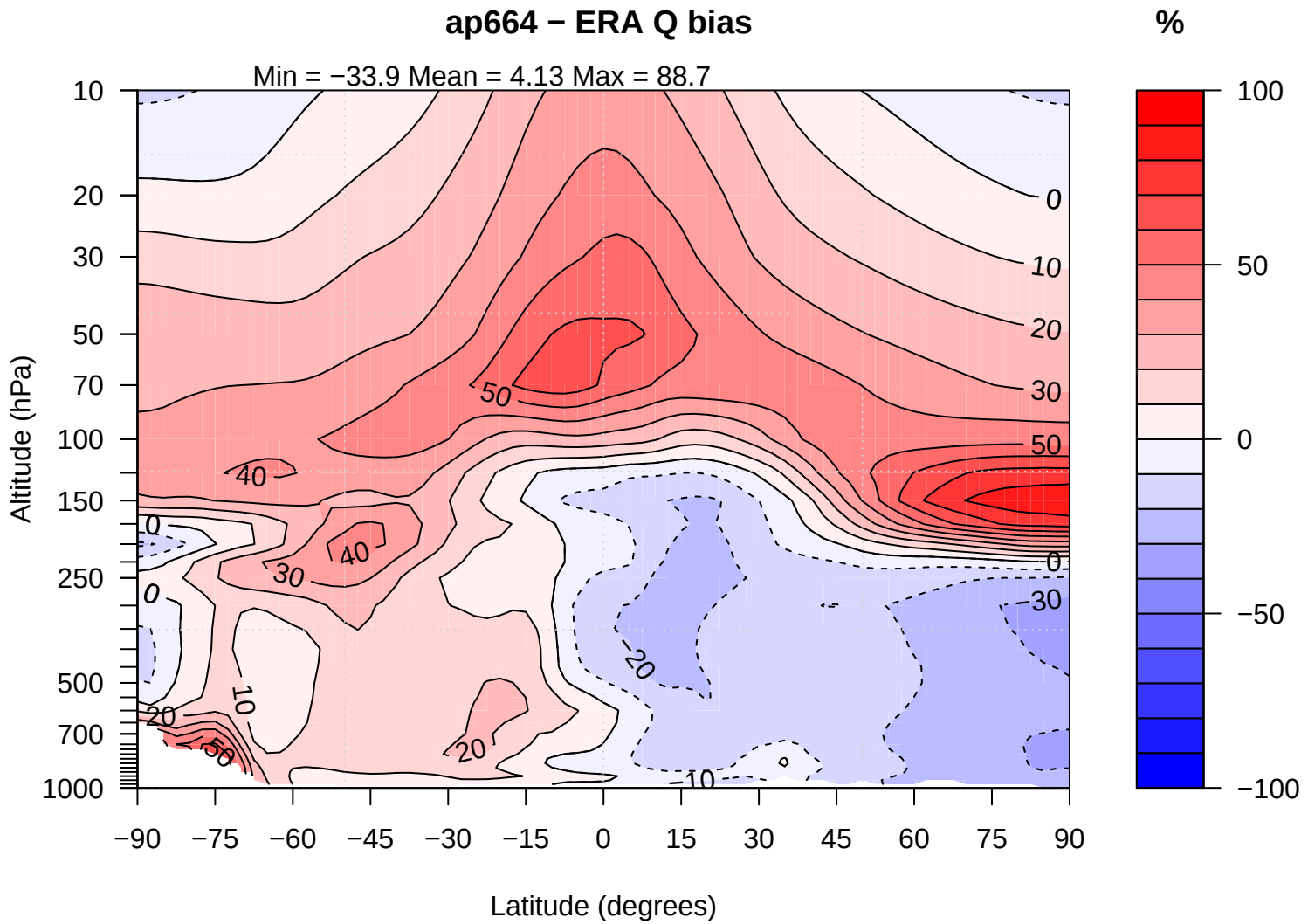
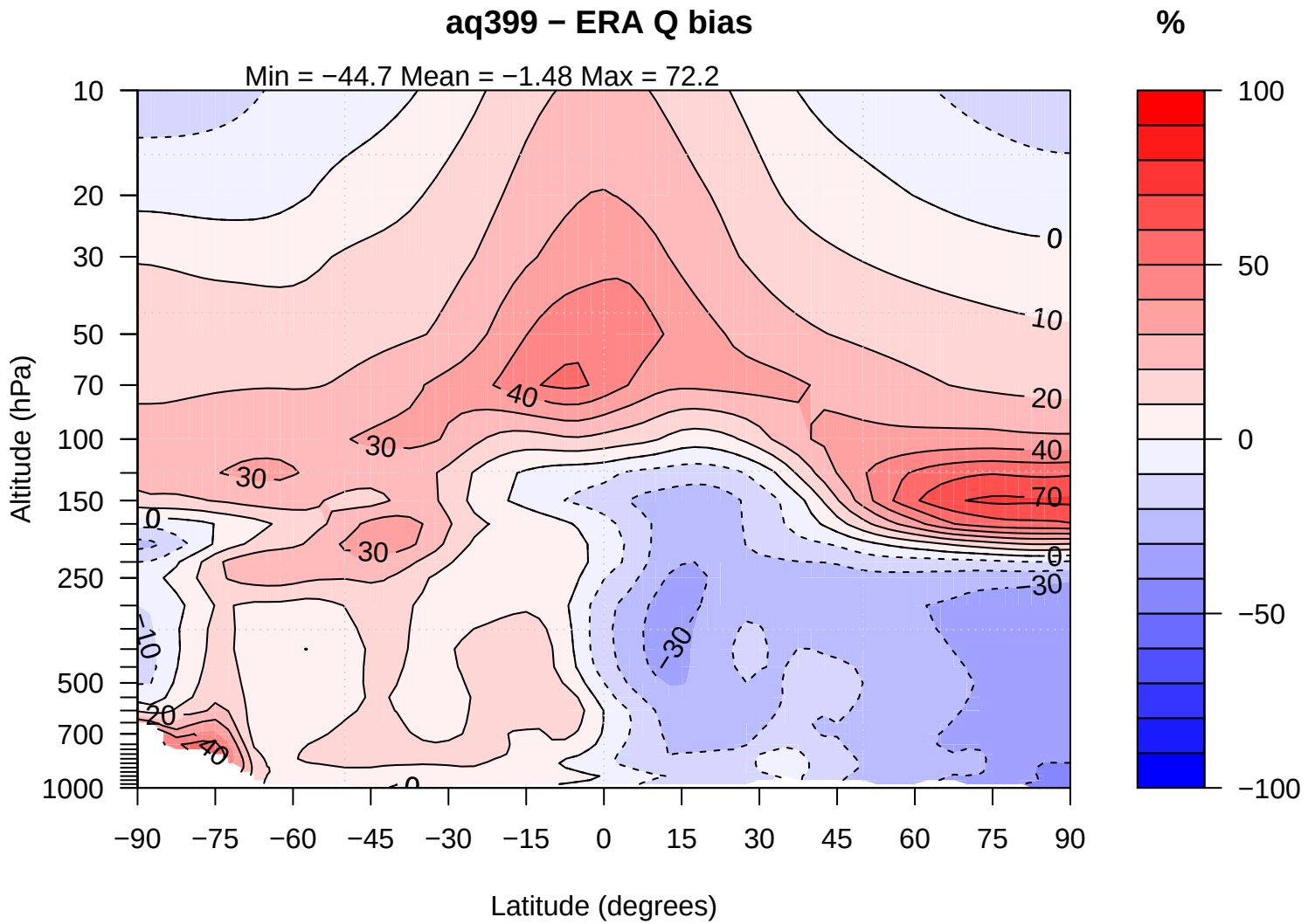
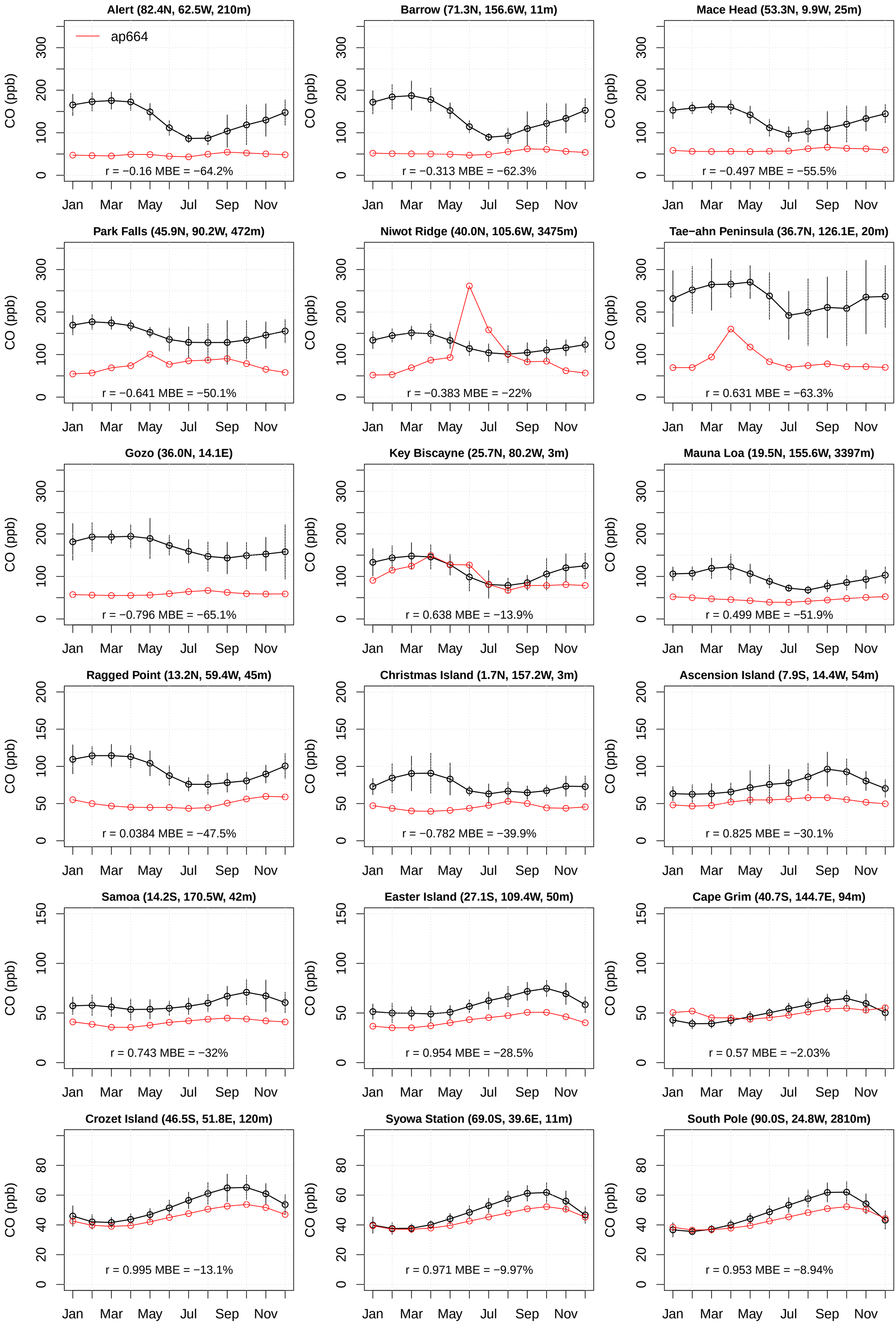
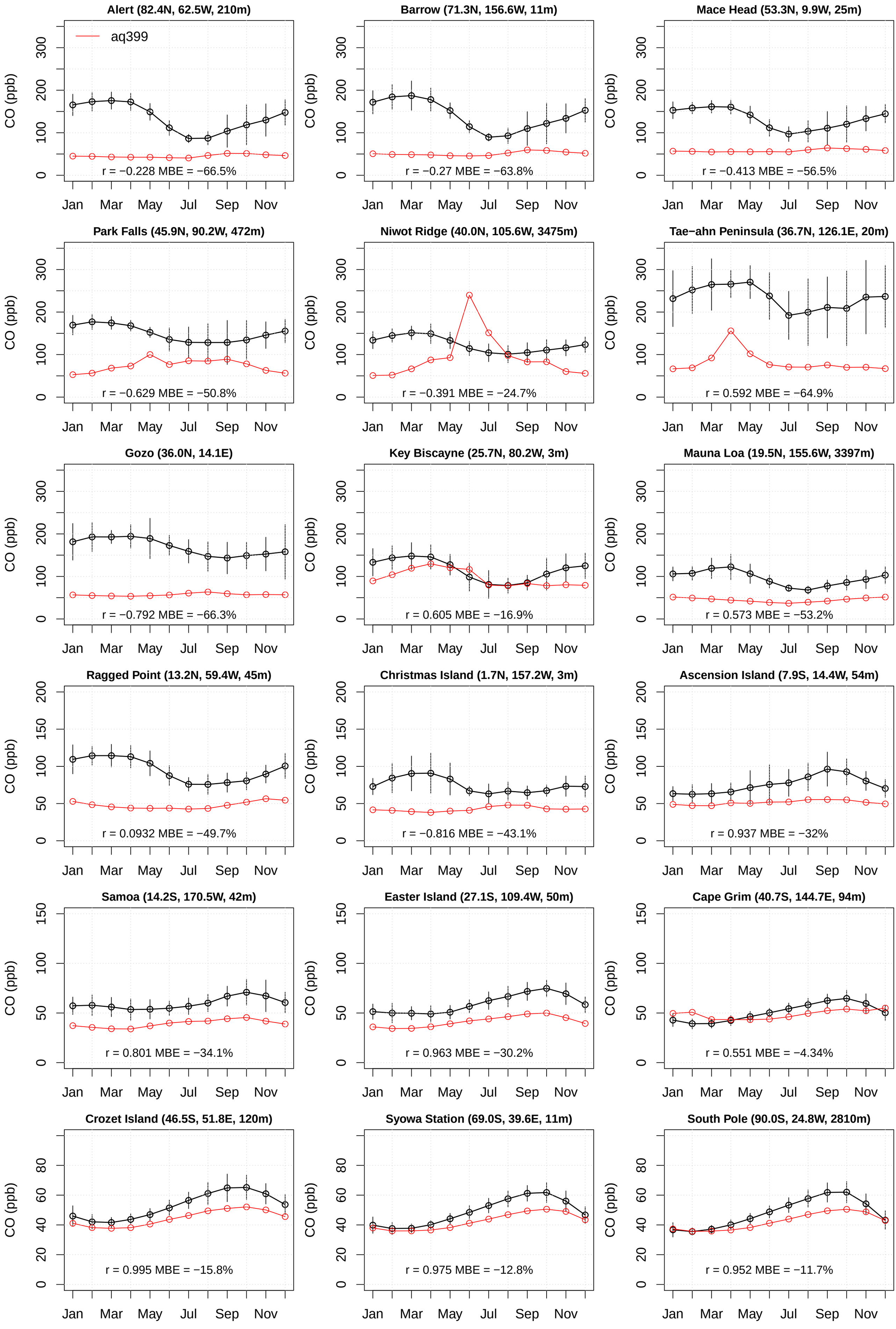
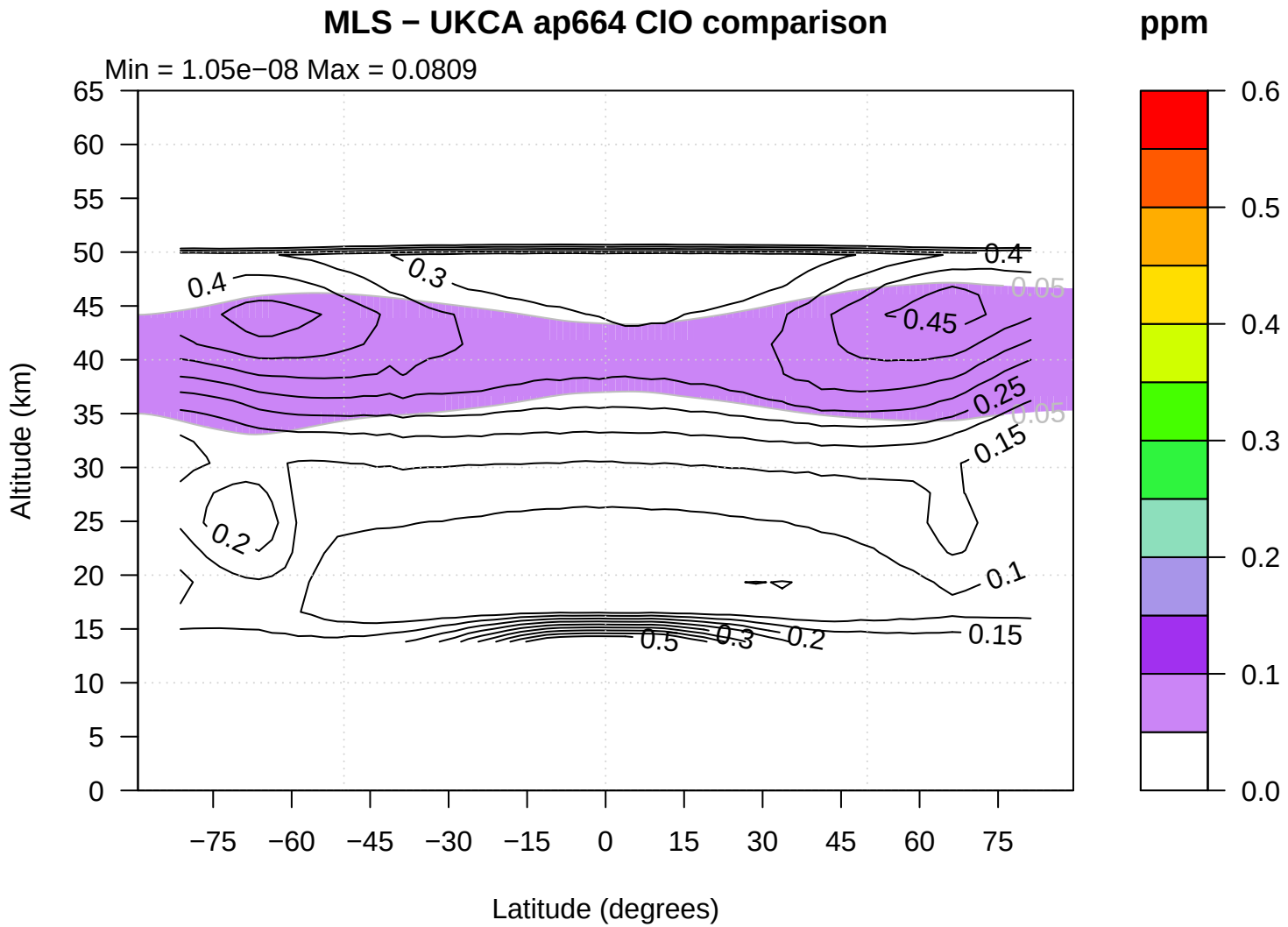
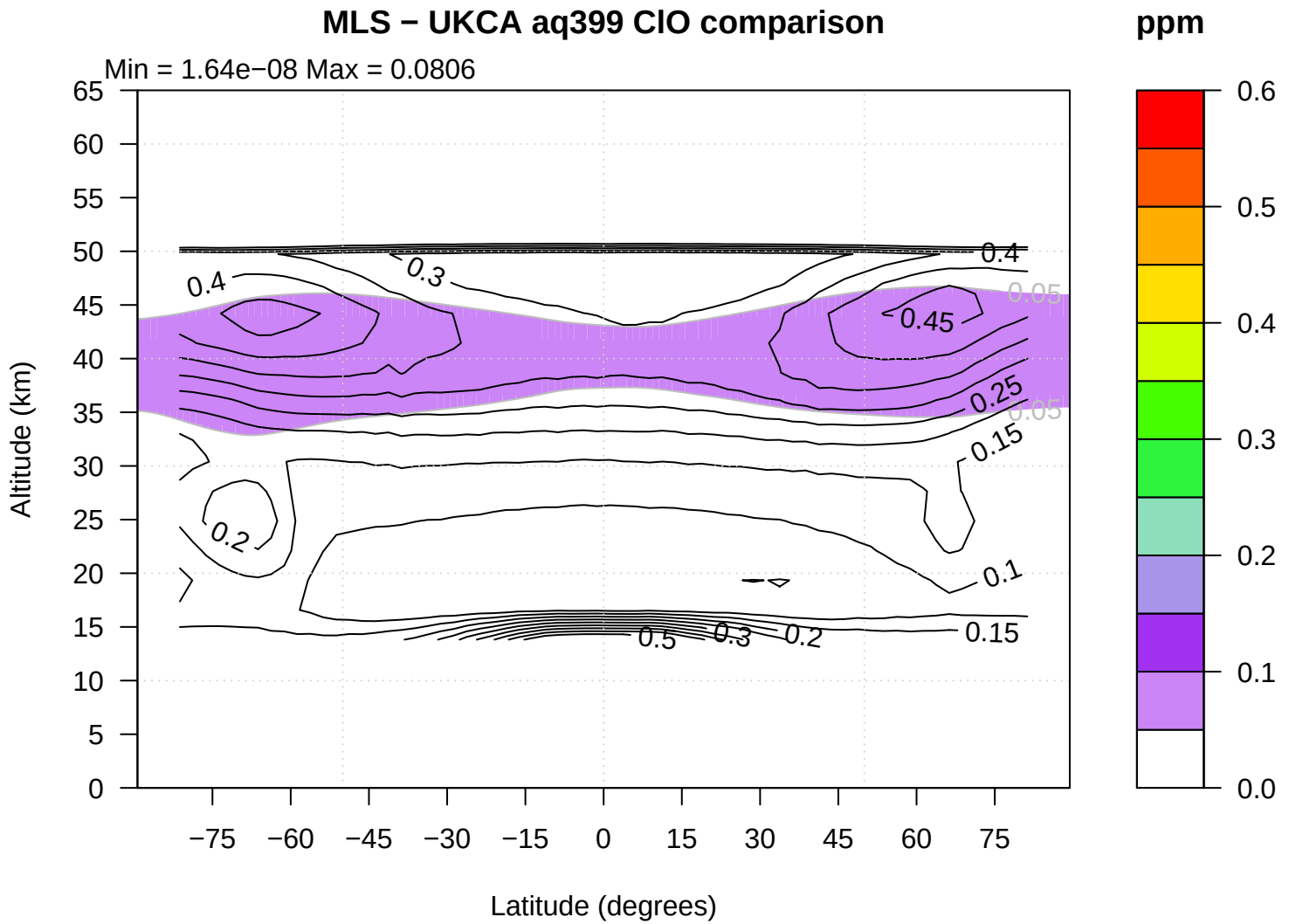

ap664 − ERA Q bias
Min = −33.9 Mean = 4.13 Max = 88.7
%
Altitude (hPa)
Latitude (degrees)
10
20
30
50
70
100
150
250
500
700
1000
−90
−75
−60
−45
−30
−15
0
15
30
45
60
75
90
100
50
0
−50
−100


aq399 − ERA Q bias
Min = −44.7 Mean = −1.48 Max = 72.2
%
Altitude (hPa)
Latitude (degrees)
10
20
30
50
70
100
150
250
500
700
1000
−90
−75
−60
−45
−30
−15
0
15
30
45
60
75
90
100
50
0
−50
−100
0
10
20
40
70
−30
−10
−40

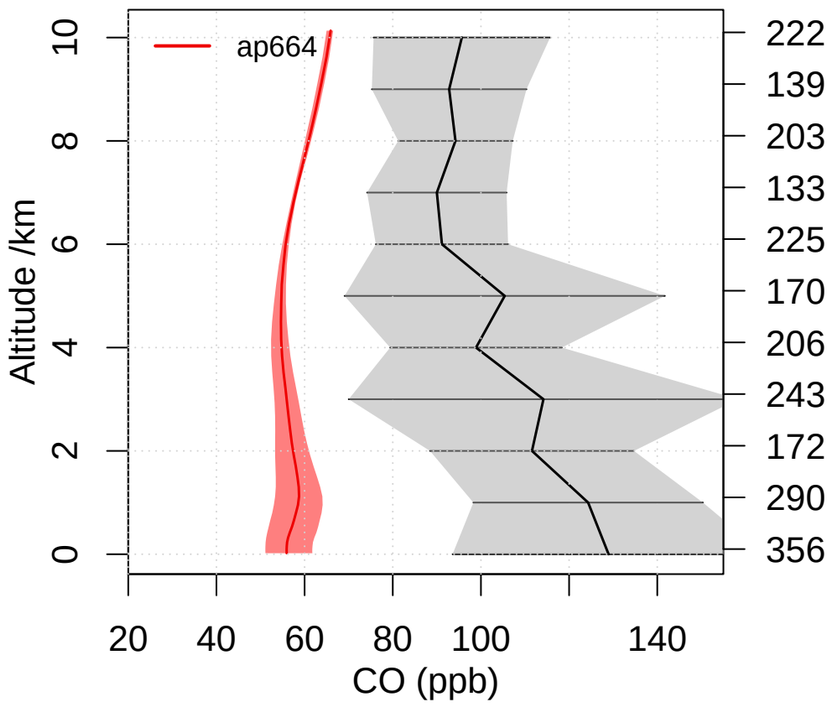

Alert (82.4N, 62.5W, 210m)
ap664
r = −0.16 MBE = −64.2%
Barrow (71.3N, 156.6W, 11m)
r = −0.313 MBE = −62.3%
Mace Head (53.3N, 9.9W, 25m)
r = −0.497 MBE = −55.5%
Park Falls (45.9N, 90.2W, 472m)
r = −0.641 MBE = −50.1%
Niwot Ridge (40.0N, 105.6W, 3475m)
r = −0.383 MBE = −22%
Tae−ahn Peninsula (36.7N, 126.1E, 20m)
r = 0.631 MBE = −63.3%
Gozo (36.0N, 14.1E)
r = −0.796 MBE = −65.1%
Key Biscayne (25.7N, 80.2W, 3m)
r = 0.638 MBE = −13.9%
Mauna Loa (19.5N, 155.6W, 3397m)
r = 0.499 MBE = −51.9%
Ragged Point (13.2N, 59.4W, 45m)
r = 0.0384 MBE = −47.5%
Christmas Island (1.7N, 157.2W, 3m)
r = −0.782 MBE = −39.9%
Ascension Island (7.9S, 14.4W, 54m)
r = 0.825 MBE = −30.1%
Samoa (14.2S, 170.5W, 42m)
r = 0.743 MBE = −32%
Easter Island (27.1S, 109.4W, 50m)
r = 0.954 MBE = −28.5%
Cape Grim (40.7S, 144.7E, 94m)
r = 0.57 MBE = −2.03%
Crozet Island (46.5S, 51.8E, 120m)
r = 0.995 MBE = −13.1%
Syowa Station (69.0S, 39.6E, 11m)
r = 0.971 MBE = −9.97%
South Pole (90.0S, 24.8W, 2810m)
r = 0.953 MBE = −8.94%
CO (ppb)
Jan
Mar
May
Jul
Sep
Nov

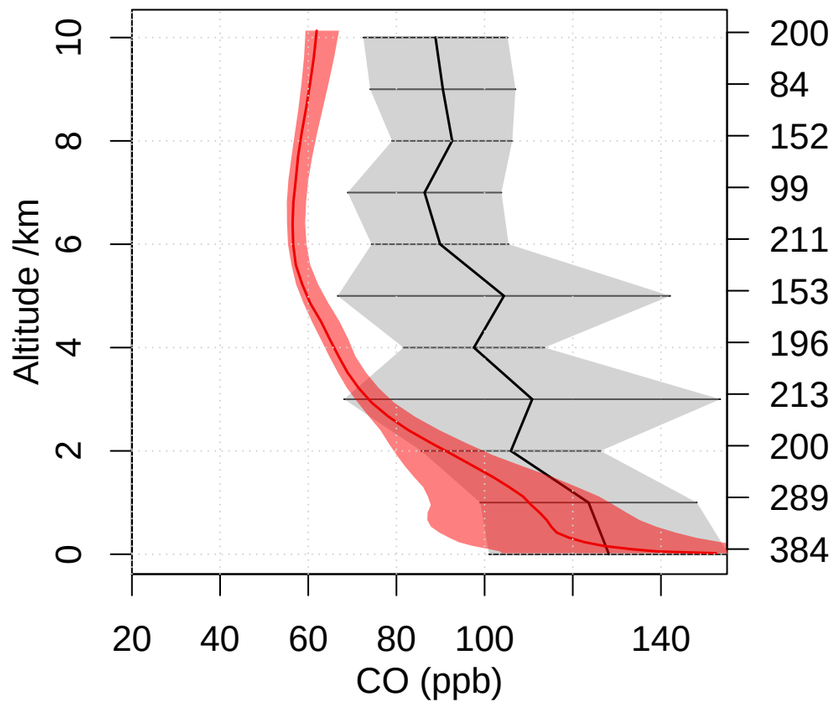

Alert (82.4N, 62.5W, 210m)
aq399
r = −0.228 MBE = −66.5%
Barrow (71.3N, 156.6W, 11m)
r = −0.27 MBE = −63.8%
Mace Head (53.3N, 9.9W, 25m)
r = −0.413 MBE = −56.5%
Park Falls (45.9N, 90.2W, 472m)
r = −0.629 MBE = −50.8%
Niwot Ridge (40.0N, 105.6W, 3475m)
r = −0.391 MBE = −24.7%
Tae−ahn Peninsula (36.7N, 126.1E, 20m)
r = 0.592 MBE = −64.9%
Gozo (36.0N, 14.1E)
r = −0.792 MBE = −66.3%
Key Biscayne (25.7N, 80.2W, 3m)
r = 0.605 MBE = −16.9%
Mauna Loa (19.5N, 155.6W, 3397m)
r = 0.573 MBE = −53.2%
Ragged Point (13.2N, 59.4W, 45m)
r = 0.0932 MBE = −49.7%
Christmas Island (1.7N, 157.2W, 3m)
r = −0.816 MBE = −43.1%
Ascension Island (7.9S, 14.4W, 54m)
r = 0.937 MBE = −32%
Samoa (14.2S, 170.5W, 42m)
r = 0.801 MBE = −34.1%
Easter Island (27.1S, 109.4W, 50m)
r = 0.963 MBE = −30.2%
Cape Grim (40.7S, 144.7E, 94m)
r = 0.551 MBE = −4.34%
Crozet Island (46.5S, 51.8E, 120m)
r = 0.995 MBE = −15.8%
Syowa Station (69.0S, 39.6E, 11m)
r = 0.975 MBE = −12.8%
South Pole (90.0S, 24.8W, 2810m)
r = 0.952 MBE = −11.7%
CO (ppb)
Jan
Mar
May
Jul
Sep
Nov

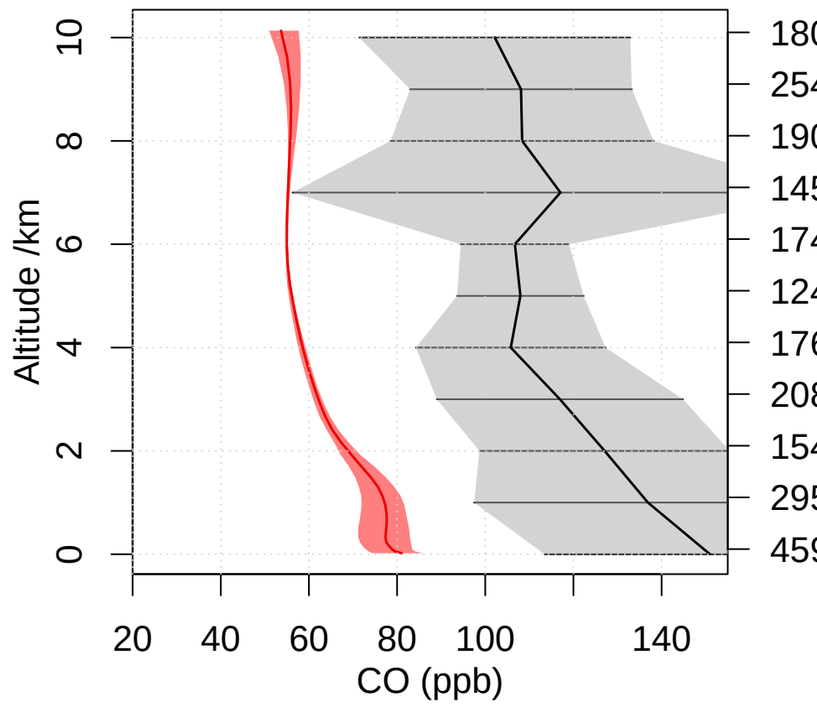

MLS − UKCA ap664 ClO comparison
ppm
Min = 1.05e−08 Max = 0.0809
Altitude (km)
Latitude (degrees)
0.4
0.3
0.45
0.25
0.15
0.2
0.1
0.5
0.05
0.6
0.0

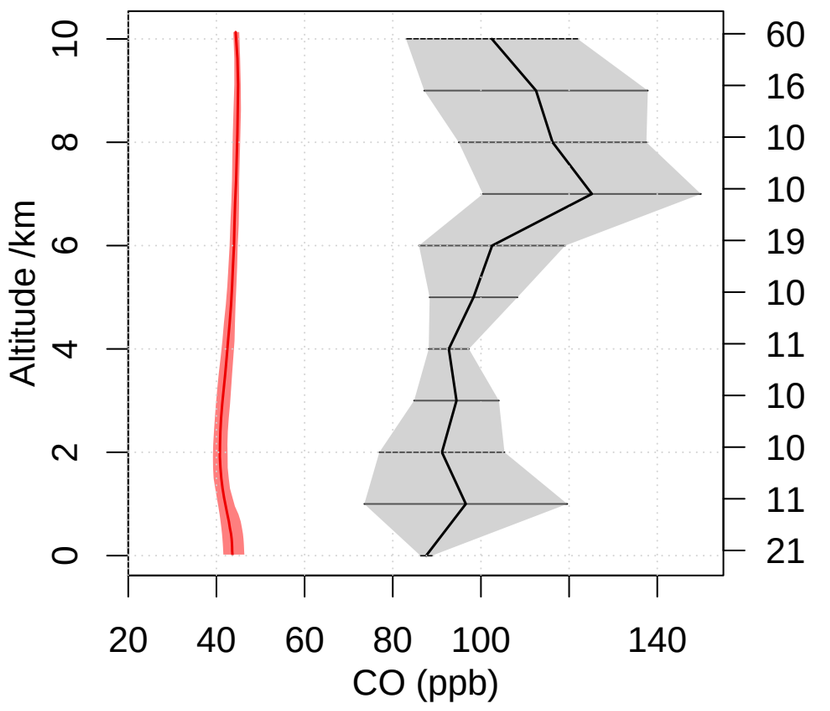

MLS − UKCA aq399 ClO comparison
ppm
Min = 1.64e−08 Max = 0.0806
Altitude (km)
Latitude (degrees)
0.4
0.3
0.45
0.25
0.15
0.2
0.1
0.5
0.05
0.6
0.0

