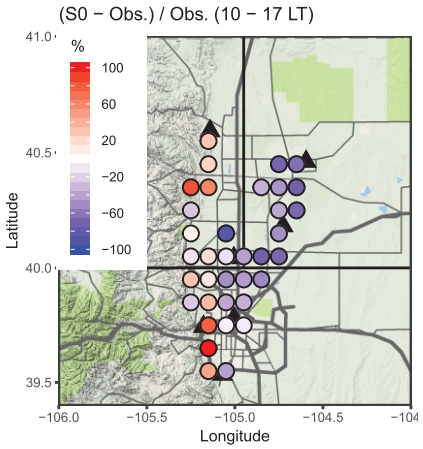

Model S0 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
Latitude
Longitude

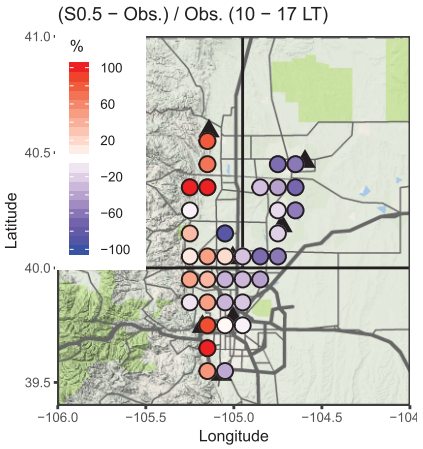

Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
Latitude
Longitude

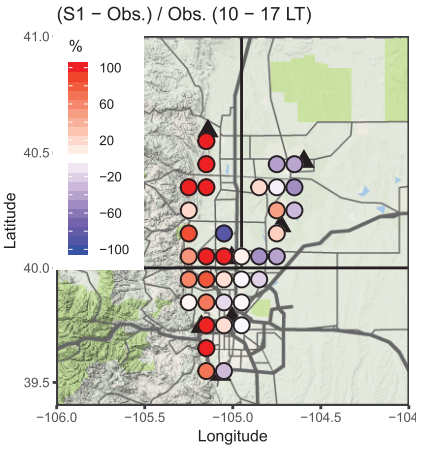

Model S1 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
Latitude
Longitude

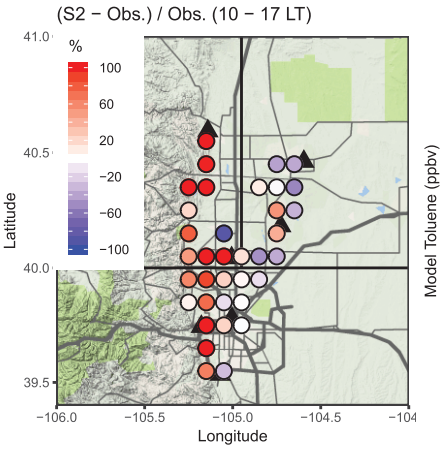

Model S2 (10 − 17 LT & < 1 km a.g.l)
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
Latitude
Longitude

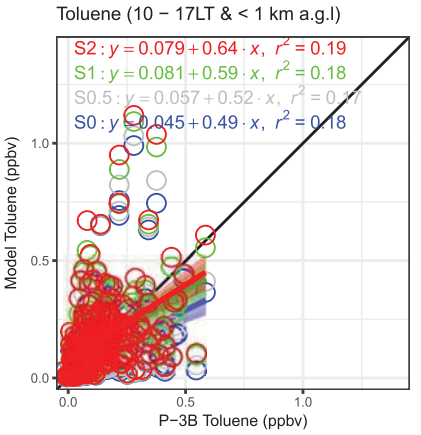

P−3B (10 − 17 LT & < 1 km a.g.l))
Toluene (ppbv)
0.4
0.32
0.24
0.16
0.08
0
Latitude
Longitude

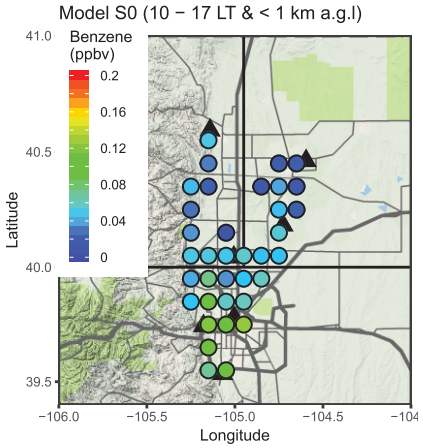

(S0 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
Latitude
Longitude

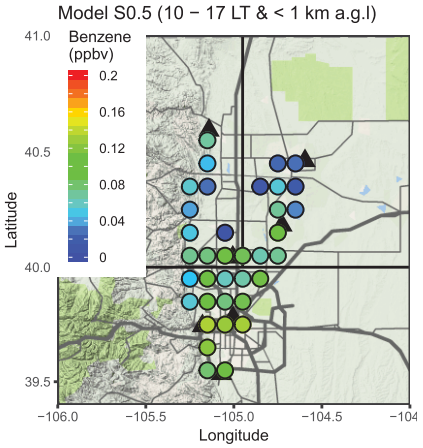

(S0.5 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
Latitude
Longitude

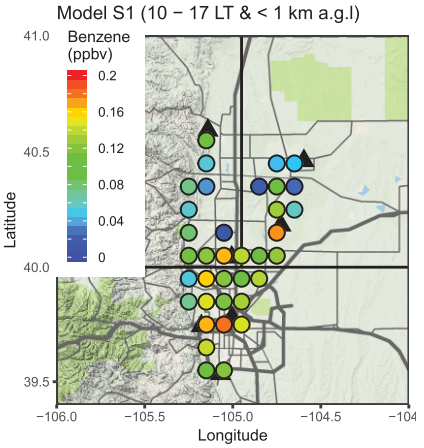

(S1 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
Latitude
Longitude

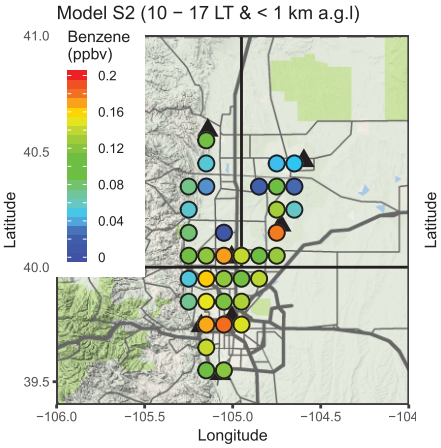

(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
Latitude
Longitude

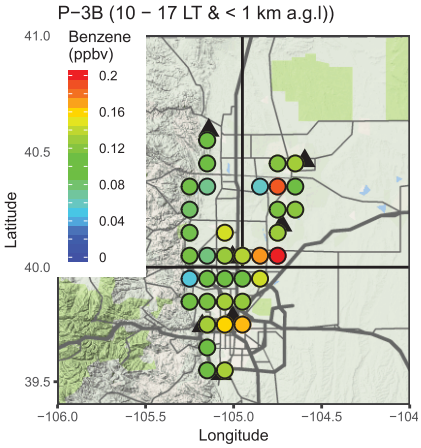

Toluene (10 − 17LT & < 1 km a.g.l)
S2 : y = 0.079 + 0.64 · x, r² = 0.19
S1 : y = 0.081 + 0.59 · x, r² = 0.18
S0 : y = 0.045 + 0.49 · x, r² = 0.18
Model Toluene (ppbv)
P−3B Toluene (ppbv)

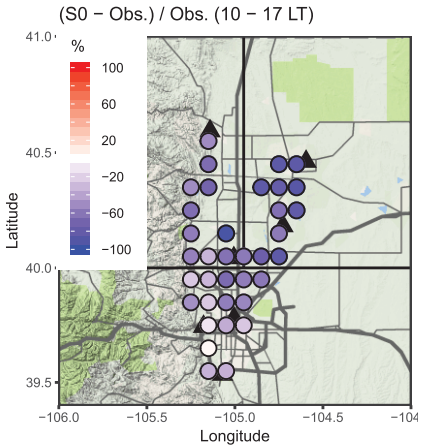

Model S0 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

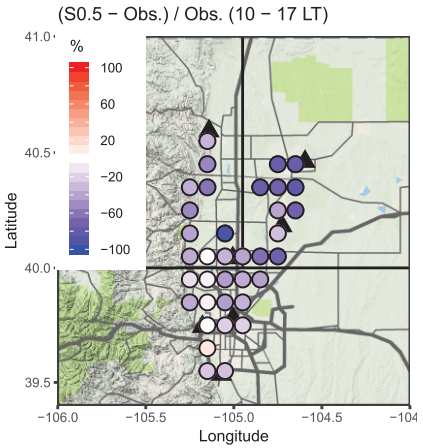

Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

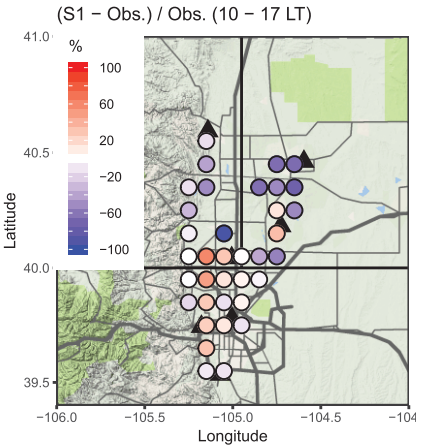

Model S1 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

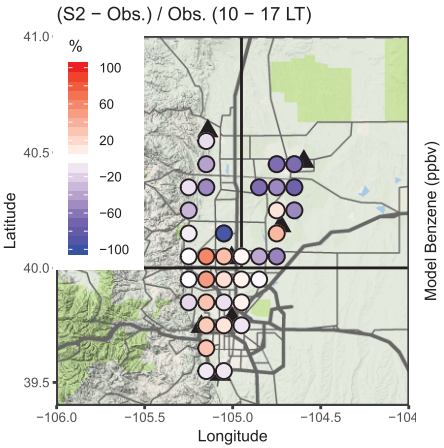

Model S2 (10 − 17 LT & < 1 km a.g.l)
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude

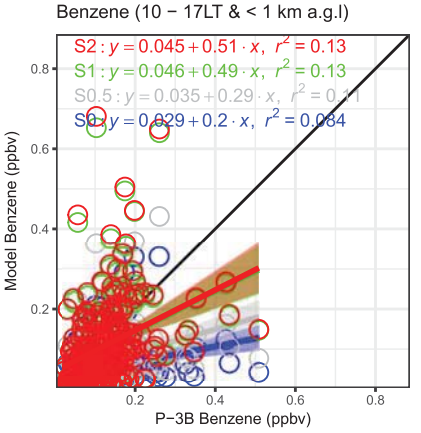

P−3B (10 − 17 LT & < 1 km a.g.l))
Benzene (ppbv)
0.2
0.16
0.12
0.08
0.04
0
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S0 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S0.5 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S1 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
41.0
40.5
40.0
39.5
Latitude
−106.0
−105.5
−105.0
−104.5
Longitude


Benzene (10 − 17LT & < 1 km a.g.l)
S2 : y = 0.045 + 0.51 · x, r² = 0.13
S1 : y = 0.046 + 0.49 · x, r² = 0.13
S0.5 : y = 0.035 + 0.29 · x, r² = 0.11
S0 : y = 0.029 + 0.2 · x, r² = 0.084
Model Benzene (ppbv)
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
P−3B Benzene (ppbv)

