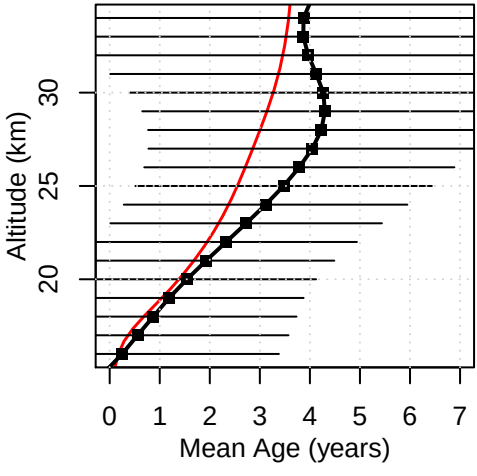
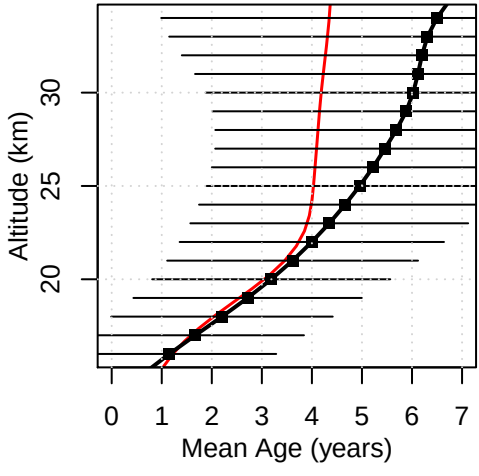
UKCA xkawa Mean Age of Air

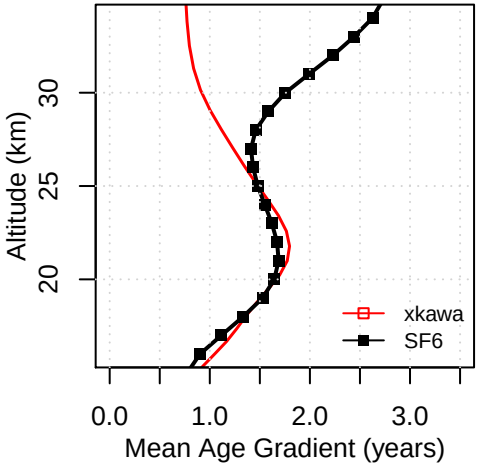
Tropical Mean Age Profile



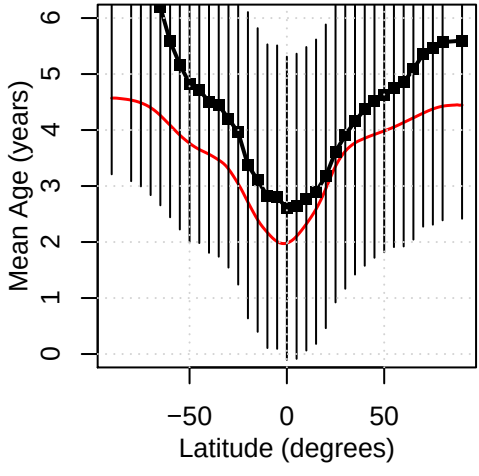
Midlatitude Mean Age Profile

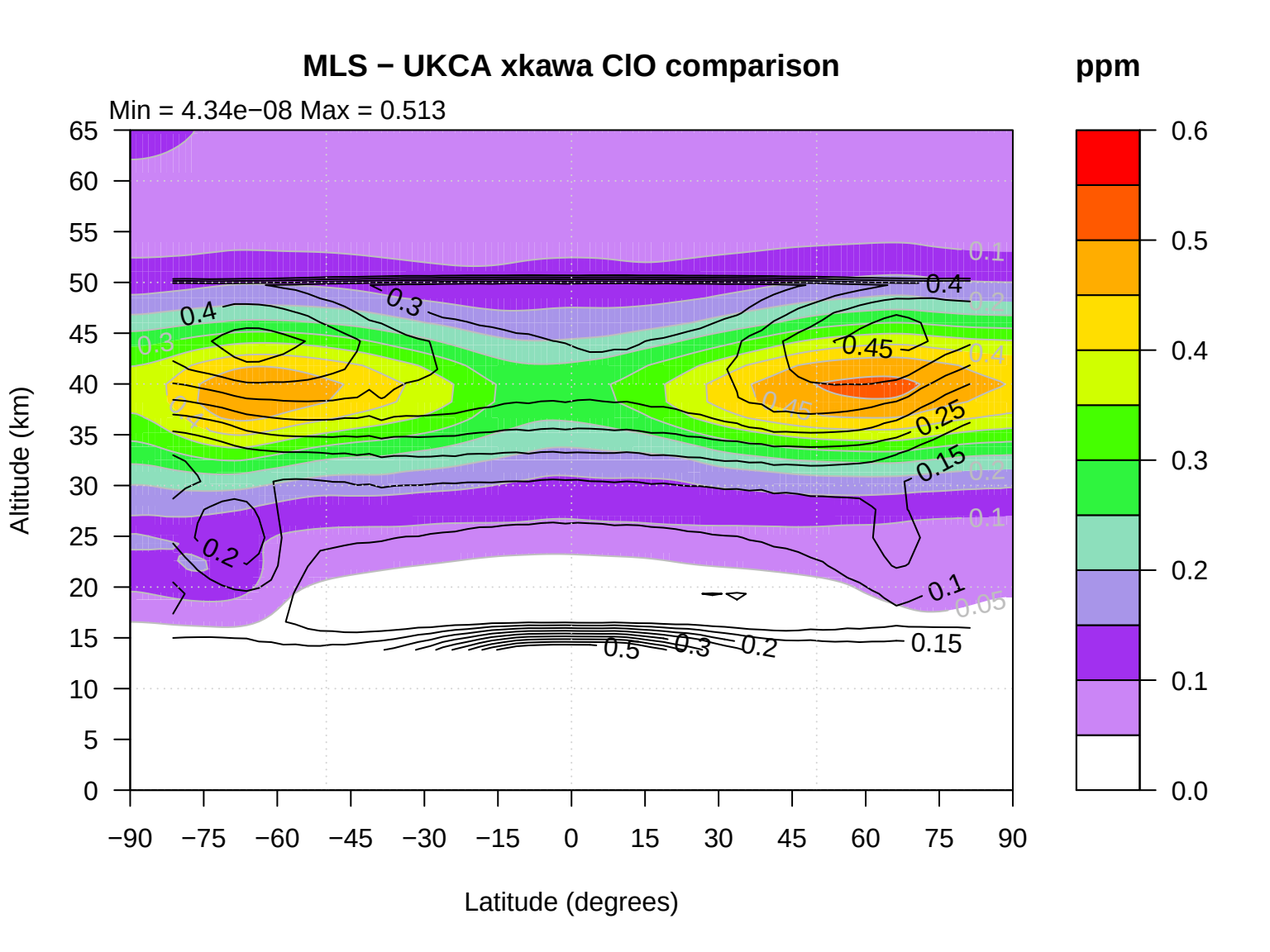


Trop−Midlat Mean Age Gradient Prof

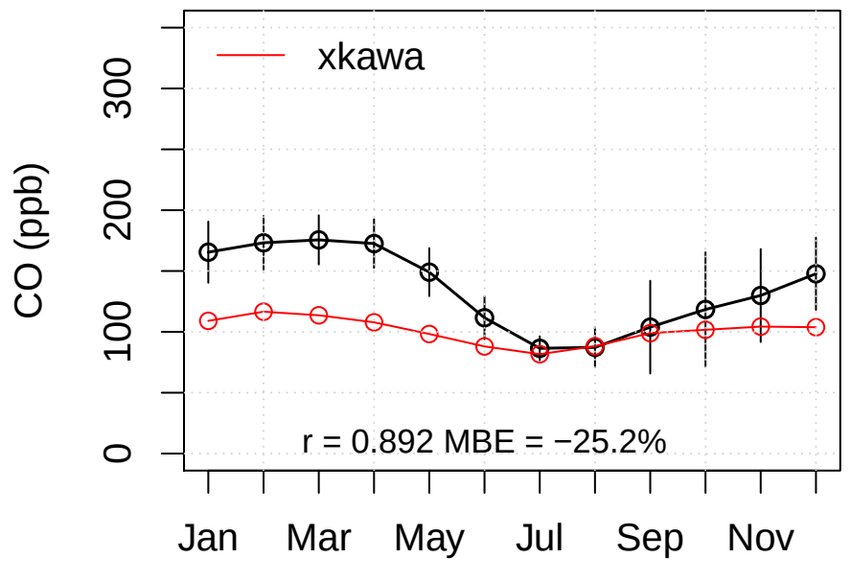


Mean Age, 23km (~50hPa)

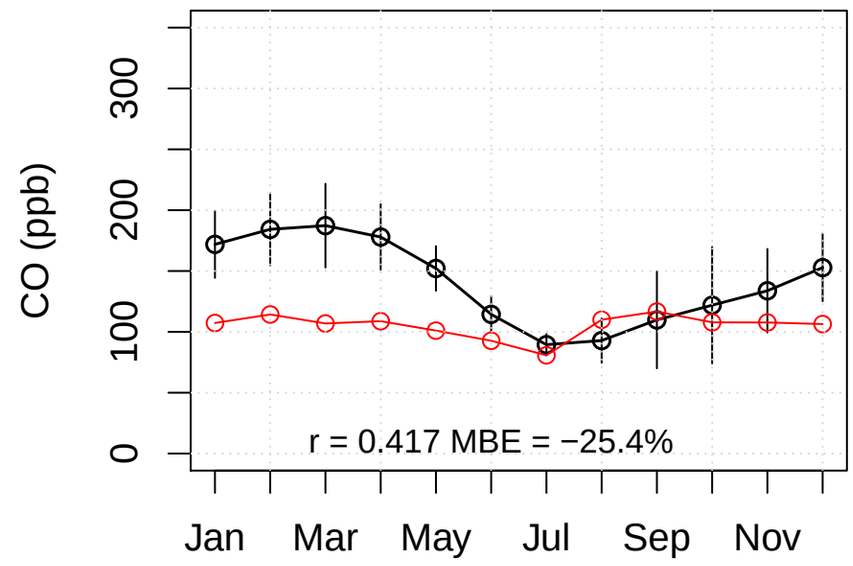



MLS − UKCA xkawa ClO comparison
ppm
Min = 4.34e−08 Max = 0.513
Altitude (km)
Latitude (degrees)
65
60
55
50
45
40
35
30
25
20
15
10
5
0
−90
−75
−60
−45
−30
−15
0
15
30
45
60
75
90
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.4
0.3
0.45
0.25
0.15
0.2
0.1
0.5
0.3
0.2
0.15
0.05

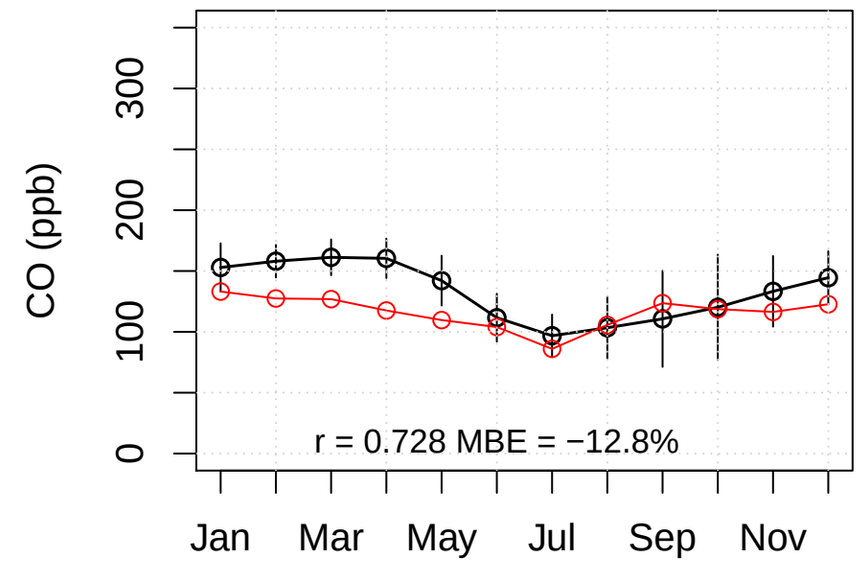
Alert (82.4N, 62.5W, 210m)



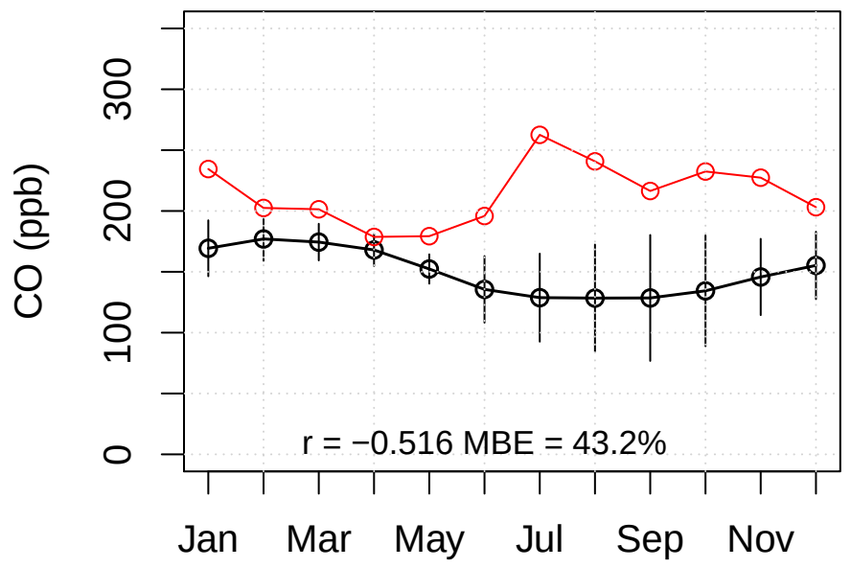
Barrow (71.3N, 156.6W, 11m)



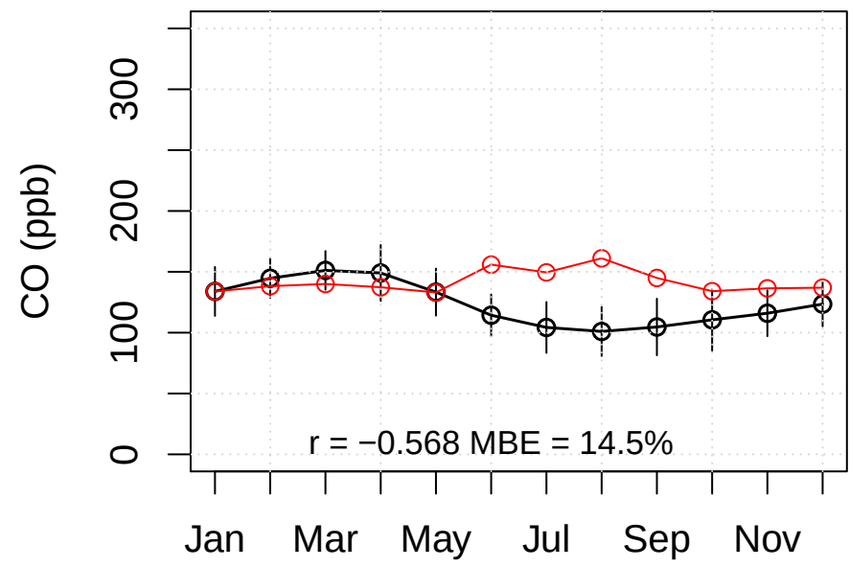
Mace Head (53.3N, 9.9W, 25m)



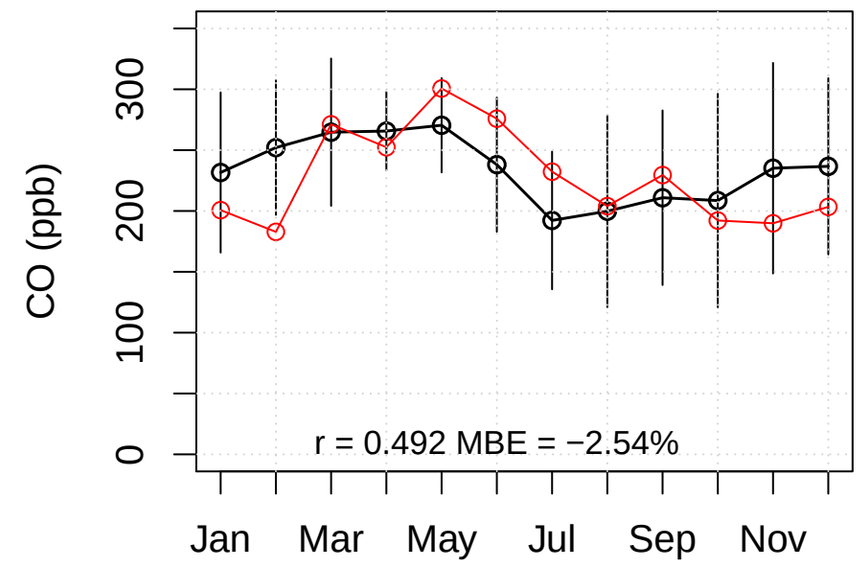
Park Falls (45.9N, 90.2W, 472m)



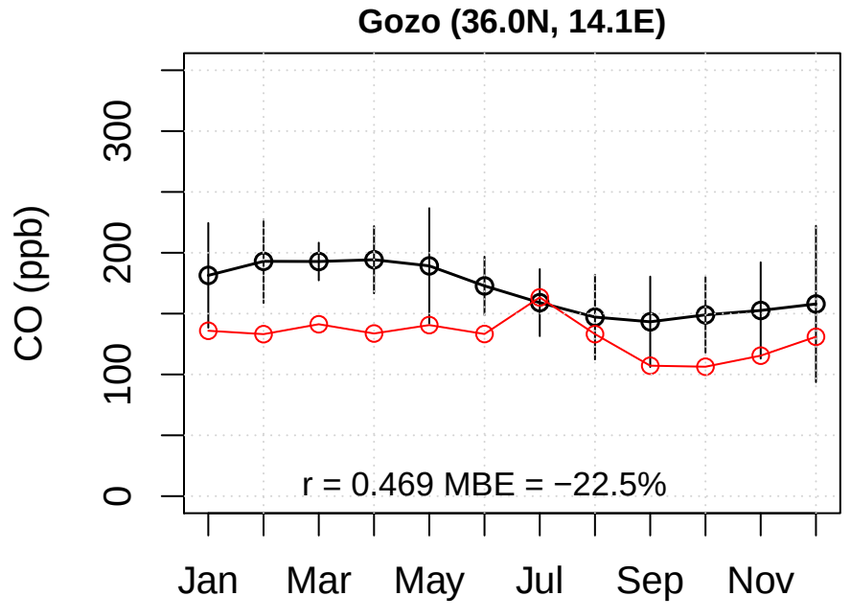
Niwot Ridge (40.0N, 105.6W, 3475m)



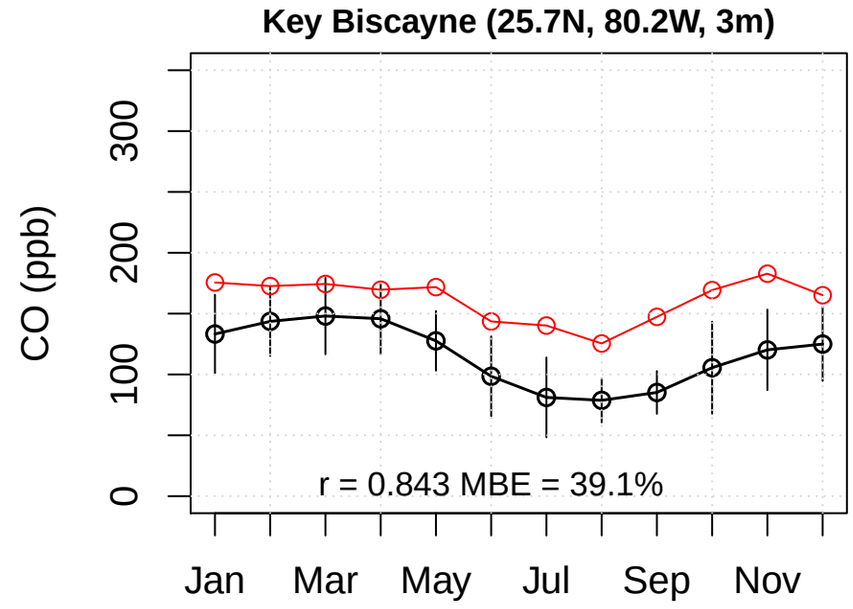
Tae−ahn Peninsula (36.7N, 126.1E, 20m)



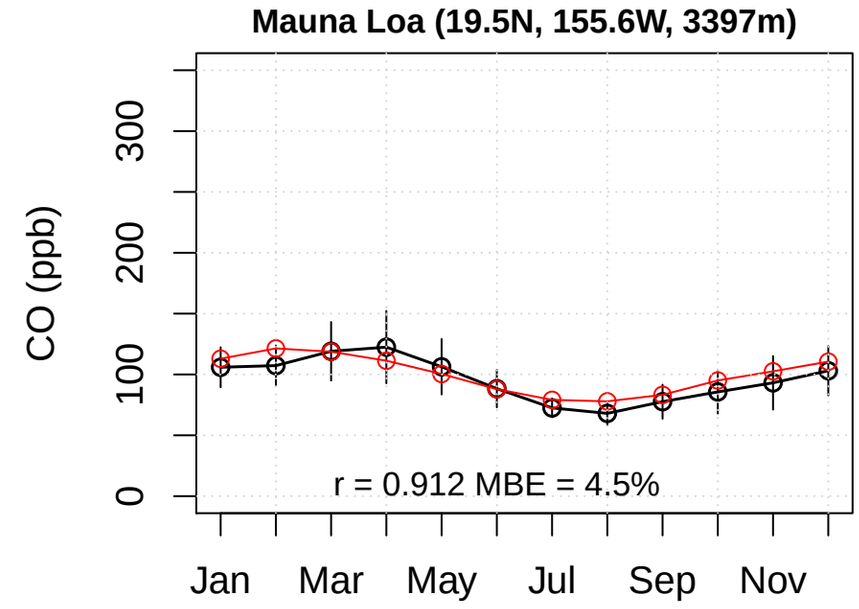
Gozo (36.0N, 14.1E)



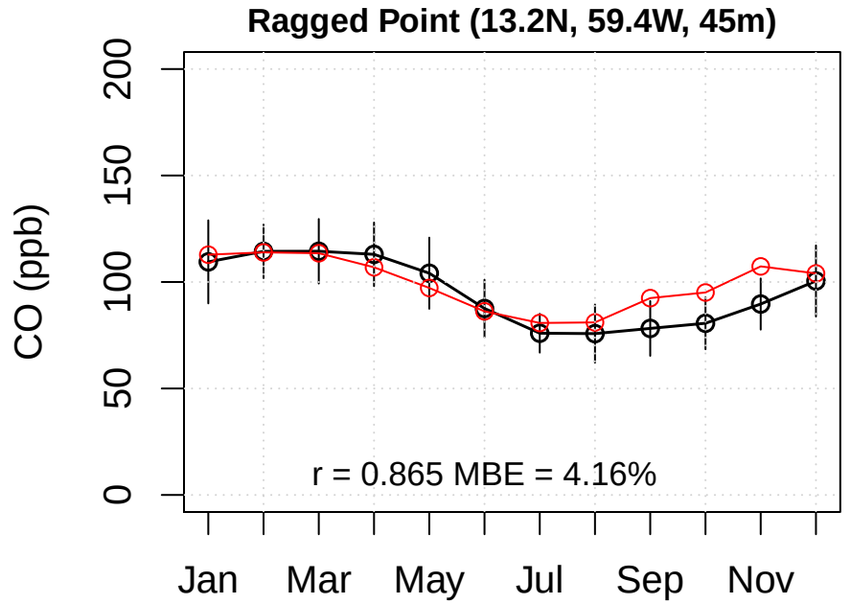
Key Biscayne (25.7N, 80.2W, 3m)



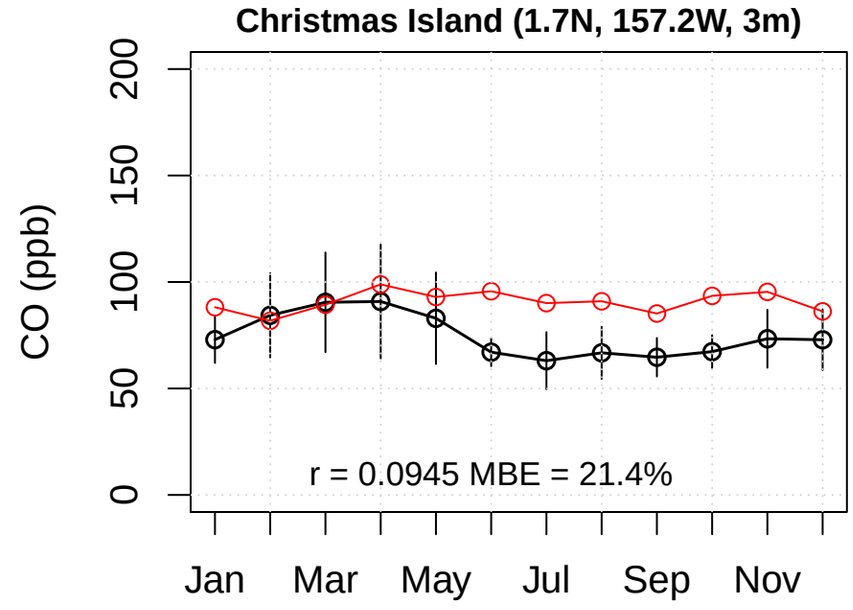
Mauna Loa (19.5N, 155.6W, 3397m)



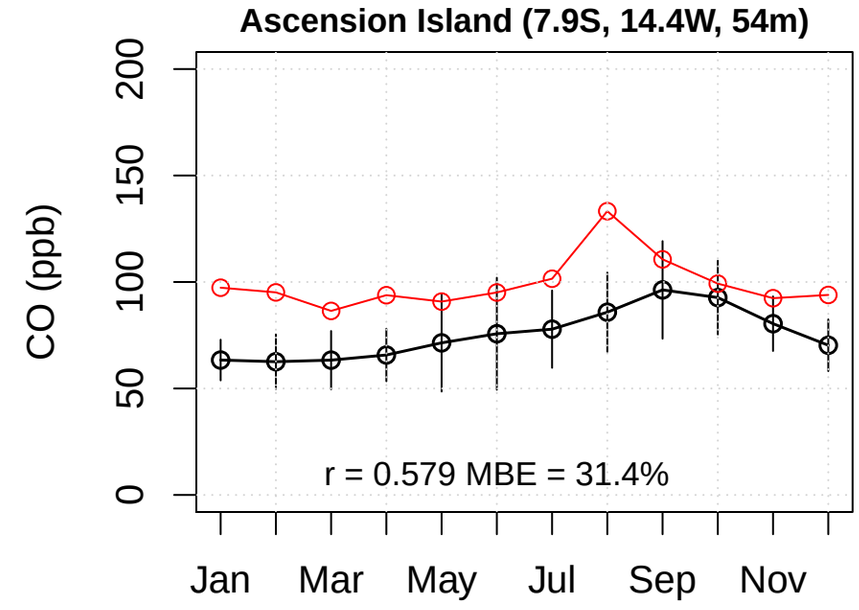
Ragged Point (13.2N, 59.4W, 45m)



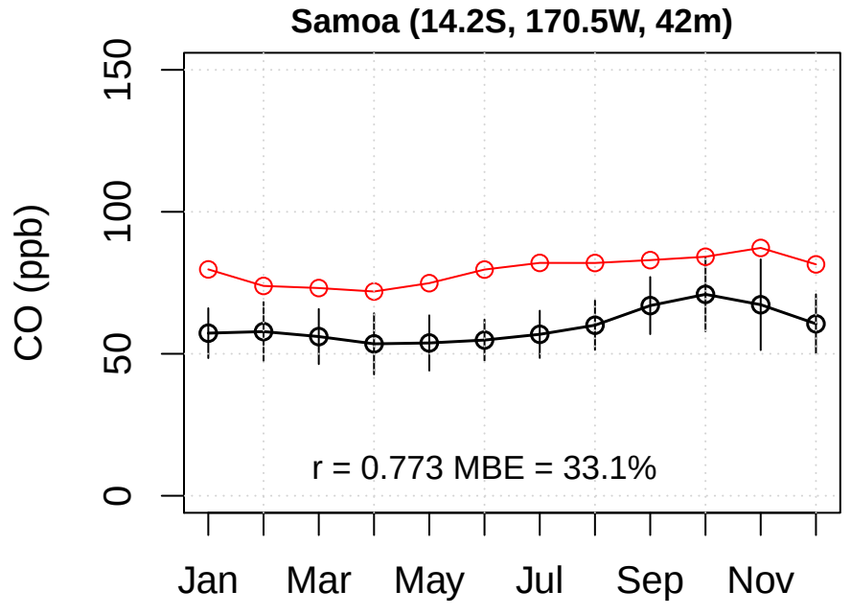
Christmas Island (1.7N, 157.2W, 3m)



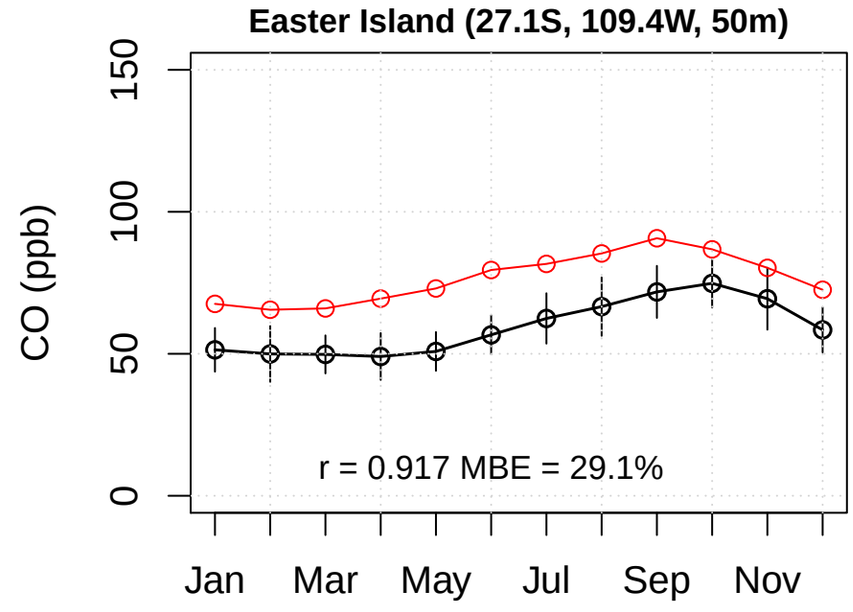
Ascension Island (7.9S, 14.4W, 54m)



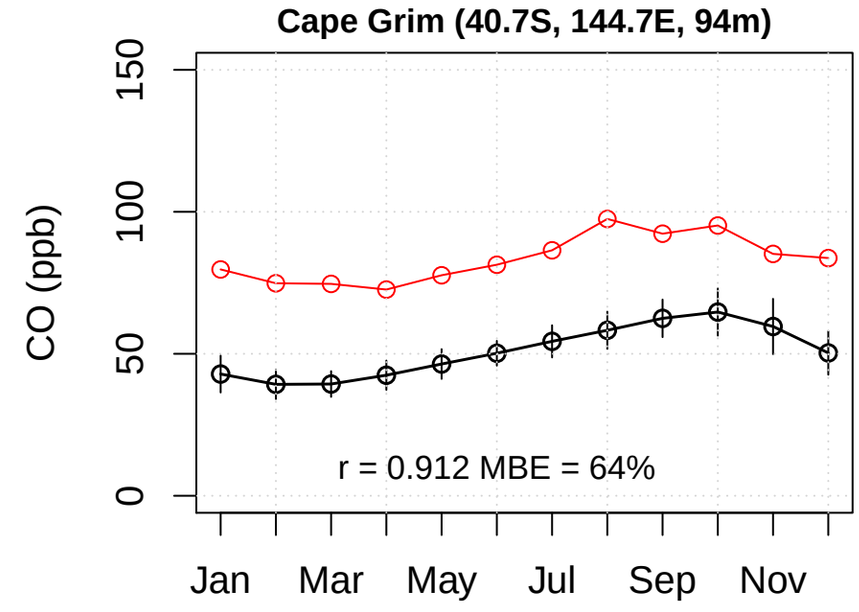
Samoa (14.2S, 170.5W, 42m)



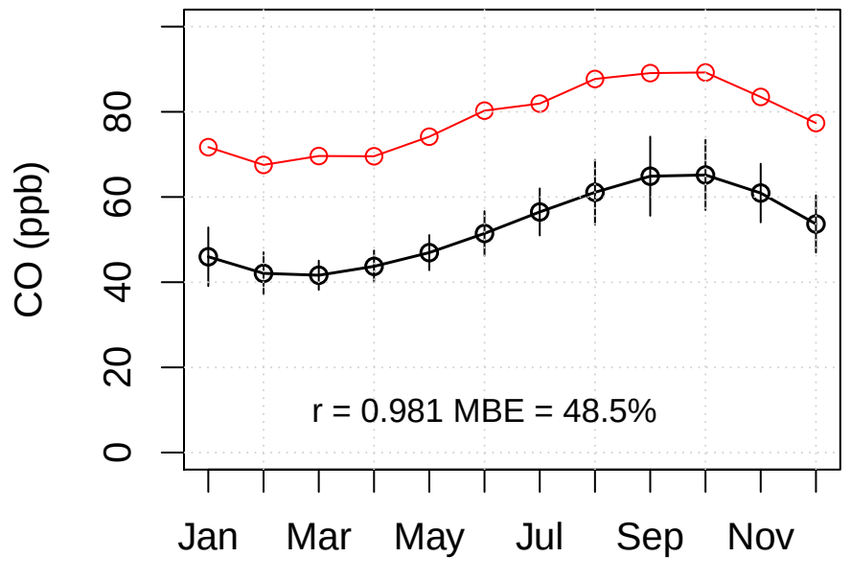
Easter Island (27.1S, 109.4W, 50m)



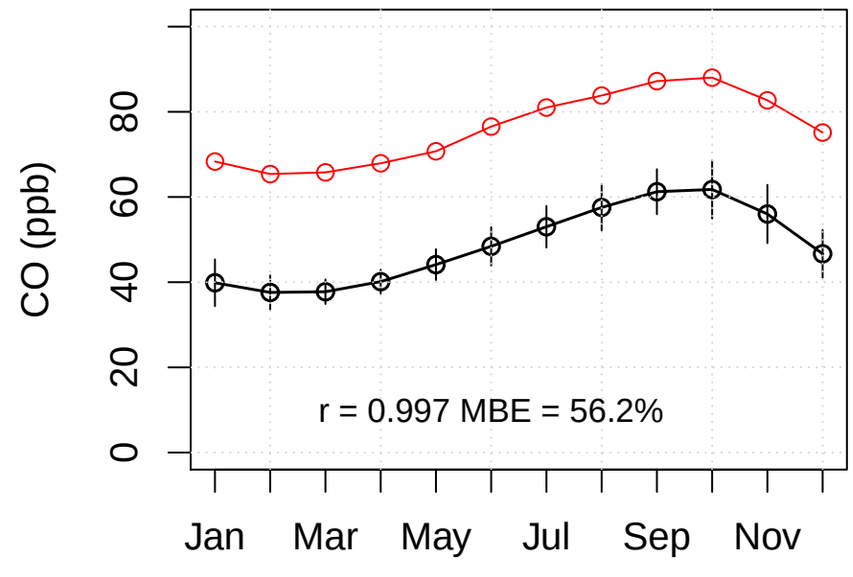
Cape Grim (40.7S, 144.7E, 94m)