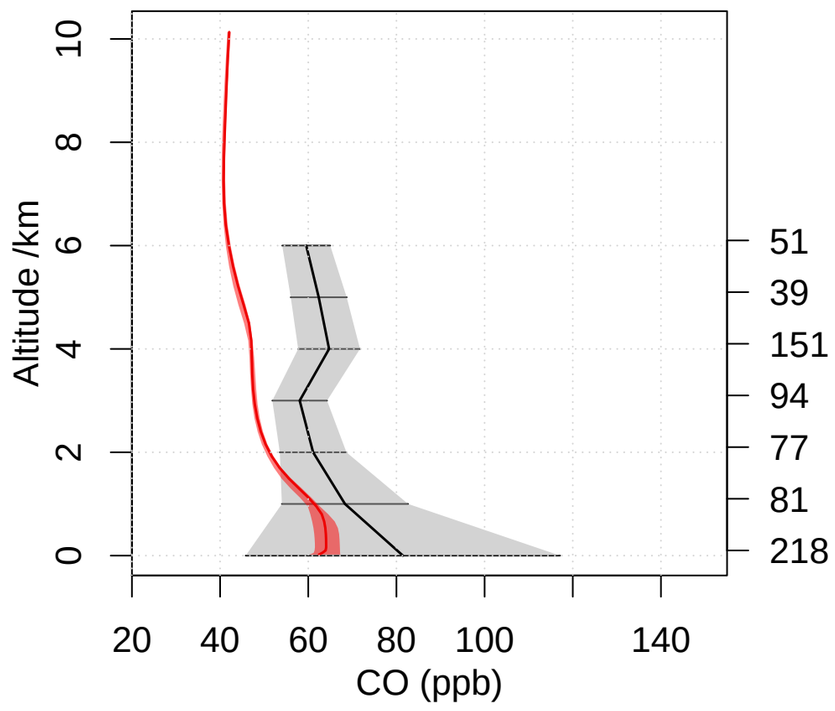
Emmons CO comparison

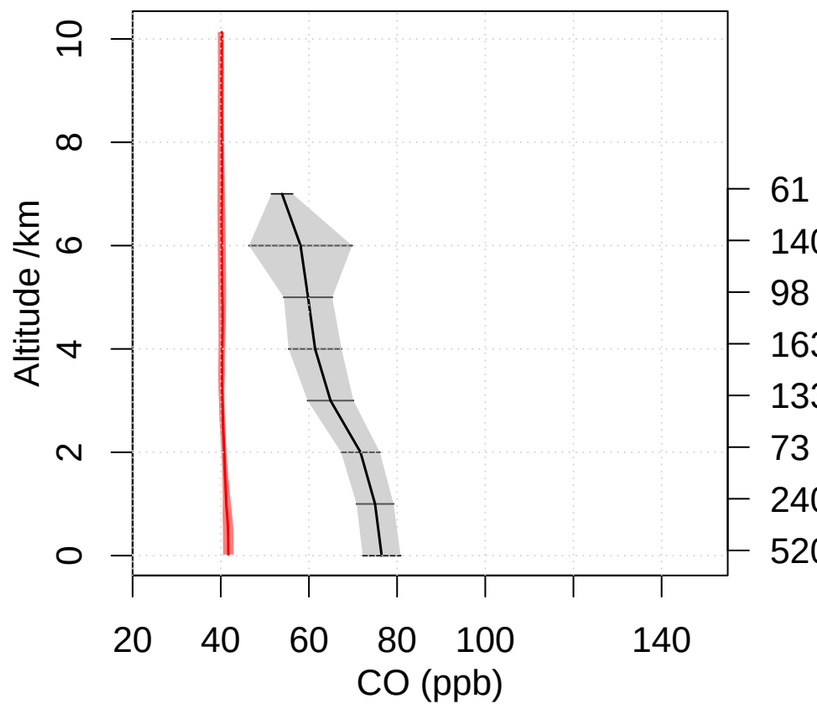


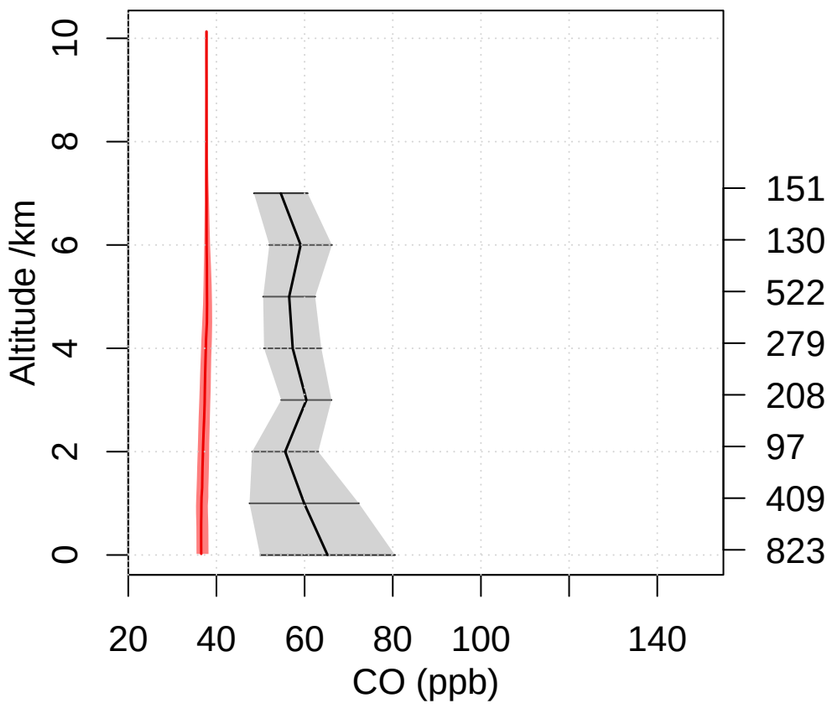


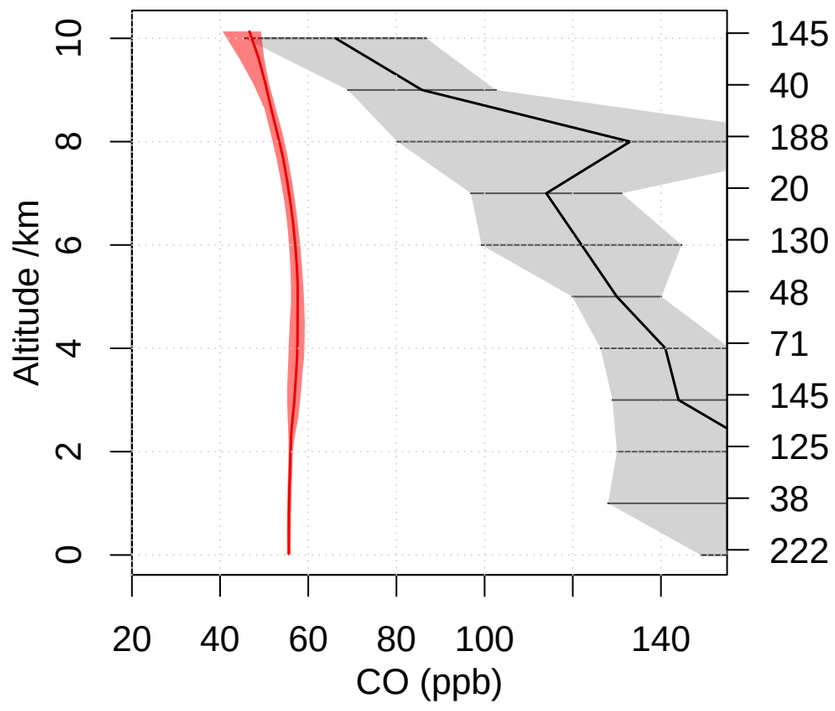


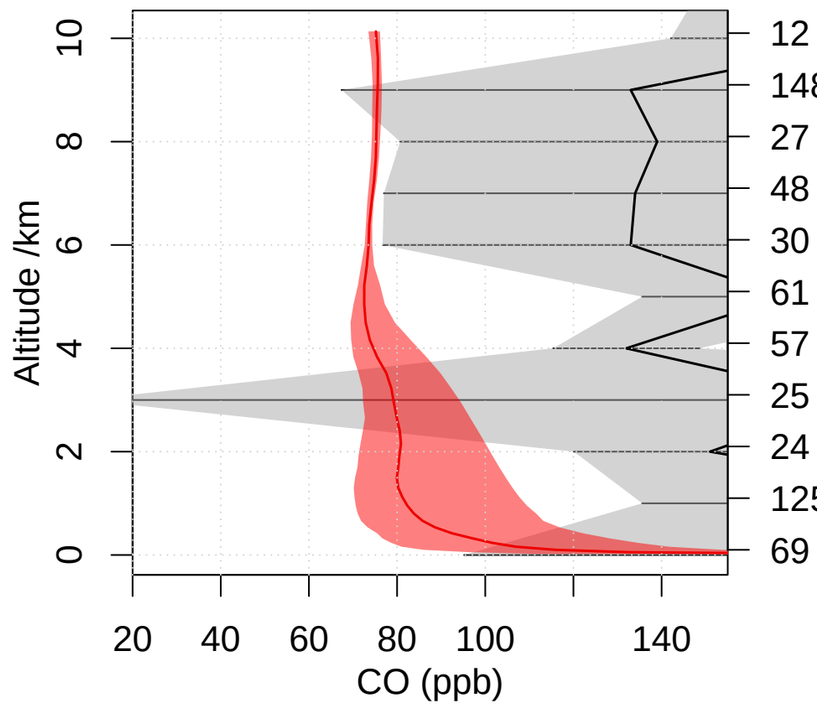


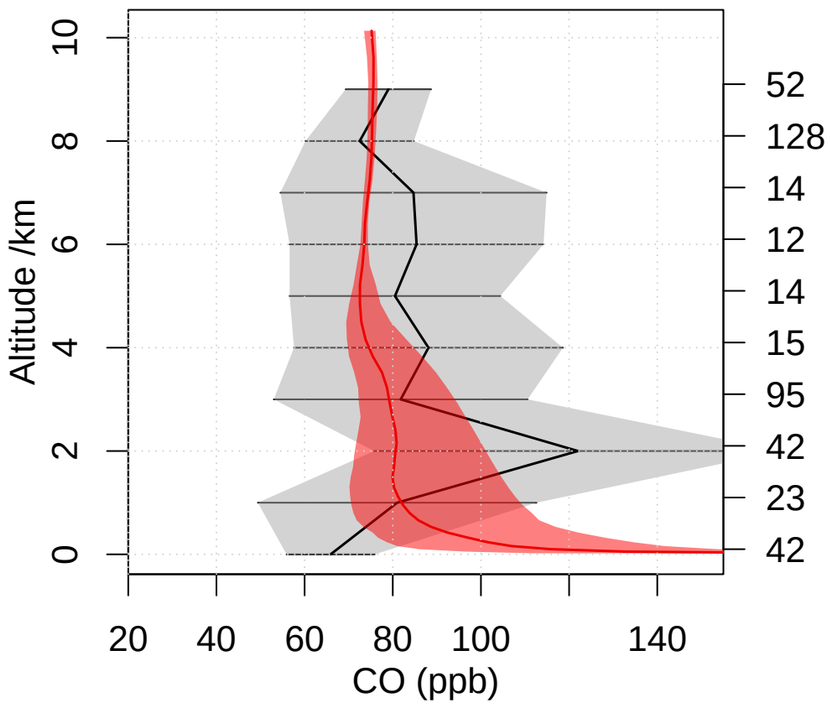


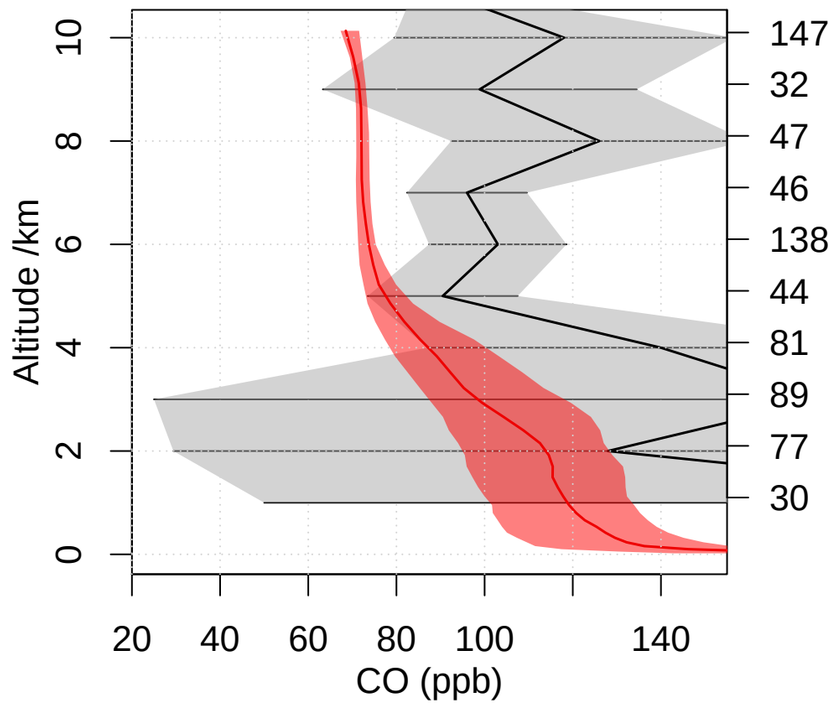


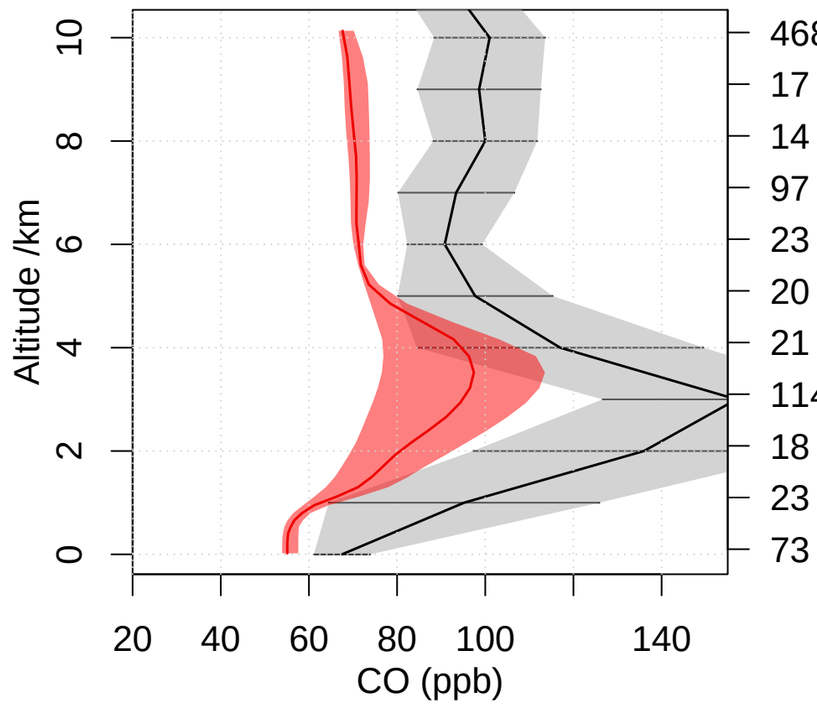




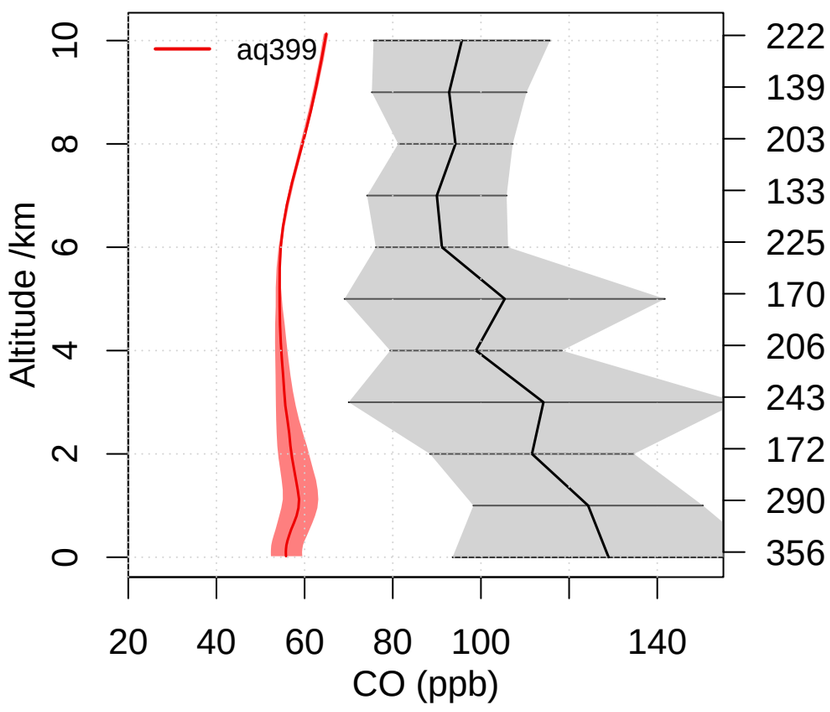


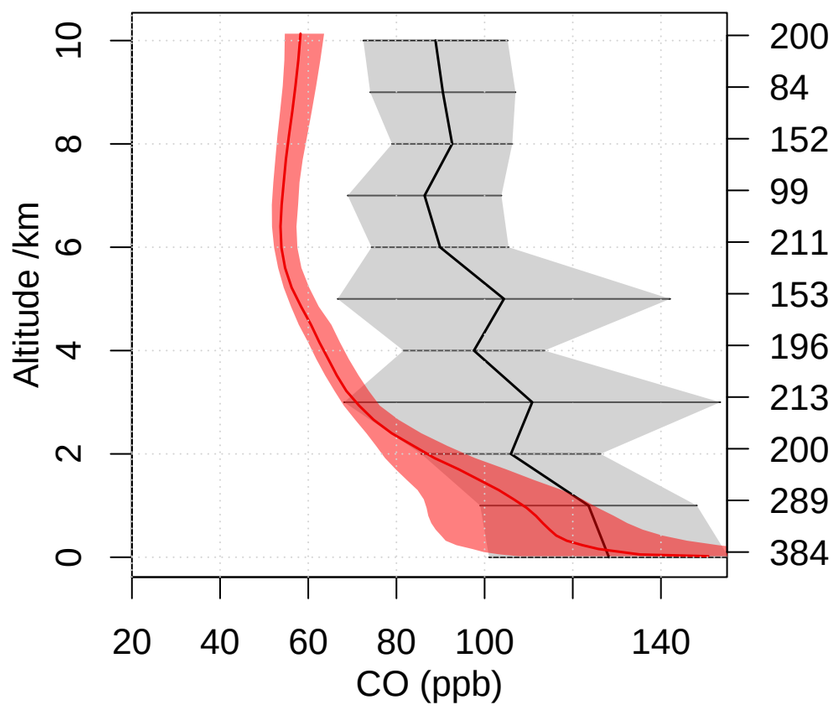


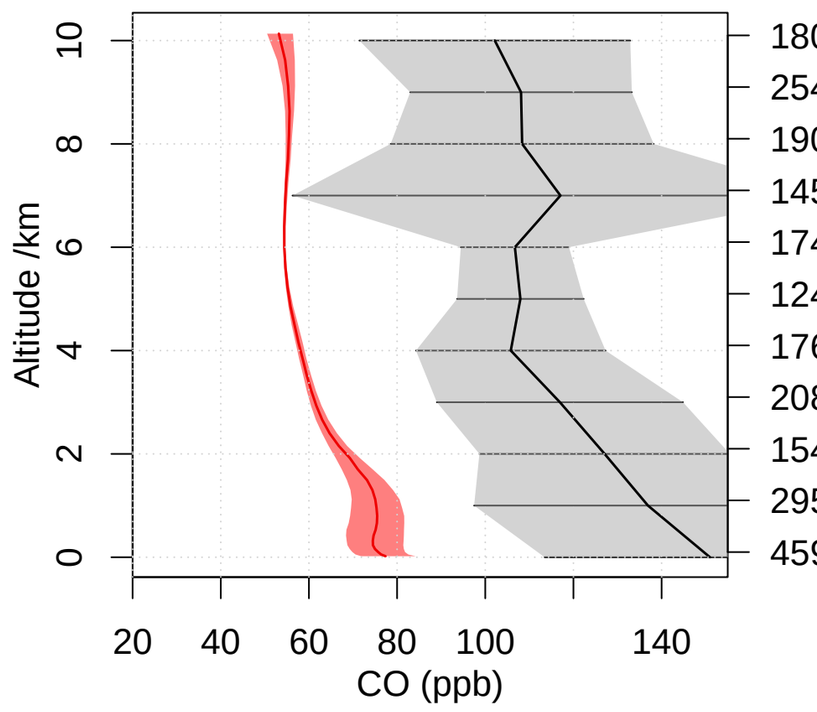


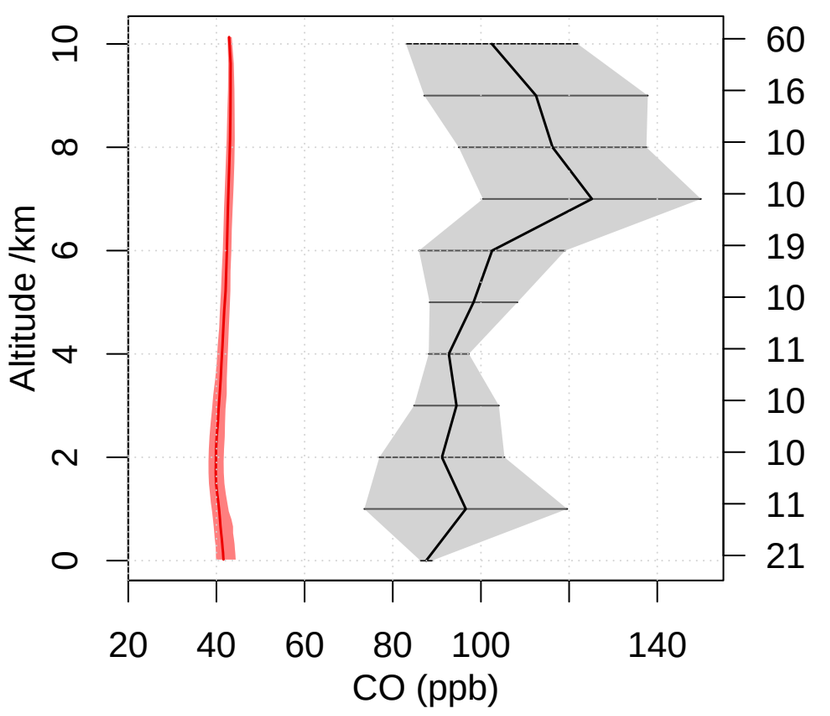


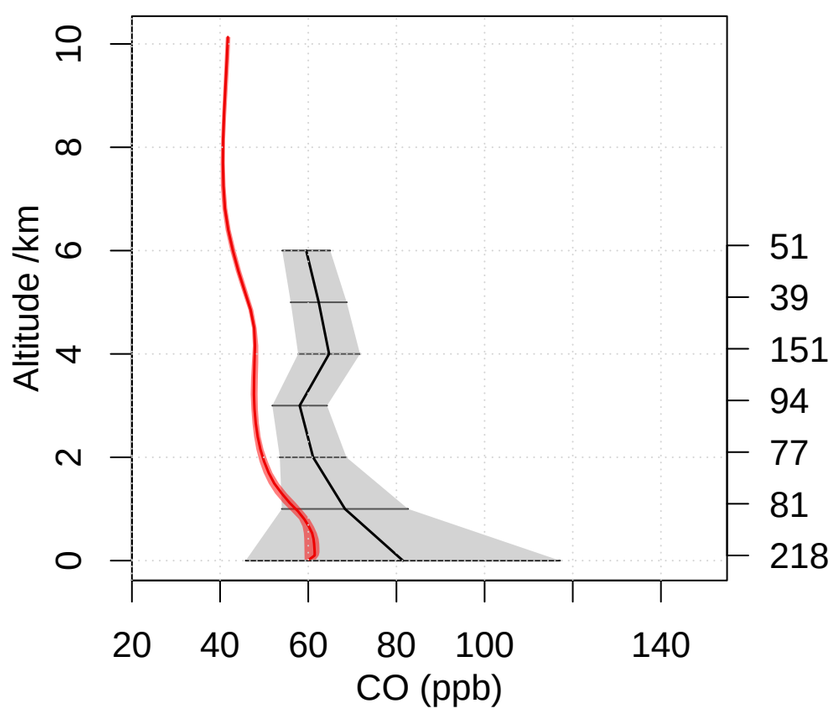
Emmons CO comparison

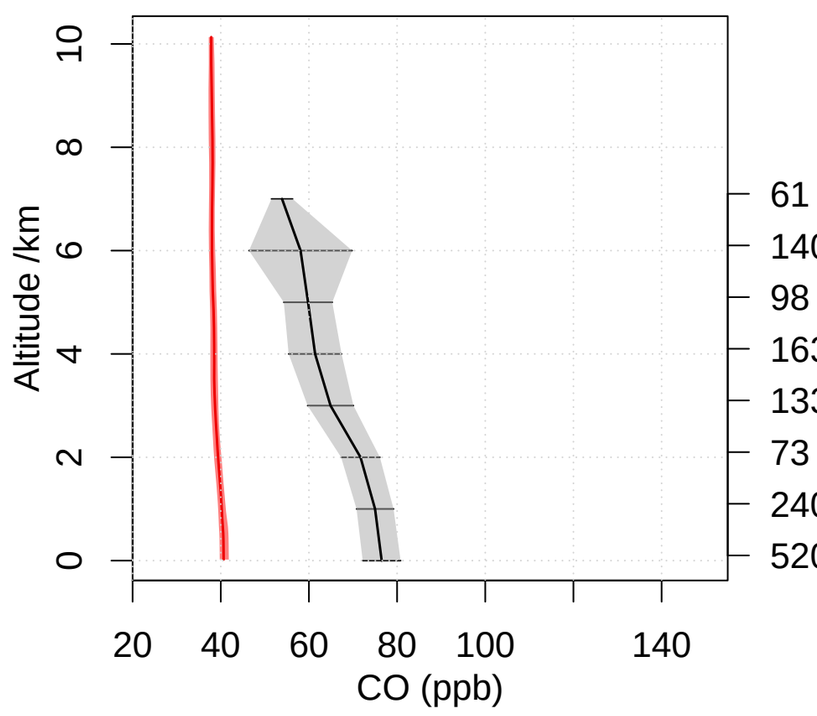


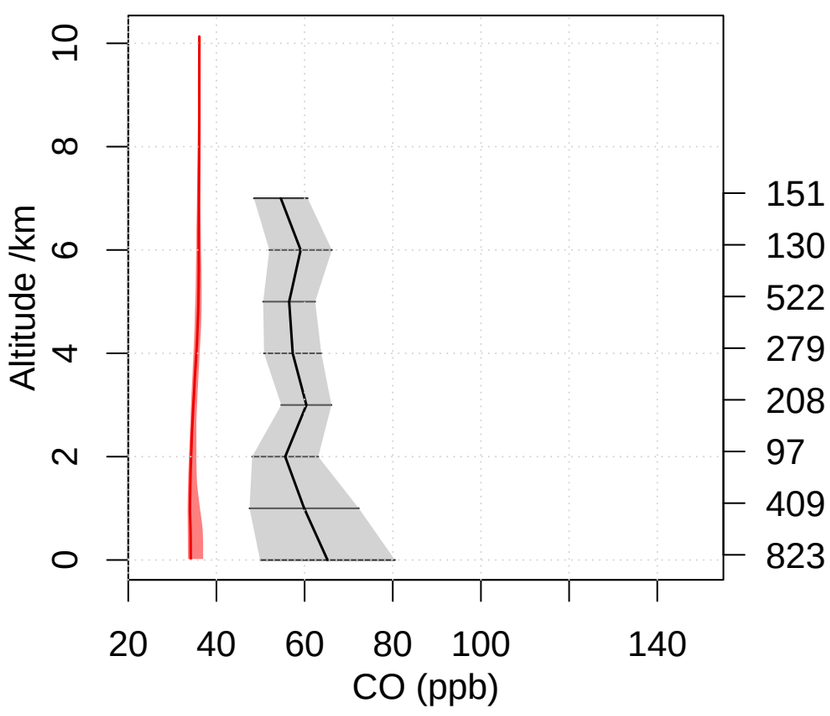


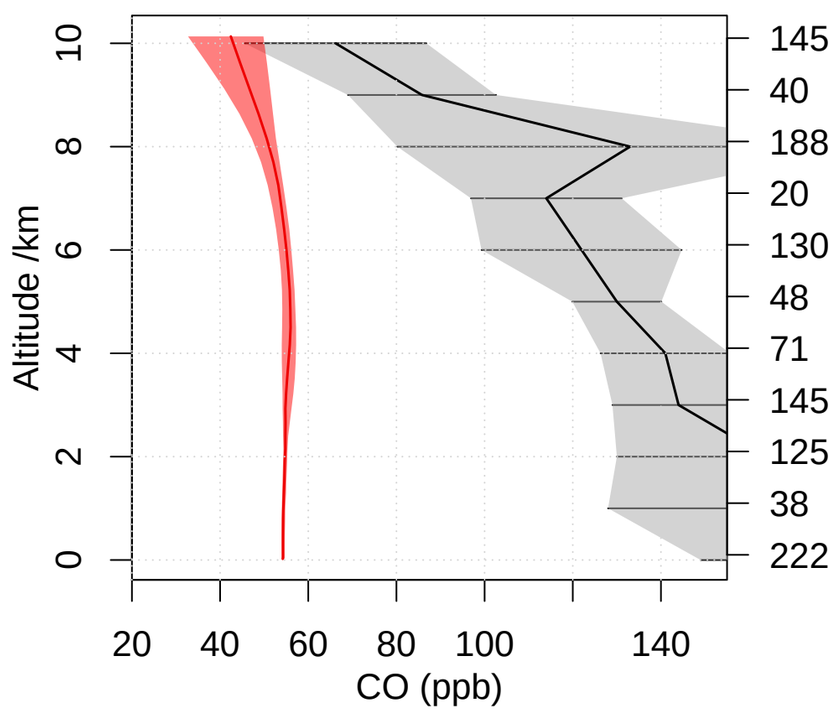


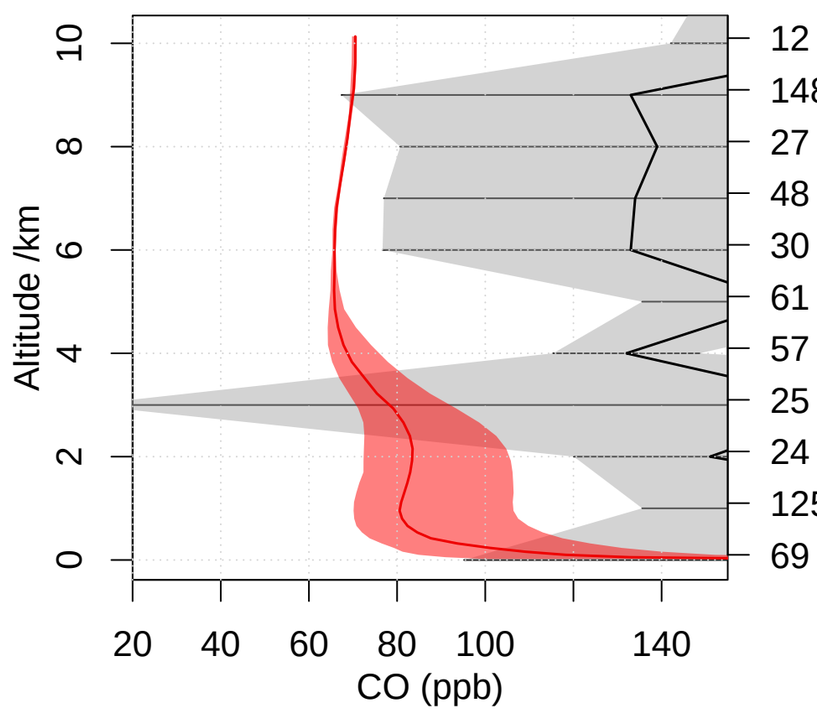


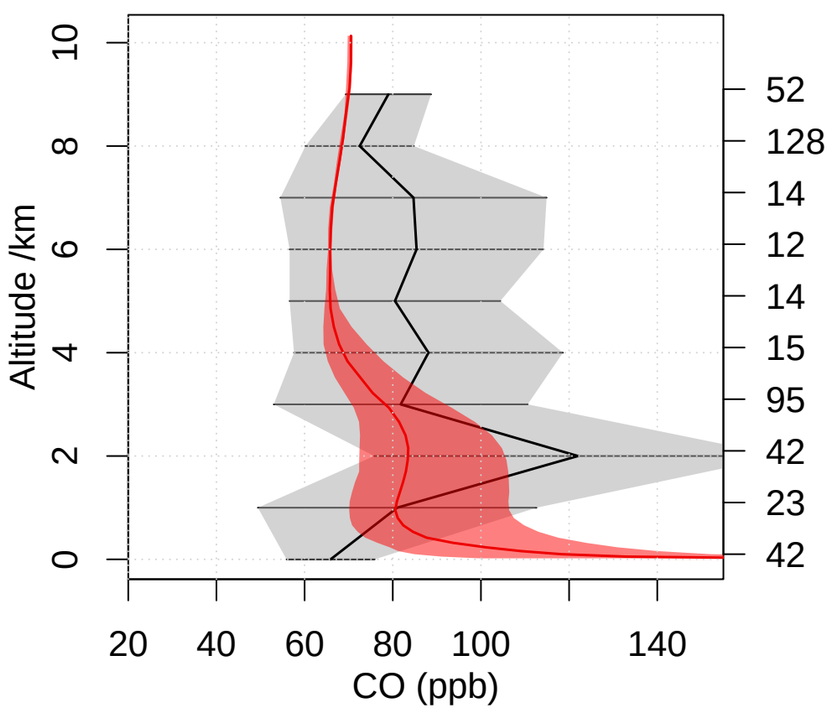


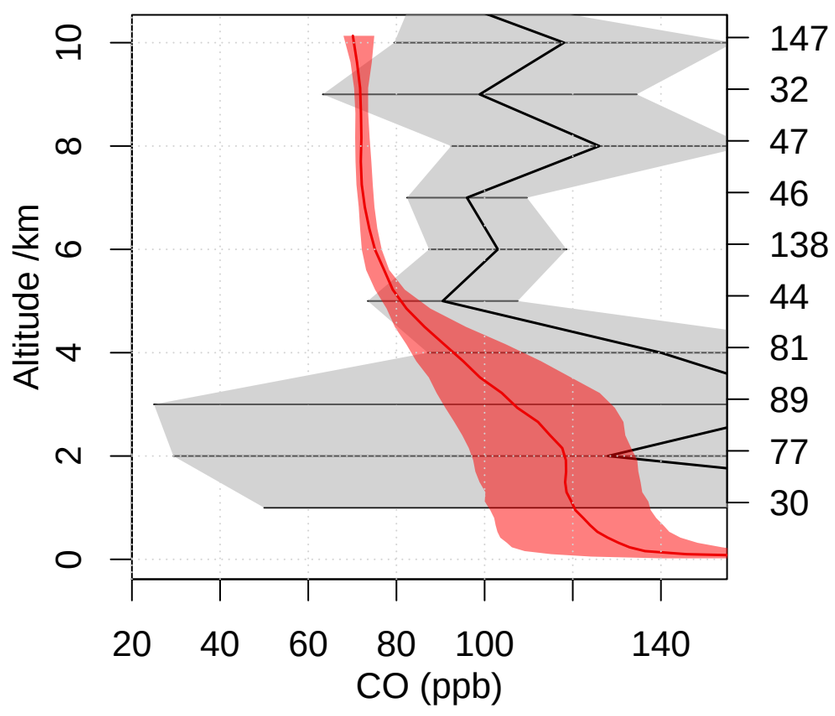


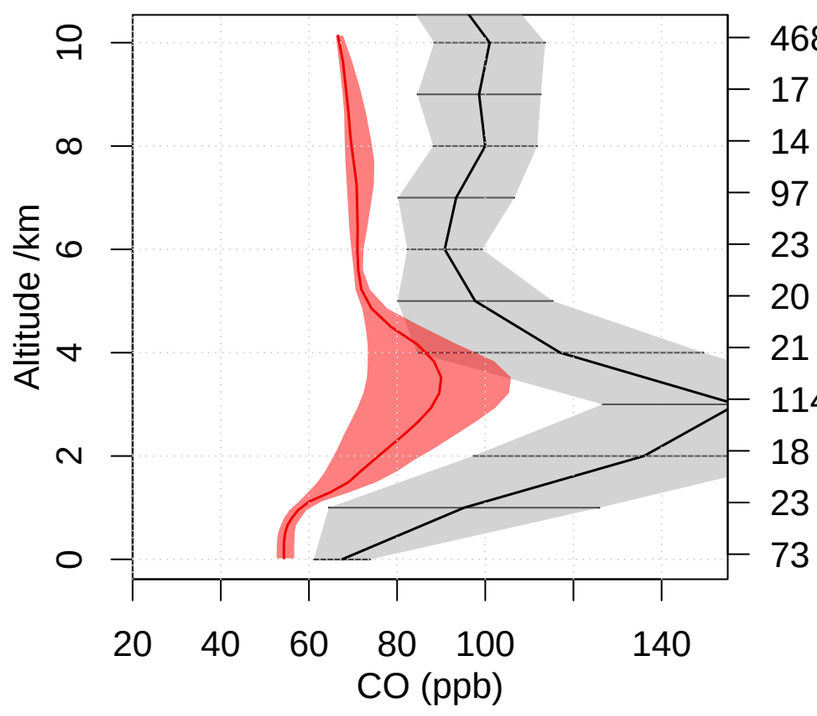




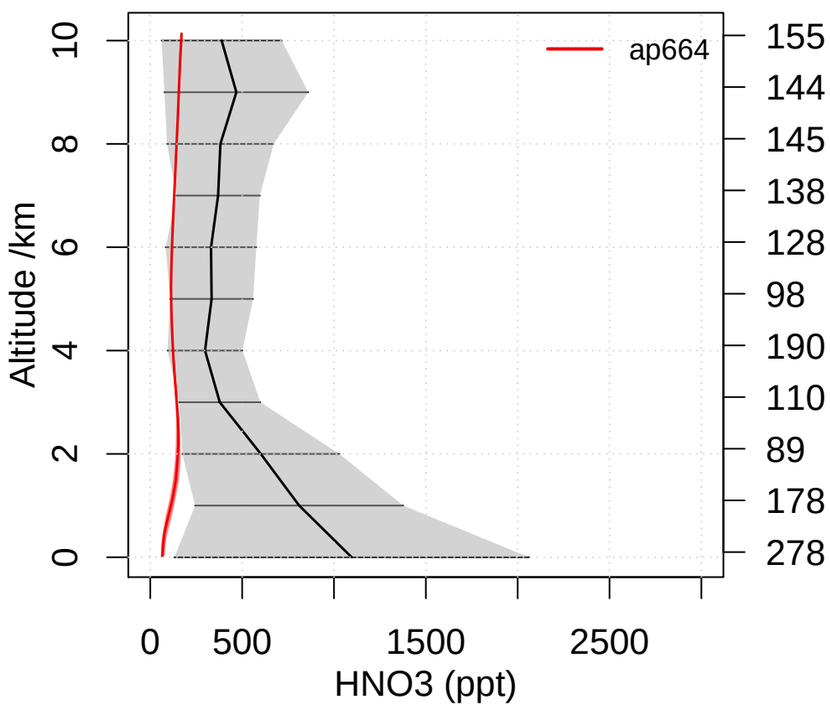


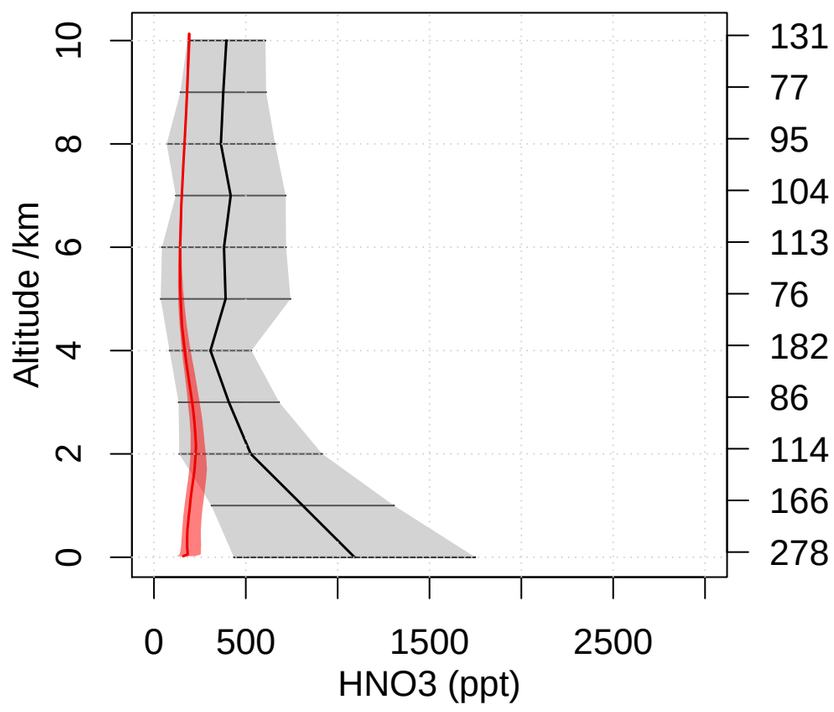


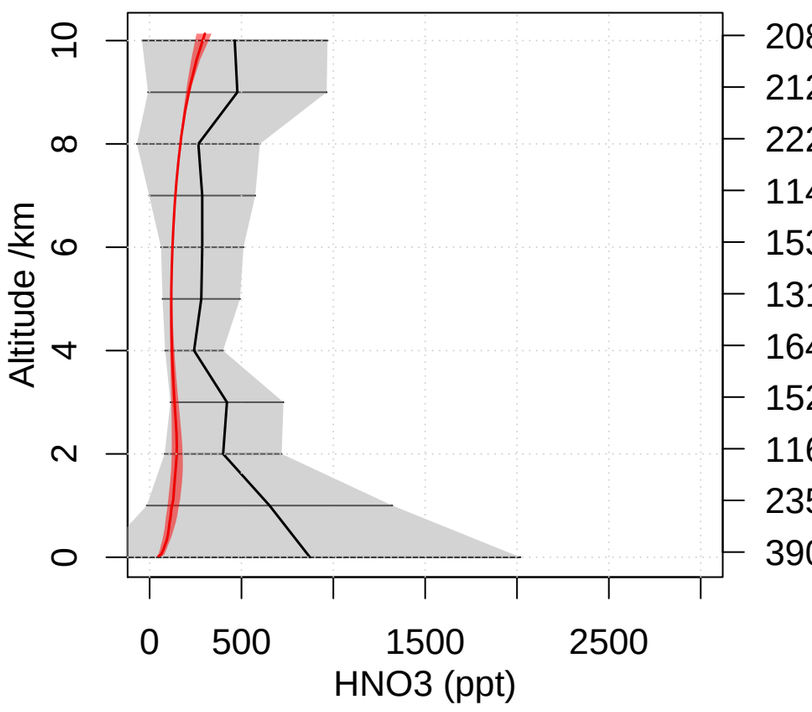


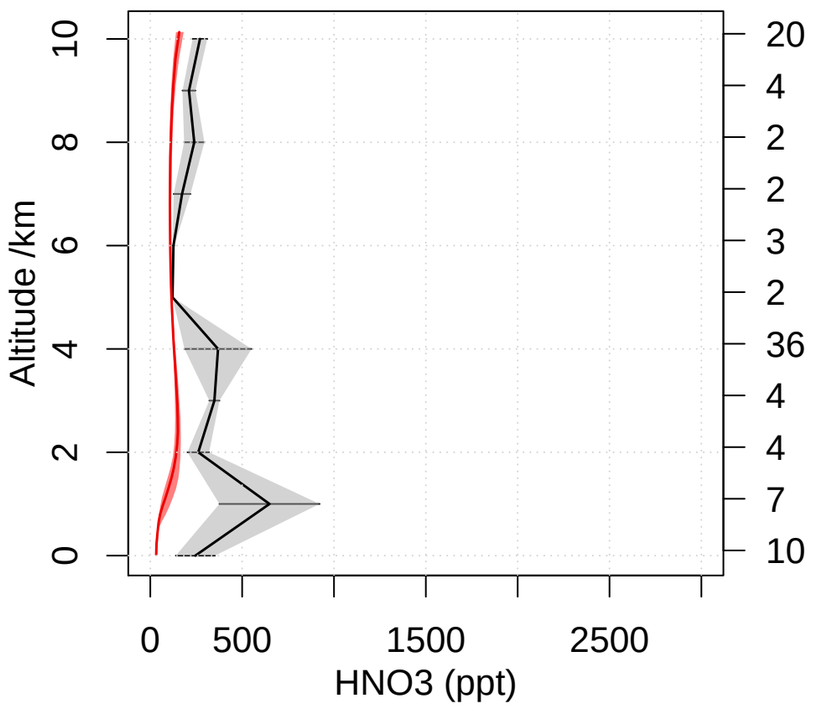


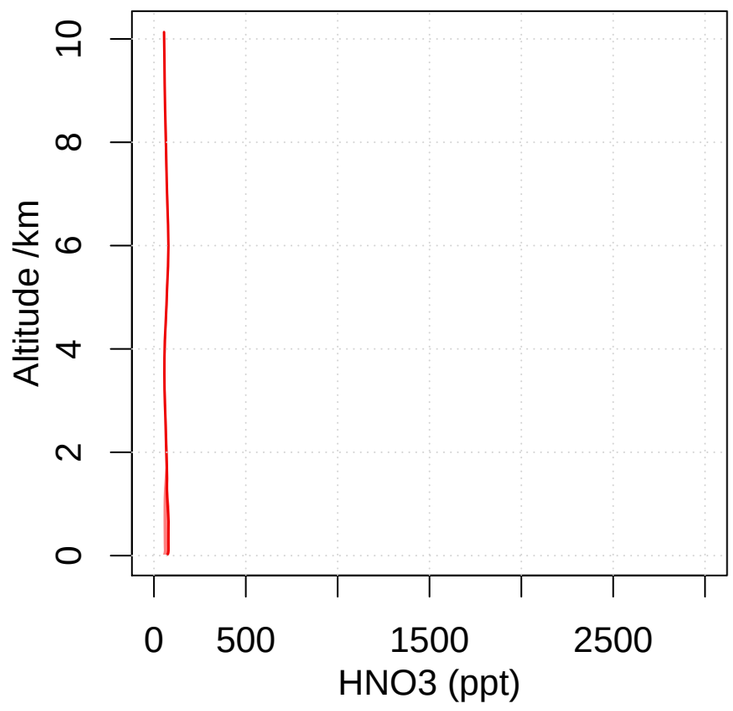
Emmons HNO3 comparison

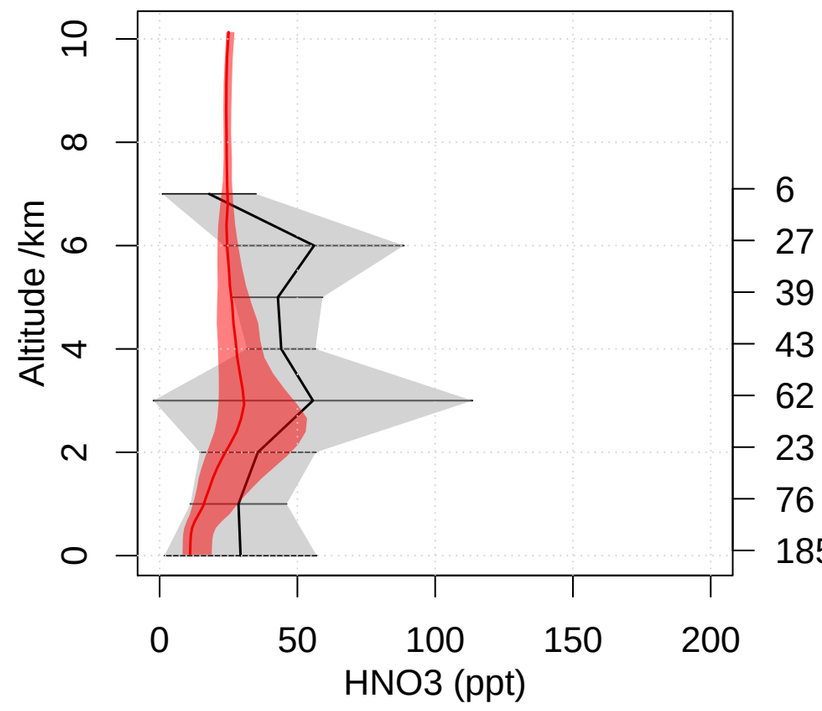


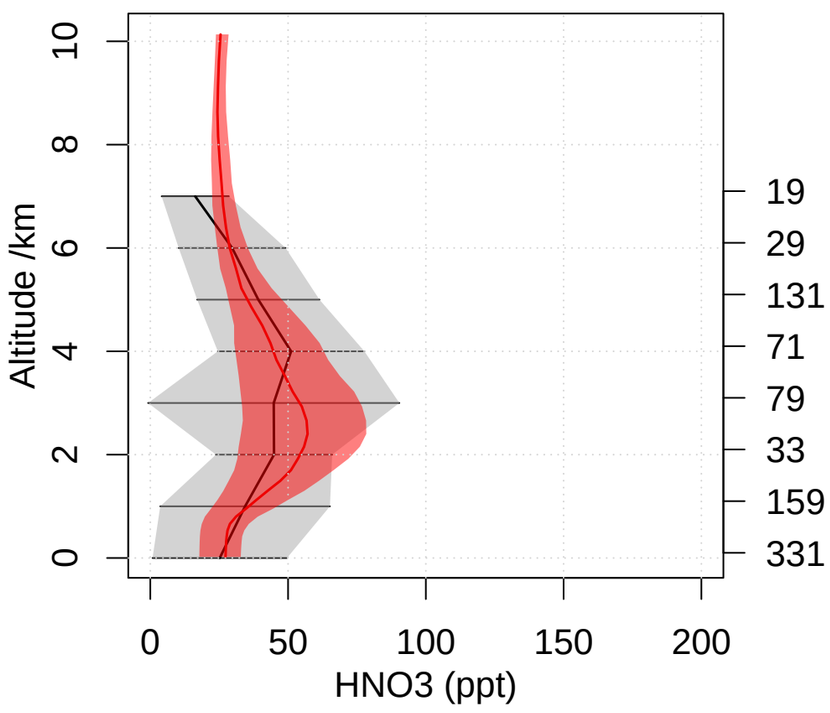


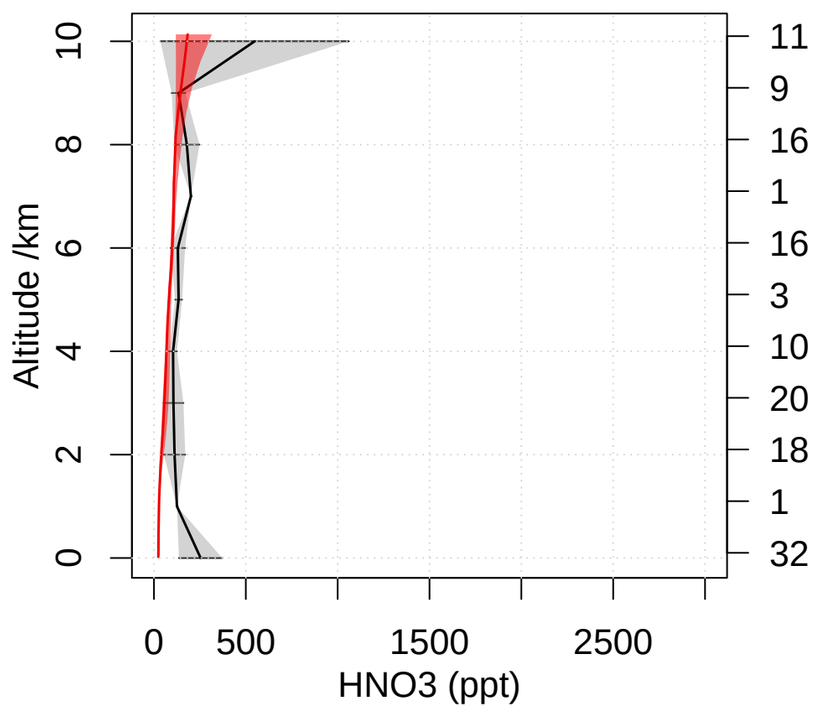


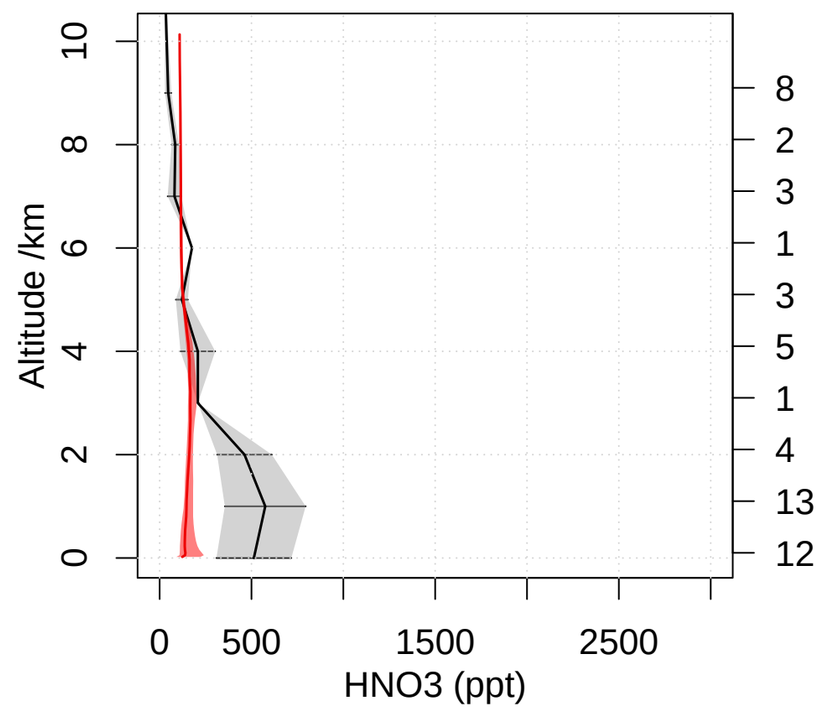


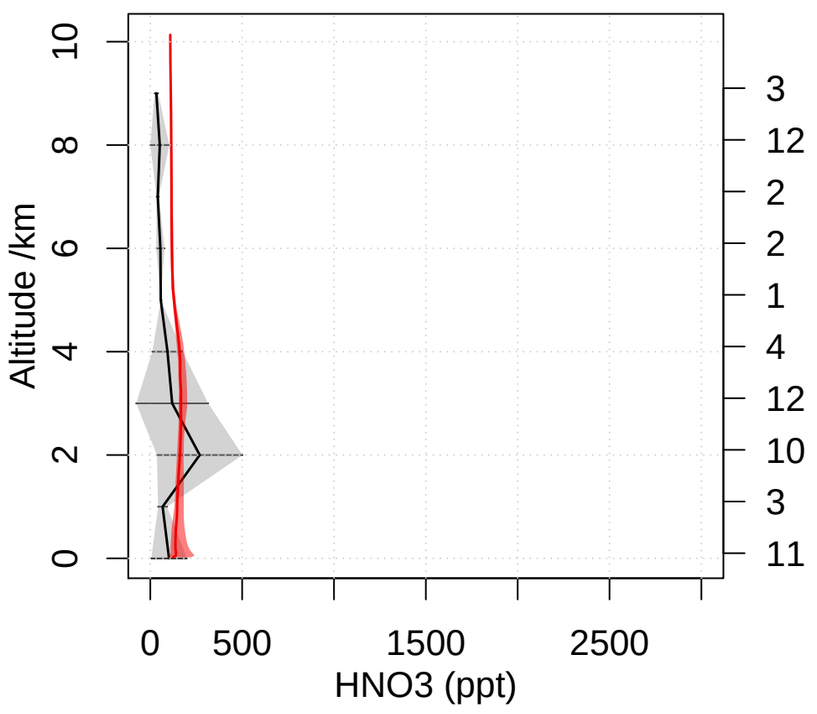


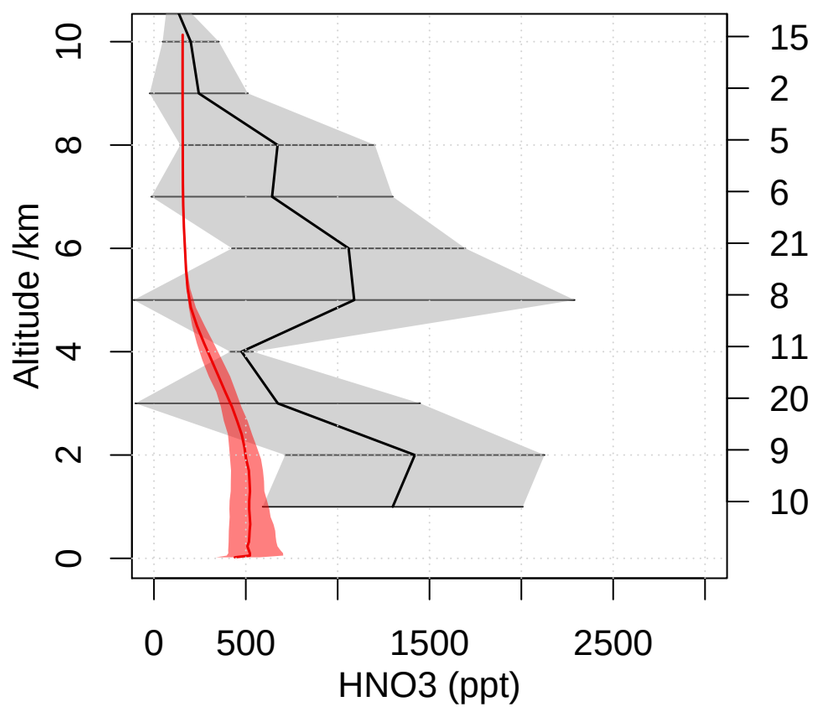


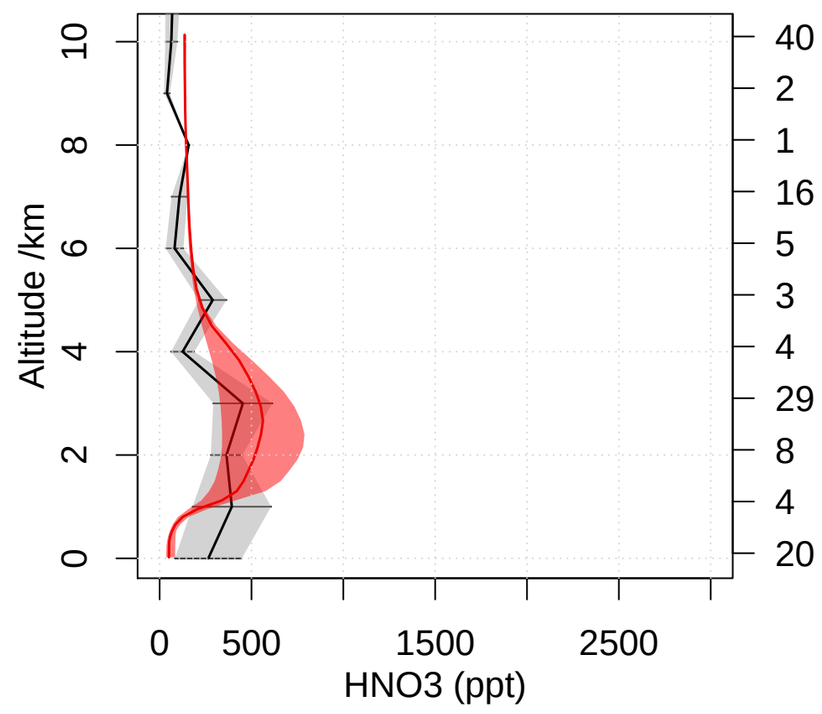




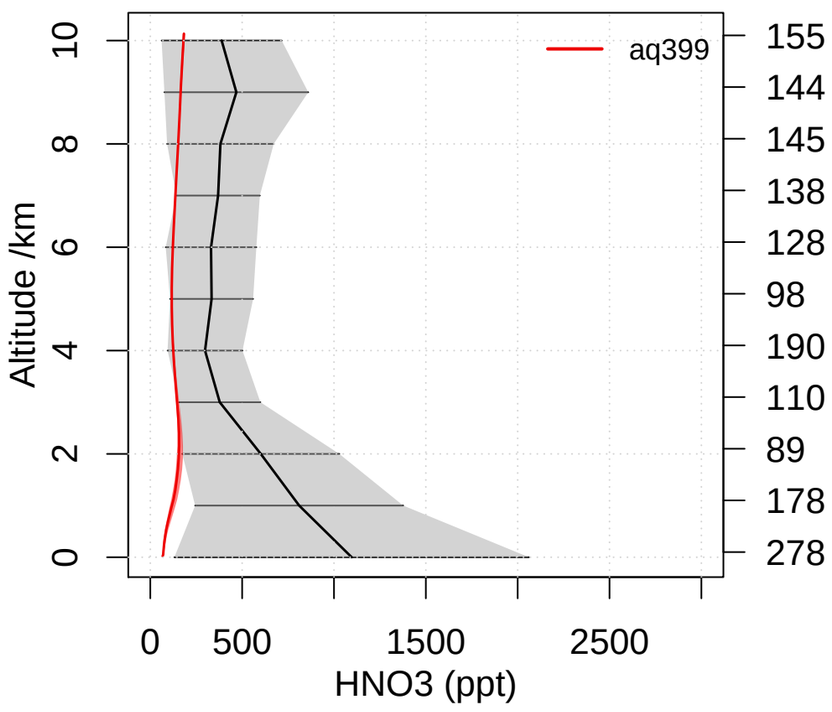


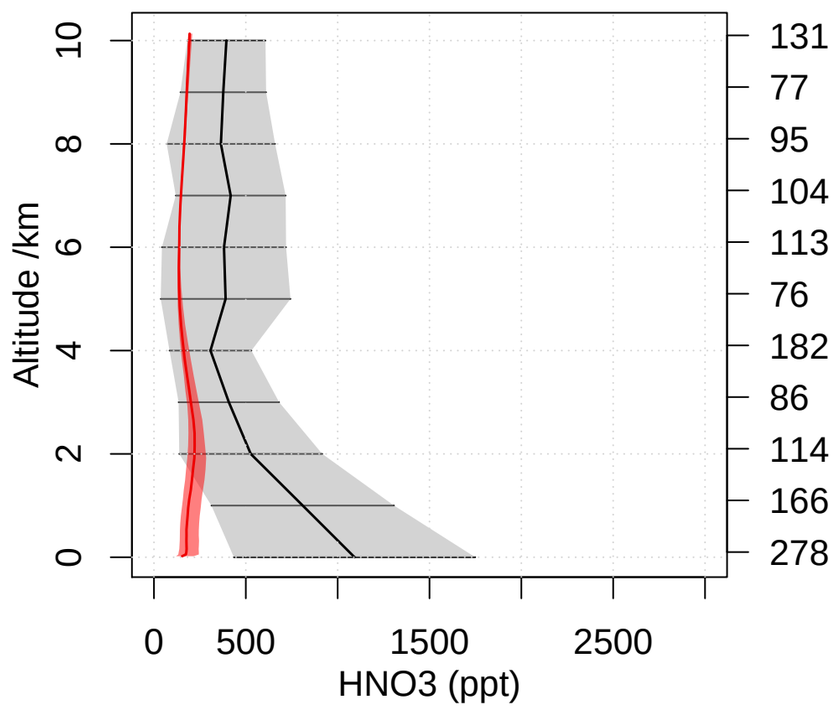


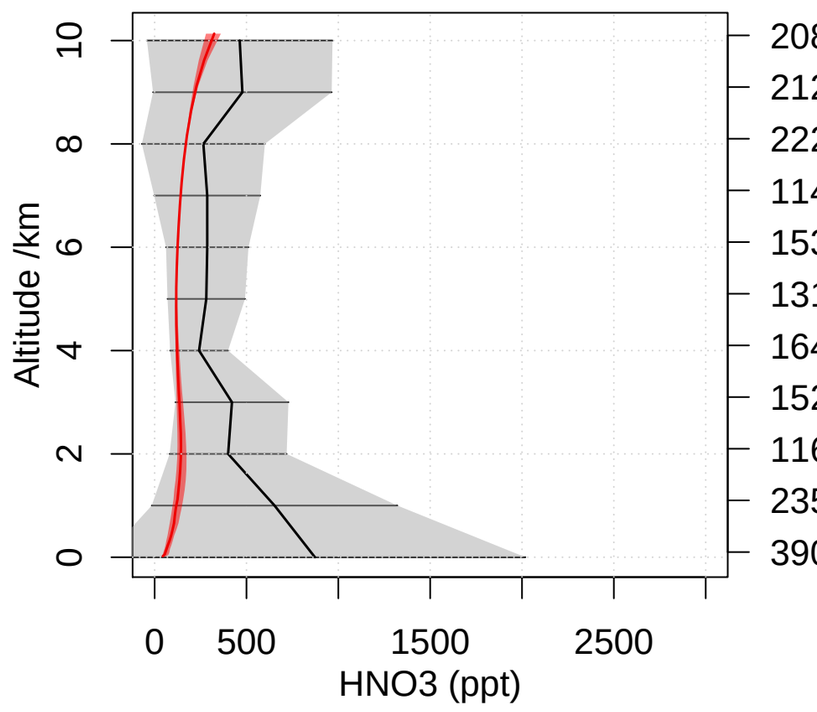


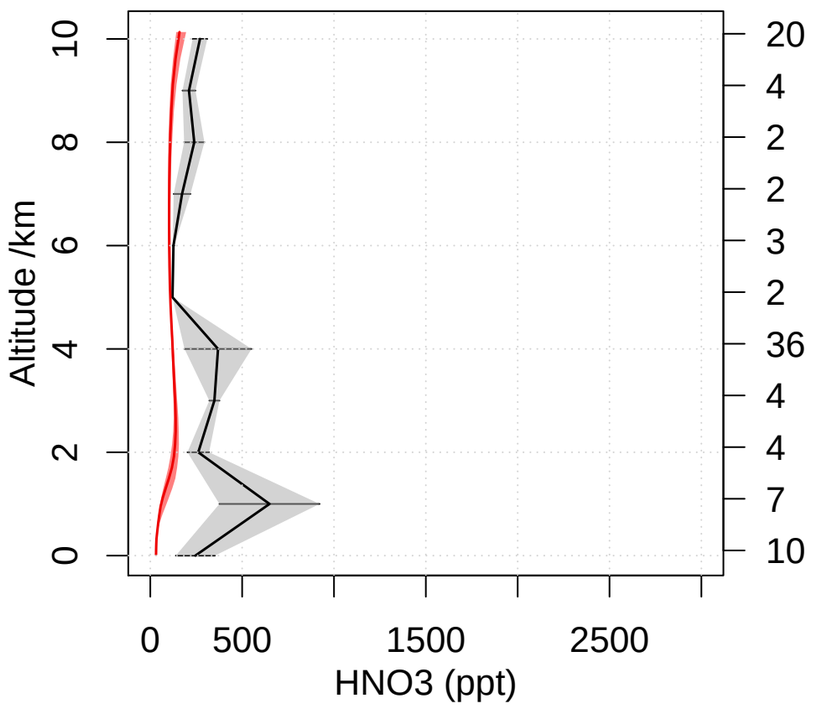


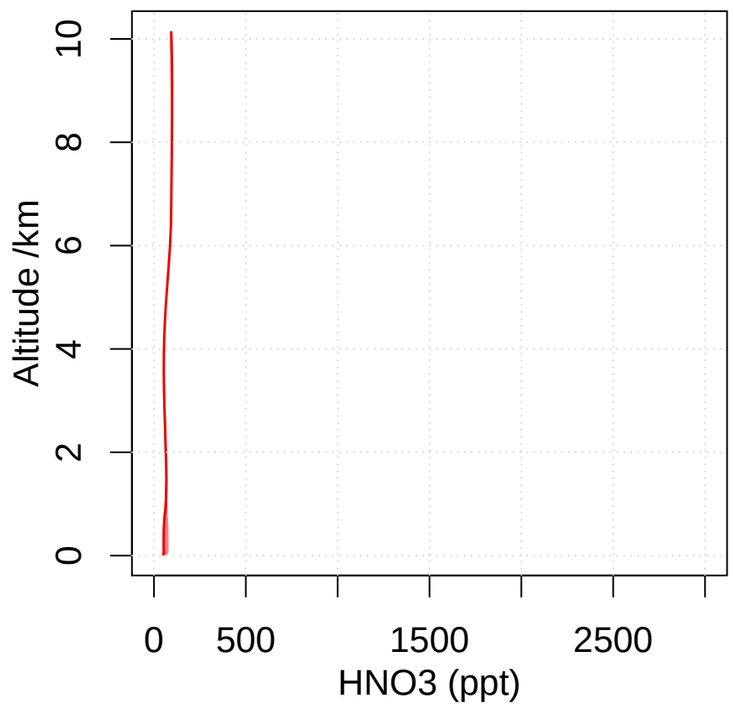
Emmons HNO3 comparison

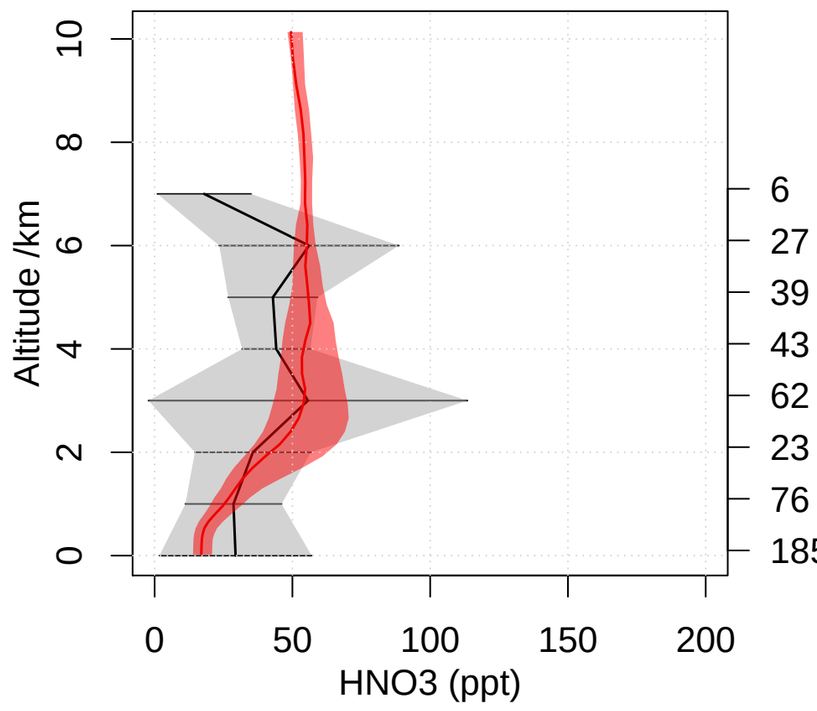


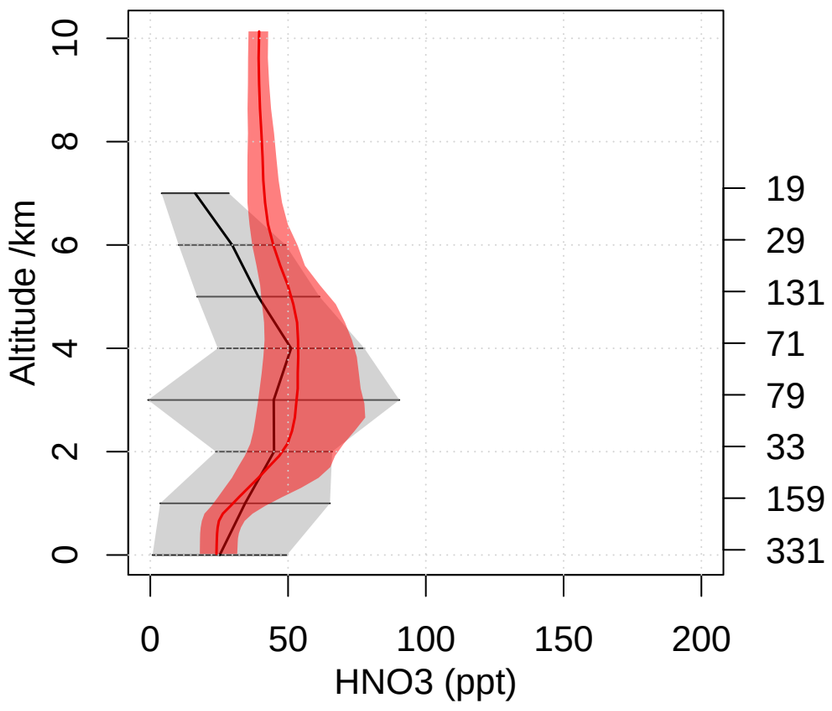


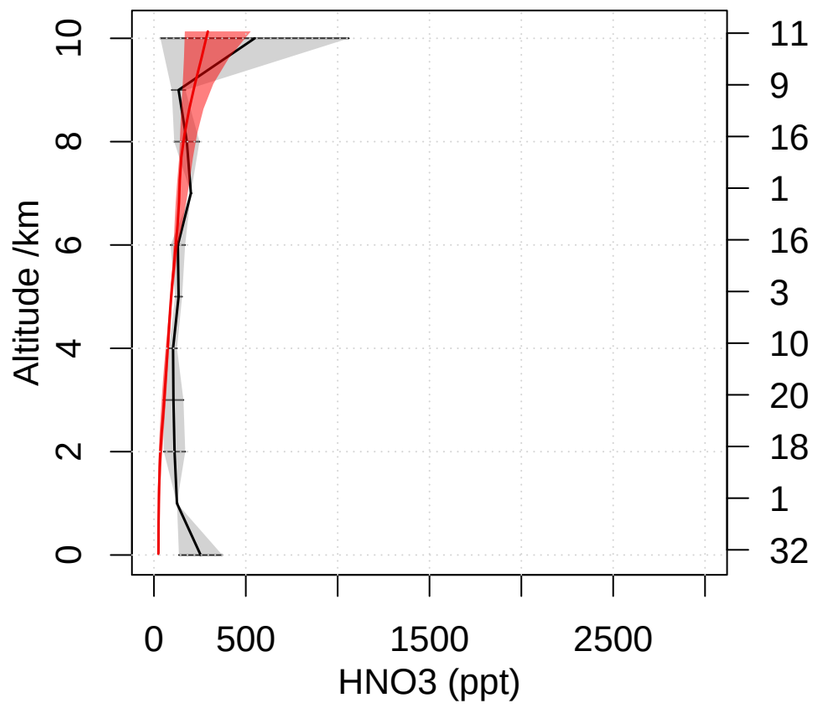


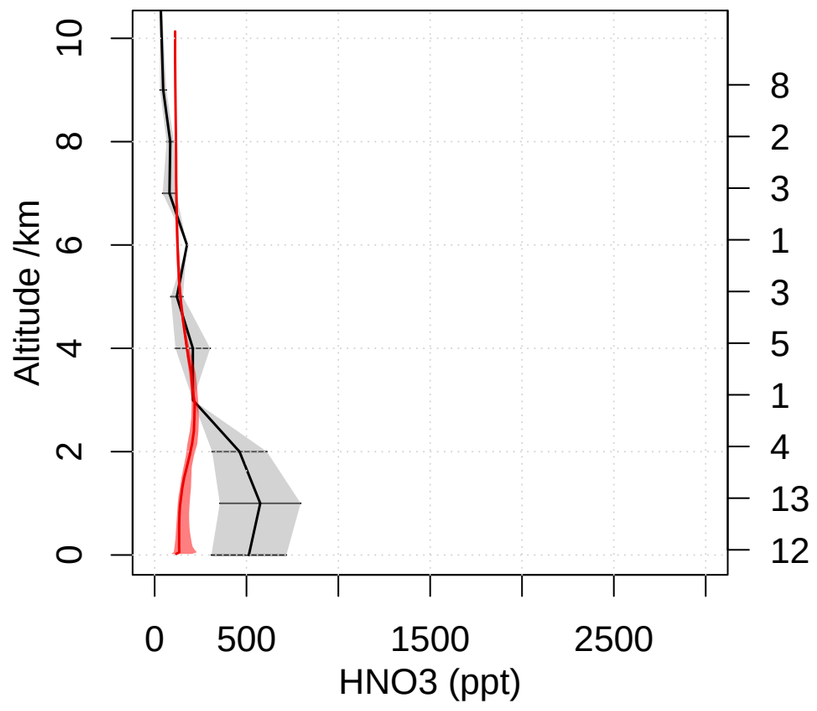


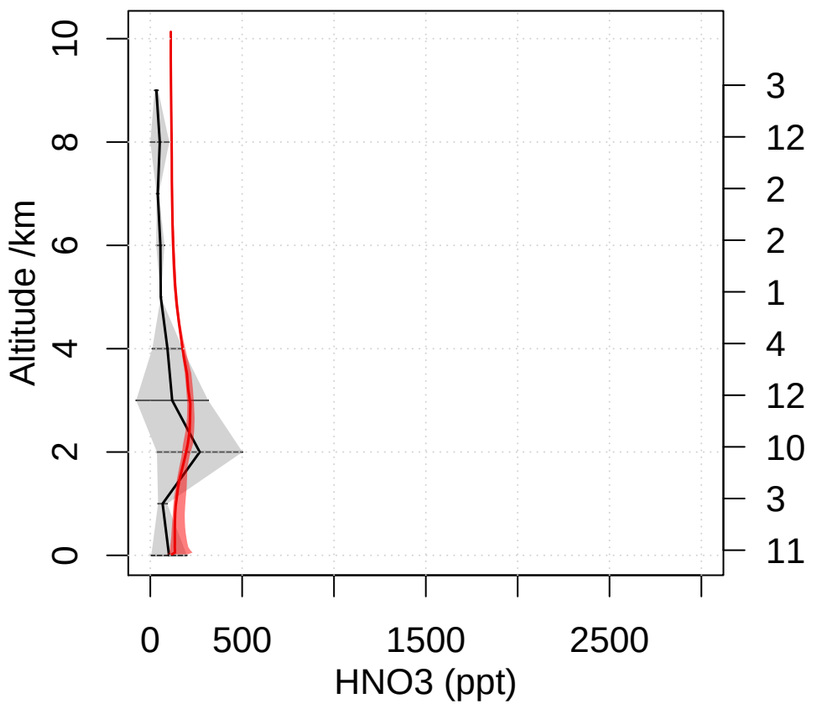


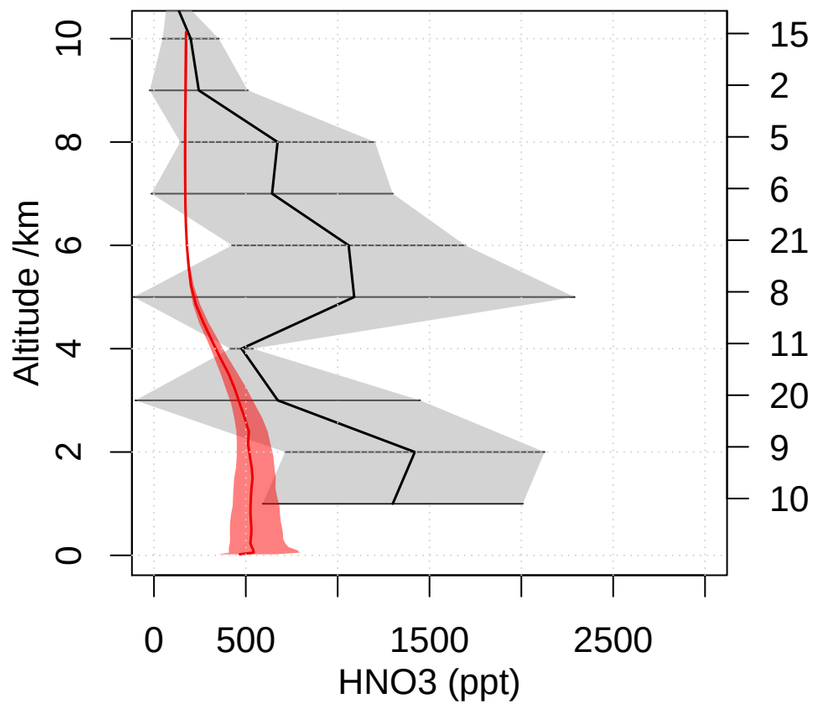


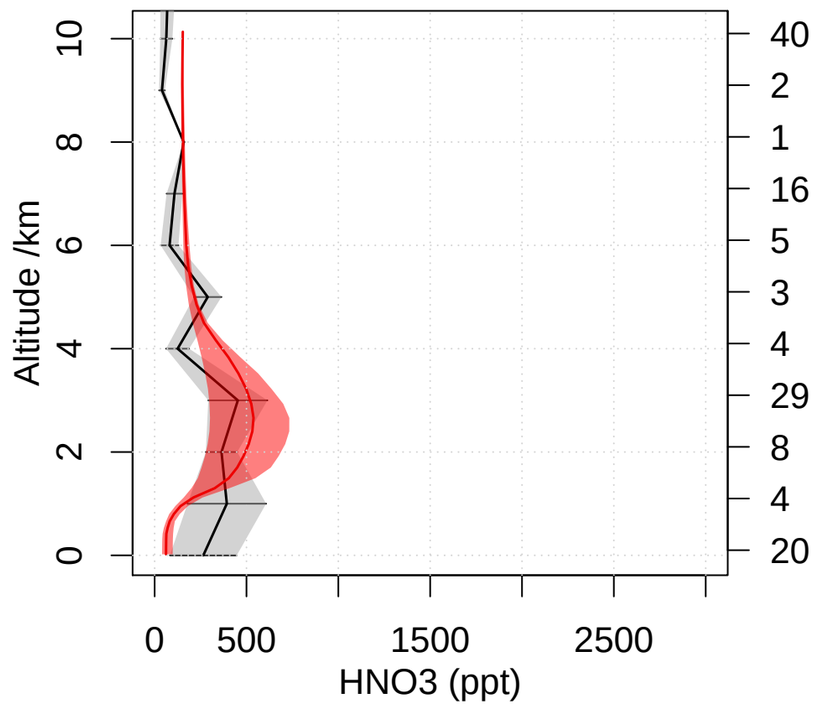




