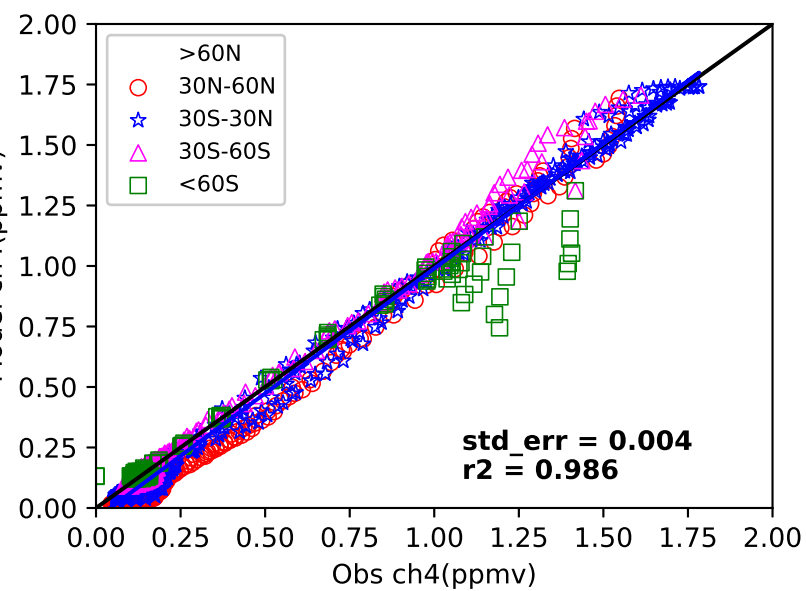
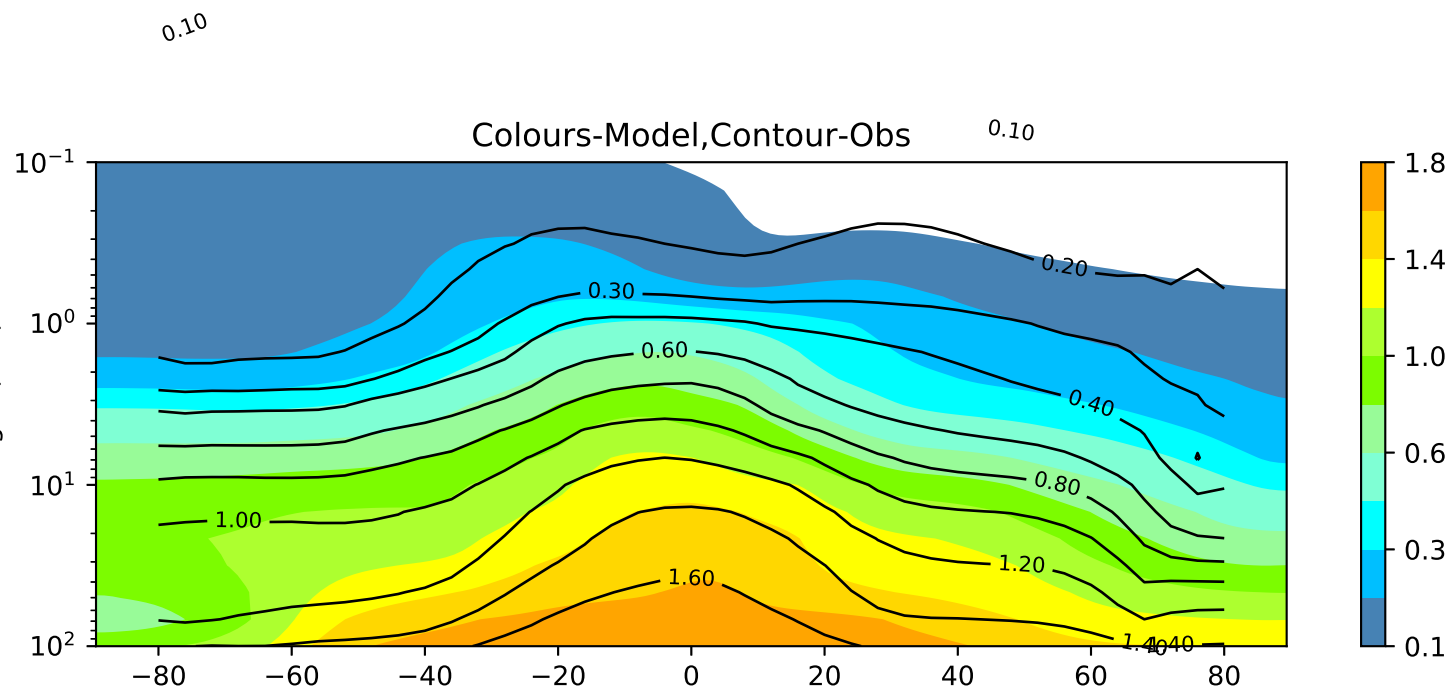
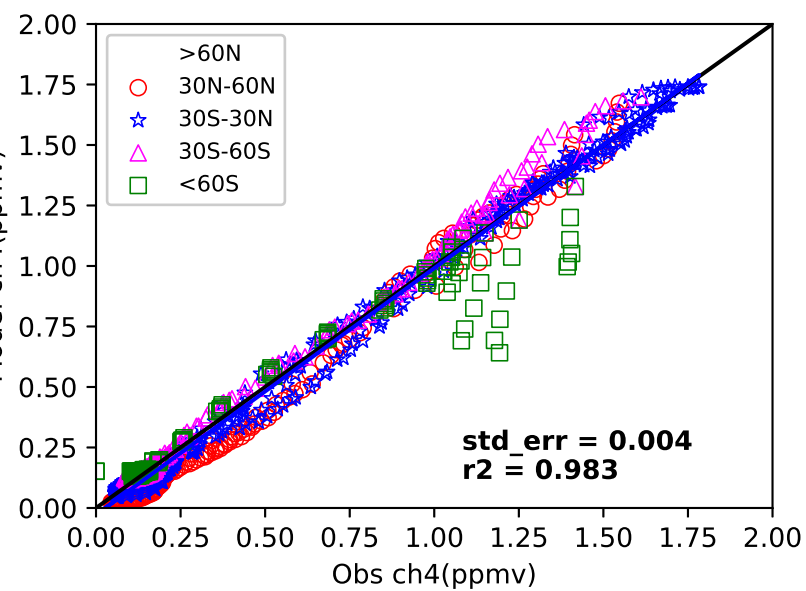
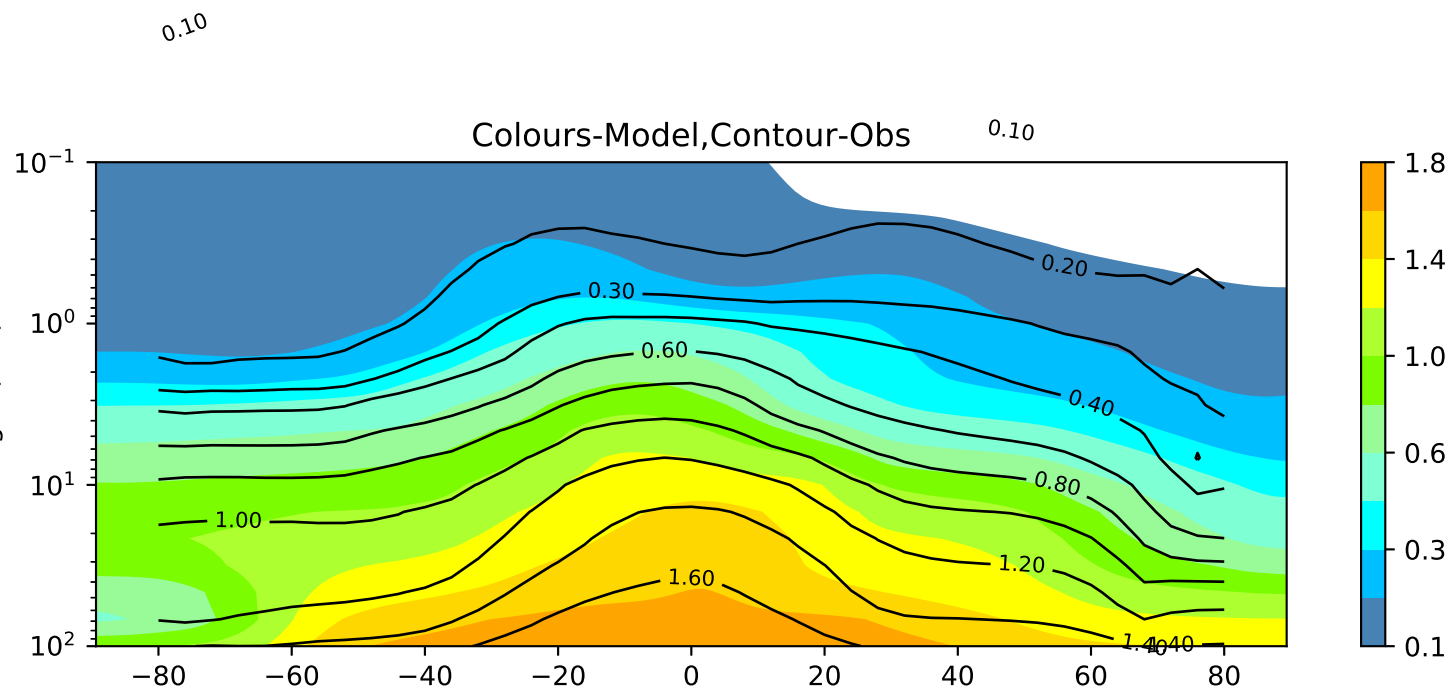
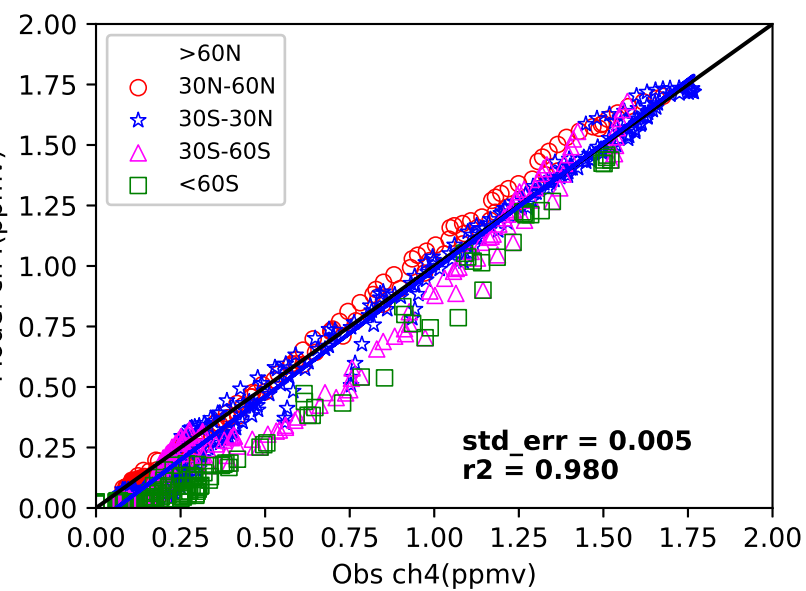
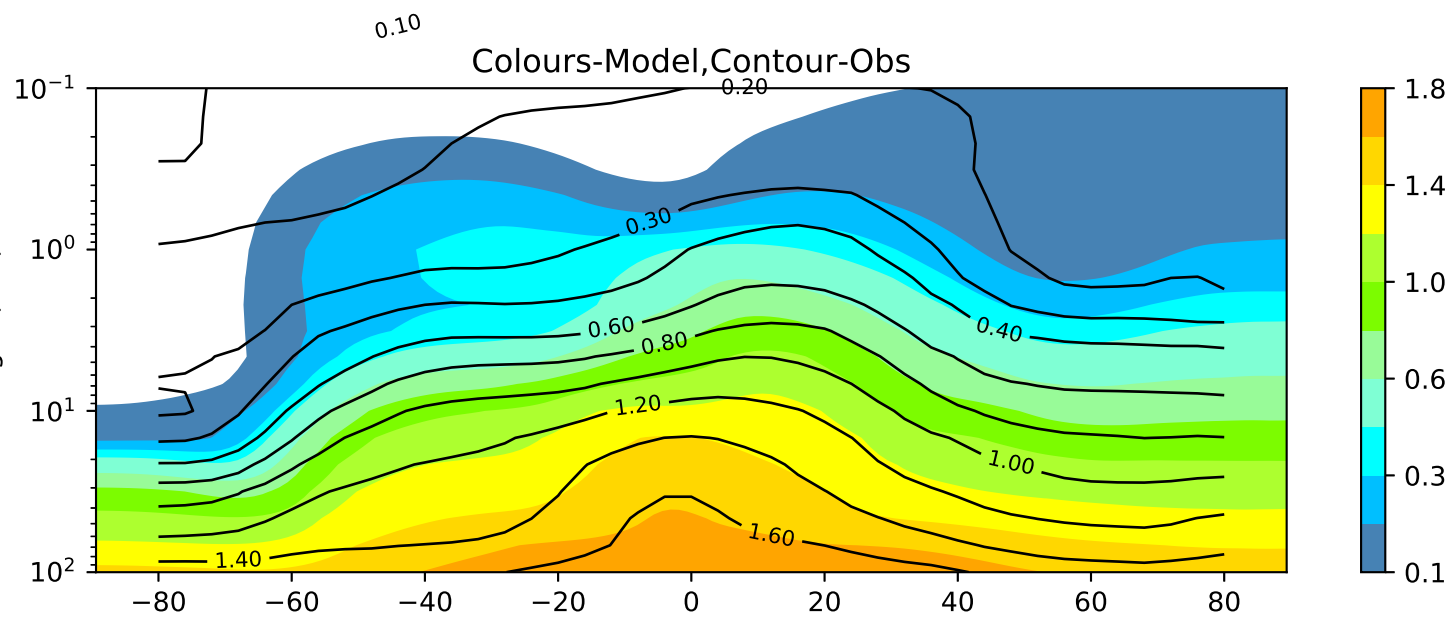
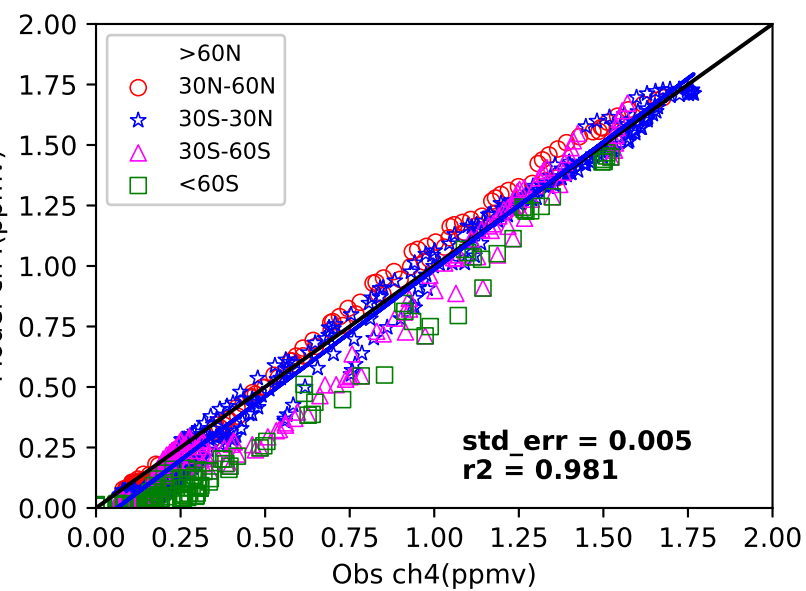
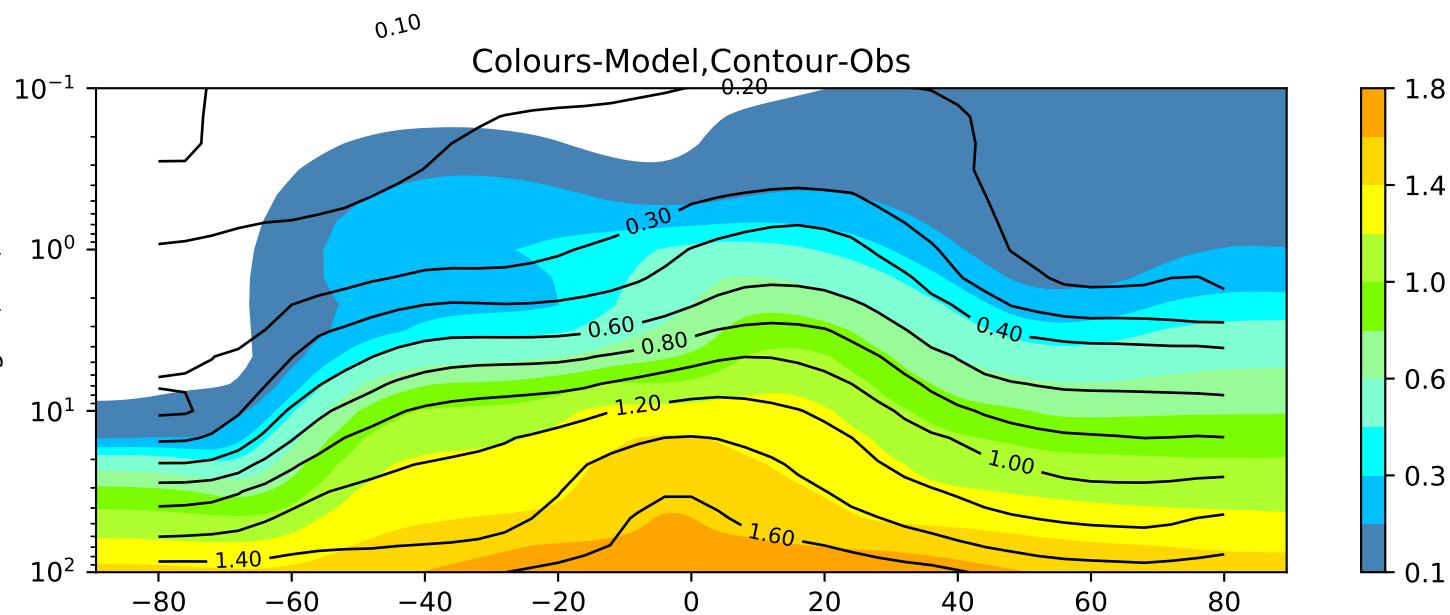