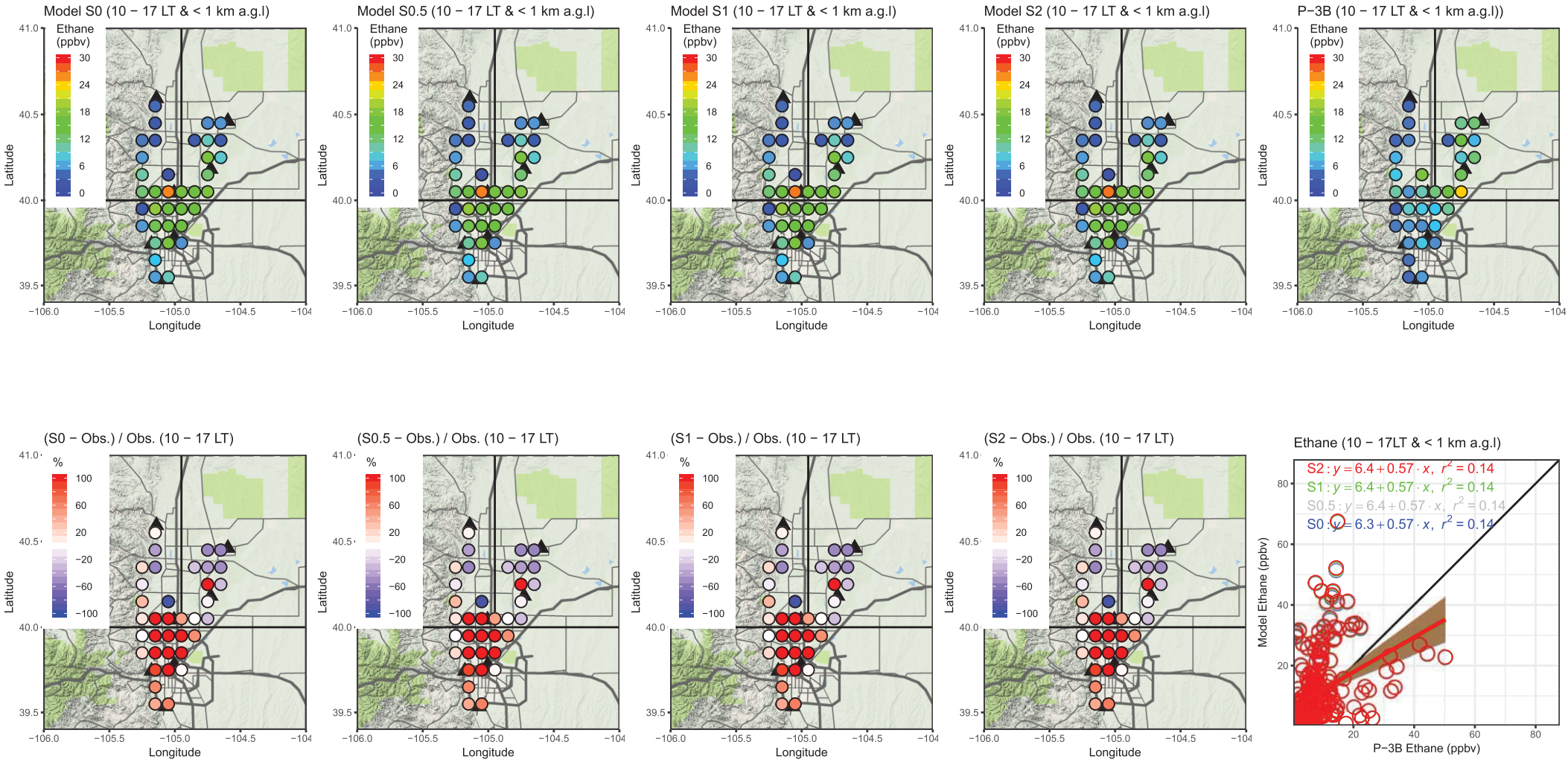
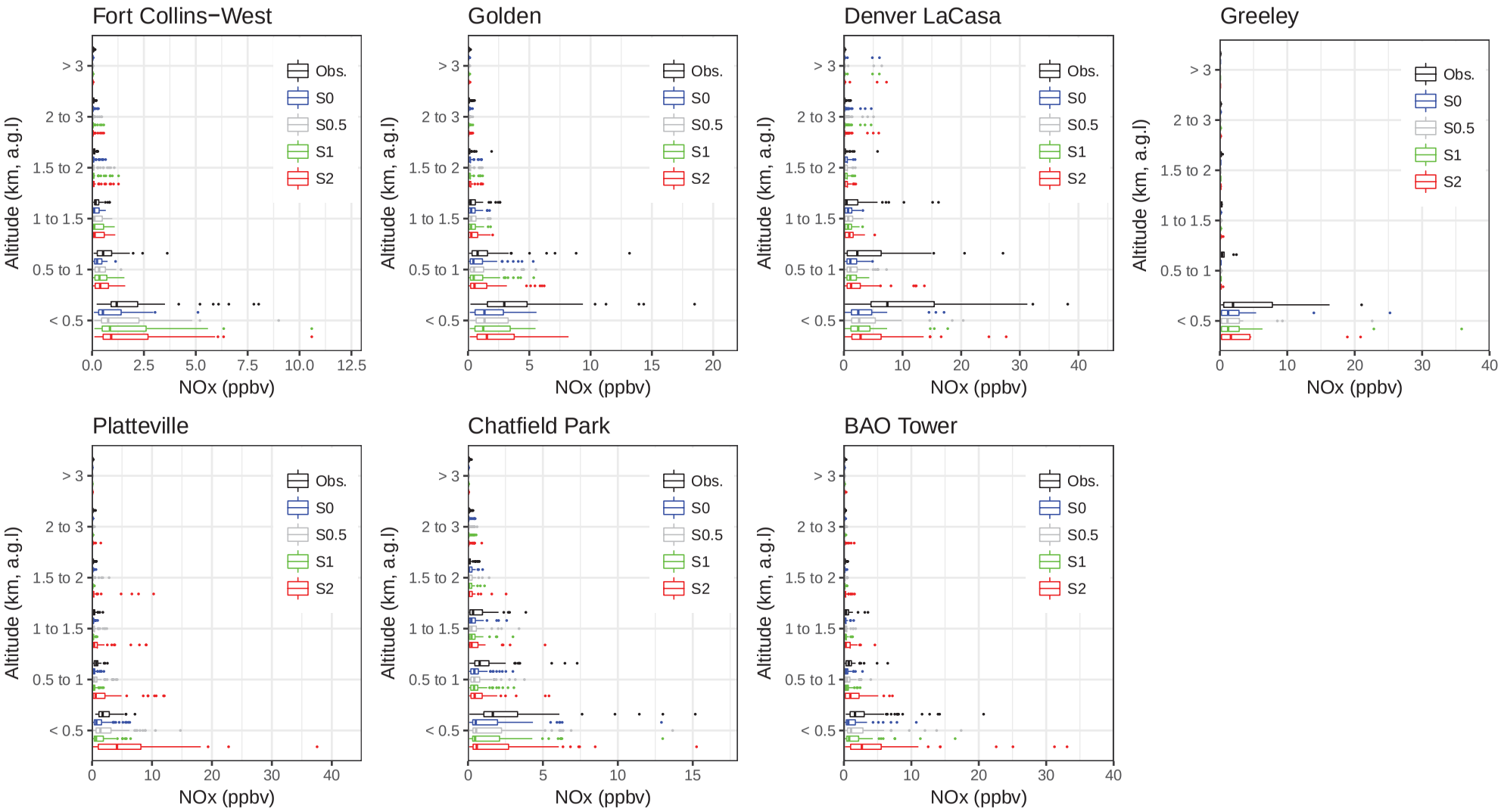
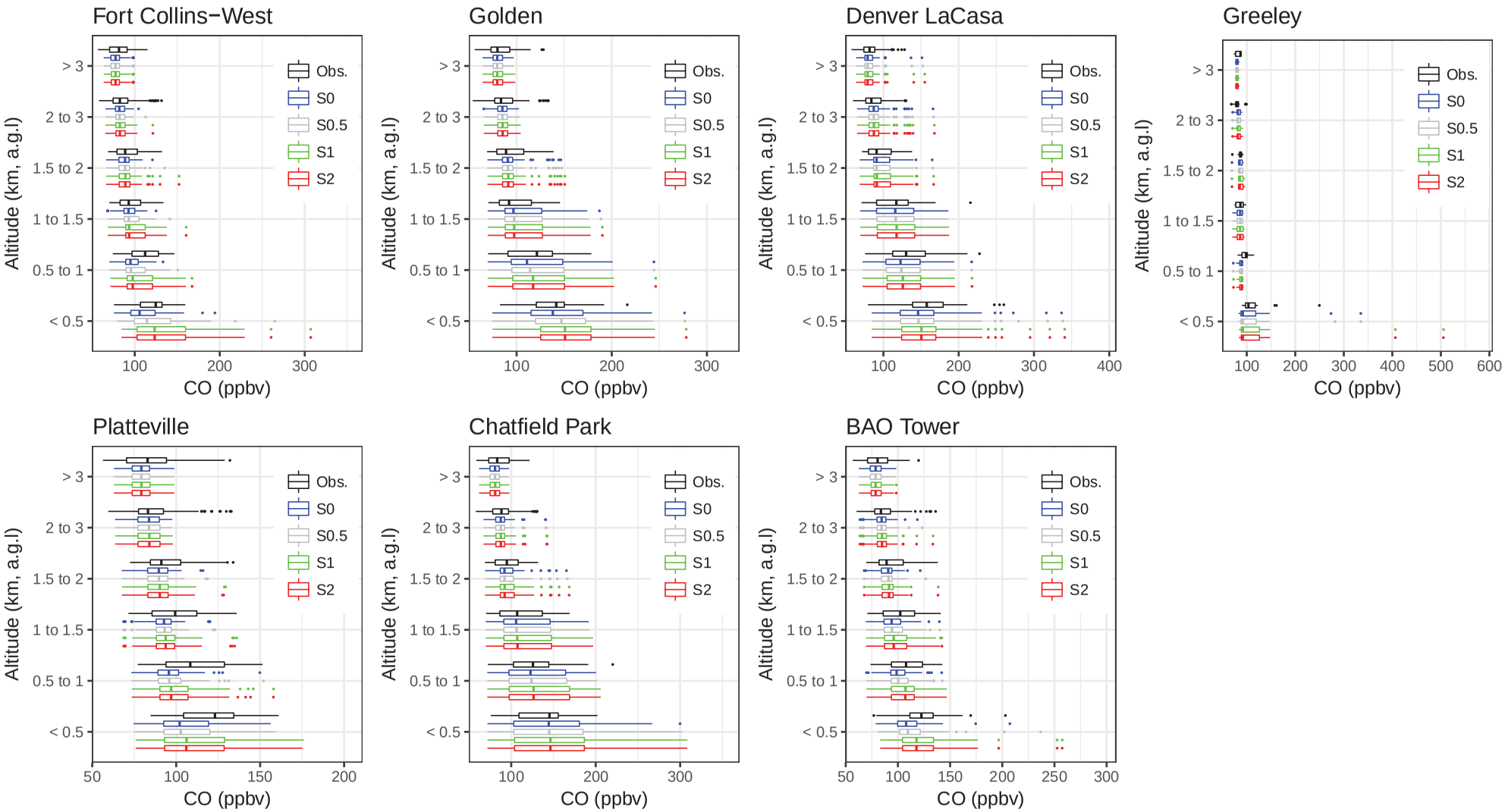
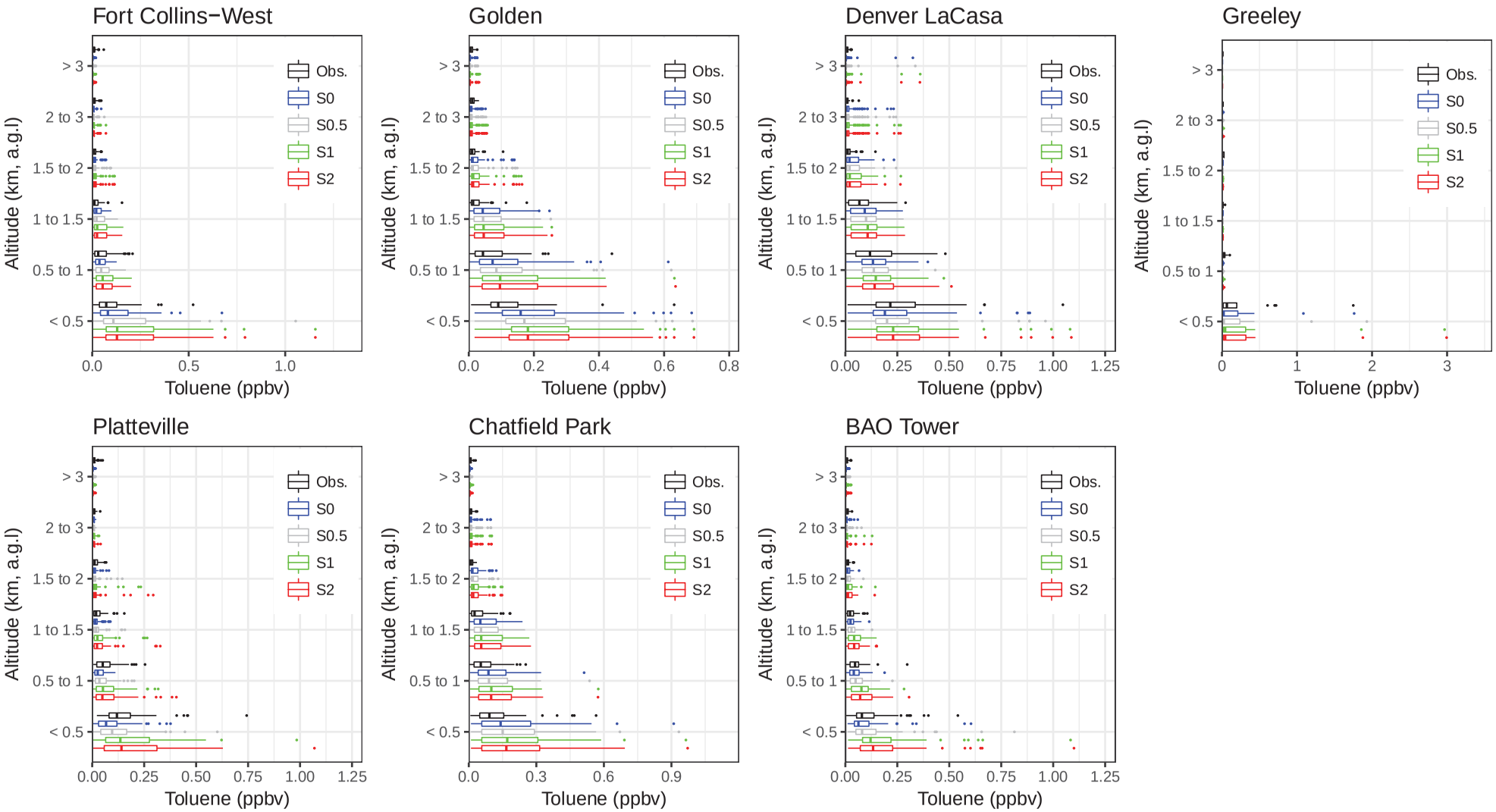
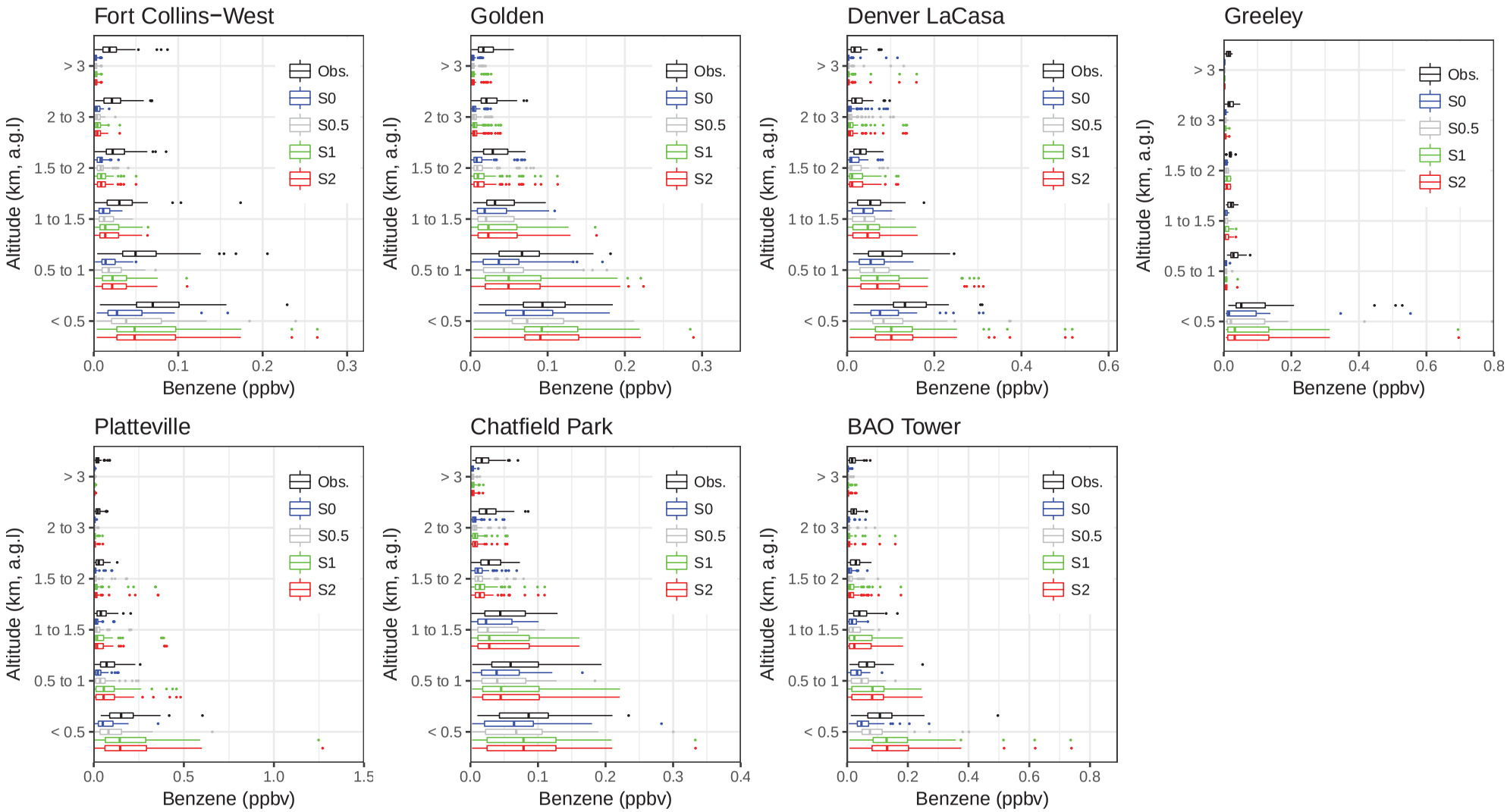

Model S0 (10 − 17 LT & < 1 km a.g.l)
Model S0.5 (10 − 17 LT & < 1 km a.g.l)
Model S1 (10 − 17 LT & < 1 km a.g.l)
Model S2 (10 − 17 LT & < 1 km a.g.l)
P−3B (10 − 17 LT & < 1 km a.g.l))
Ethane (ppbv)
30
24
18
12
6
0
Latitude
Longitude
41.0
40.5
40.0
39.5
−106.0
−105.5
−105.0
−104.5
(S0 − Obs.) / Obs. (10 − 17 LT)
(S0.5 − Obs.) / Obs. (10 − 17 LT)
(S1 − Obs.) / Obs. (10 − 17 LT)
(S2 − Obs.) / Obs. (10 − 17 LT)
%
100
60
20
−20
−60
−100
Ethane (10 − 17LT & < 1 km a.g.l)
S2 : y = 6.4 + 0.57 · x, r2 = 0.14
S1 : y = 6.4 + 0.57 · x, r2 = 0.14
S0.5 : y = 6.4 + 0.57 · x, r2 = 0.14
S0 : y = 6.3 + 0.57 · x, r2 = 0.14
Model Ethane (ppbv)
P−3B Ethane (ppbv)
80
60
40
20

Figure C2: Bar-Whisker plots for vertical profiles of various trace gases over the six spiraling sites as well as the missed approached flown over Greely. P-3 measurements are compared to S0, S05, S1 and S2 model simulations. Note that the concentration scale varies between the sites. Some of the outliers for Greeley NOx and benzene have been omitted for better visualization.




Fort Collins−West
Golden
Denver LaCasa
Greeley
Platteville
Chatfield Park
BAO Tower
Altitude (km, a.g.l)
> 3
2 to 3
1.5 to 2
1 to 1.5
0.5 to 1
< 0.5
CO (ppbv)
Obs.
S0
S0.5
S1
S2


Fort Collins−West
Golden
Denver LaCasa
Greeley
Platteville
Chatfield Park
BAO Tower
Altitude (km, a.g.l)
> 3
2 to 3
1.5 to 2
1 to 1.5
0.5 to 1
< 0.5
Toluene (ppbv)
Obs.
S0
S0.5
S1
S2


Fort Collins−West
Golden
Denver LaCasa
Greeley
Platteville
Chatfield Park
BAO Tower
Altitude (km, a.g.l.)
> 3
2 to 3
1.5 to 2
1 to 1.5
0.5 to 1
< 0.5
Benzene (ppbv)
Obs.
S0
S0.5
S1
S2