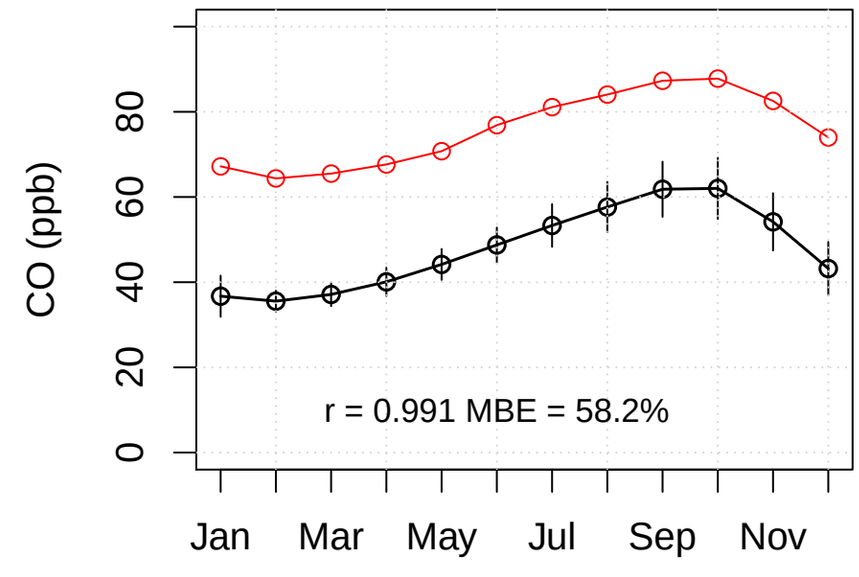
Crozet Island (46.5S, 51.8E, 120m)



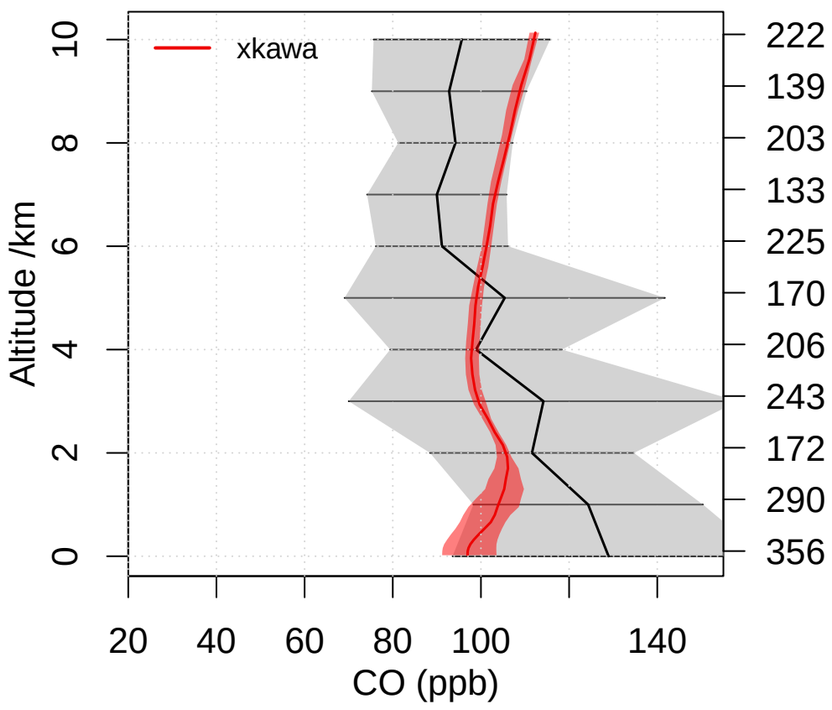
Syowa Station (69.0S, 39.6E, 11m)

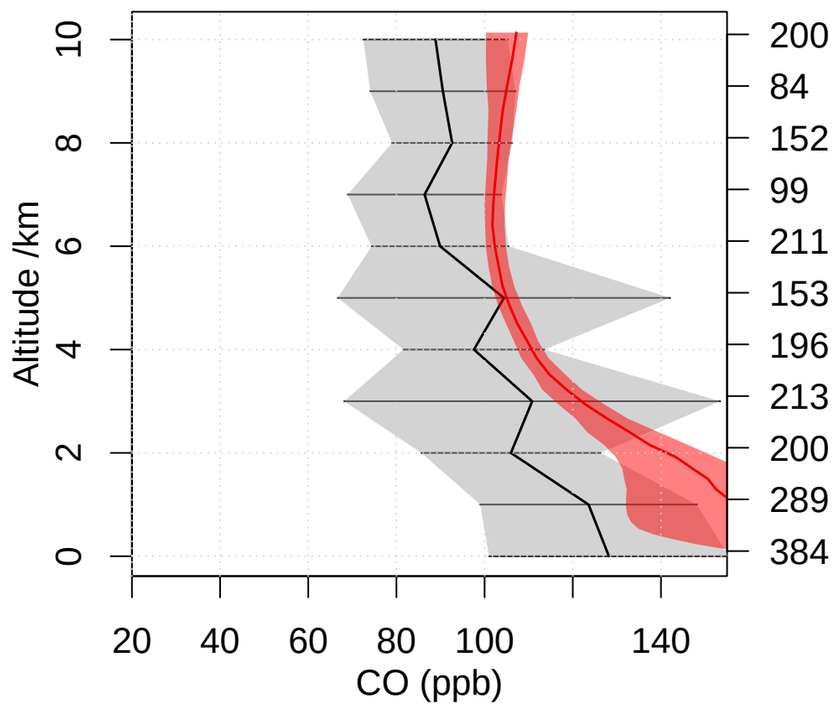


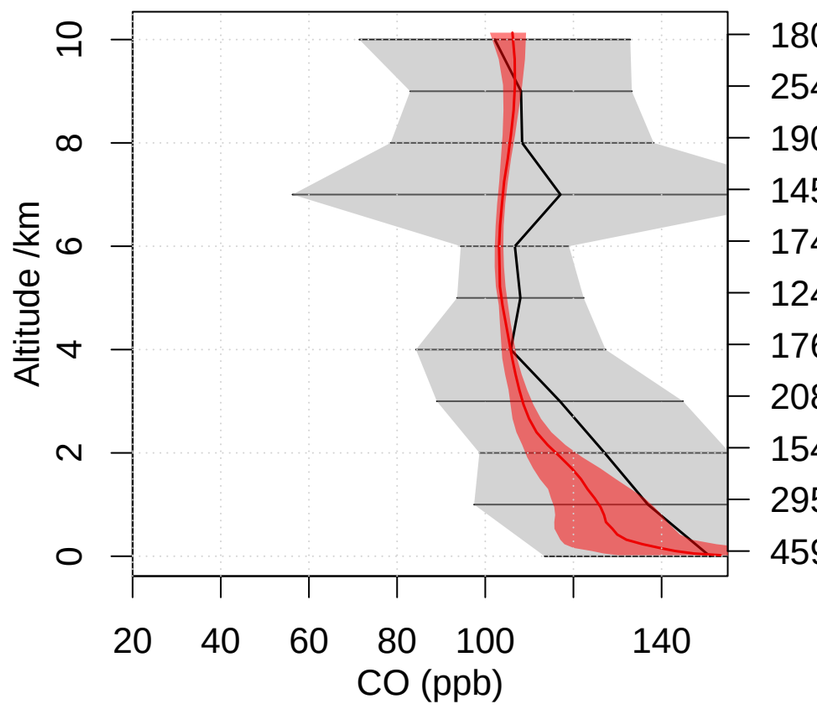
South Pole (90.0S, 24.8W, 2810m)