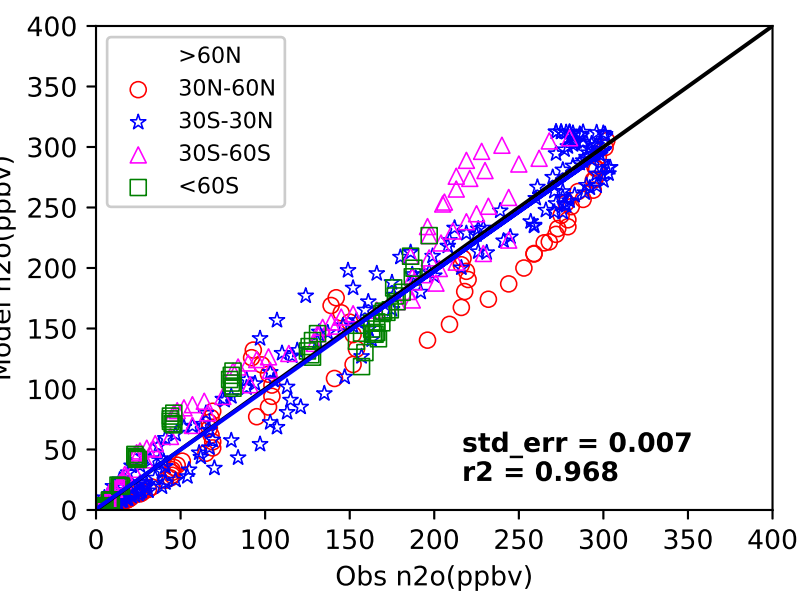
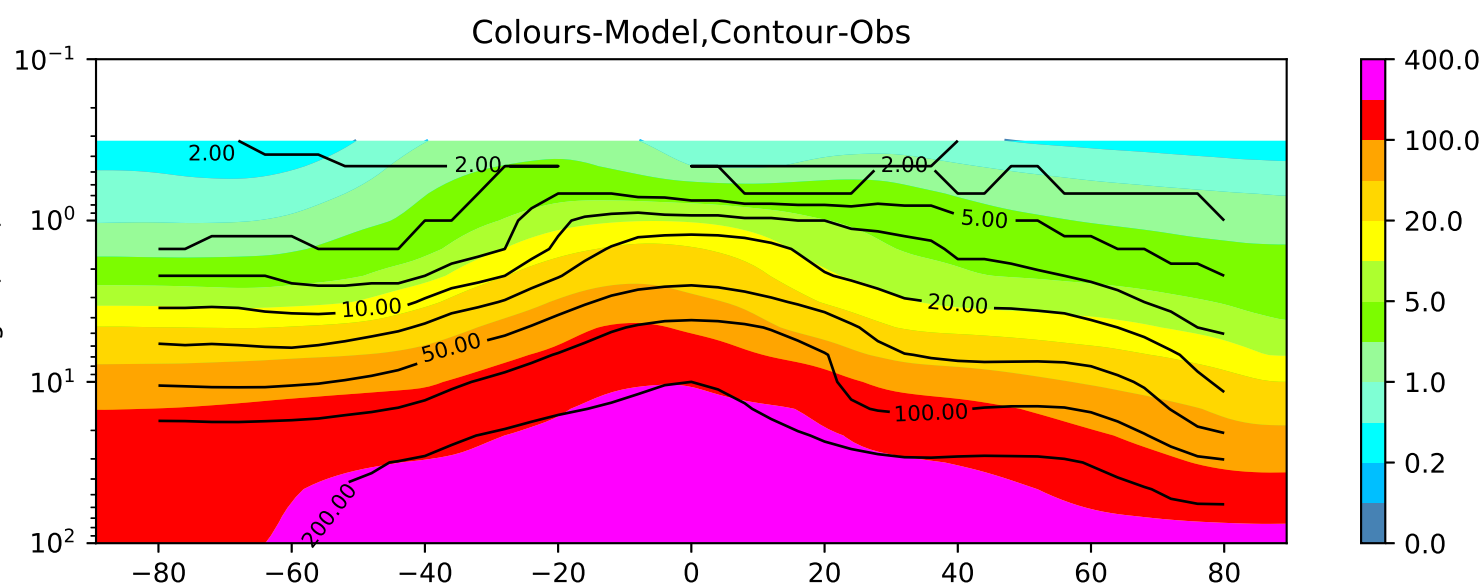