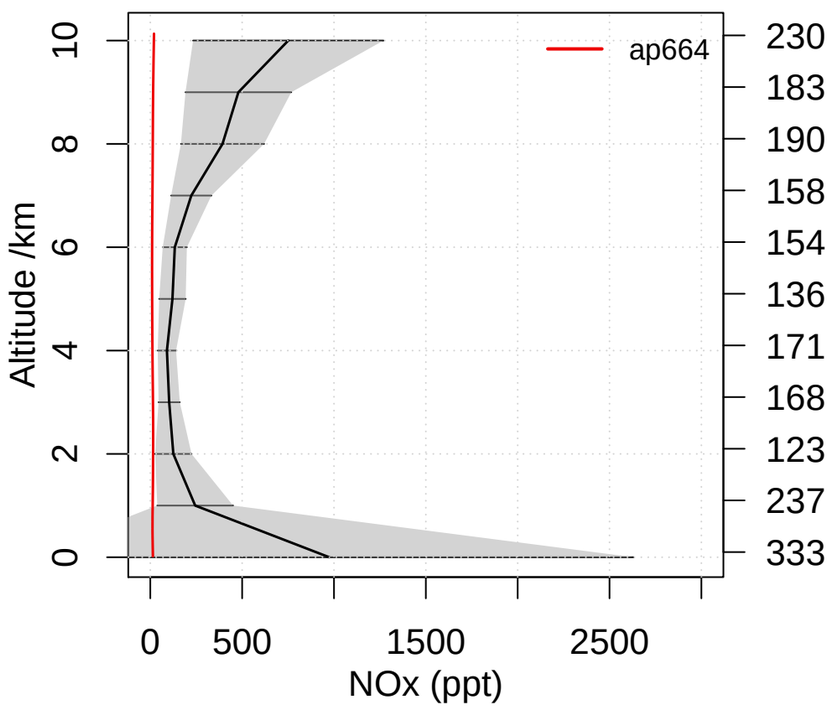


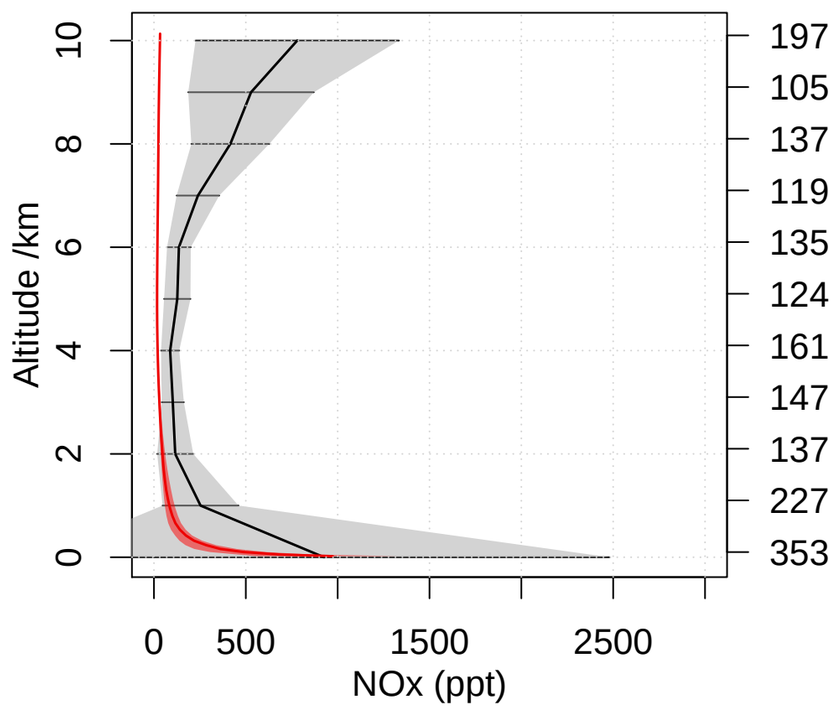


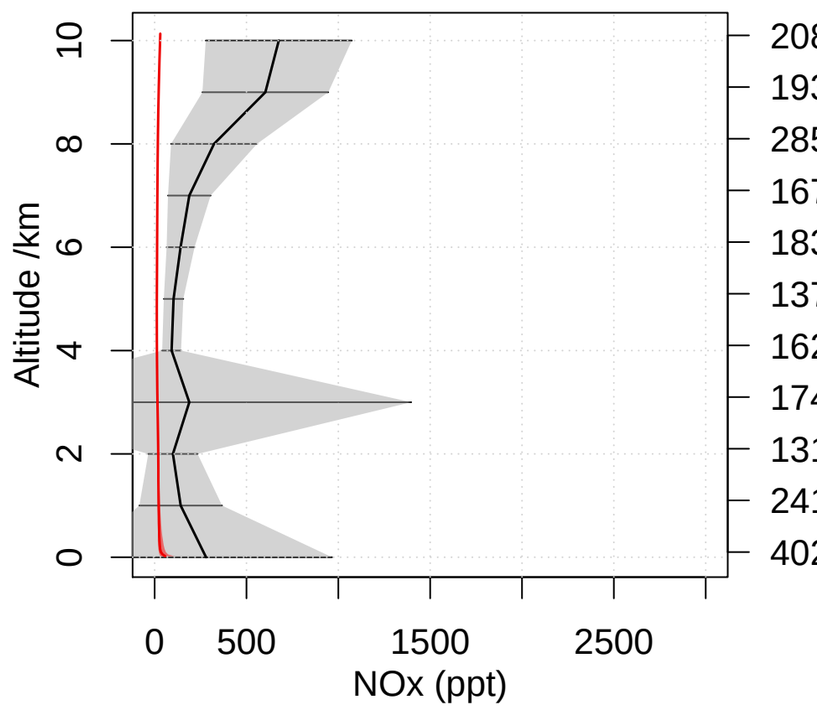


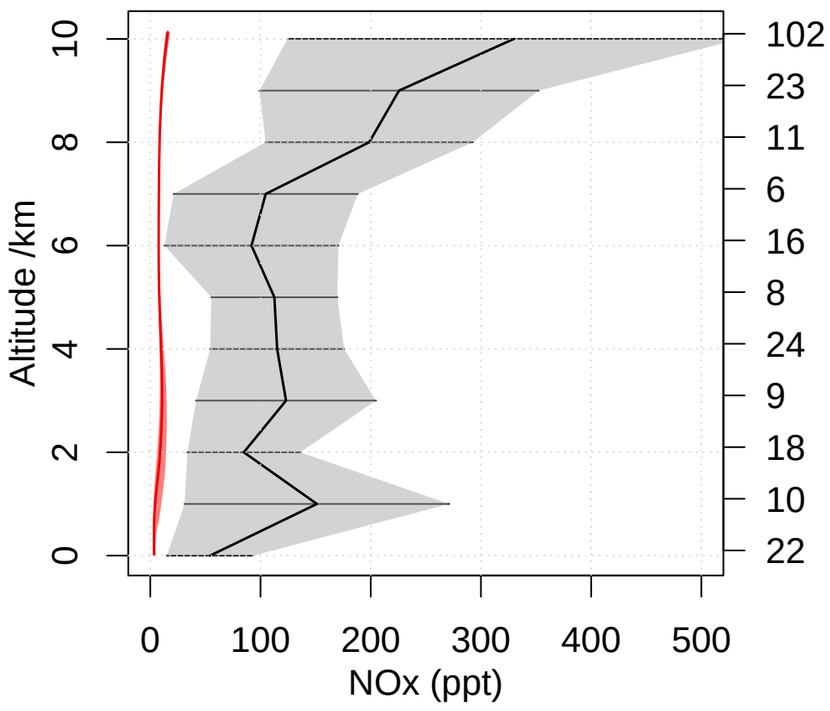


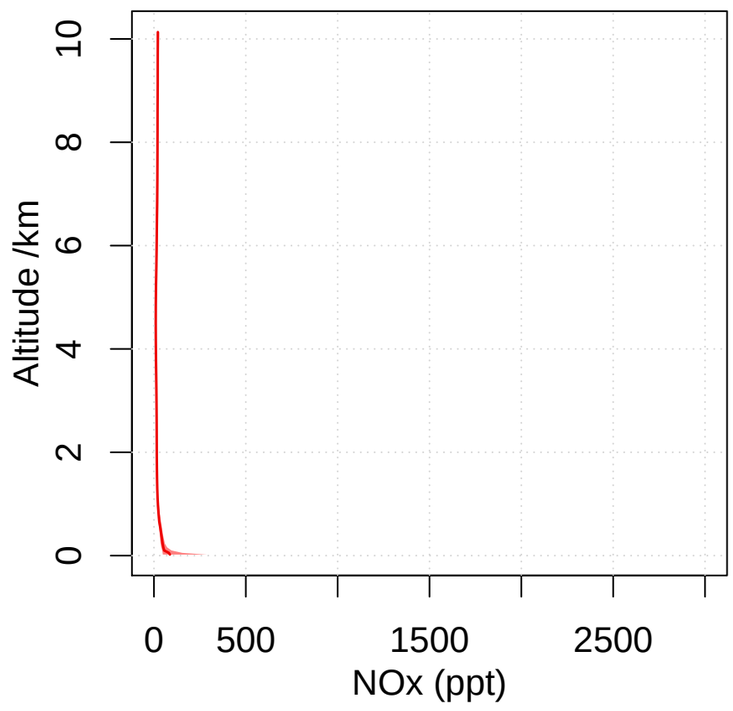
Emmons NOx comparison

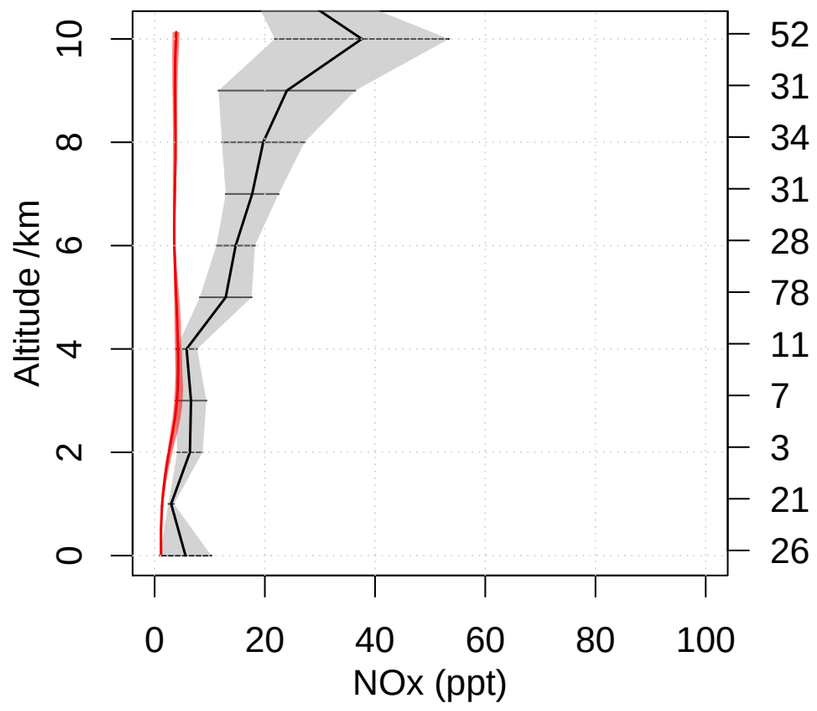


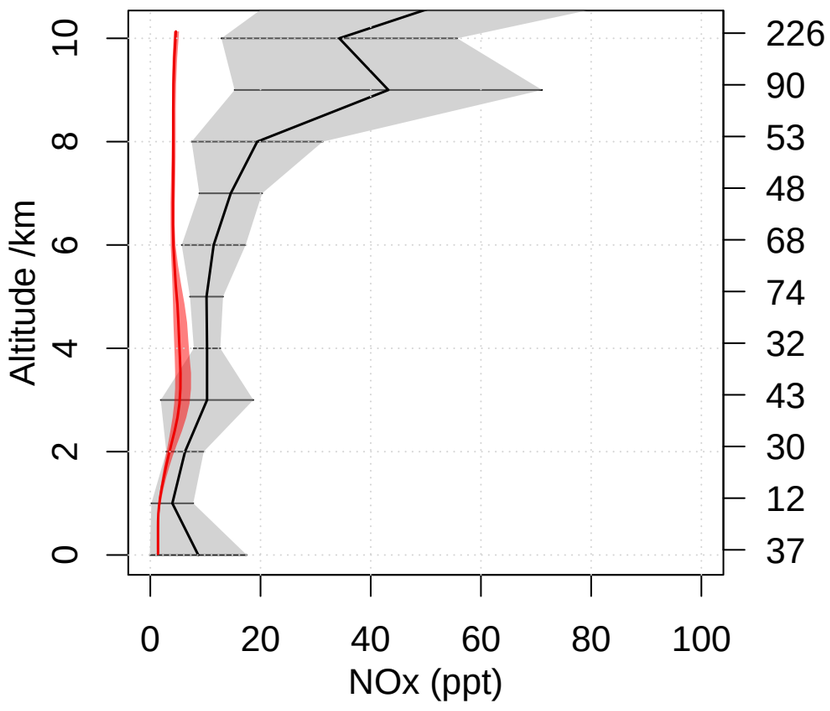


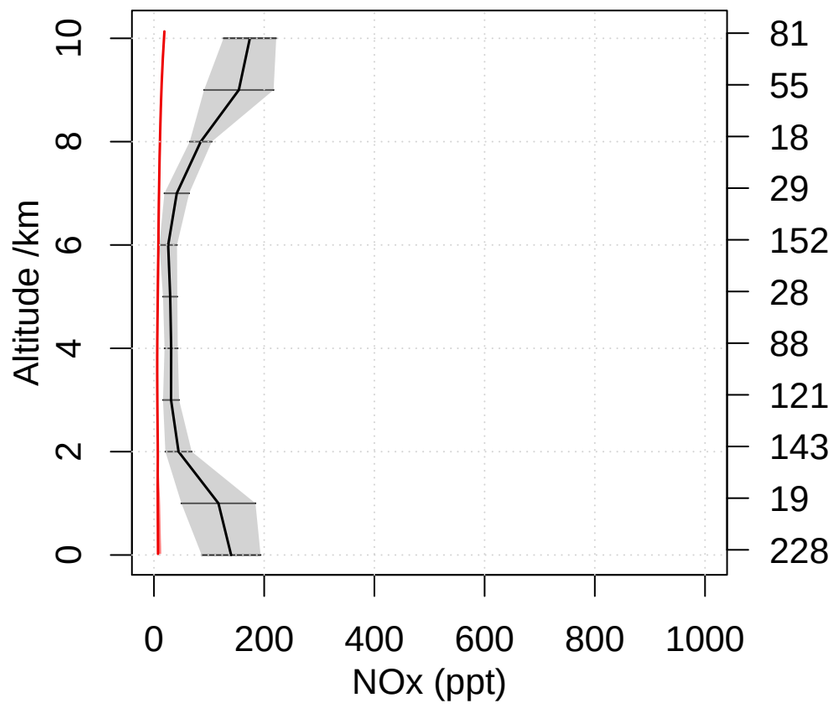


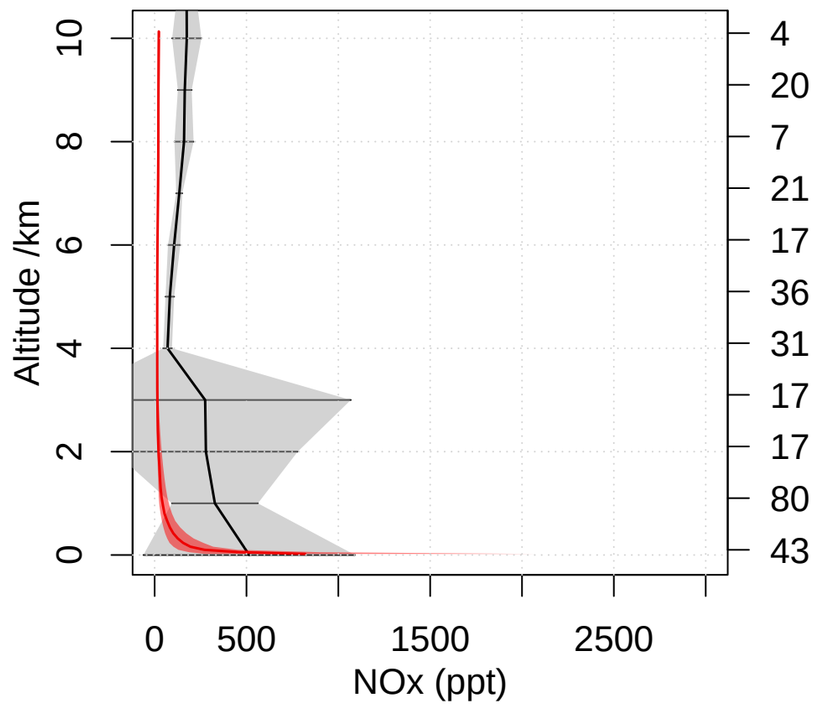


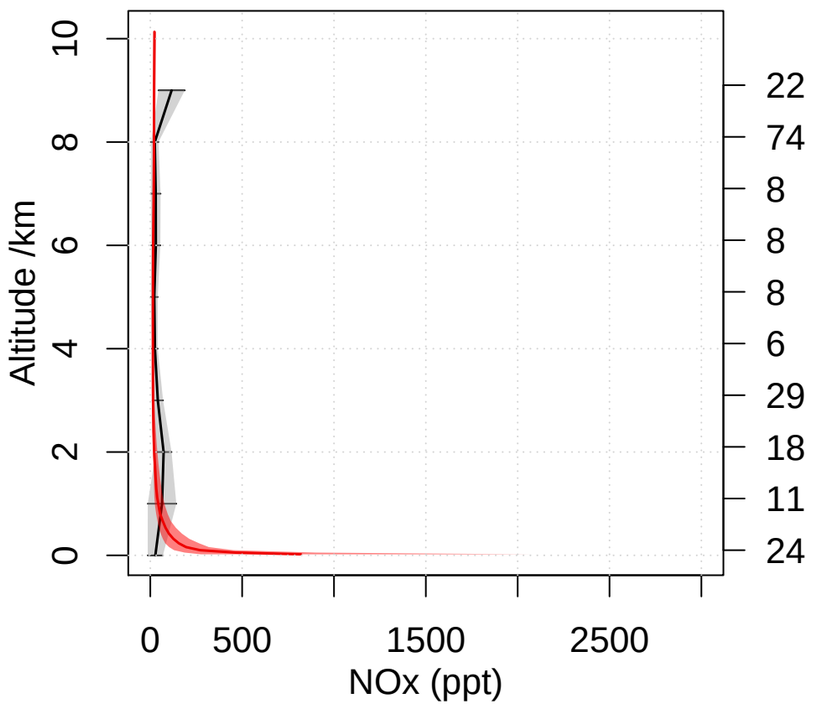


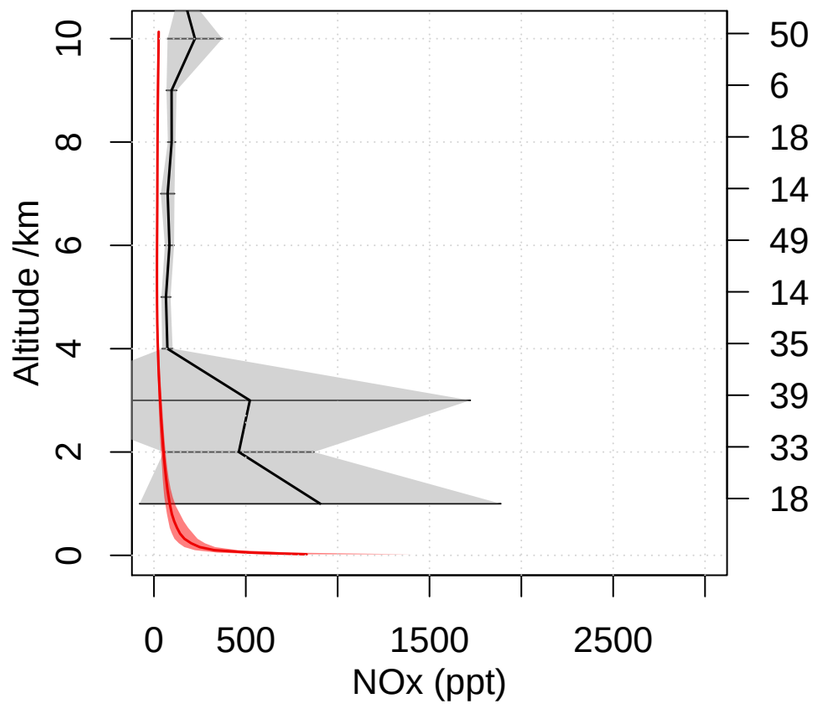


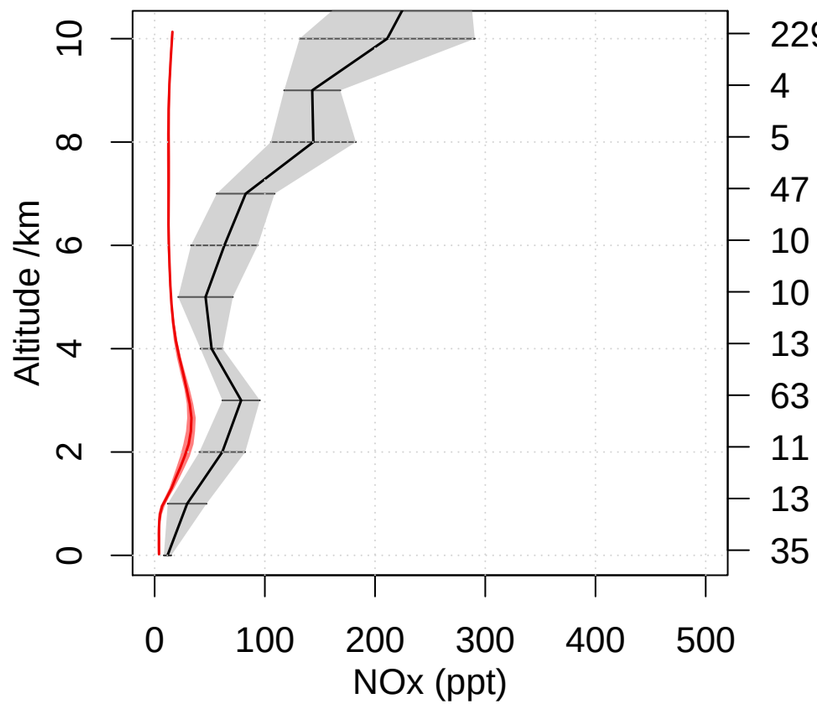




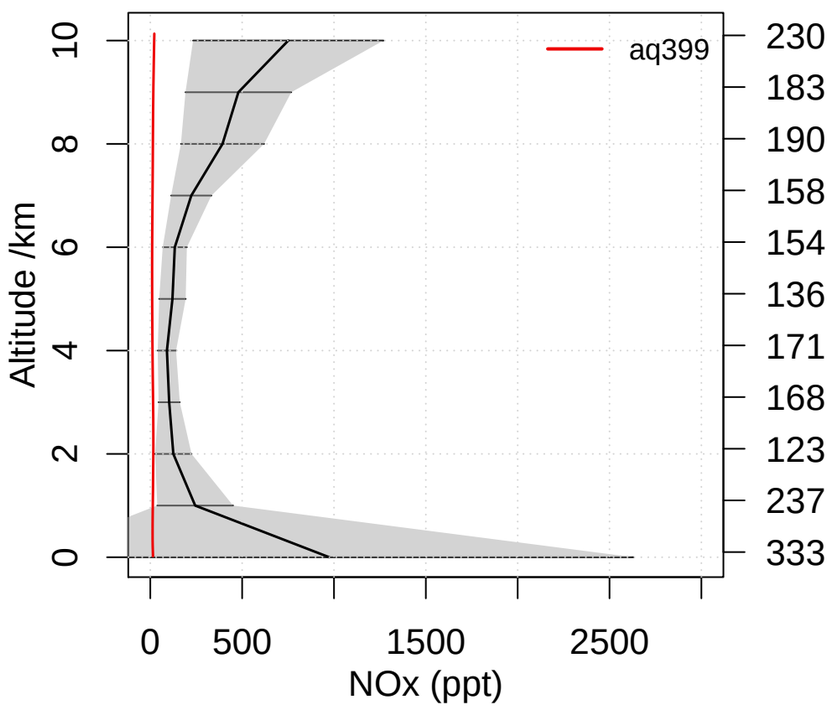


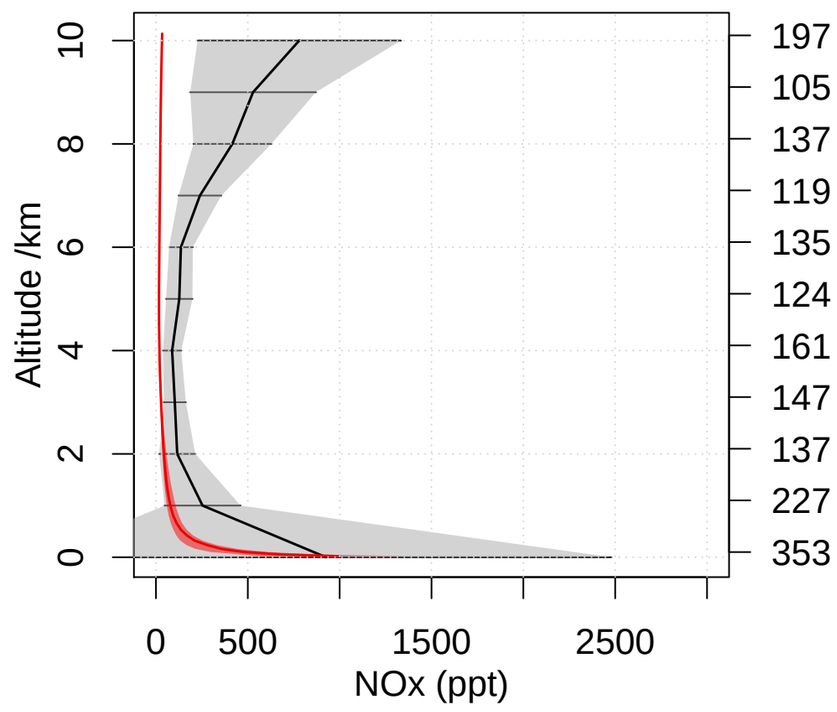


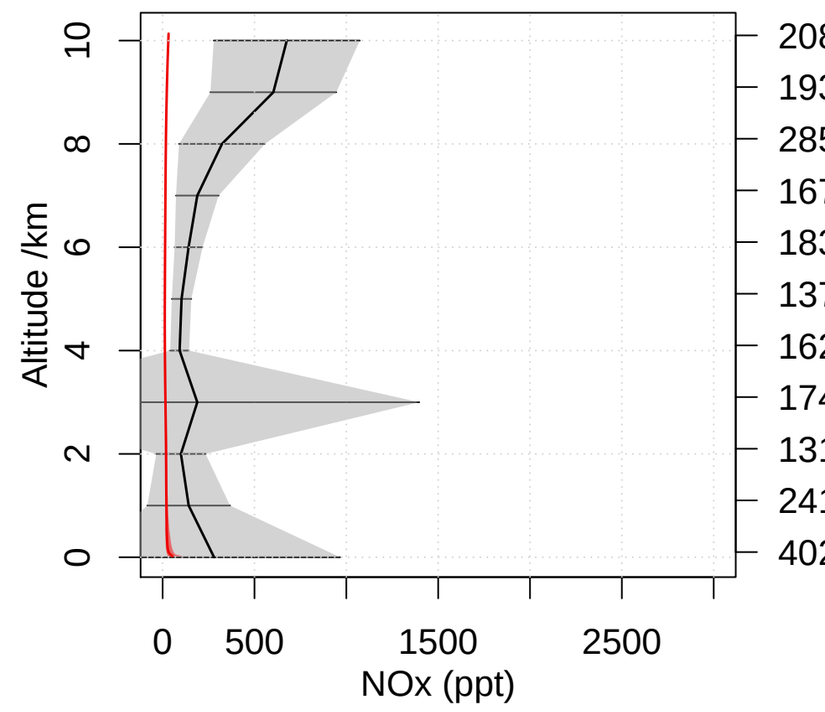


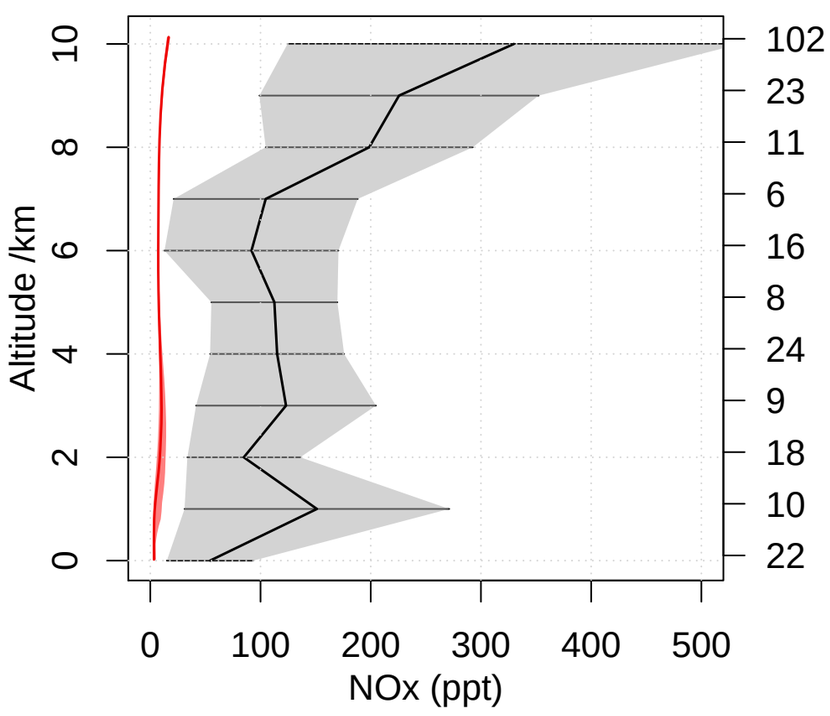


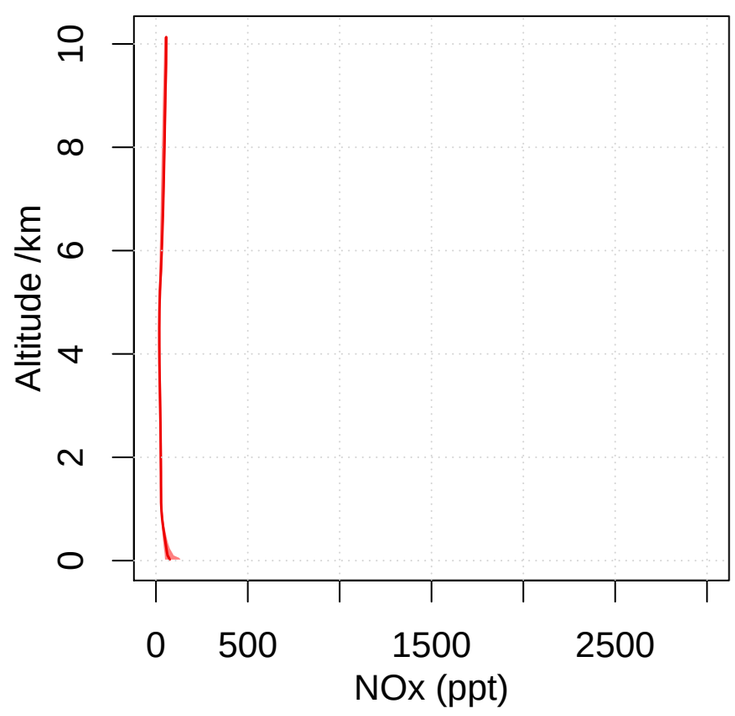
Emmons NOx comparison

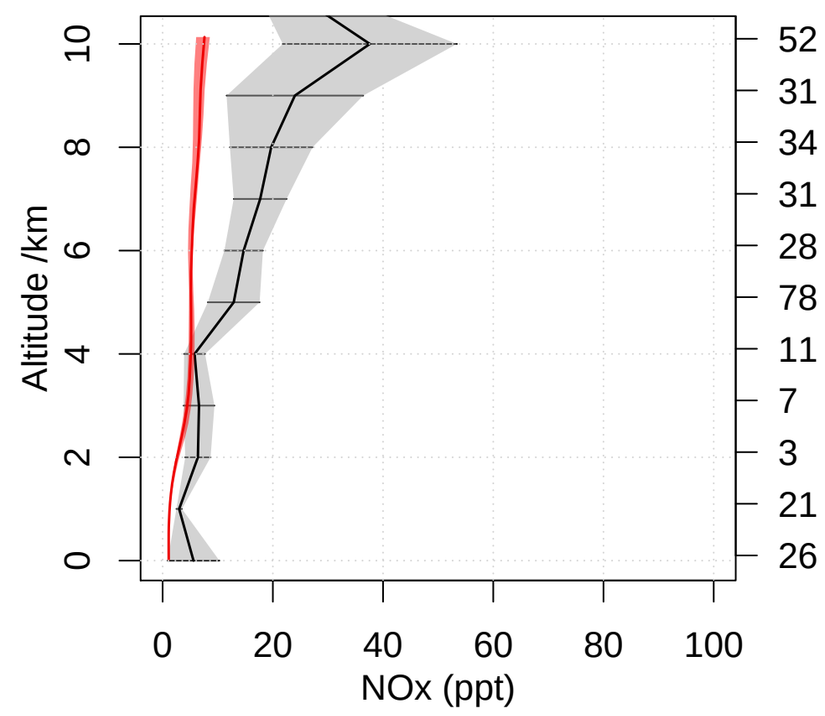


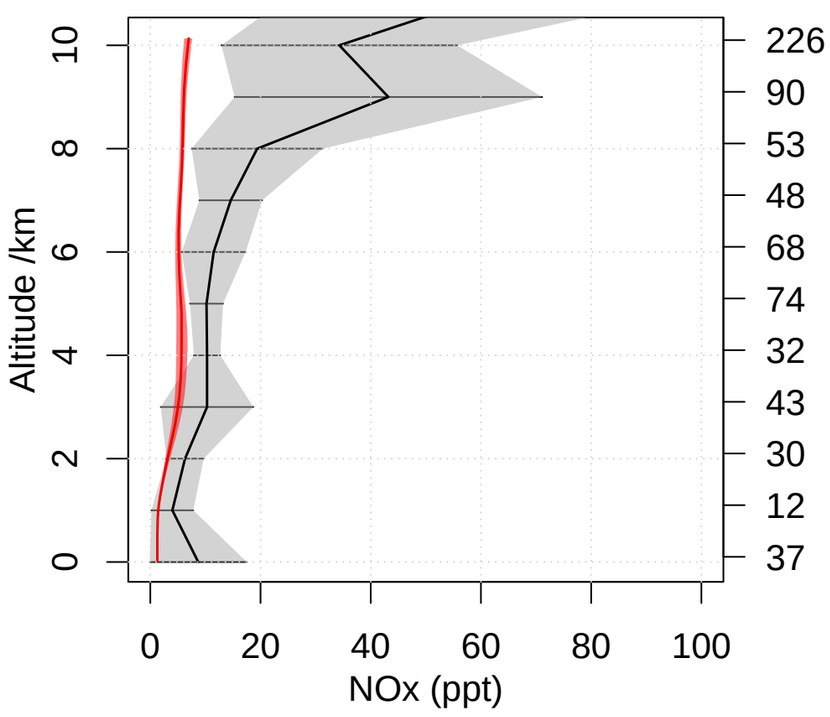


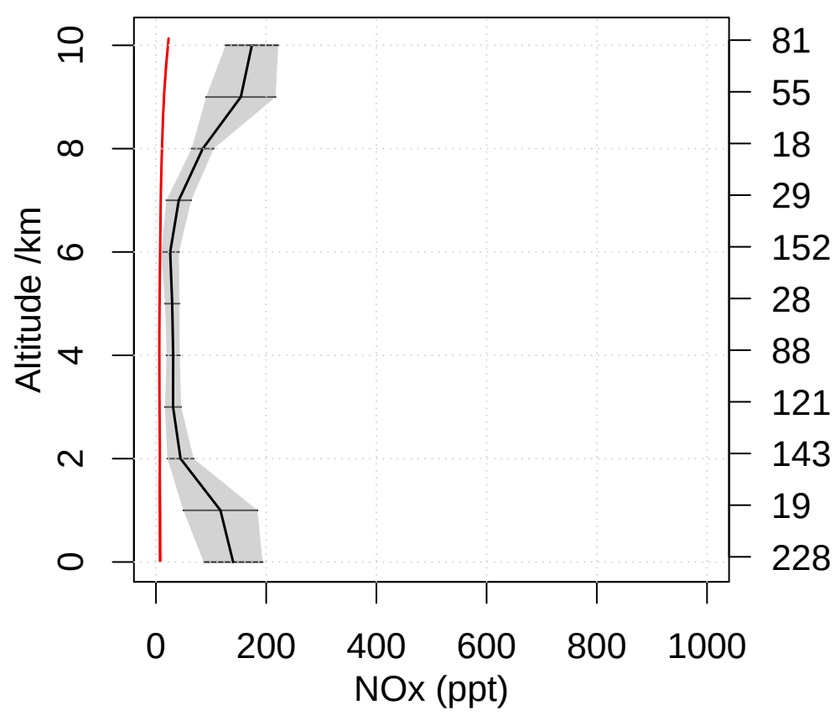


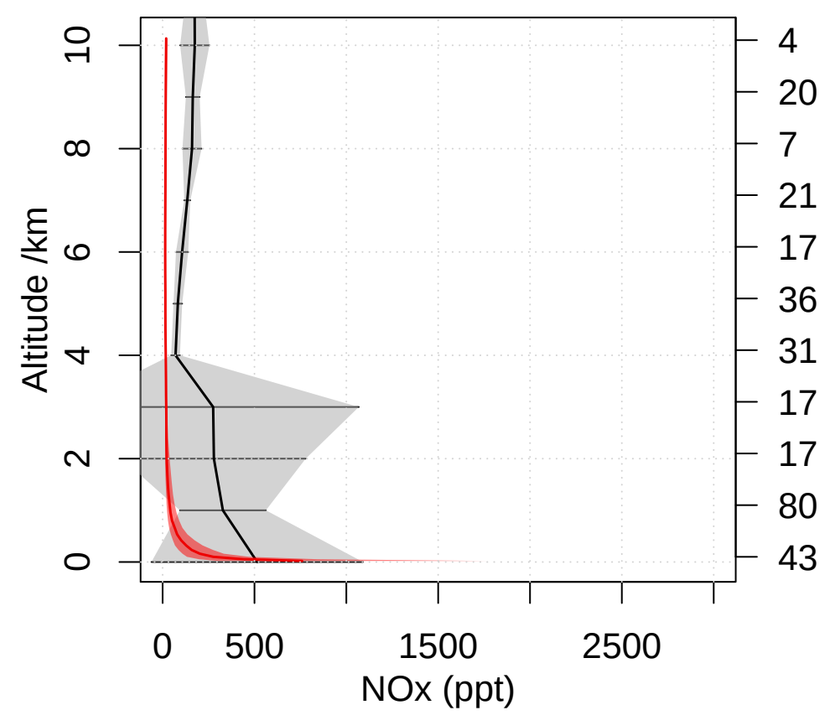


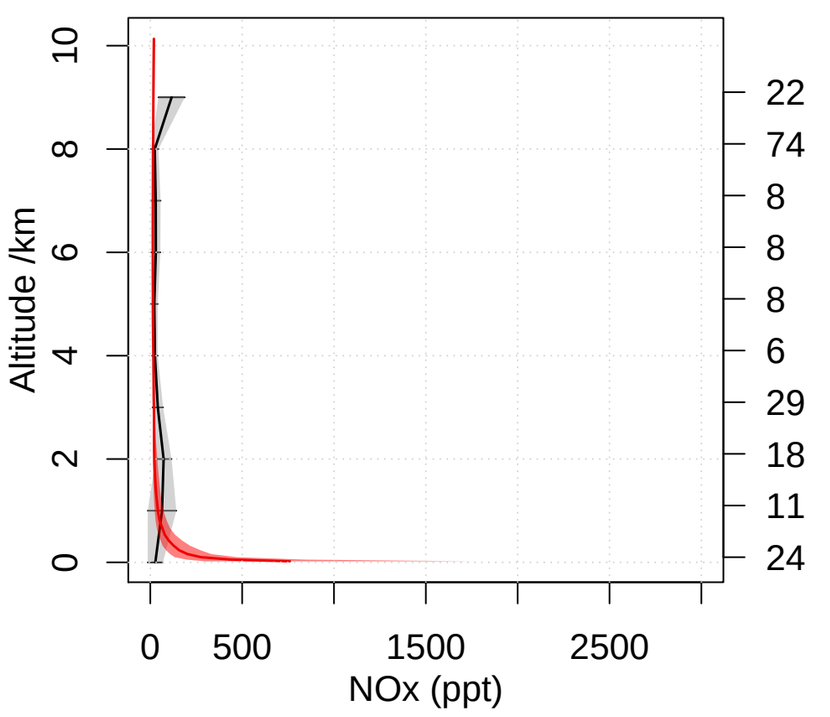


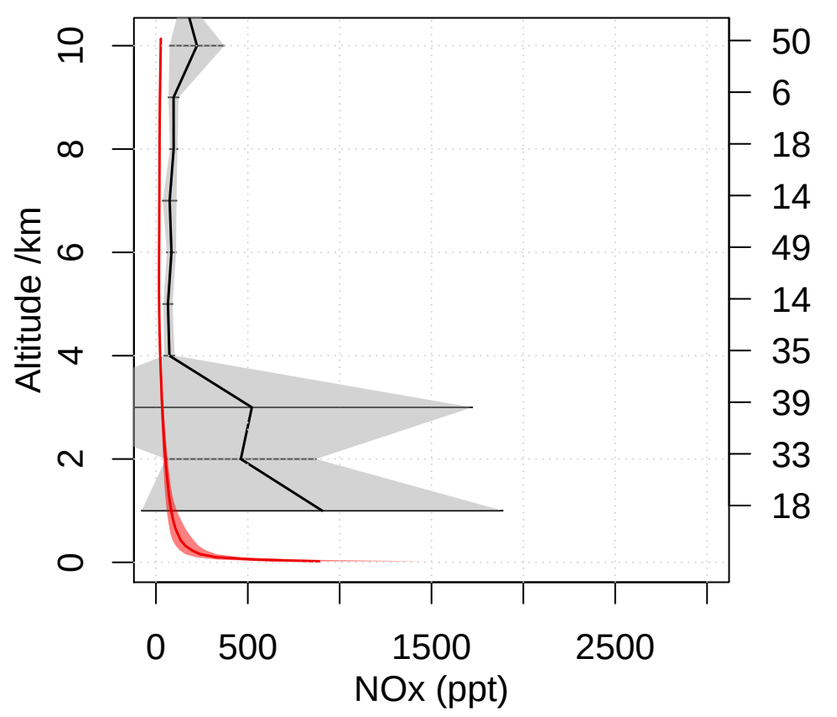


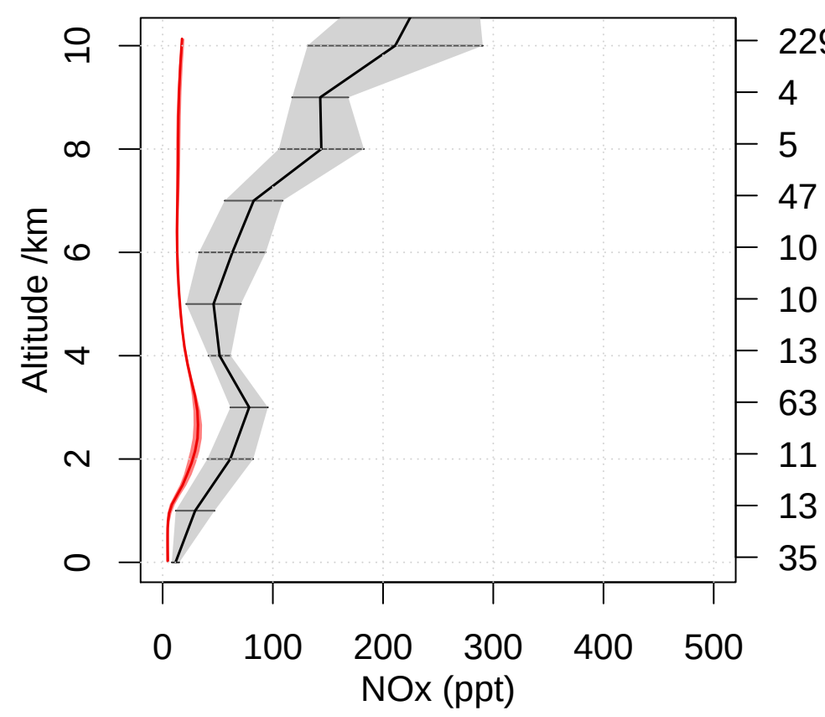


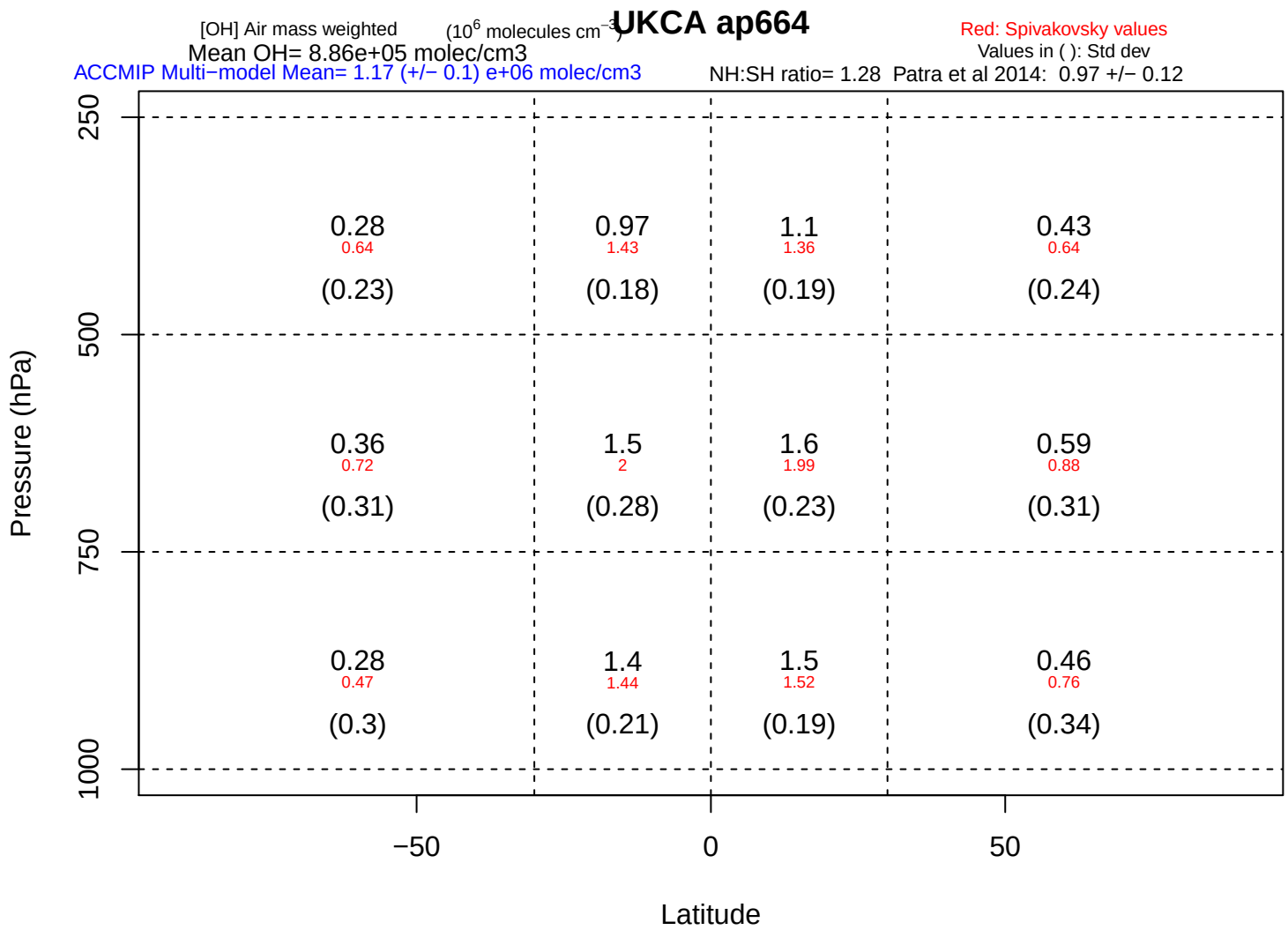


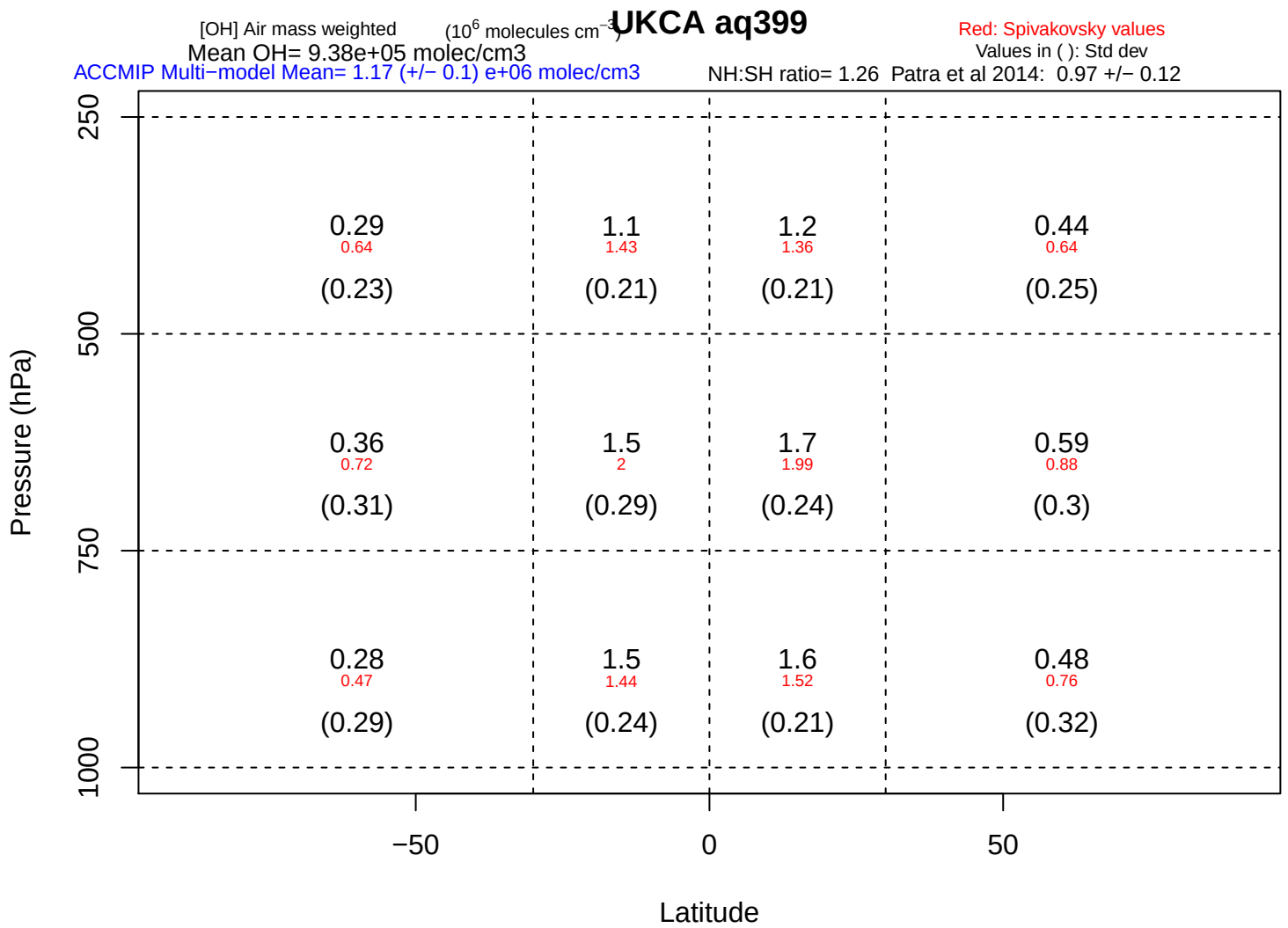


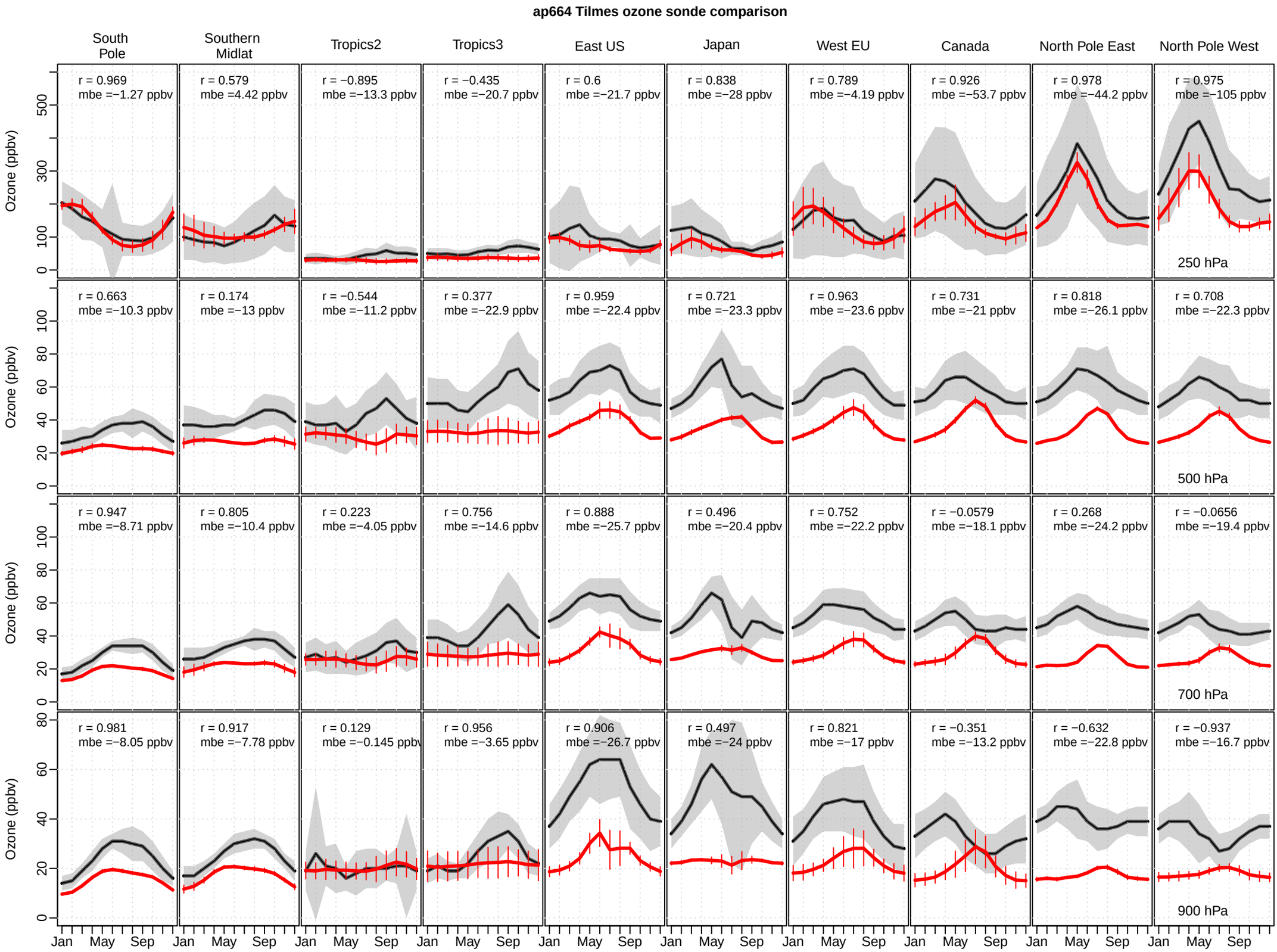


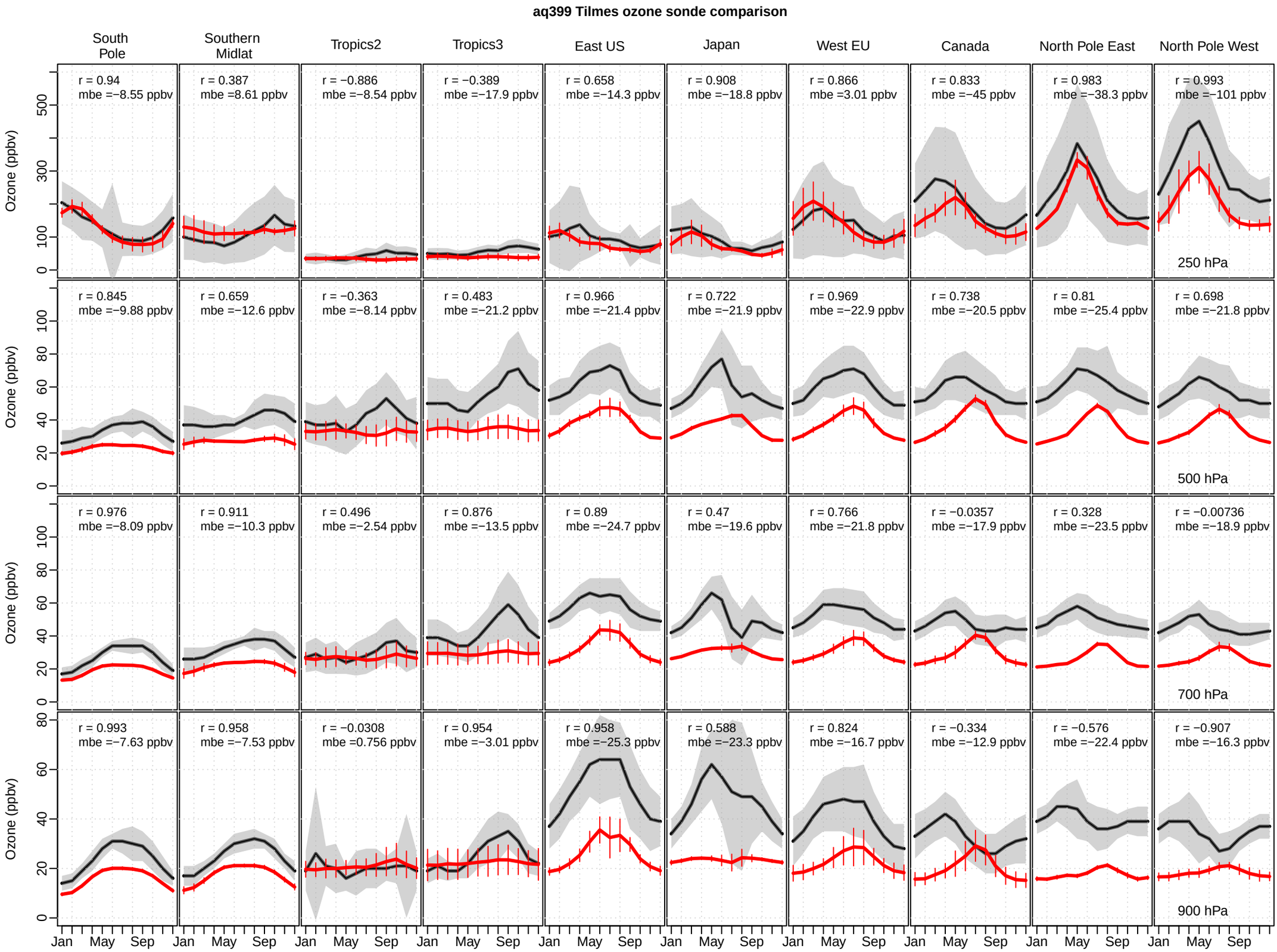


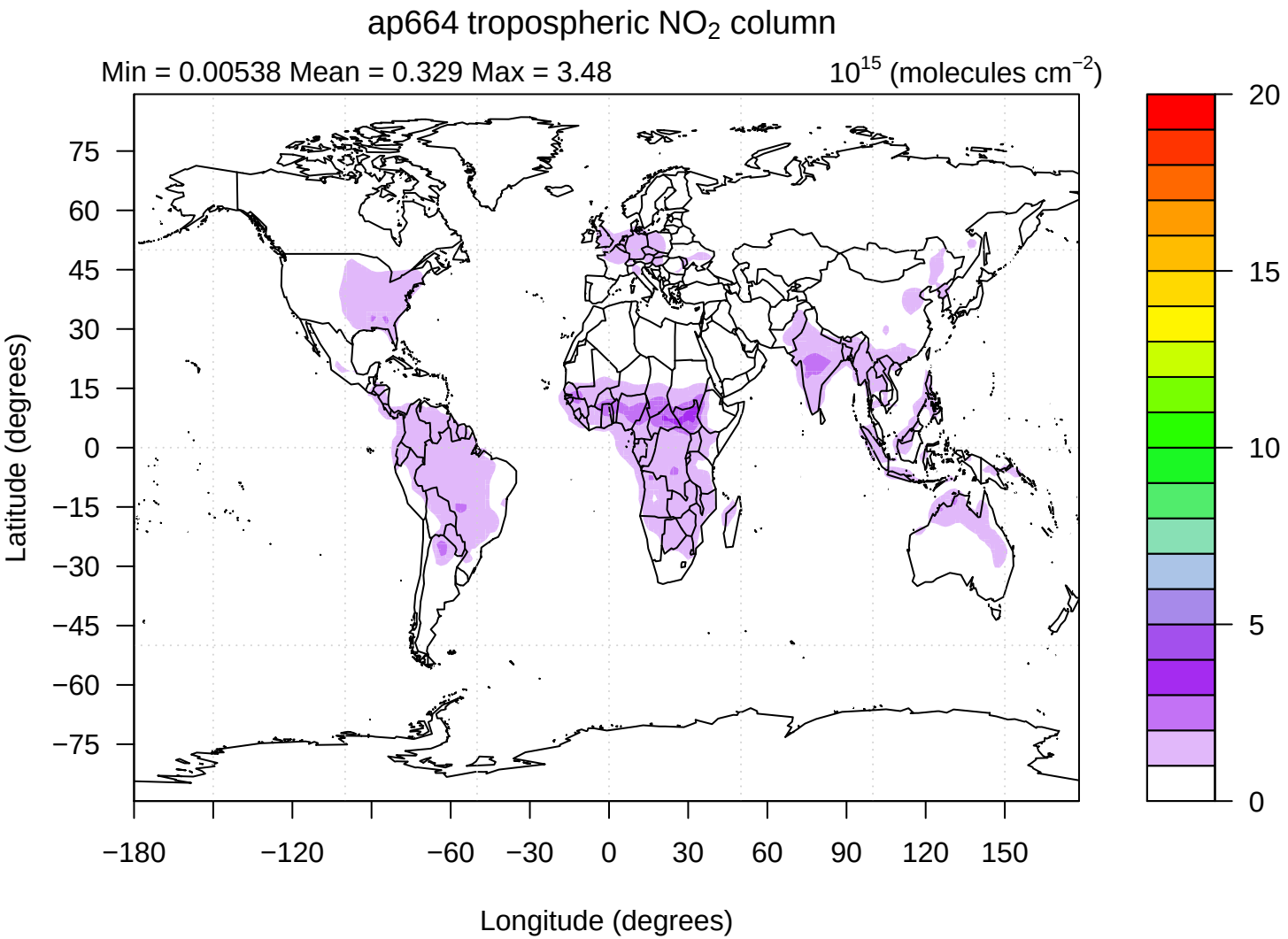


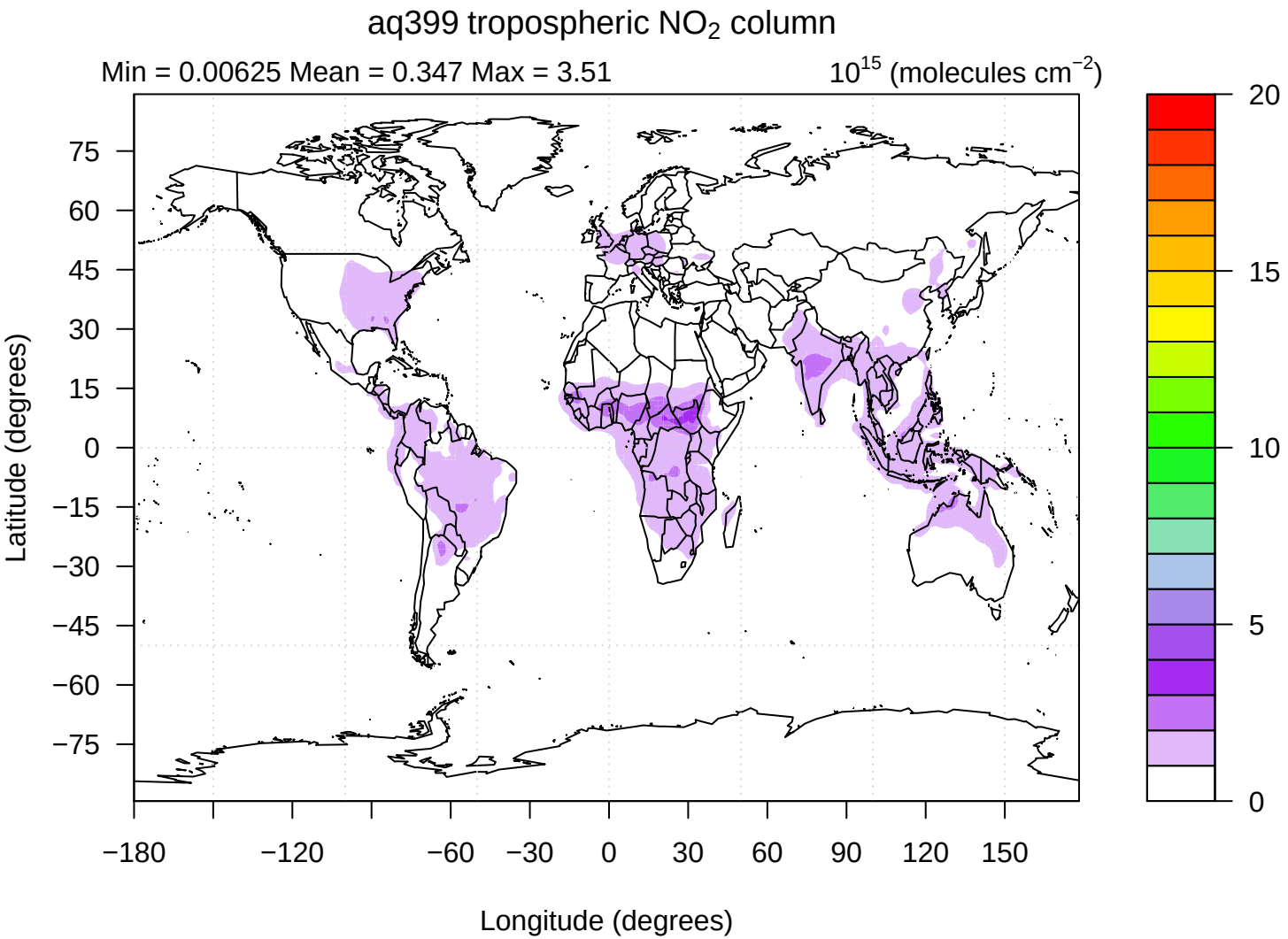

[OH] Air mass weighted
(10^6 molecules cm^{-3})
UKCA ap664
Red: Spivakovsky values
Values in ( ): Std dev
Mean OH= 8.86e+05 molec/cm3
ACCMIP Multi−model Mean= 1.17 (+/− 0.1) e+06 molec/cm3
NH:SH ratio= 1.28 Patra et al 2014: 0.97 +/− 0.12
0.28
0.64
(0.23)
0.97
1.43
(0.18)
1.1
1.36
(0.19)
0.43
0.64
(0.24)
0.36
0.72
(0.31)
1.5
2
(0.28)
1.6
1.99
(0.23)
0.59
0.88
(0.31)
0.28
0.47
(0.3)
1.4
1.44
(0.21)
1.5
1.52
(0.19)
0.46
0.76
(0.34)
Pressure (hPa)
250
500
750
1000
−50
0
50
Latitude

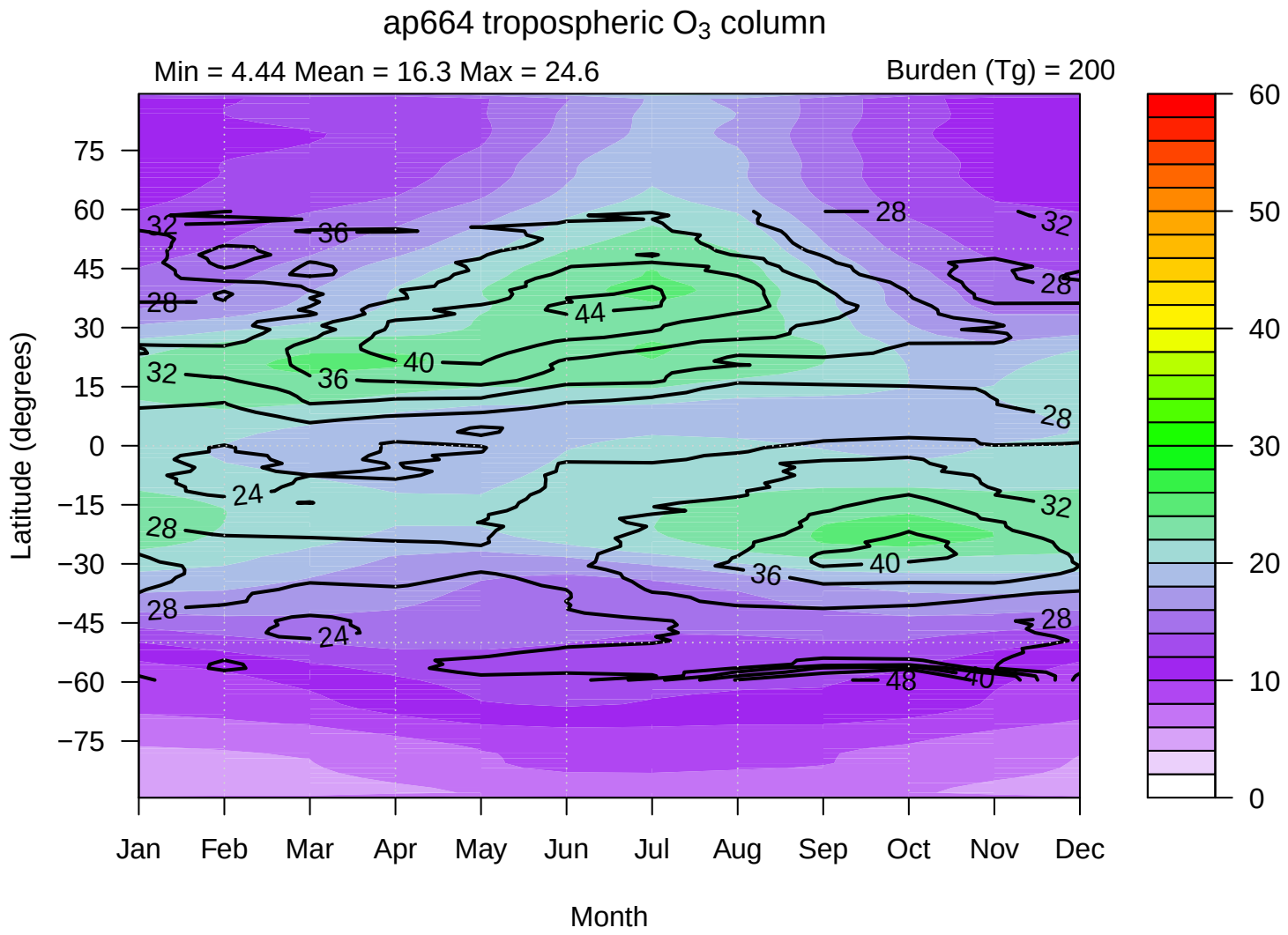

[OH] Air mass weighted
(10^6 molecules cm^{-3})
UKCA aq399
Red: Spivakovsky values
Values in ( ): Std dev