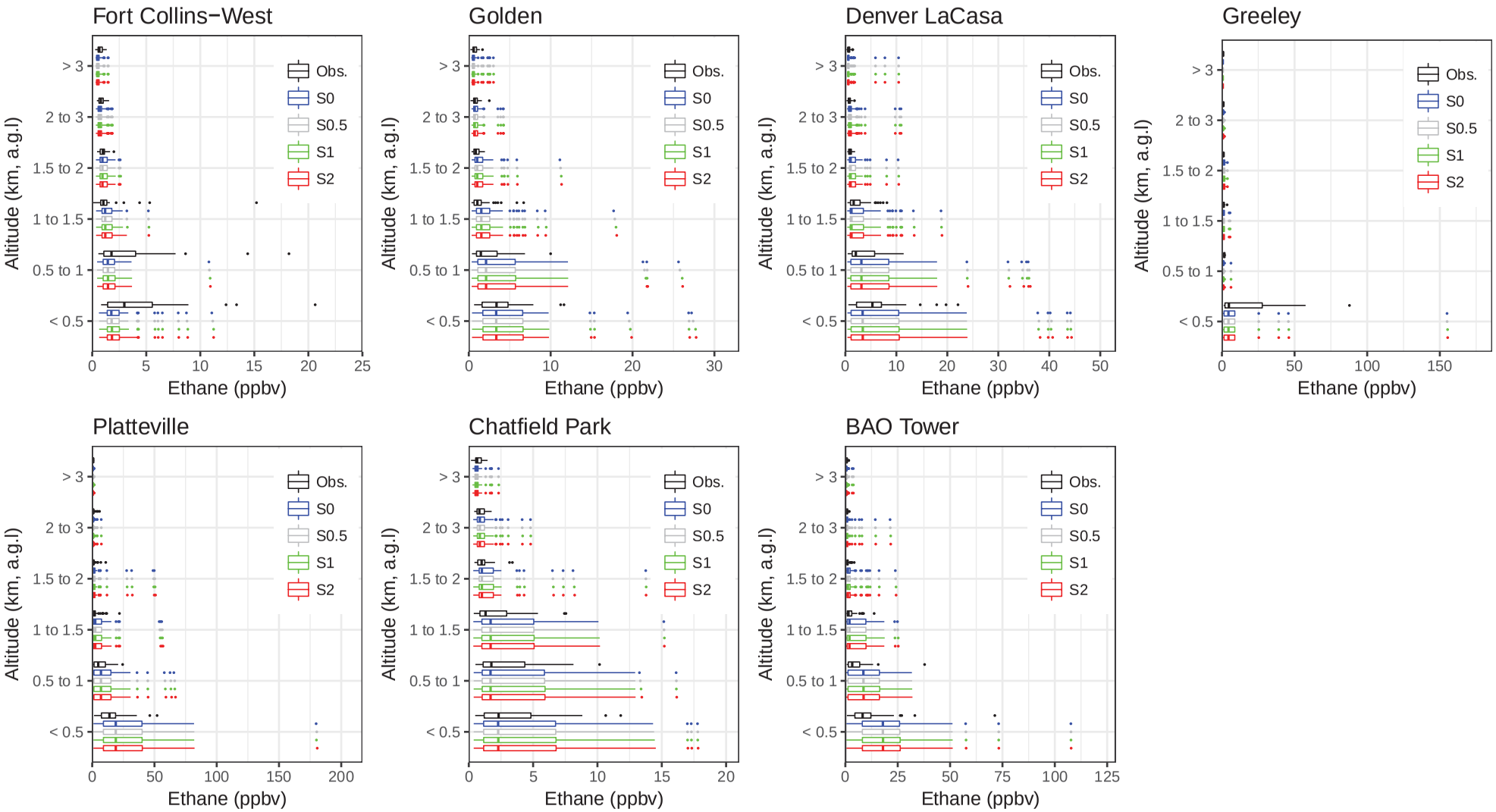
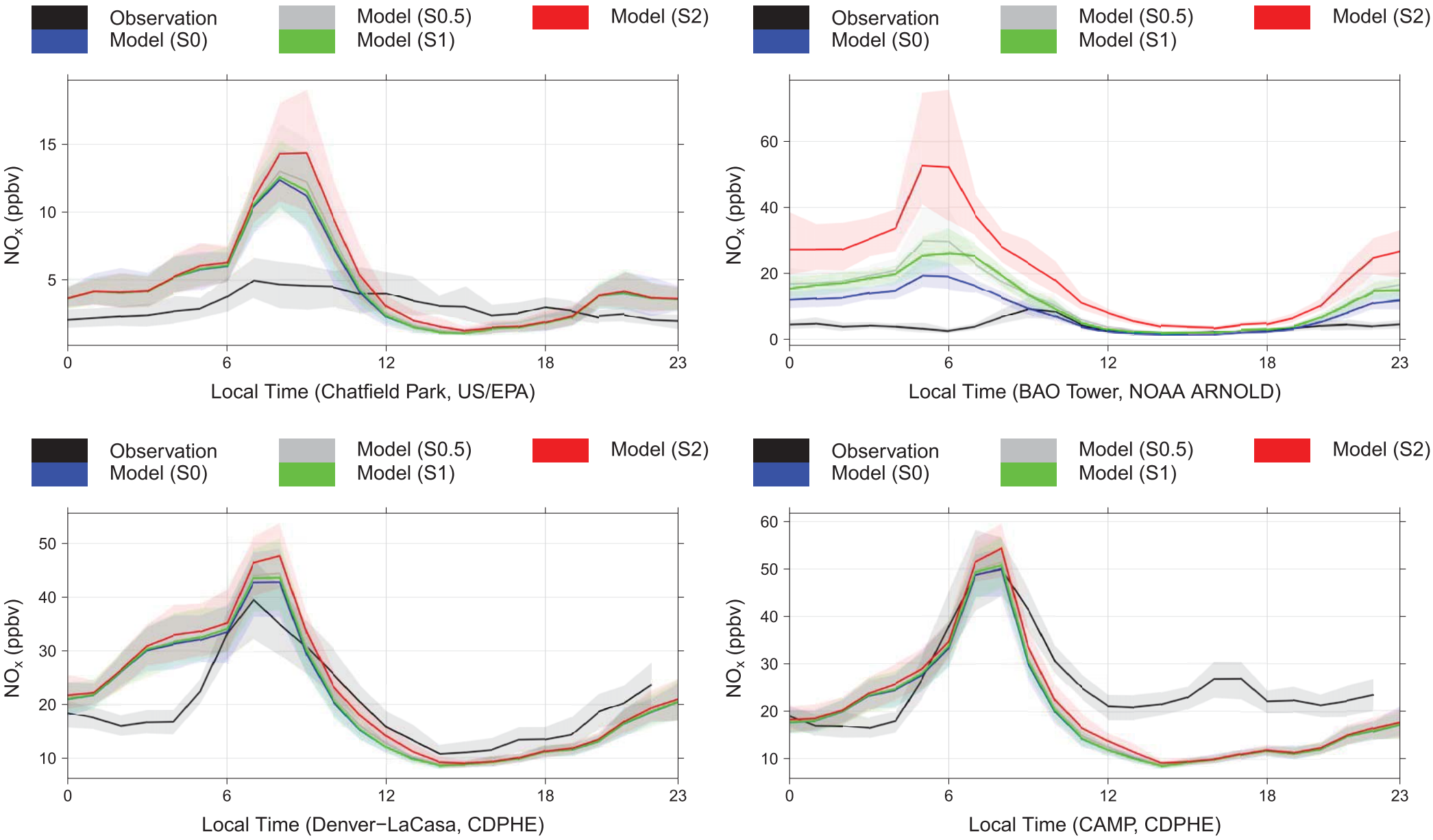
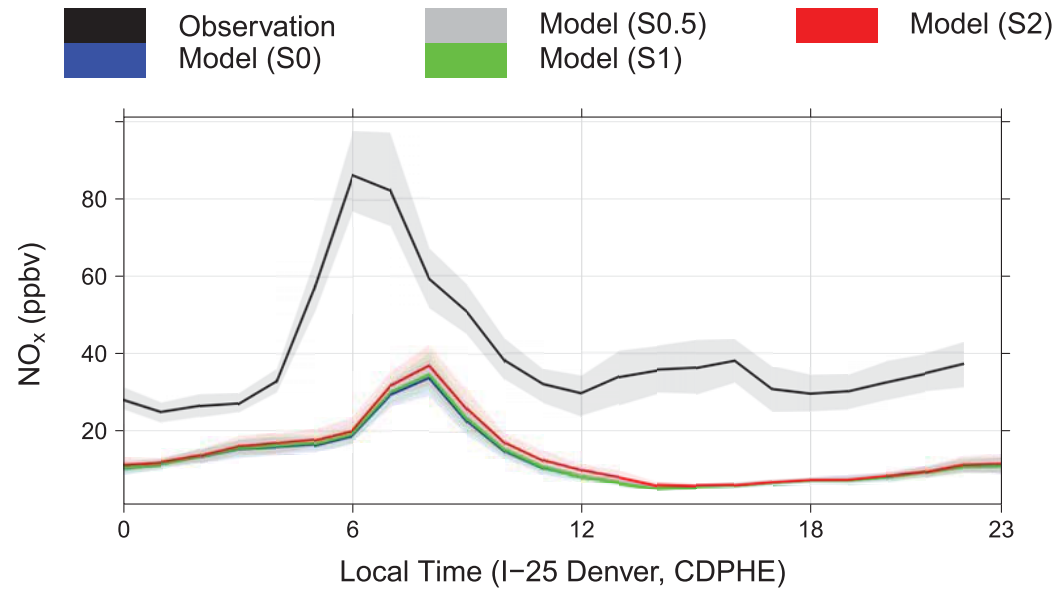
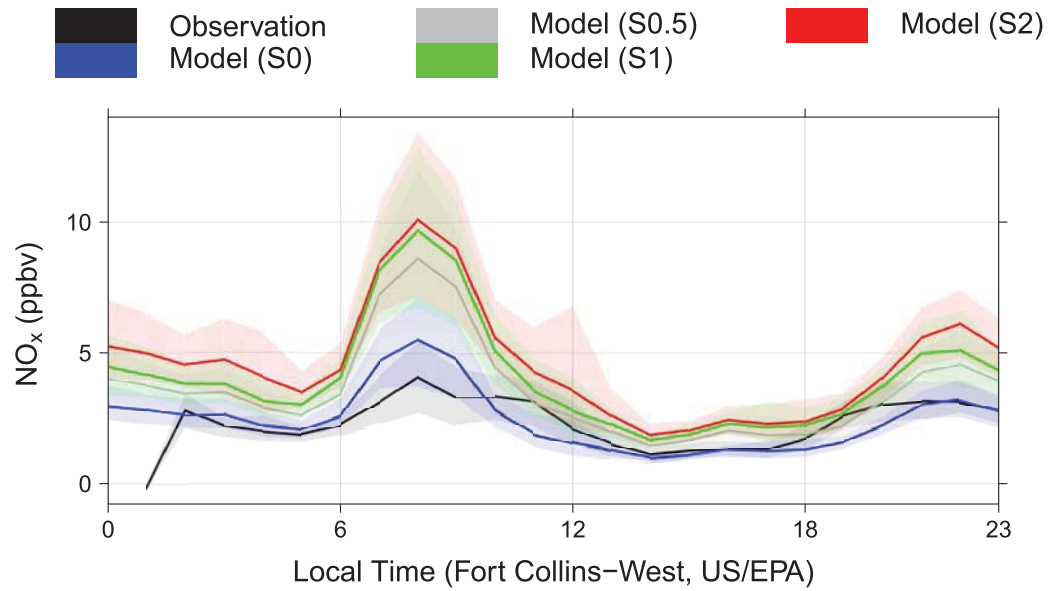
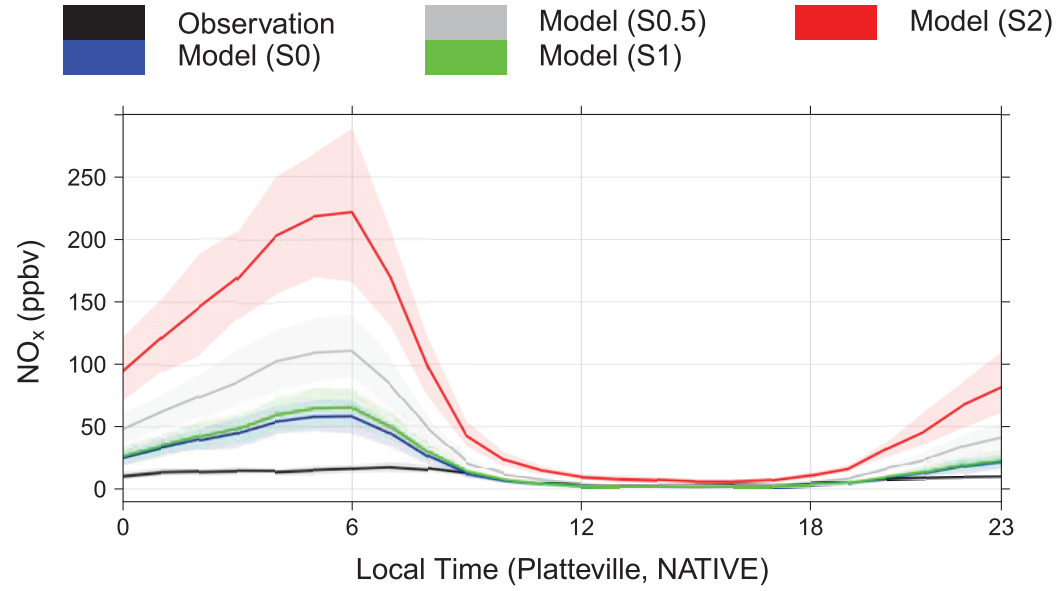

Fort Collins−West
Golden
Denver LaCasa
Greeley
Platteville
Chatfield Park
BAO Tower
Altitude (km, a.g.l.)
> 3
2 to 3
1.5 to 2
1 to 1.5
0.5 to 1
< 0.5
Ethane (ppbv)
Obs.
S0
S0.5
S1
S2

Figure C3: Average diurnal cycle of surface NOx at surface sites in the NFRMA. Shown are measurements (black) and model results for S0 (blue), S05 (gray), S1 (green) and S2 (red).




Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
NOx (ppbv)
0
20
40
60
80
0
6
12
18
23
Local Time (I−25 Denver, CDPHE)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
NOx (ppbv)
0
5
10
0
6
12
18
23
Local Time (Fort Collins−West, US/EPA)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
NOx (ppbv)
0
50
100
150
200
250
0
6
12
18
23
Local Time (Platteville, NATIVE)

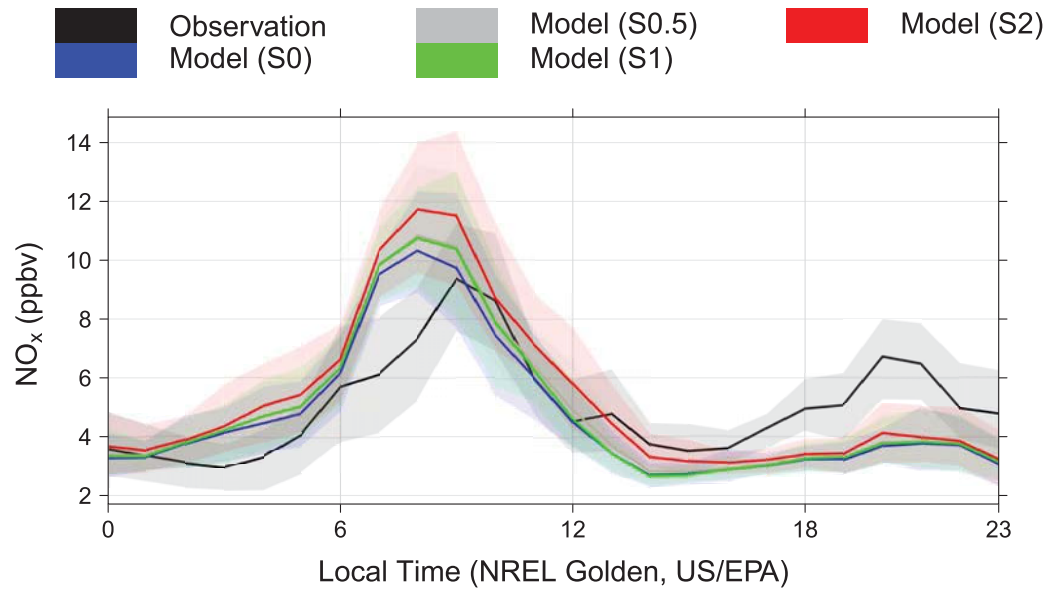
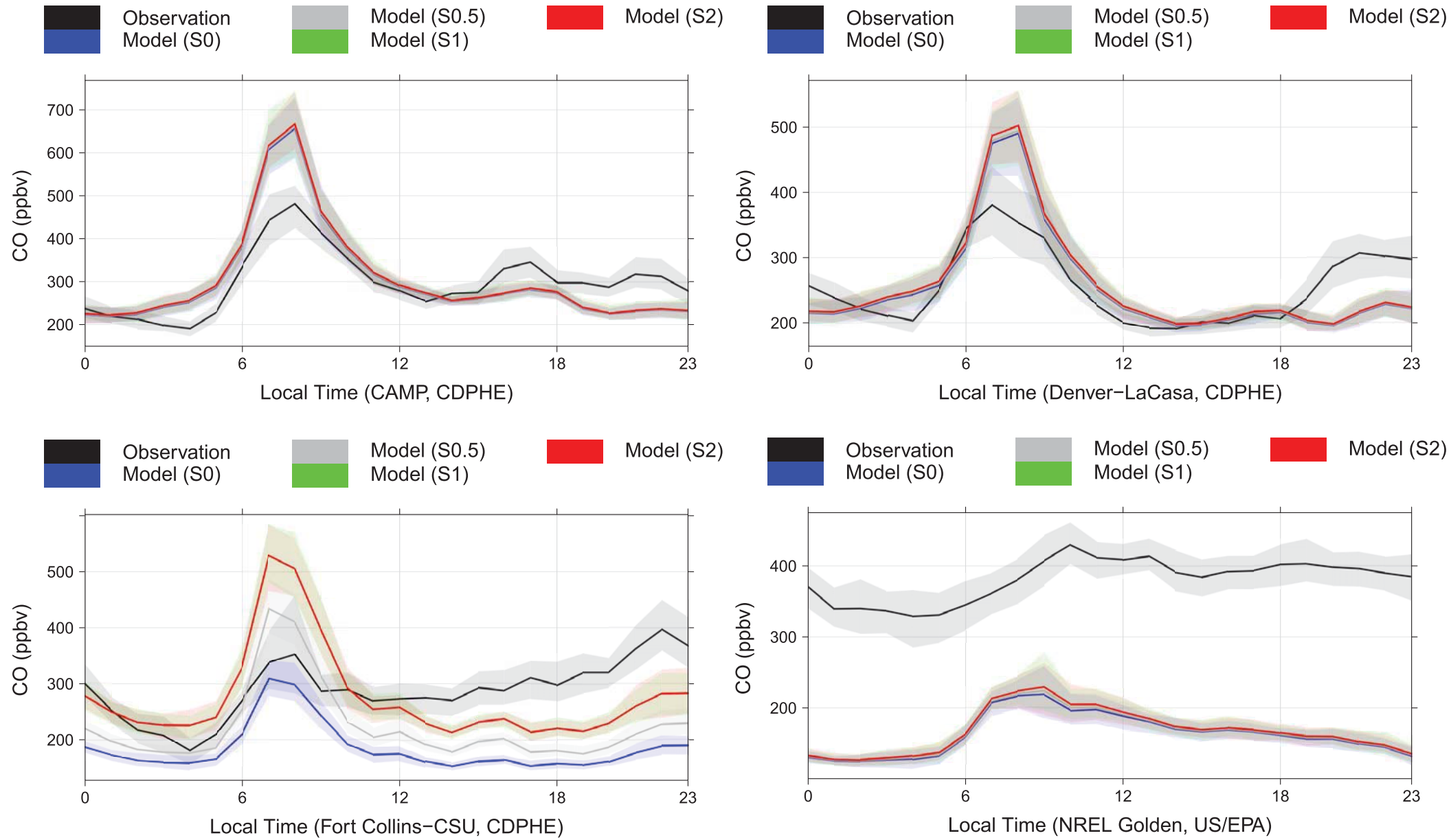
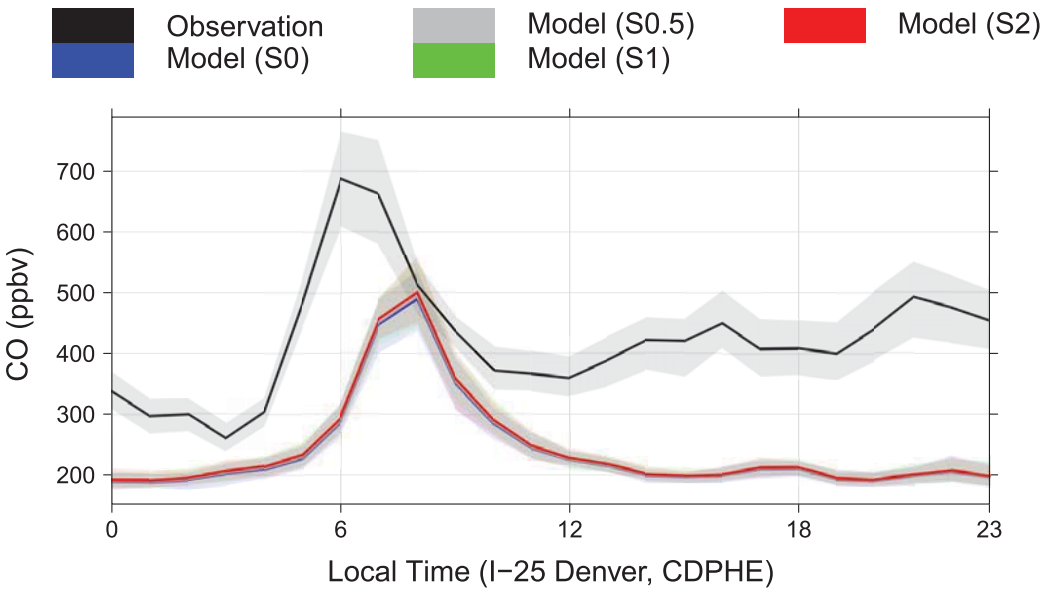
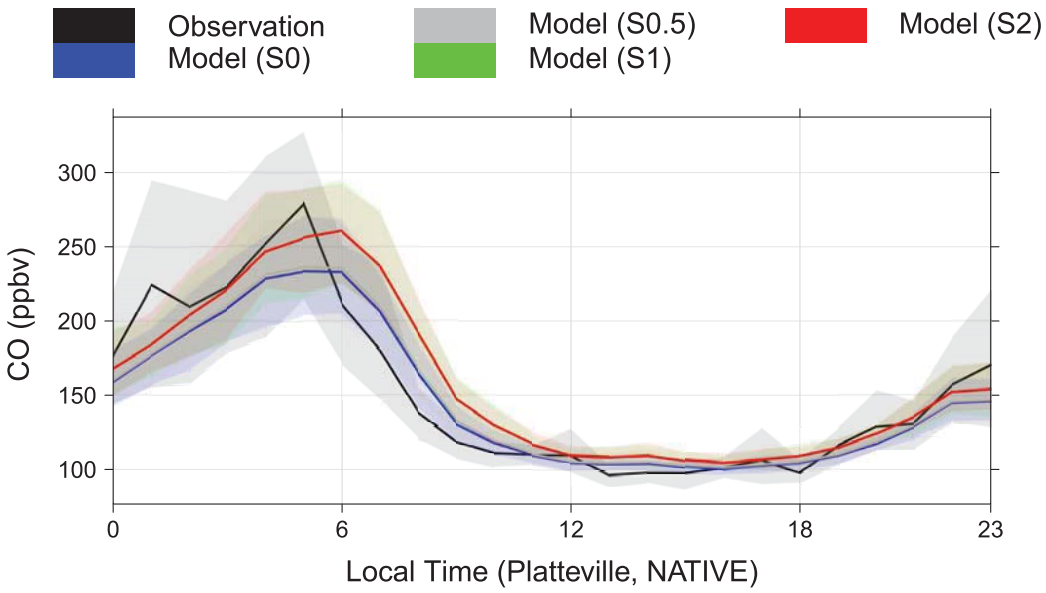