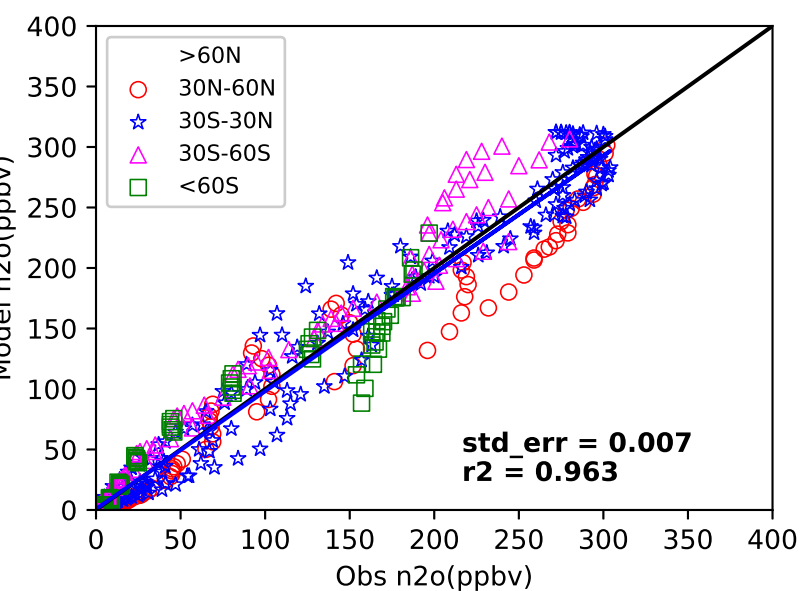
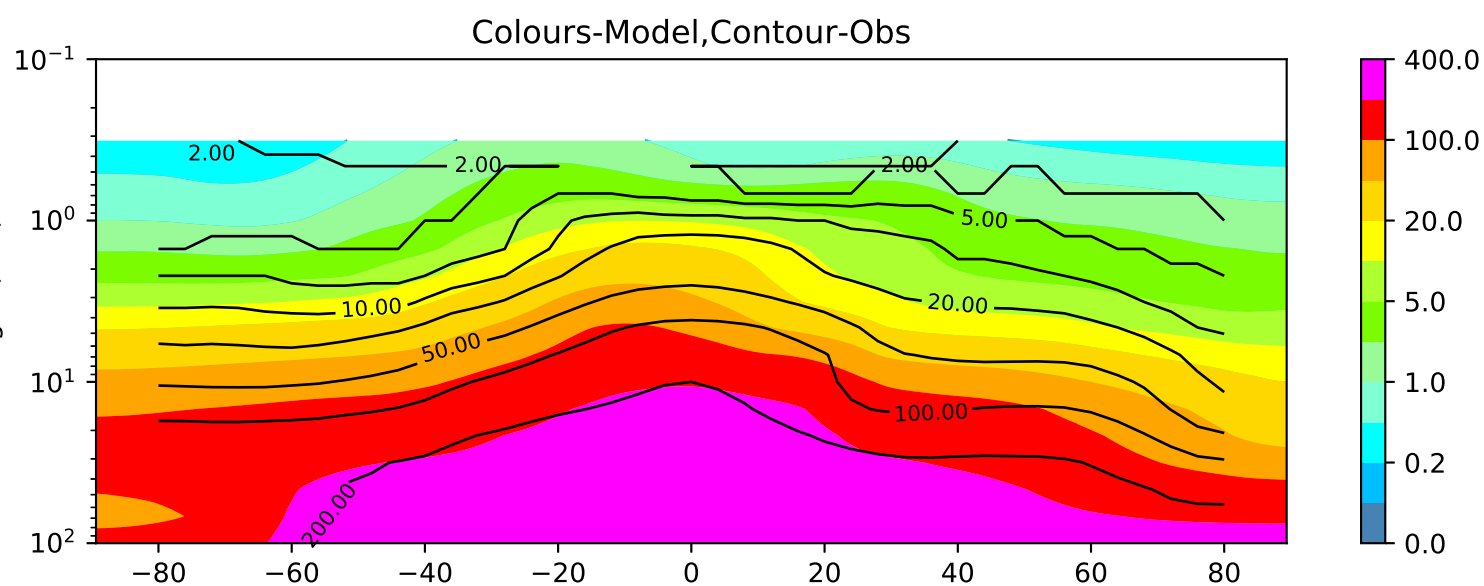
UKCA cd037 vs HALOE:  
CH4 (ppmv) Jul



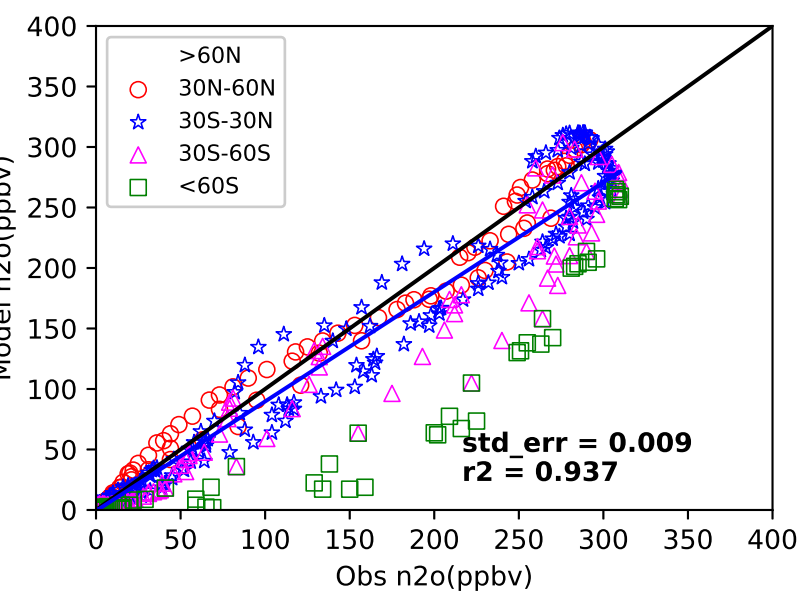
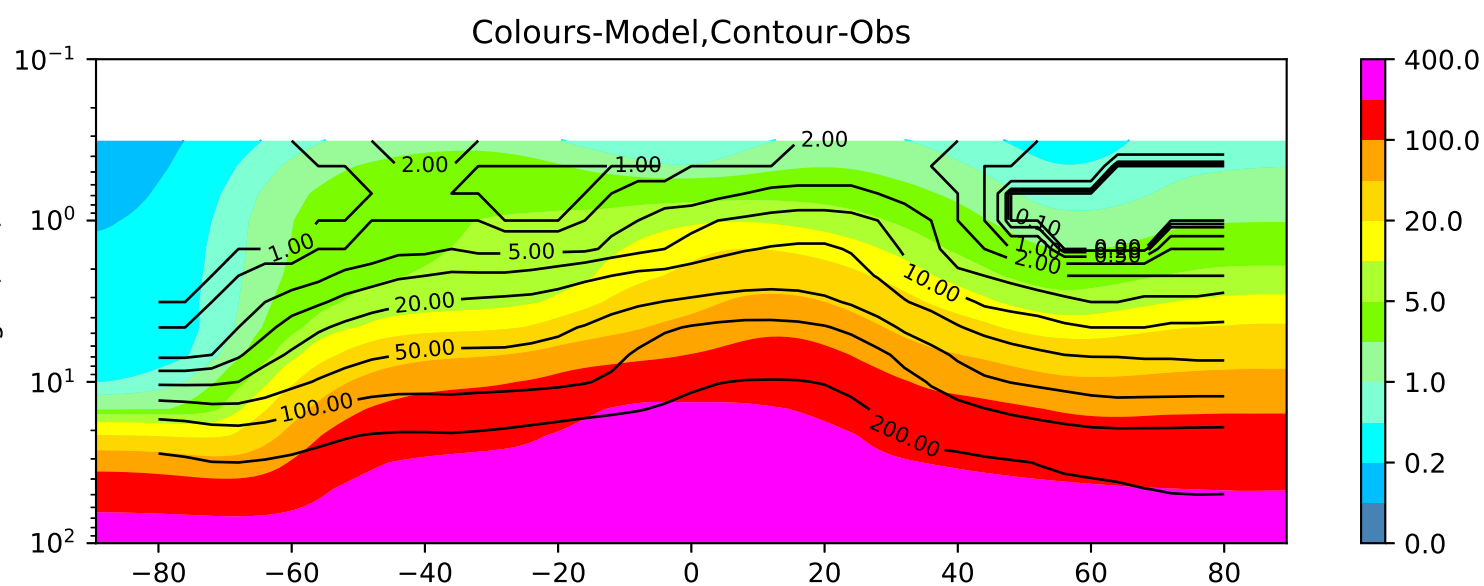
UKCA cf821 vs HALOE:  
CH4 (ppmv) Jul



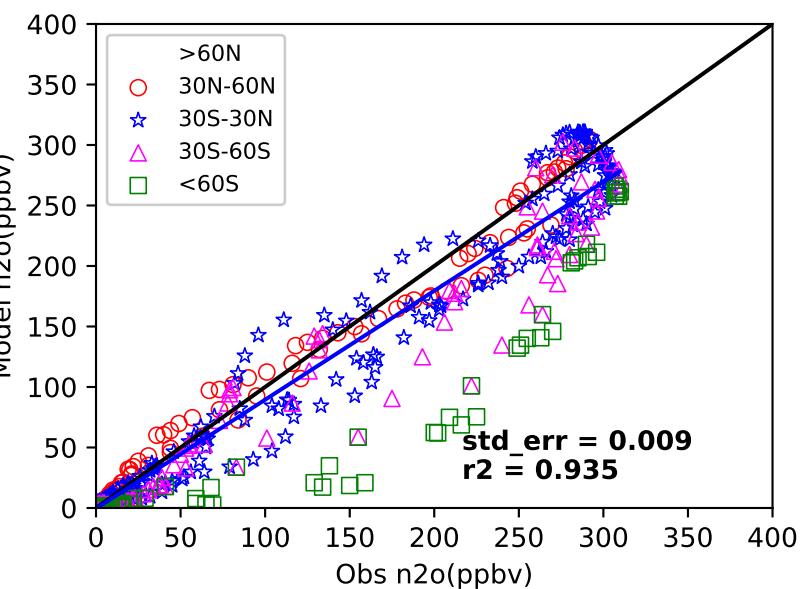
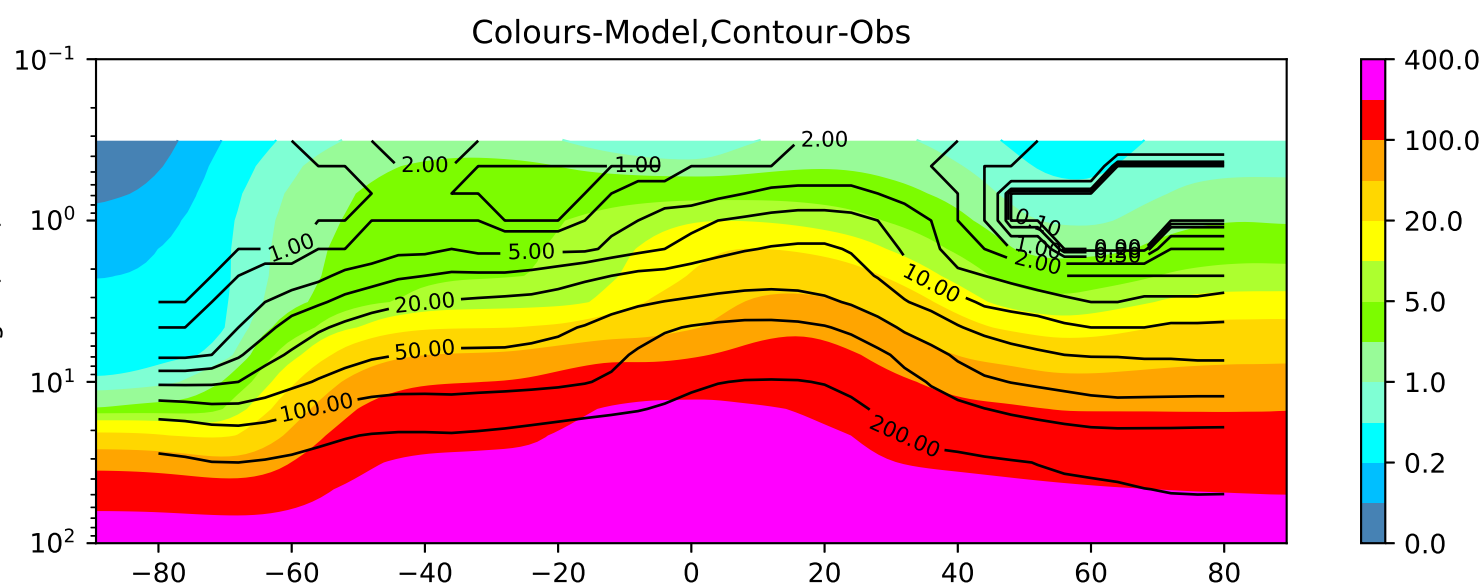
UKCA cd037 vs HALOE:  
N2O (ppmv) Jan