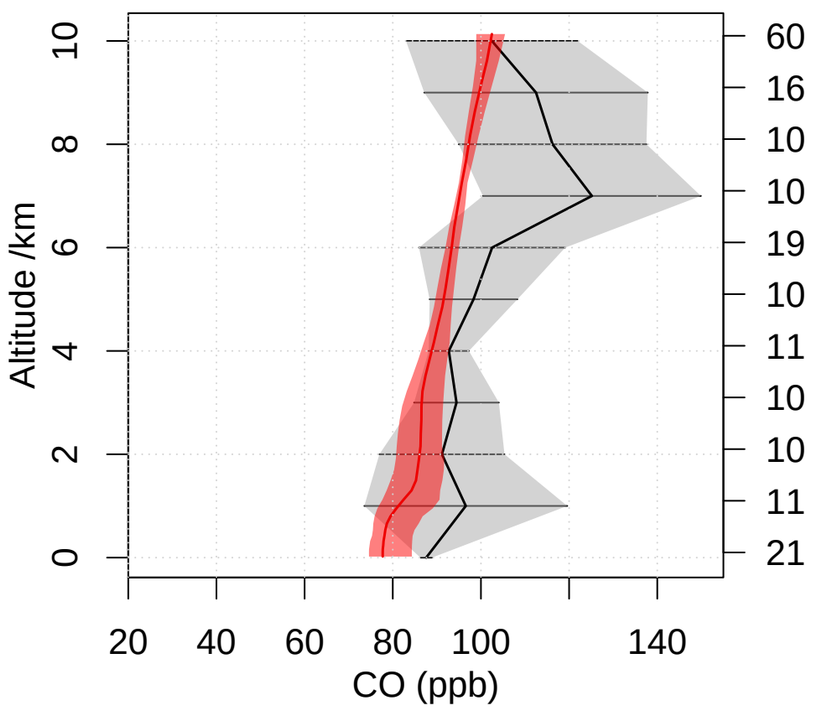


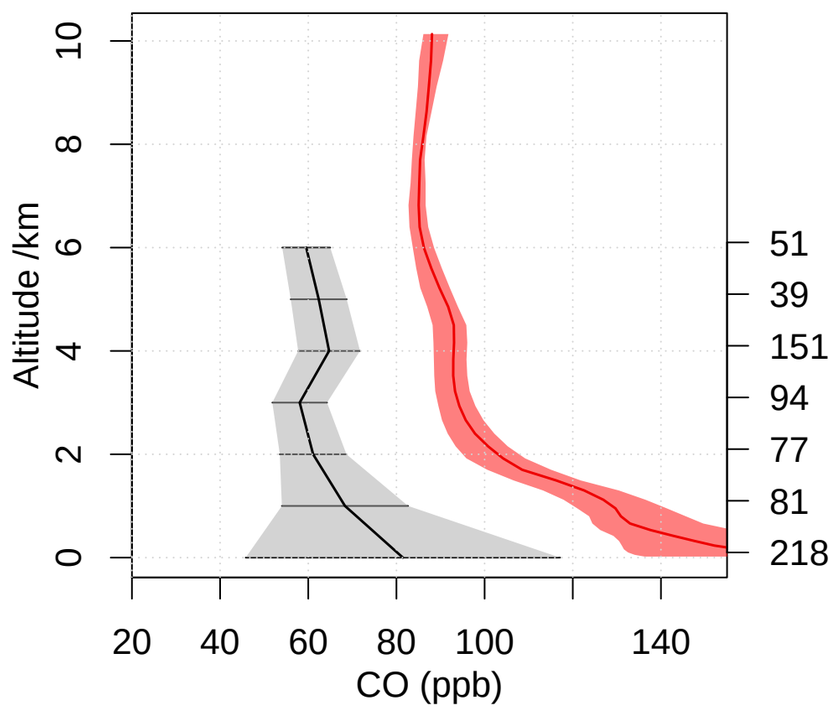
Emmons CO comparison

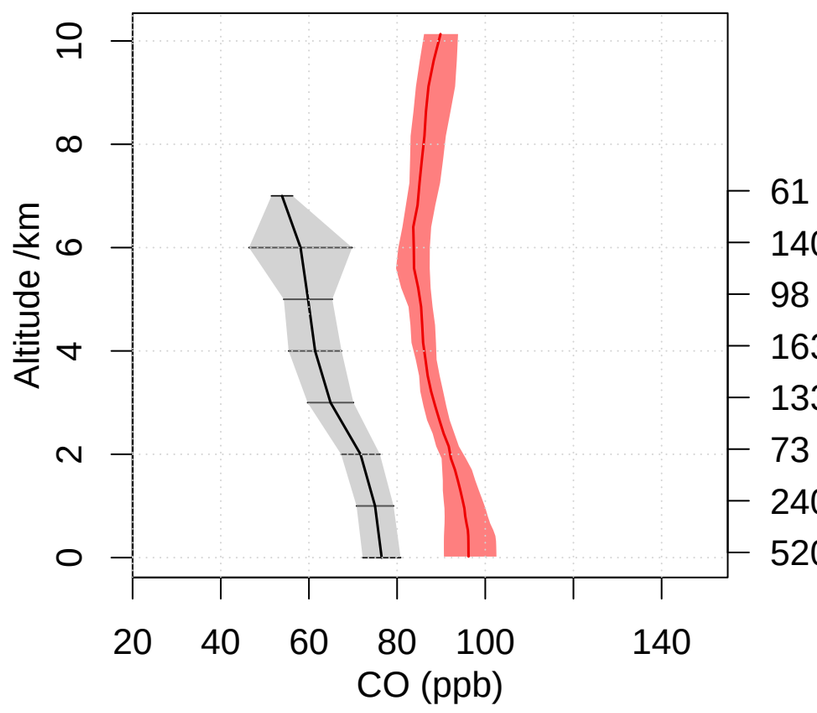


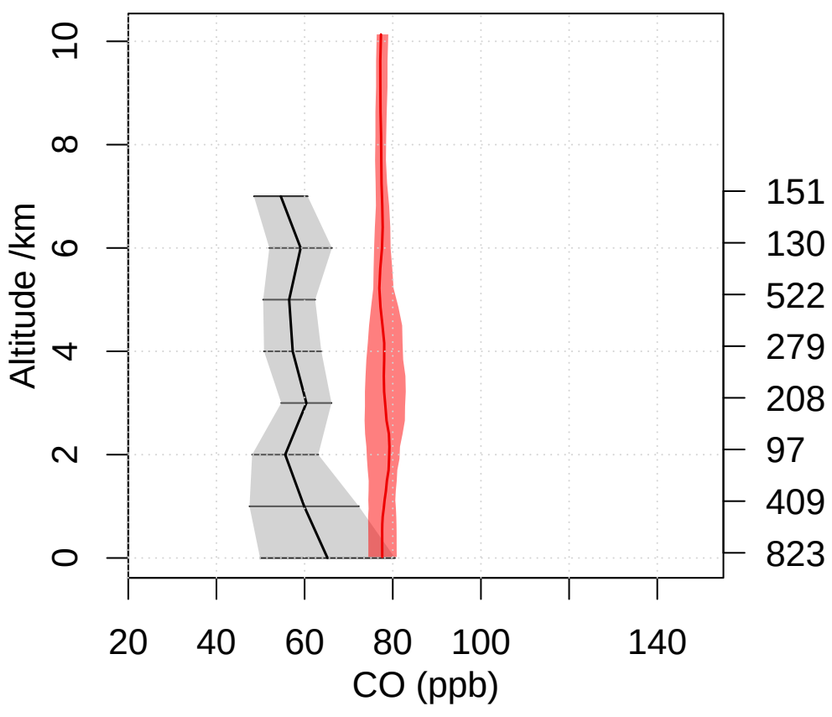


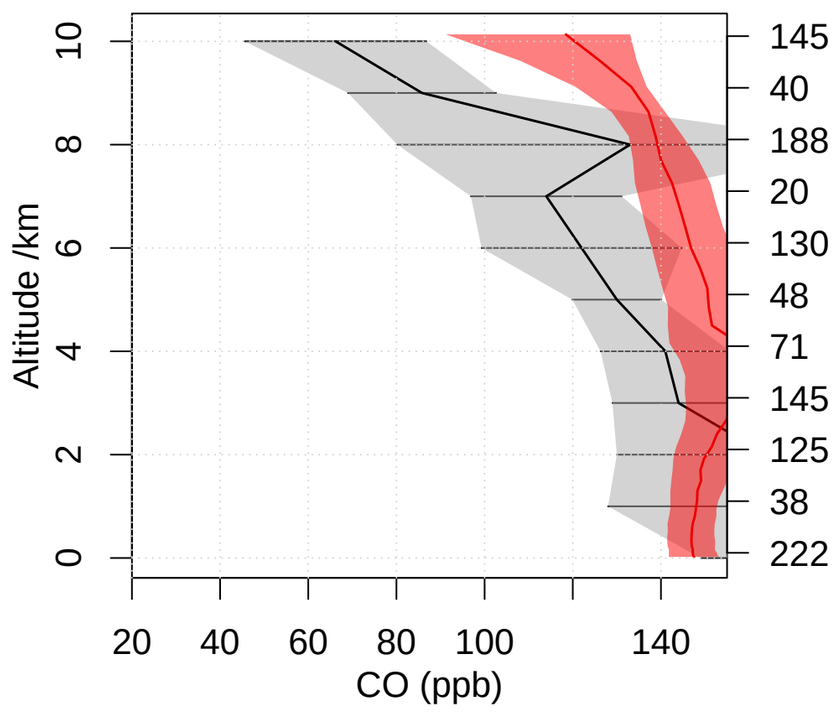


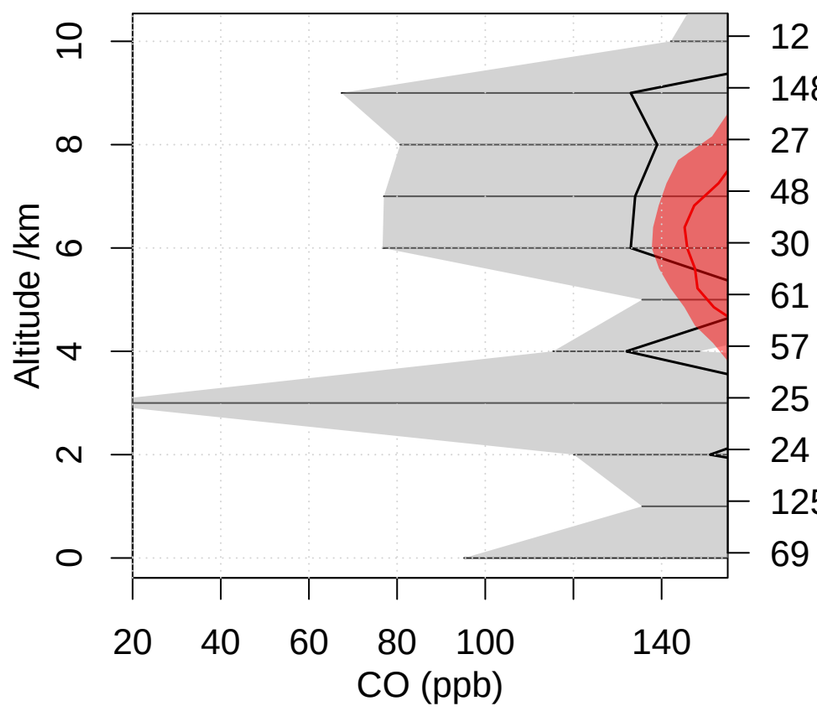


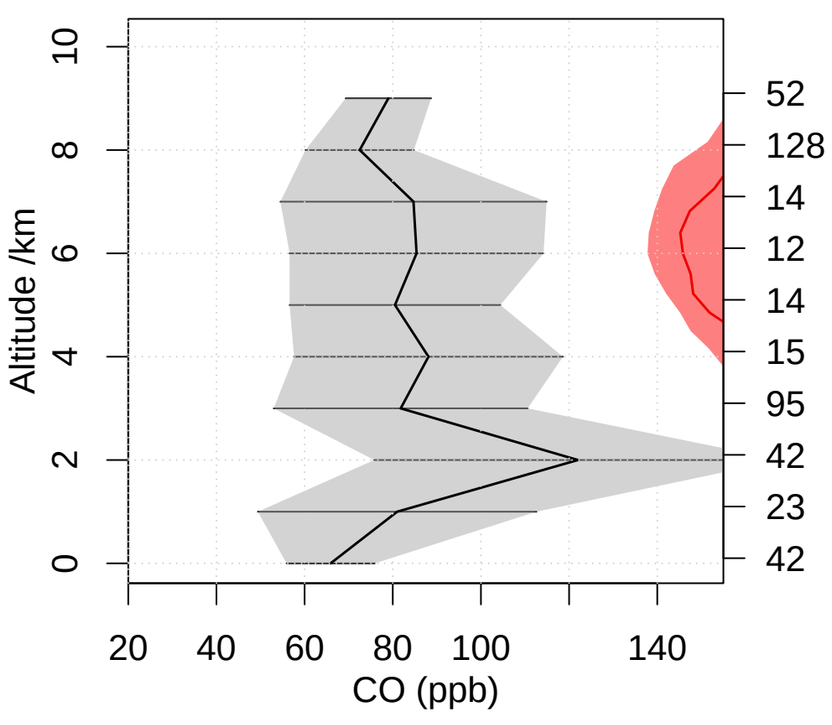


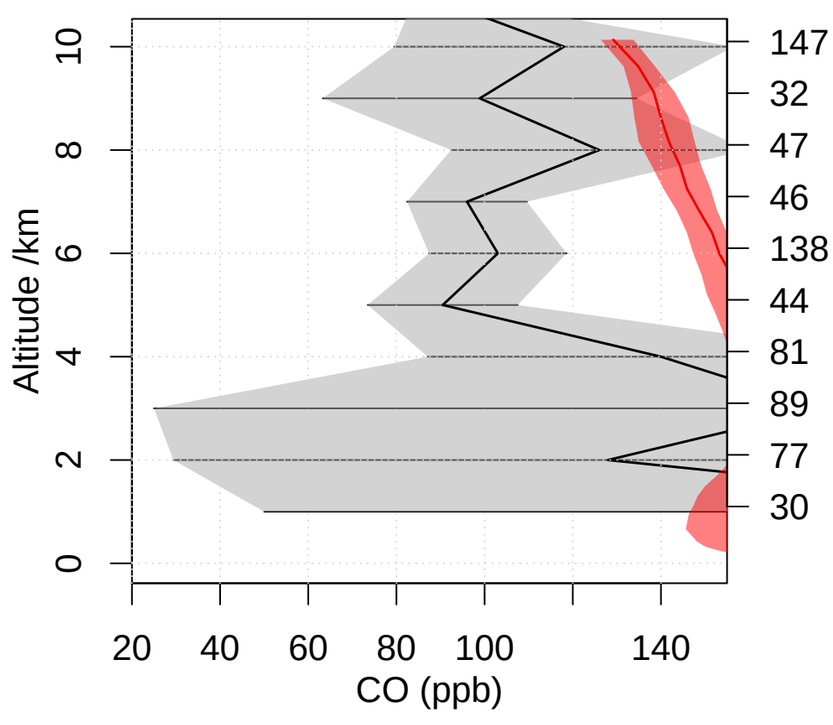


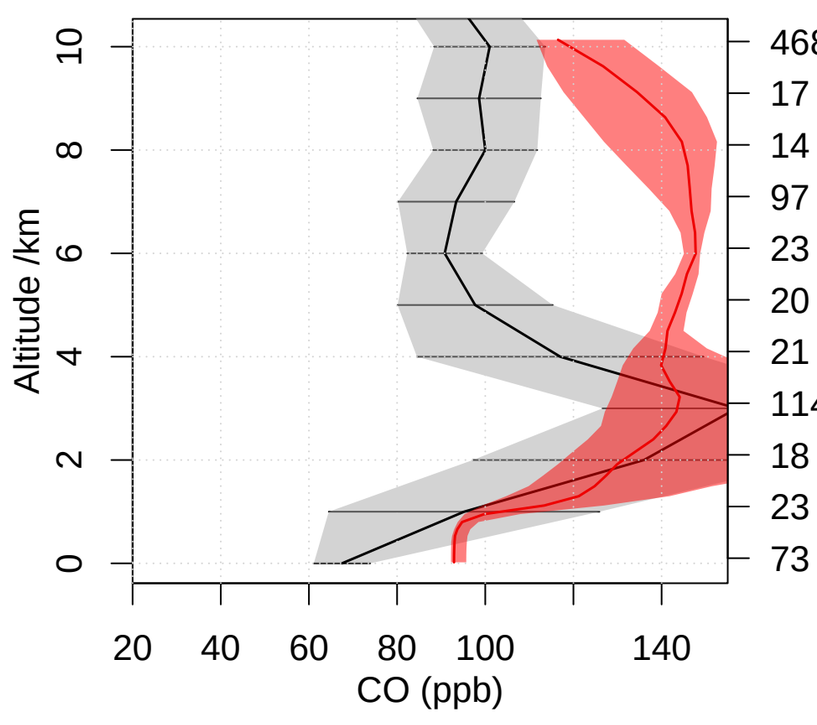




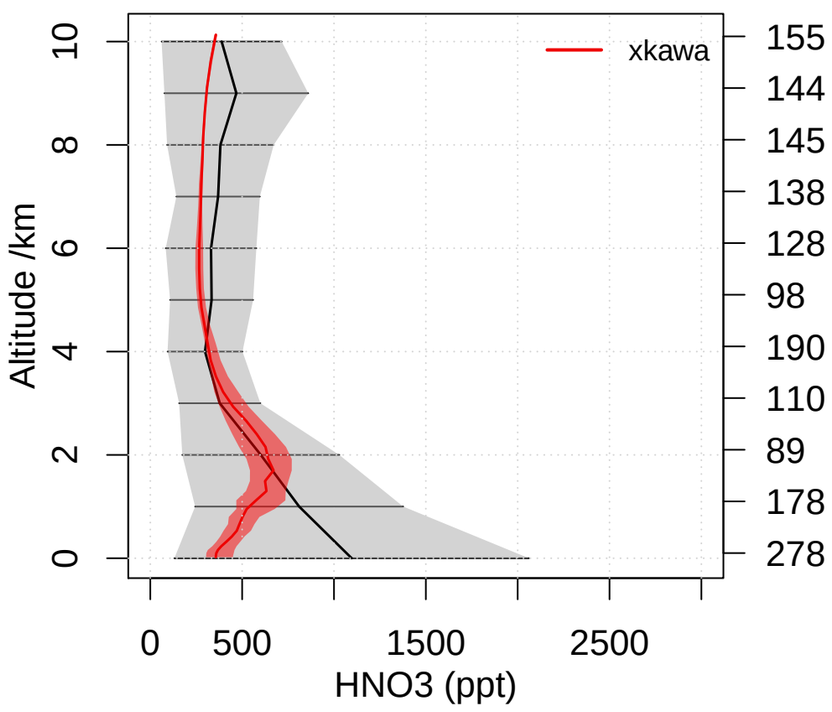


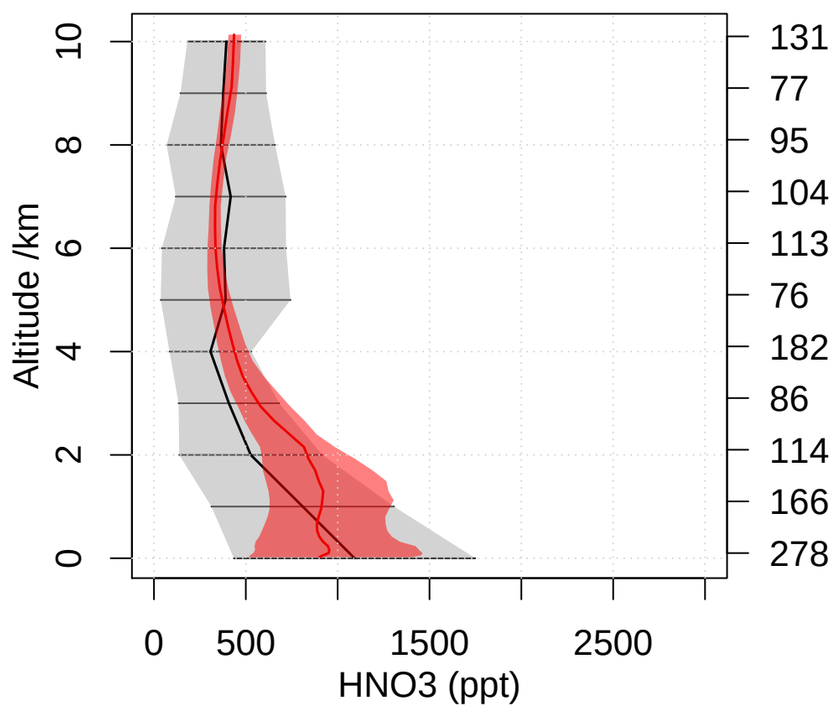


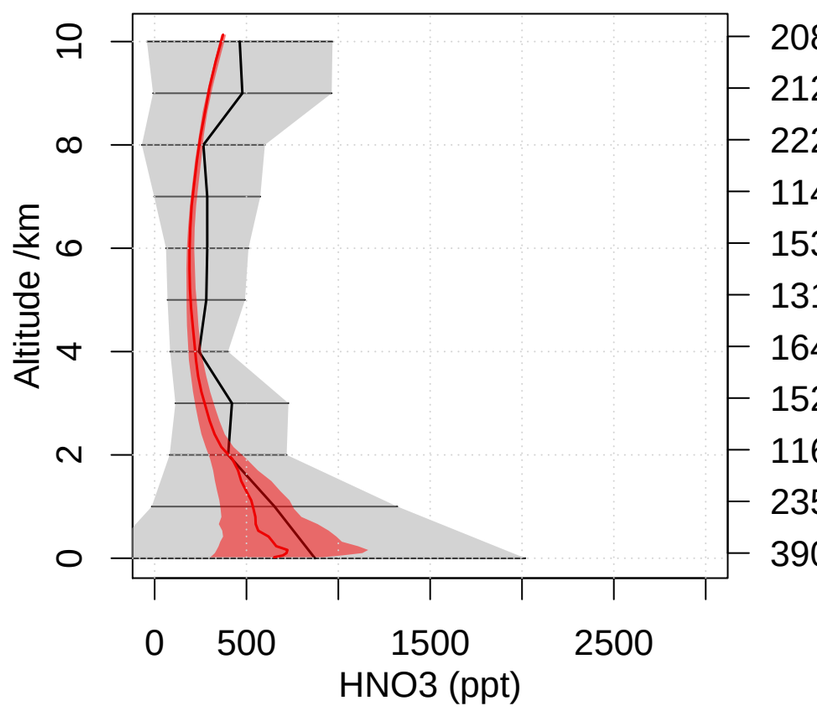


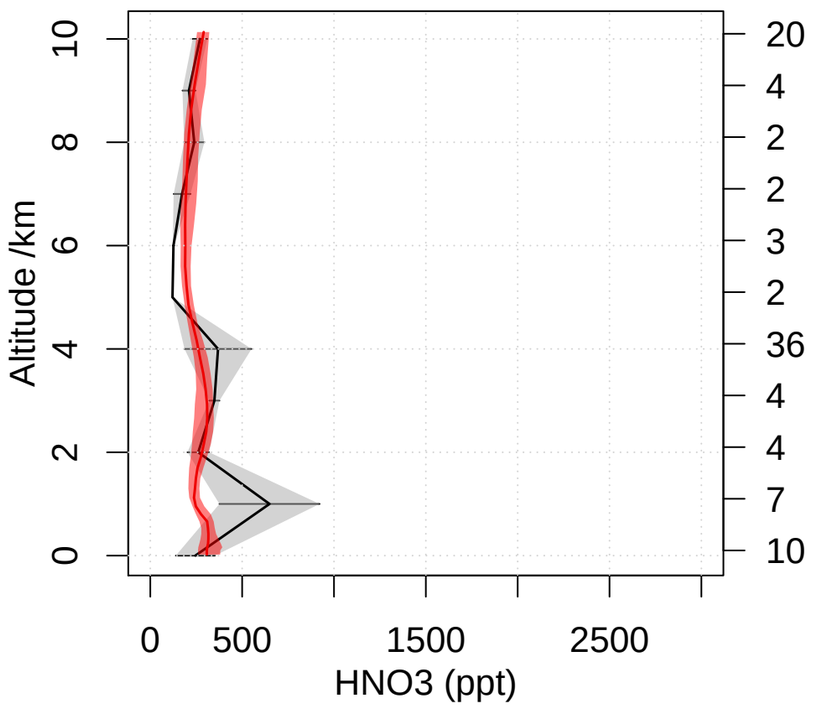


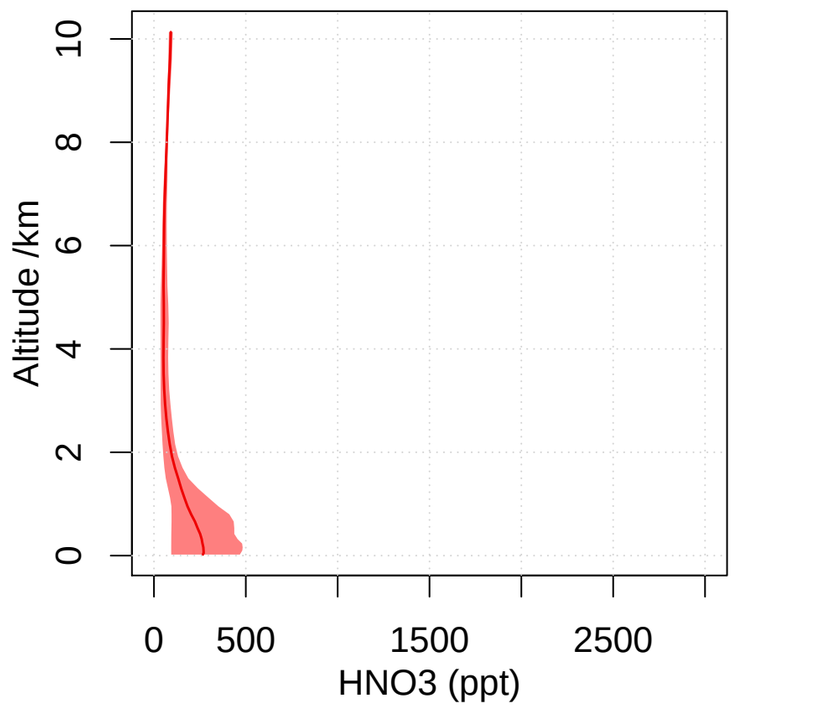
Emmons HNO3 comparison

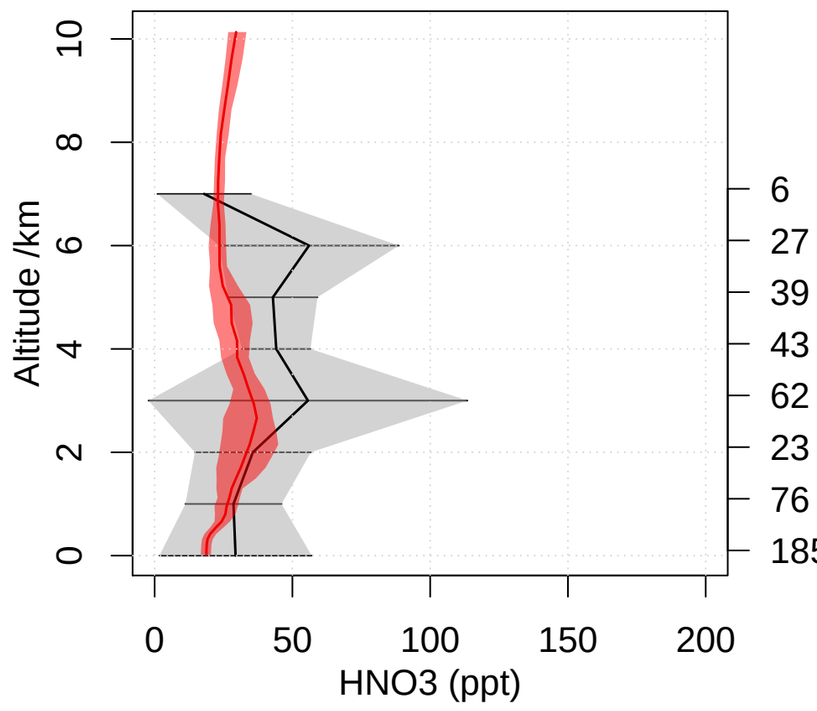


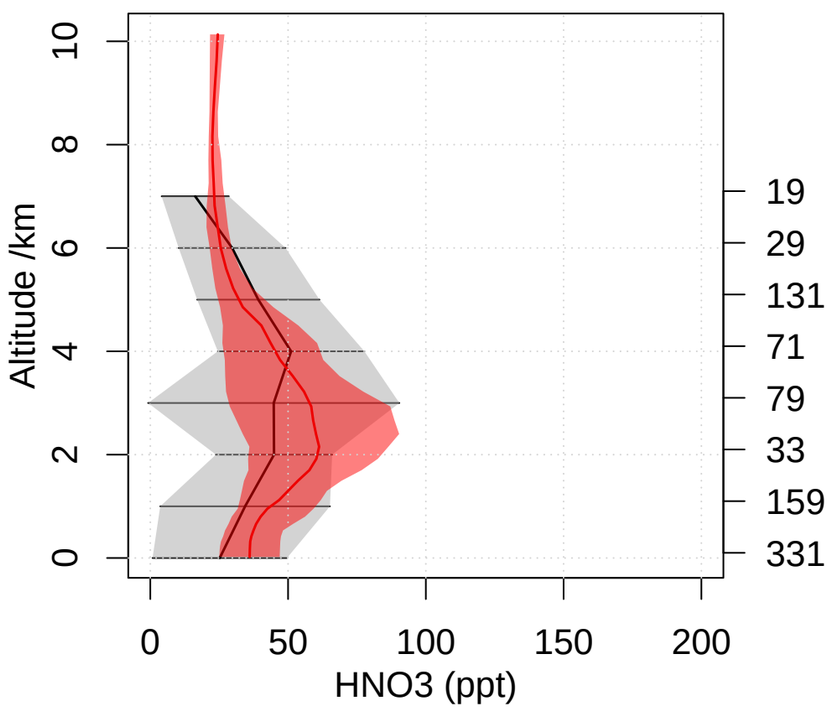


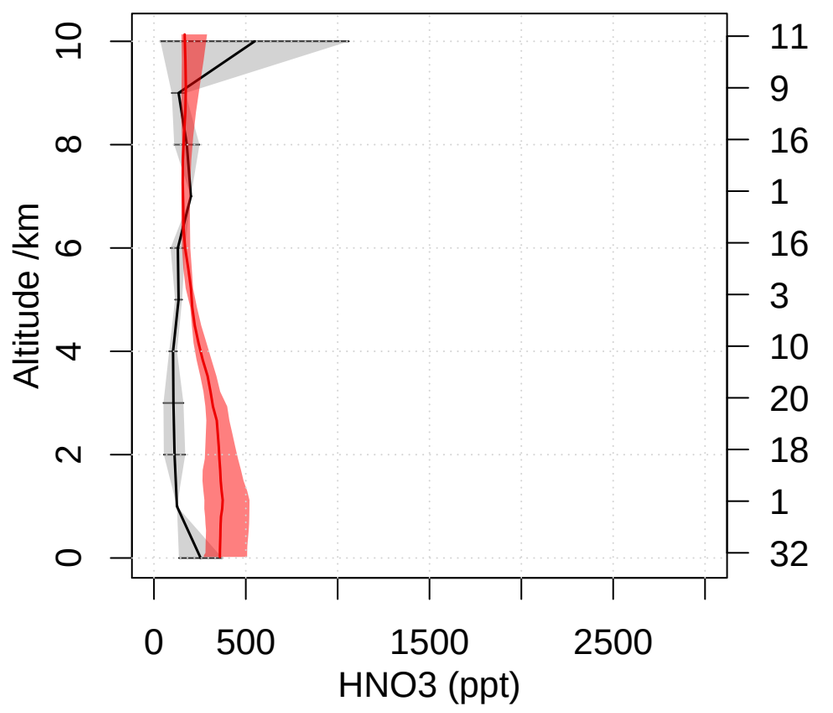


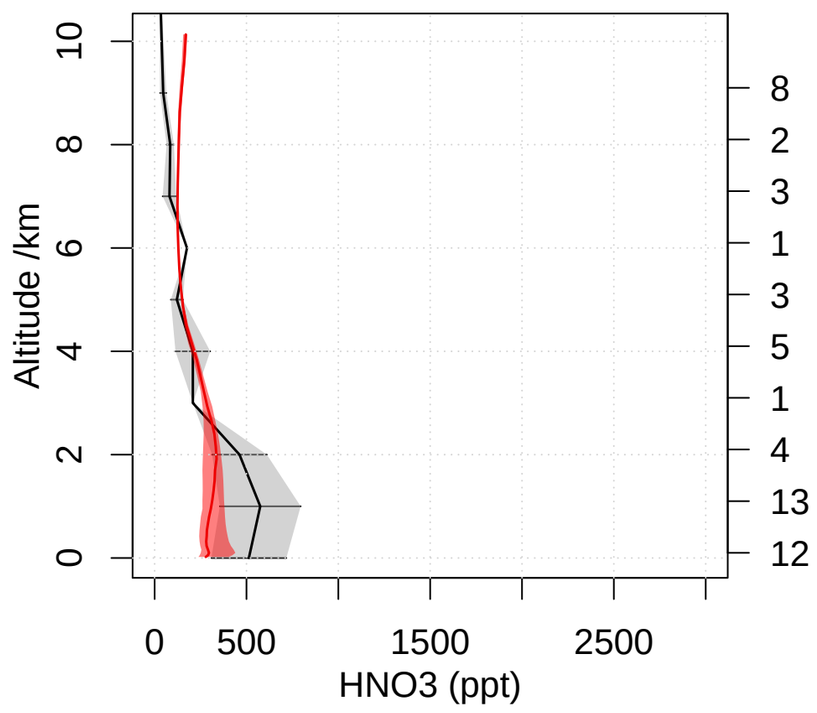


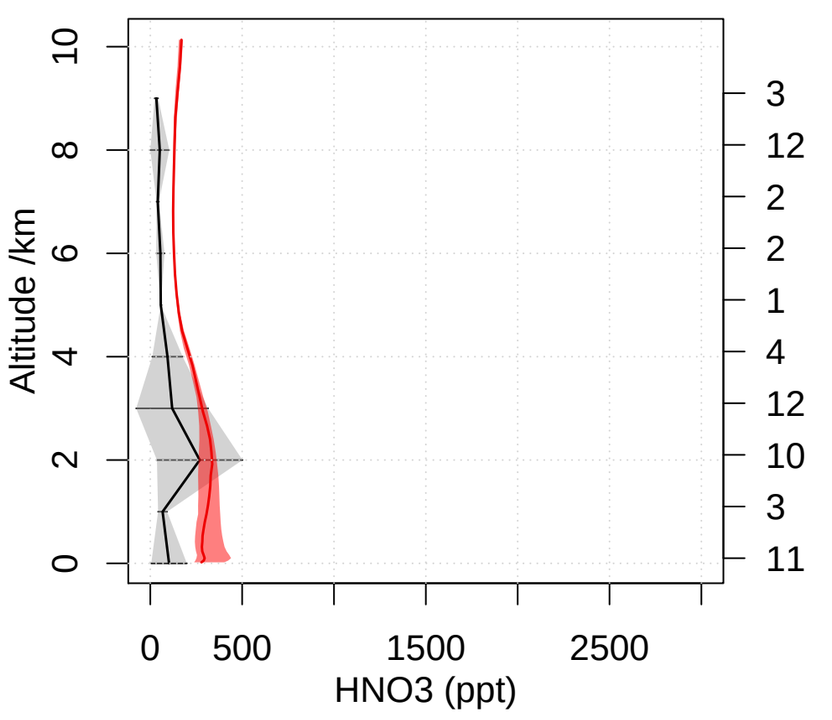


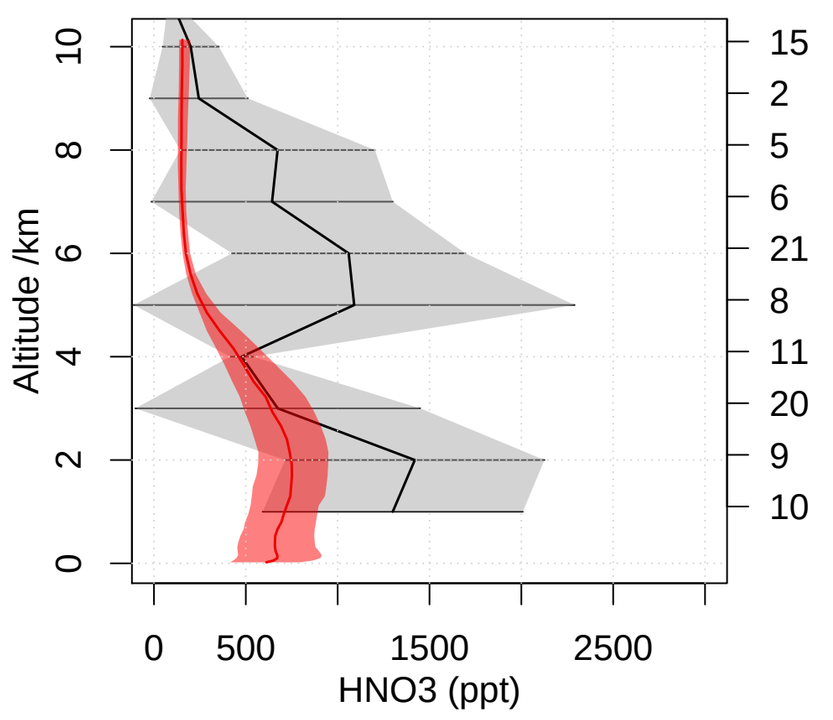


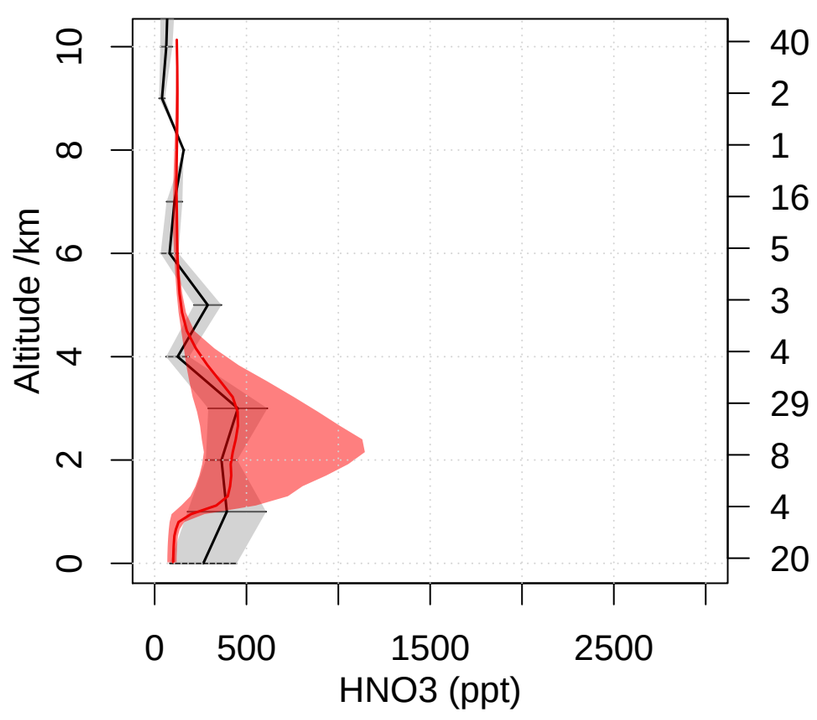




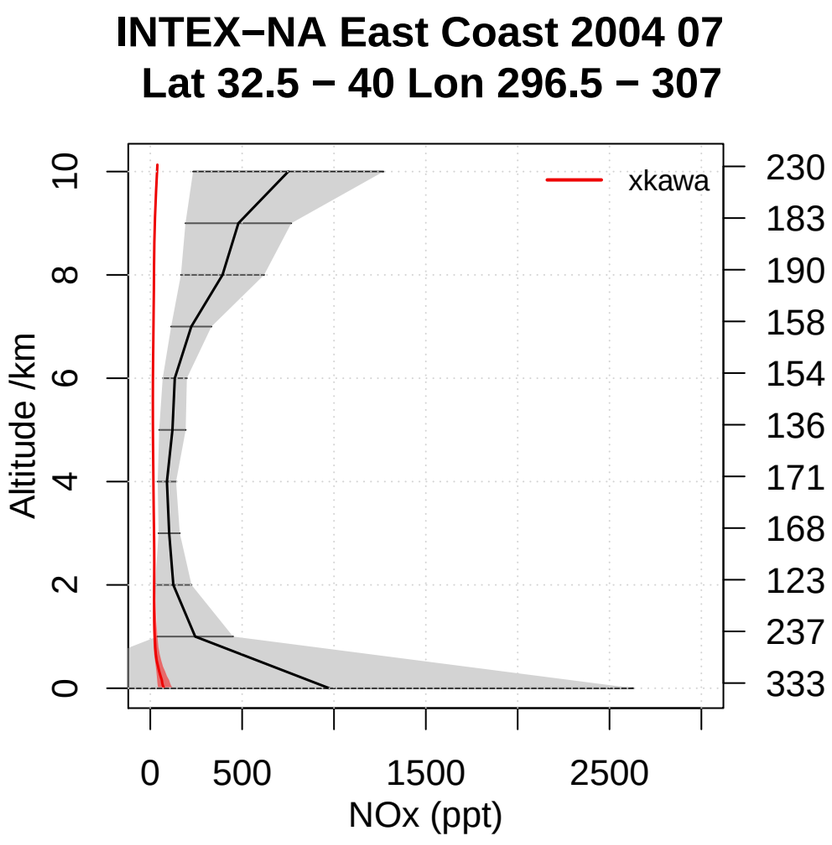


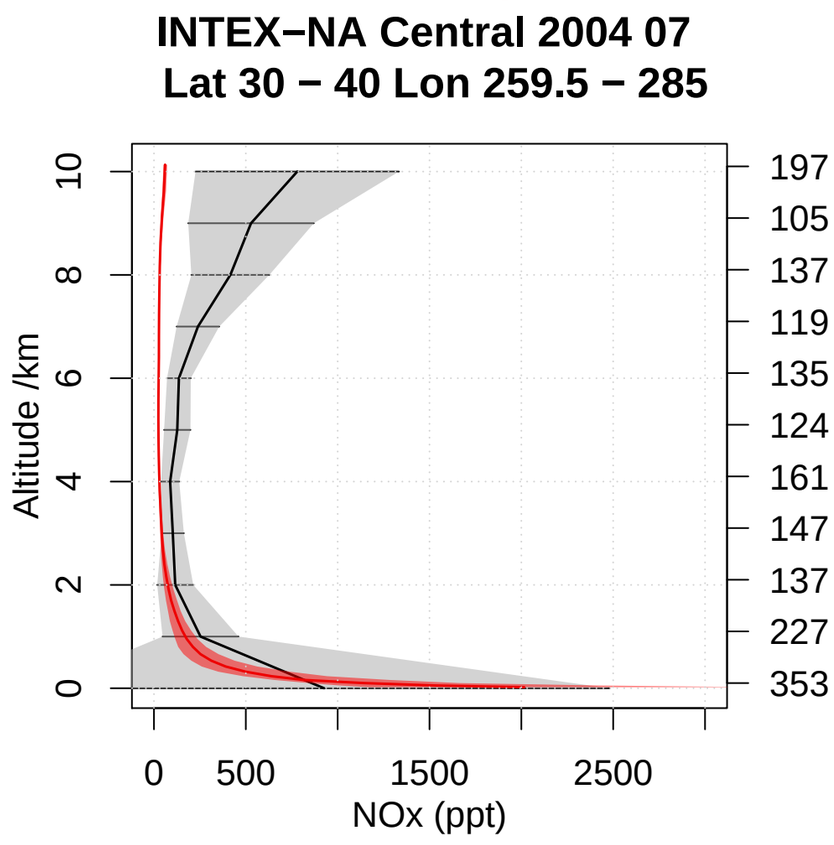


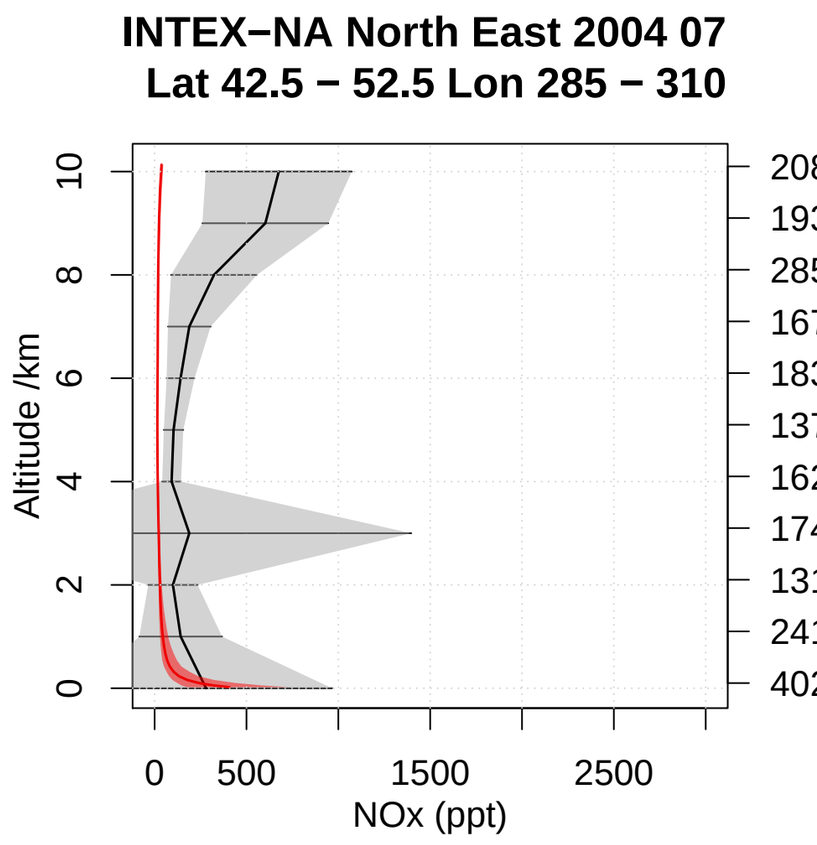


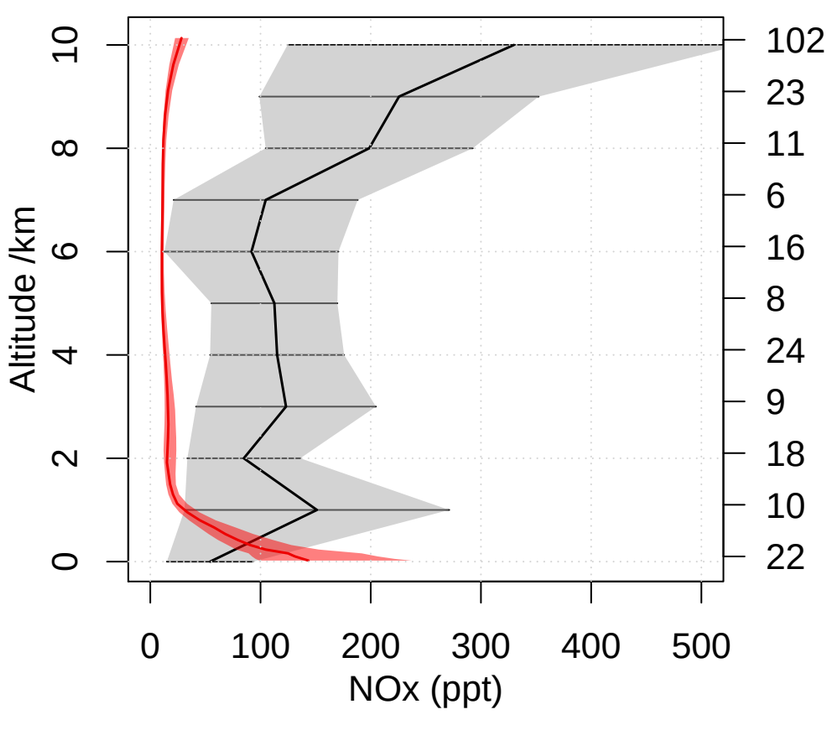


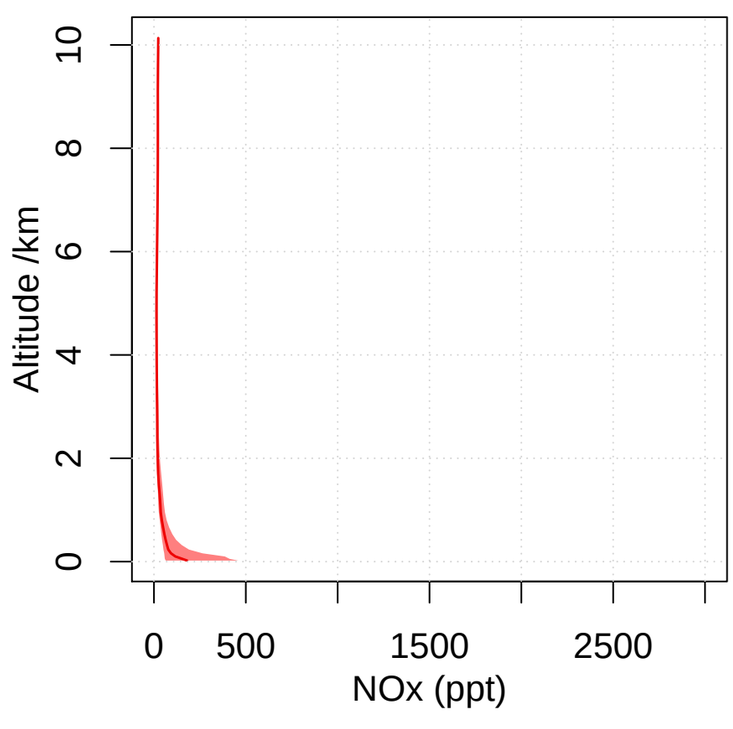
Emmons NOx comparison

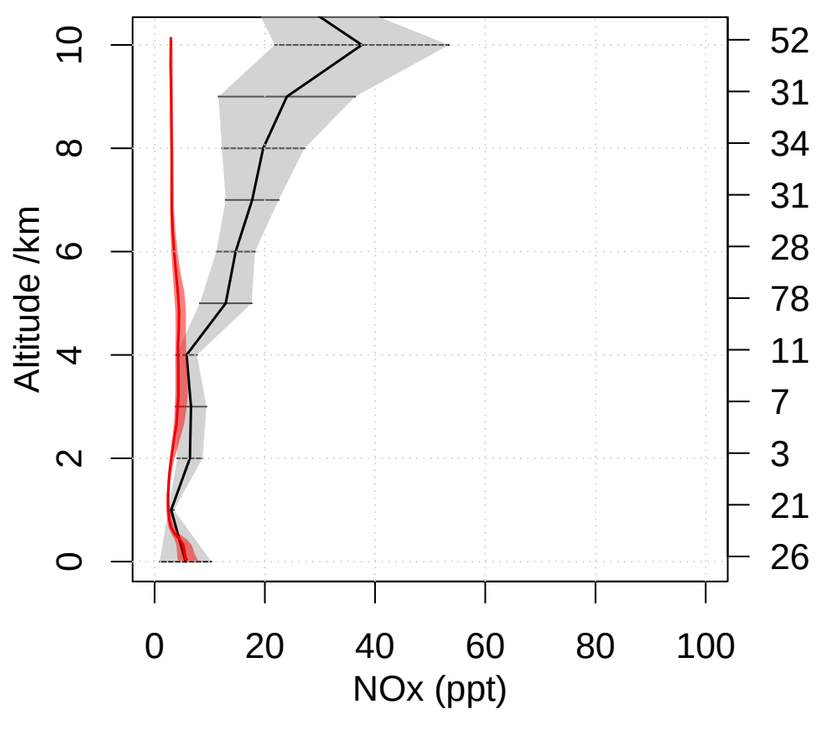


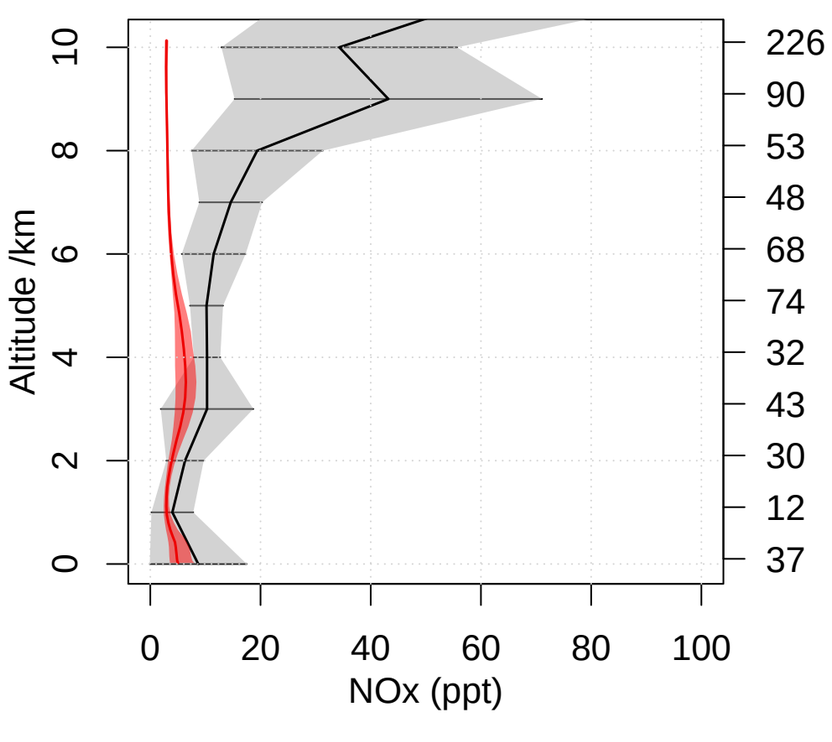


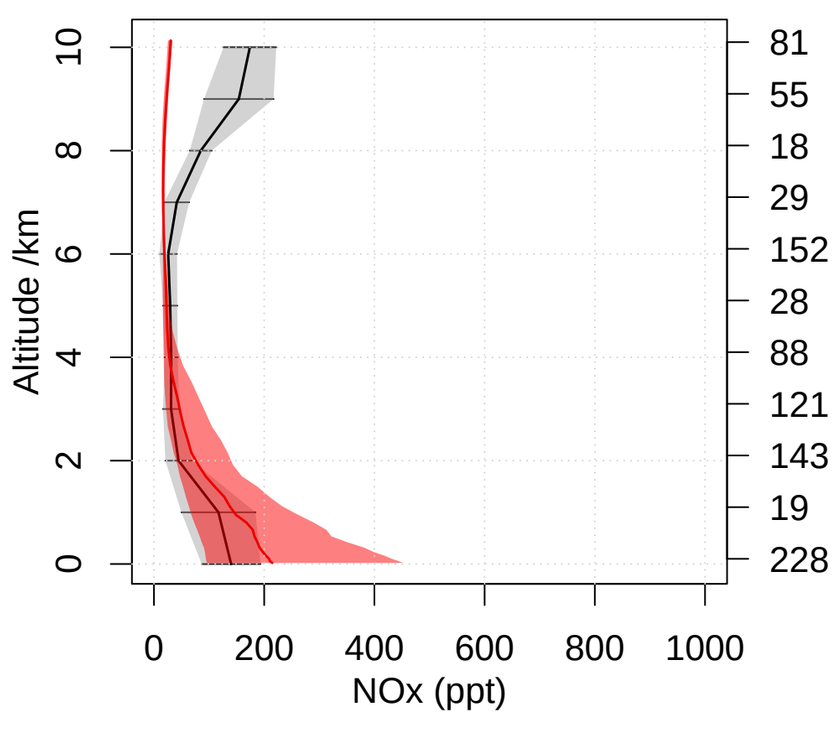


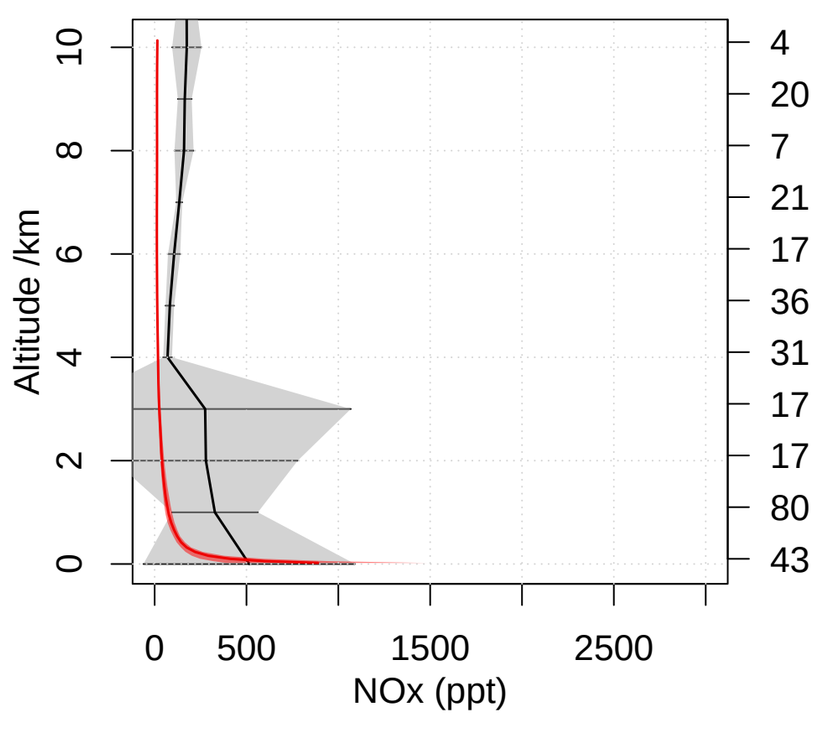


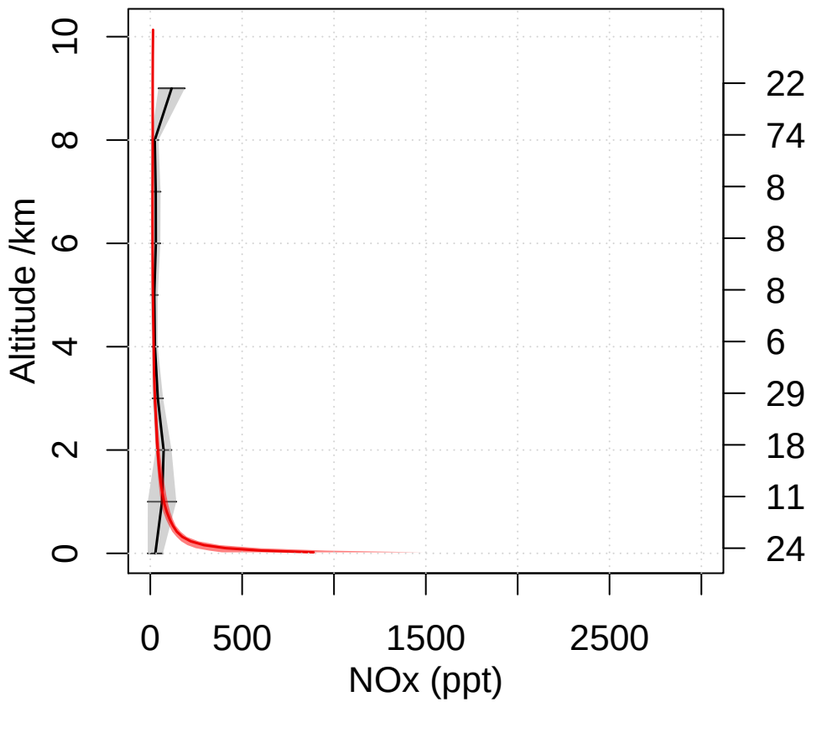


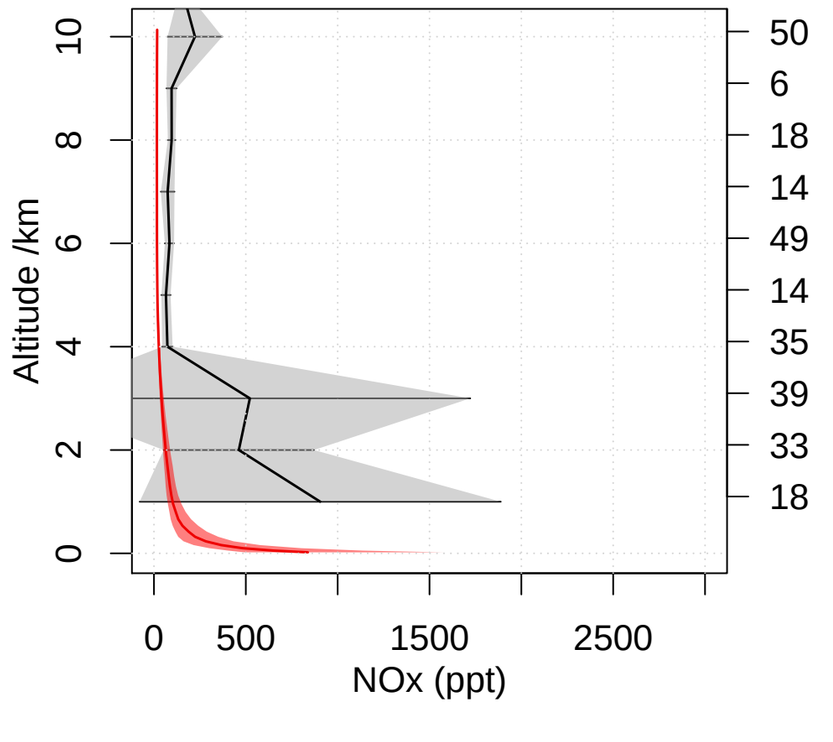


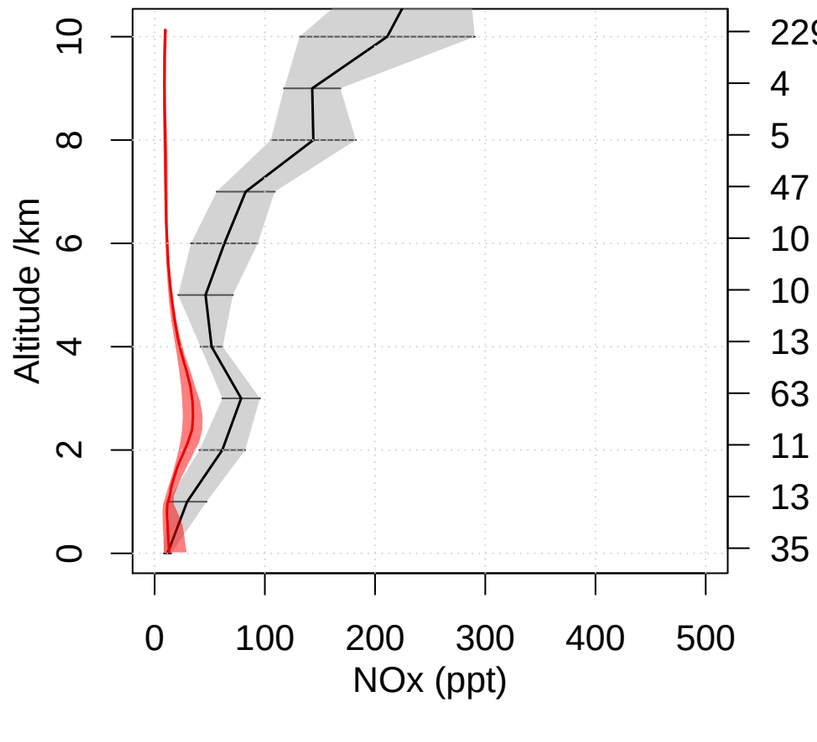


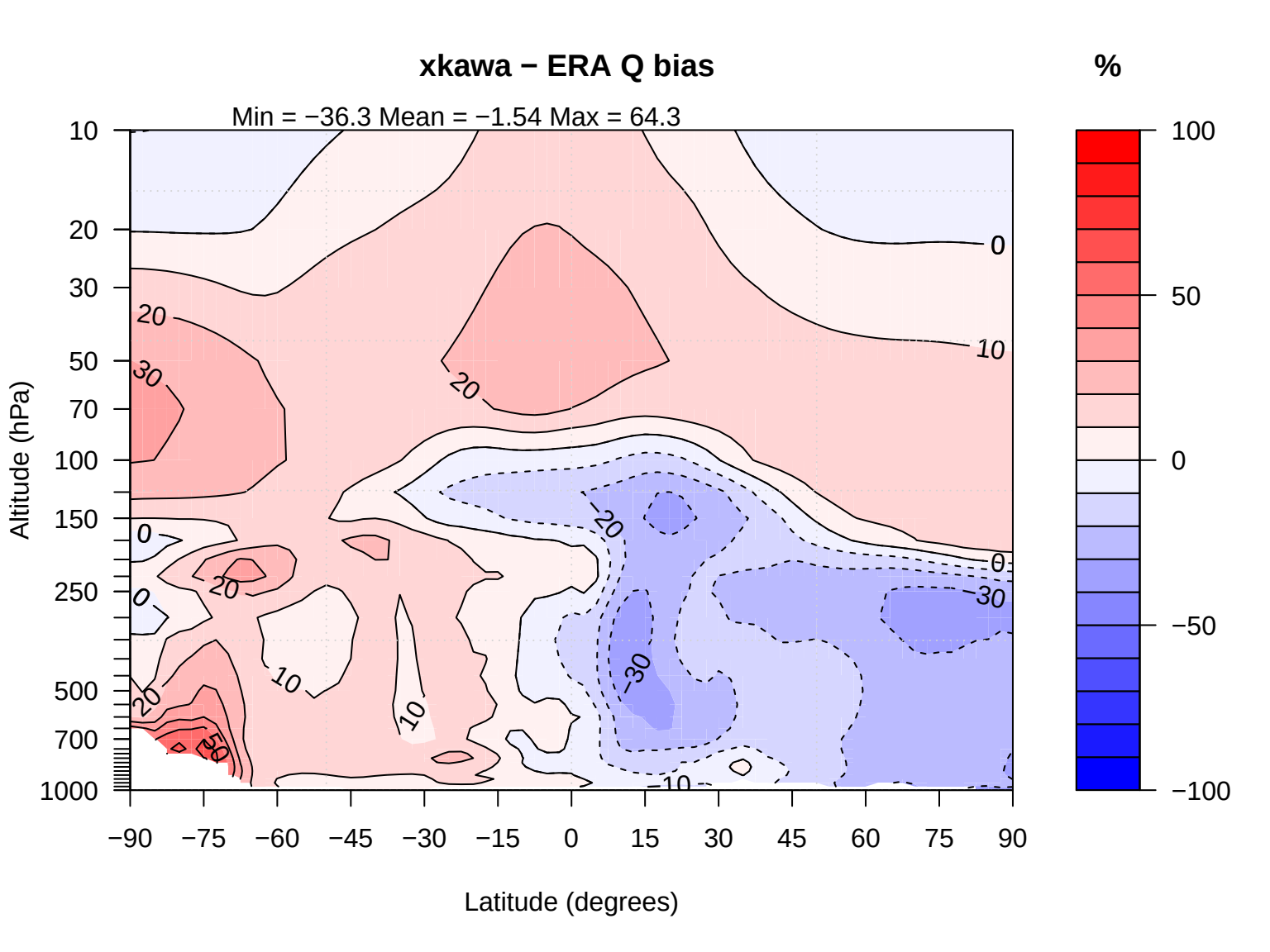


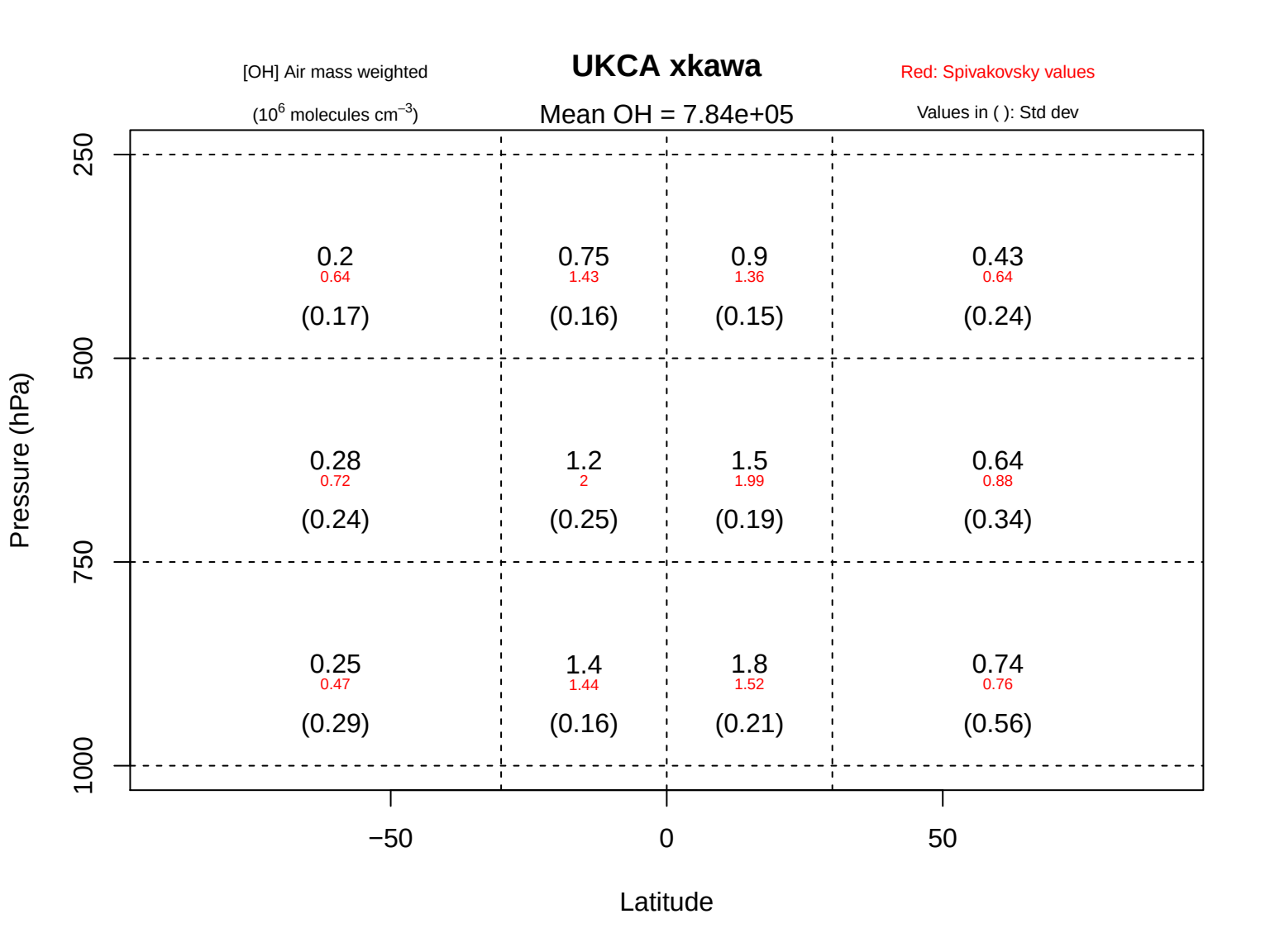


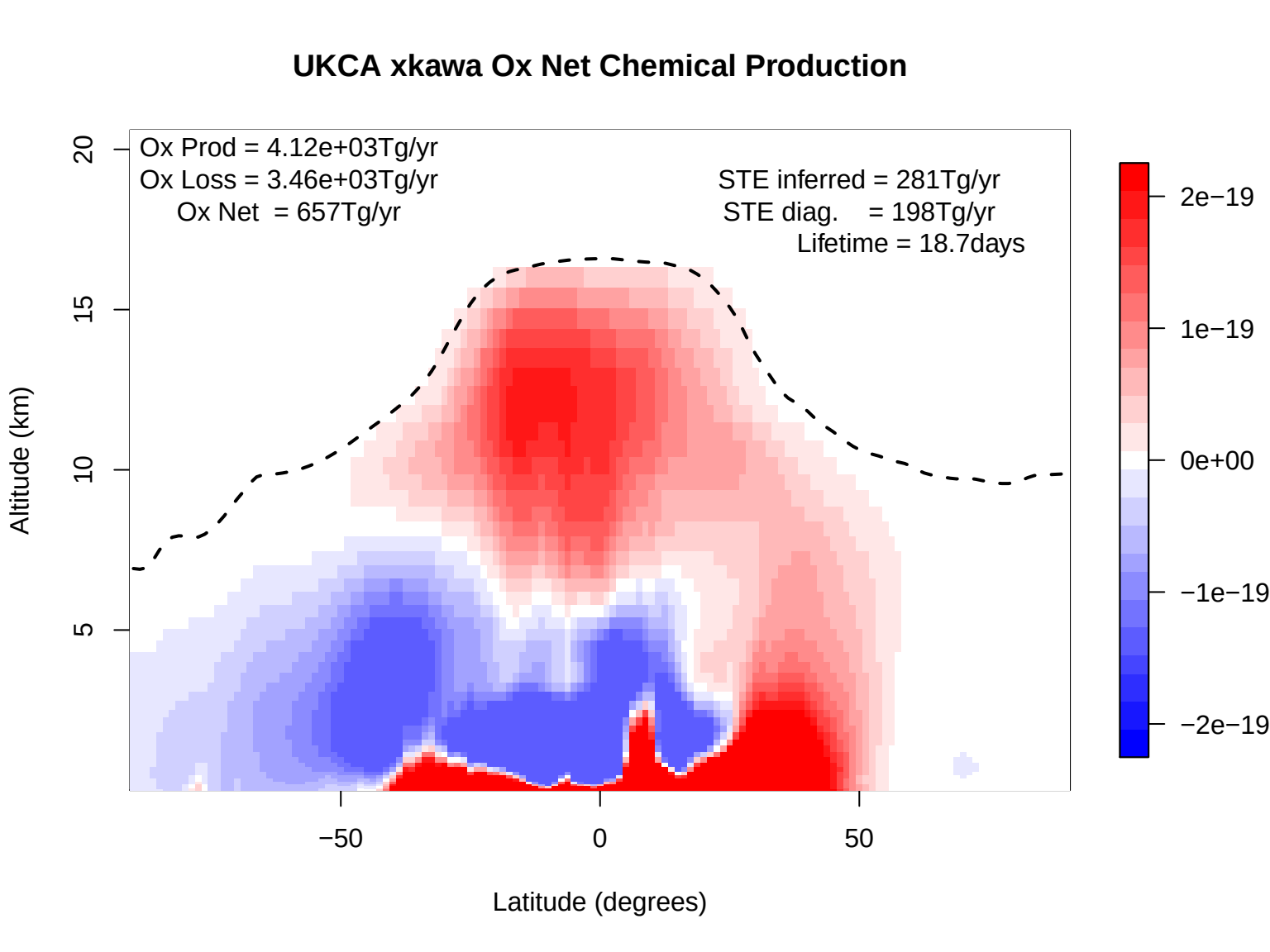


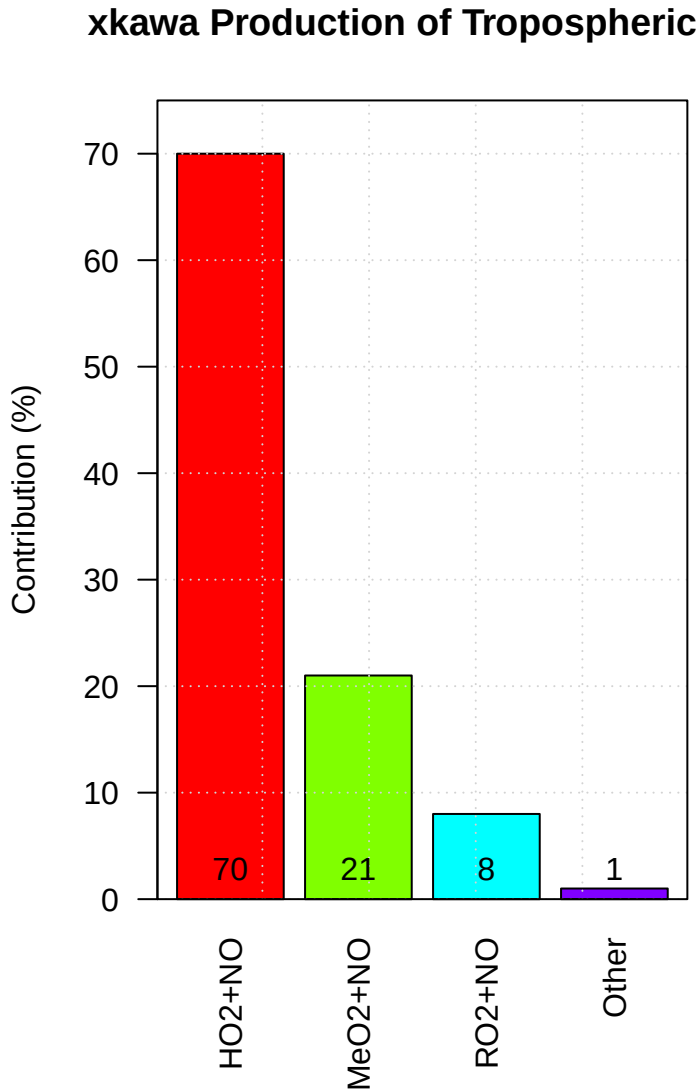