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
NOx (ppbv)
2
4
6
8
10
12
14
0
6
12
18
23
Local Time (NREL Golden, US/EPA)

Figure C4: Average diurnal cycle of surface CO at surface sites in the NFRMA. Shown are measurements (black) and model results for S0 (blue), S05 (gray), S1 (green) and S2 (red).




Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
CO (ppbv)
700
600
500
400
300
200
0
6
12
18
23
Local Time (I−25 Denver, CDPHE)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
CO (ppbv)
300
250
200
150
100
0
6
12
18
23
Local Time (Platteville, NATIVE)

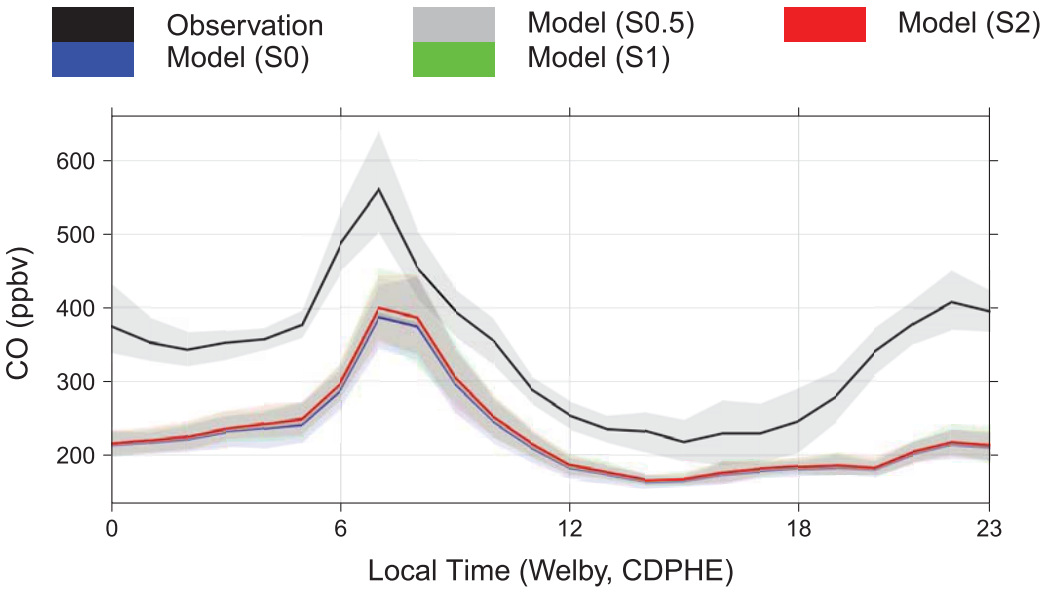

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
CO (ppbv)
600
500
400
300
200
0
6
12
18
23
Local Time (Welby, CDPHE)

Figure C5: Average diurnal cycle of surface benzene and toluene at Platteville. Shown are measurements (black) and model results for S0 (blue), S05 (gray), S1 (green) and S2 (red).

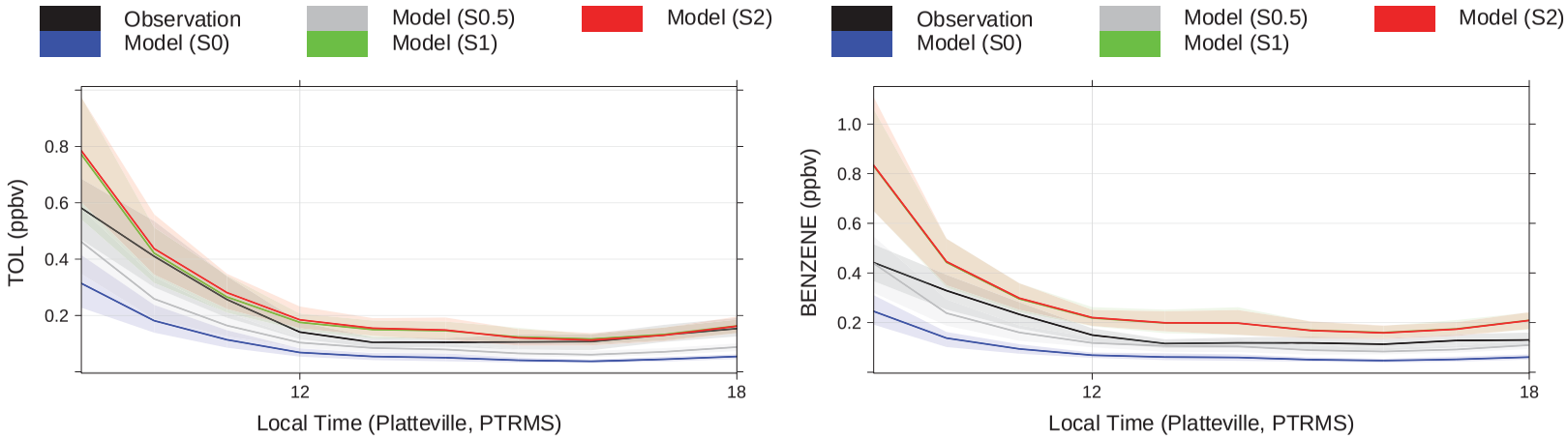


Figure C6: Tracer ratios of urban tracers versus ethyne over the Denver and non-Denver area and O&G tracers versus propane from mobile van WAS canister samples and model results for S0.

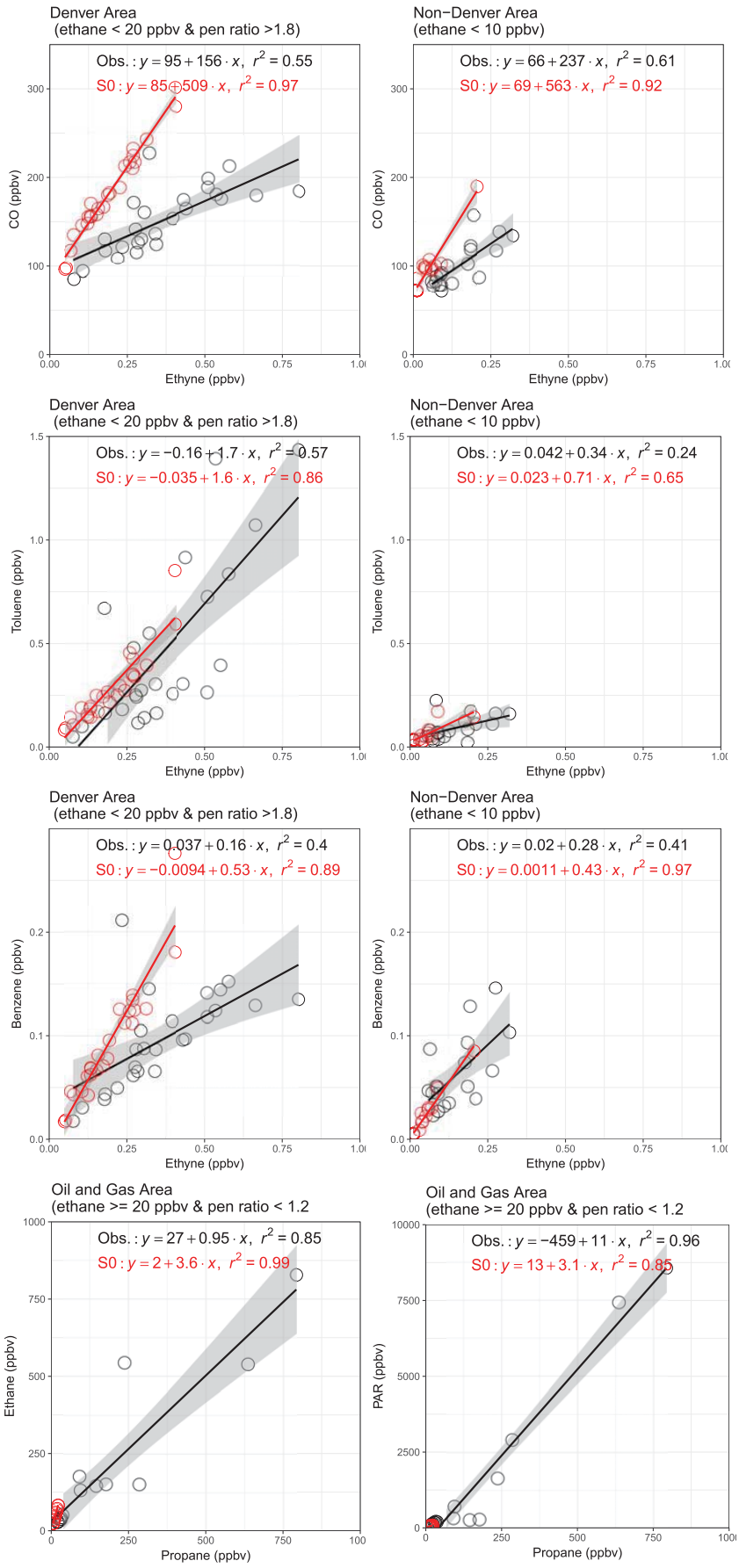


Figure C7: As Figure C6 but for S05 model results.

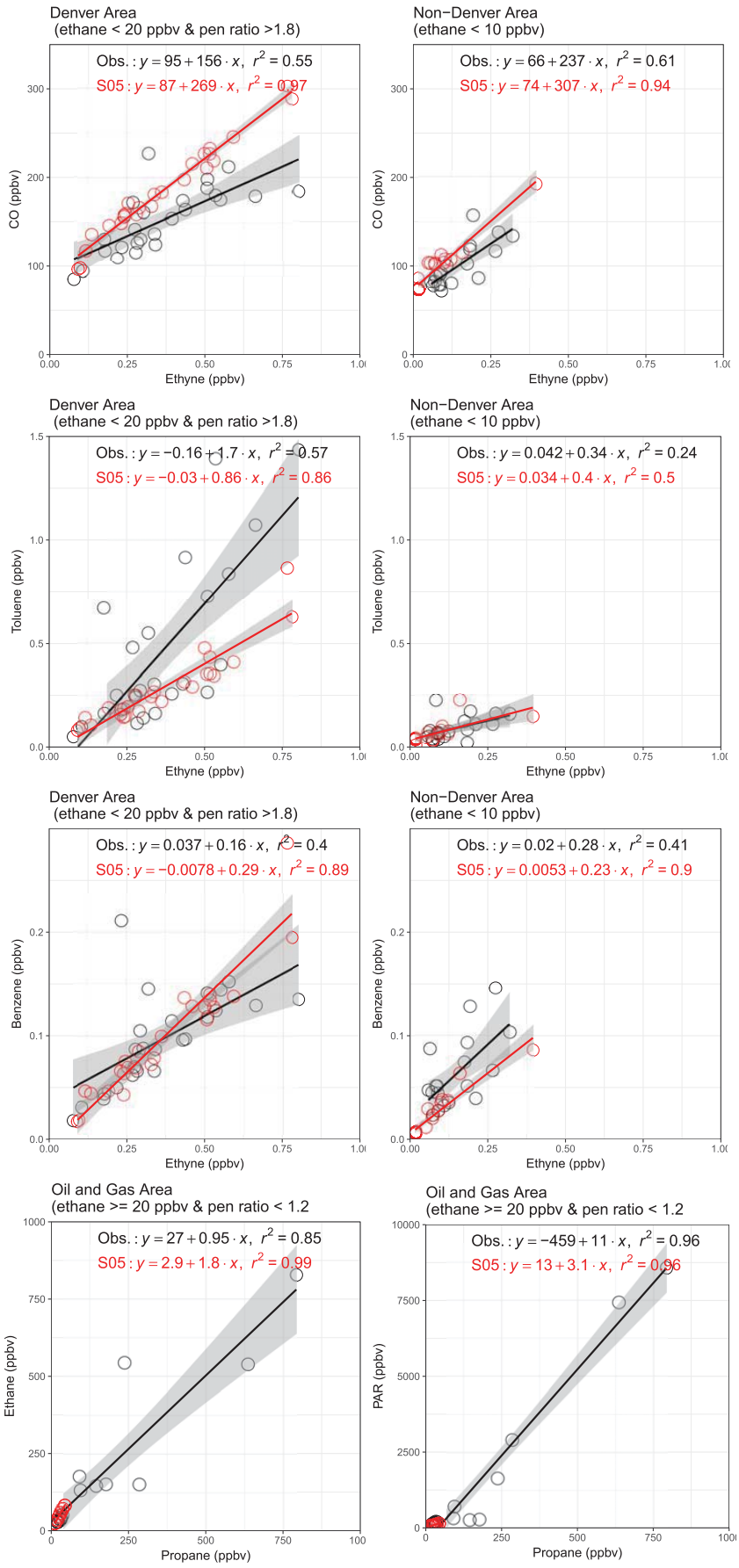


Figure C8: As Figure C6 but for S1 model results.