UKCA cf821 vs HALOE:  
N2O (ppmv) Jan

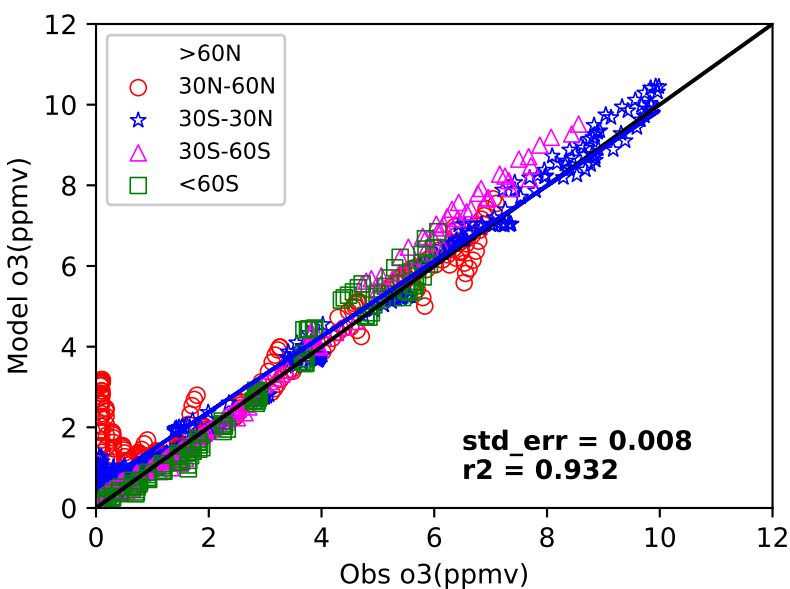
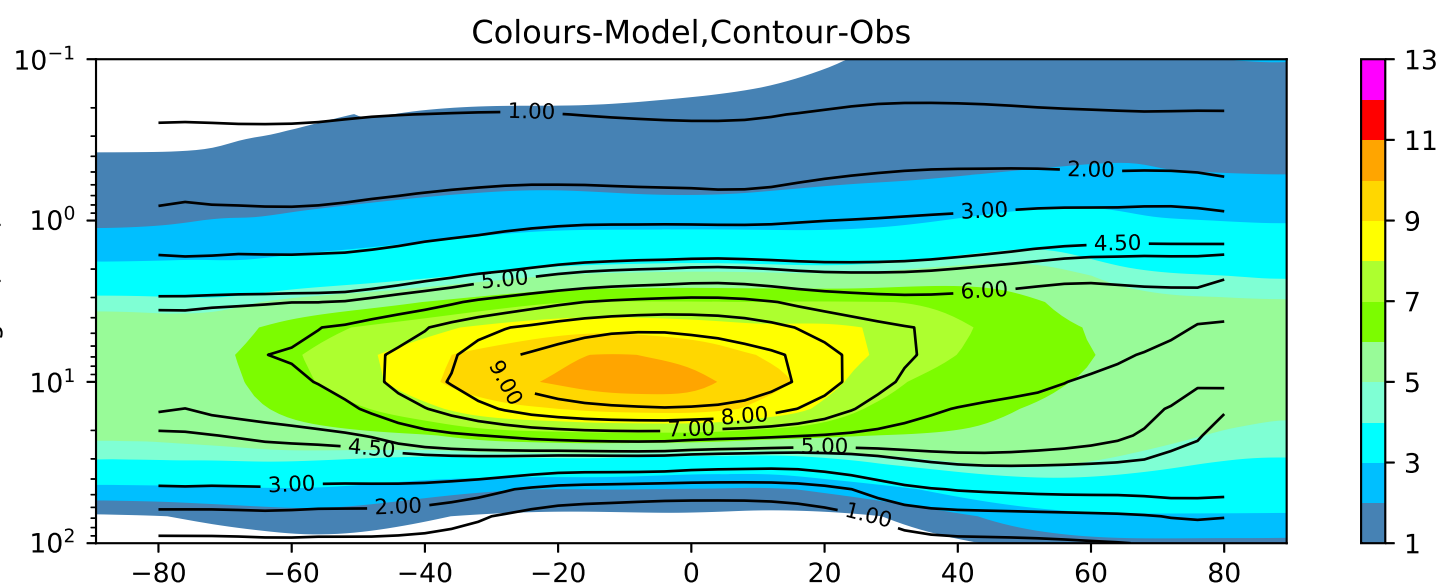


UKCA cd037 vs HALOE:  
N2O (ppmv) Jul

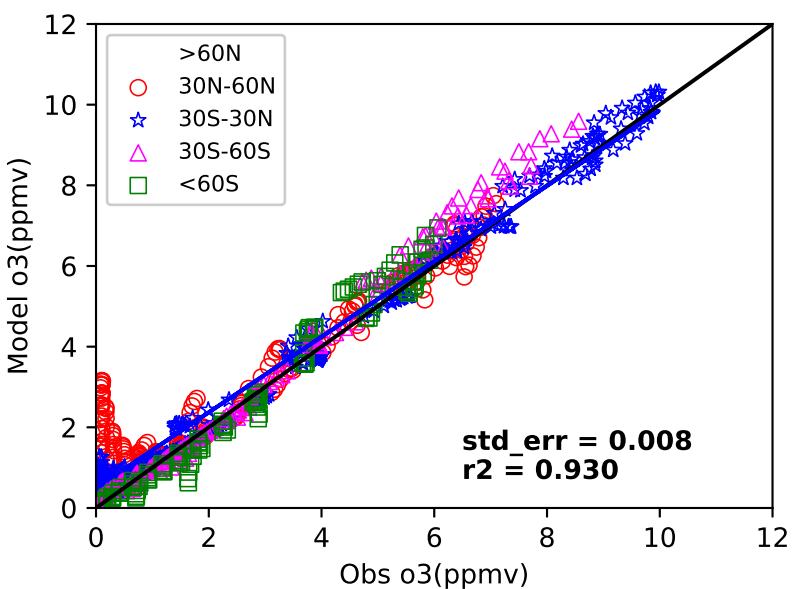
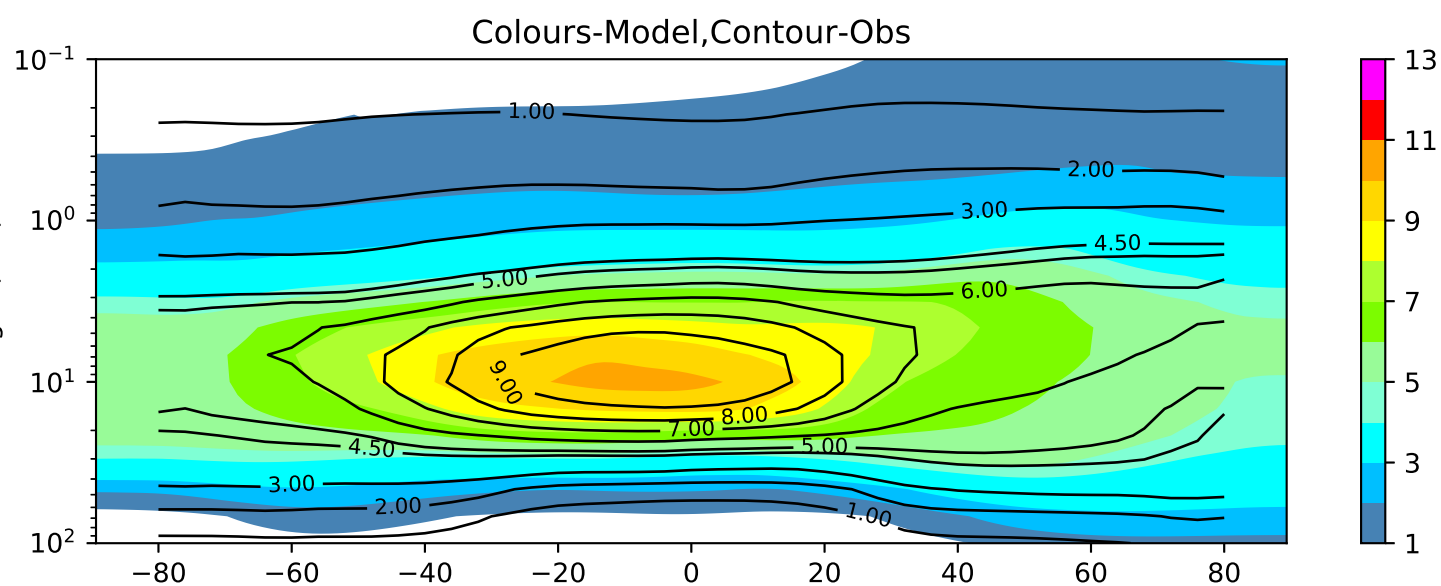


UKCA cf821 vs HALOE:  
N2O (ppmv) Jul

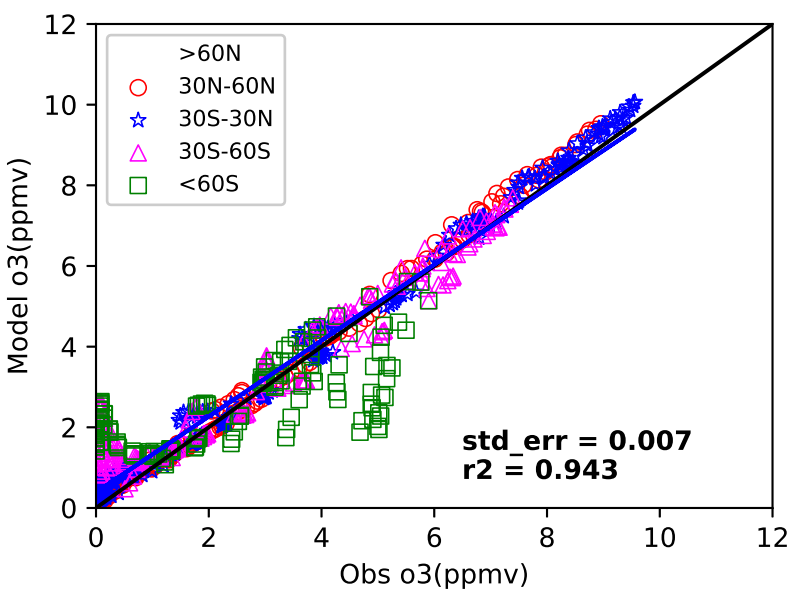
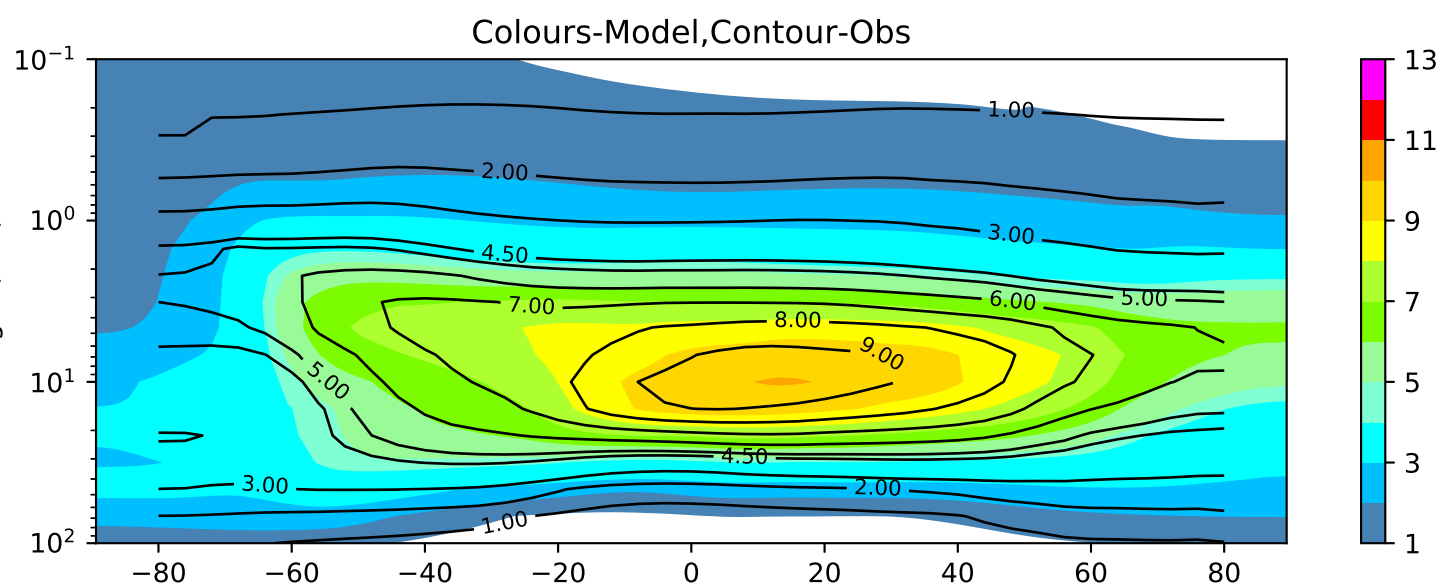