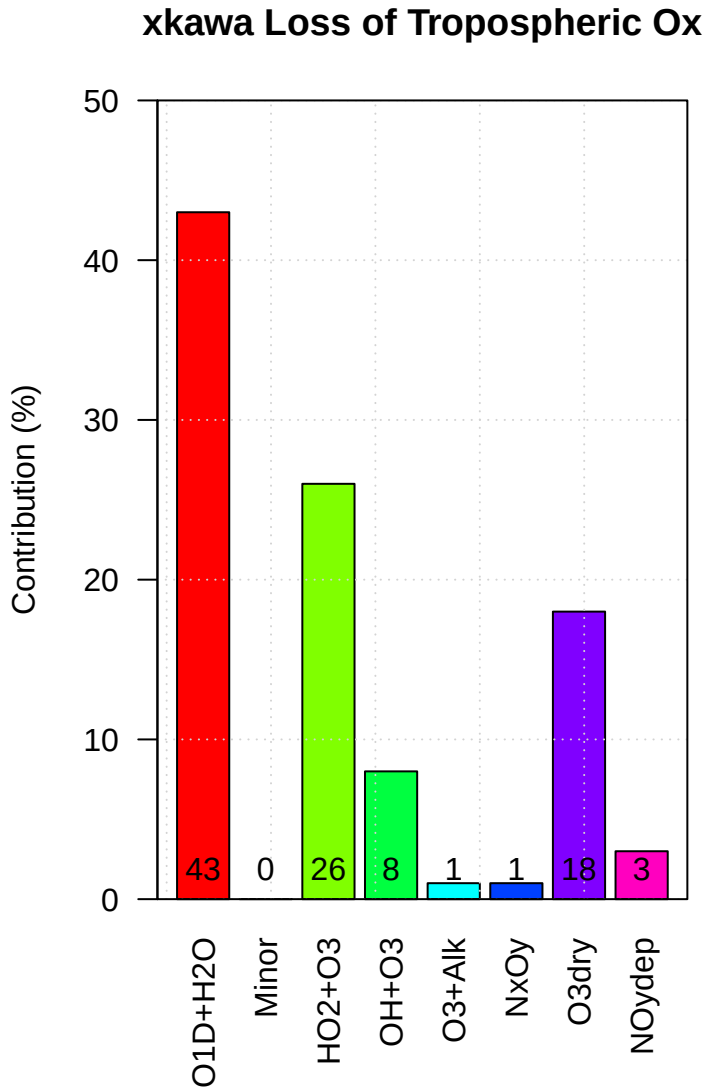


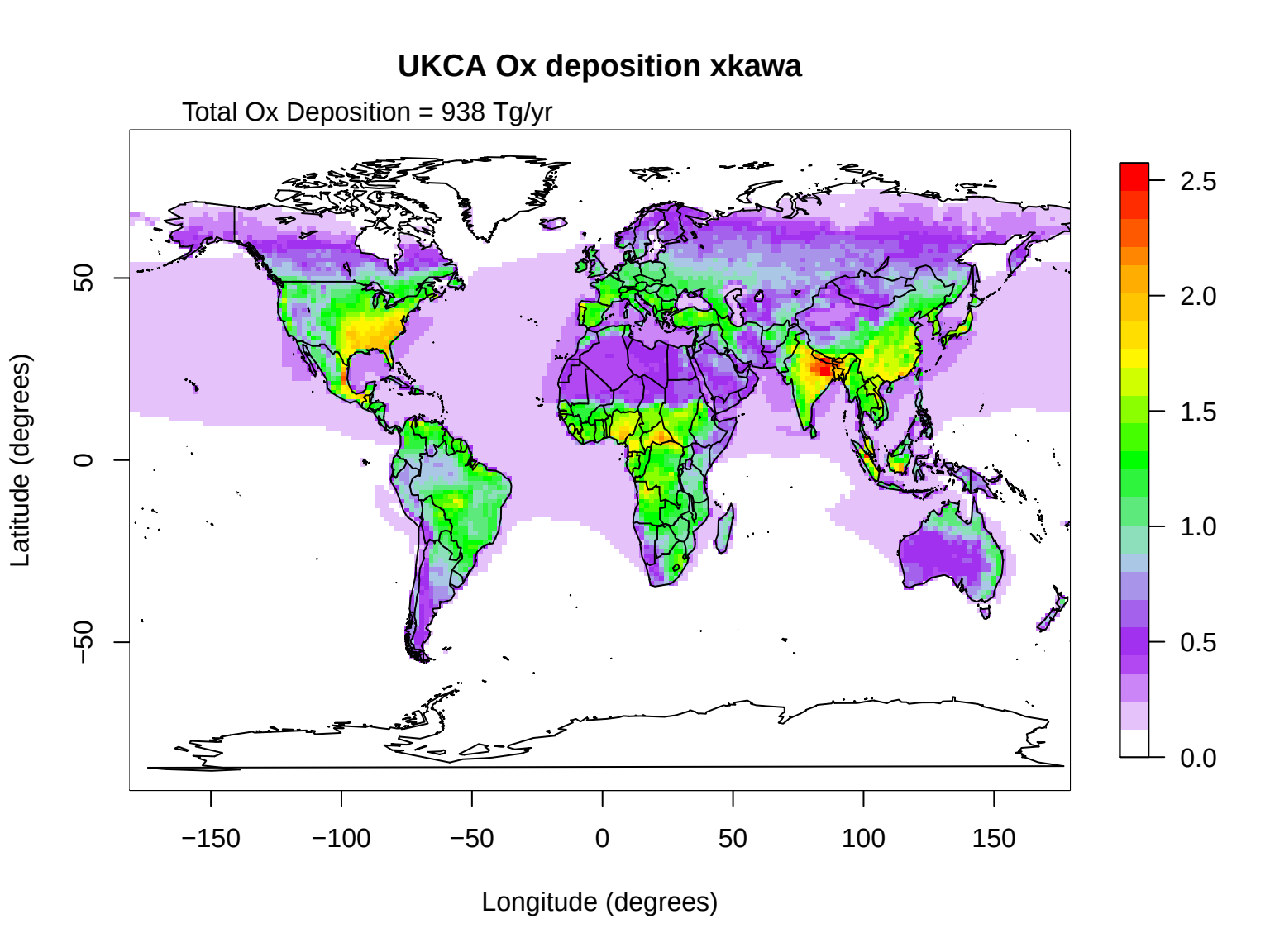

xkawa − ERA Q bias
%
Min = −36.3 Mean = −1.54 Max = 64.3
Altitude (hPa)
10
20
30
50
70
100
150
250
500
700
1000
−90
−75
−60
−45
−30
−15
0
15
30
45
60
75
90
Latitude (degrees)
100
50
0
−50
−100

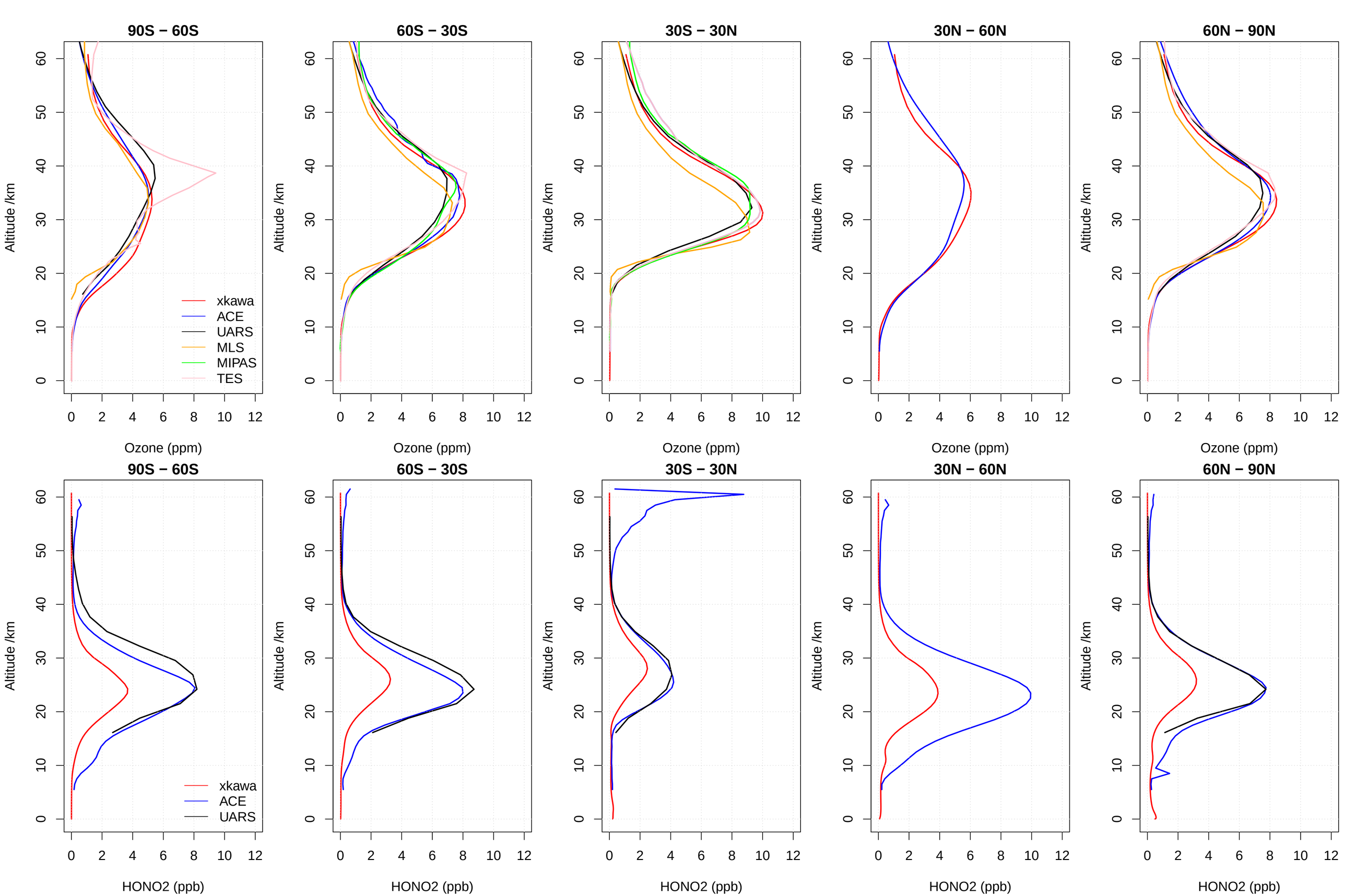

[OH] Air mass weighted
(10^6 molecules cm^{-3})
UKCA xkawa
Mean OH = 7.84e+05
Red: Spivakovsky values
Values in ( ): Std dev
0.2
0.64
(0.17)
0.75
1.43
(0.16)
0.9
1.36
(0.15)
0.43
0.64
(0.24)
0.28
0.72
(0.24)
1.2
2
(0.25)
1.5
1.99
(0.19)
0.64
0.88
(0.34)
0.25
0.47
(0.29)
1.4
1.44
(0.16)
1.8
1.52
(0.21)
0.74
0.76
(0.56)
Pressure (hPa)
250
500
750
1000
−50
0
50
Latitude


UKCA xkawa Ox Net Chemical Production
Ox Prod = 4.12e+03Tg/yr
Ox Loss = 3.46e+03Tg/yr
Ox Net = 657Tg/yr
STE inferred = 281Tg/yr
STE diag. = 198Tg/yr
Lifetime = 18.7days
Altitude (km)
20
15
10
5
−50
0
50
Latitude (degrees)
2e−19
1e−19
0e+00
−1e−19
−2e−19


xkawa Production of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
60
70
70
21
8
1
HO2+NO
MeO2+NO
RO2+NO
Other


xkawa Loss of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
43
0
26
8
1
1
18
3
O1D+H2O
Minor
HO2+O3
OH+O3
O3+Alk
NxOy
O3dry
NOydep


UKCA Ox deposition xkawa
Total Ox Deposition = 938 Tg/yr
Latitude (degrees)
50
0
−50
−150
−100
−50
0
50
100
150
Longitude (degrees)
2.5
2.0
1.5
1.0
0.5
0.0


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

90S − 60S

60S − 30S

30S − 30N

30N − 60N

60N − 90N

Altitude /km

0 10 20 30 40 50 60

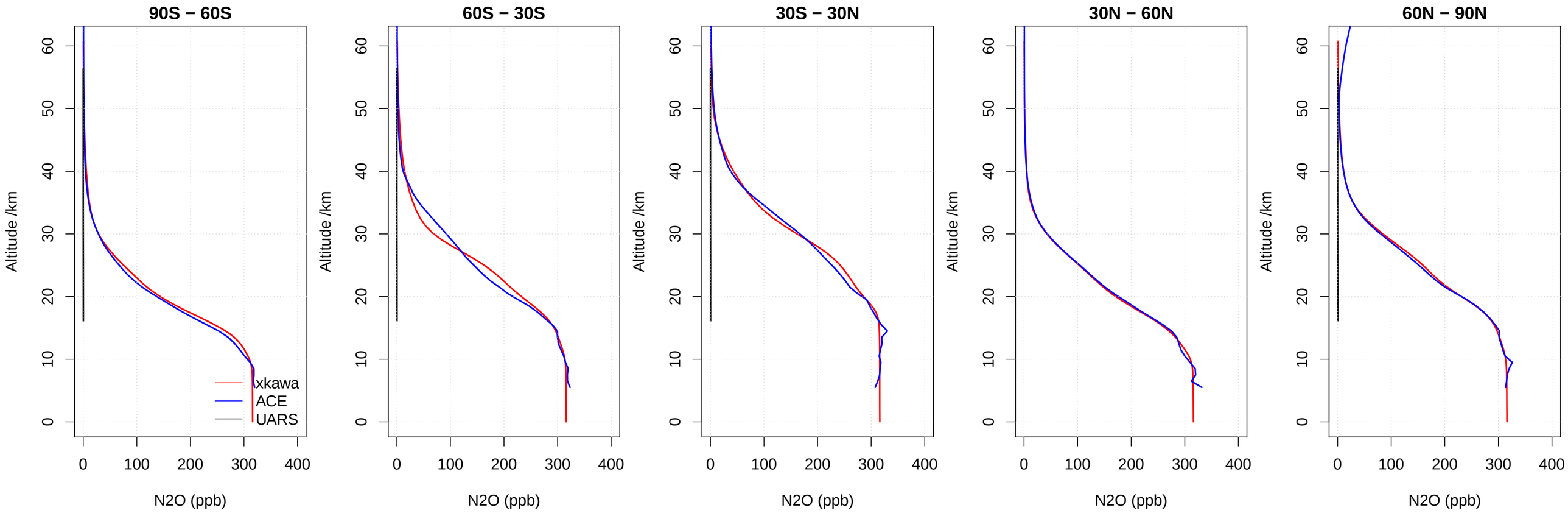
0 2 4 6 8 10

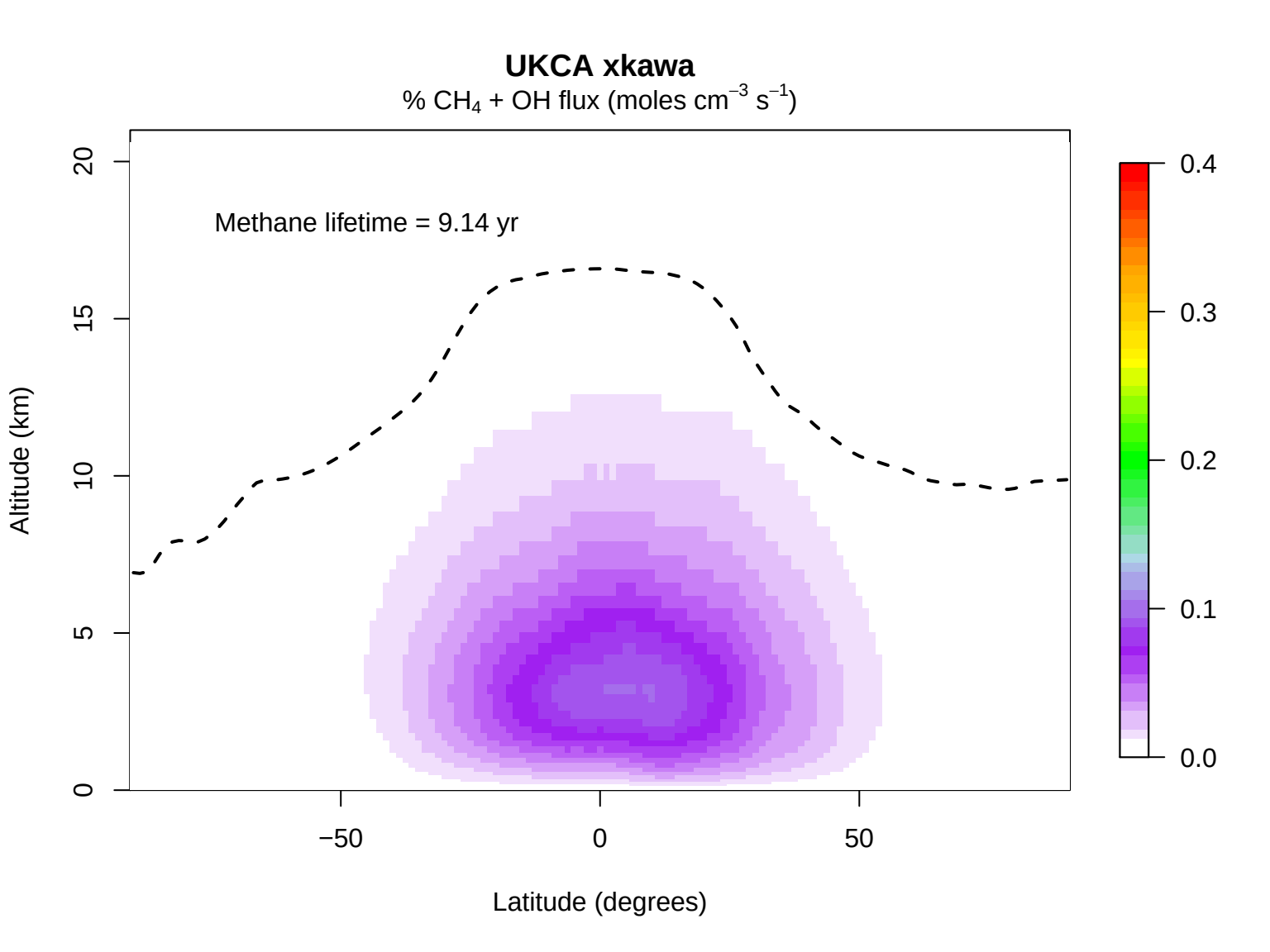
xkawa
ACE
UARS

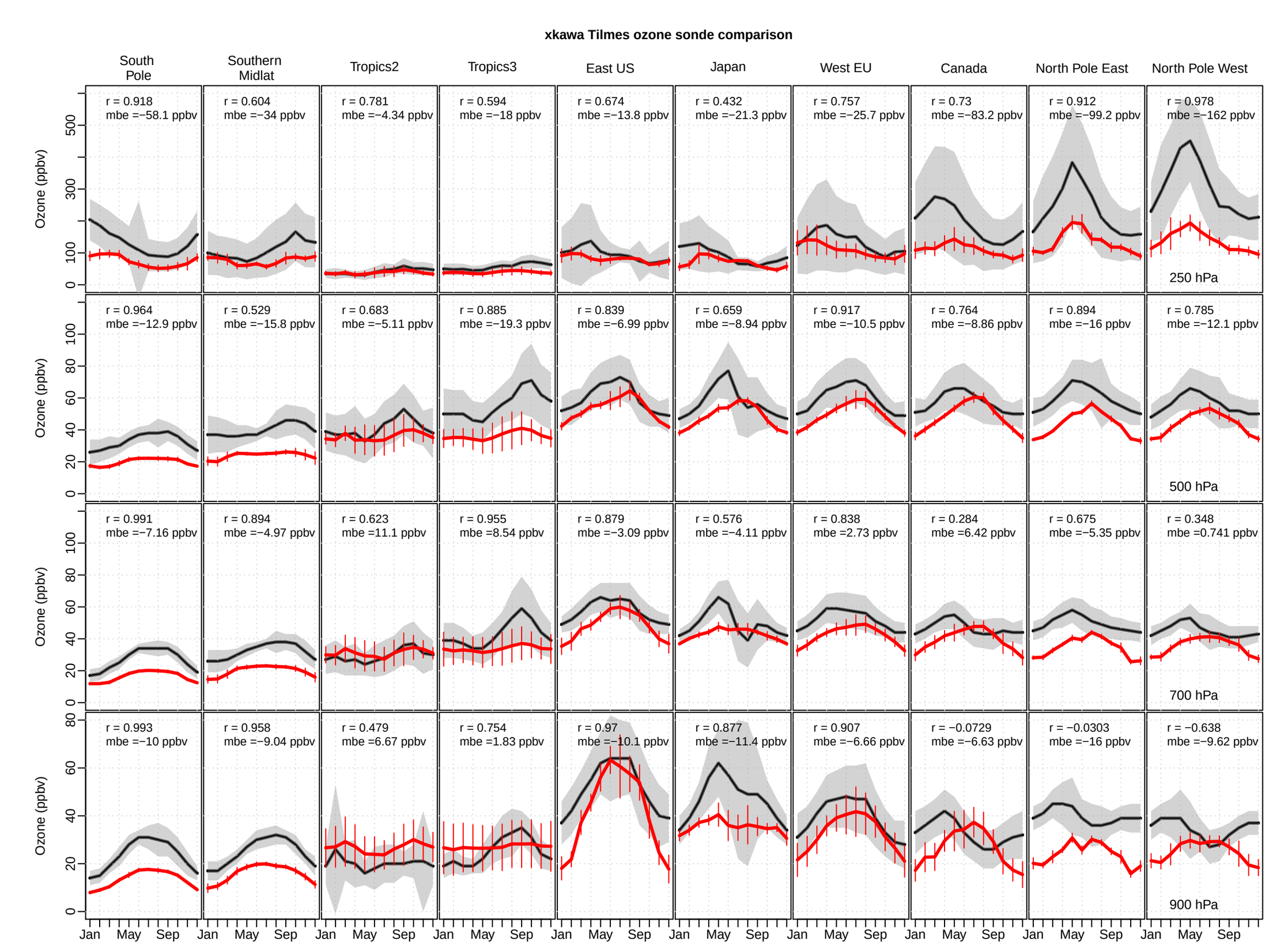
NO2 (ppb)