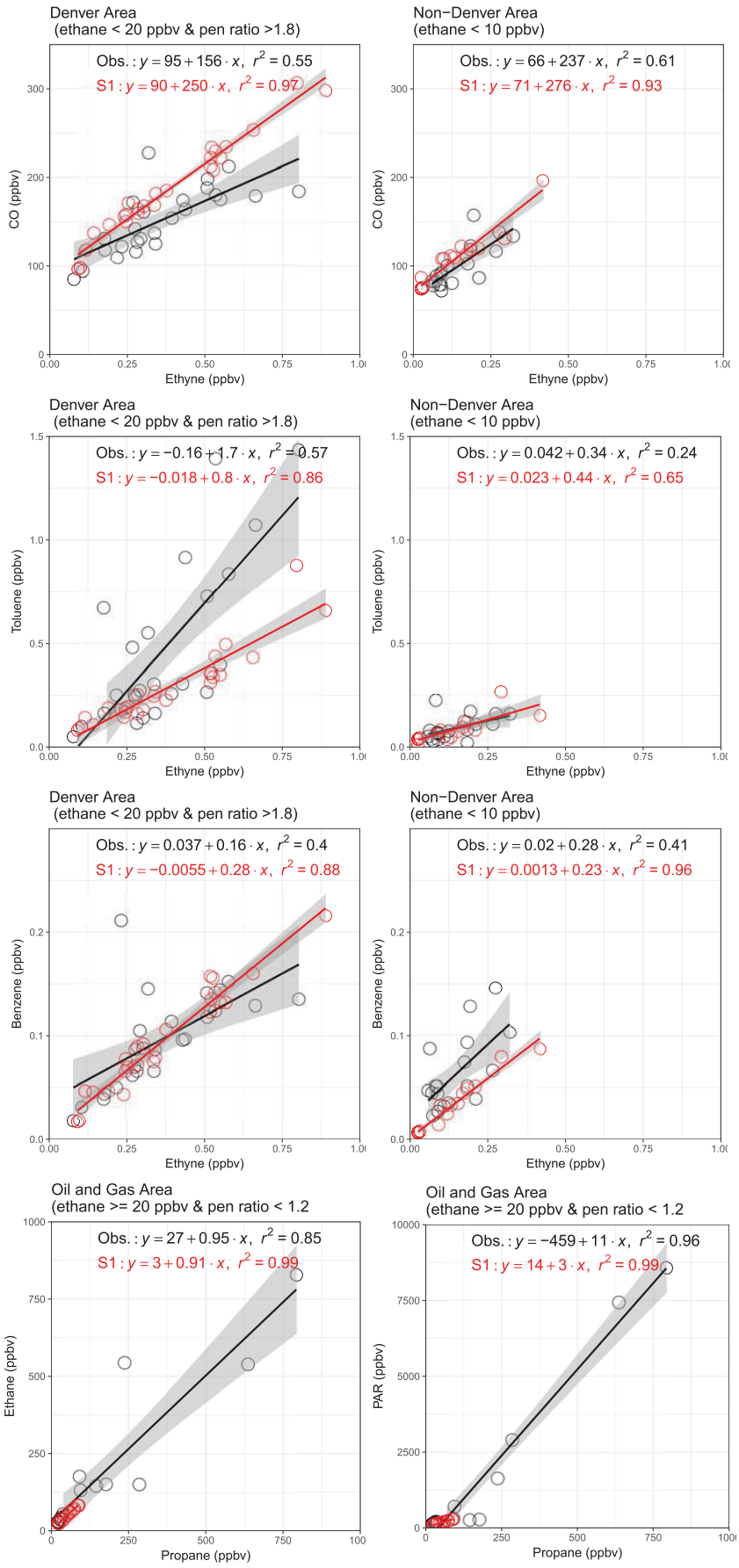


Figure C9: As Figure C6 but for S2 model results.

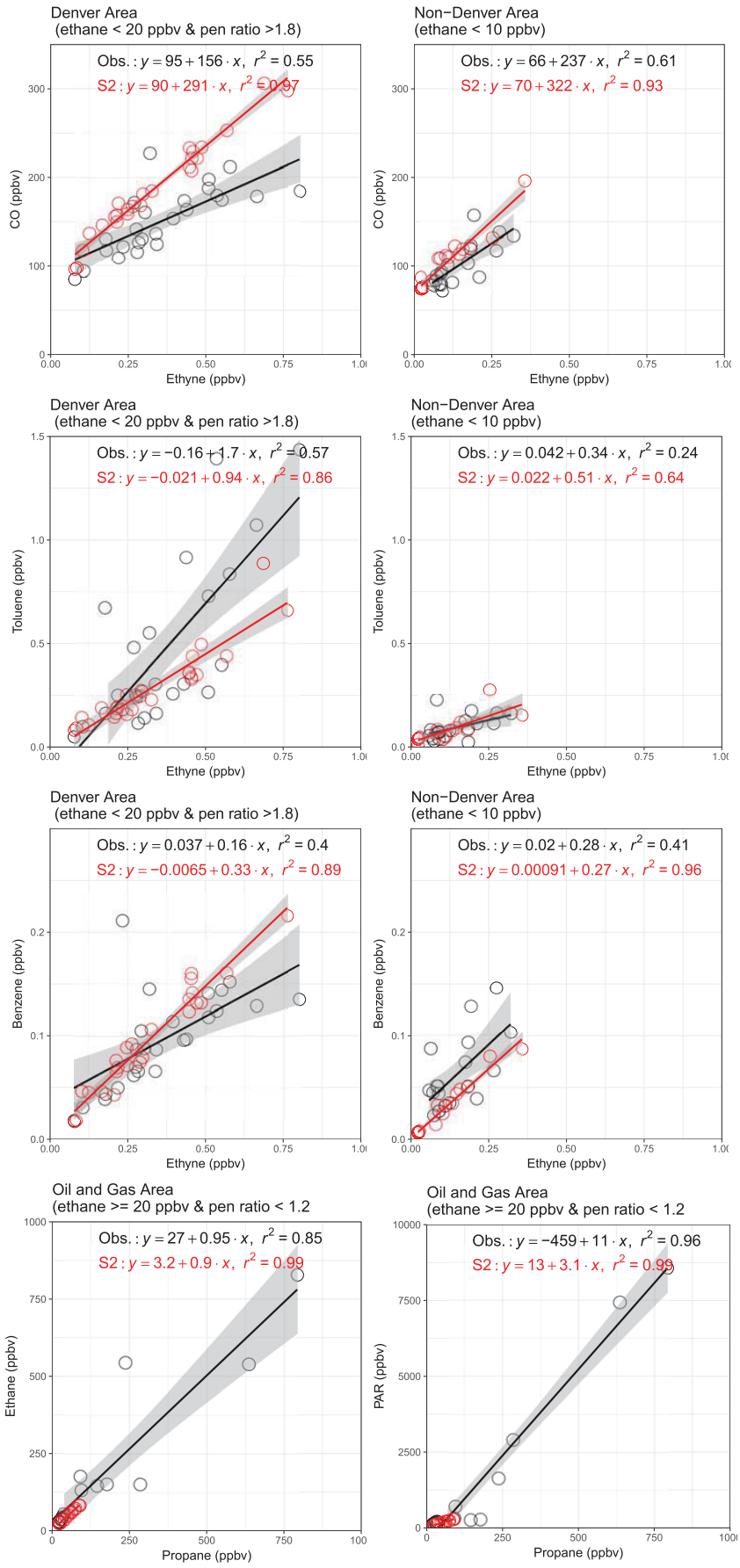


Figure D1: Comparisons of S0, S05, S1 and S2 model results to 1-minute C-130 aircraft measurement of ozone concentrations. All data were sampled below 1km a.g.l. and averaged over 0.1° × 0.1° except for the scatter plots for which we use 1-minute average measurements compared with interpolated 1-hour instantaneous model data for each measurement location. Only flights for July 2014 are shown.

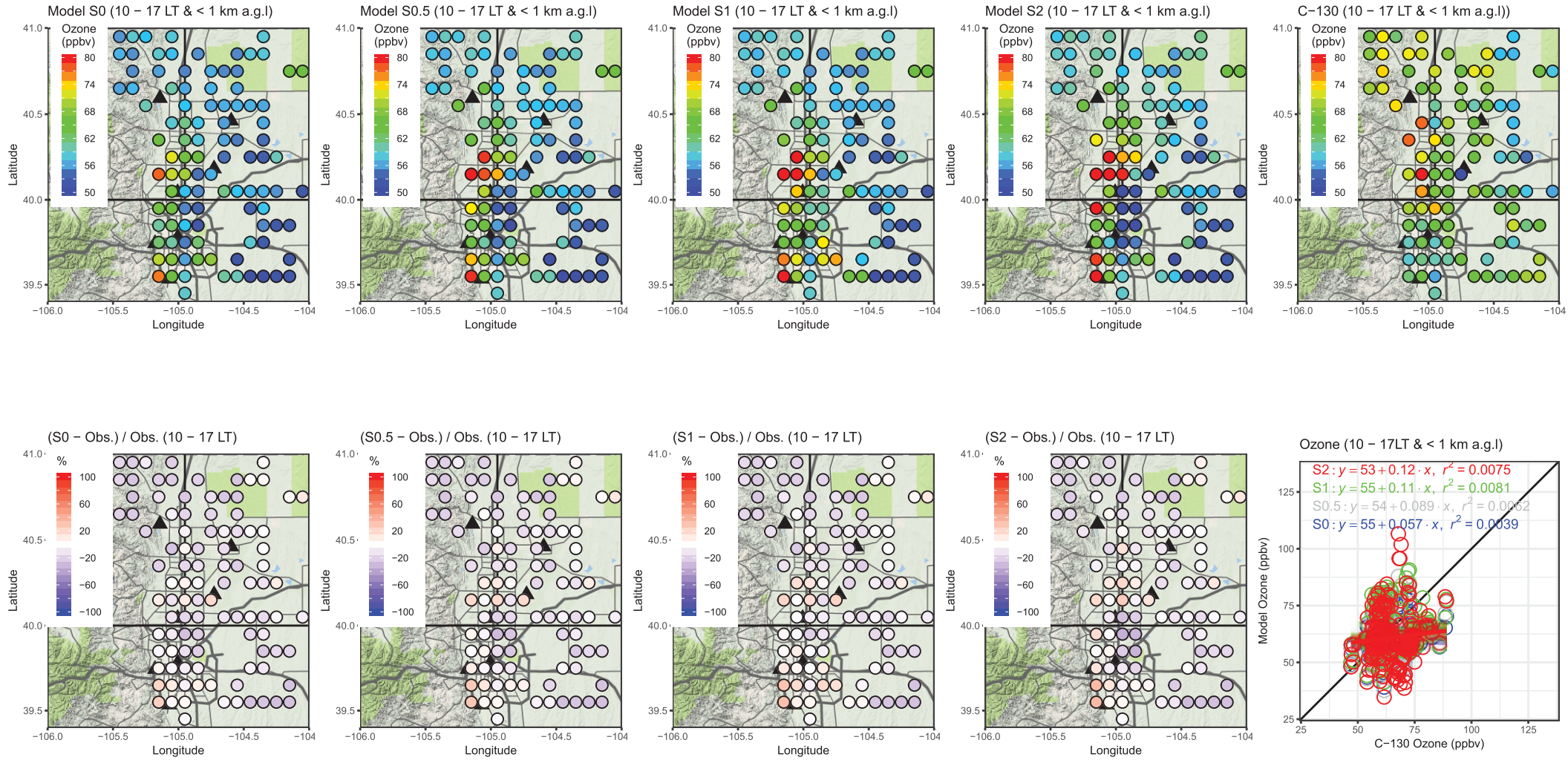


Figure D2: As Figure D1 but for flights in August only.

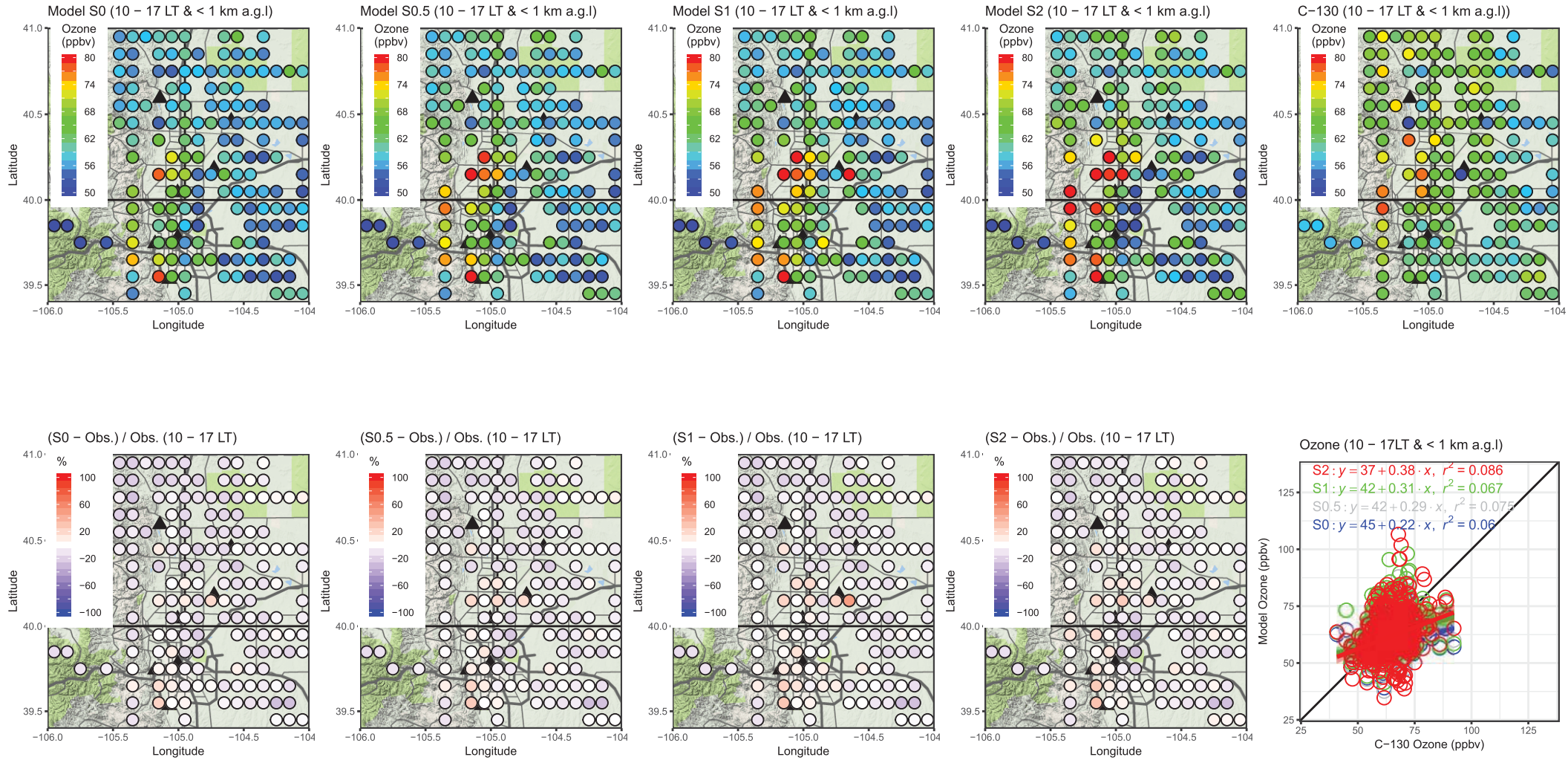


Figure D3: Comparisons of S0, S05, S1 and S2 model results to 1-minute P-3 aircraft measurement of ozone concentrations. All data were sampled below 1km a.g.l. and averaged over 0.1° × 0.1° except for the scatter plots for which we use 1-minute average measurements compared with interpolated 1-hour instantaneous model data for each measurement location.