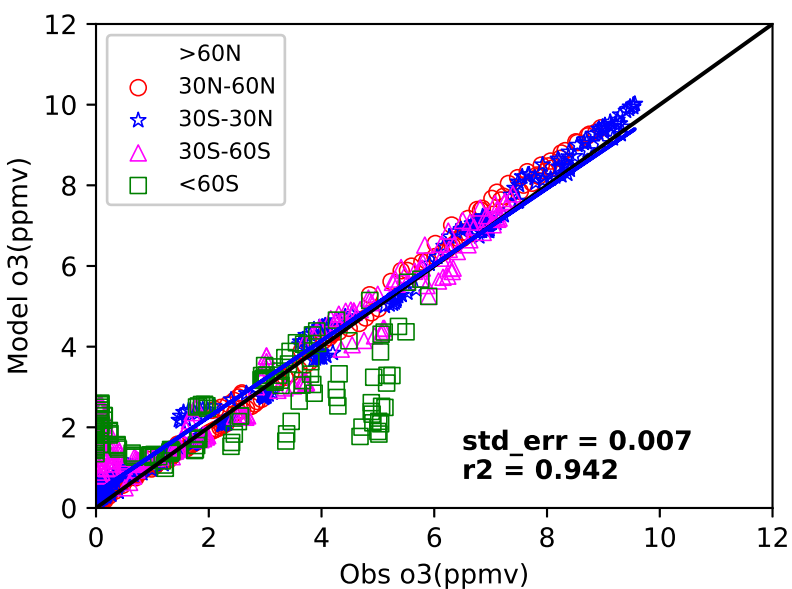
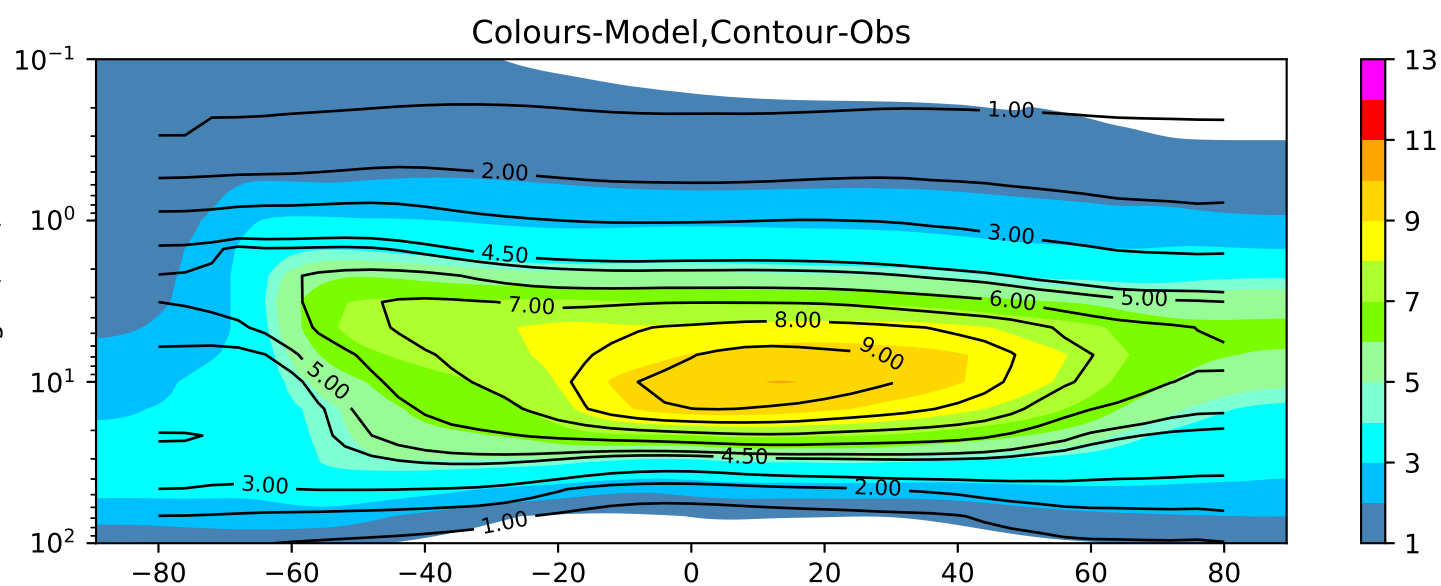
UKCA cd037 vs HALOE:  
O<sub>3</sub> (ppmv) Jan



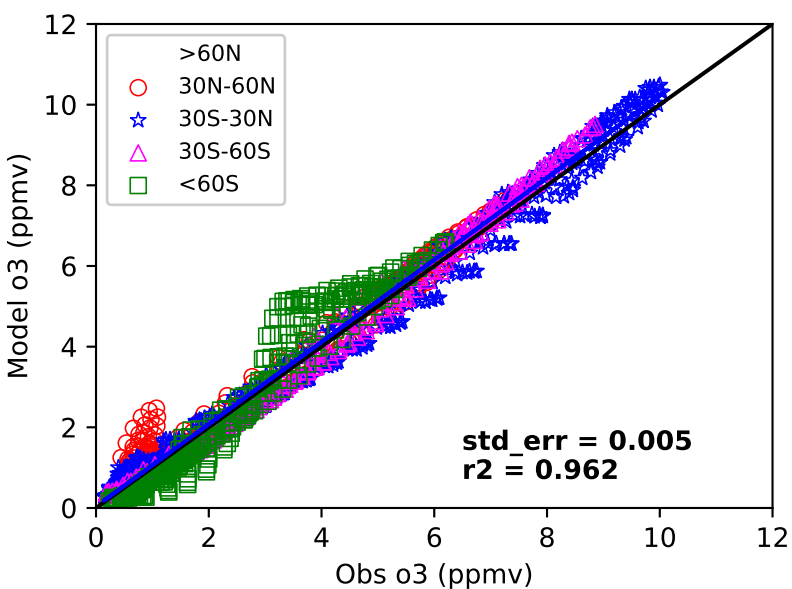
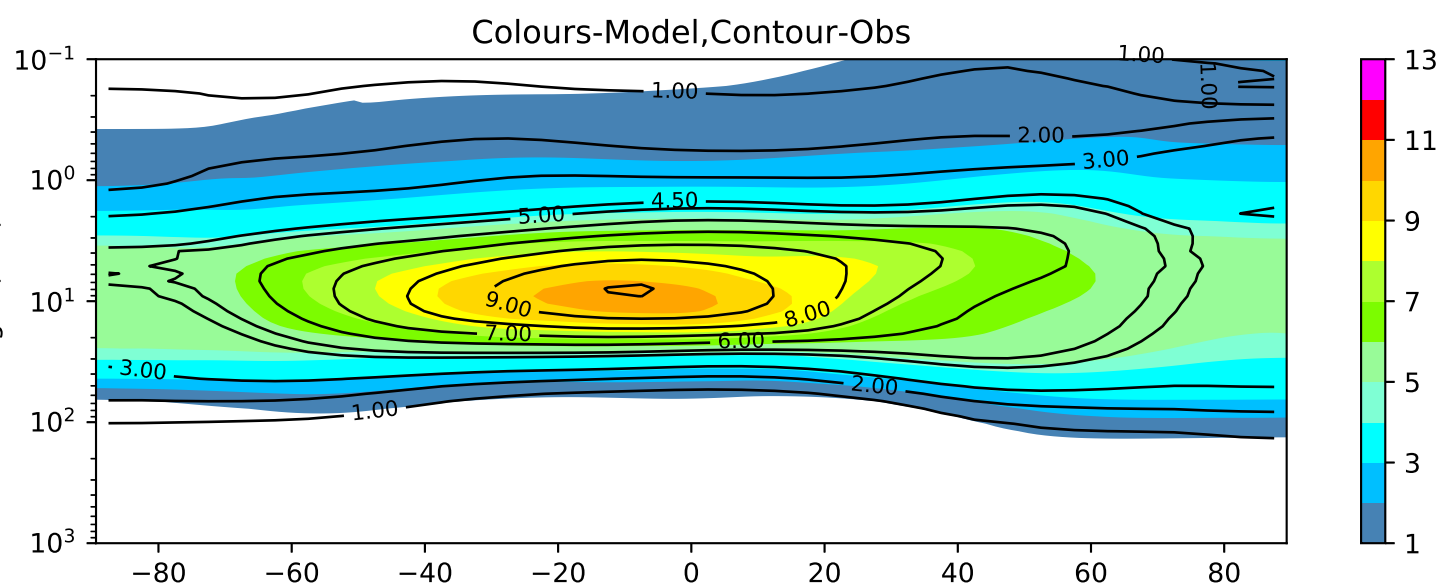
UKCA cf821 vs HALOE:  
O3 (ppmv) Jan



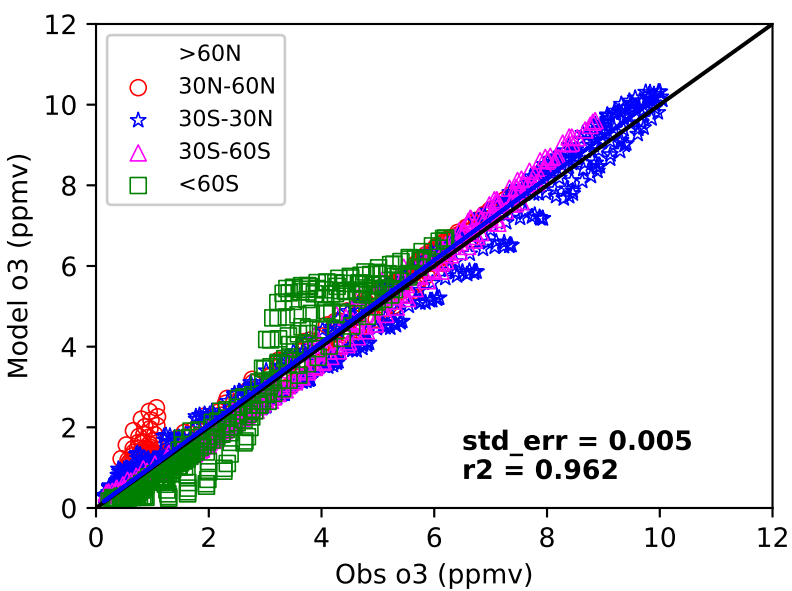
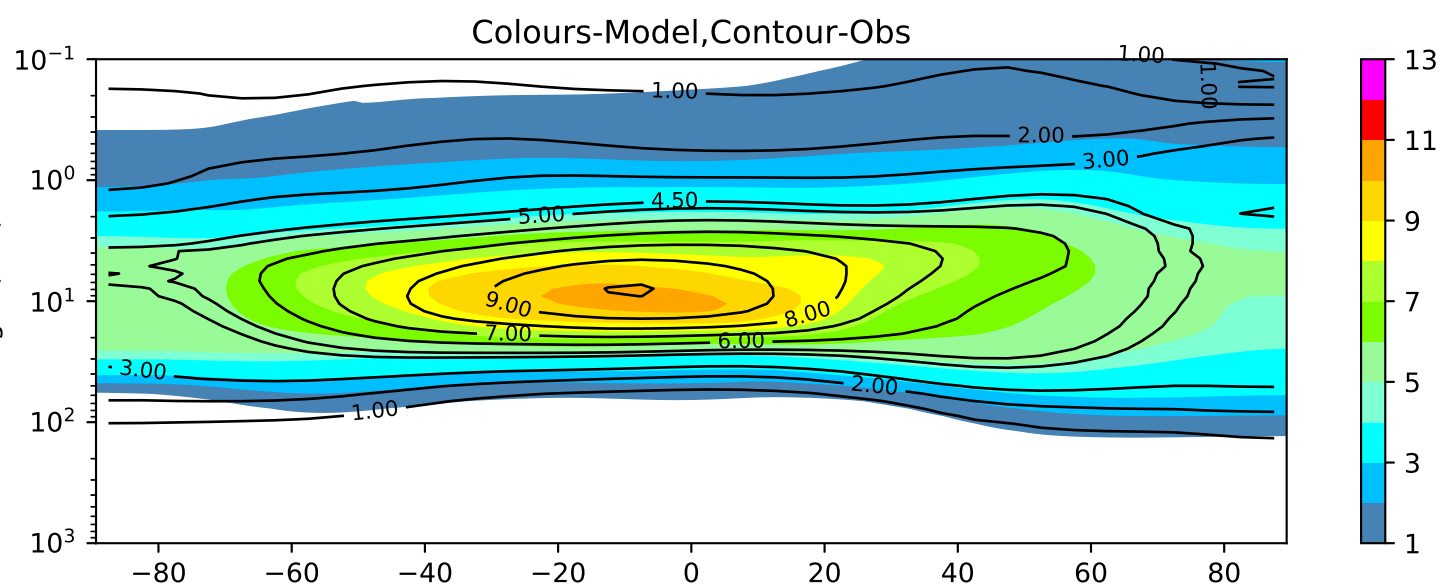
UKCA cd037 vs HALOE:  
O<sub>3</sub> (ppmv) Jul