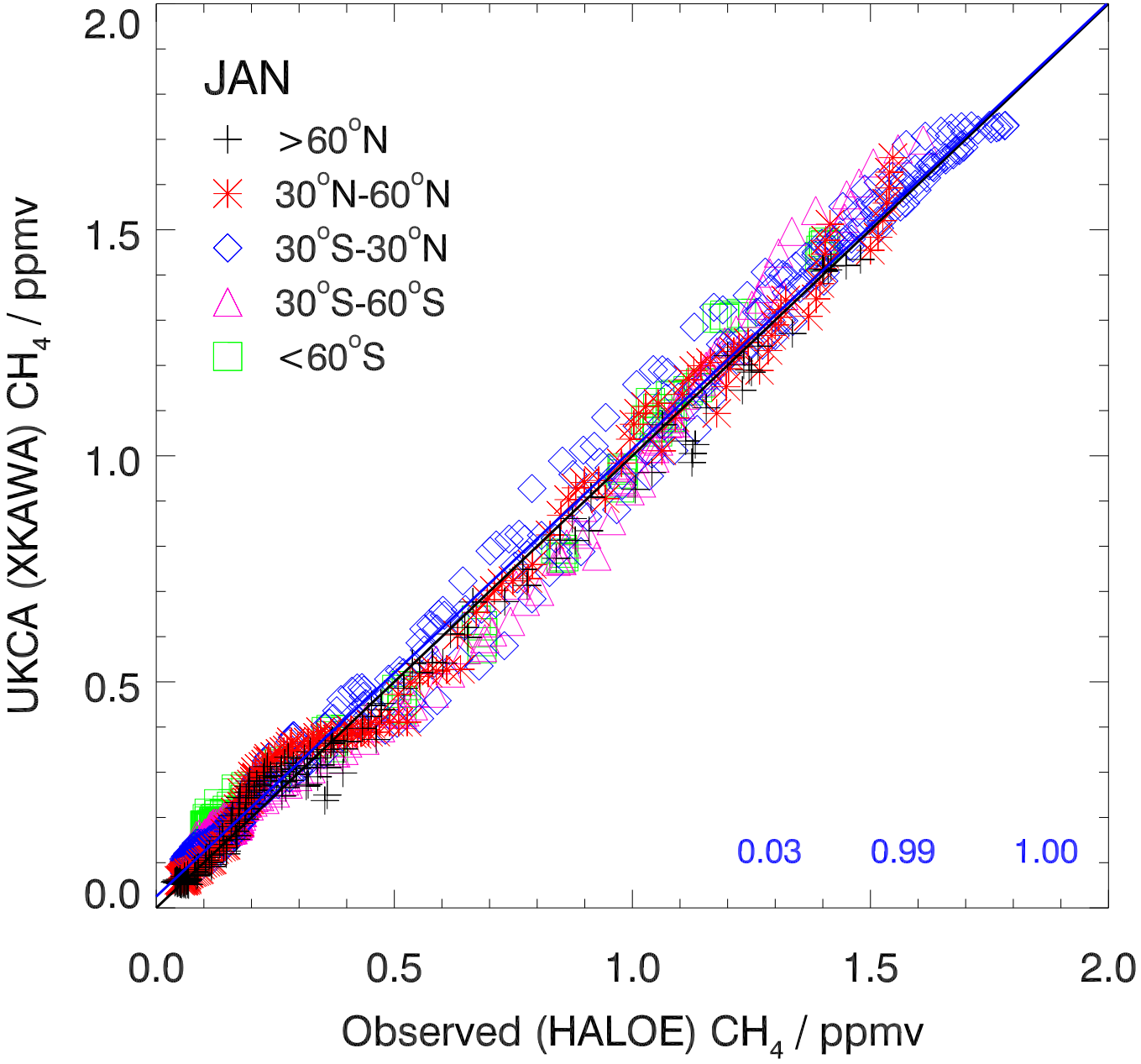
0 50 100 200 300

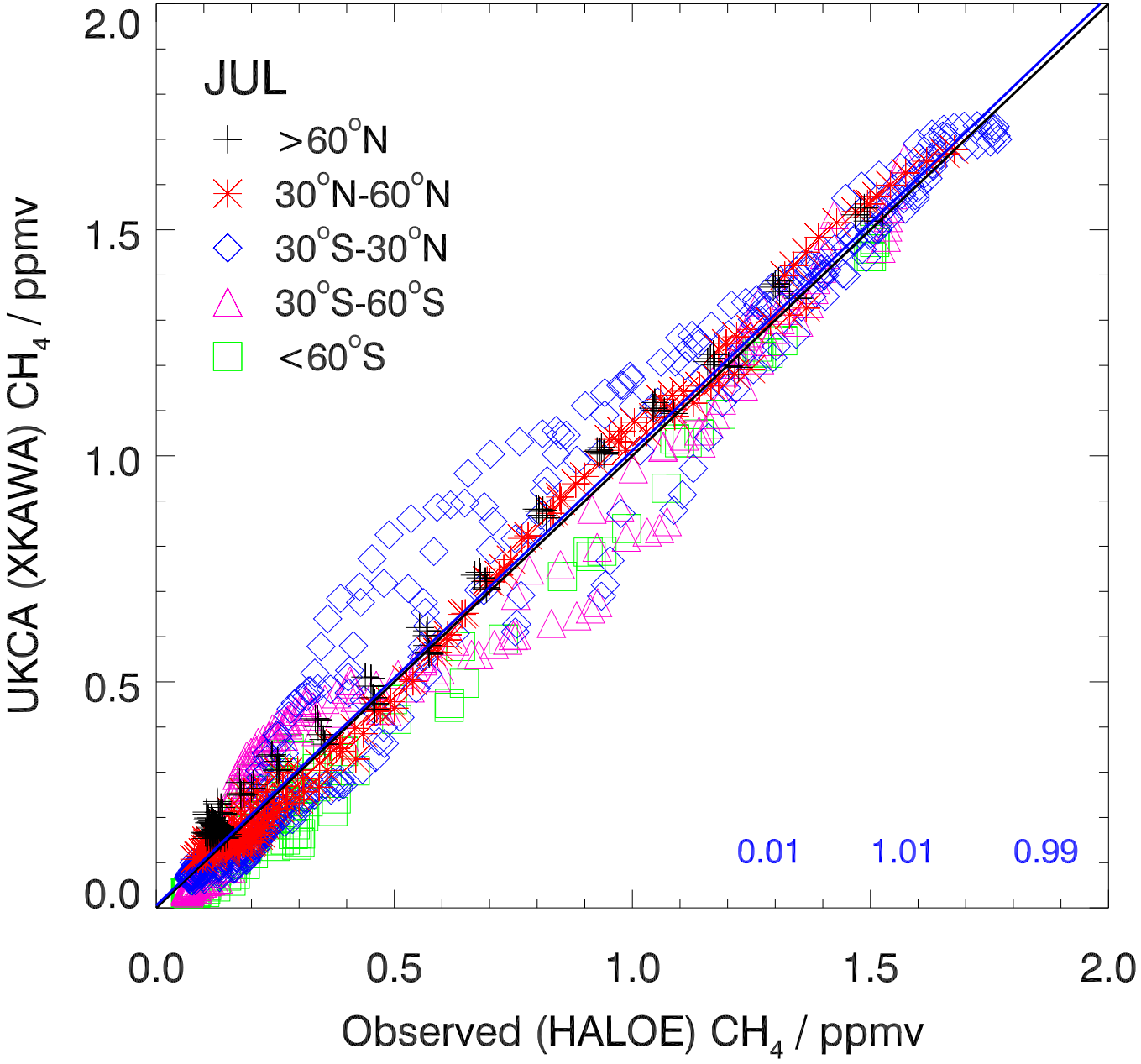
H2O (ppm)

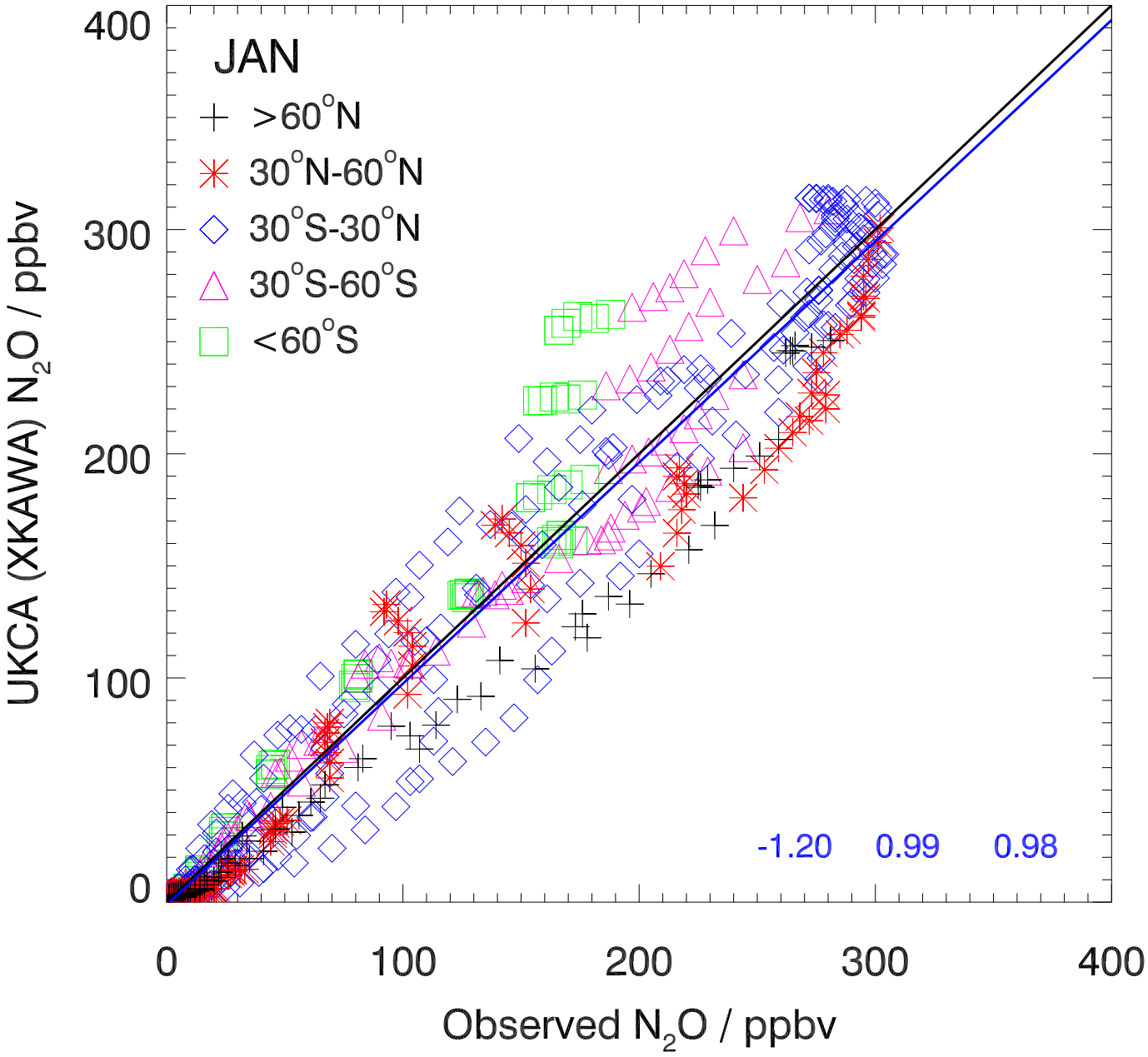

90S − 60S
60S − 30S
30S − 30N
30N − 60N
60N − 90N
Altitude /km
N2O (ppb)
0
10
20
30
40
50
60
0
100
200
300
400
xkawa
ACE
UARS

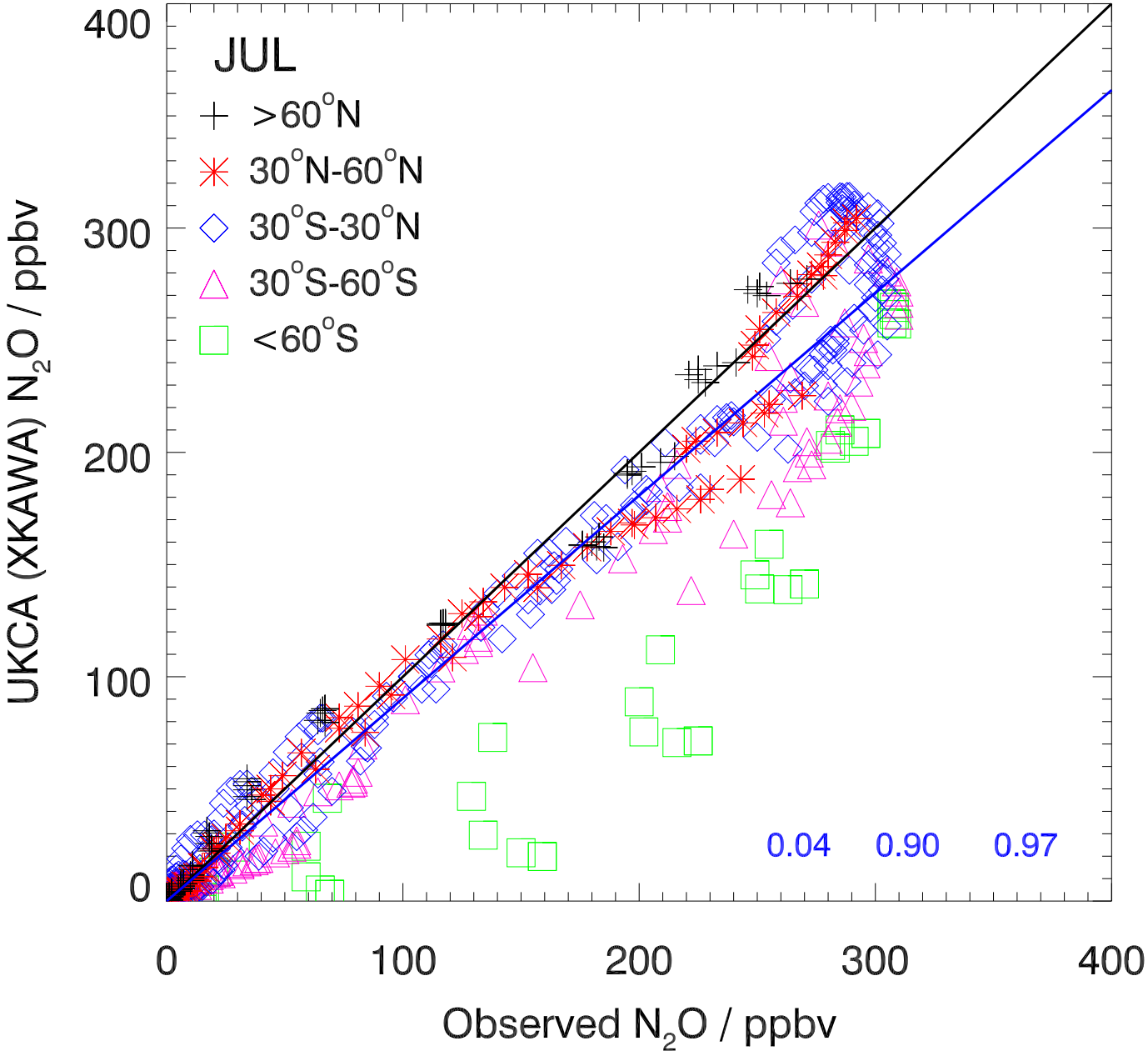

UKCA xkawa
% CH4 + OH flux (moles cm−3 s−1)
Methane lifetime = 9.14 yr
Altitude (km)
0
5
10
15
20
−50
0
50
Latitude (degrees)
0.4
0.3
0.2
0.1
0.0

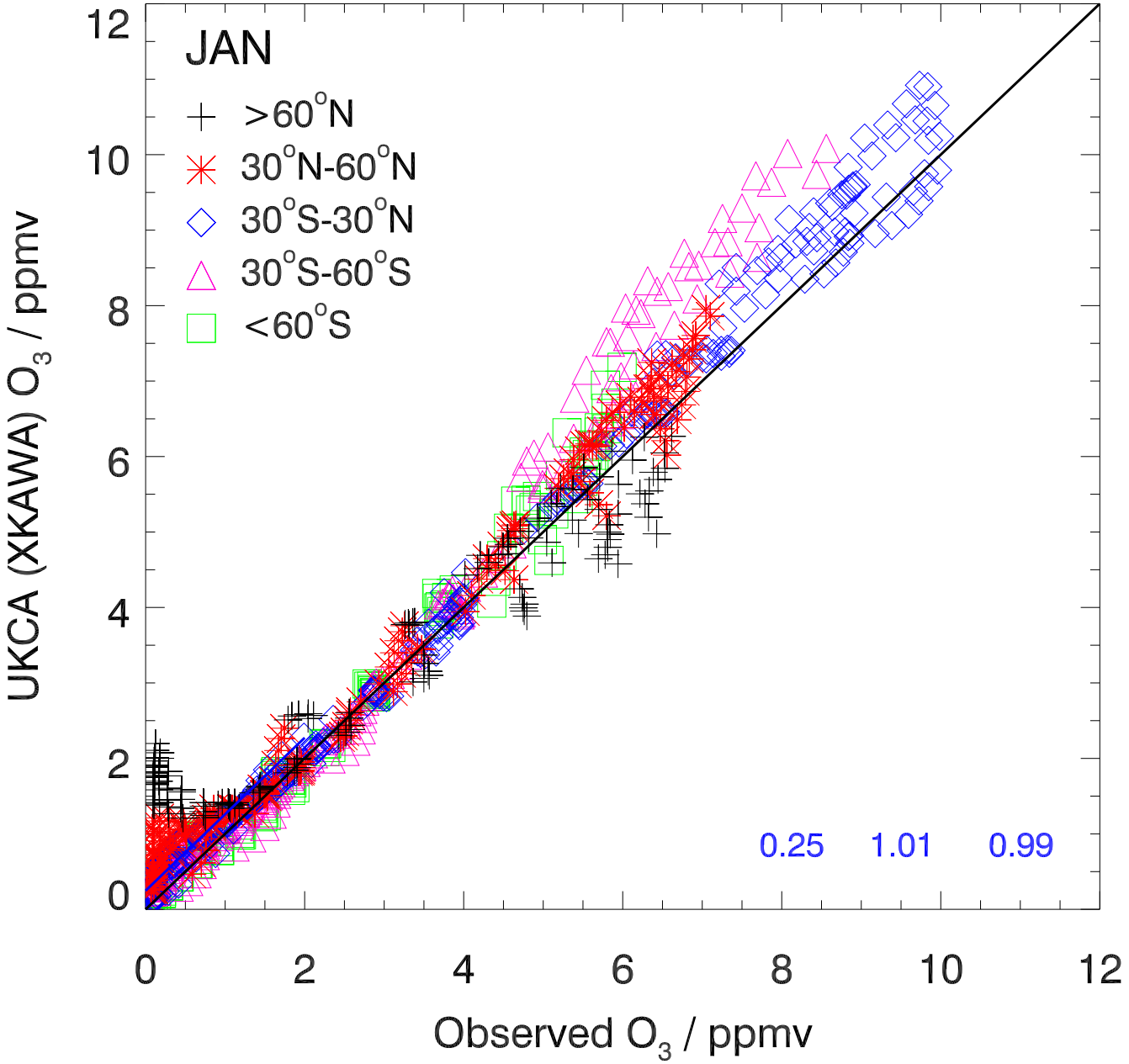

xkawa Tilmes ozone sonde comparison
South Pole
Southern Midlat
Tropics2
Tropics3
East US
Japan
West EU
Canada
North Pole East
North Pole West
Ozone (ppbv)
r = 0.918
mbe =−58.1 ppbv
r = 0.604
mbe =−34 ppbv
r = 0.781
mbe =−4.34 ppbv
r = 0.594
mbe =−18 ppbv
r = 0.674
mbe =−13.8 ppbv
r = 0.432
mbe =−21.3 ppbv
r = 0.757
mbe =−25.7 ppbv
r = 0.73
mbe =−83.2 ppbv
r = 0.912
mbe =−99.2 ppbv
r = 0.978
mbe =−162 ppbv
250 hPa
r = 0.964
mbe =−12.9 ppbv
r = 0.529
mbe =−15.8 ppbv
r = 0.683
mbe =−5.11 ppbv
r = 0.885
mbe =−19.3 ppbv
r = 0.839
mbe =−6.99 ppbv
r = 0.659
mbe =−8.94 ppbv
r = 0.917
mbe =−10.5 ppbv
r = 0.764
mbe =−8.86 ppbv
r = 0.894
mbe =−16 ppbv
r = 0.785
mbe =−12.1 ppbv
500 hPa
r = 0.991
mbe =−7.16 ppbv
r = 0.894
mbe =−4.97 ppbv
r = 0.623
mbe =11.1 ppbv
r = 0.955
mbe =8.54 ppbv
r = 0.879
mbe =−3.09 ppbv
r = 0.576
mbe =−4.11 ppbv
r = 0.838
mbe =2.73 ppbv
r = 0.284
mbe =6.42 ppbv
r = 0.675
mbe =−5.35 ppbv
r = 0.348
mbe =0.741 ppbv
700 hPa
r = 0.993
mbe =−10 ppbv
r = 0.958
mbe =−9.04 ppbv
r = 0.479
mbe =6.67 ppbv
r = 0.754
mbe =1.83 ppbv
r = 0.97
mbe =−10.1 ppbv
r = 0.877
mbe =−11.4 ppbv
r = 0.907
mbe =−6.66 ppbv
r = −0.0729
mbe =−6.63 ppbv
r = −0.0303
mbe =−16 ppbv
r = −0.638
mbe =−9.62 ppbv
900 hPa
Jan
May
Sep

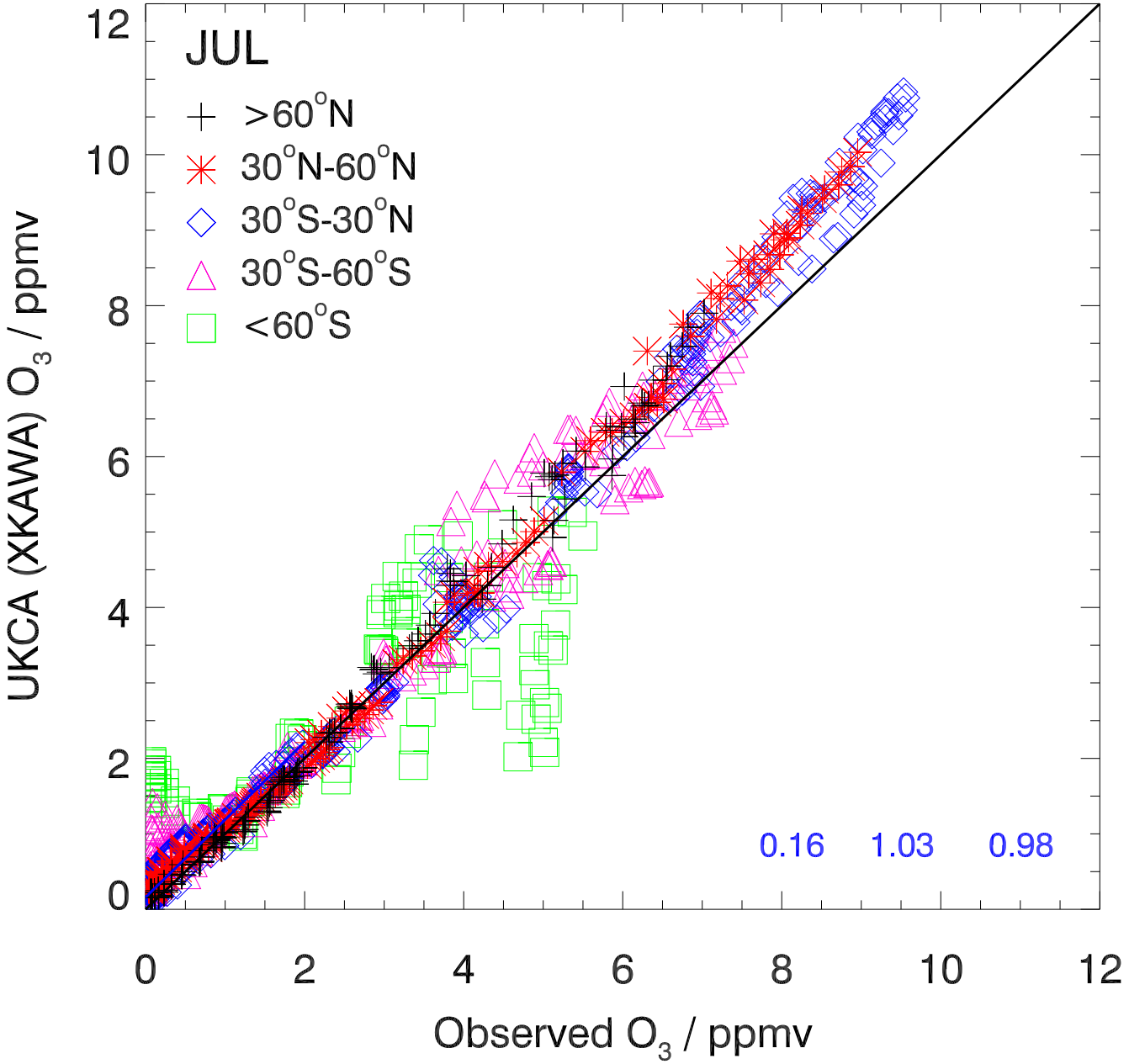

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.03
0.99
1.00
UKCA (XKAWA) CH4 / ppmv
Observed (HALOE) CH4 / ppmv
0.0
0.5
1.0
1.5
2.0

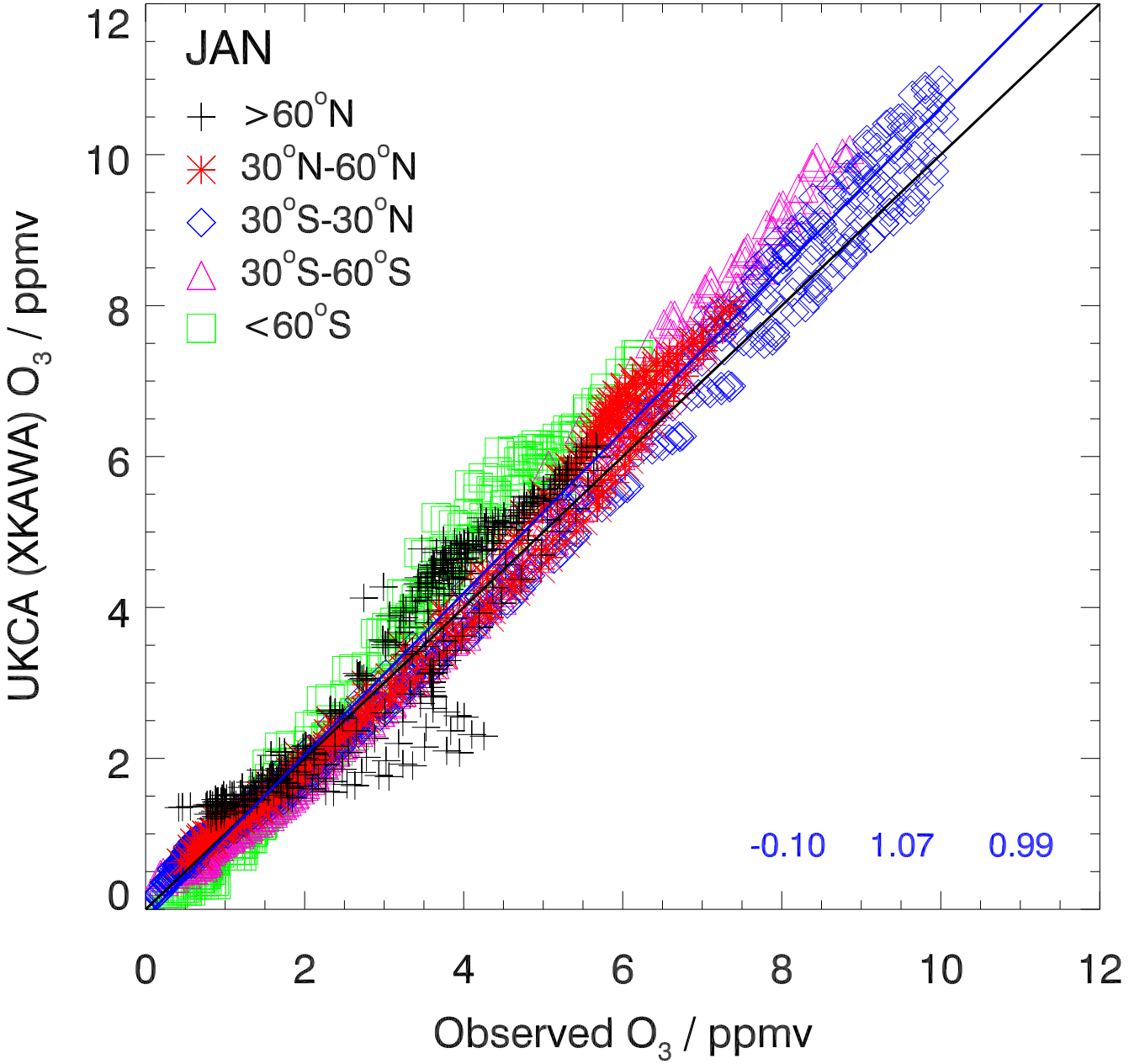

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.01
1.01
0.99
UKCA (XKAWA) CH4 / ppmv
Observed (HALOE) CH4 / ppmv
0.0
0.5
1.0
1.5
2.0

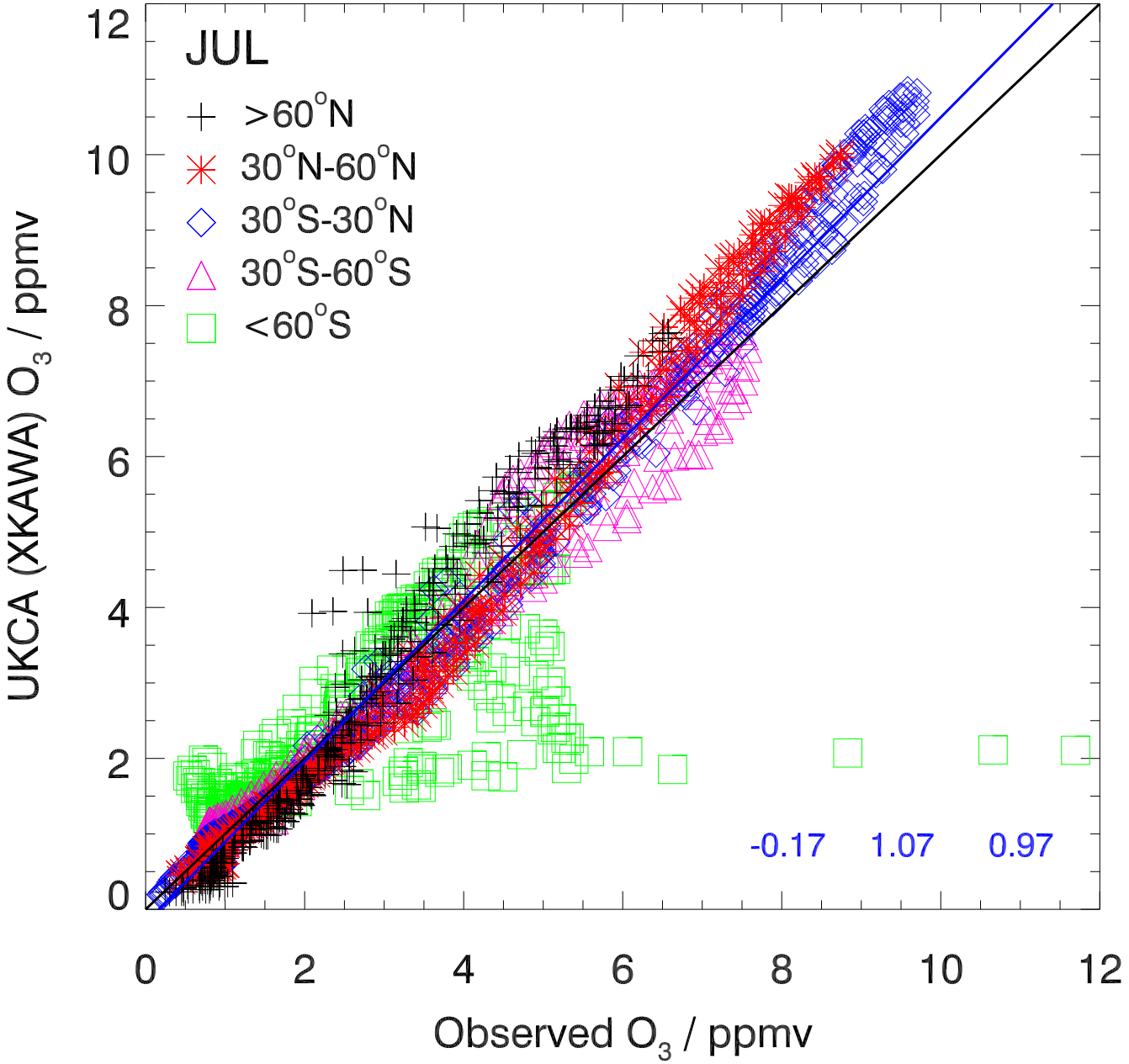

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-1.20
0.99
0.98
UKCA (XKAWA) N2O / ppbv
Observed N2O / ppbv
0
100
200
300
400

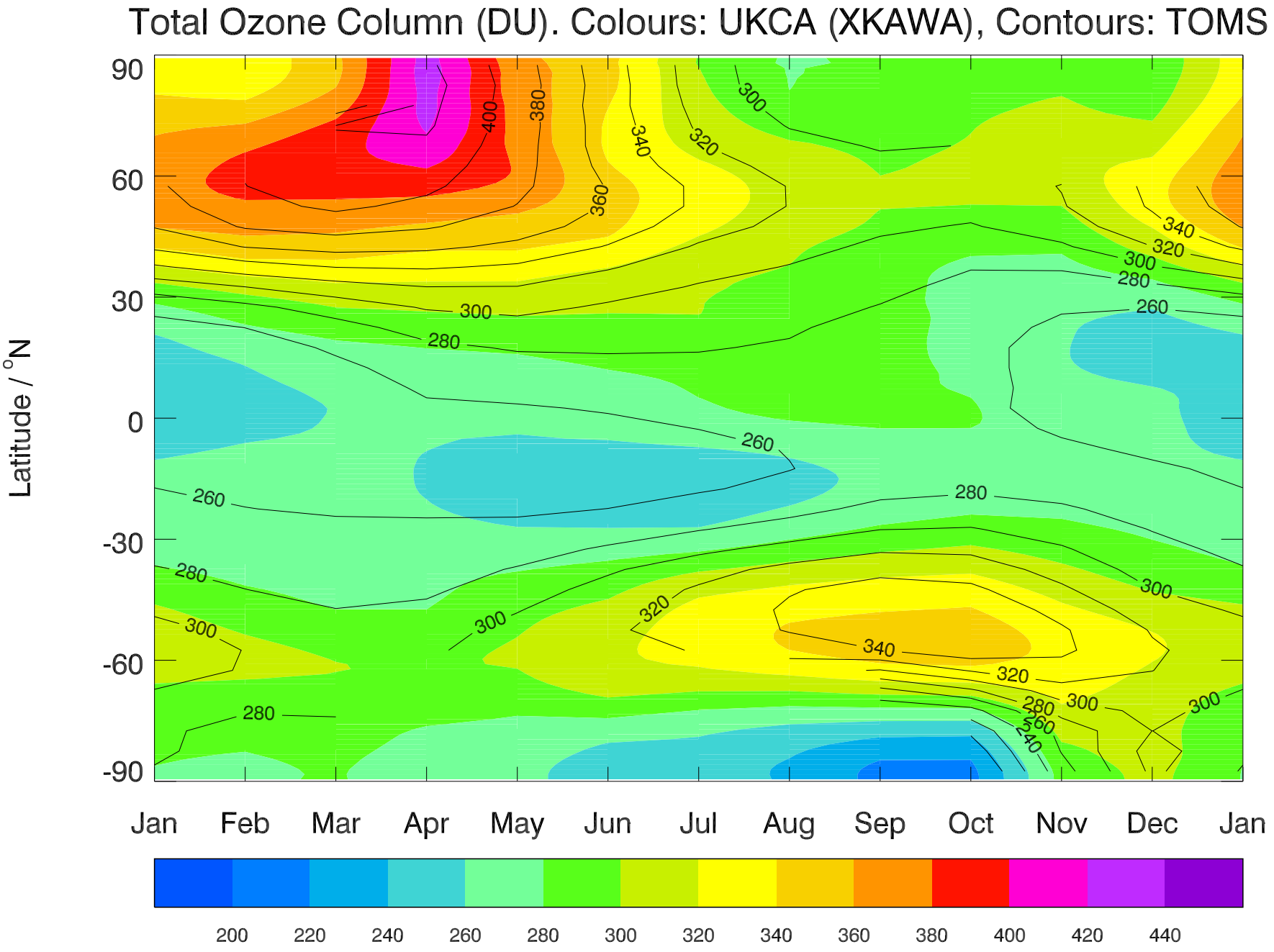

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.04
0.90
0.97
UKCA (XKAWA) N2O / ppbv
Observed N2O / ppbv
0
100
200
300
400