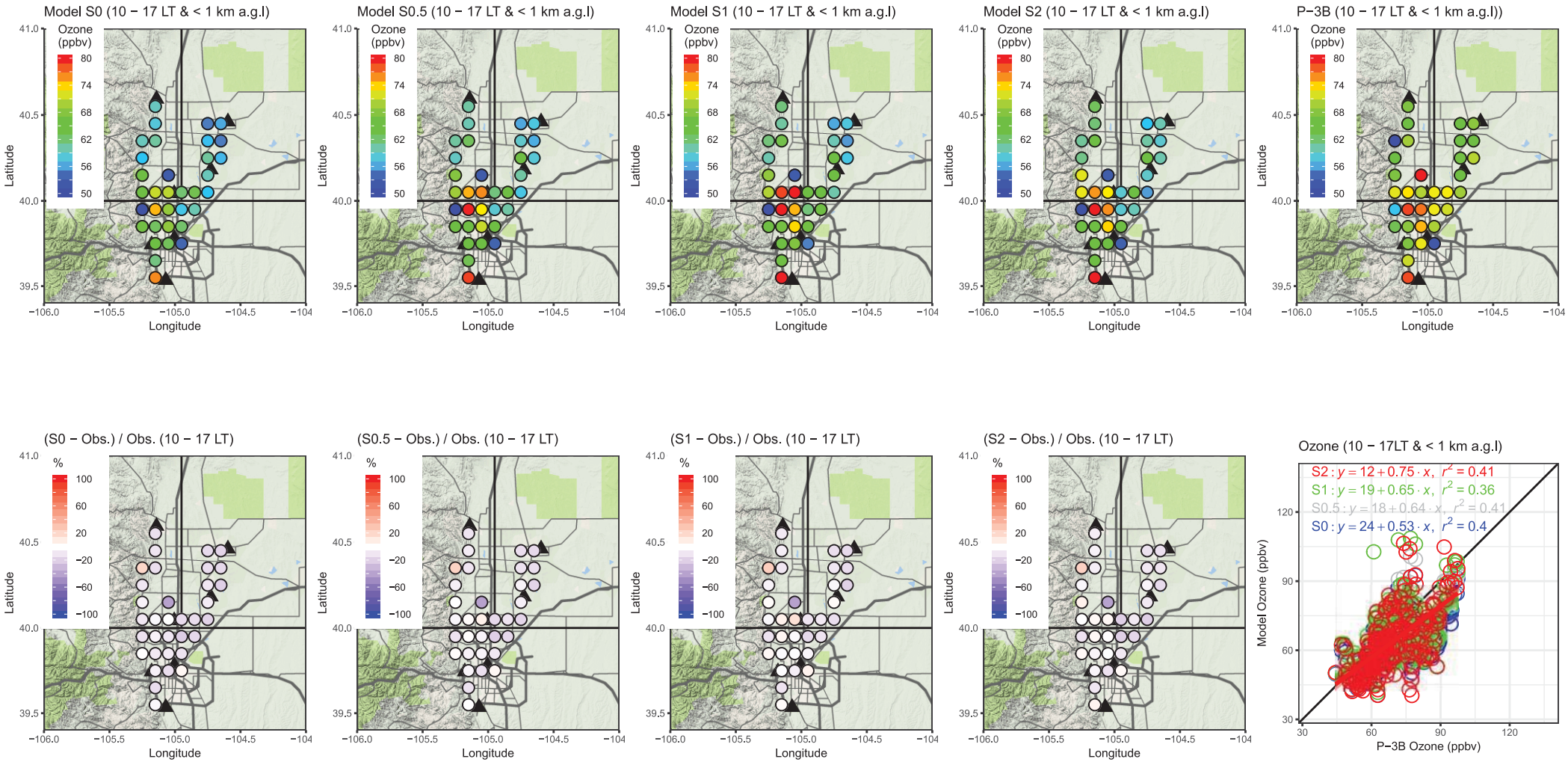


Figure D4: Bar-Whisker plots for vertical profiles of ozone over the six spiraling sites. P-3 measurements are compared to S0 (blue), S05 (gray), S1 (green) and S2 (red) model simulations.

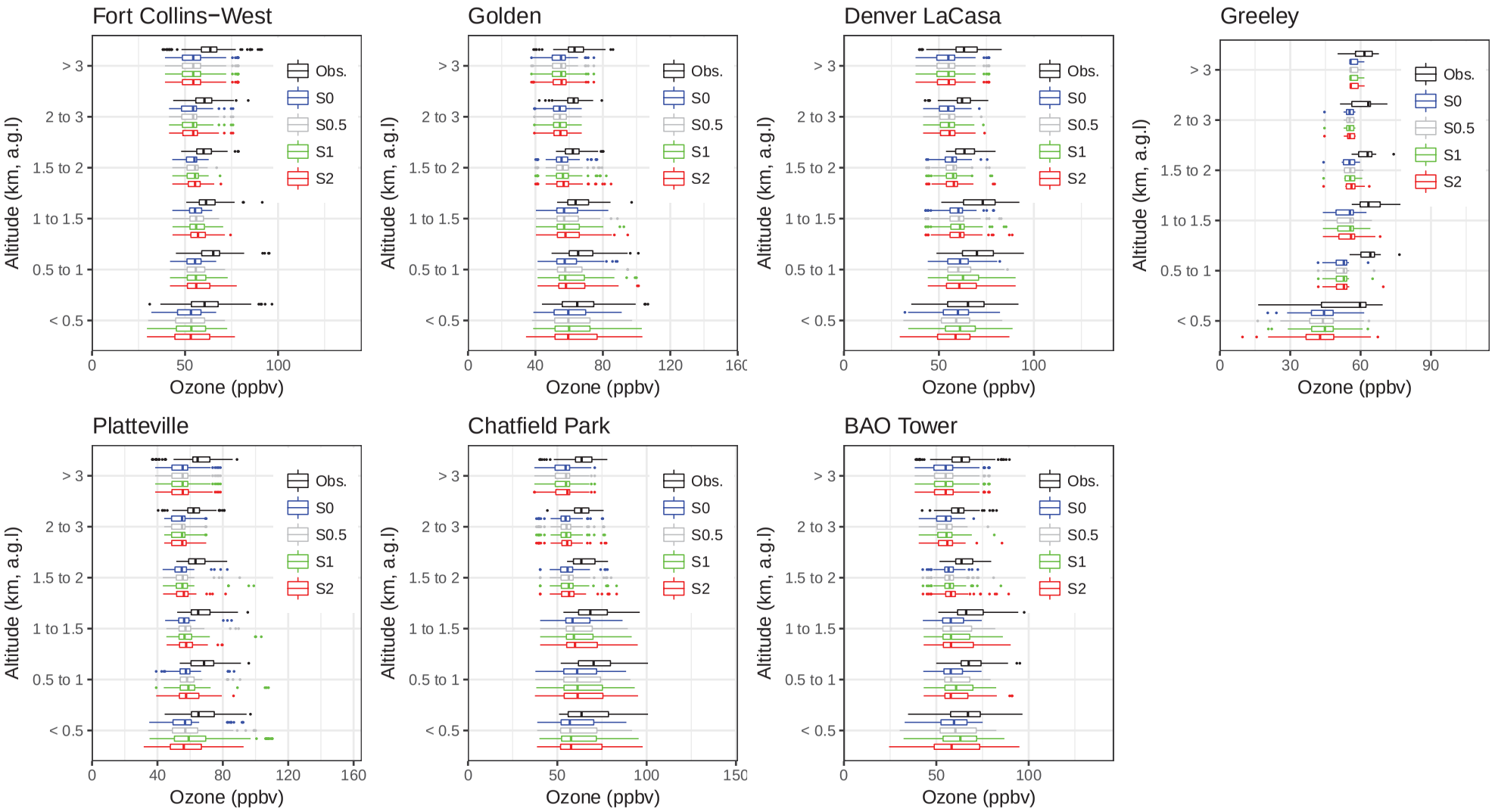
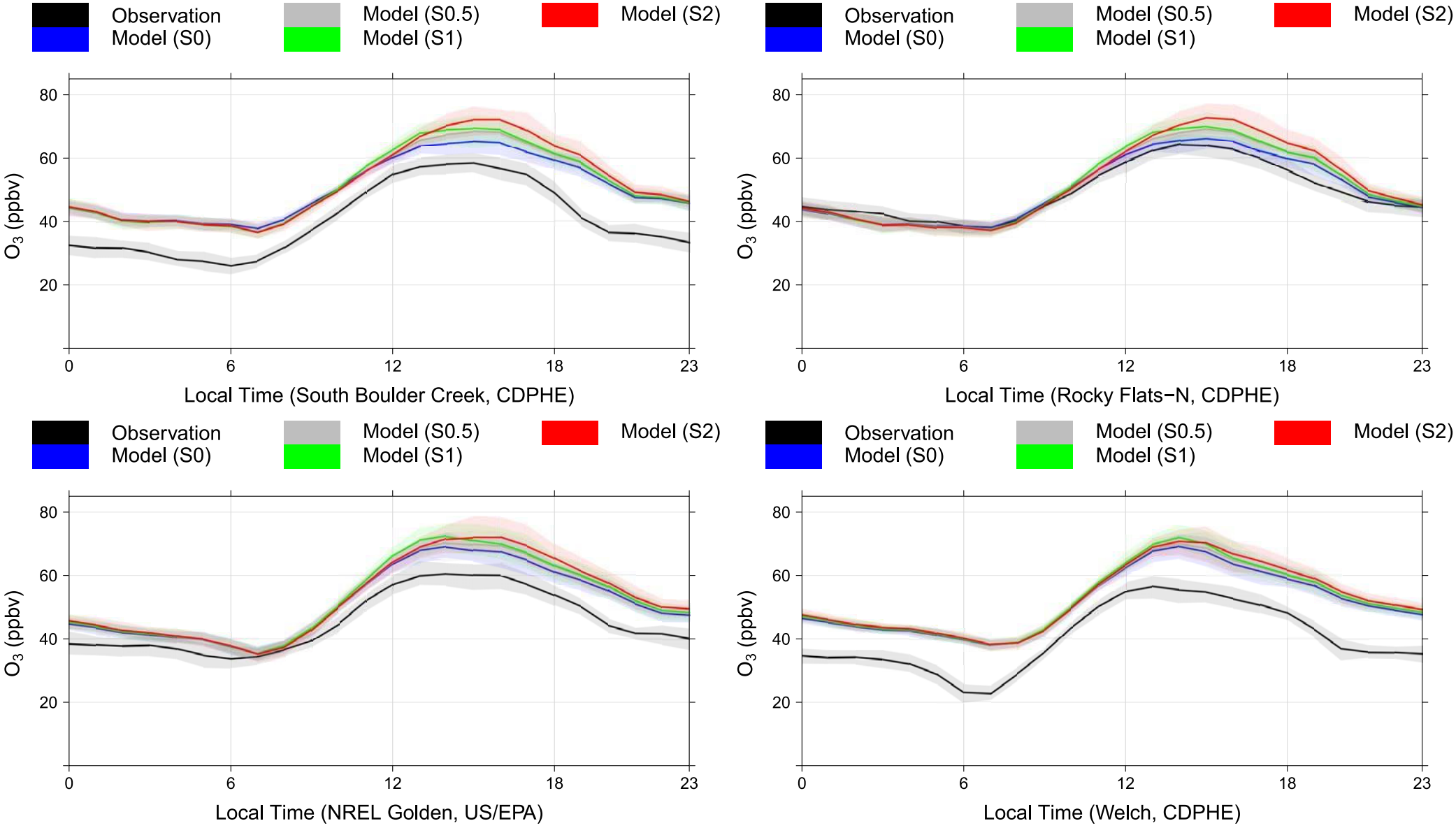
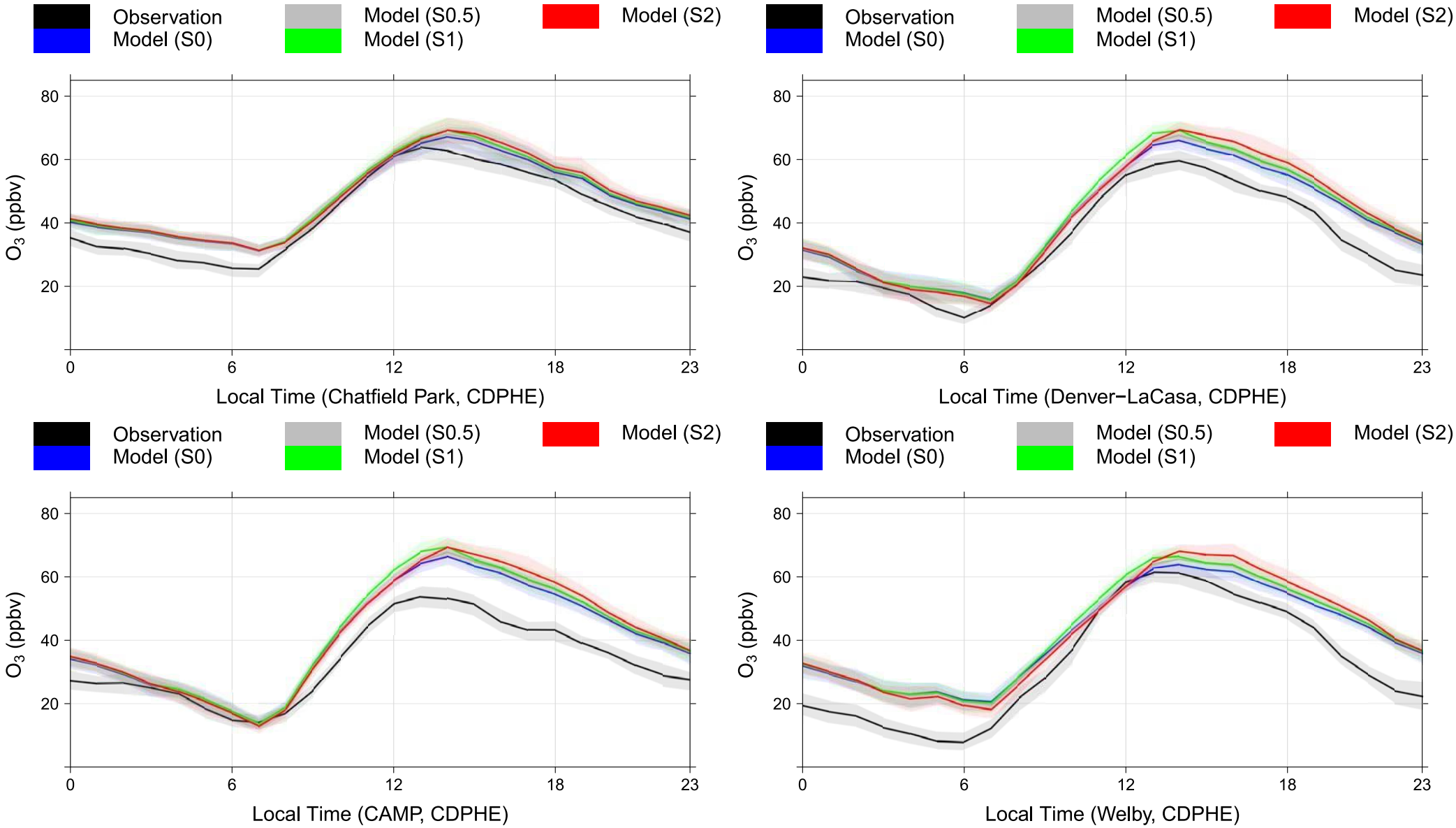
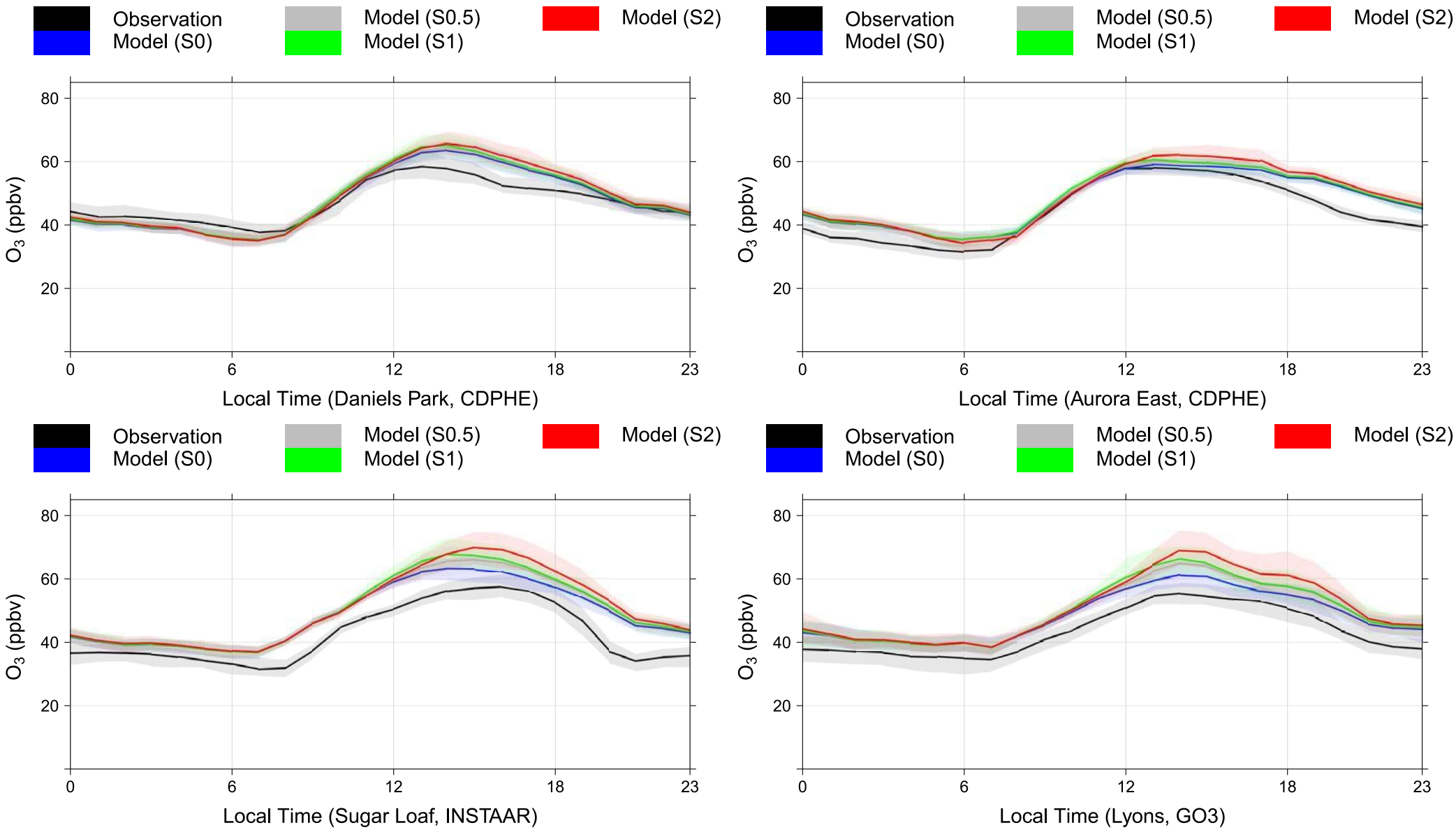
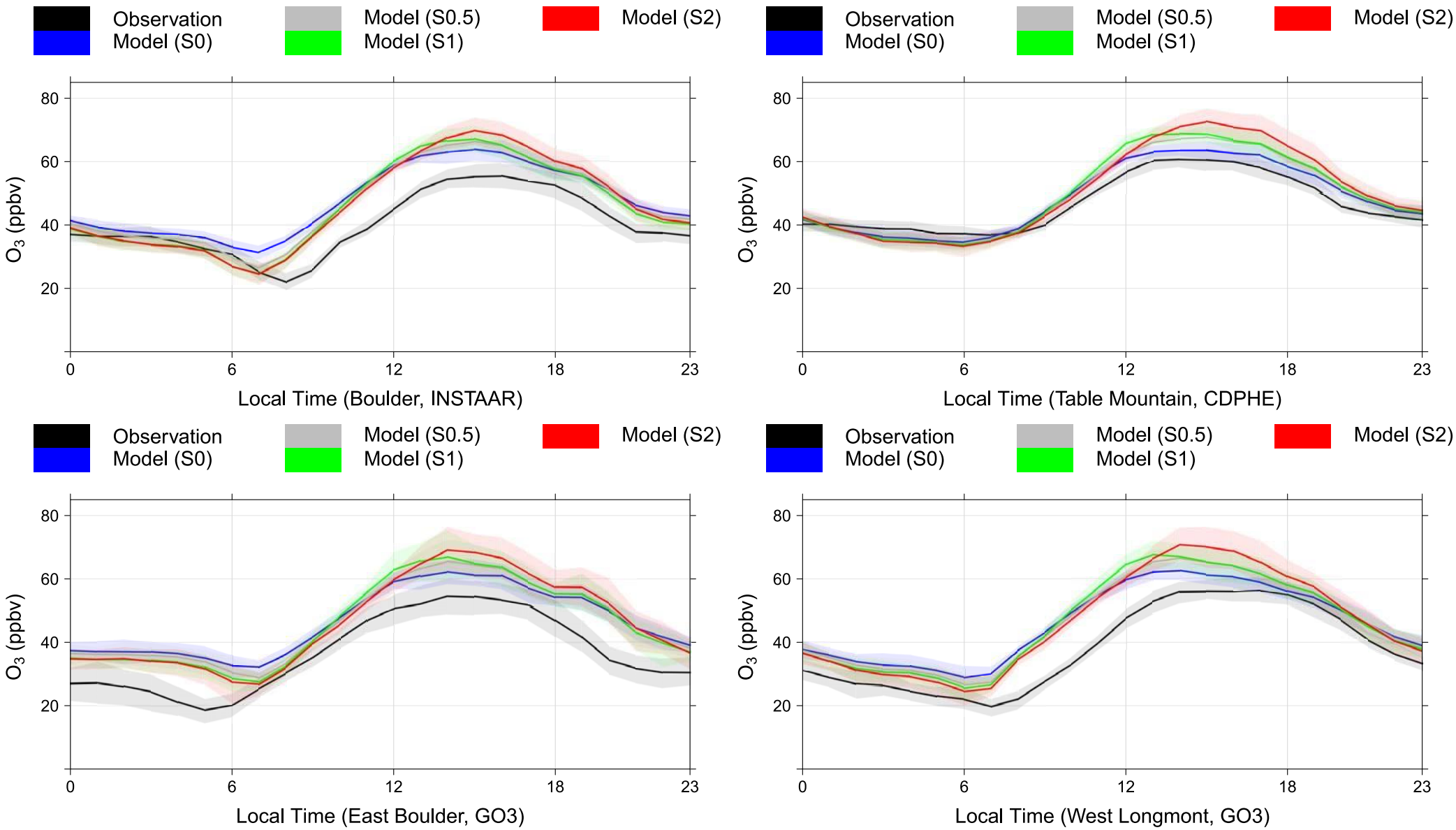