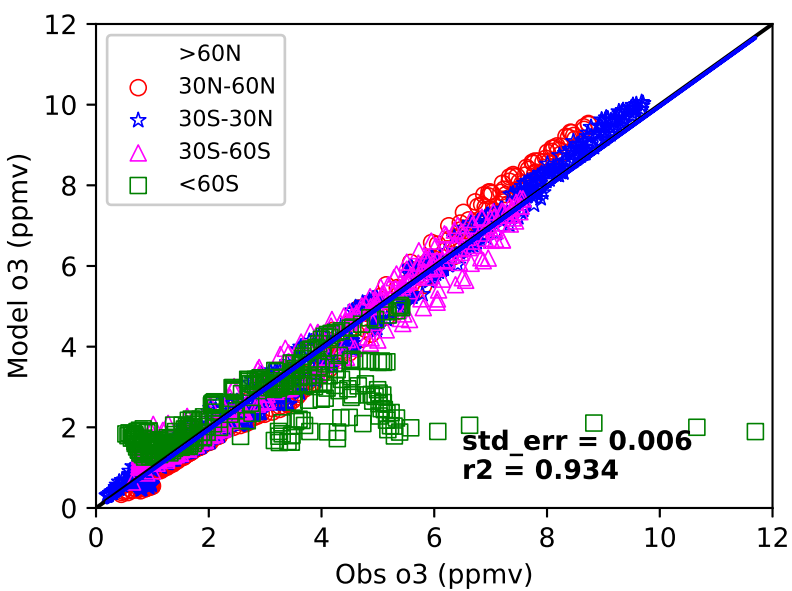
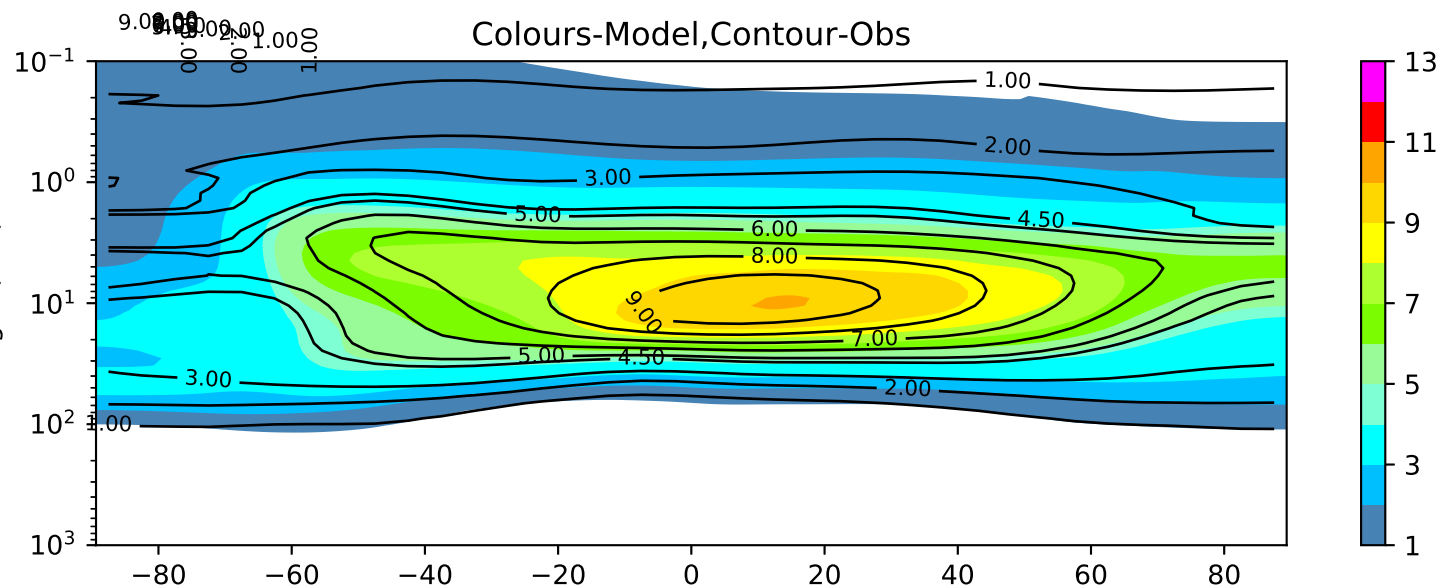
UKCA cf821 vs HALOE:  
O<sub>3</sub> (ppmv) Jul



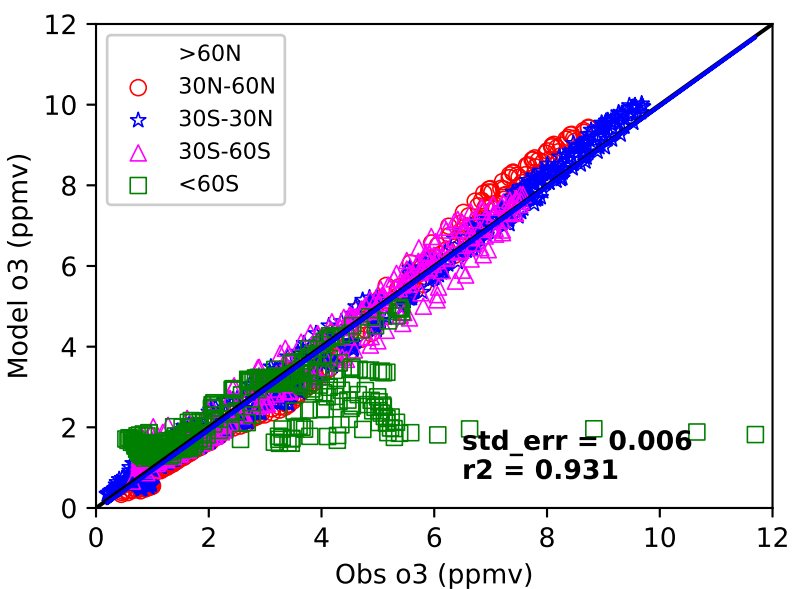
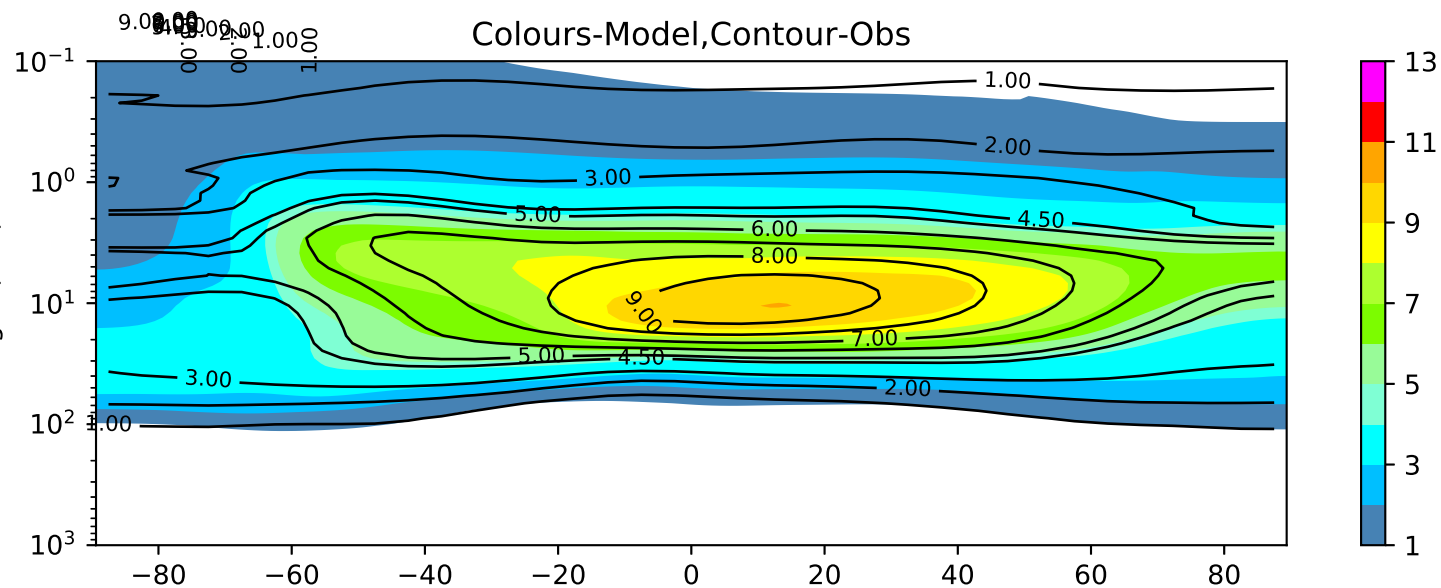
UKCA cd037 vs NIWA-CCMVal:  
O3 (ppmv) Jan