Mean OH= 9.38e+05 molec/cm3
ACCMIP Multi−model Mean= 1.17 (+/− 0.1) e+06 molec/cm3
NH:SH ratio= 1.26 Patra et al 2014: 0.97 +/− 0.12
0.29
0.64
(0.23)
1.1
1.43
(0.21)
1.2
1.36
(0.21)
0.44
0.64
(0.25)
0.36
0.72
(0.31)
1.5
2
(0.29)
1.7
1.99
(0.24)
0.59
0.88
(0.3)
0.28
0.47
(0.29)
1.5
1.44
(0.24)
1.6
1.52
(0.21)
0.48
0.76
(0.32)
Pressure (hPa)
250
500
750
1000
−50
0
50
Latitude

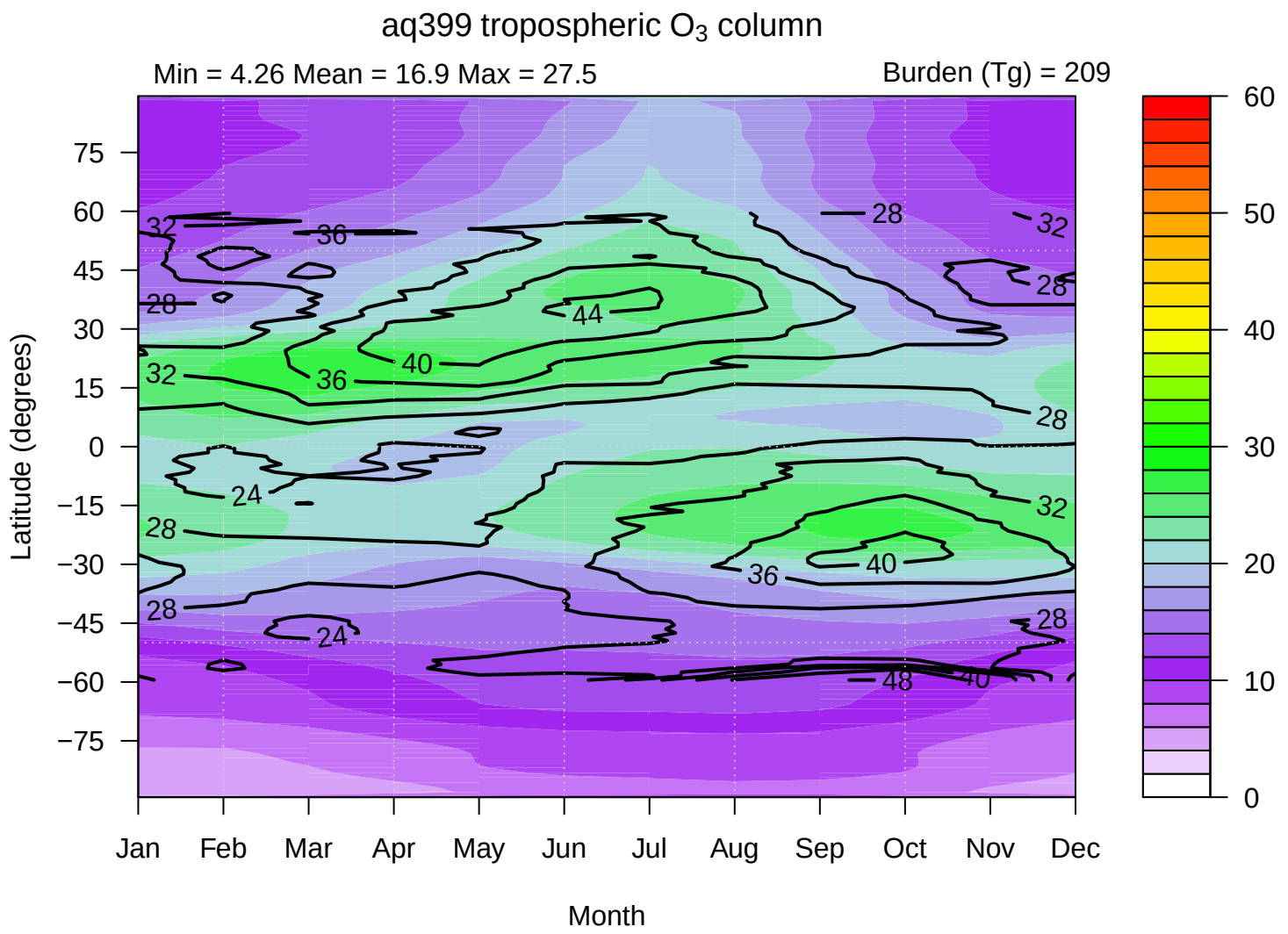

ap664 Tilmes ozone sonde comparison
South Pole
Southern Midlat
Tropics2
Tropics3
East US
Japan
West EU
Canada
North Pole East
North Pole West
Ozone (ppbv)
r = 0.969
mbe =−1.27 ppbv
r = 0.579
mbe =4.42 ppbv
r = −0.895
mbe =−13.3 ppbv
r = −0.435
mbe =−20.7 ppbv
r = 0.6
mbe =−21.7 ppbv
r = 0.838
mbe =−28 ppbv
r = 0.789
mbe =−4.19 ppbv
r = 0.926
mbe =−53.7 ppbv
r = 0.978
mbe =−44.2 ppbv
r = 0.975
mbe =−105 ppbv
250 hPa
r = 0.663
mbe =−10.3 ppbv
r = 0.174
mbe =−13 ppbv
r = −0.544
mbe =−11.2 ppbv
r = 0.377
mbe =−22.9 ppbv
r = 0.959
mbe =−22.4 ppbv
r = 0.721
mbe =−23.3 ppbv
r = 0.963
mbe =−23.6 ppbv
r = 0.731
mbe =−21 ppbv
r = 0.818
mbe =−26.1 ppbv
r = 0.708
mbe =−22.3 ppbv
500 hPa
r = 0.947
mbe =−8.71 ppbv
r = 0.805
mbe =−10.4 ppbv
r = 0.223
mbe =−4.05 ppbv
r = 0.756
mbe =−14.6 ppbv
r = 0.888
mbe =−25.7 ppbv
r = 0.496
mbe =−20.4 ppbv
r = 0.752
mbe =−22.2 ppbv
r = −0.0579
mbe =−18.1 ppbv
r = 0.268
mbe =−24.2 ppbv
r = −0.0656
mbe =−19.4 ppbv
700 hPa
r = 0.981
mbe =−8.05 ppbv
r = 0.917
mbe =−7.78 ppbv
r = 0.129
mbe =−0.145 ppbv
r = 0.956
mbe =−3.65 ppbv
r = 0.906
mbe =−26.7 ppbv
r = 0.497
mbe =−24 ppbv
r = 0.821
mbe =−17 ppbv
r = −0.351
mbe =−13.2 ppbv
r = −0.632
mbe =−22.8 ppbv
r = −0.937
mbe =−16.7 ppbv
900 hPa
Jan
May
Sep


aq399 Tilmes ozone sonde comparison
South Pole
Southern Midlat
Tropics2
Tropics3
East US
Japan
West EU
Canada
North Pole East
North Pole West
Ozone (ppbv)
r = 0.94
mbe =−8.55 ppbv
r = 0.387
mbe =8.61 ppbv
r = −0.886
mbe =−8.54 ppbv
r = −0.389
mbe =−17.9 ppbv
r = 0.658
mbe =−14.3 ppbv
r = 0.908
mbe =−18.8 ppbv