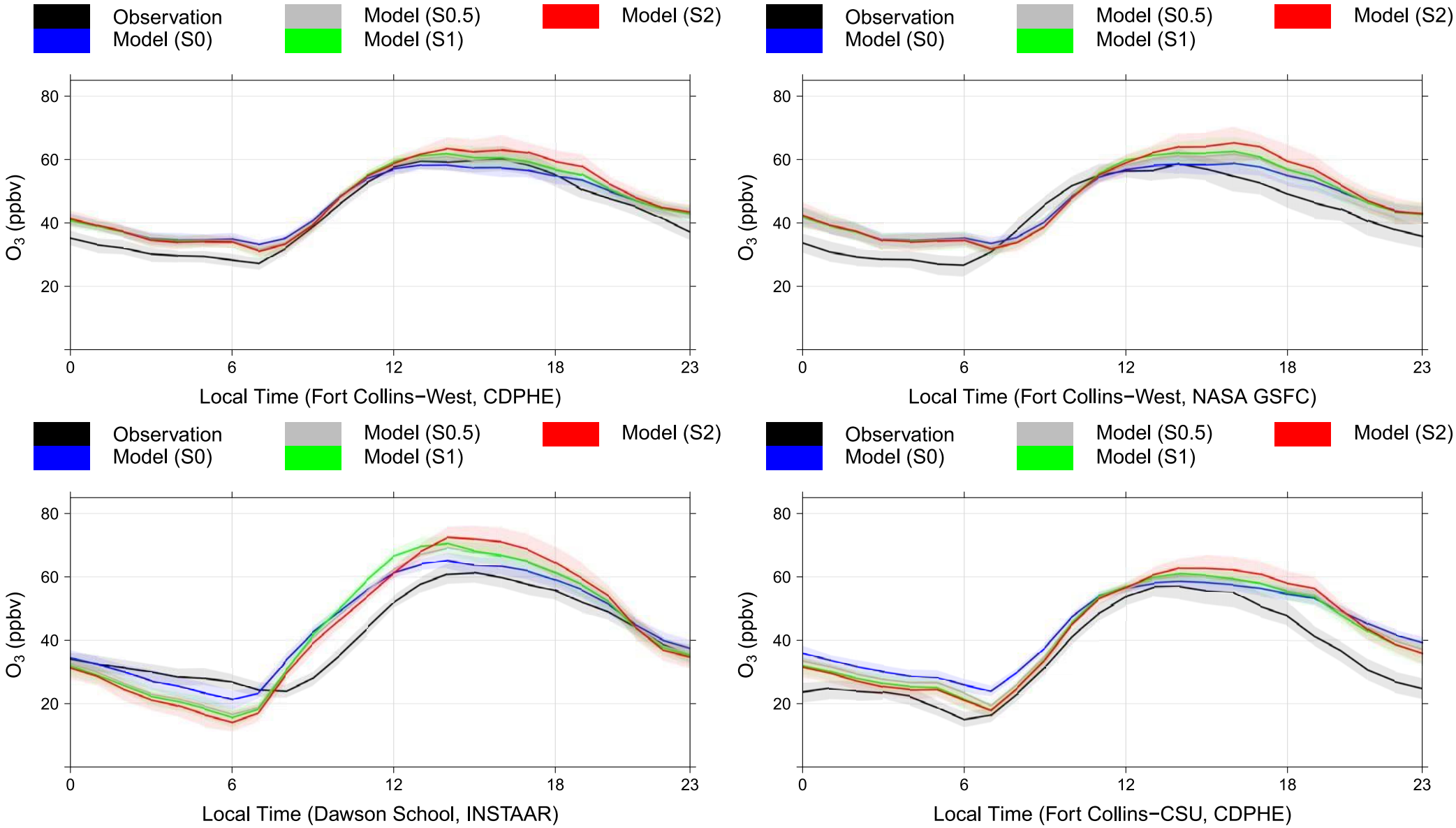
Figure D5: Average diurnal cycle of surface ozone at surface sites in the NFRMA and the nearby mountains. Shown are measurements (black) and model results for S0 (blue), S05 (gray), S1 (green) and S2 (red). The sites are ordered by sites located in the Denver area, in the non-Denver urban area, the O&G region, the Foothills and nearby-mountains to the west of the NFRMA and sites not located in any of the above regions.

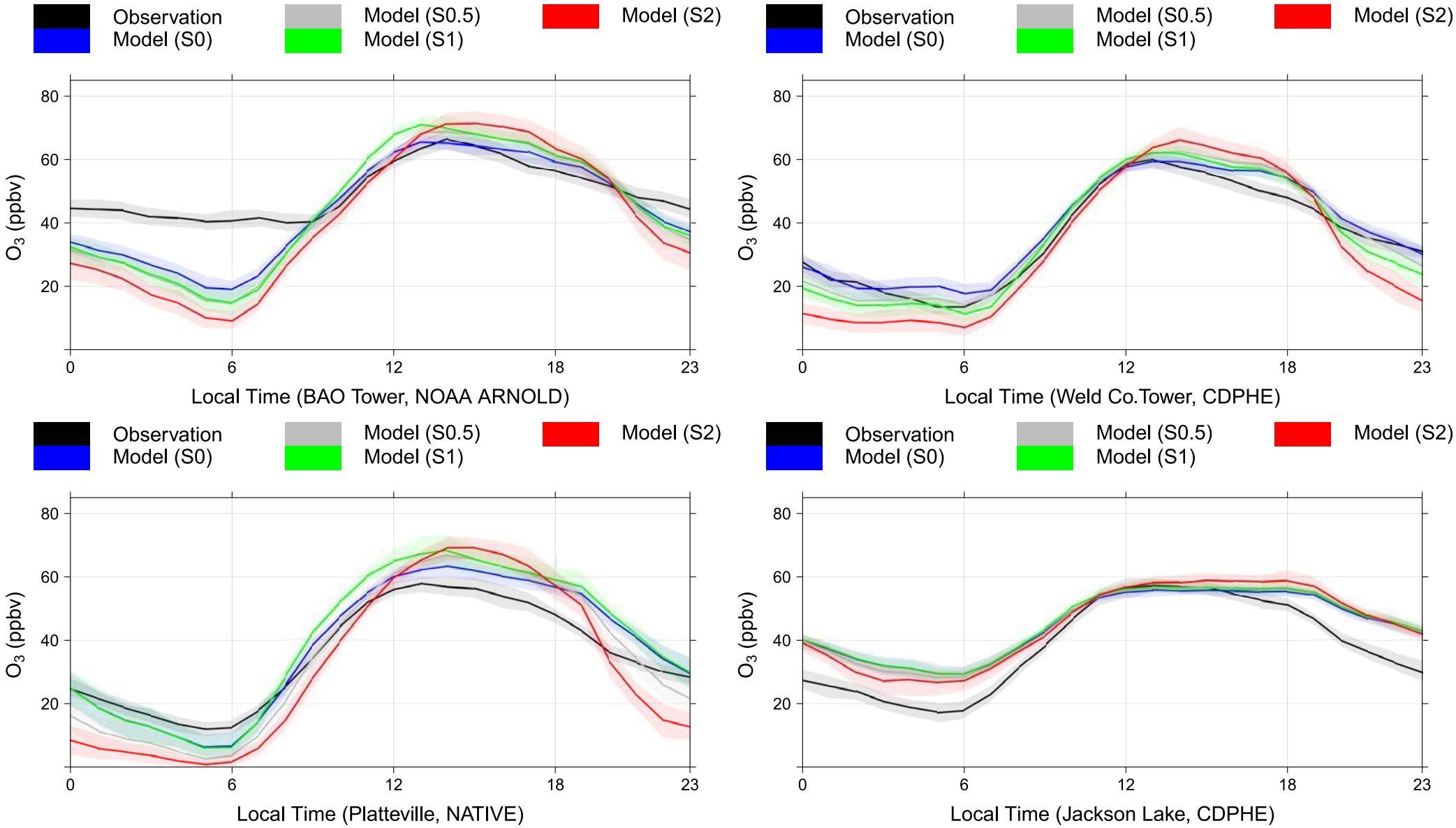


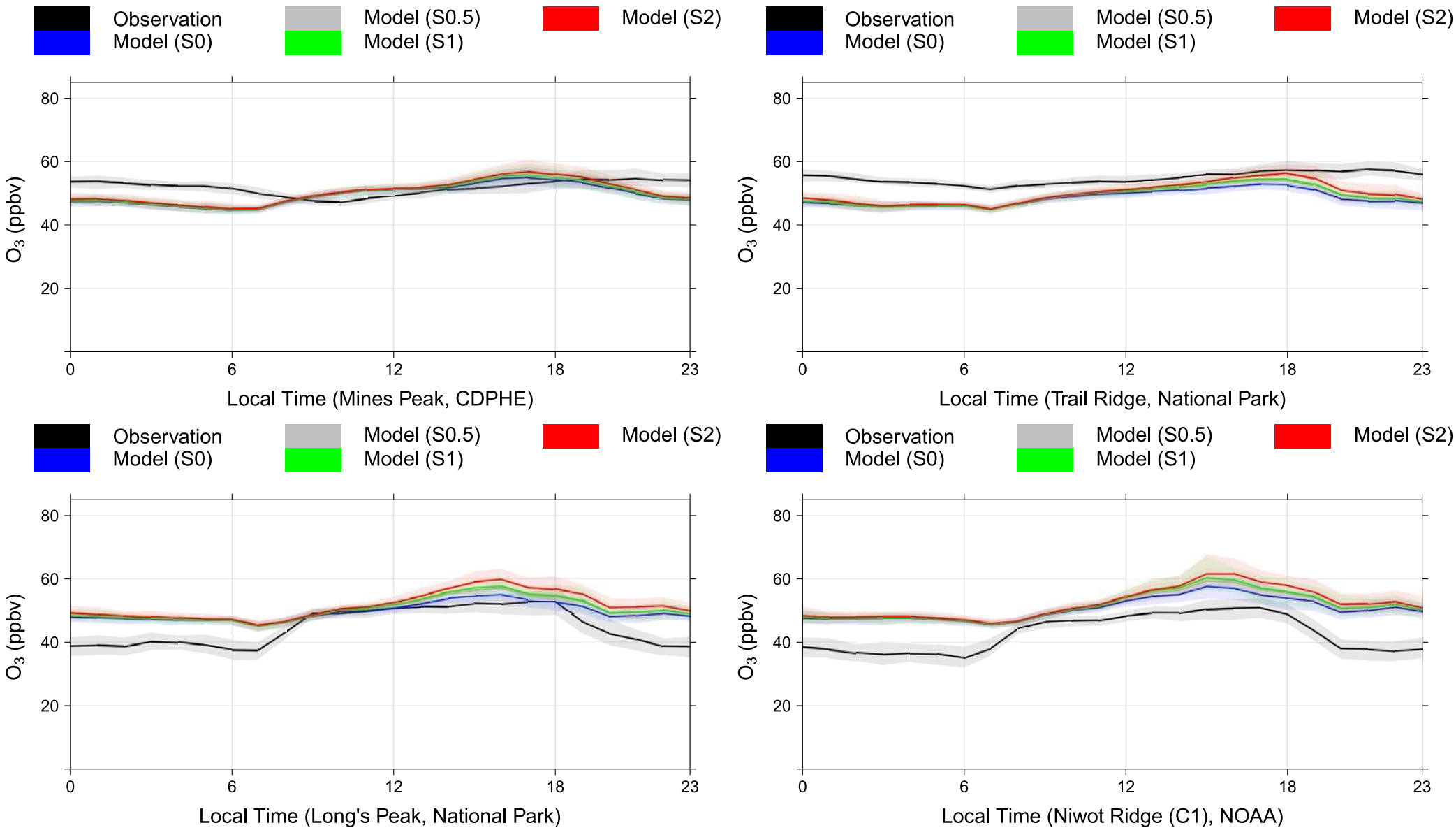

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
20
40
60
80
0
6
12
18
23
Local Time (Chatfield Park, CDPHE)
Local Time (Denver−LaCasa, CDPHE)
Local Time (CAMP, CDPHE)
Local Time (Welby, CDPHE)