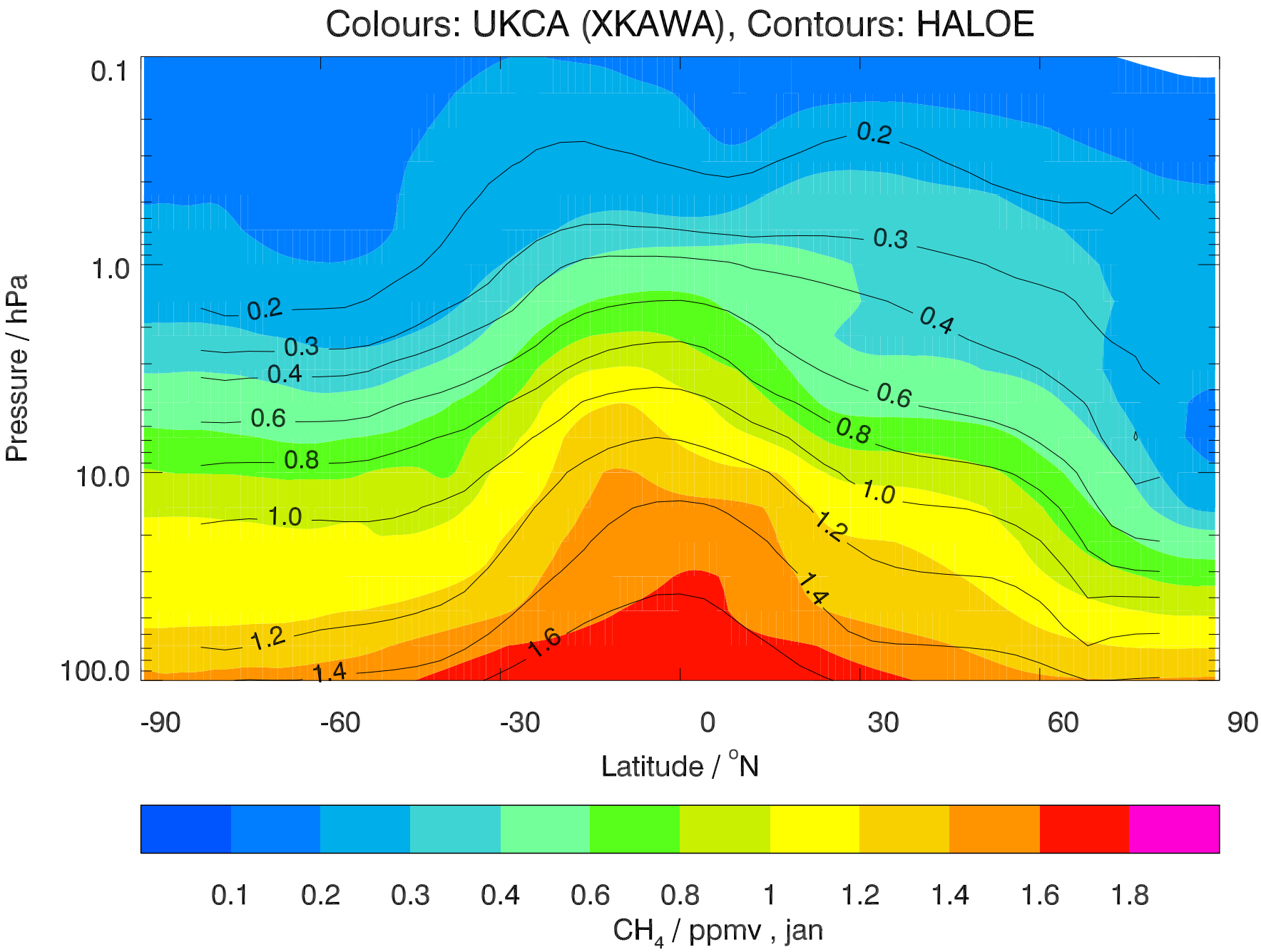

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.25
1.01
0.99
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

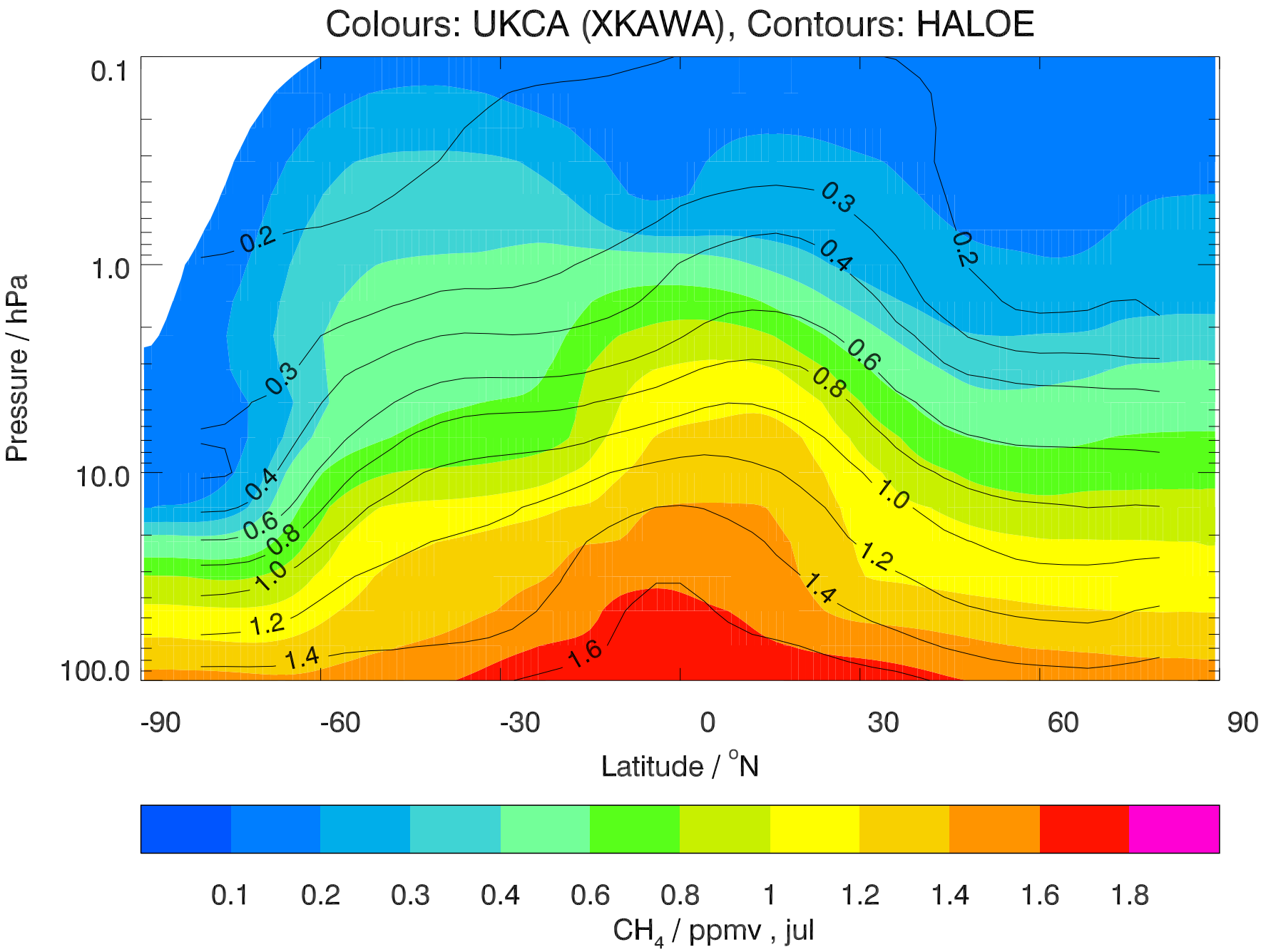

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.16
1.03
0.98
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

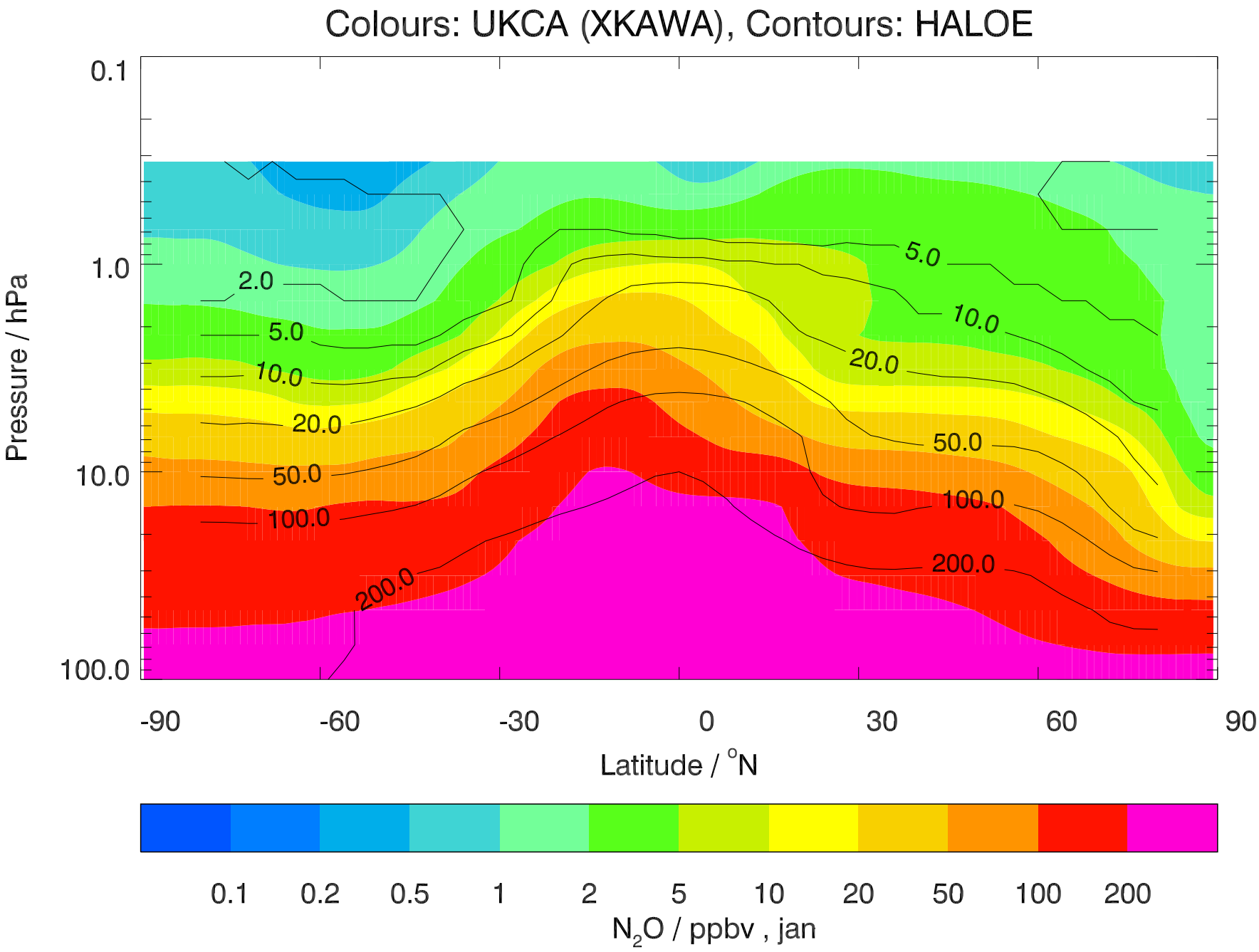

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-0.10
1.07
0.99
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

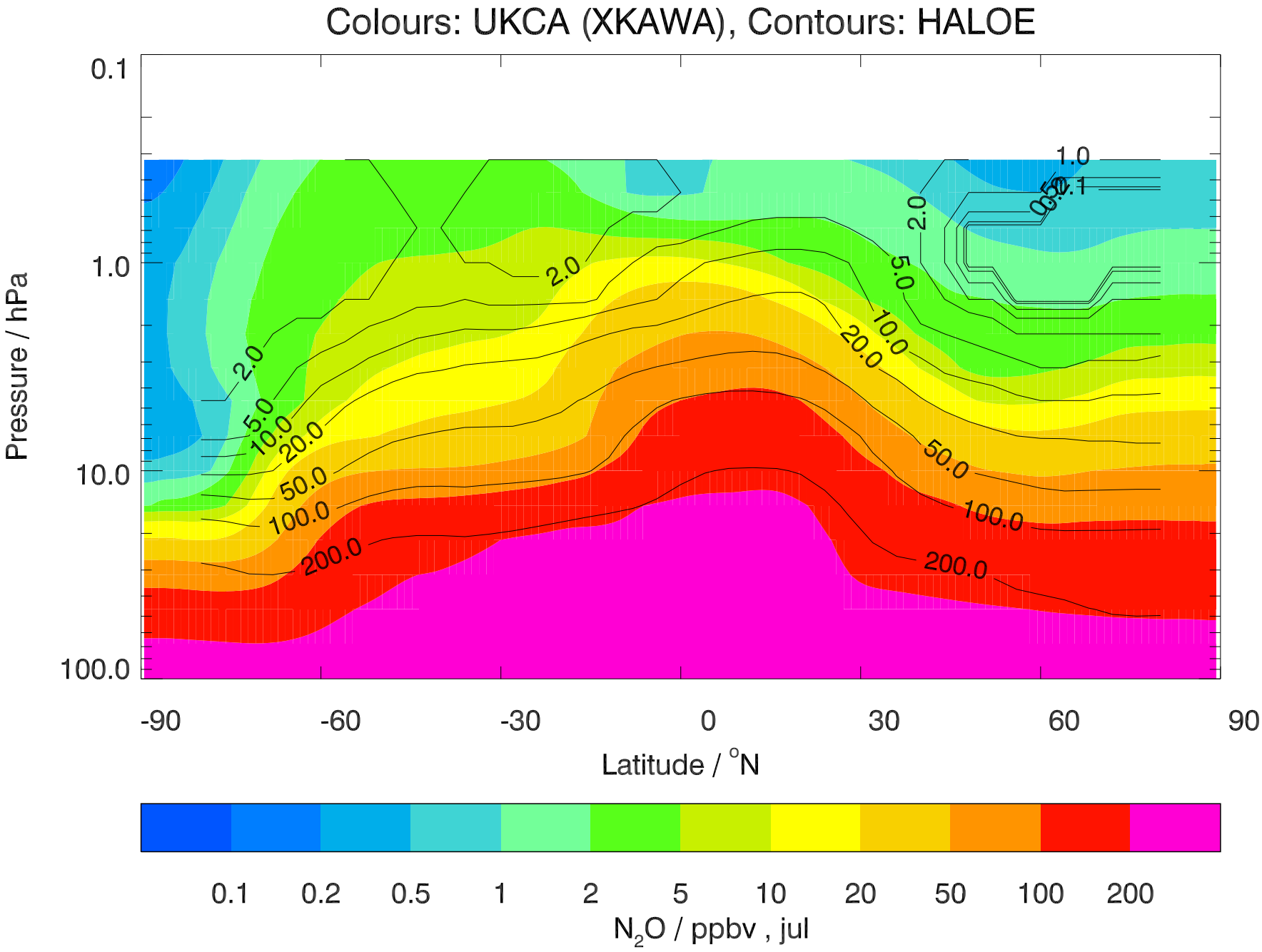

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-0.17
1.07
0.97
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

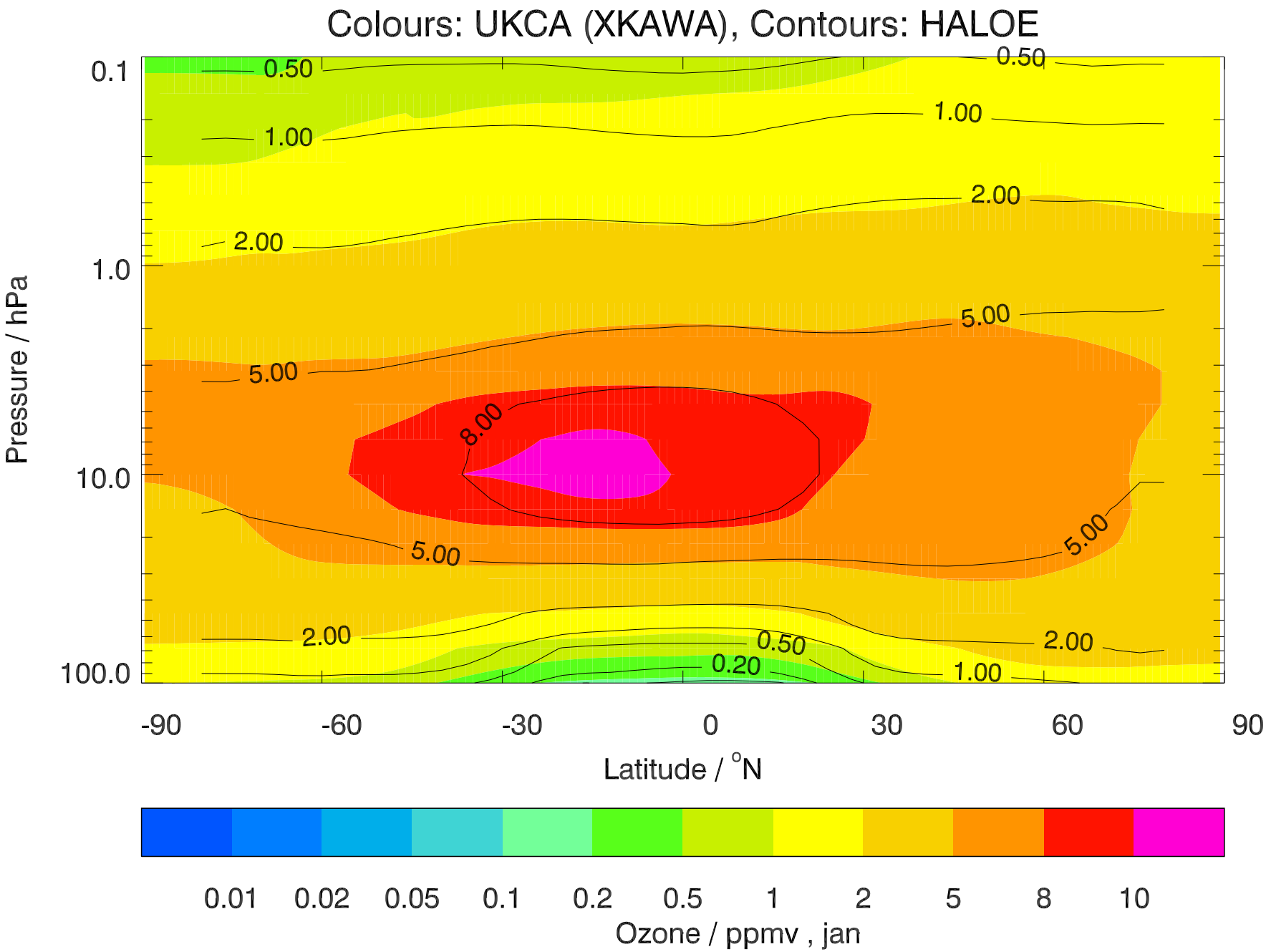

Total Ozone Column (DU). Colours: UKCA (XKAWA), Contours: TOMS
Latitude / °N
90
60
30
0
-30
-60
-90
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
200
220
240
260
280
300
320
340
360
380
400
420
440

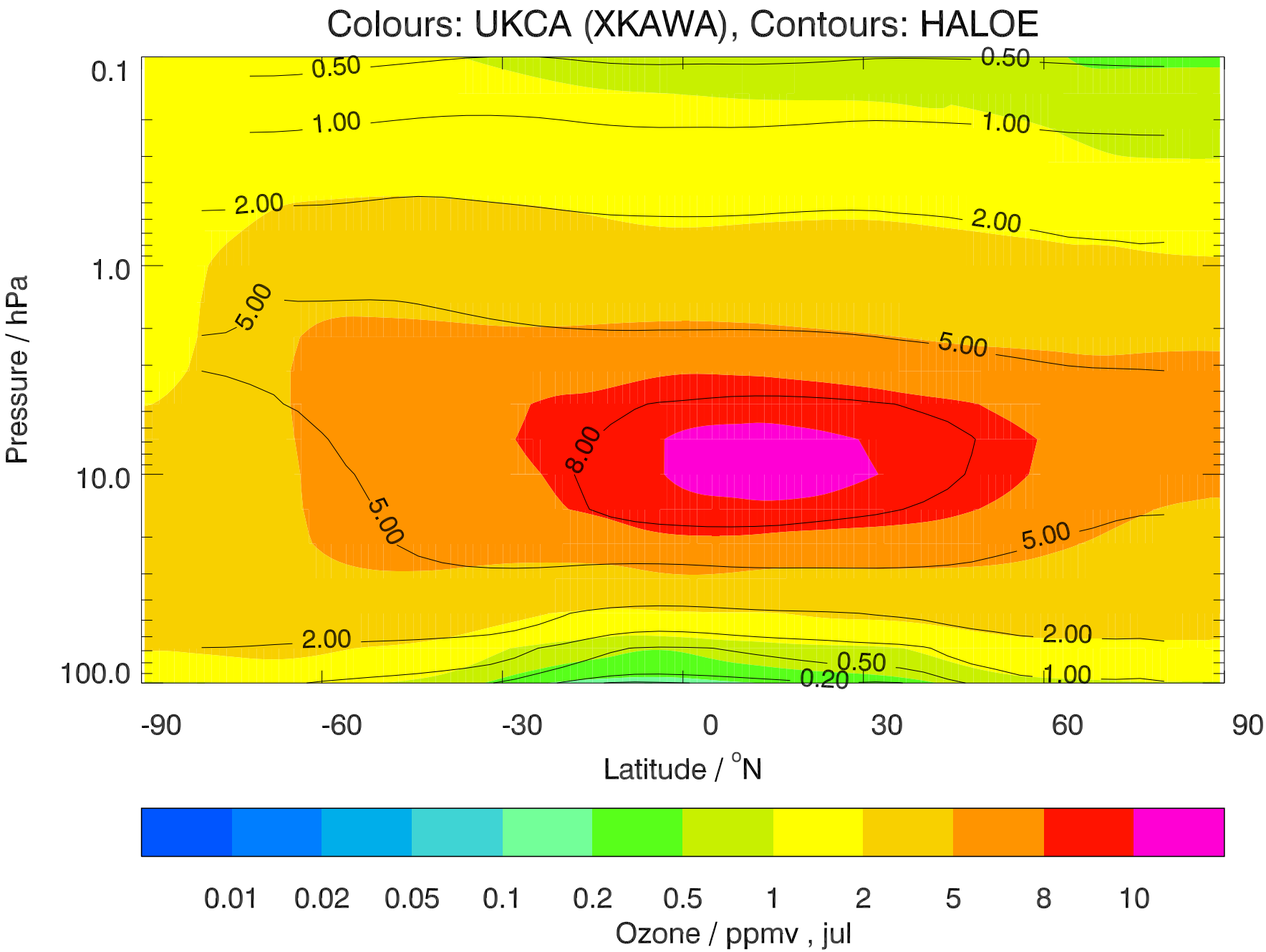

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
0.2
0.3
0.4
0.6
0.8
1.0
1.2
1.4
1.6
-90
-60
-30
0
30
60
90
Latitude / °N
0.1
0.2
0.3
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
CH4 / ppmv , jan

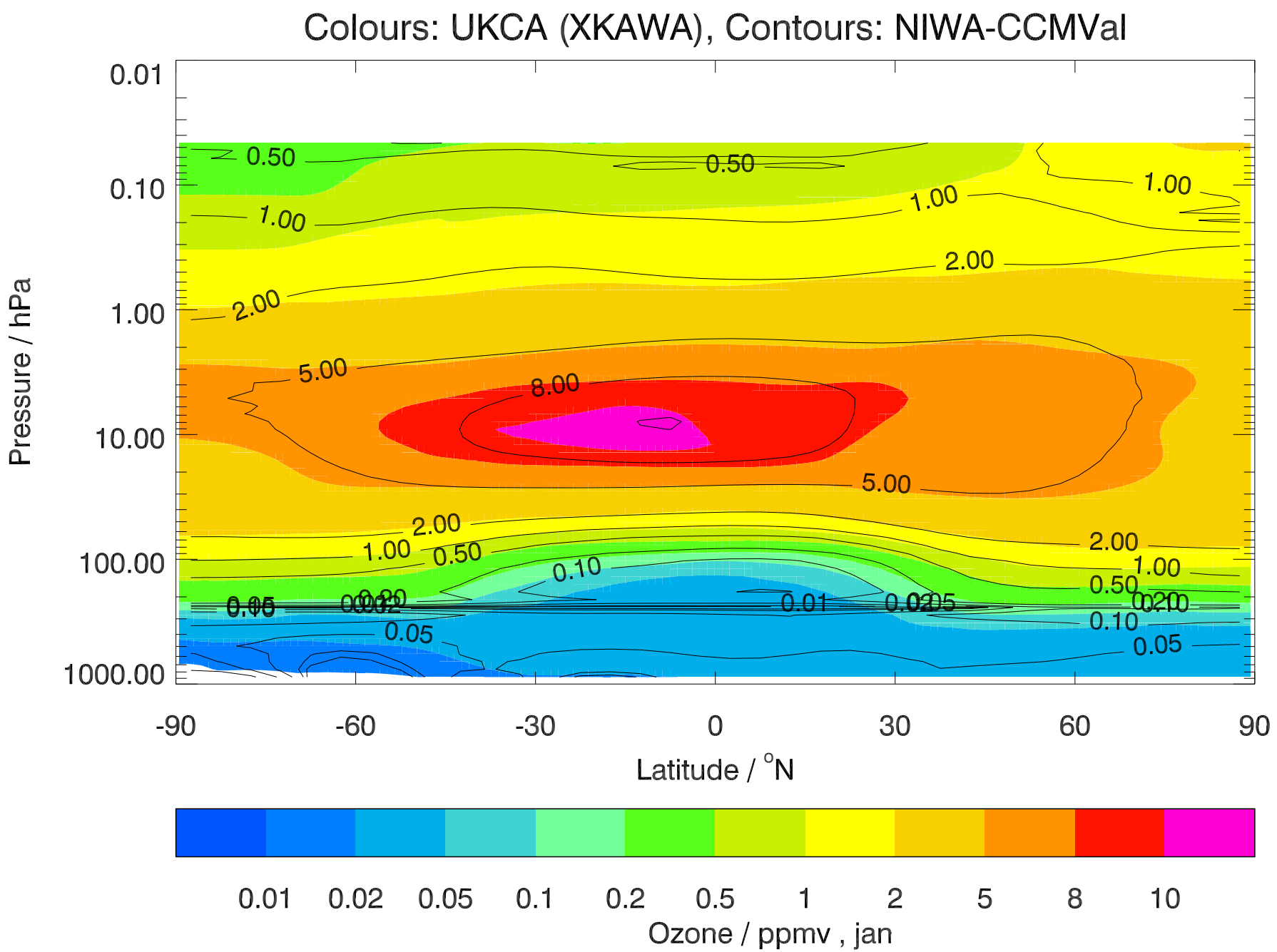

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
0.2
0.3
0.4
0.6
0.8
1.0
1.2
1.4
1.6
-90
-60
-30
0
30
60
90
Latitude / °N
0.1
0.2
0.3
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
CH4 / ppmv , jul

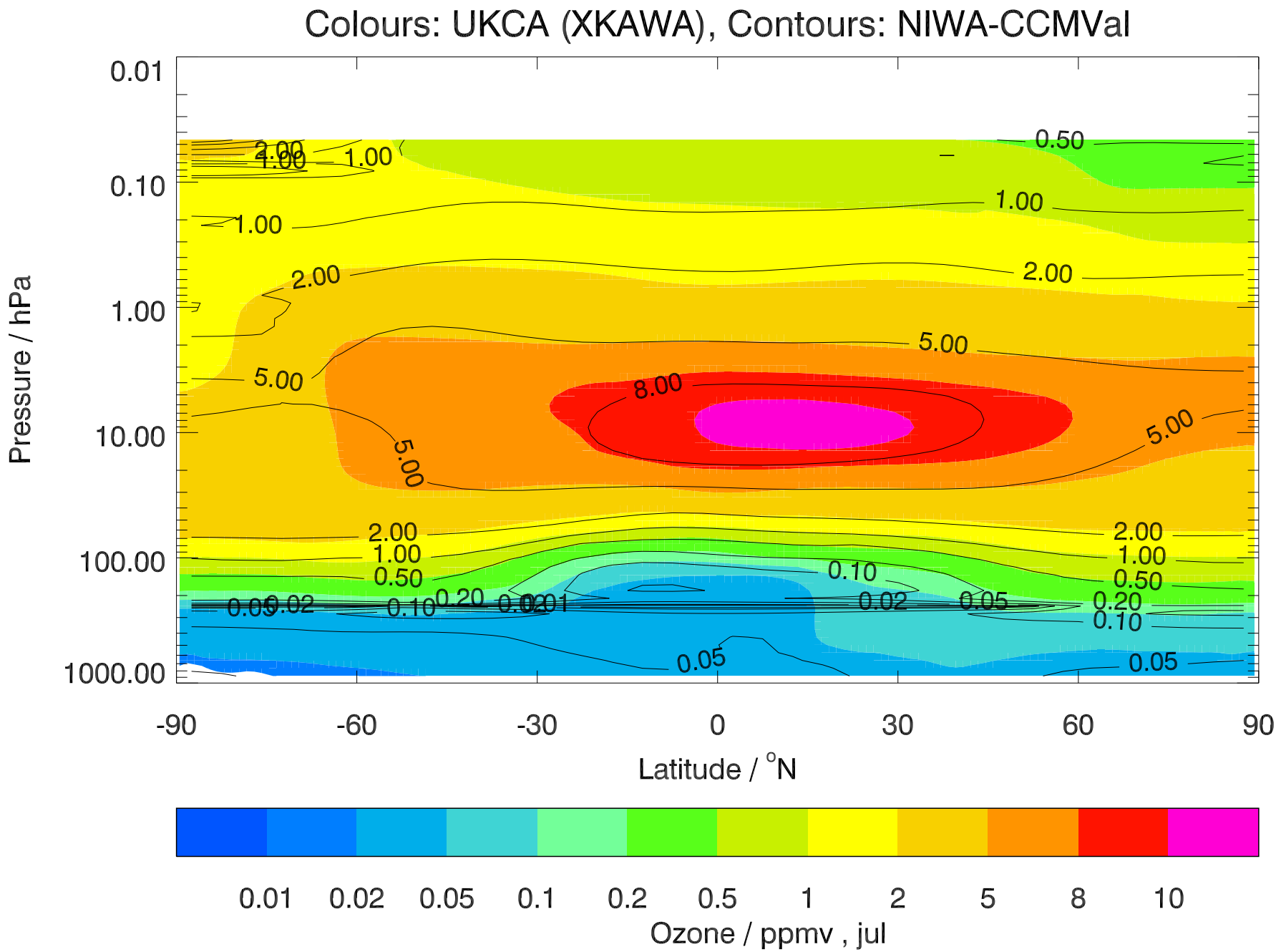

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
2.0
5.0
10.0
20.0
50.0
100.0
200.0
-90
-60
-30
0
30
60
90
Latitude / °N
0.1
0.2
0.5
1
2
5
10
20
50
100
200
N2O / ppbv , jan

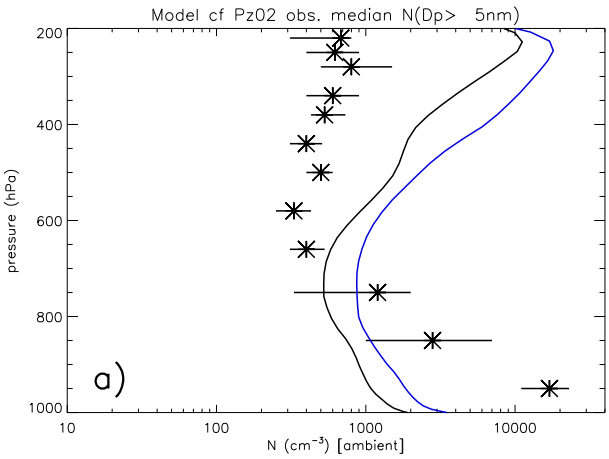

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
-90
-60
-30
0
30
60
90
Latitude / °N
1.0
0.5
0.1
2.0
5.0
10.0
20.0
50.0
100.0
200.0
0.1
0.2
0.5
1
2
5
10
20
50
100
200
N2O / ppbv , jul

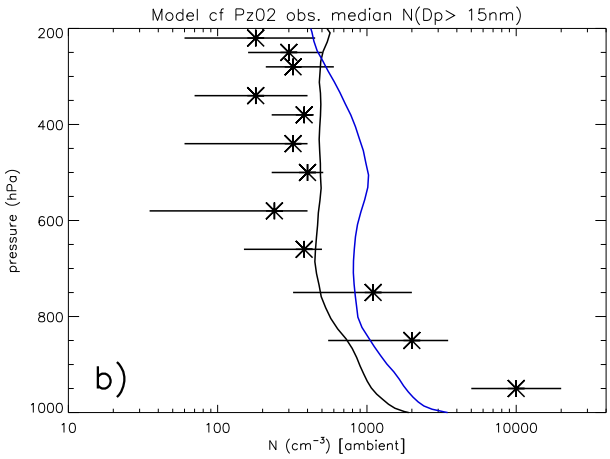

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
0.50
1.00
2.00
5.00
8.00
0.20
-90
-60
-30
0
30
60
90
Latitude / °N
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jan

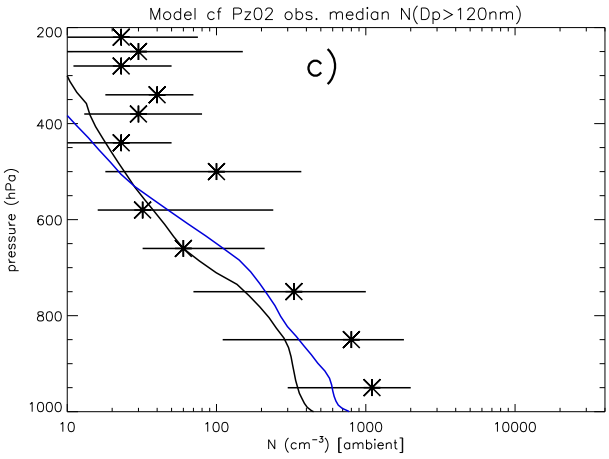

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
0.50
1.00
2.00
5.00
8.00
0.20
-90
-60
-30
0
30
60
90
Latitude / °N
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jul