r = 0.866
mbe =3.01 ppbv
r = 0.833
mbe =−45 ppbv
r = 0.983
mbe =−38.3 ppbv
r = 0.993
mbe =−101 ppbv
250 hPa
r = 0.845
mbe =−9.88 ppbv
r = 0.659
mbe =−12.6 ppbv
r = −0.363
mbe =−8.14 ppbv
r = 0.483
mbe =−21.2 ppbv
r = 0.966
mbe =−21.4 ppbv
r = 0.722
mbe =−21.9 ppbv
r = 0.969
mbe =−22.9 ppbv
r = 0.738
mbe =−20.5 ppbv
r = 0.81
mbe =−25.4 ppbv
r = 0.698
mbe =−21.8 ppbv
500 hPa
r = 0.976
mbe =−8.09 ppbv
r = 0.911
mbe =−10.3 ppbv
r = 0.496
mbe =−2.54 ppbv
r = 0.876
mbe =−13.5 ppbv
r = 0.89
mbe =−24.7 ppbv
r = 0.47
mbe =−19.6 ppbv
r = 0.766
mbe =−21.8 ppbv
r = −0.0357
mbe =−17.9 ppbv
r = 0.328
mbe =−23.5 ppbv
r = −0.00736
mbe =−18.9 ppbv
700 hPa
r = 0.993
mbe =−7.63 ppbv
r = 0.958
mbe =−7.53 ppbv
r = −0.0308
mbe =0.756 ppbv
r = 0.954
mbe =−3.01 ppbv
r = 0.958
mbe =−25.3 ppbv
r = 0.588
mbe =−23.3 ppbv
r = 0.824
mbe =−16.7 ppbv
r = −0.334
mbe =−12.9 ppbv
r = −0.576
mbe =−22.4 ppbv
r = −0.907
mbe =−16.3 ppbv
900 hPa
Jan
May
Sep

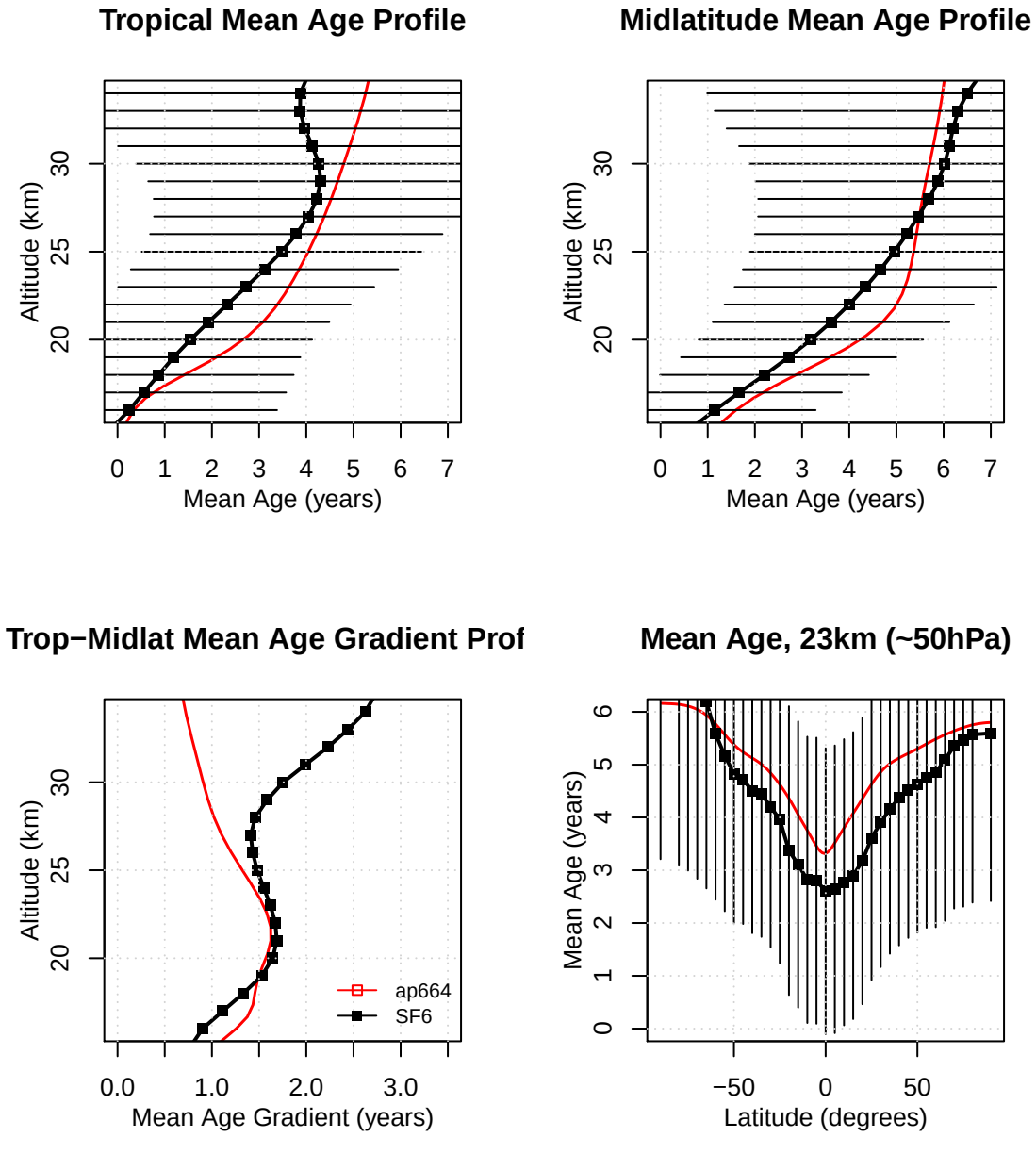

ap664 tropospheric NO2 column
Min = 0.00538 Mean = 0.329 Max = 3.48
10^15 (molecules cm^-2)
Latitude (degrees)
Longitude (degrees)
75
60
45
30
15
0
−15
−30
−45
−60
−75
−180
−120
−60
−30
0
30
60
90
120
150
20
15
10
5
0


aq399 tropospheric NO_2 column
Min = 0.00625 Mean = 0.347 Max = 3.51
10^{15} (molecules cm^{-2})
Latitude (degrees)
Longitude (degrees)
75
60
45
30
15
0
−15
−30
−45
−60
−75
−180
−120
−60
−30
0
30
60
90
120
150
20
15
10
5
0

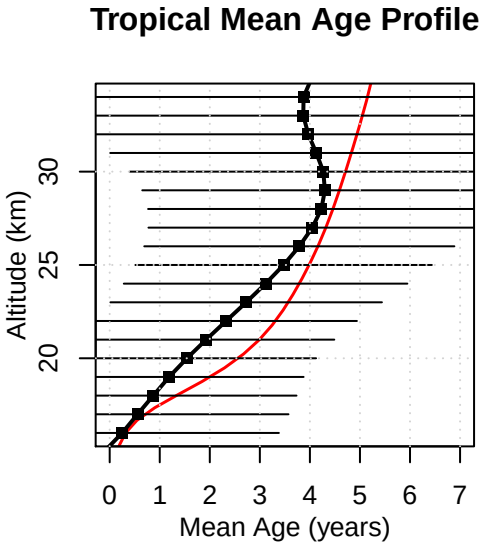

ap664 tropospheric O_3 column
Min = 4.44 Mean = 16.3 Max = 24.6
Burden (Tg) = 200
Latitude (degrees)
75
60
45
30
15
0
−15
−30
−45
−60
−75
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
60
50
40
30
20
10
0
32
36
28
44
40
24
48

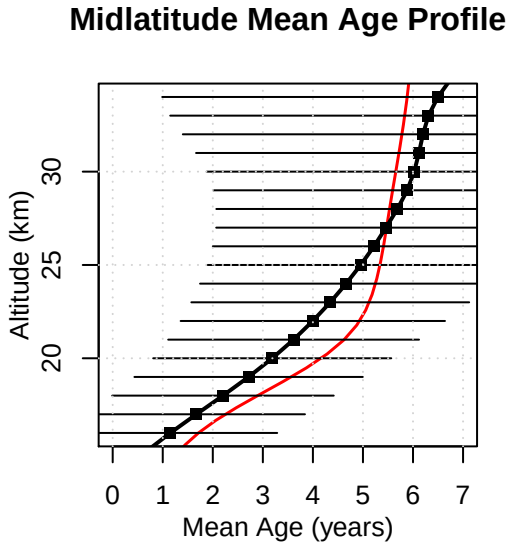

aq399 tropospheric O_3 column
Min = 4.26 Mean = 16.9 Max = 27.5
Burden (Tg) = 209
Latitude (degrees)
75
60
45
30
15
0
−15
−30
−45
−60
−75
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
60
50
40
30
20
10
0
32
36
28
44
40
24
48