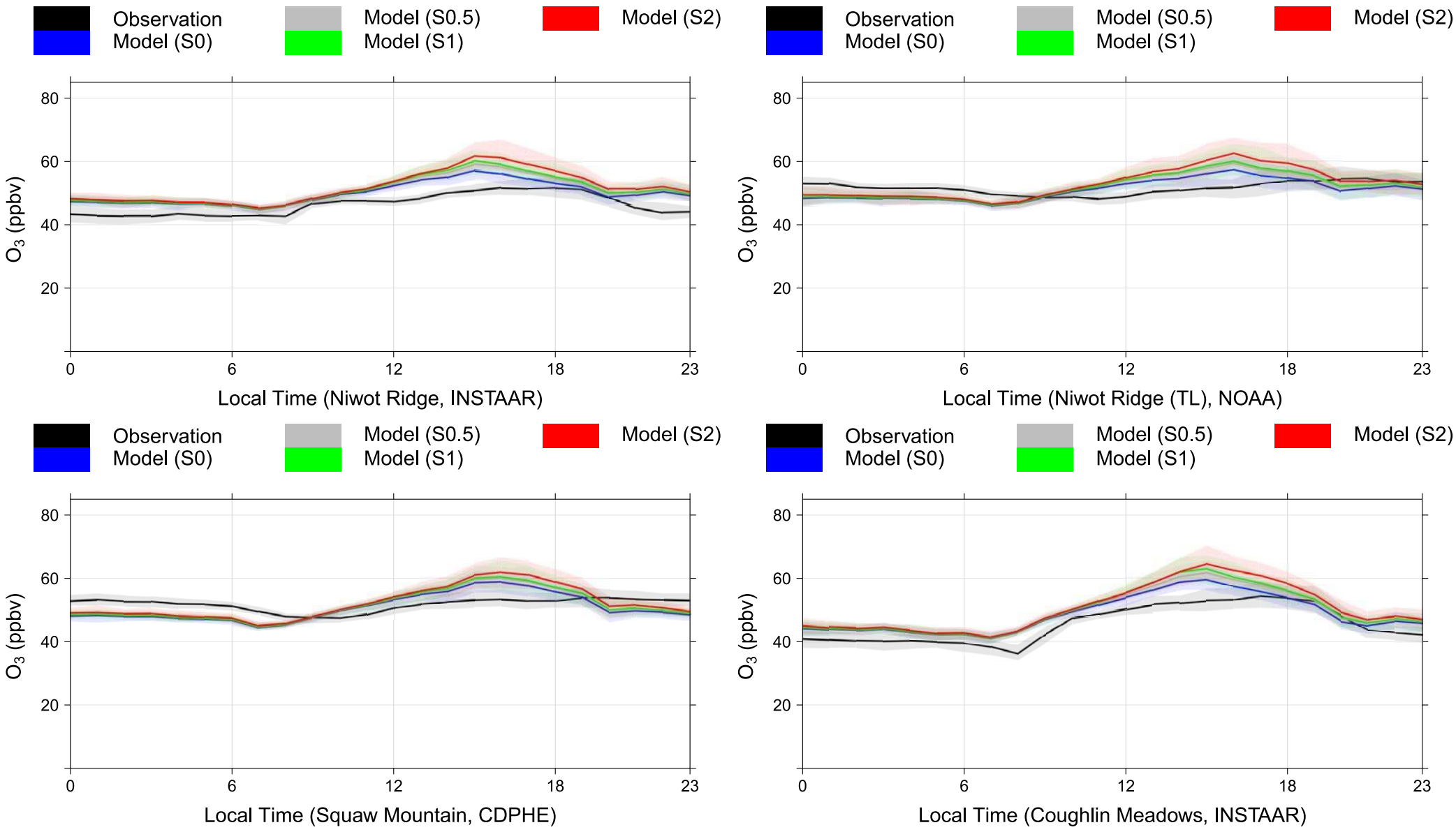

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
Local Time (Daniels Park, CDPHE)
Local Time (Aurora East, CDPHE)
Local Time (Sugar Loaf, INSTAAR)
Local Time (Lyons, GO3)

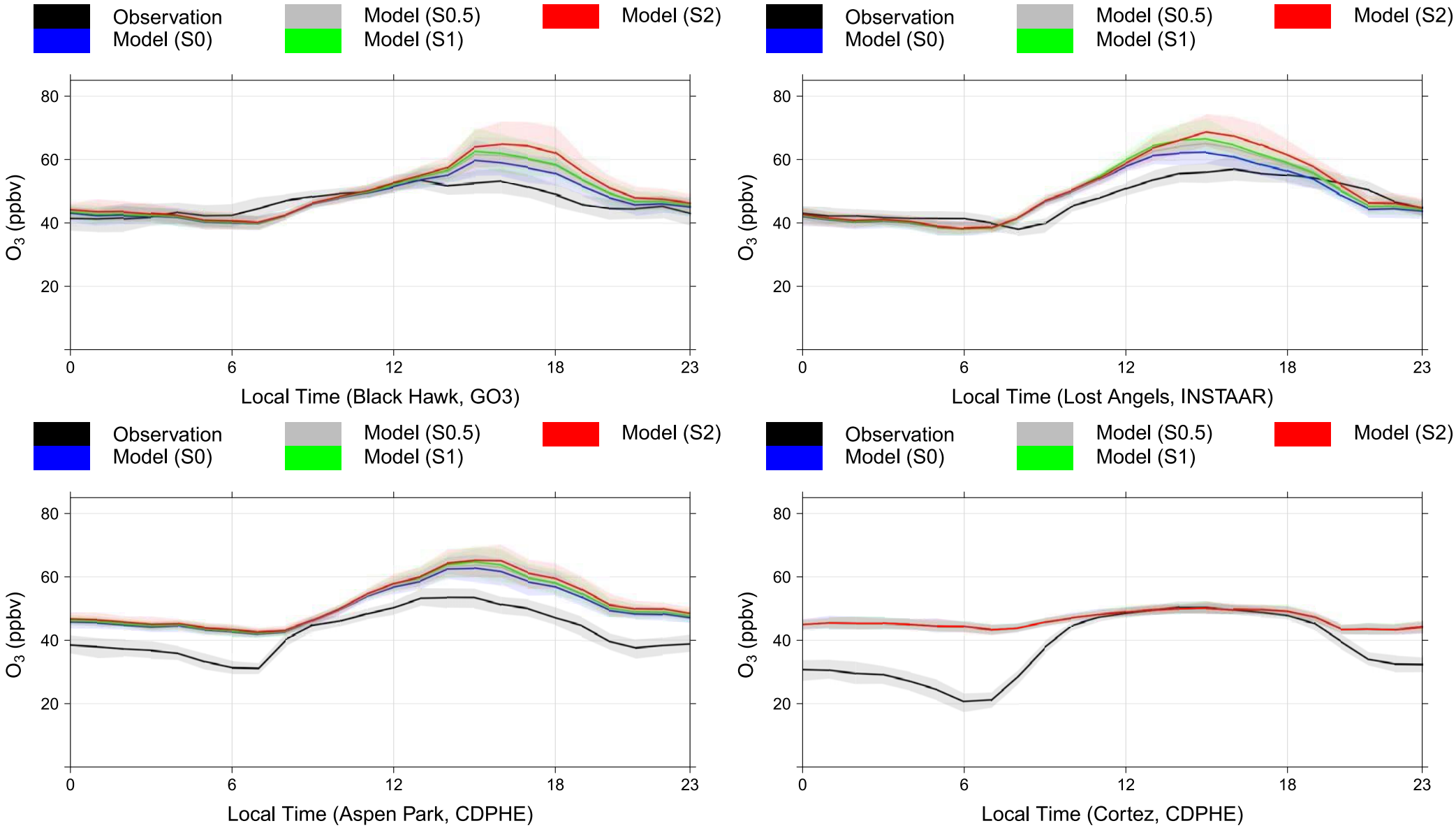

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
Local Time (Boulder, INSTAAR)
Local Time (Table Mountain, CDPHE)
Local Time (East Boulder, GO3)
Local Time (West Longmont, GO3)

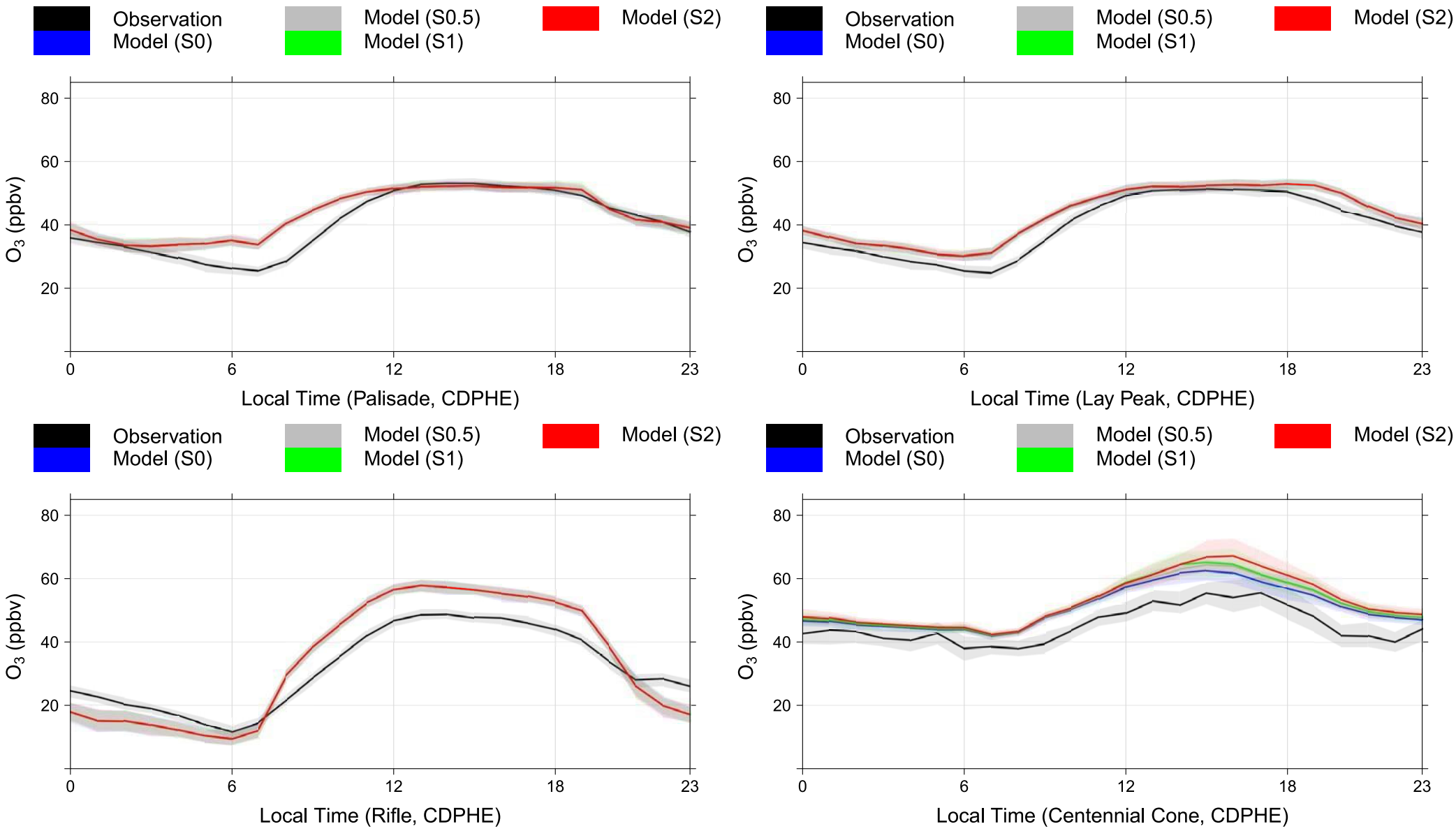

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
Local Time (Fort Collins−West, CDPHE)
Local Time (Fort Collins−West, NASA GSFC)
Local Time (Dawson School, INSTAAR)
Local Time (Fort Collins−CSU, CDPHE)

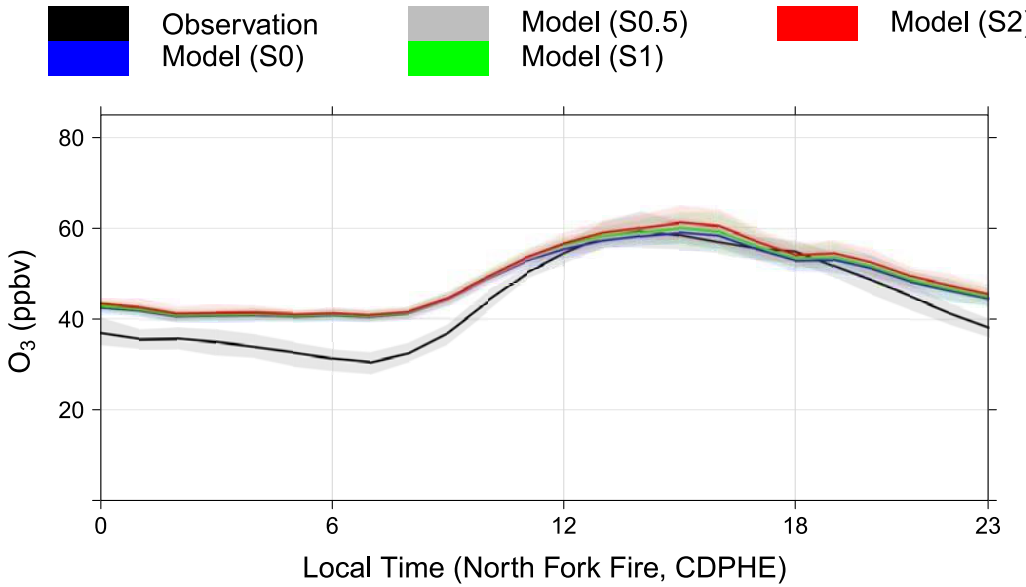

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
Local Time (BAO Tower, NOAA ARNOLD)
Local Time (Weld Co.Tower, CDPHE)
Local Time (Platteville, NATIVE)
Local Time (Jackson Lake, CDPHE)

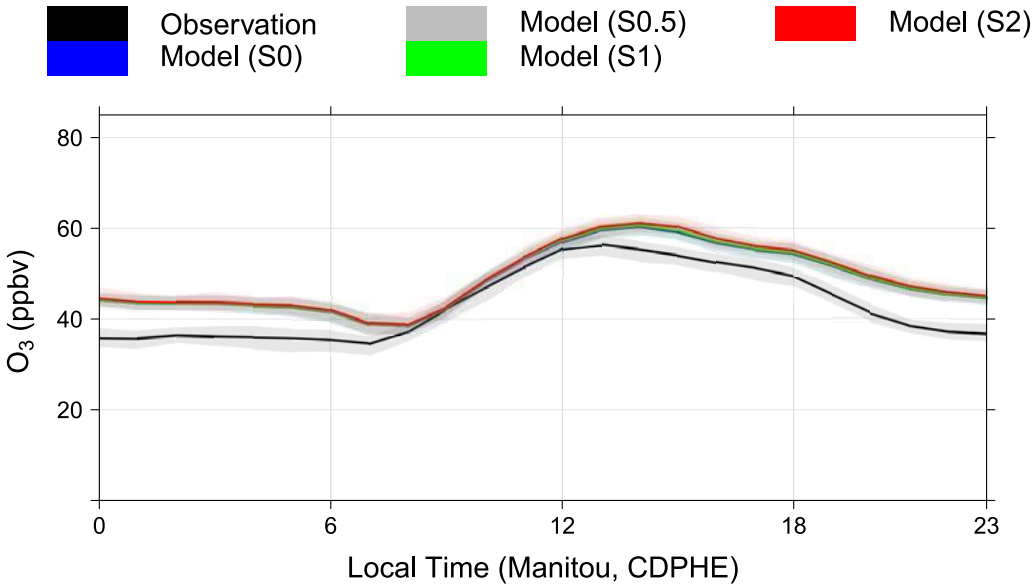

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
Local Time (Mines Peak, CDPHE)
Local Time (Trail Ridge, National Park)
Local Time (Long's Peak, National Park)
Local Time (Niwot Ridge (C1), NOAA)

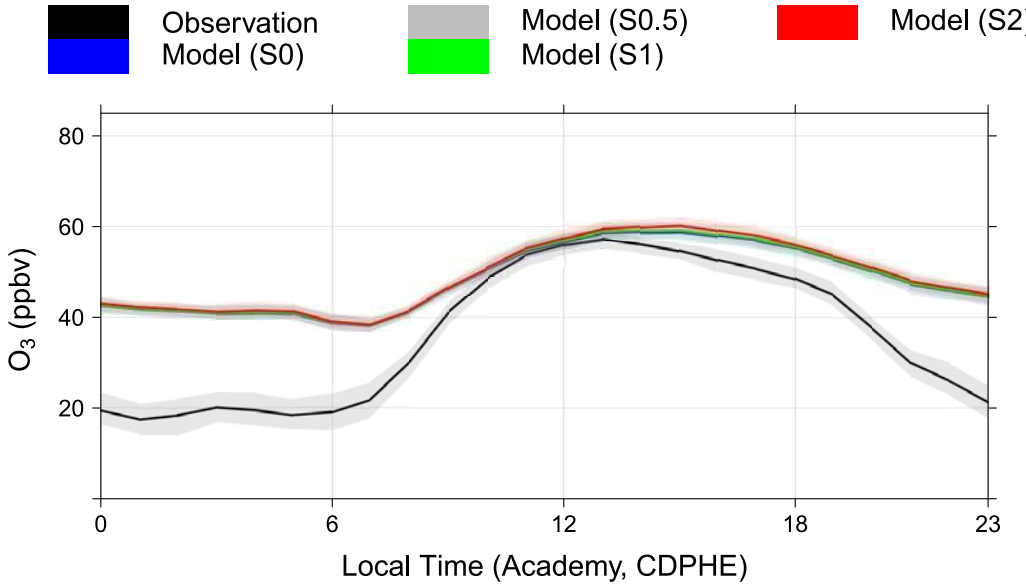

Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
Local Time (Niwot Ridge, INSTAAR)
Local Time (Niwot Ridge (TL), NOAA)
Local Time (Squaw Mountain, CDPHE)
Local Time (Coughlin Meadows, INSTAAR)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
20
40
60
80
0
6
12
18
23
Local Time (Black Hawk, GO3)
Local Time (Lost Angels, INSTAAR)
Local Time (Aspen Park, CDPHE)
Local Time (Cortez, CDPHE)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
O_3 (ppbv)
Local Time (Palisade, CDPHE)
Local Time (Lay Peak, CDPHE)
Local Time (Rifle, CDPHE)
Local Time (Centennial Cone, CDPHE)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
80
60
40
20
O_3 (ppbv)
0
6
12
18
23
Local Time (North Fork Fire, CDPHE)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
80
60
40
20
O_3 (ppbv)
0
6
12
18
23
Local Time (Manitou, CDPHE)


Observation
Model (S0)
Model (S0.5)
Model (S1)
Model (S2)
80
60
40
20
O_3 (ppbv)
0
6
12
18
23
Local Time (Academy, CDPHE)