Colours: UKCA (XKAWA), Contours: NIWA-CCMVal
Pressure / hPa
0.01
0.10
1.00
10.00
100.00
1000.00
-90
-60
-30
0
30
60
90
Latitude / °N
0.50
1.00
2.00
5.00
8.00
0.10
0.05
0.01
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jan

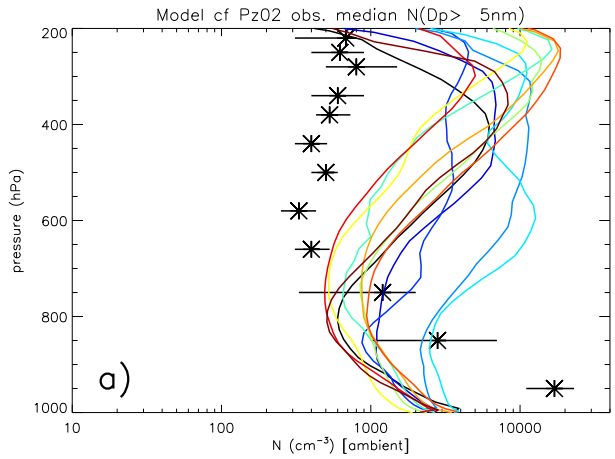

Colours: UKCA (XKAWA), Contours: NIWA-CCMVal
Pressure / hPa
0.01
0.10
1.00
10.00
100.00
1000.00
-90
-60
-30
0
30
60
90
Latitude / °N
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jul

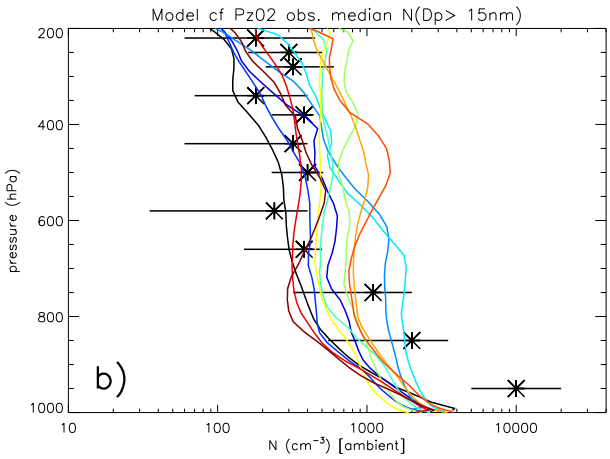


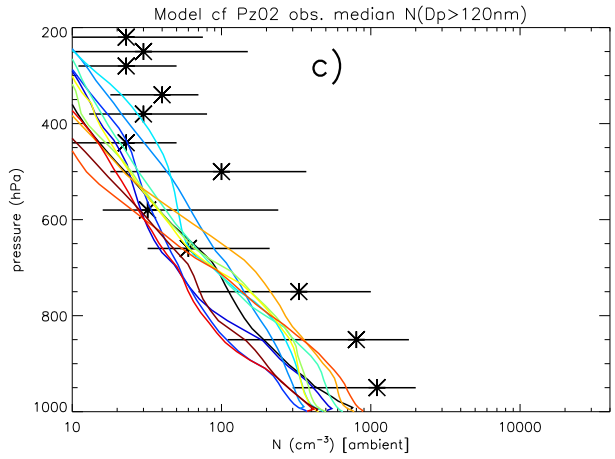




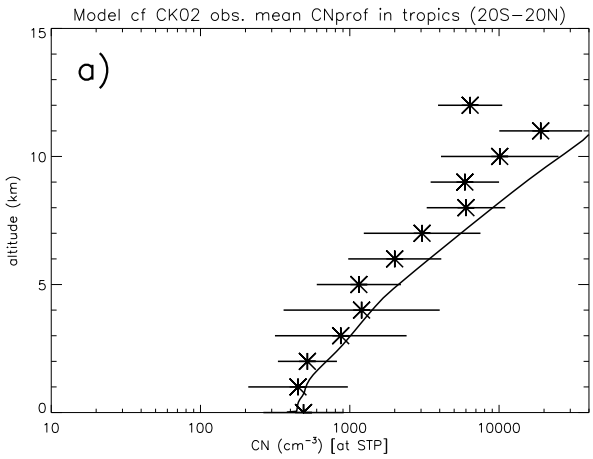
HadGEM3UKCA_XKAWA_2004

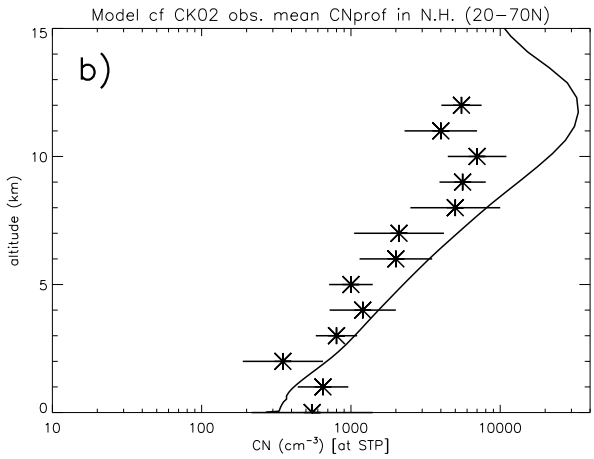


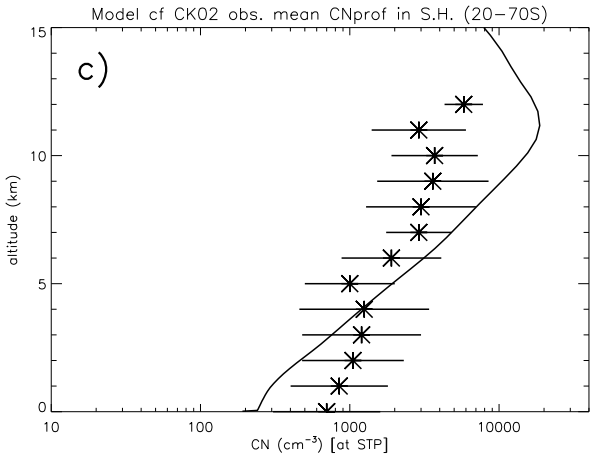




HadGEM3UKCA_XKAWA_2004







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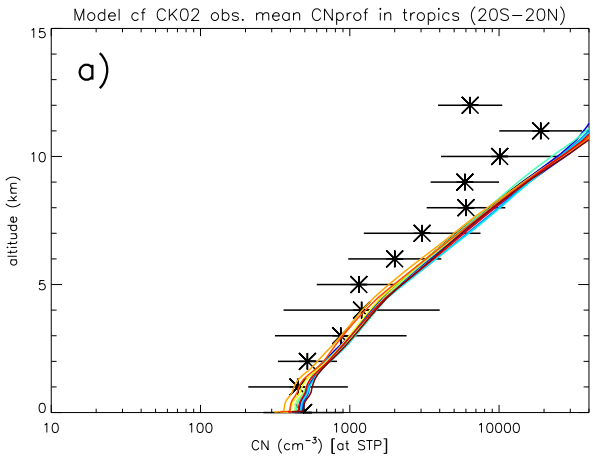
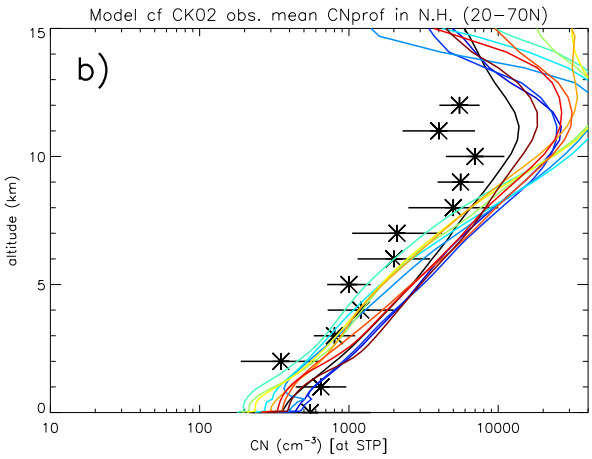
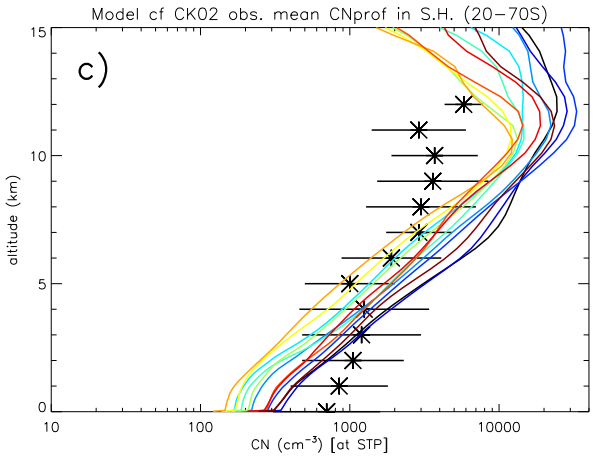
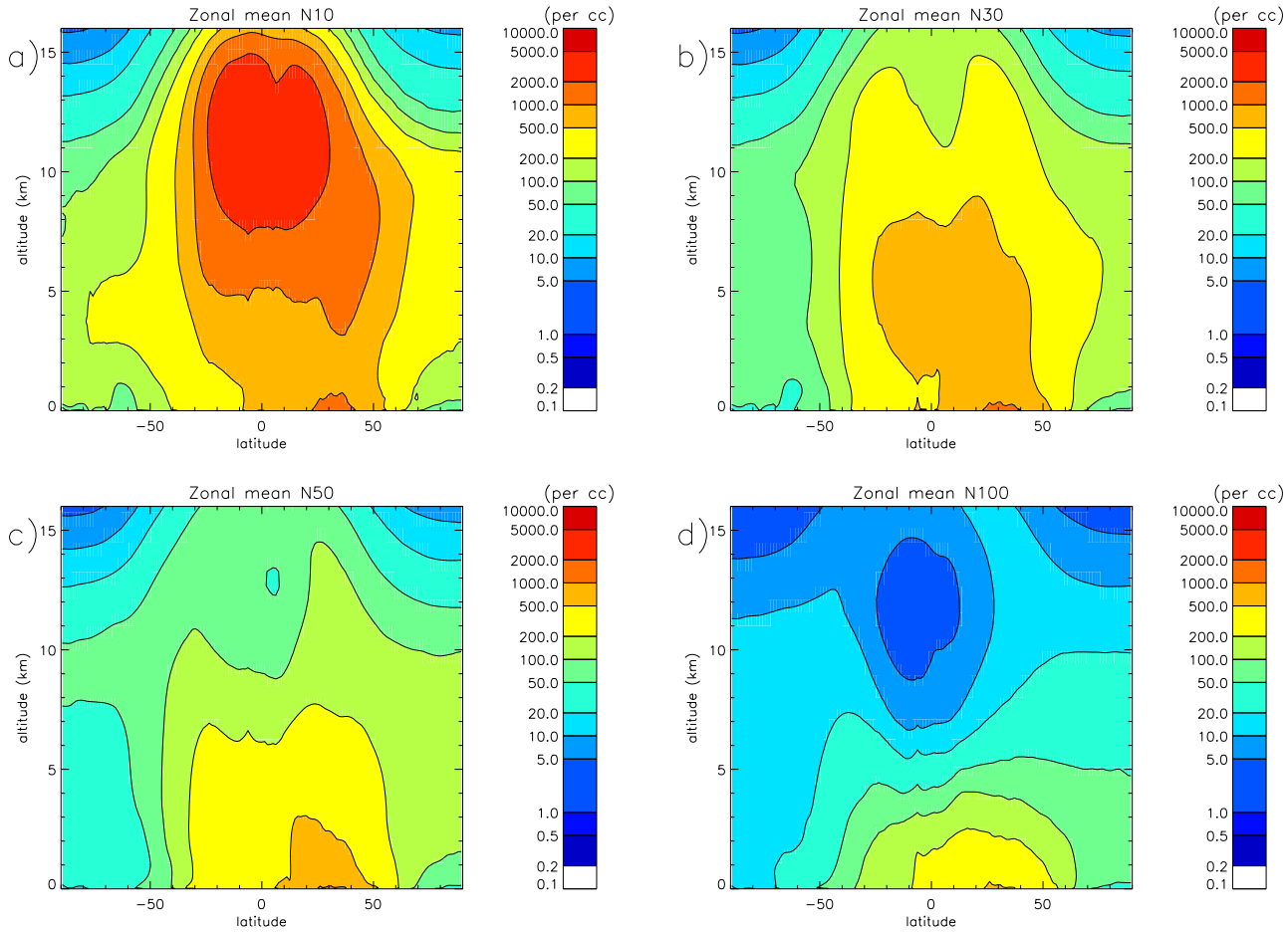






HadGEM3UKCA_XKAWA_2004

HadGEM3UKCA_XKAWA_2004



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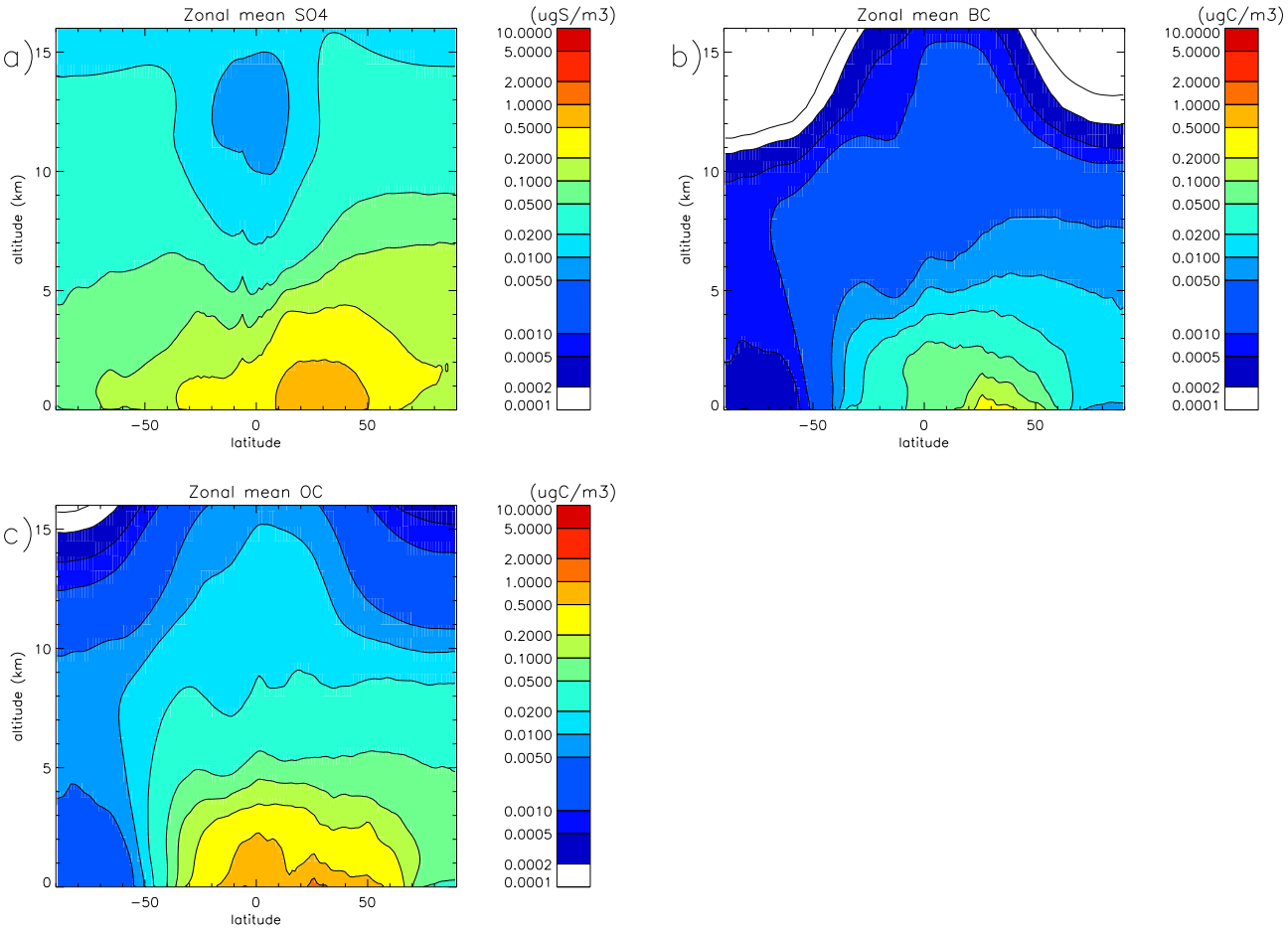
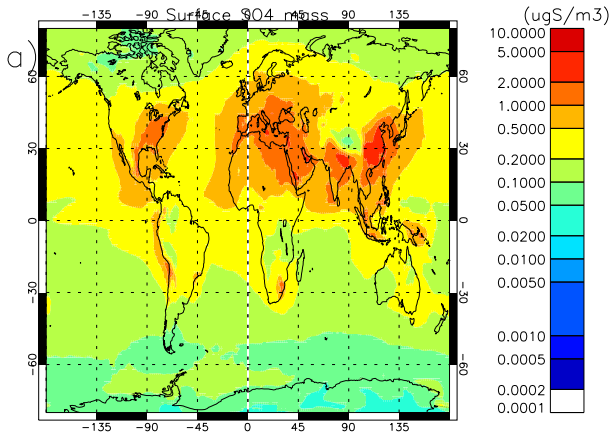
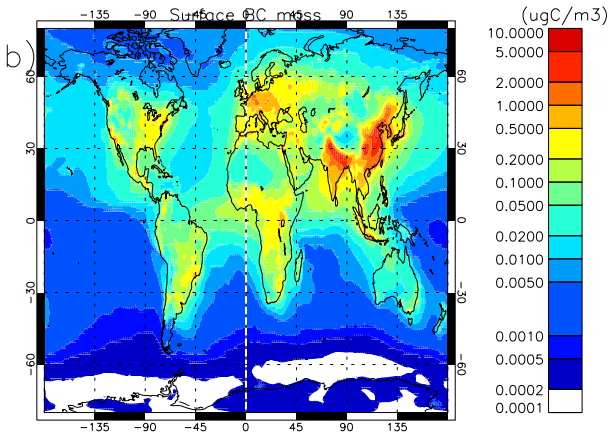
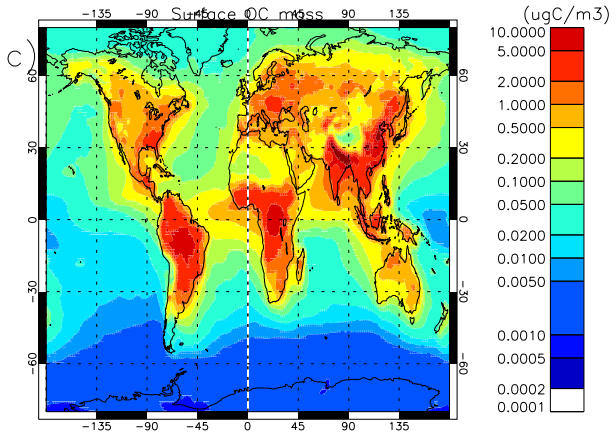


HadGEM3UKCA_XKAWA_2004







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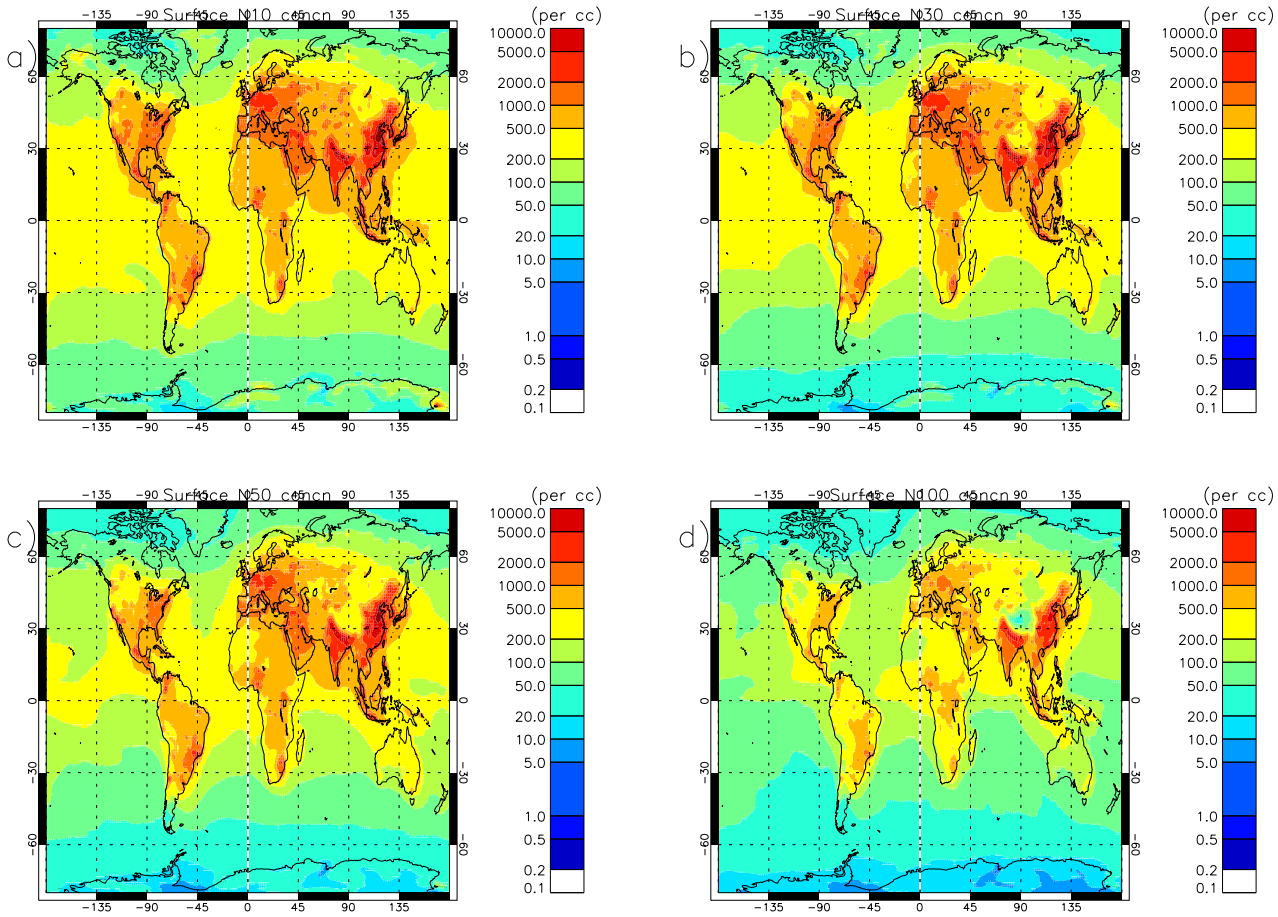
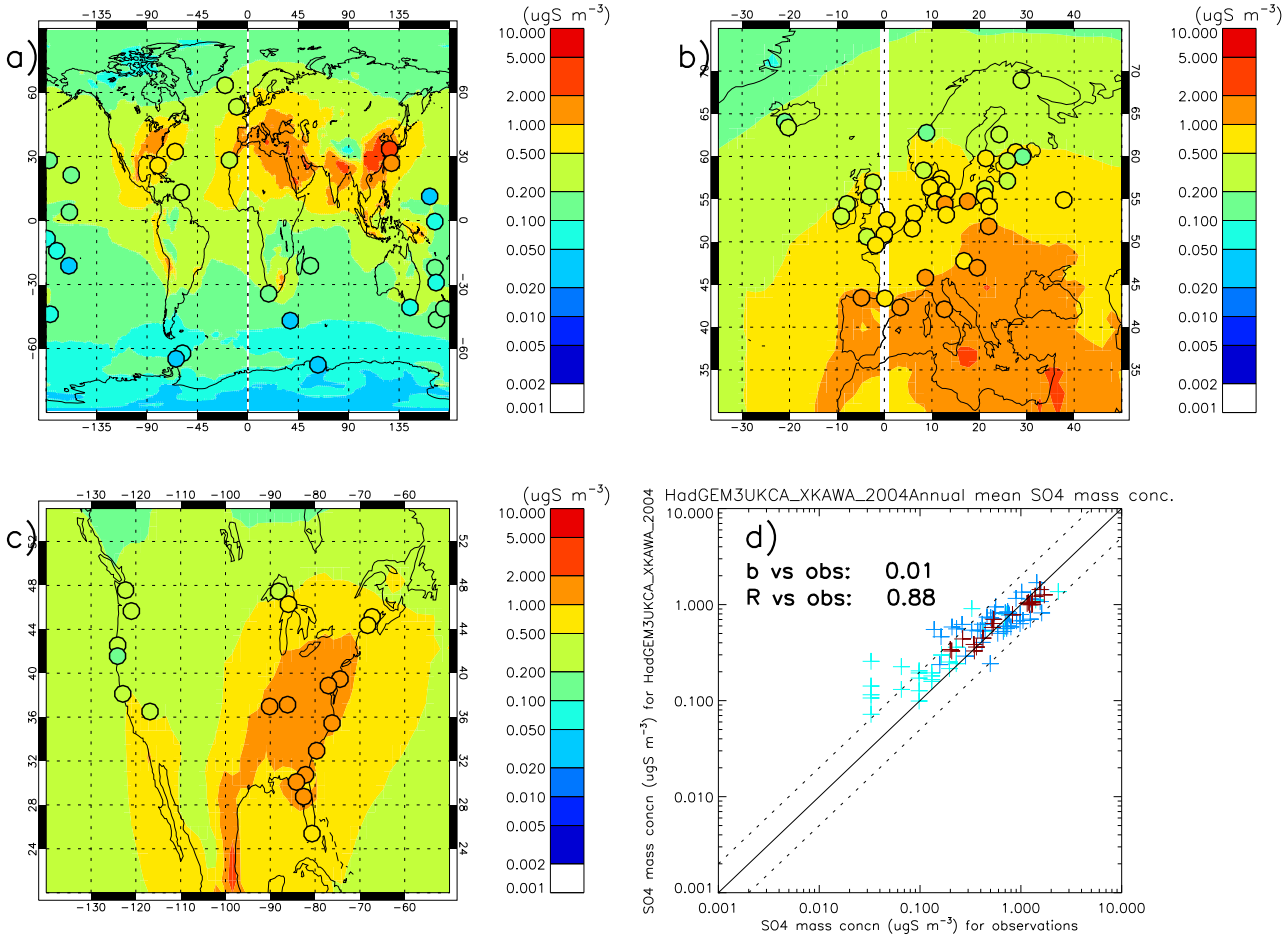
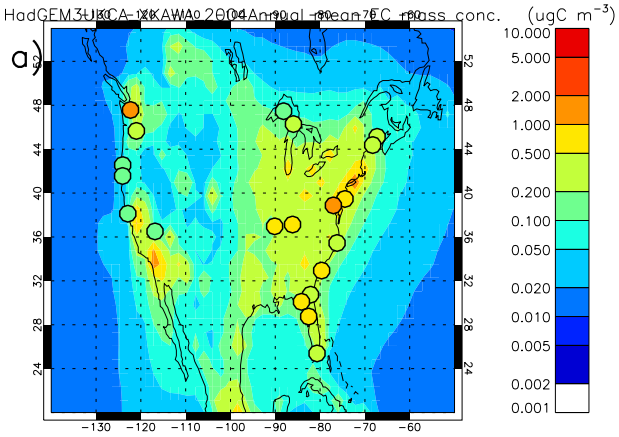
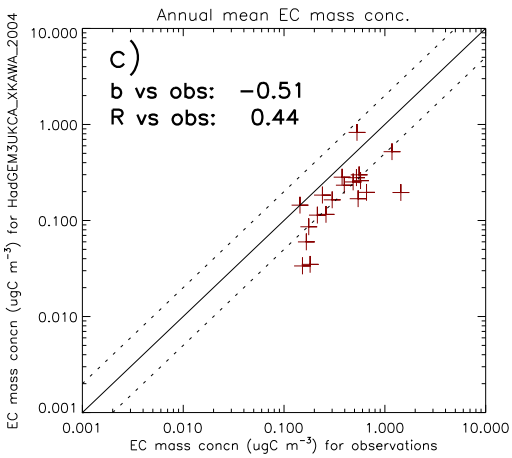
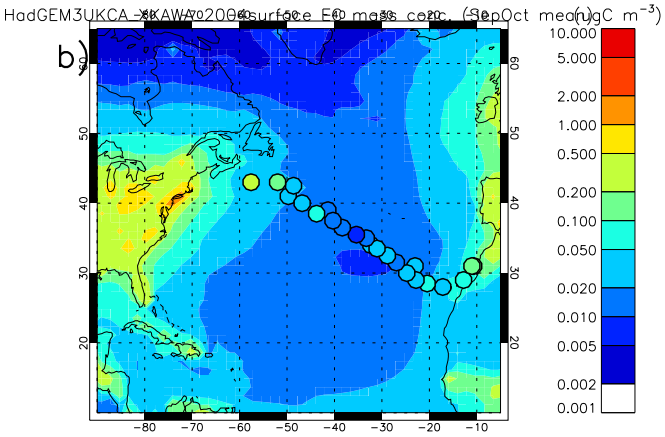
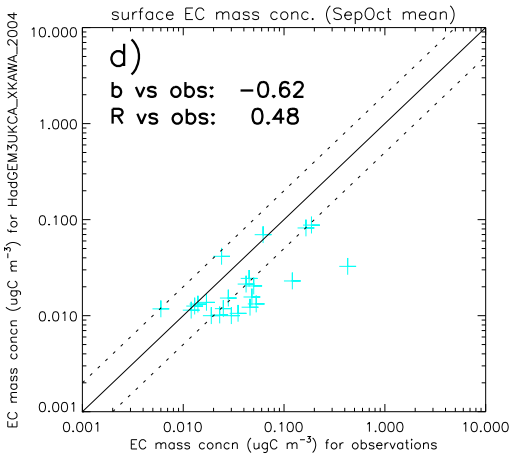


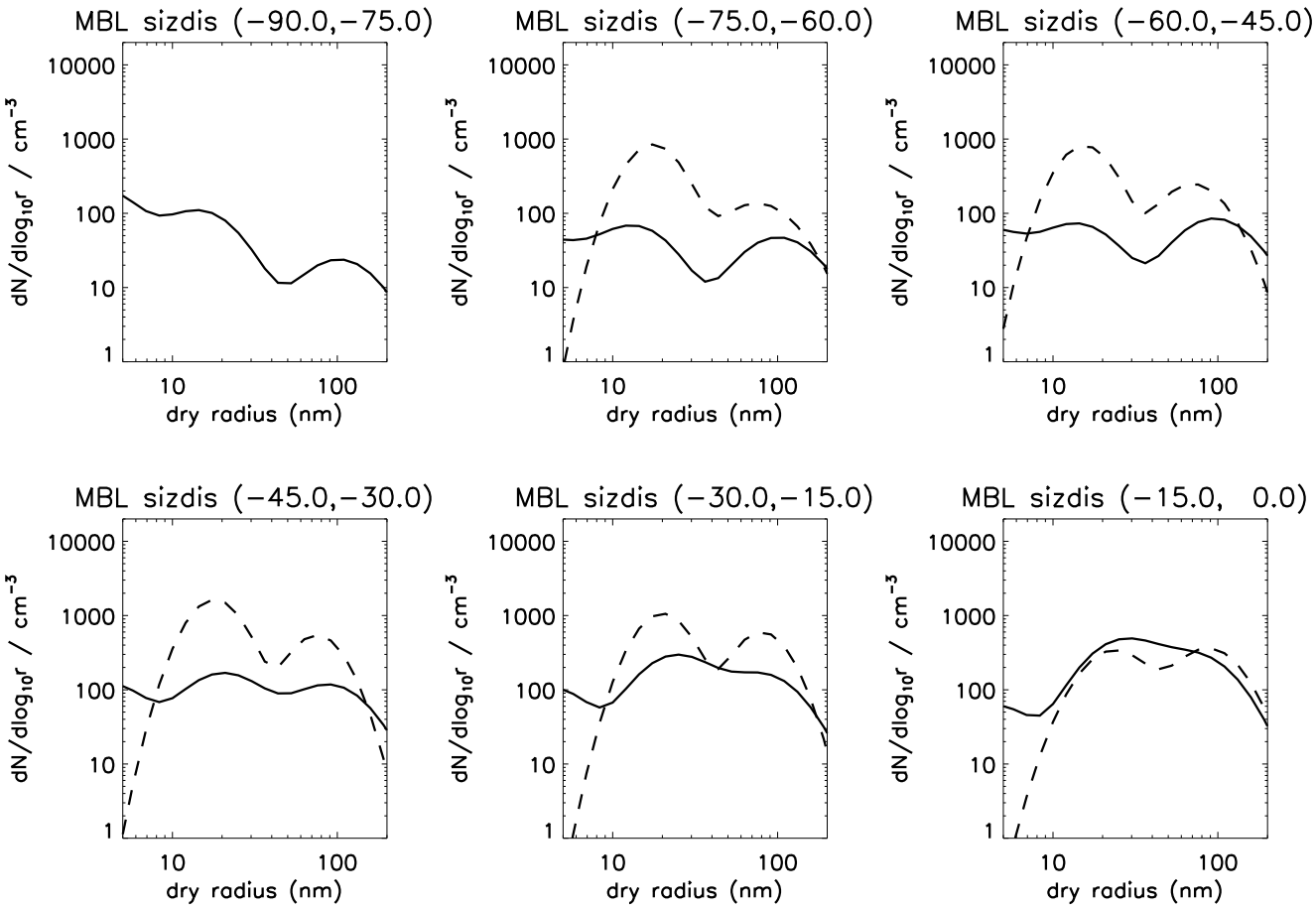

a)
b)
c)
d)
(ugS m^{-3})
10.000
5.000
2.000
1.000
0.500
0.200
0.100
0.050
0.020
0.010
0.005
0.002
0.001
HadGEM3UKCA_XKAWA_2004Annual mean SO4 mass conc.
b vs obs: 0.01
R vs obs: 0.88
SO4 mass concn (ugS m^{-3}) for HadGEM3UKCA_XKAWA_2004
SO4 mass concn (ugS m^{-3}) for observations