UKCA cf821 vs NIWA-CCMVal:  
O3 (ppmv) Jan

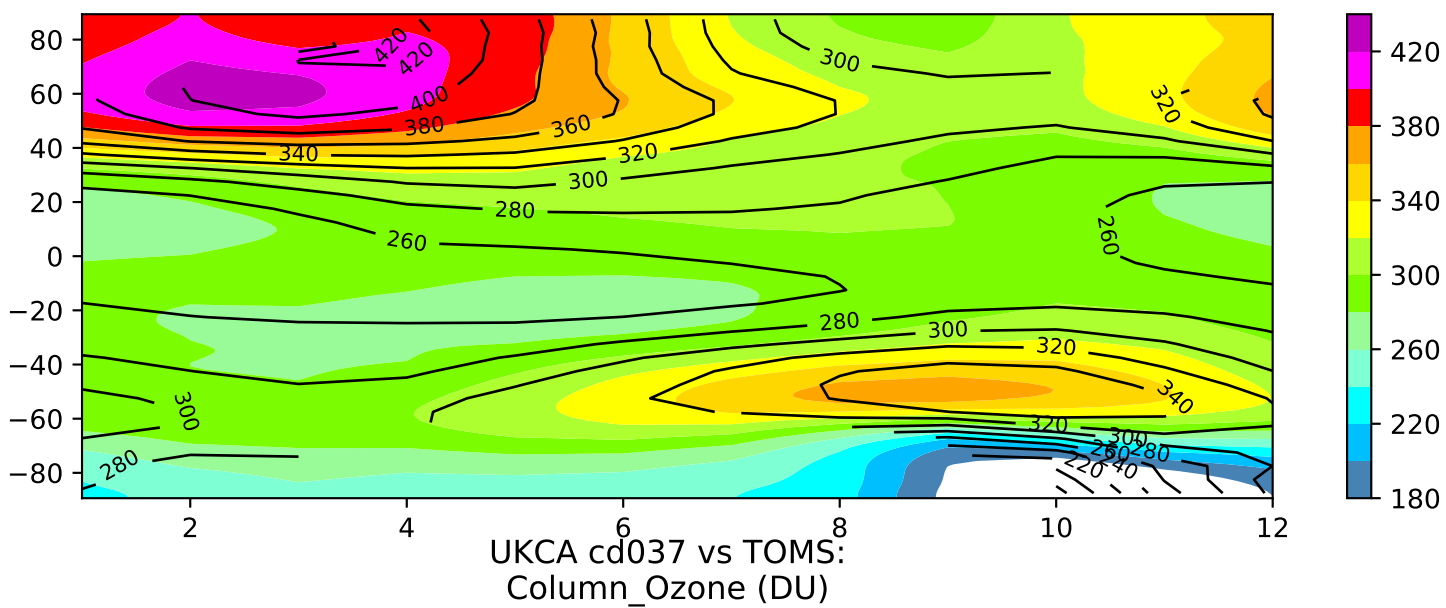


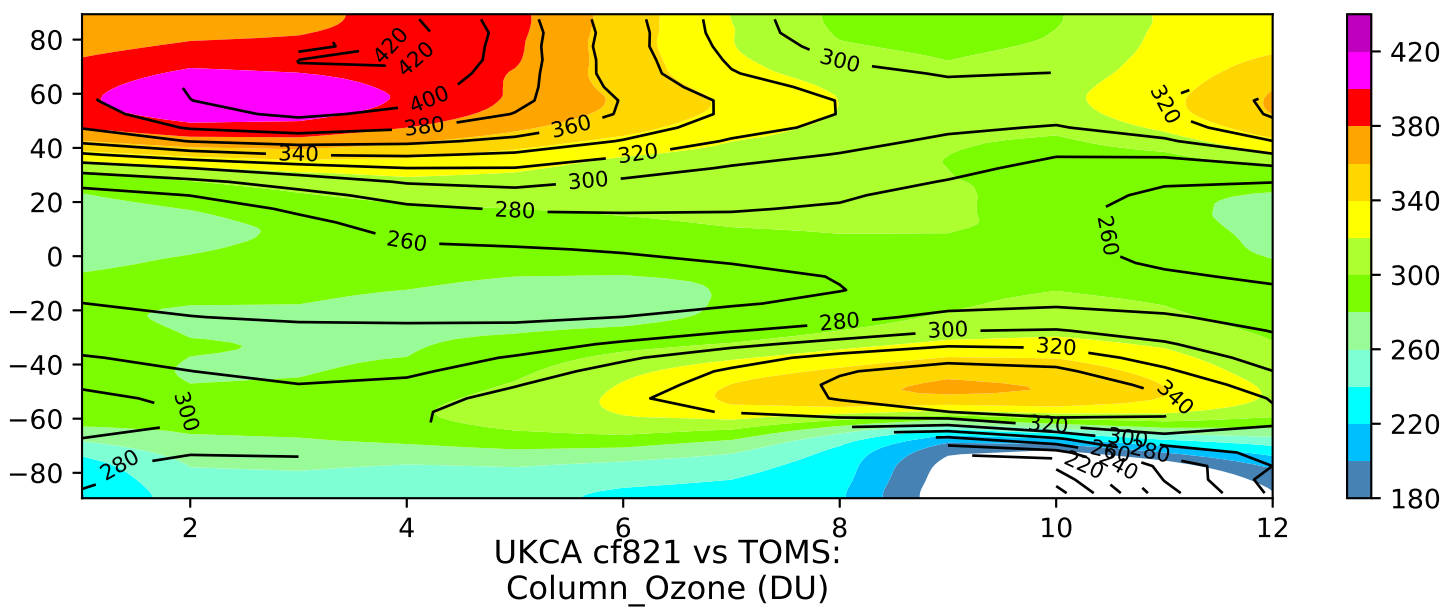
UKCA cd037 vs NIWA-CCMVal:  
O3 (ppmv) Jul