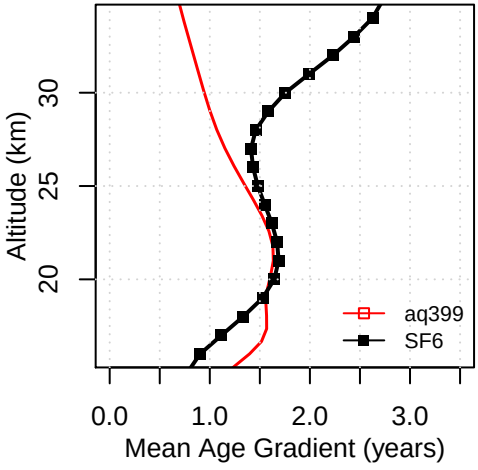
UKCA ap664 Mean Age of Air

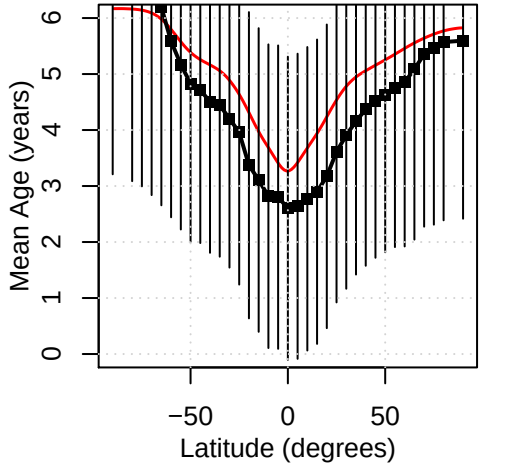


UKCA aq399 Mean Age of Air

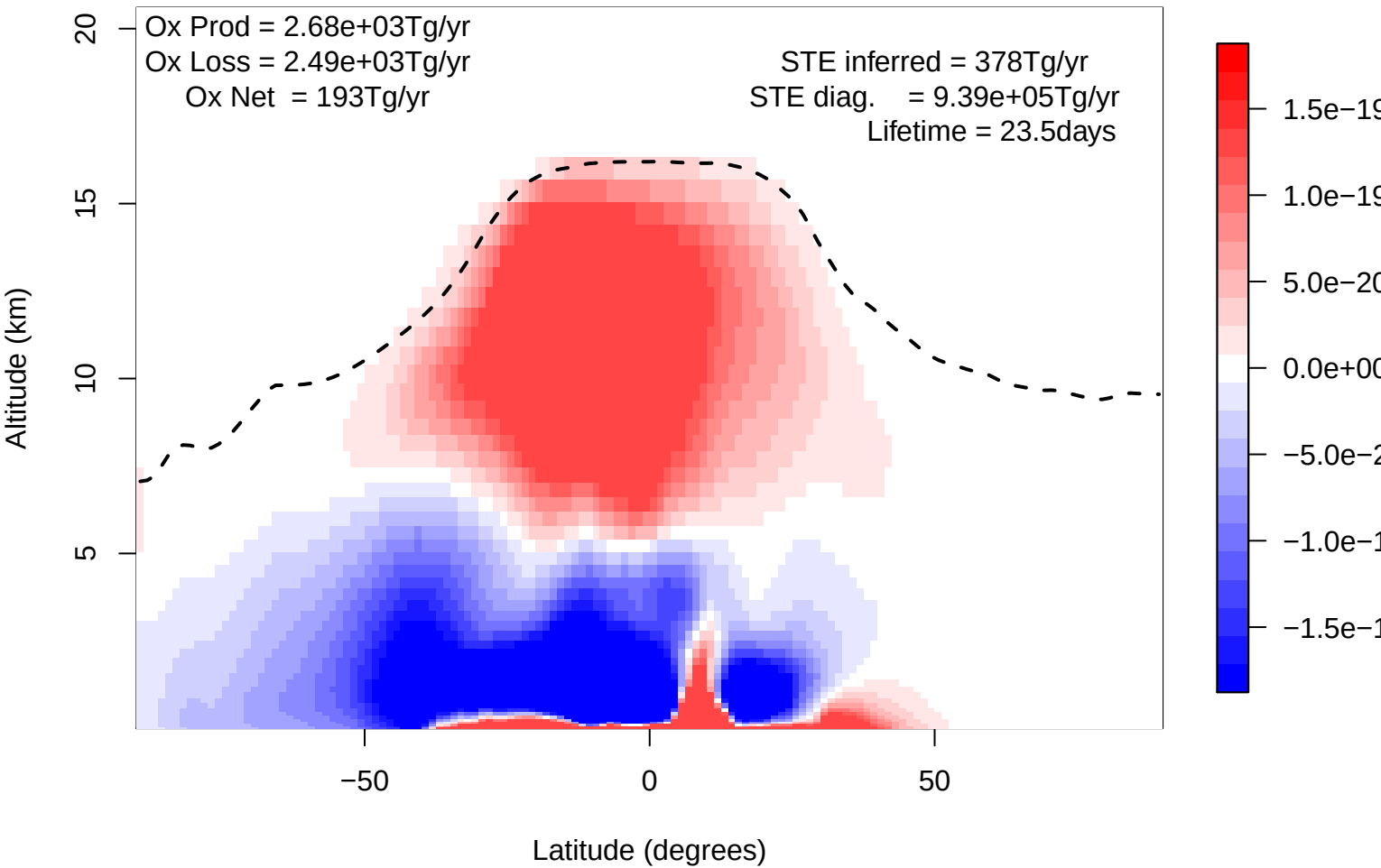




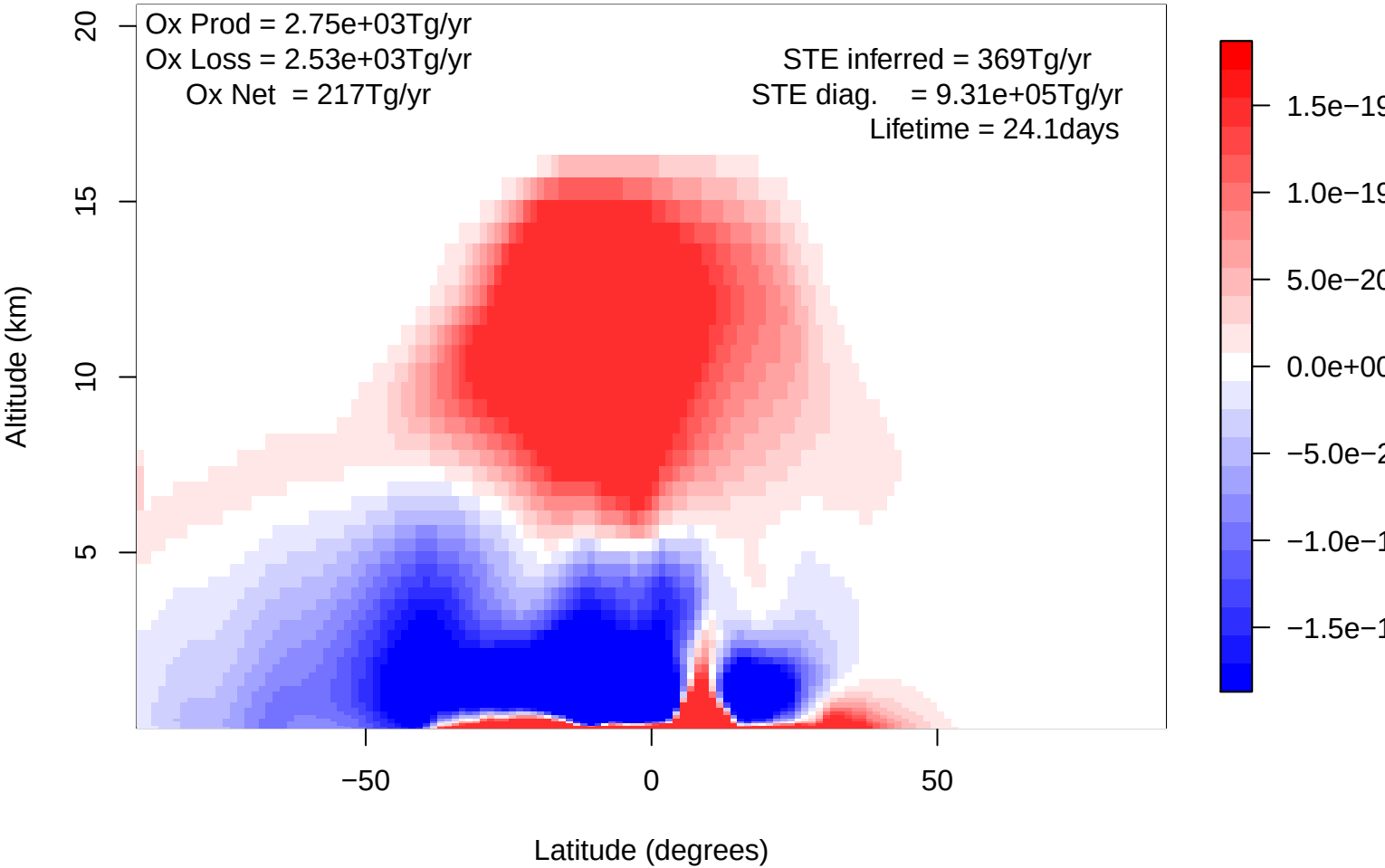


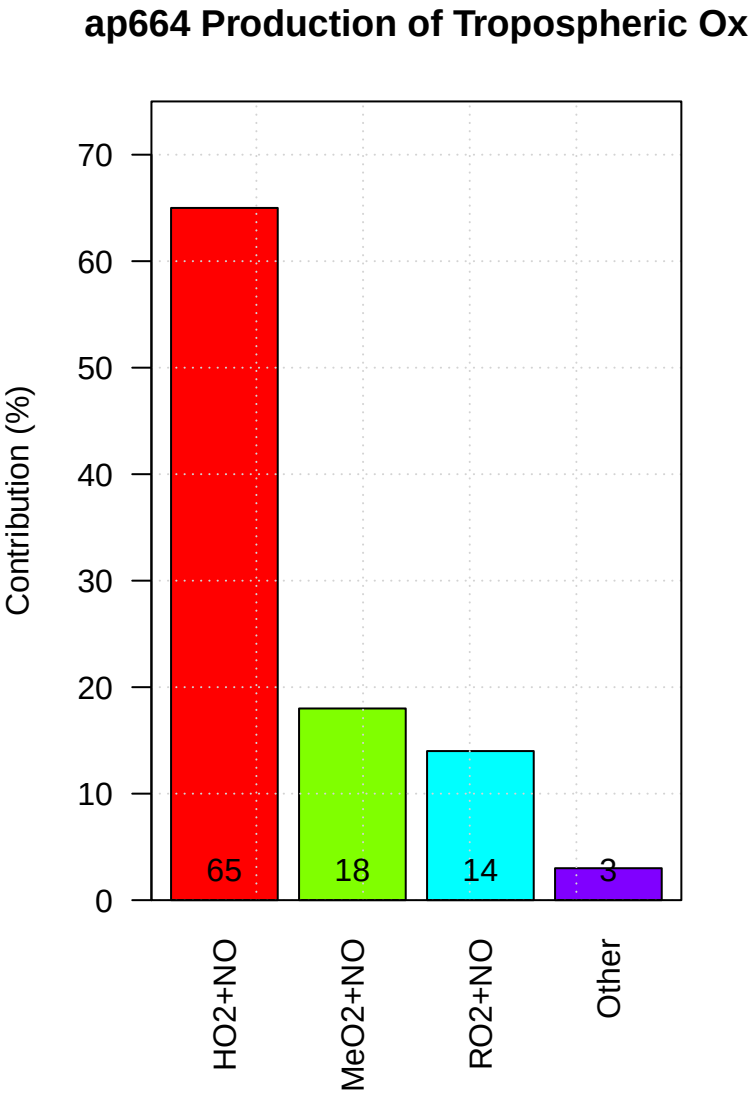


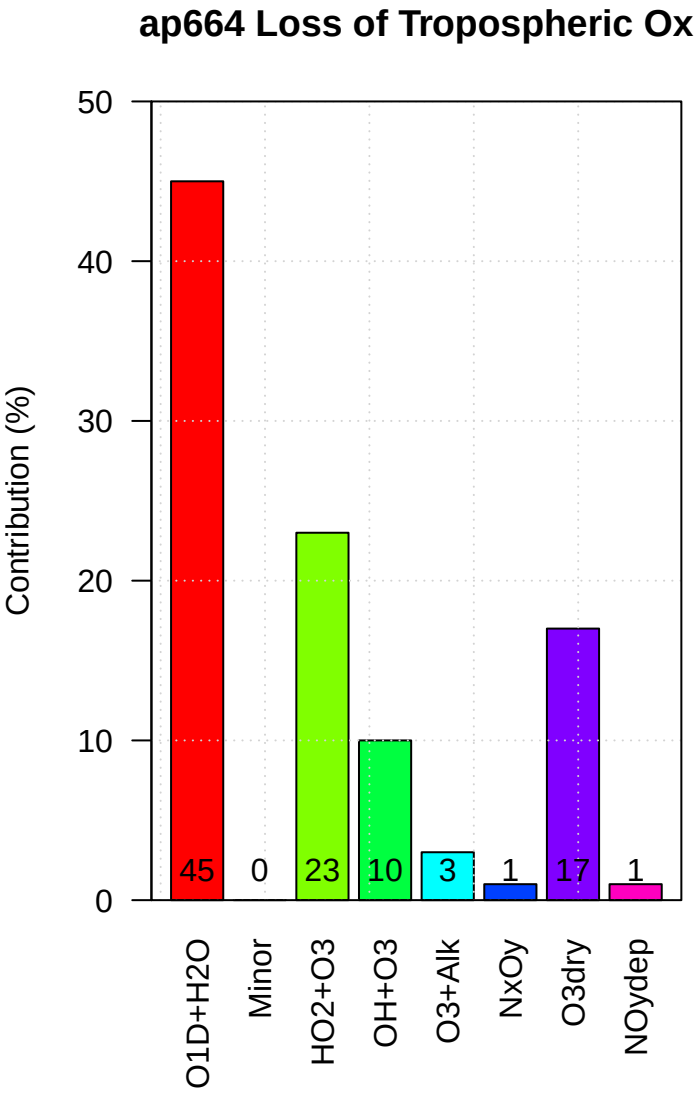
UKCA ap664 Ox Net Chemical Production

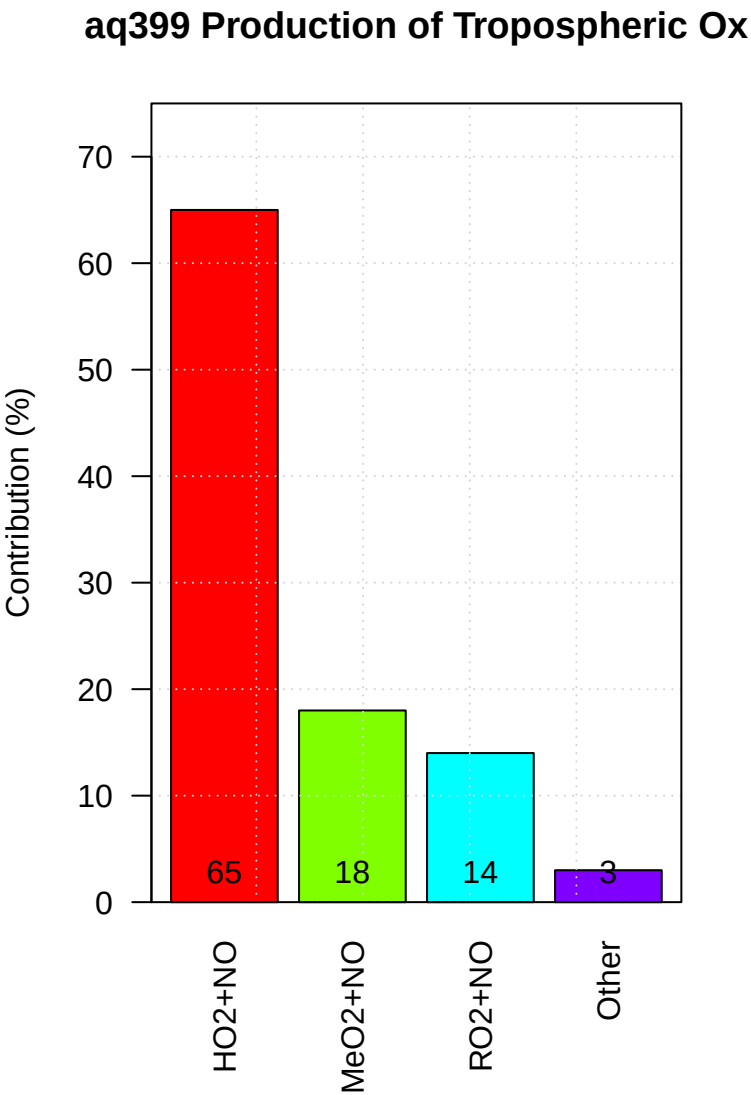


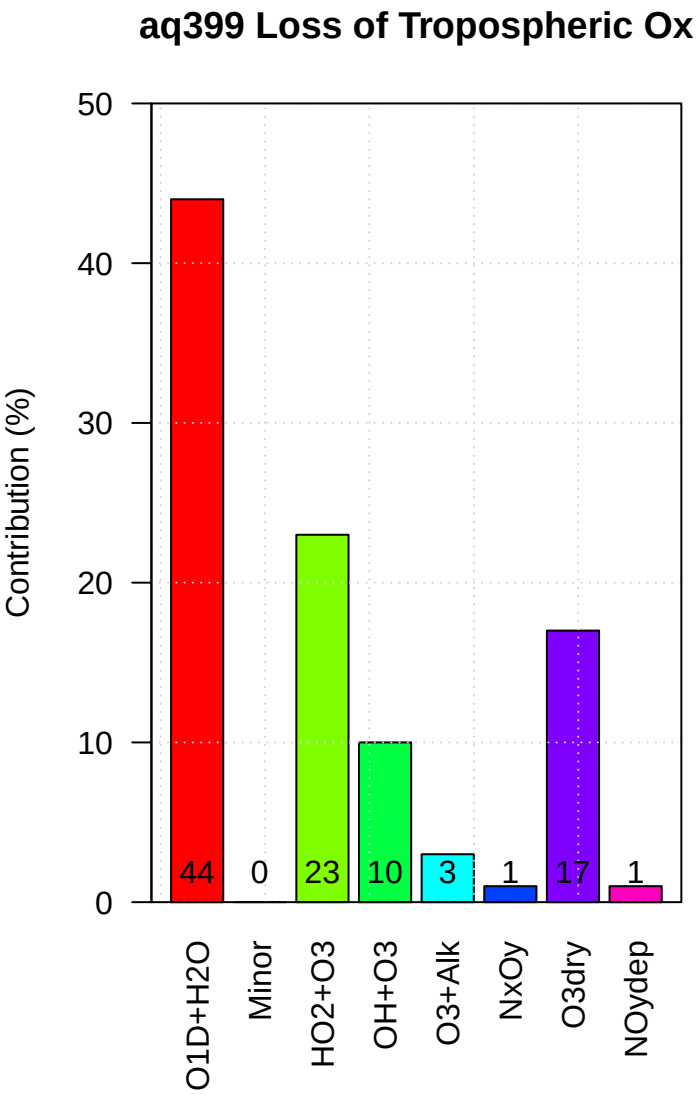
UKCA aq399 Ox Net Chemical Production

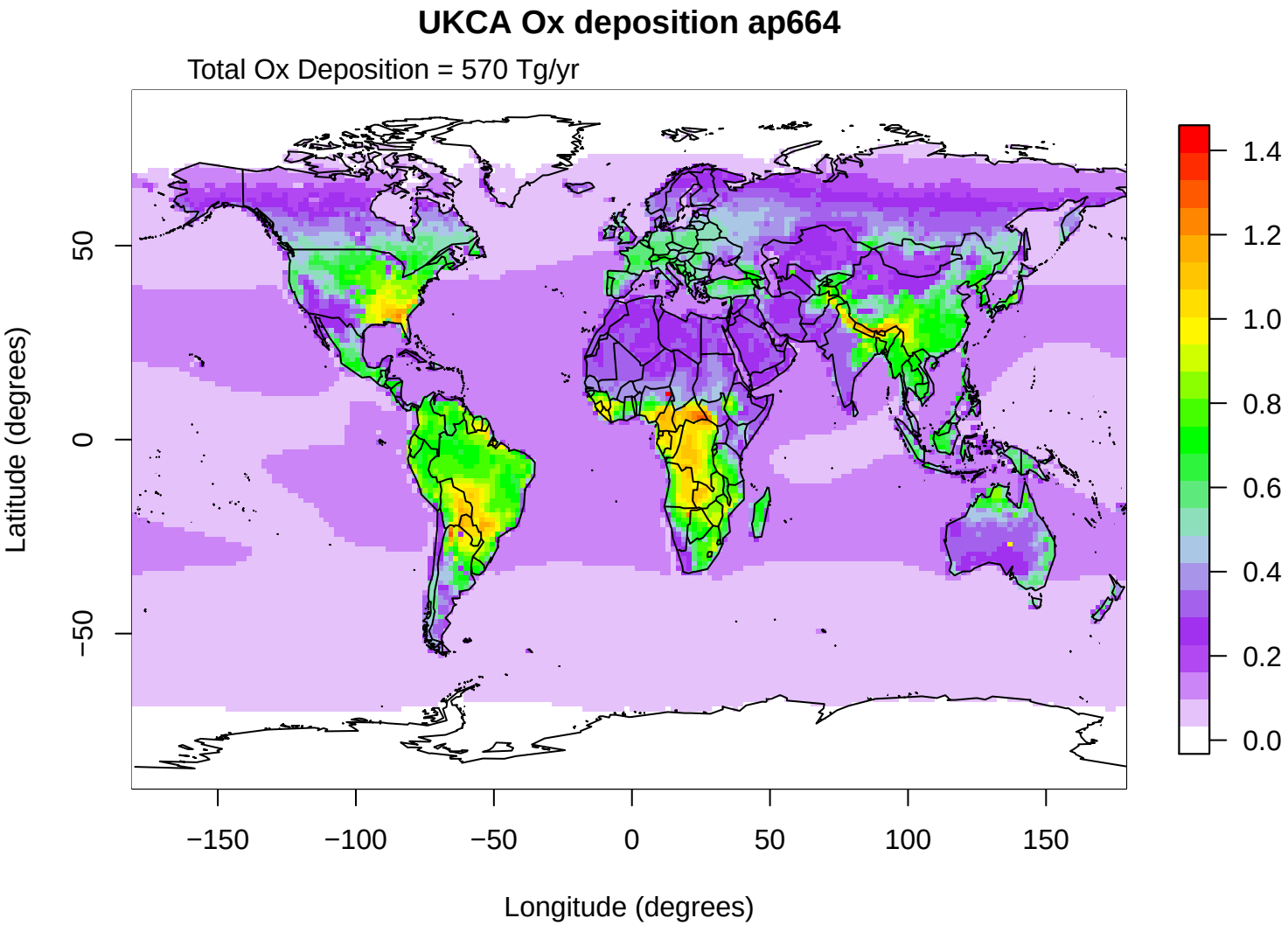


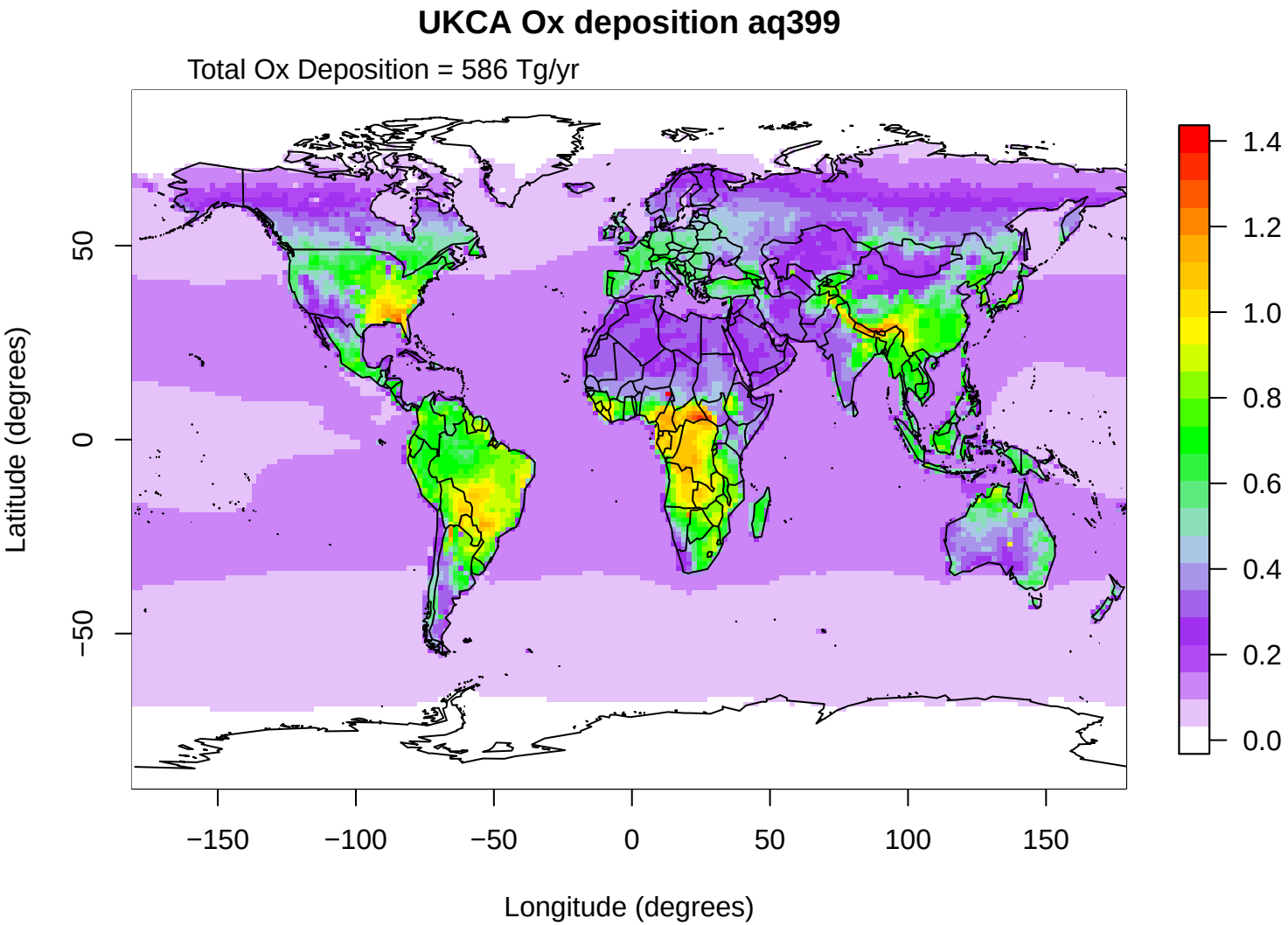

ap664 Production of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
60
70
65
18
14
3
HO2+NO
MeO2+NO
RO2+NO
Other

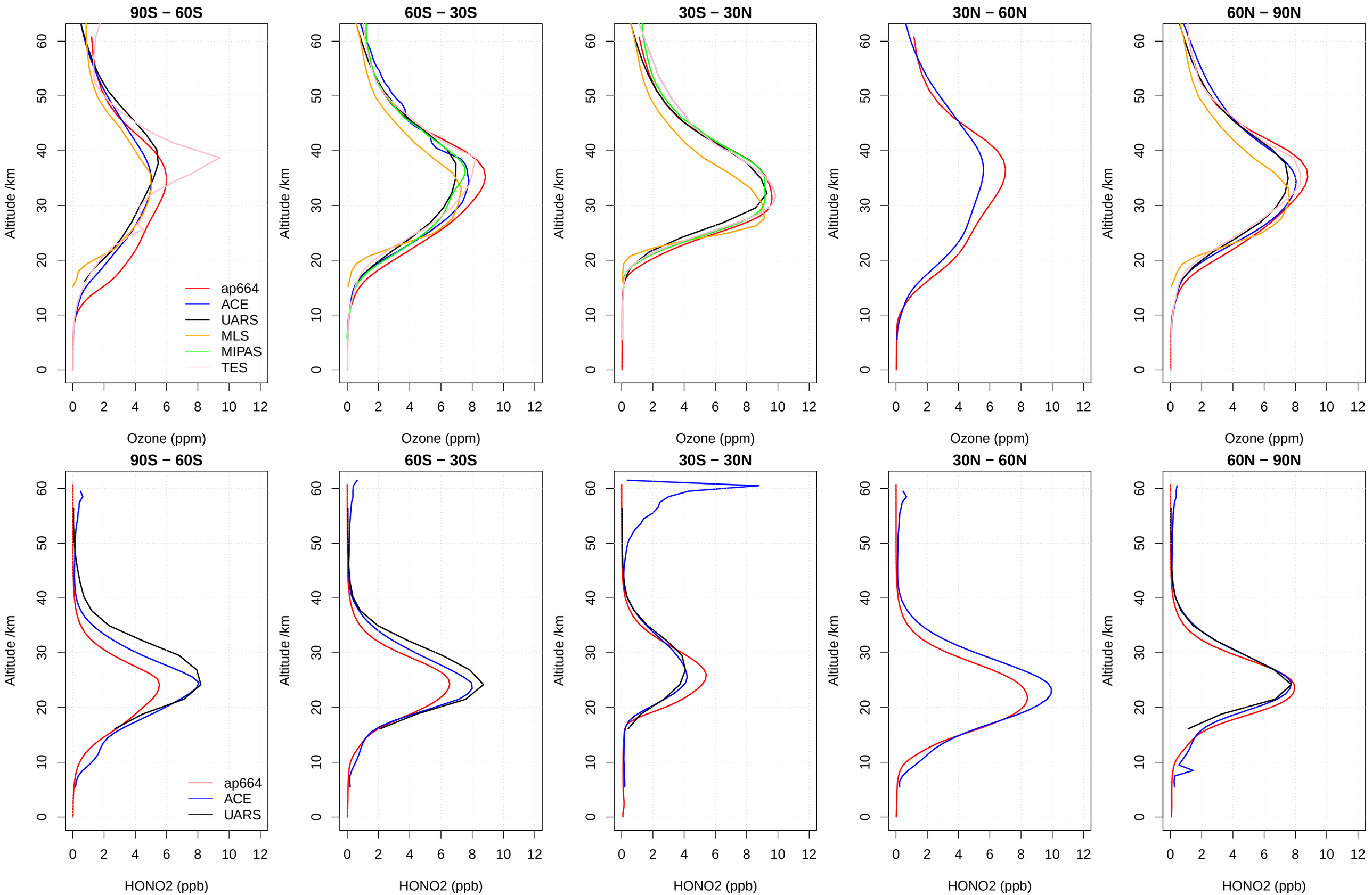

ap664 Loss of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
45
0
23
10
3
1
17
1
O1D+H2O
Minor
HO2+O3
OH+O3
O3+Alk
NxOy
O3dry
NOydep

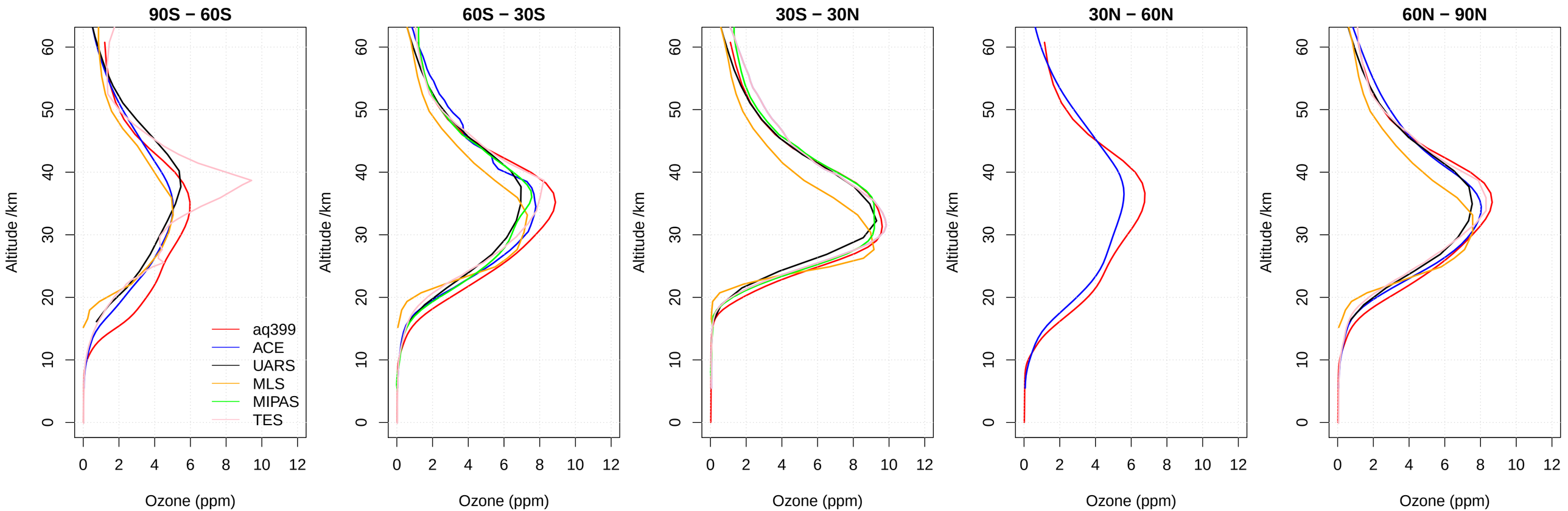

aq399 Production of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
60
70
65
18
14
3
HO2+NO
MeO2+NO
RO2+NO
Other

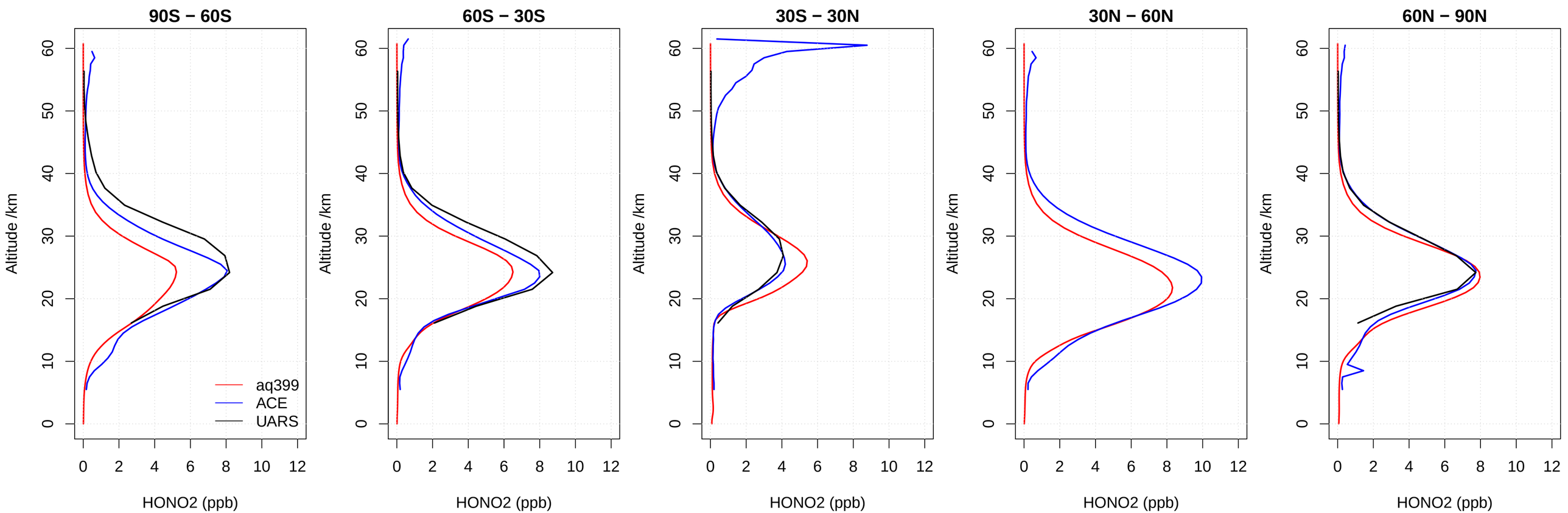

aq399 Loss of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
44
0
23
10
3
1
17
1
O1D+H2O
Minor
HO2+O3
OH+O3
O3+Alk
NxOy
O3dry
NOydep

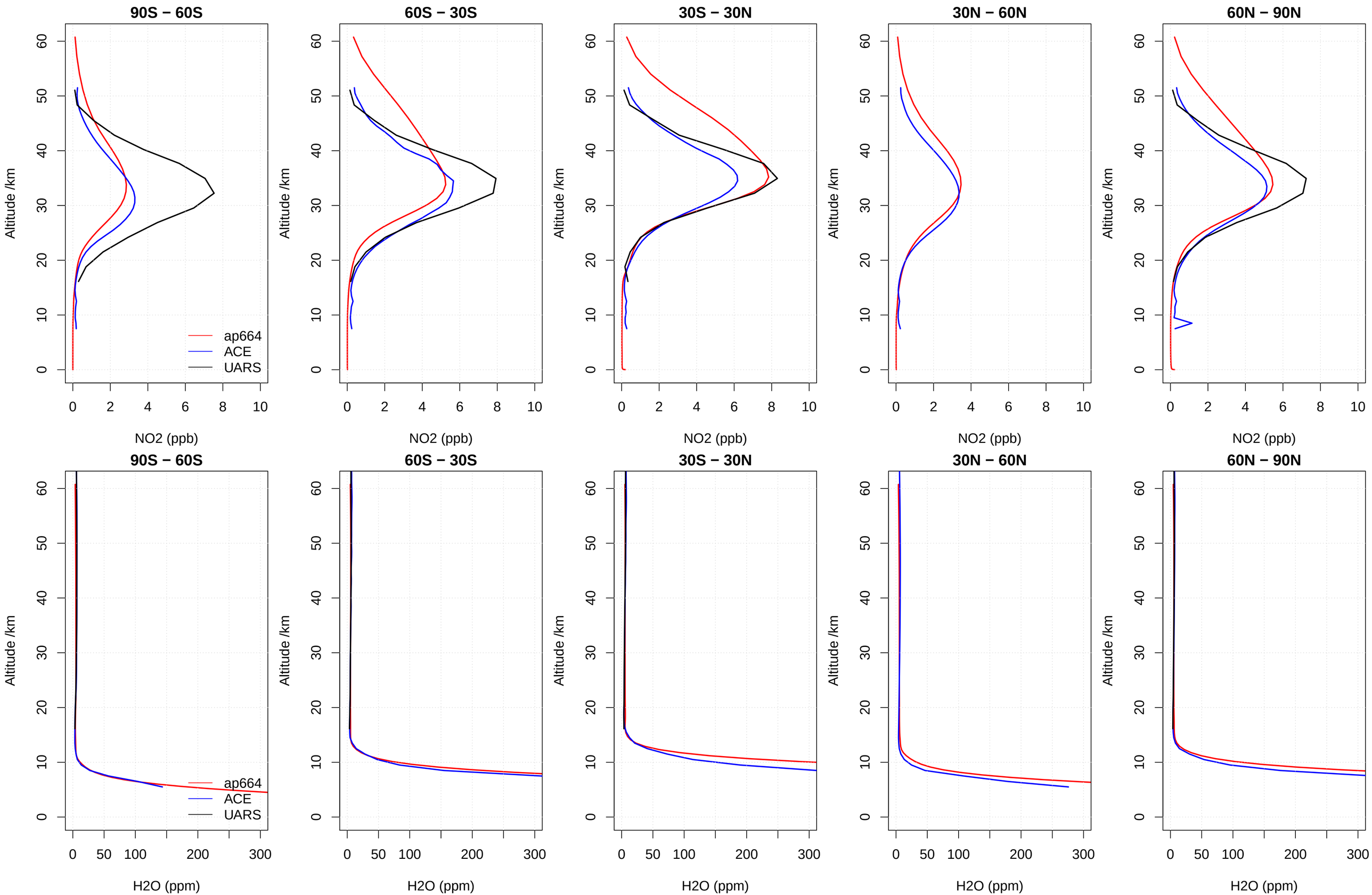

UKCA Ox deposition ap664
Total Ox Deposition = 570 Tg/yr
Latitude (degrees)
50
0
−50
−150
−100
−50
0
50
100
150
Longitude (degrees)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0

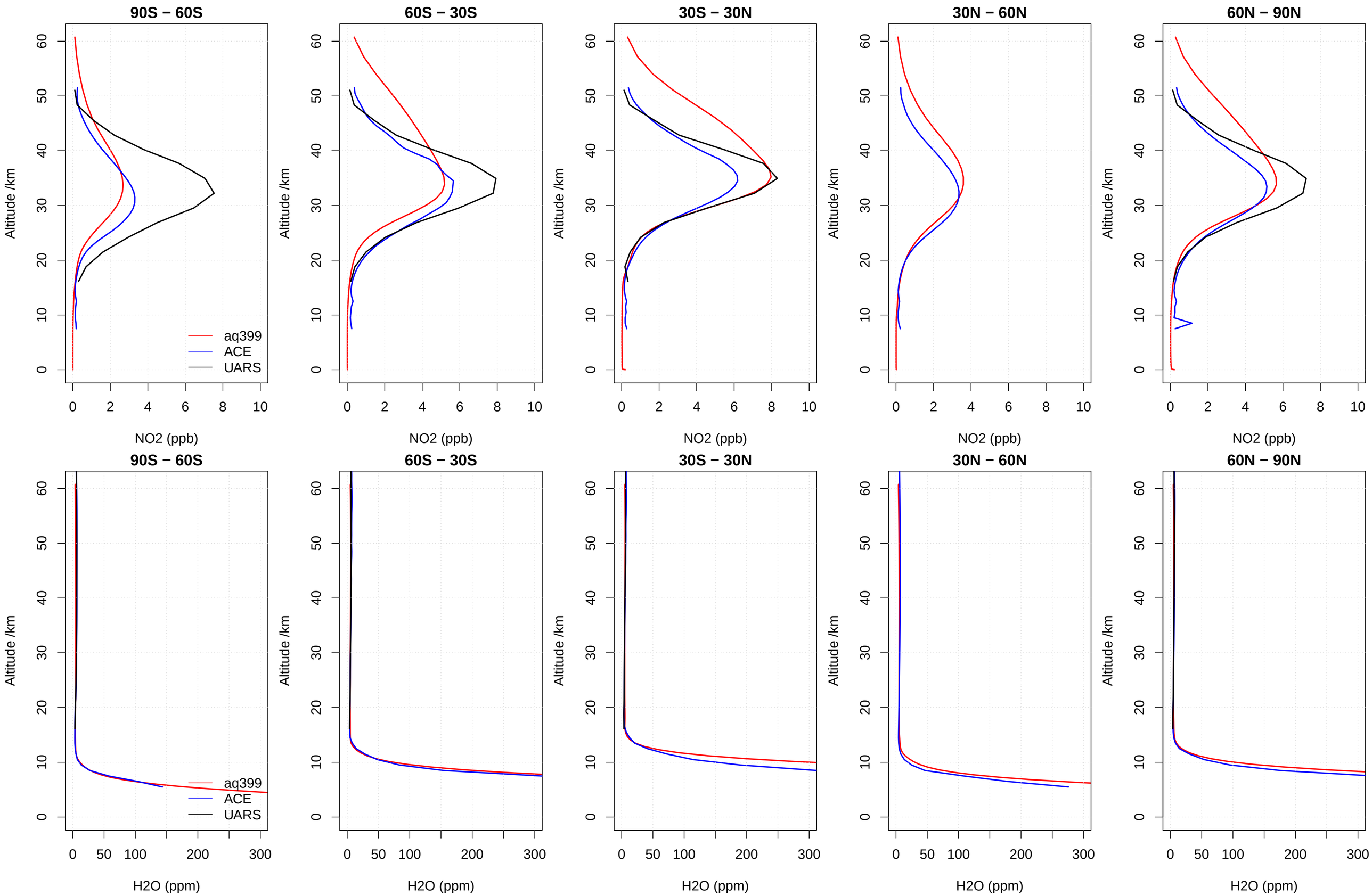

UKCA Ox deposition aq399
Total Ox Deposition = 586 Tg/yr
Latitude (degrees)
50
0
−50
−150
−100
−50
0
50
100
150
Longitude (degrees)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0

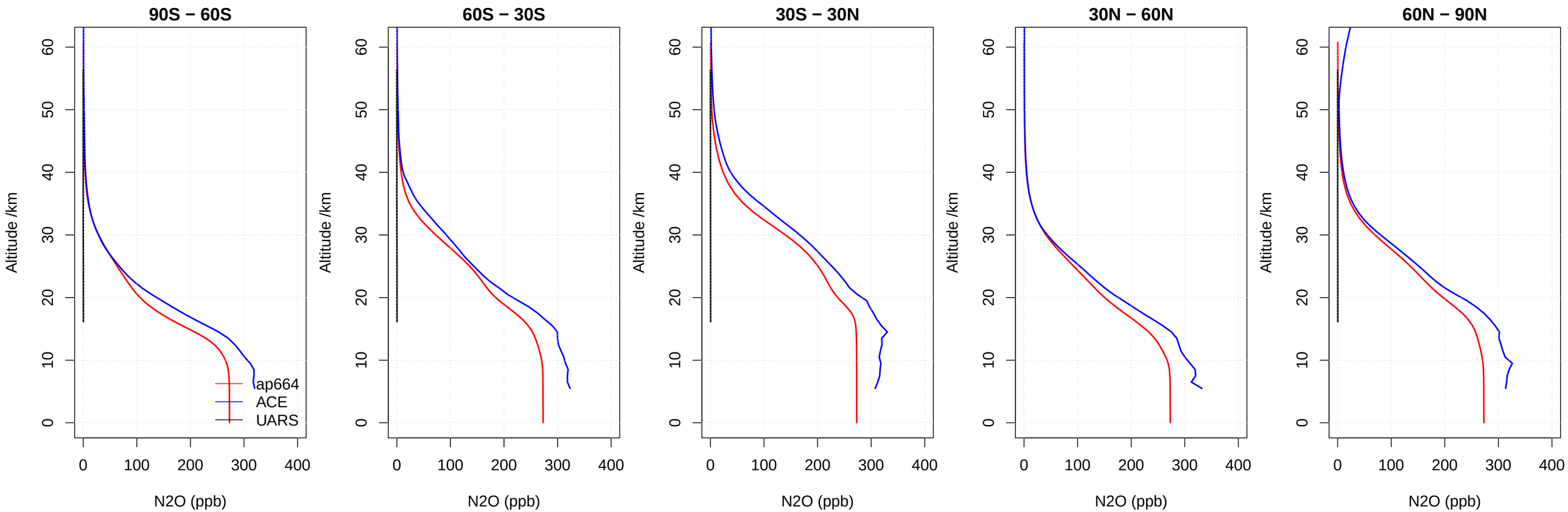

90S – 60S
60S – 30S
30S – 30N
30N – 60N
60N – 90N
Altitude /km
Ozone (ppm)
ap664
ACE
UARS
MLS
MIPAS
TES
HONO2 (ppb)

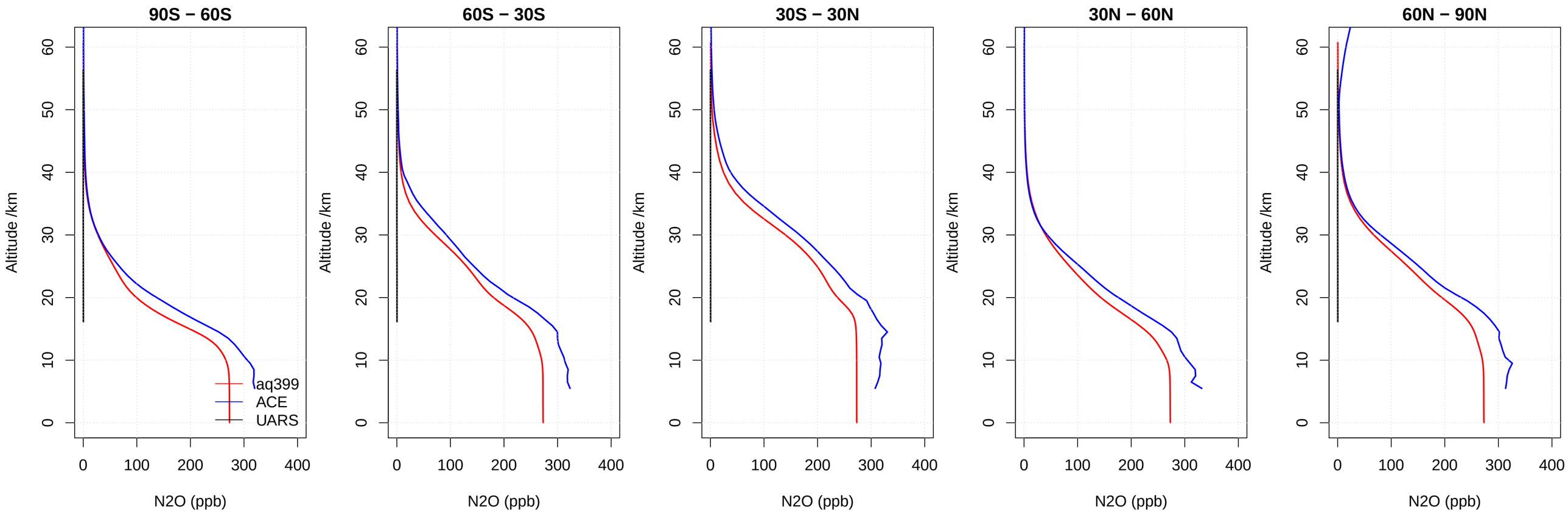

90S – 60S
60S – 30S
30S – 30N
30N – 60N
60N – 90N
Altitude /km
Ozone (ppm)
aq399
ACE
UARS
MLS
MIPAS
TES