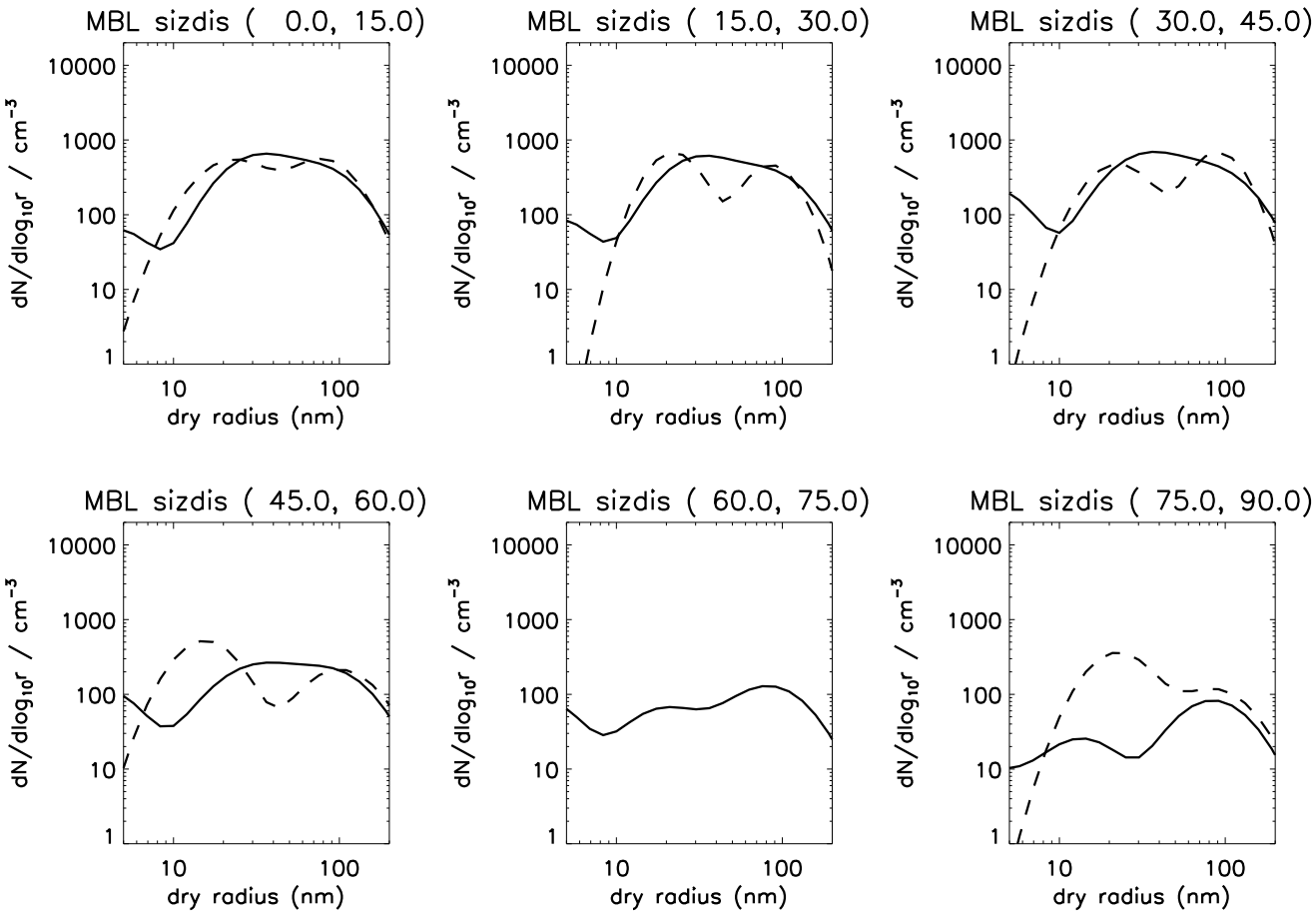

a)
HadGEM3UKCA-XKAWA 2004 Annual mean EC mass conc. (ugC m^{-3})
10.000
5.000
2.000
1.000
0.500
0.200
0.100
0.050
0.020
0.010
0.005
0.002
0.001

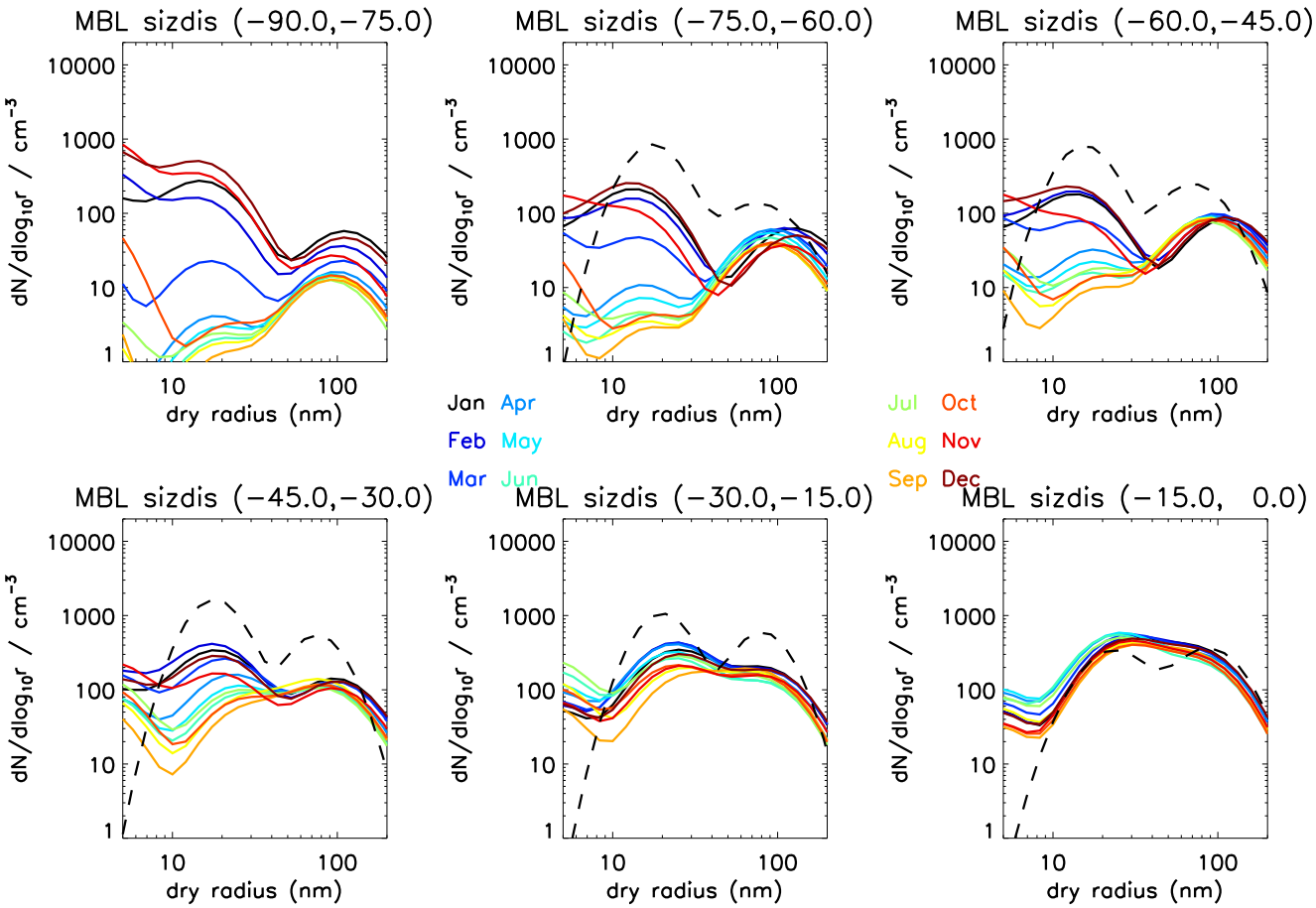

c)
Annual mean EC mass conc.
b vs obs: −0.51
R vs obs: 0.44
EC mass concn (ugC m^{-3}) for HadGEM3UKCA_XKAWA_2004
EC mass concn (ugC m^{-3}) for observations
0.001
0.010
0.100
1.000
10.000

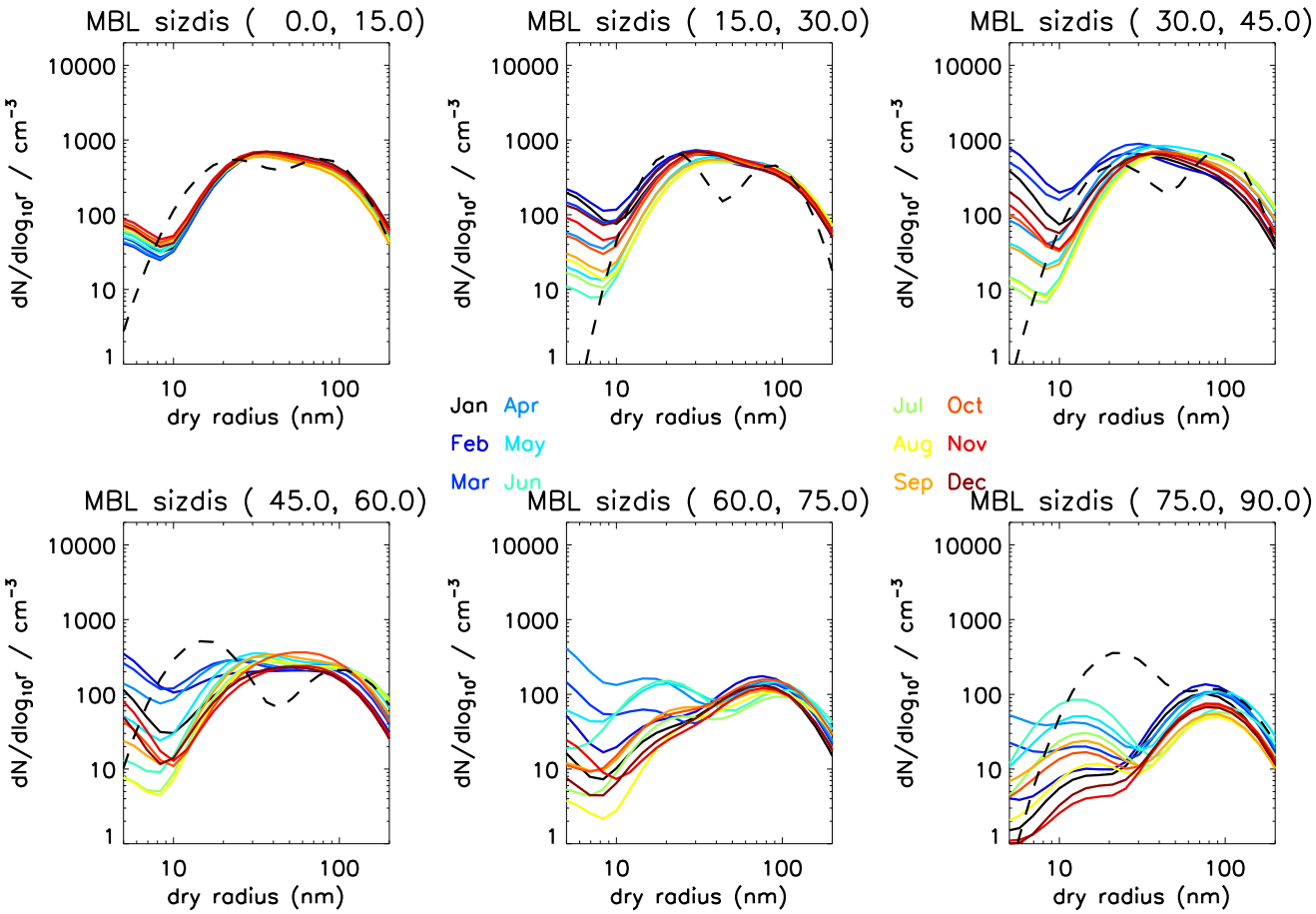

b)
HadGEM3UKCA-XKAWA 2004 surface EC mass conc. (SepOct mean) (ugC m^{-3})
10.000
5.000
2.000
1.000
0.500
0.200
0.100
0.050
0.020
0.010
0.005
0.002
0.001

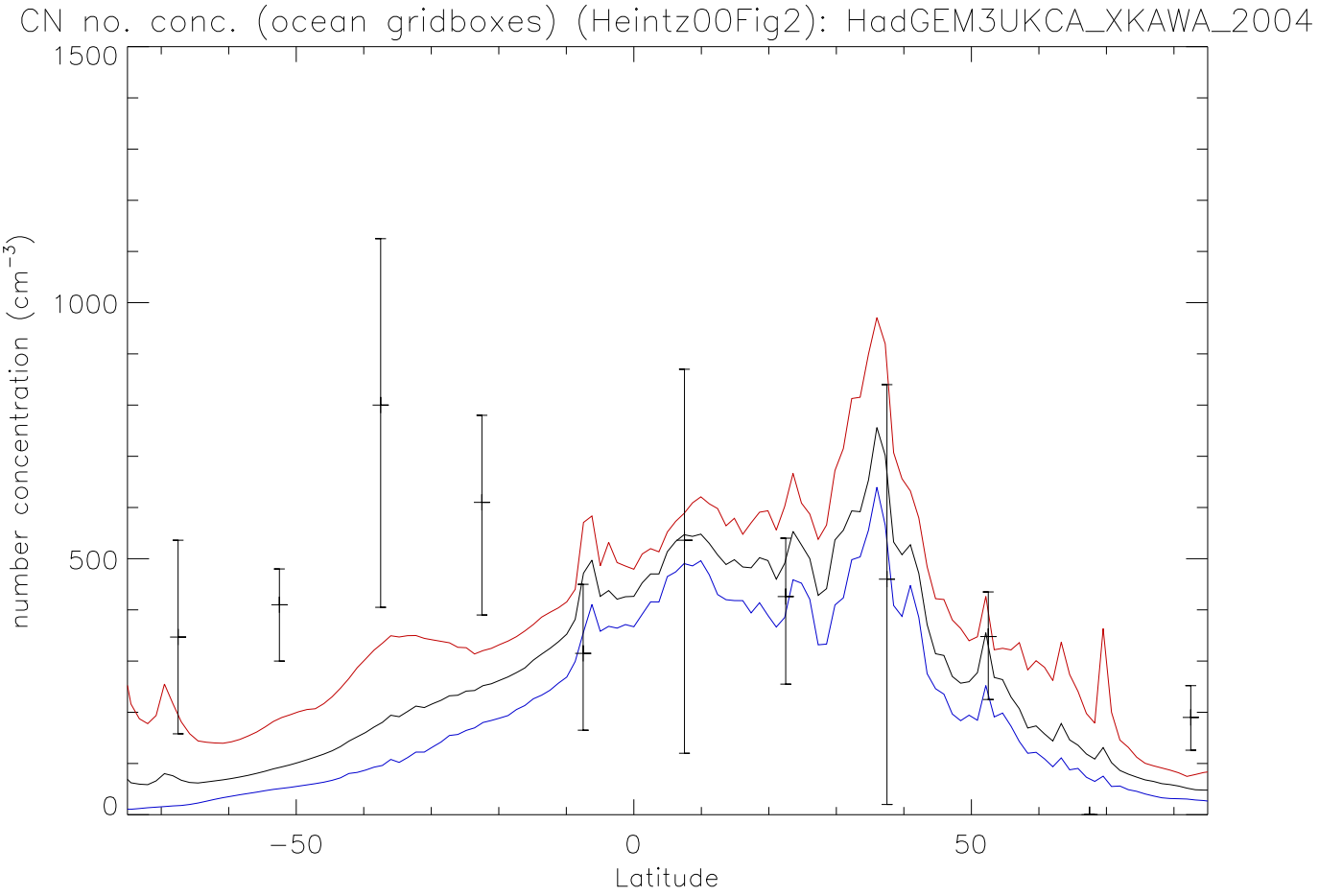

d)
surface EC mass conc. (SepOct mean)
b vs obs: −0.62
R vs obs: 0.48
EC mass concn (ugC m^{-3}) for HadGEM3UKCA_XKAWA_2004
EC mass concn (ugC m^{-3}) for observations
0.001
0.010
0.100
1.000
10.000

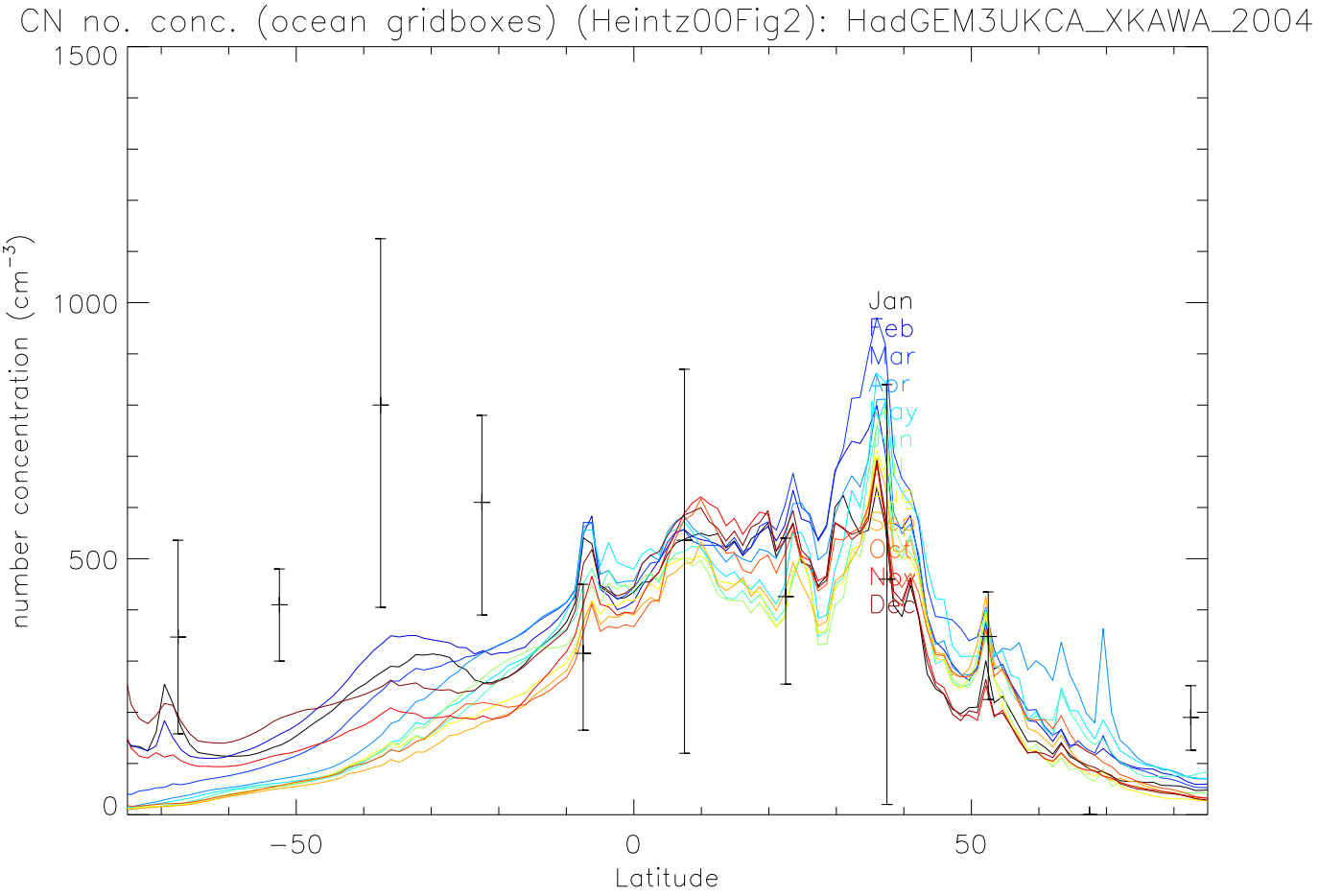

MBL sizdis (−90.0,−75.0)
MBL sizdis (−75.0,−60.0)
MBL sizdis (−60.0,−45.0)
MBL sizdis (−45.0,−30.0)
MBL sizdis (−30.0,−15.0)
MBL sizdis (−15.0, 0.0)
dN/dlog10r / cm-3
dry radius (nm)
10000
1000
100
10
1
10
100

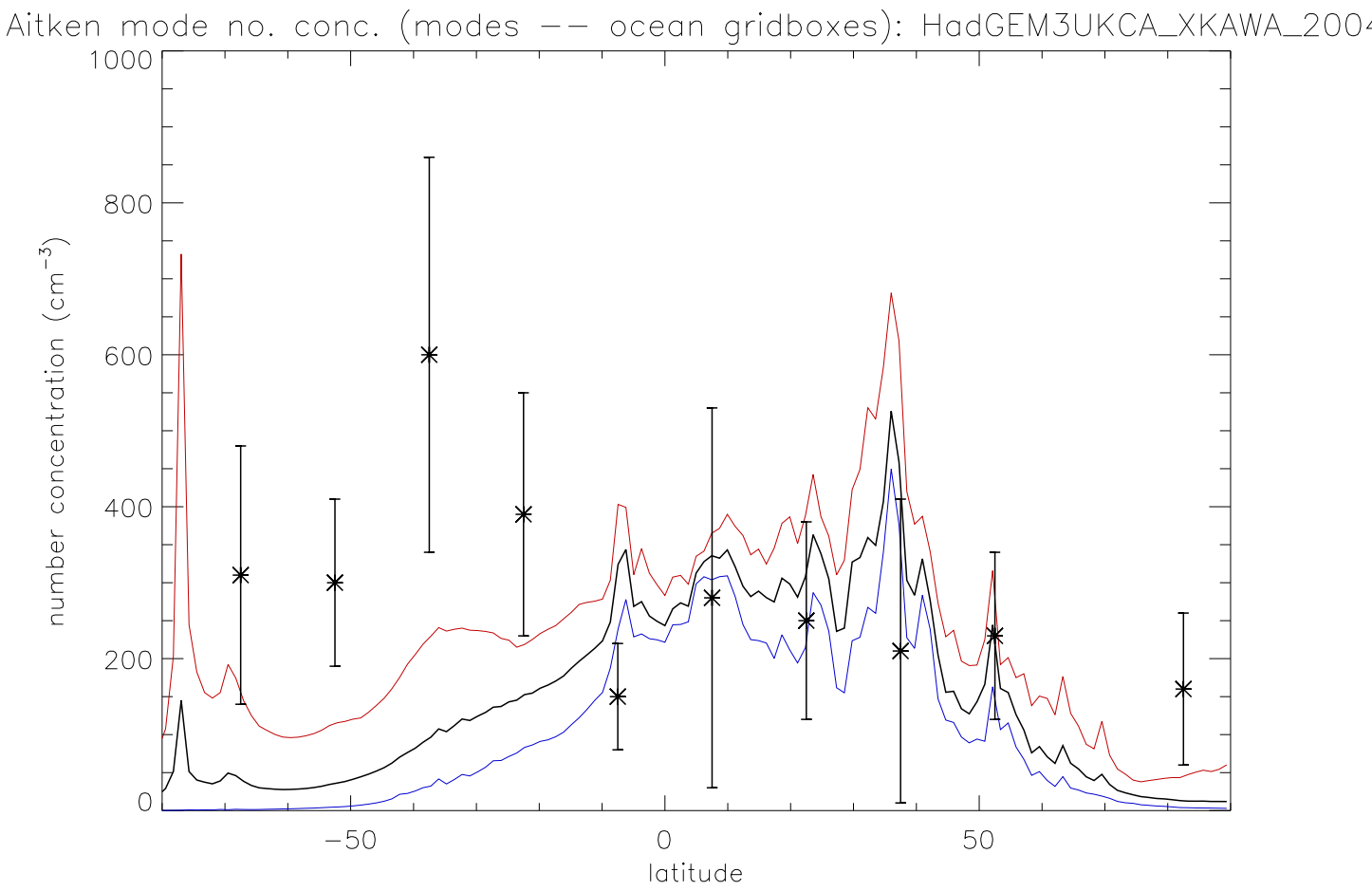

MBL sizdis (0.0, 15.0)
MBL sizdis (15.0, 30.0)
MBL sizdis (30.0, 45.0)
MBL sizdis (45.0, 60.0)
MBL sizdis (60.0, 75.0)
MBL sizdis (75.0, 90.0)
dN/dlog10r / cm-3
dry radius (nm)
10000
1000
100
10
1
10
100

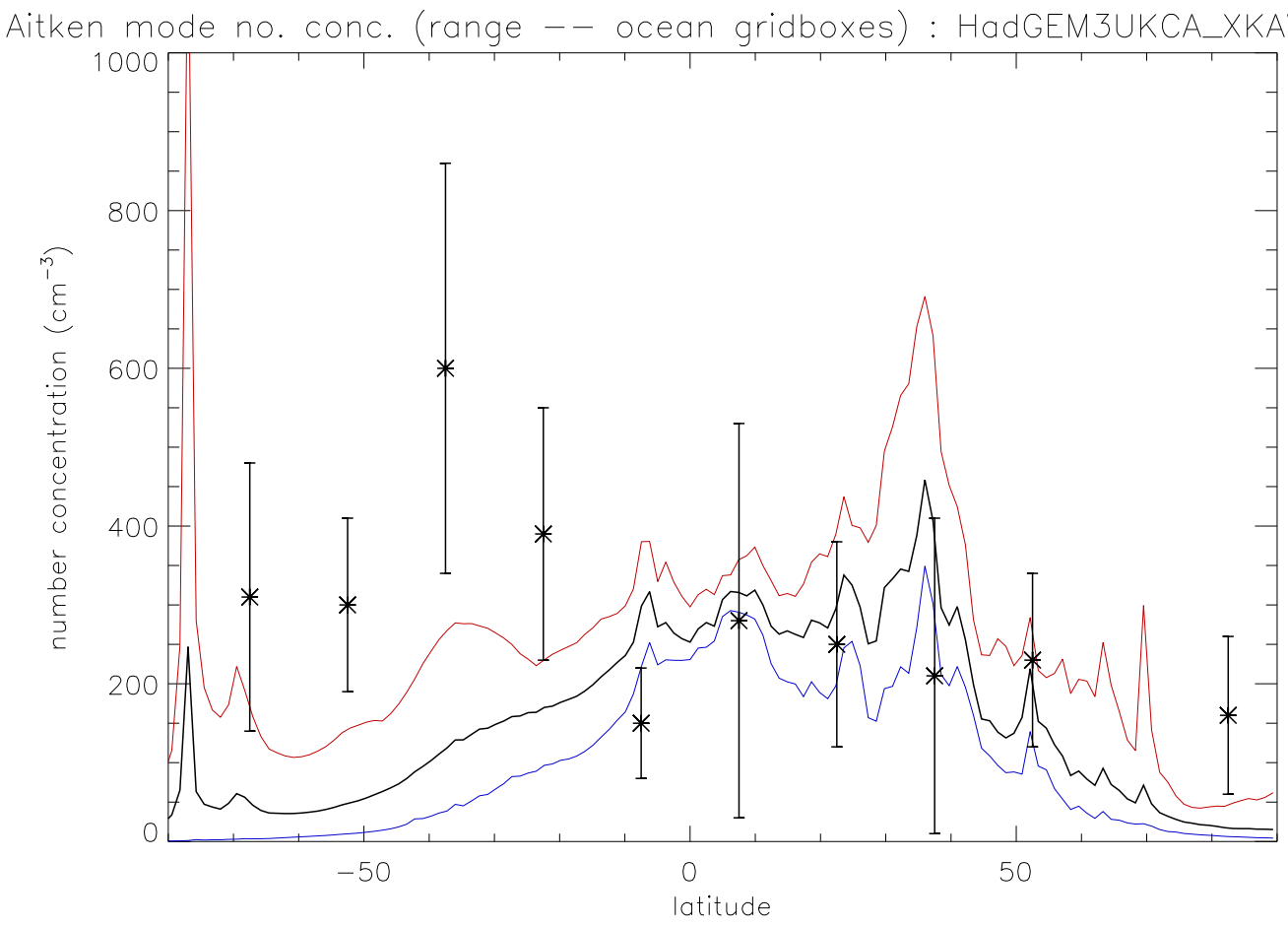

MBL sizdis (−90.0,−75.0)
MBL sizdis (−75.0,−60.0)
MBL sizdis (−60.0,−45.0)
MBL sizdis (−45.0,−30.0)
MBL sizdis (−30.0,−15.0)
MBL sizdis (−15.0, 0.0)
dN/dlog10r / cm-3
dry radius (nm)
10000
1000
100
10
1
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

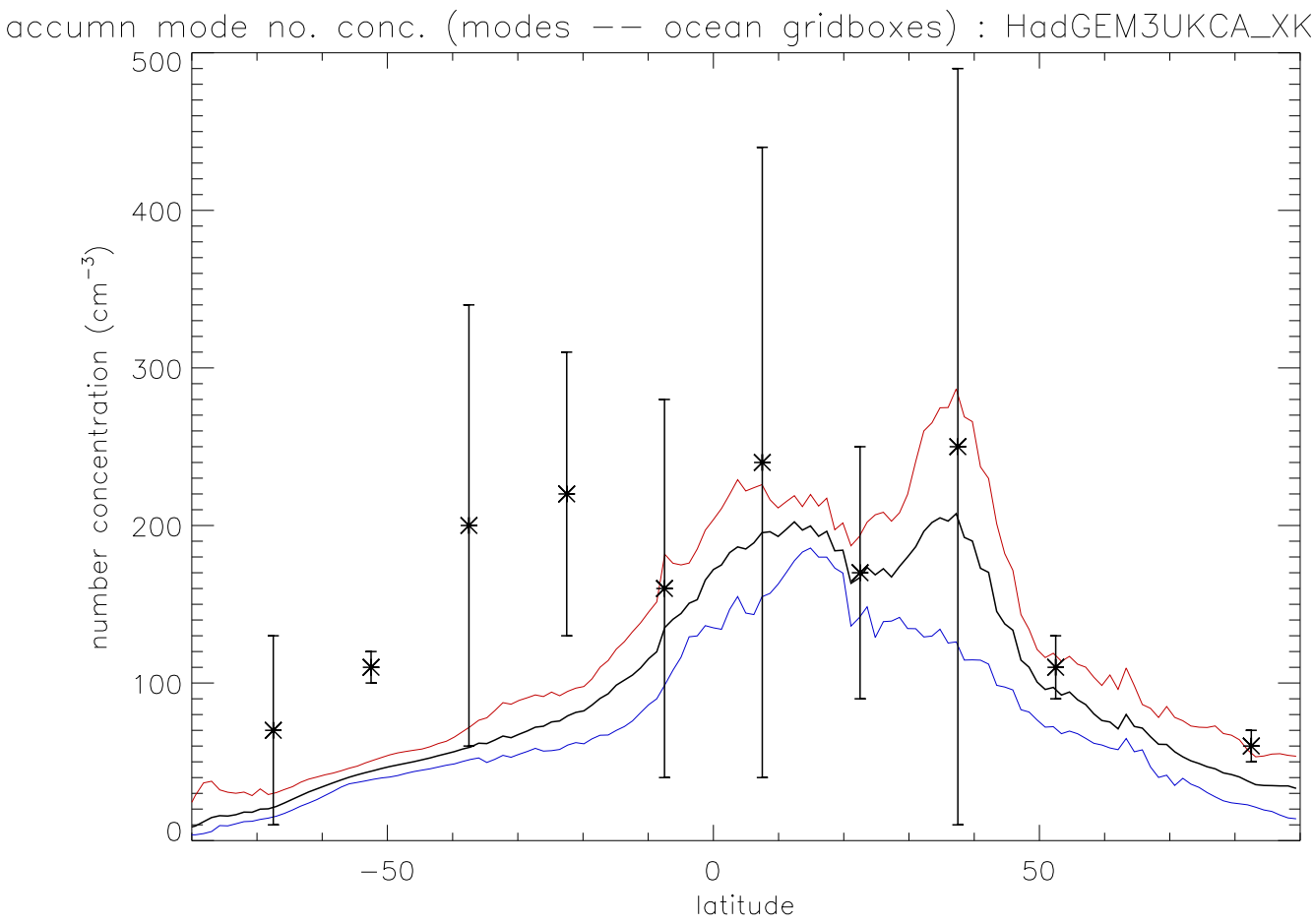

MBL sizdis (0.0, 15.0)
MBL sizdis (15.0, 30.0)
MBL sizdis (30.0, 45.0)
MBL sizdis (45.0, 60.0)
MBL sizdis (60.0, 75.0)
MBL sizdis (75.0, 90.0)
dN/dlog10r / cm-3
dry radius (nm)
10000
1000
100
10
1
10
100
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

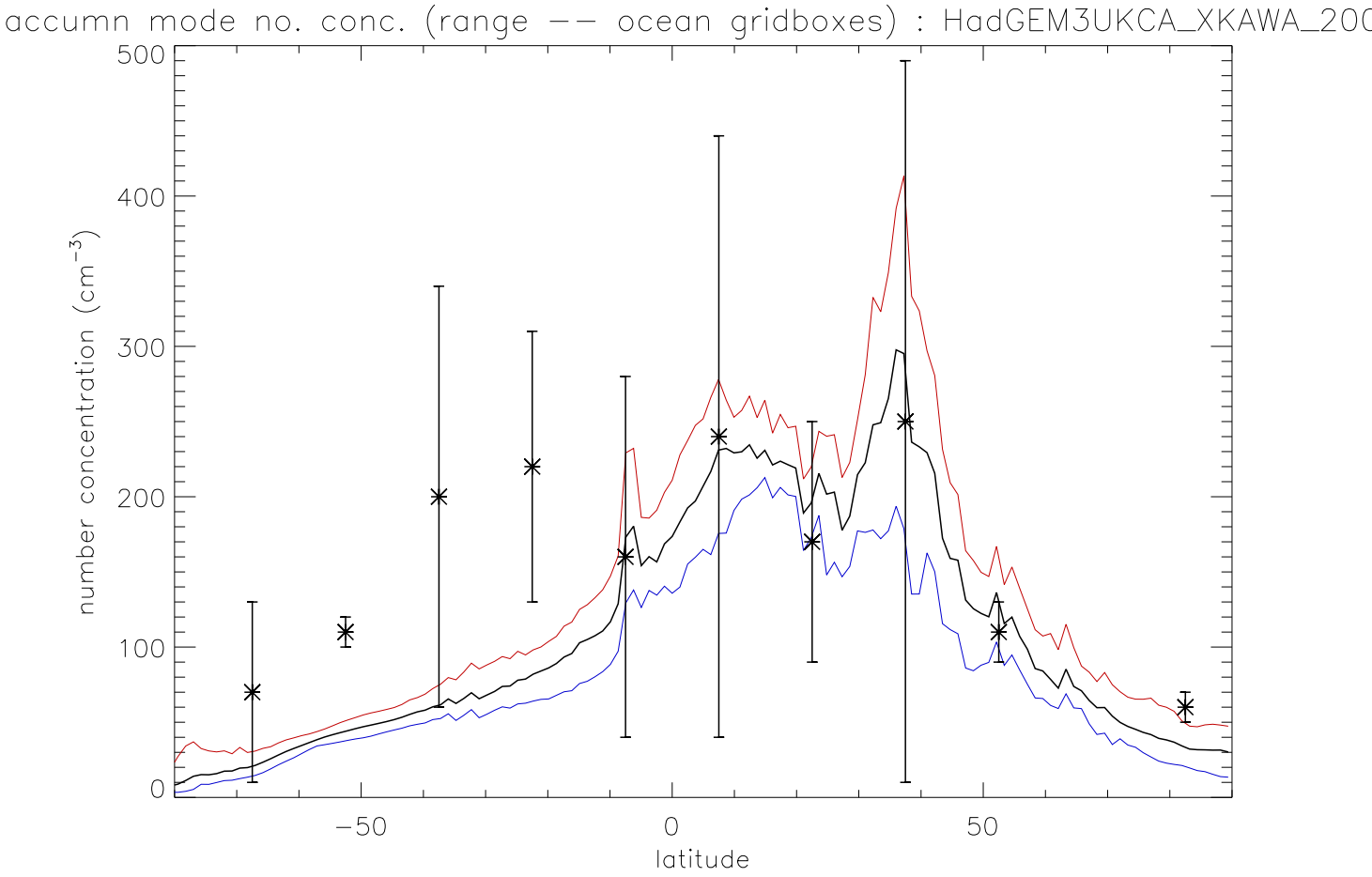

CN no. conc. (ocean gridboxes) (Heintz00Fig2): HadGEM3UKCA_XKAWA_2004
1500
1000
500
0
number concentration (cm^{-3})
−50
0
50
Latitude


CN no. conc. (ocean gridboxes) (Heintz00Fig2): HadGEM3UKCA_XKAWA_2004
number concentration (cm^{-3})
1500
1000
500
0
−50
0
50
Latitude
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Aitken mode no. conc. (modes -- ocean gridboxes): HadGEM3UKCA_XKAWA_2004
number concentration (cm^{-3})
1000
800
600
400
200
0
−50
0
50
latitude


Aitken mode no. conc. (range −− ocean gridboxes) : HadGEM3UKCA_XKAWA_2004
number concentration (cm^{-3})
1000
800
600
400
200
0
−50
0
50
latitude


accumn mode no. conc. (modes −− ocean gridboxes) : HadGEM3UKCA_XKAWA_20
number concentration (cm^{-3})
500
400
300
200
100
0
−50
0
50
latitude


accumn mode no. conc. (range -- ocean gridboxes) : HadGEM3UKCA_XKAWA_200
number concentration (cm^{-3})
500
400
300
200
100
0
−50
0
50
latitude