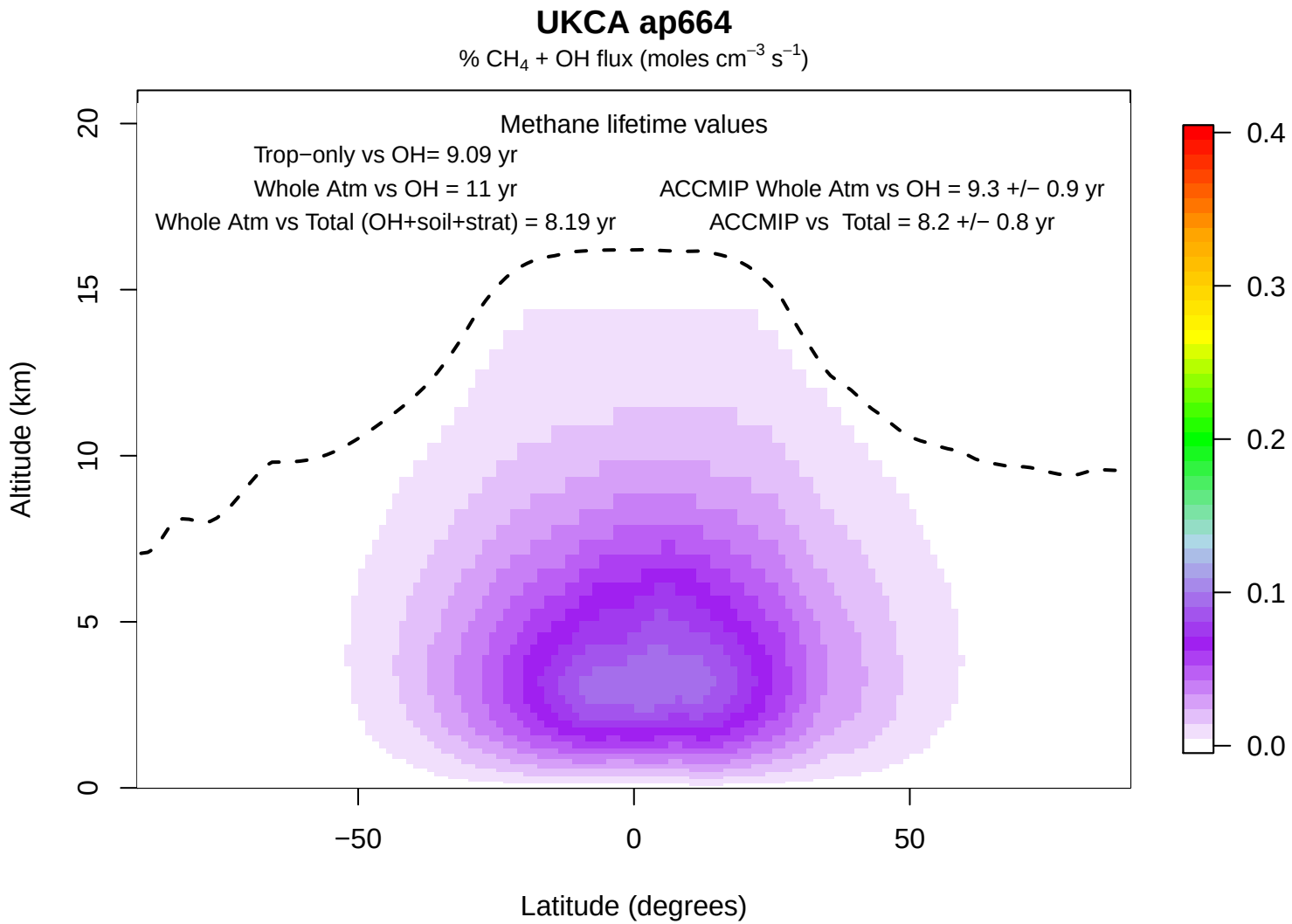

90S – 60S
60S – 30S
30S – 30N
30N – 60N
60N – 90N
Altitude /km
HONO2 (ppb)
aq399
ACE
UARS

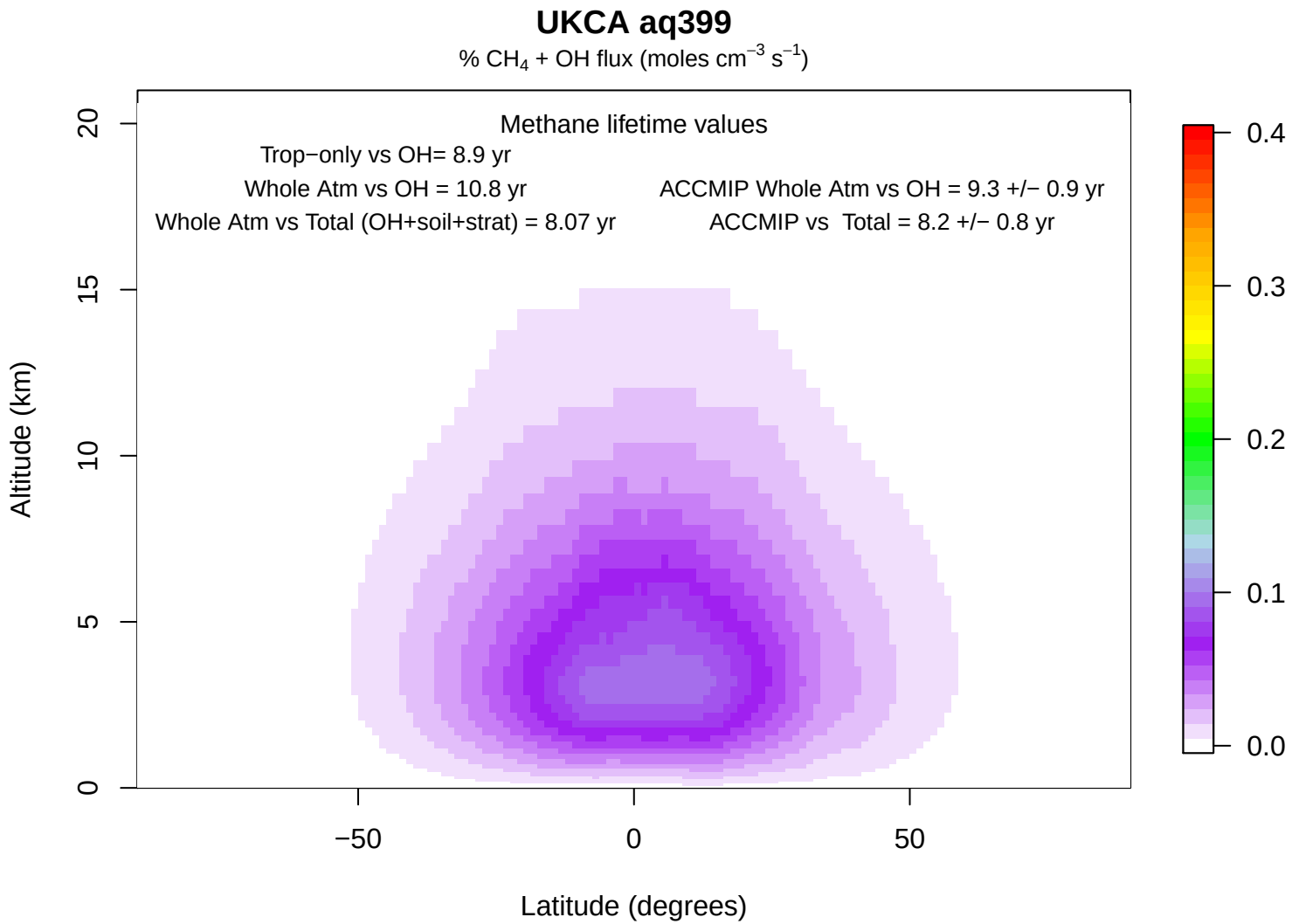

90S – 60S
60S – 30S
30S – 30N
30N – 60N
60N – 90N
Altitude /km
NO2 (ppb)
H2O (ppm)
ap664
ACE
UARS

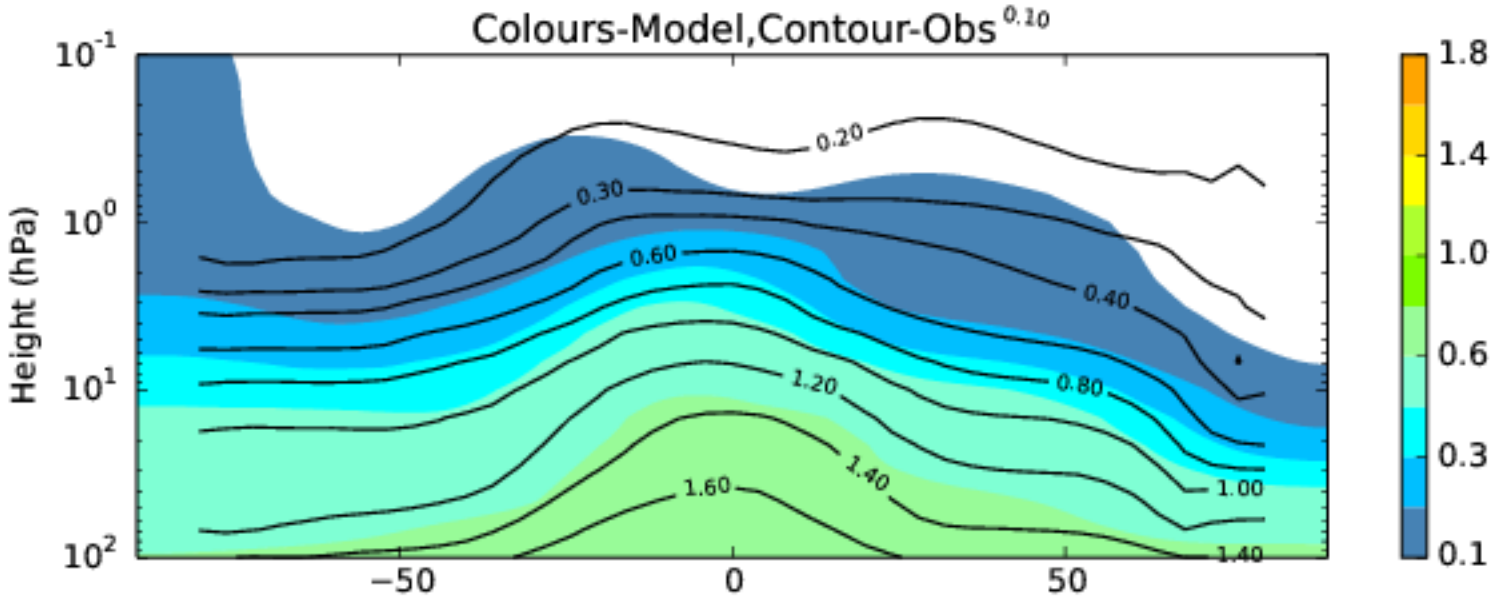

90S – 60S
60S – 30S
30S – 30N
30N – 60N
60N – 90N
Altitude /km
NO2 (ppb)
aq399
ACE
UARS
H2O (ppm)

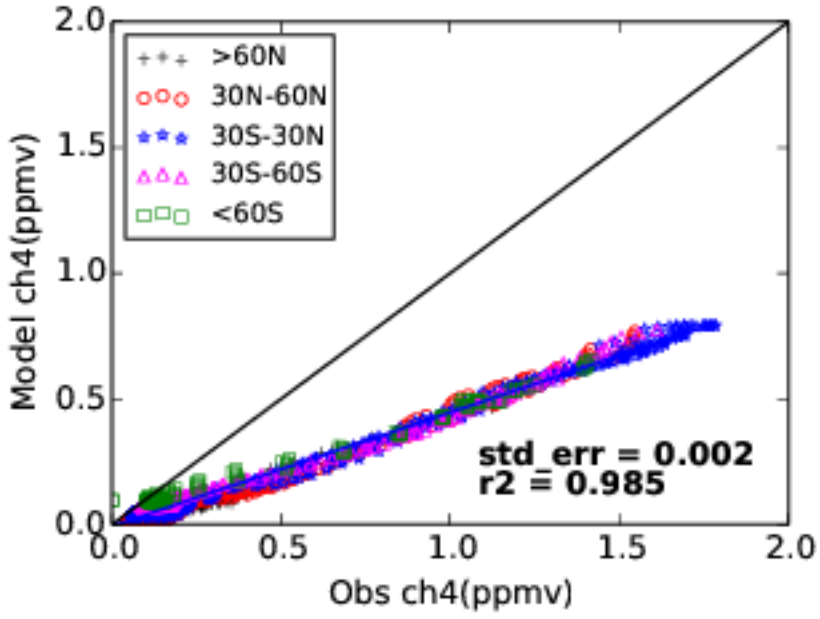

90S − 60S
60S − 30S
30S − 30N
30N − 60N
60N − 90N
Altitude /km
N2O (ppb)
ap664
ACE
UARS
0
10
20
30
40
50
60
0
100
200
300
400


90S − 60S
60S − 30S
30S − 30N
30N − 60N
60N − 90N
Altitude /km
N2O (ppb)
aq399
ACE
UARS
0
10
20
30
40
50
60
0
100
200
300
400

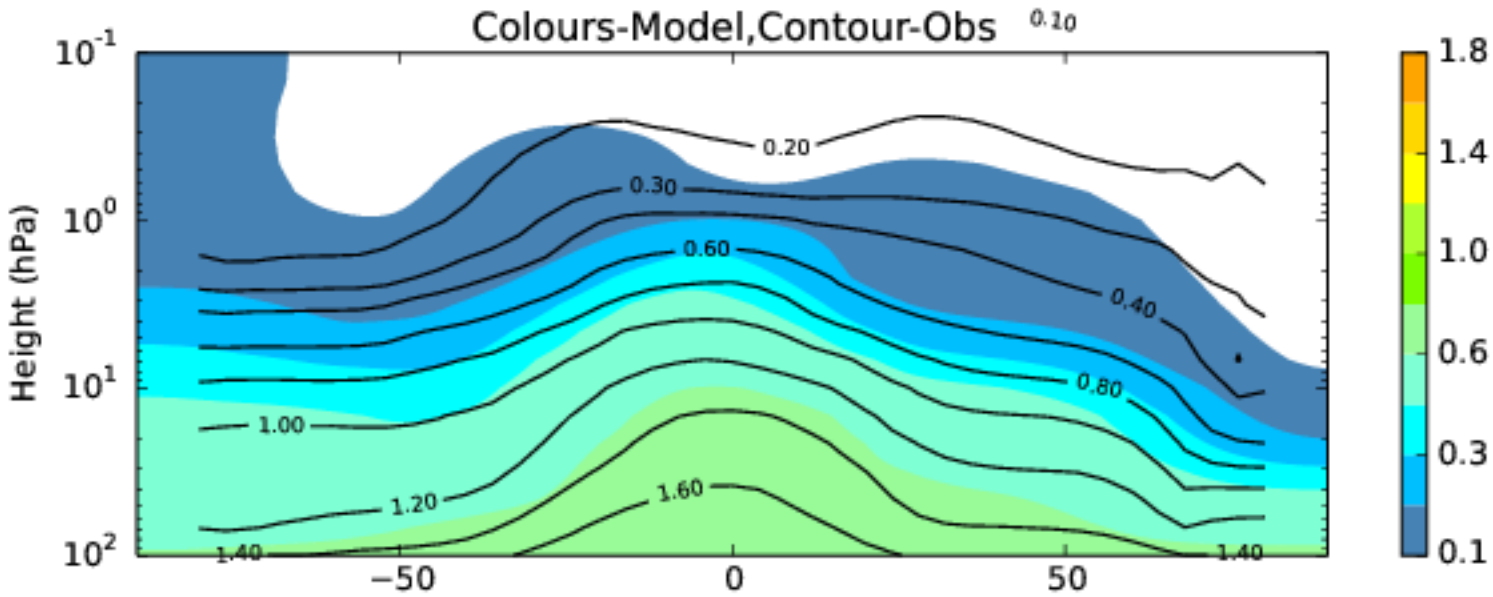

UKCA ap664
% CH4 + OH flux (moles cm−3 s−1)
Methane lifetime values
Trop−only vs OH= 9.09 yr
Whole Atm vs OH = 11 yr
Whole Atm vs Total (OH+soil+strat) = 8.19 yr
ACCMIP Whole Atm vs OH = 9.3 +/− 0.9 yr
ACCMIP vs Total = 8.2 +/− 0.8 yr
Altitude (km)
0
5
10
15
20
−50
0
50
Latitude (degrees)
0.0
0.1
0.2
0.3
0.4

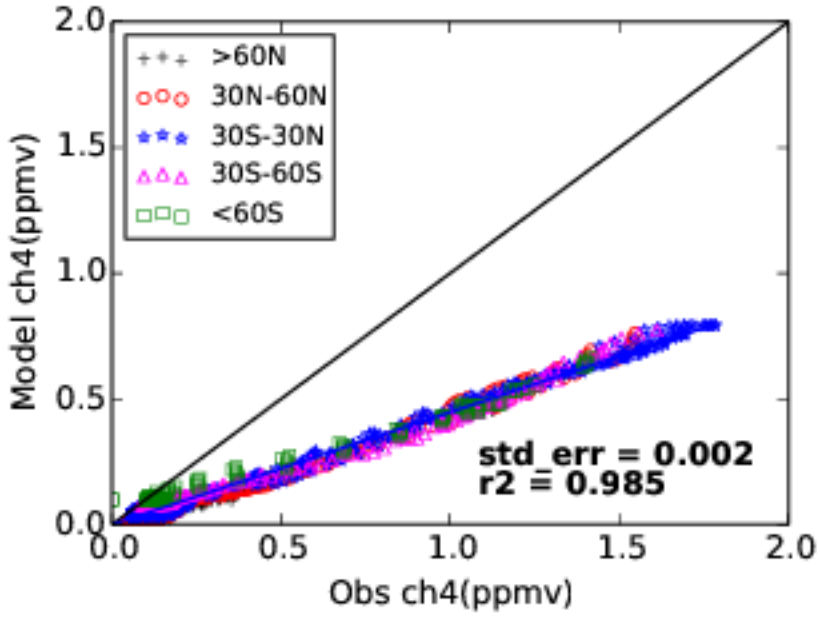

UKCA aq399
% CH4 + OH flux (moles cm−3 s−1)
Methane lifetime values
Trop−only vs OH= 8.9 yr
Whole Atm vs OH = 10.8 yr
Whole Atm vs Total (OH+soil+strat) = 8.07 yr
ACCMIP Whole Atm vs OH = 9.3 +/− 0.9 yr
ACCMIP vs Total = 8.2 +/− 0.8 yr
Altitude (km)
0
5
10
15
20
−50
0
50
Latitude (degrees)
0.0
0.1
0.2
0.3
0.4



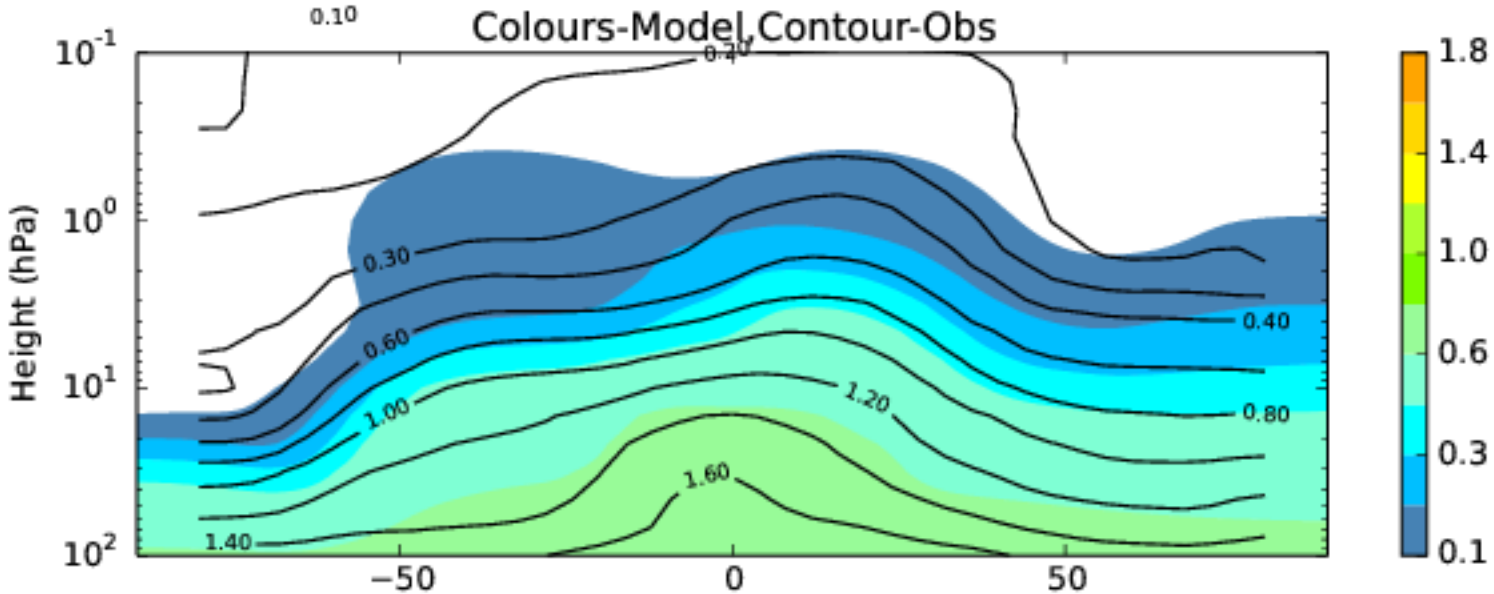


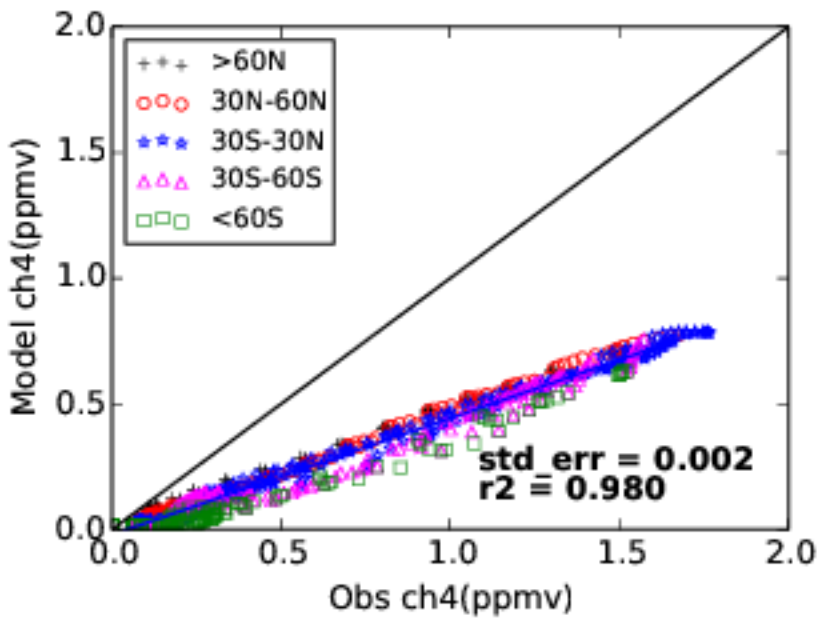
UKCA ap664 vs HALOE:
CH4 (ppmv) Jan



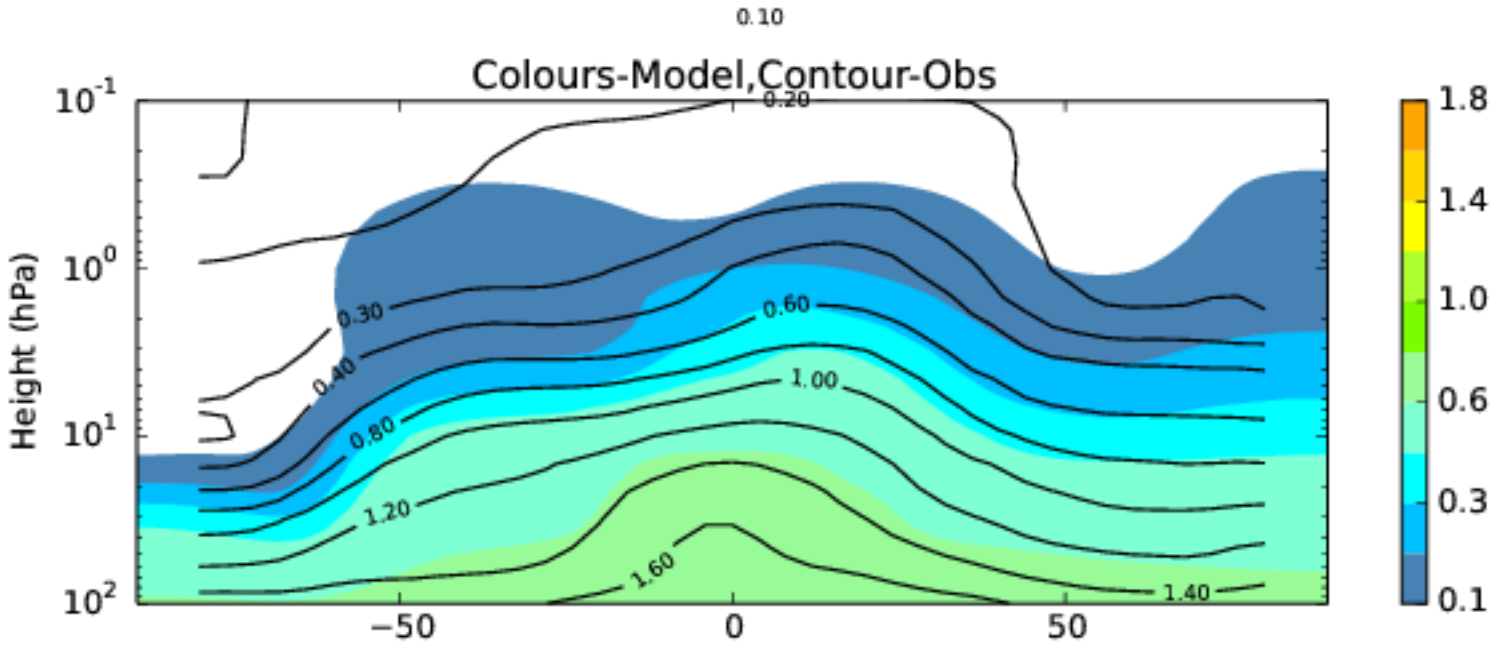


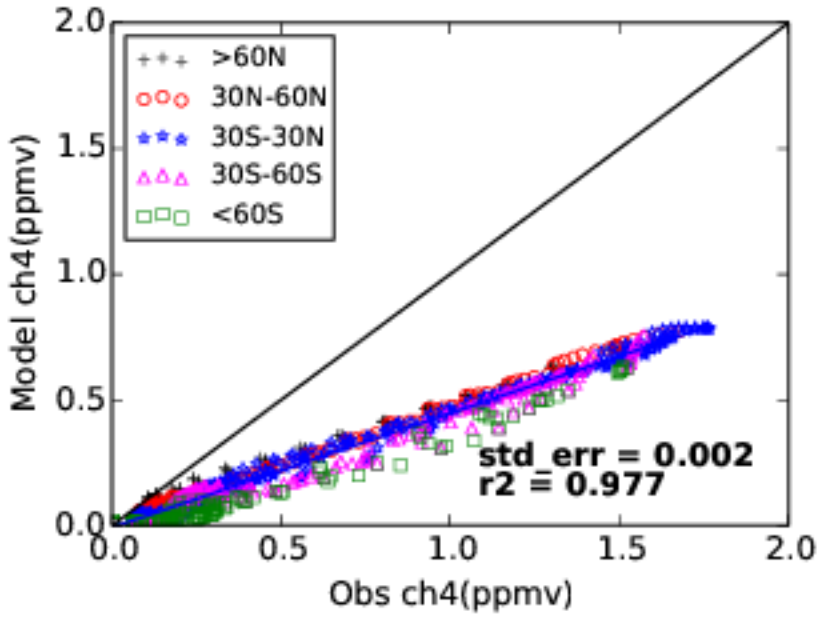
UKCA aq399 vs HALOE:
CH4 (ppmv) Jan



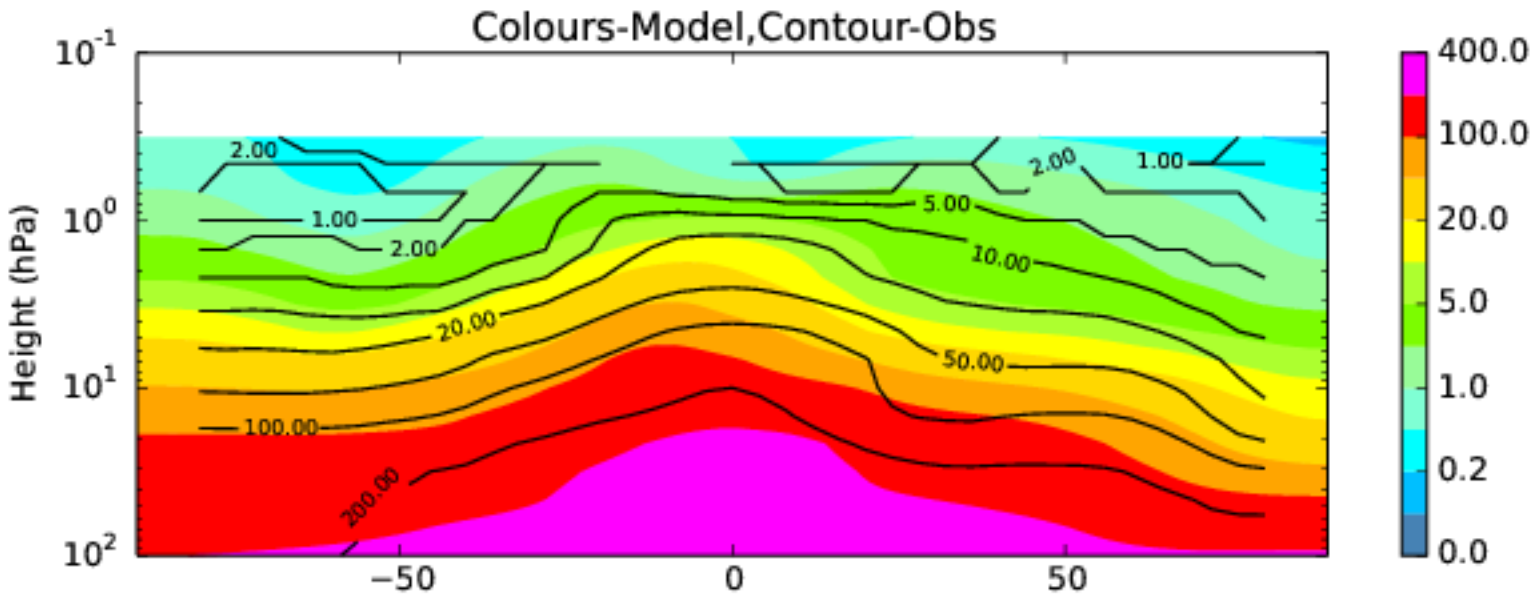


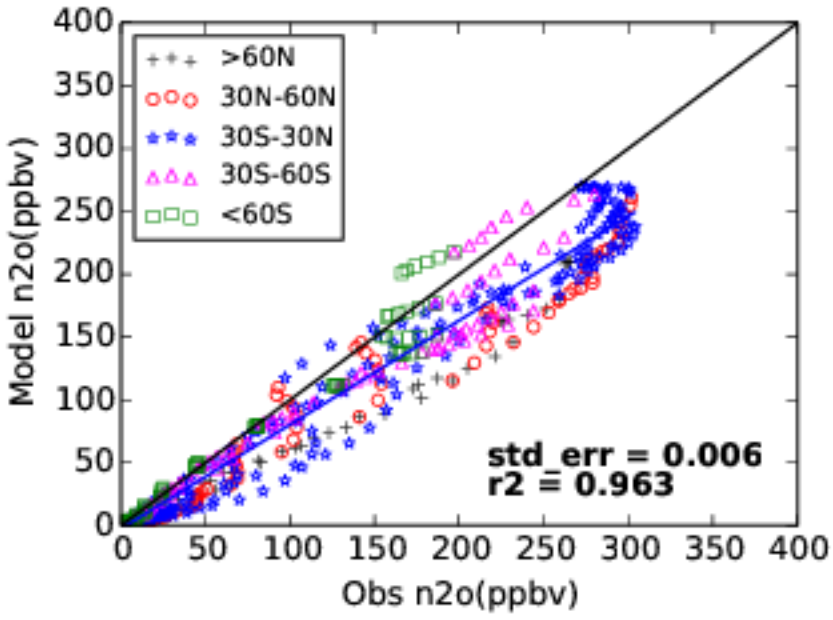
UKCA ap664 vs HALOE:
CH4 (ppmv) Jul



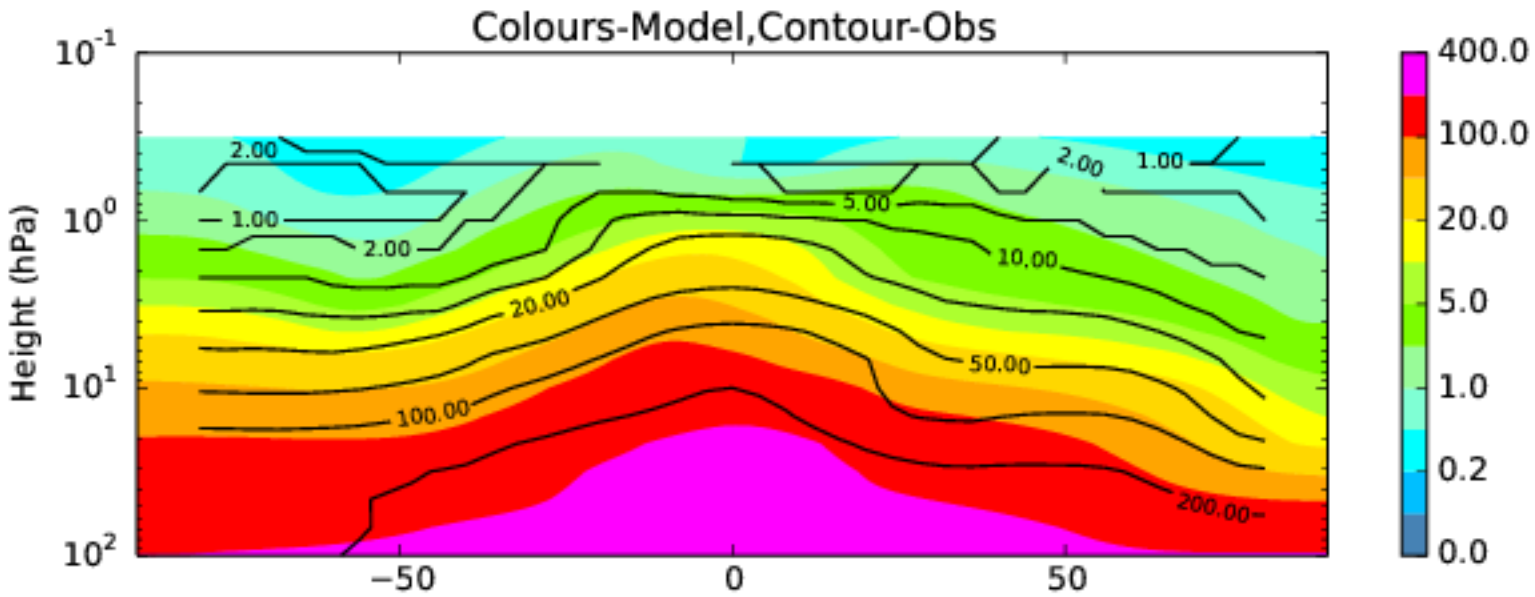


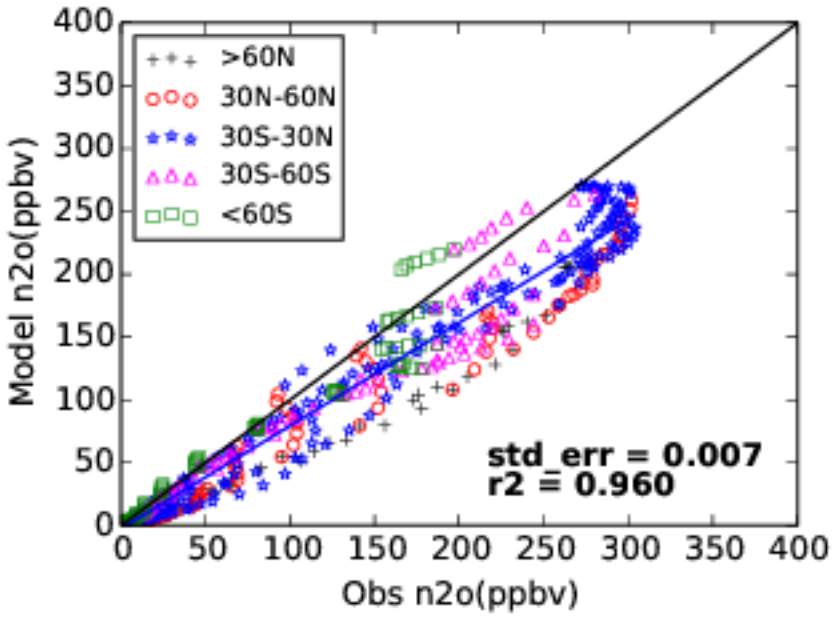
UKCA aq399 vs HALOE:
CH4 (ppmv) Jul



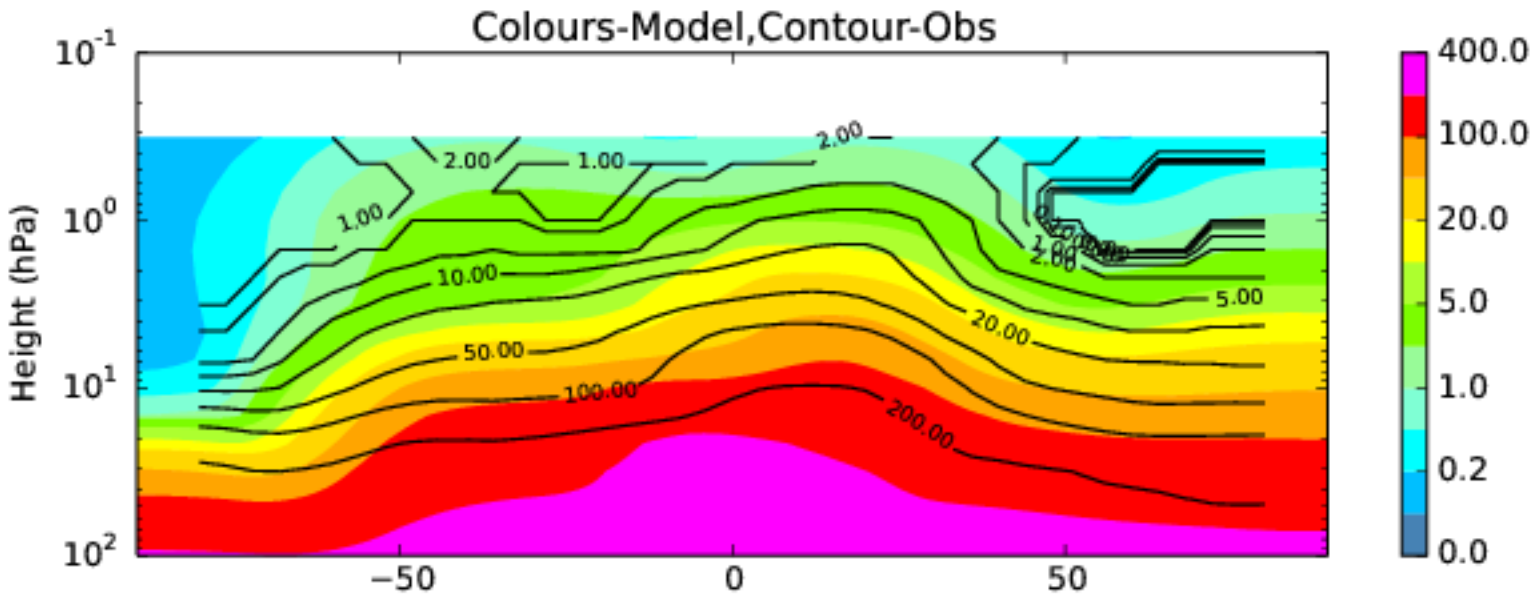


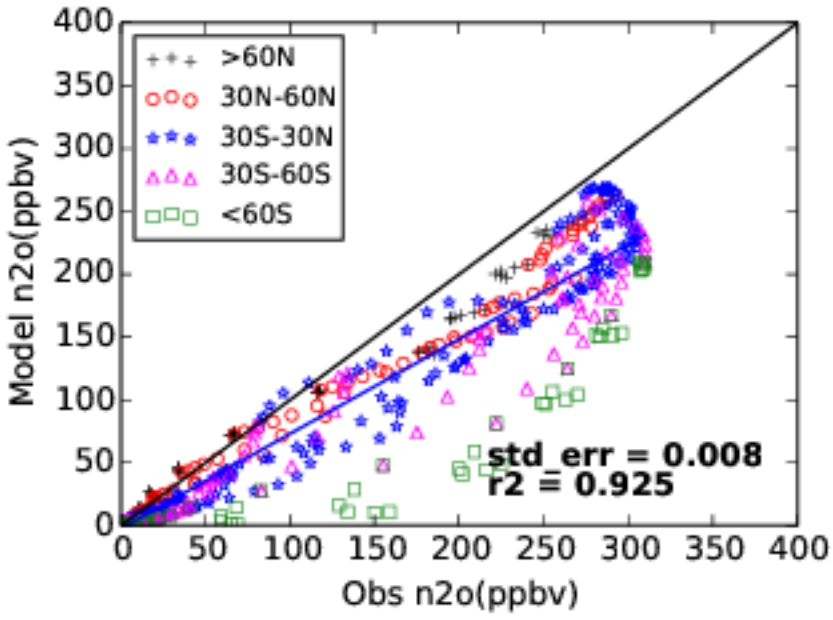
UKCA ap664 vs HALOE:
N2O (ppmv) Jan



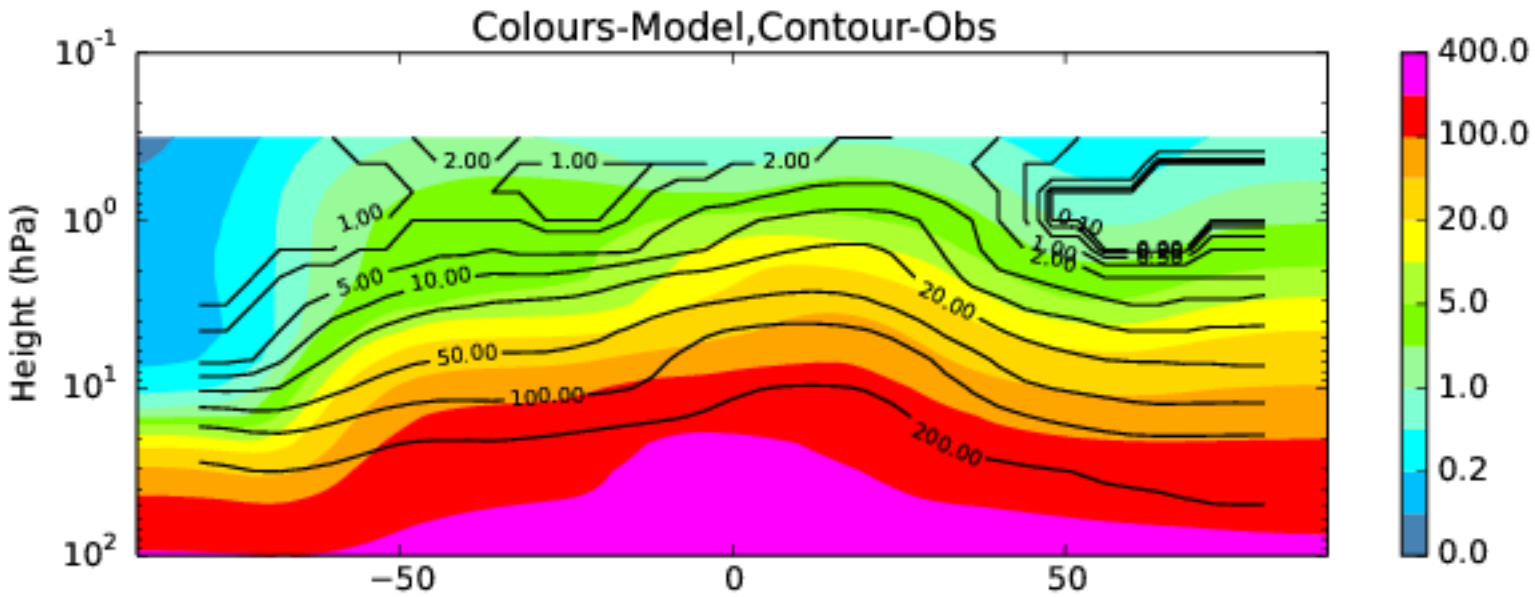


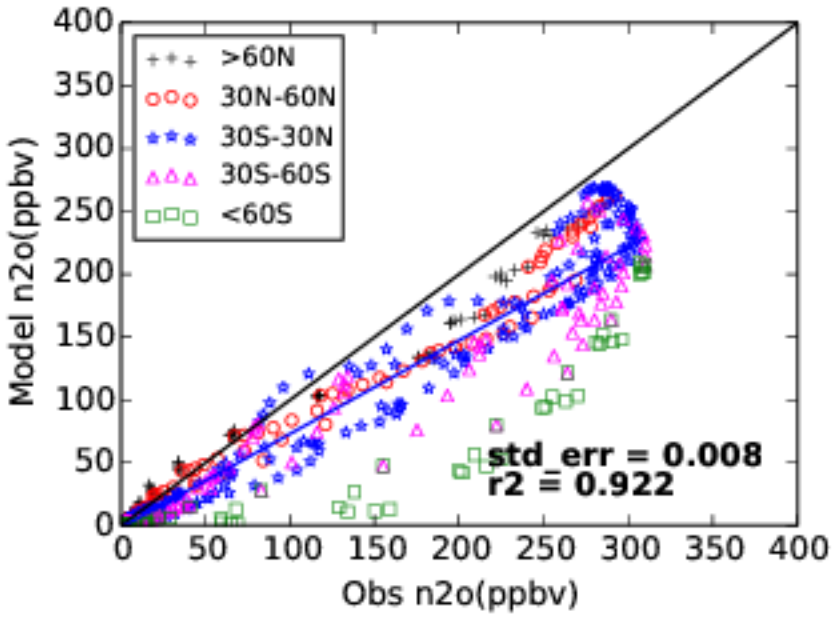
UKCA aq399 vs HALOE:
N2O (ppmv) Jan



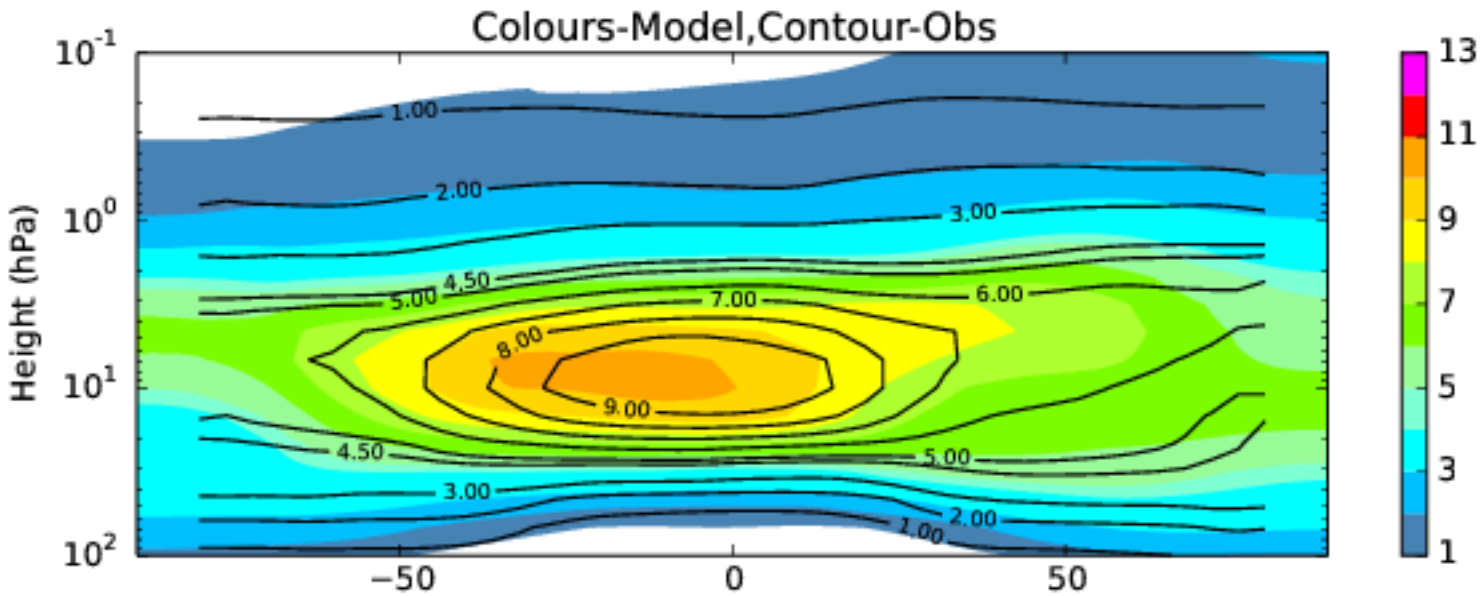


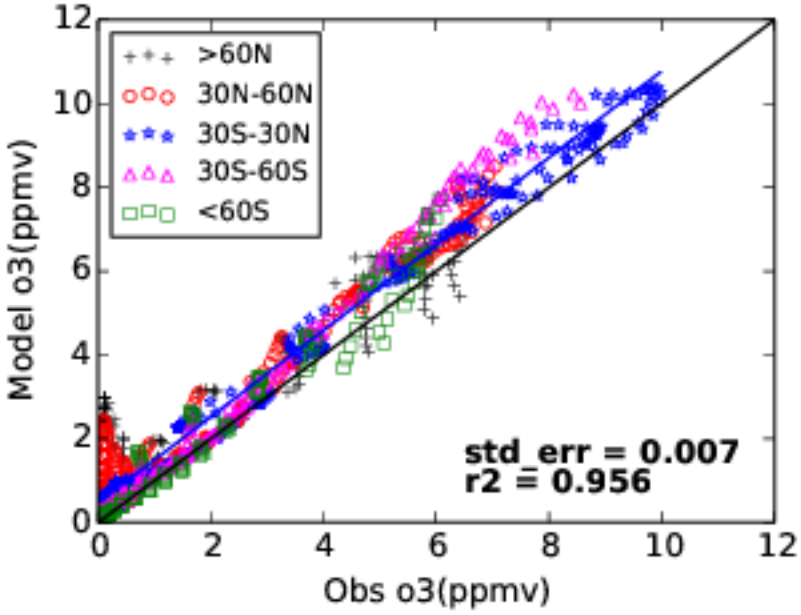
UKCA ap664 vs HALOE:
N2O (ppmv) Jul



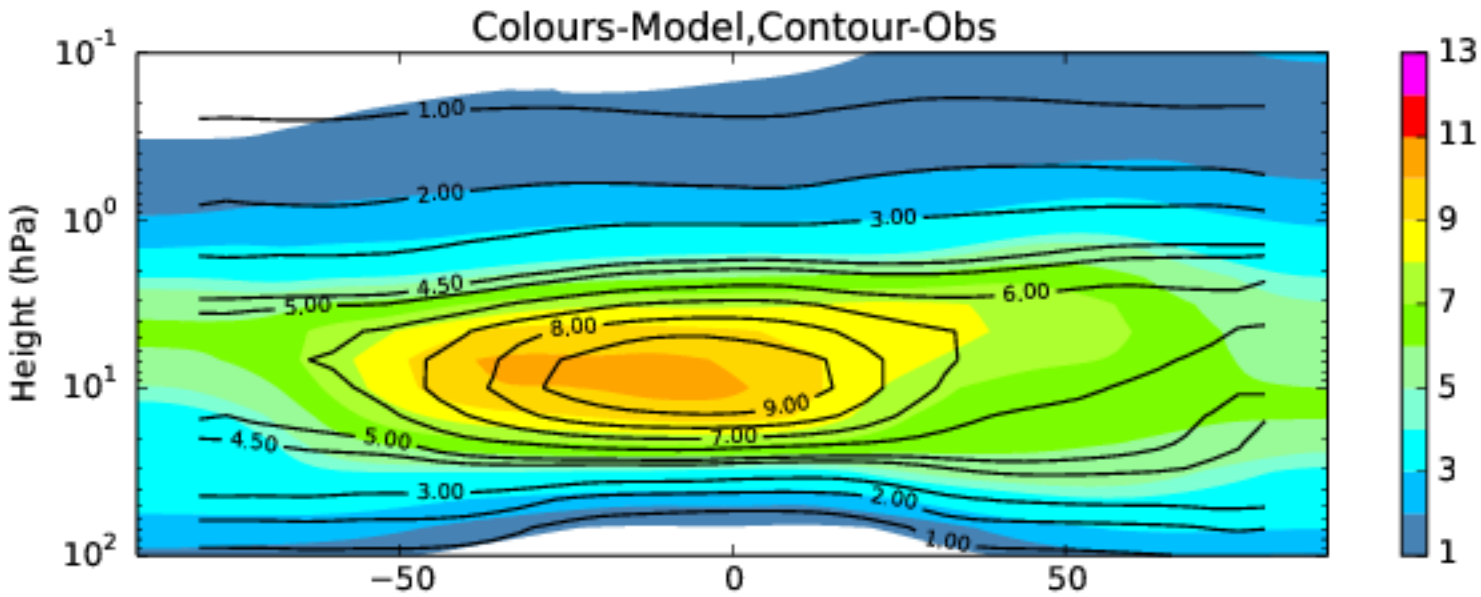


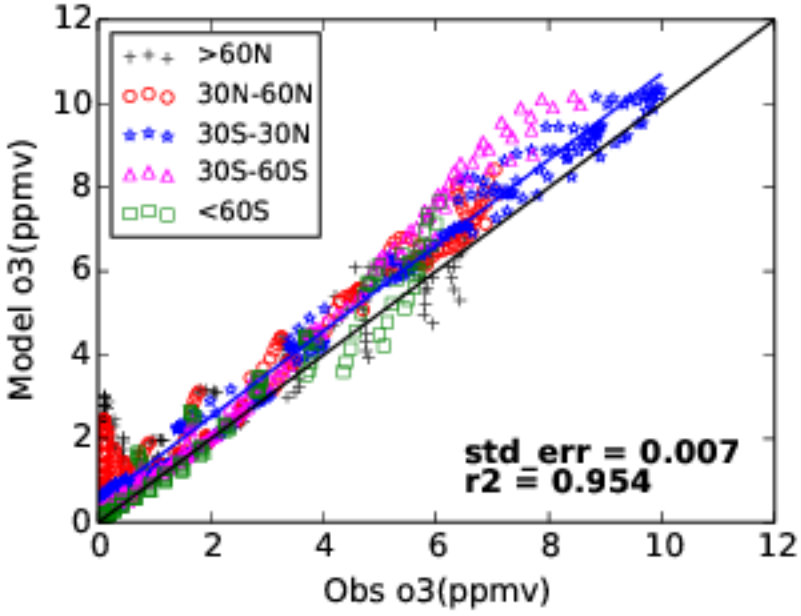
UKCA aq399 vs HALOE:
N2O (ppmv) Jul



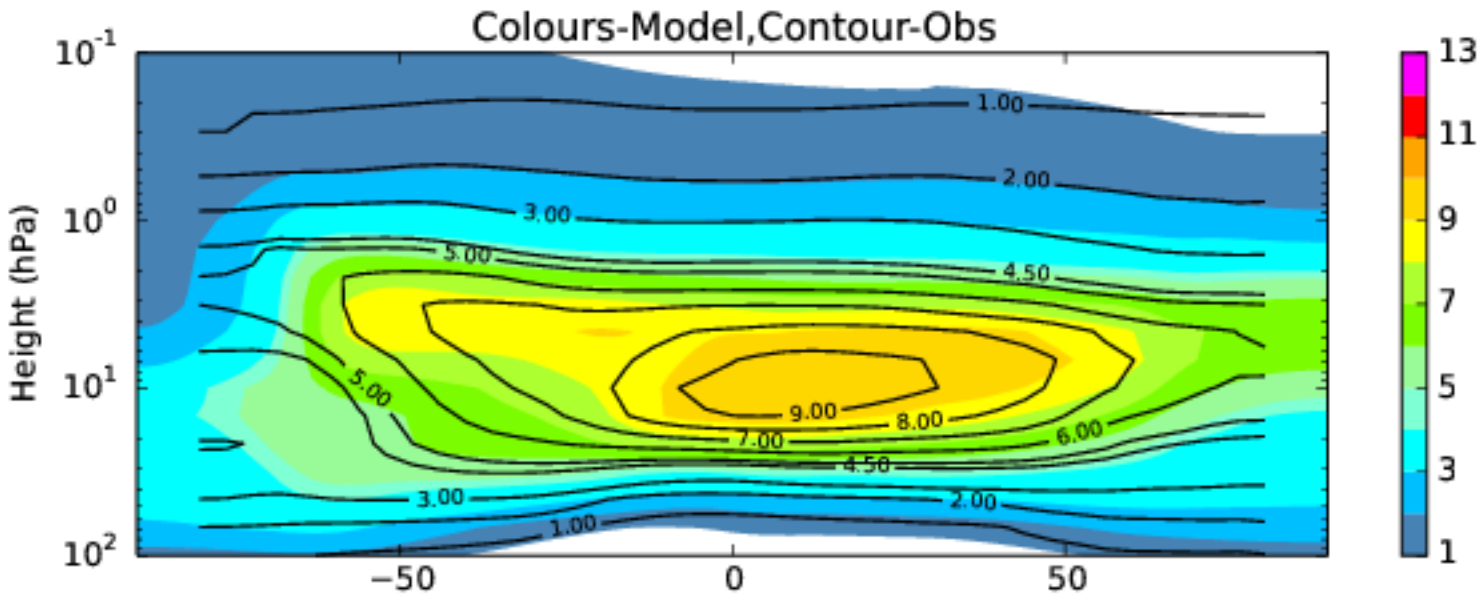


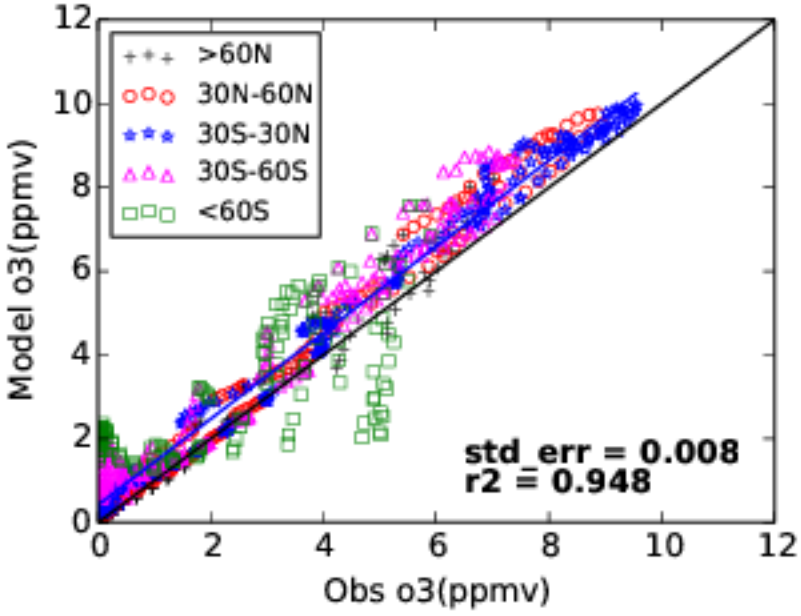
UKCA ap664 vs HALOE:
O3 (ppmv) Jan



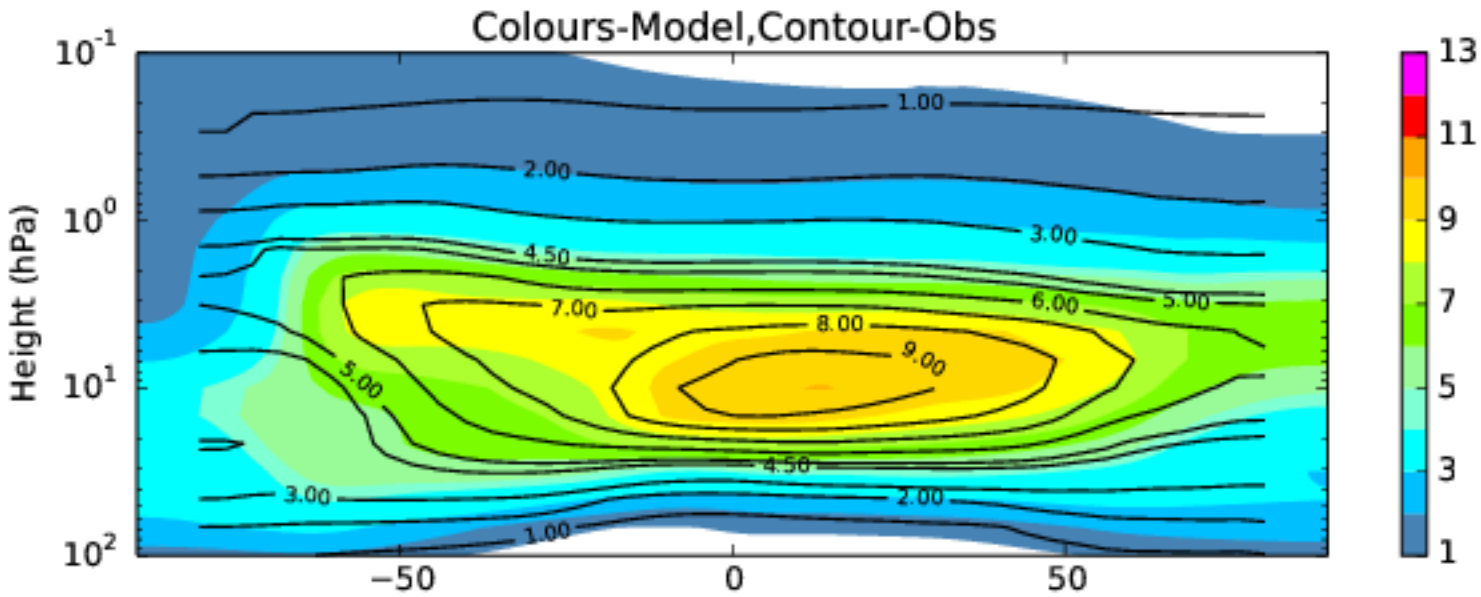


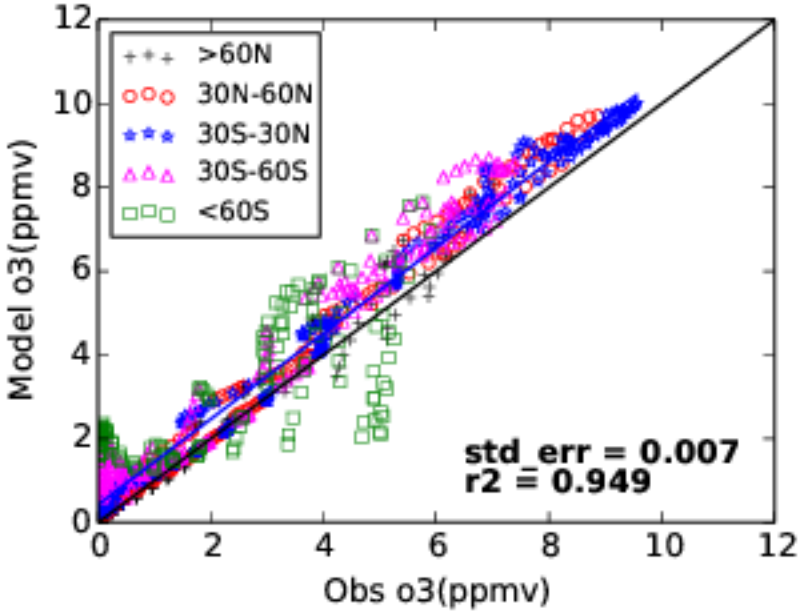
UKCA aq399 vs HALOE:
O3 (ppmv) Jan



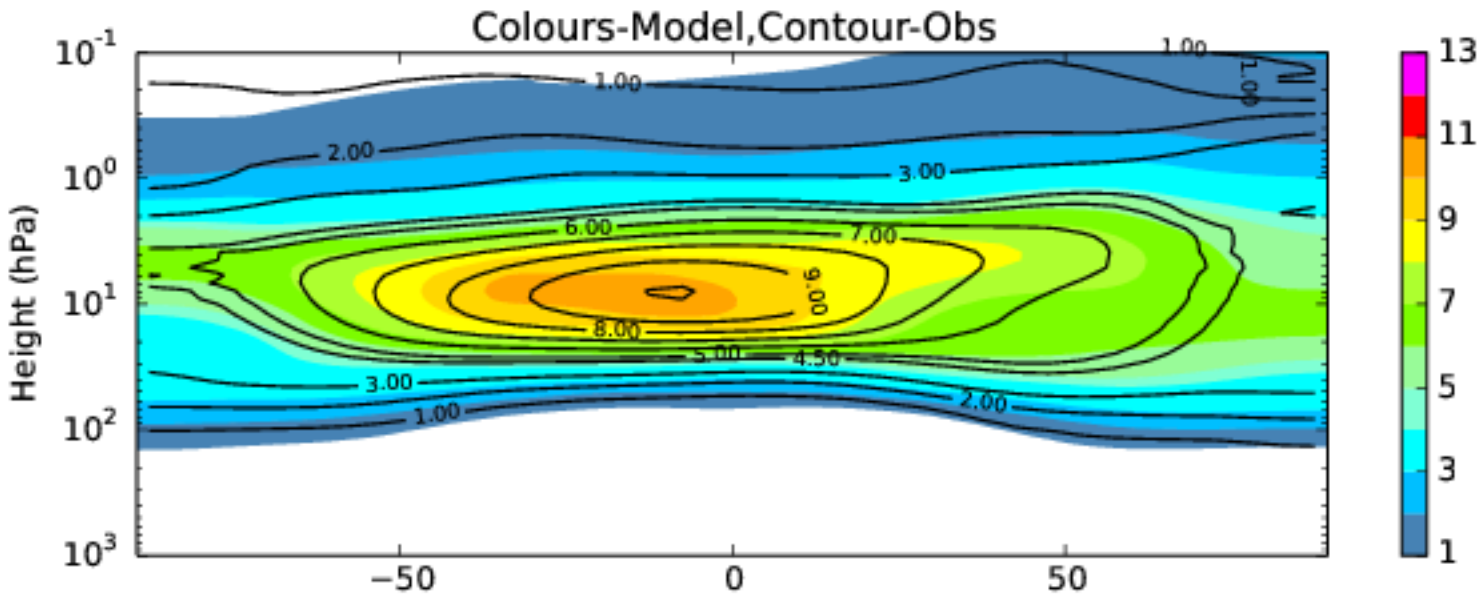


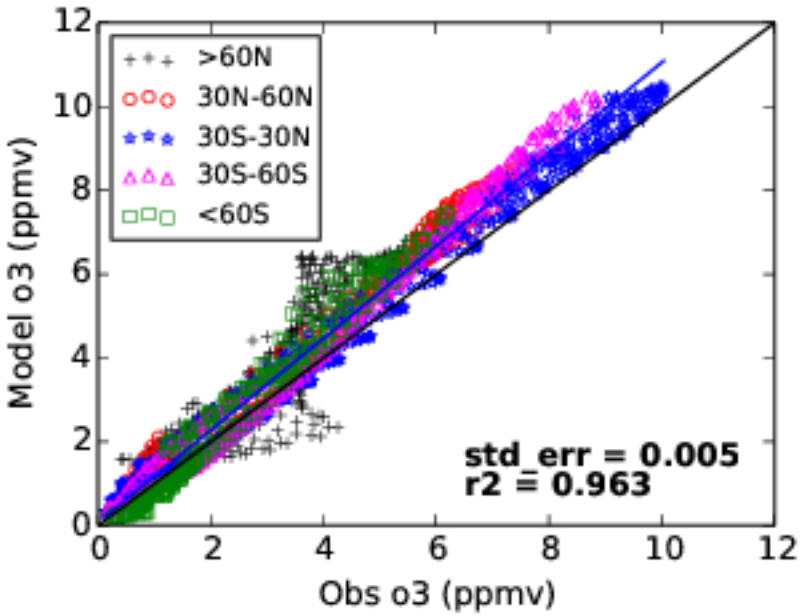
UKCA ap664 vs HALOE:
O3 (ppmv) Jul



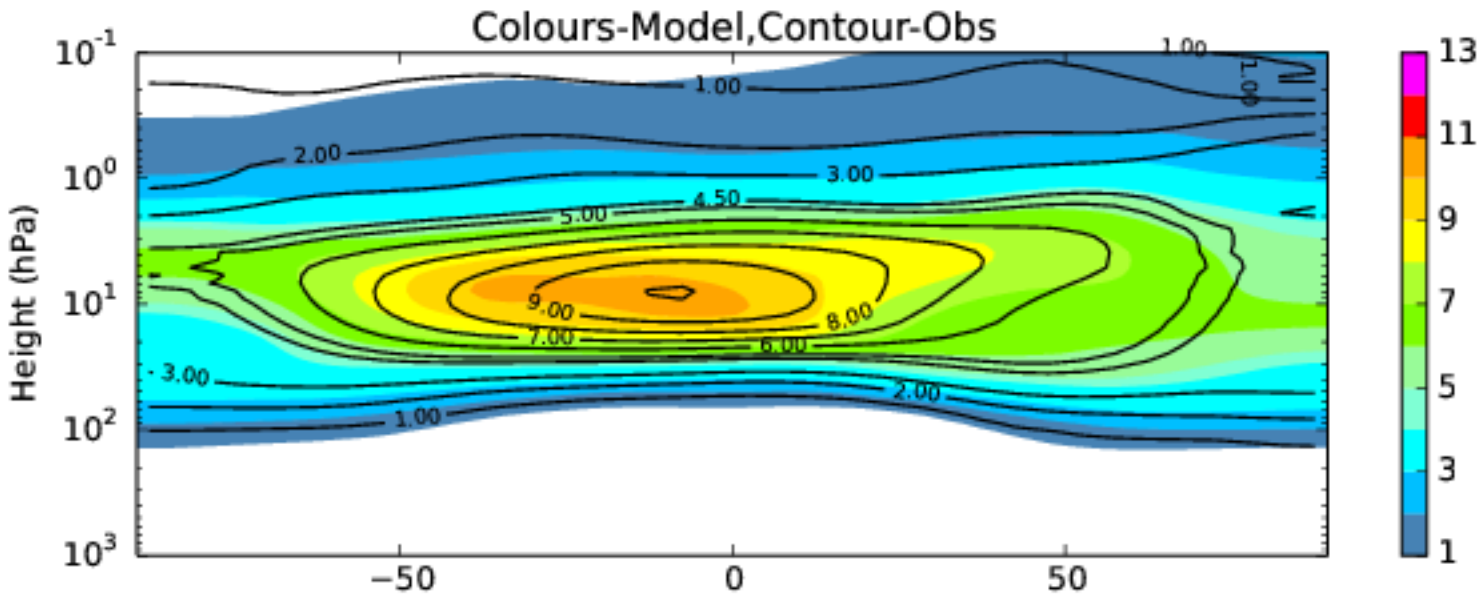


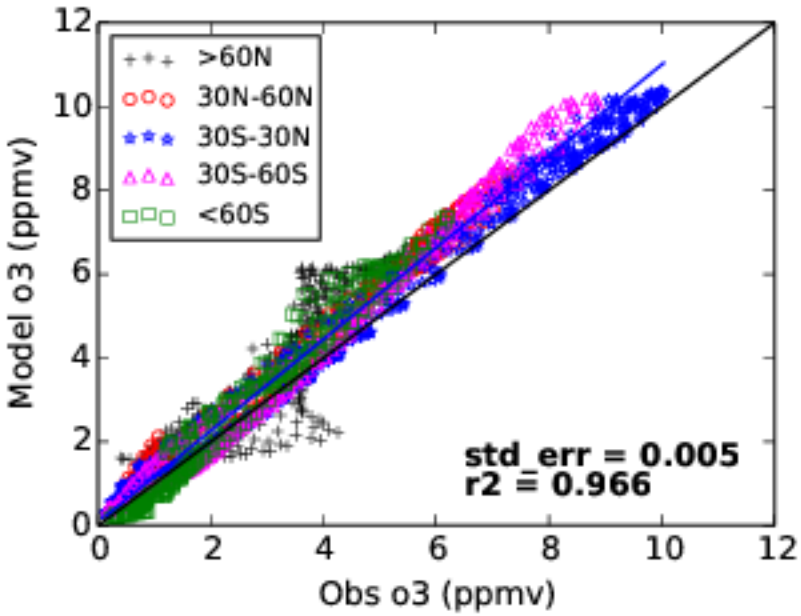
UKCA aq399 vs HALOE:
O3 (ppmv) Jul



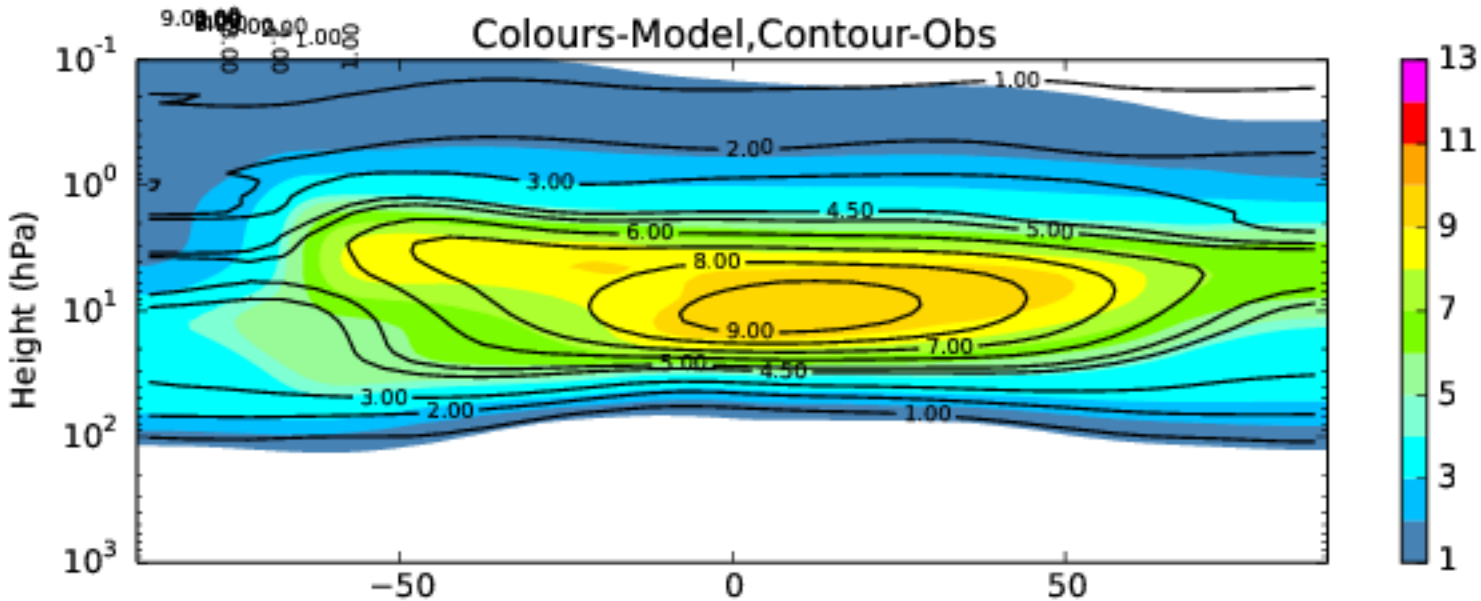


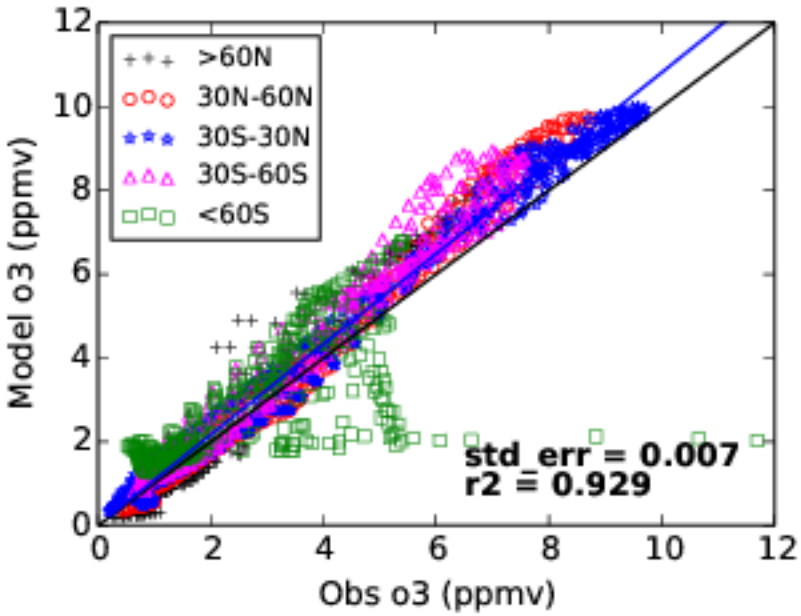
UKCA ap664 vs NIWA-CCMVal:
O3 (ppmv) Jan



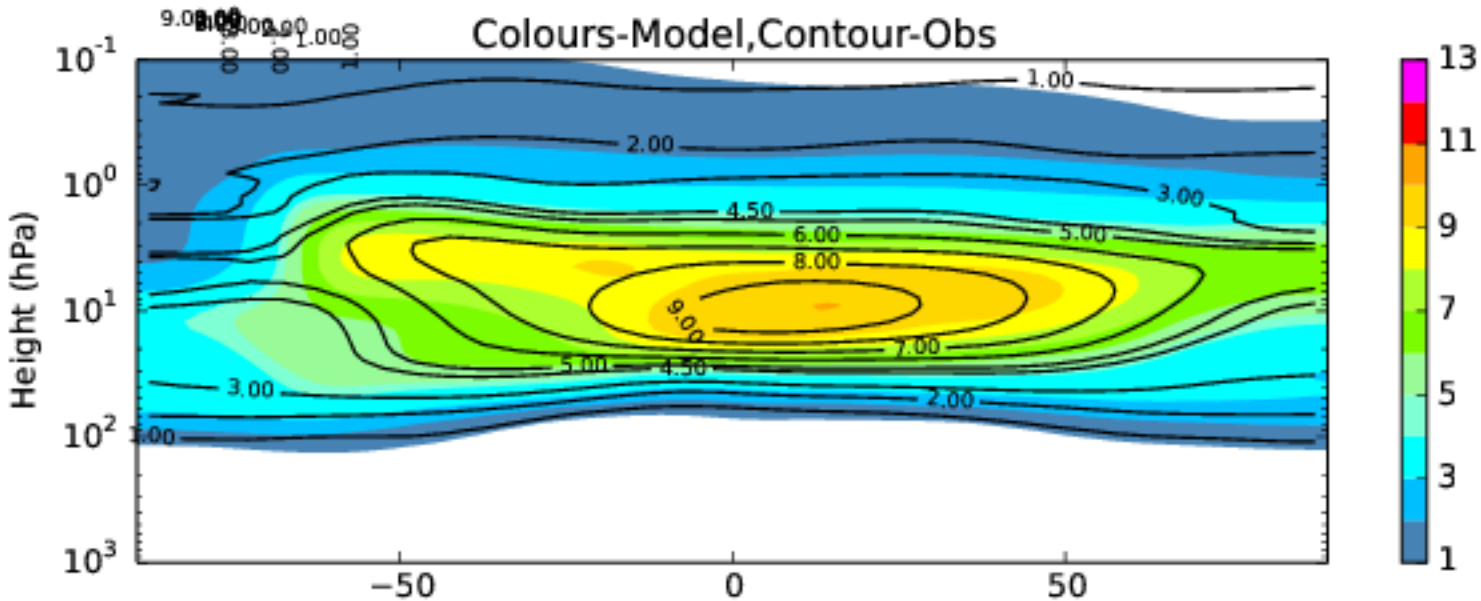


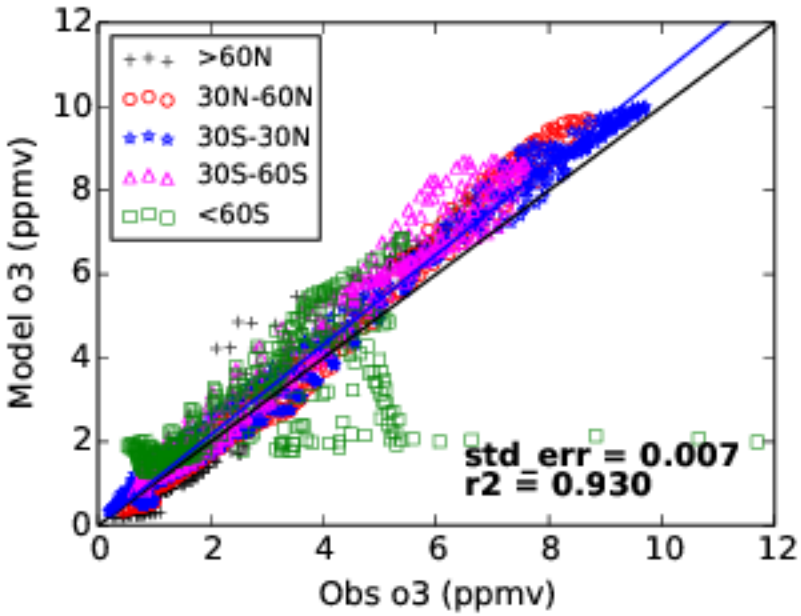
UKCA aq399 vs NIWA-CCMVal:
O3 (ppmv) Jan



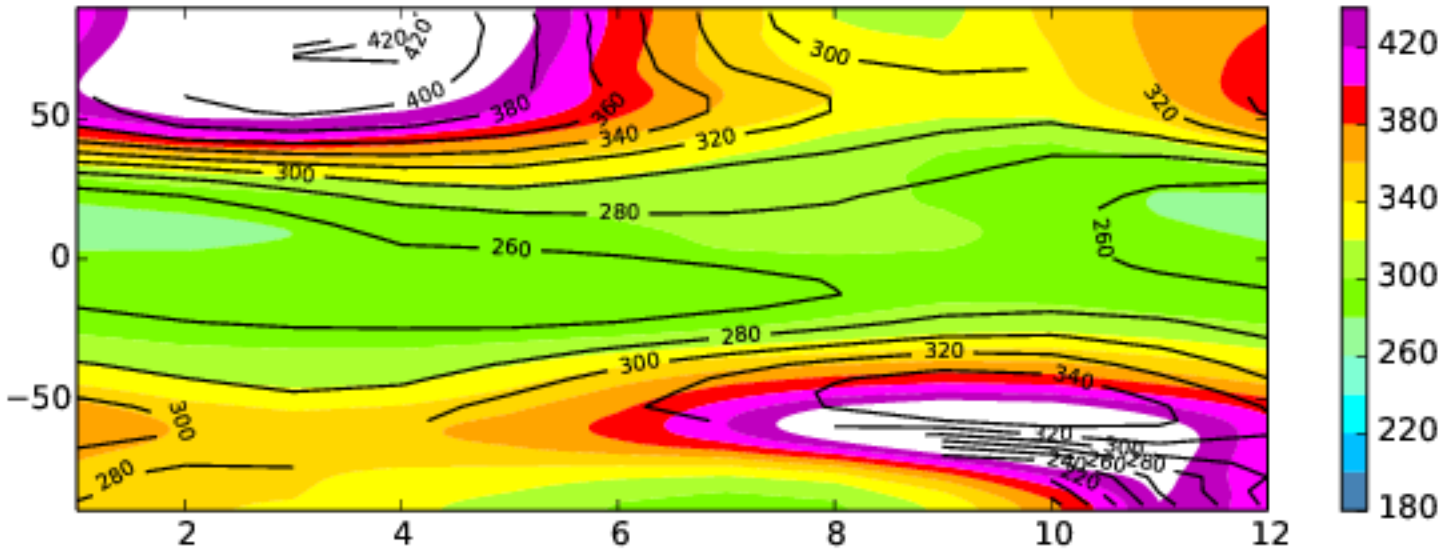


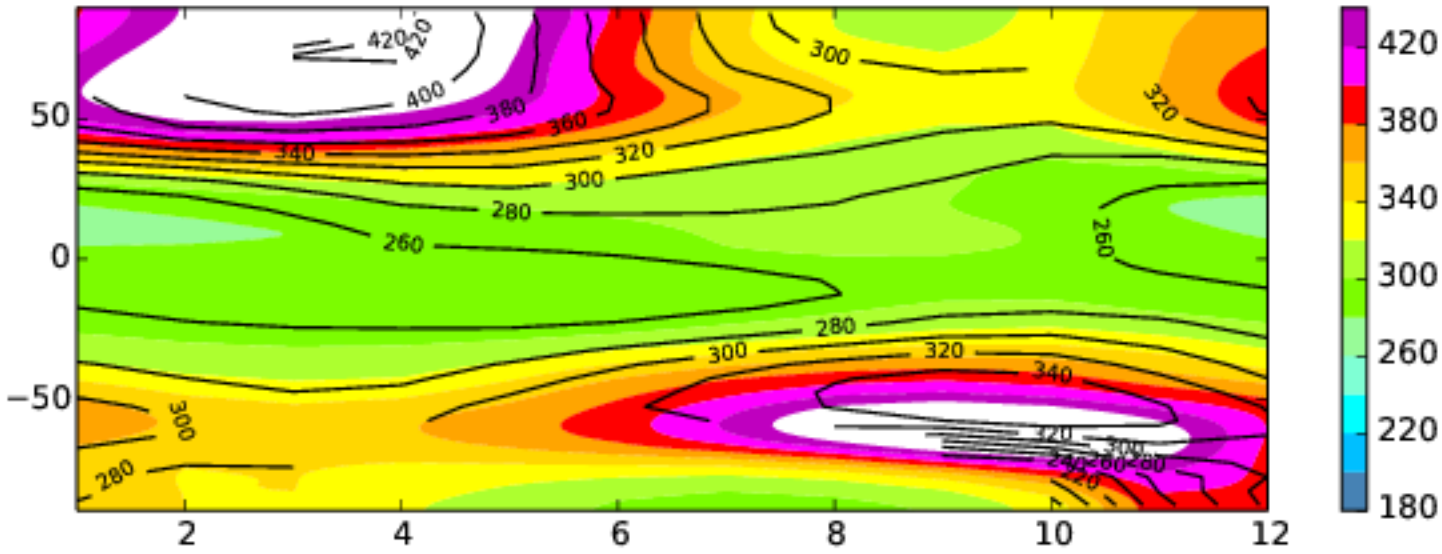
UKCA ap664 vs NIWA-CCMVal:
O3 (ppmv) Jul





UKCA aq399 vs NIWA-CCMVal:
O3 (ppmv) Jul


50
0
−50
2
4
6
8
10
12
420
380
340
300
260
220
180
UKCA ap664 vs TOMS:
Column_Ozone (DU)



UKCA aq399 vs TOMS:
Column_Ozone (DU)