UKCA cf821 vs NIWA-CCMVal:  
O3 (ppmv) Jul

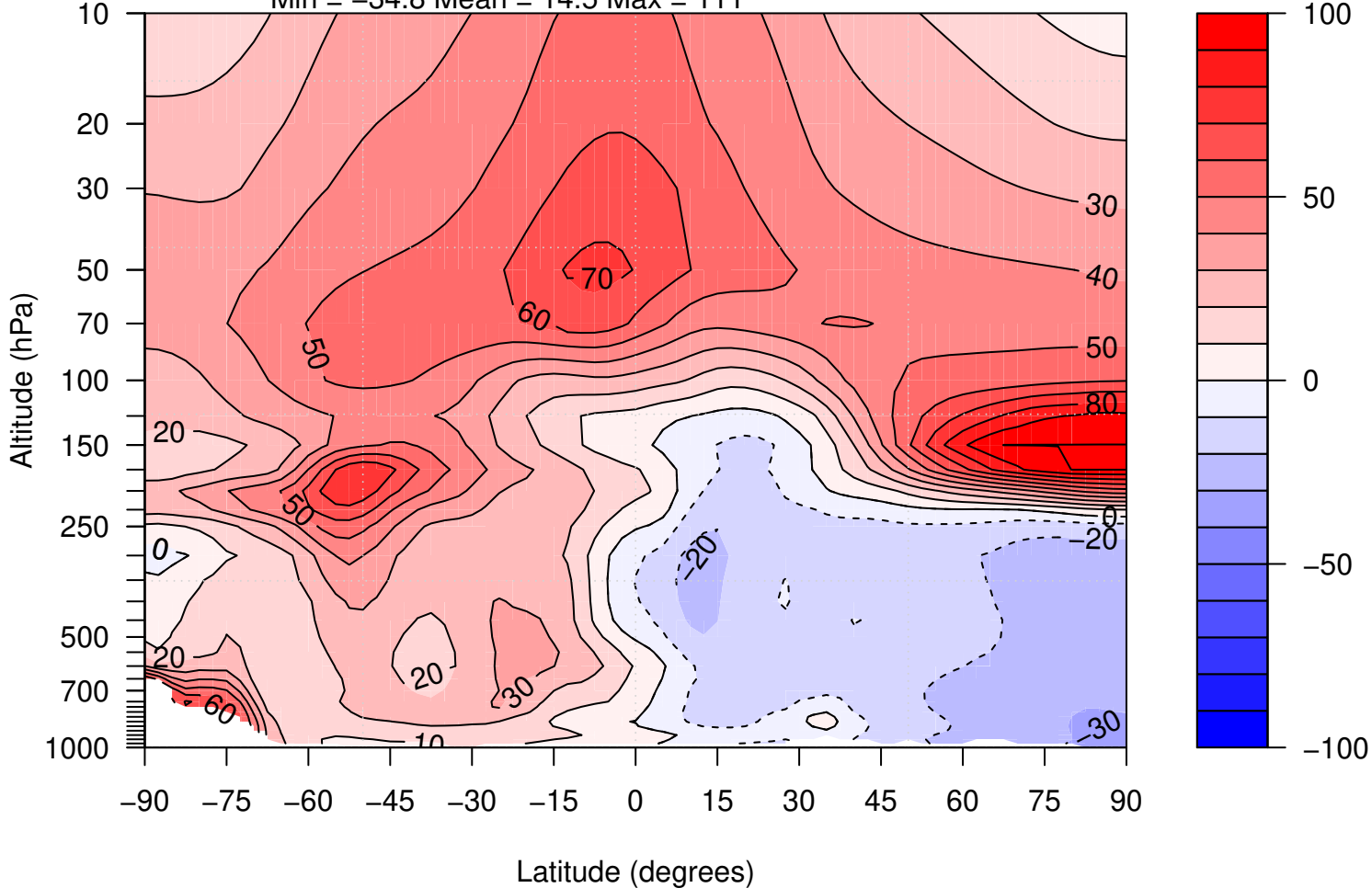






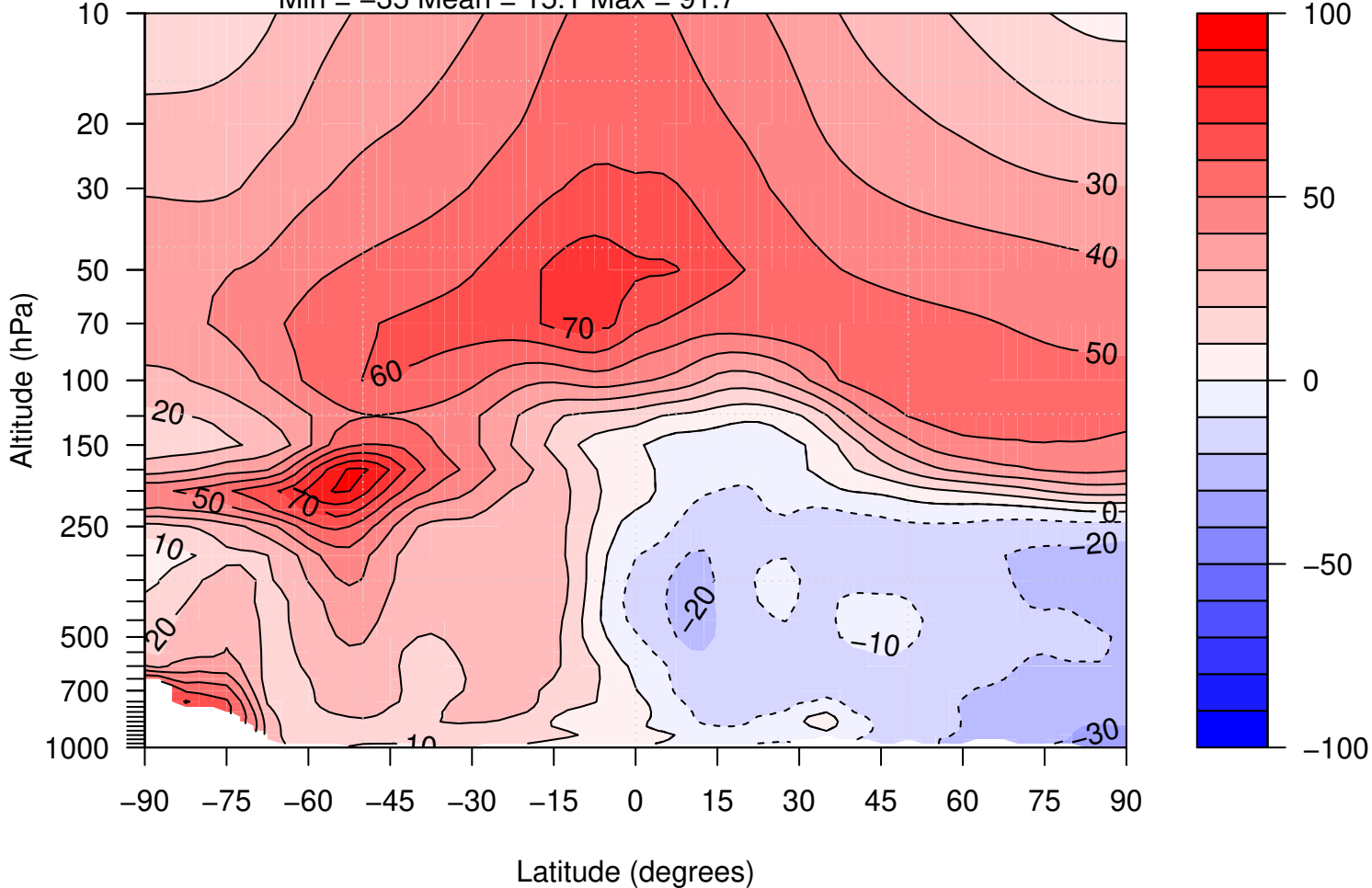
# cd037 – ERA Q bias

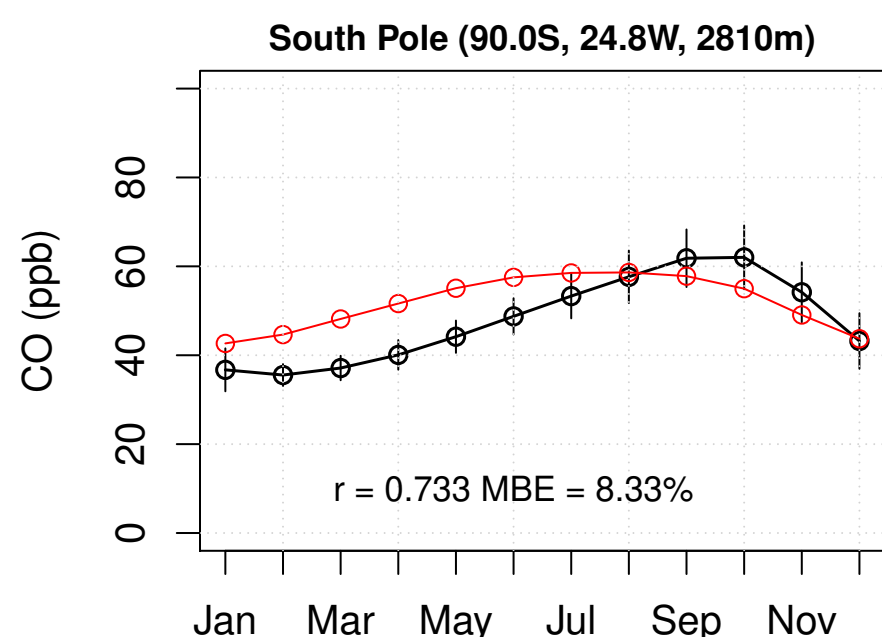
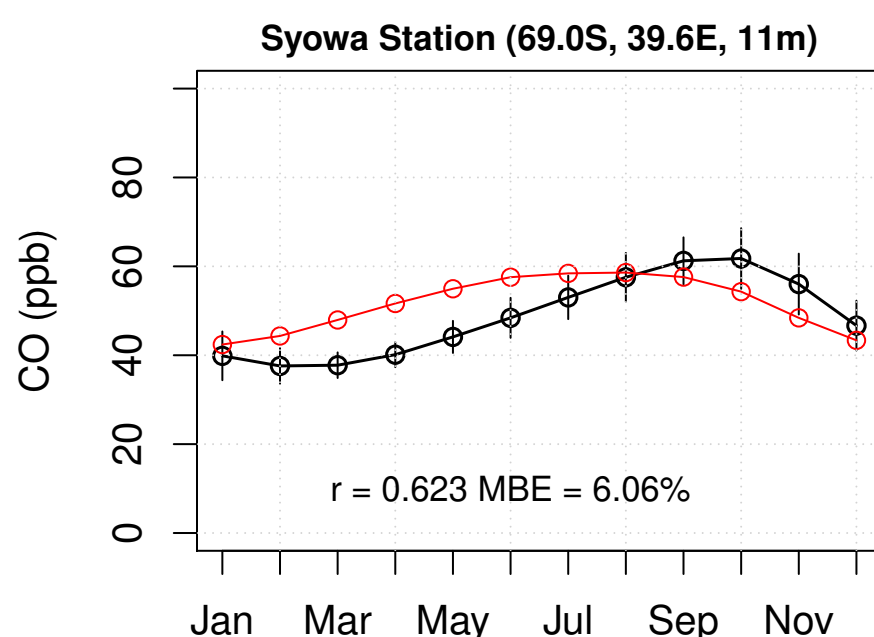
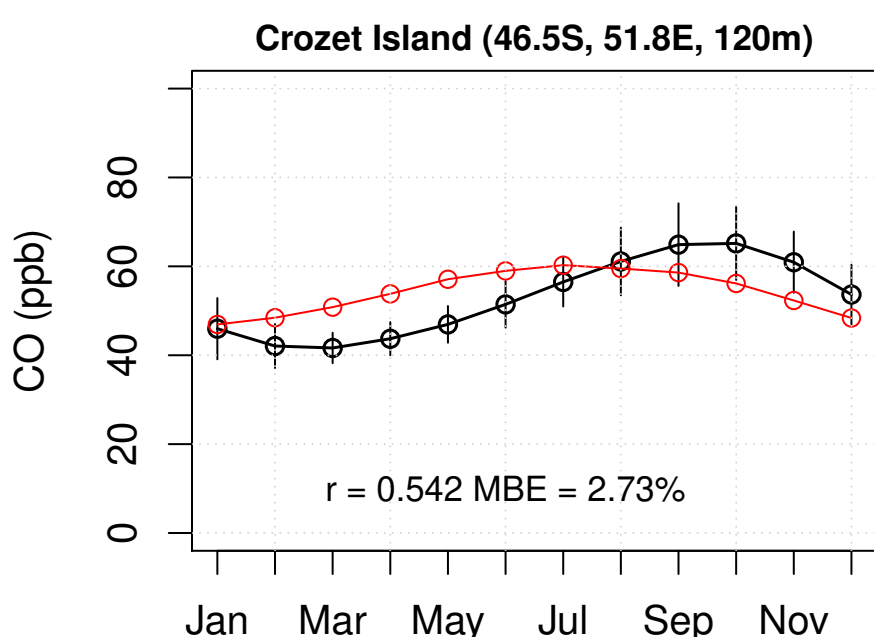
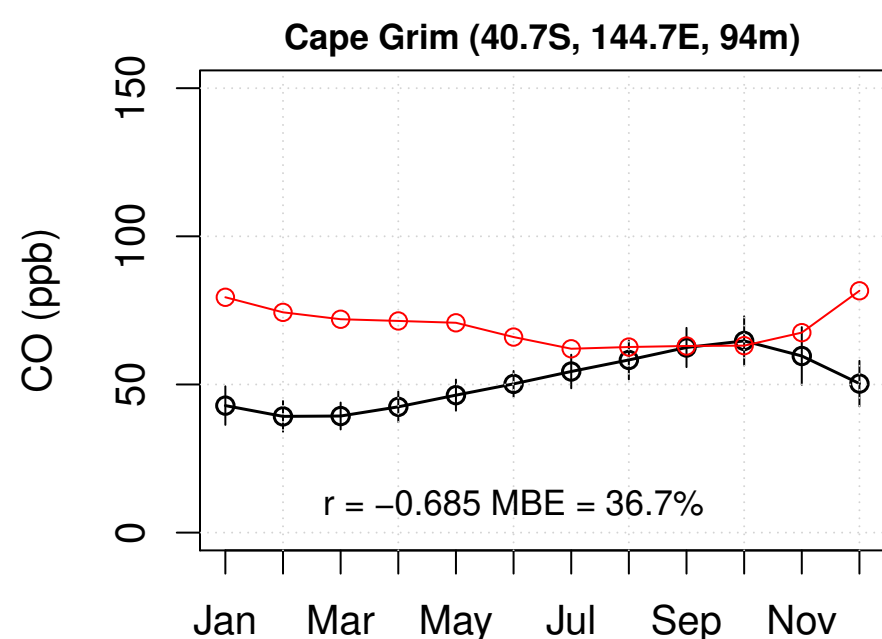
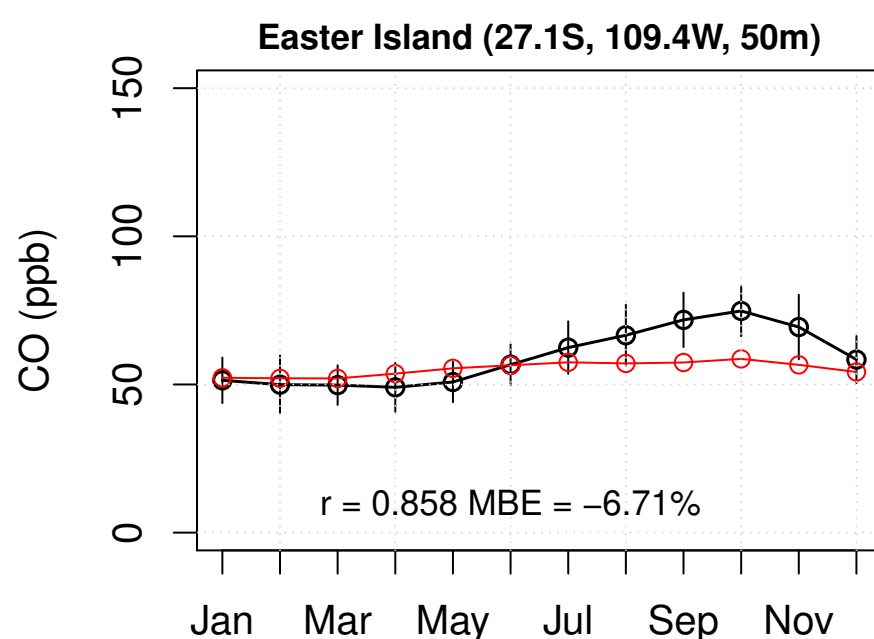
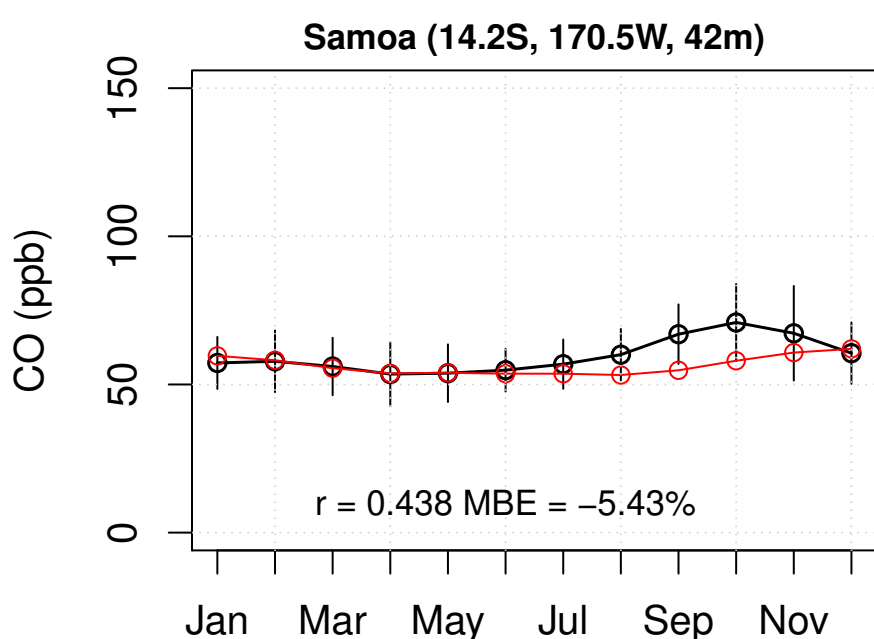
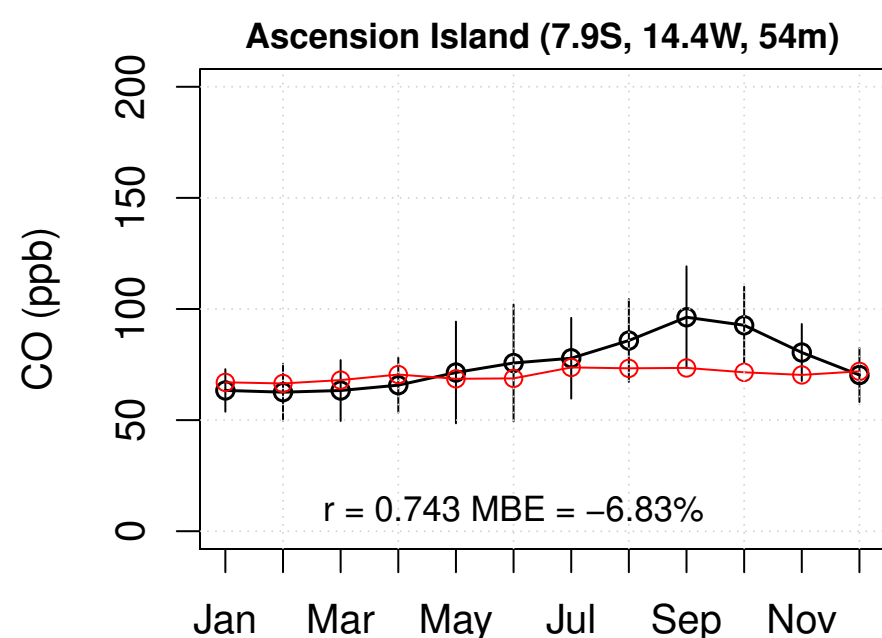
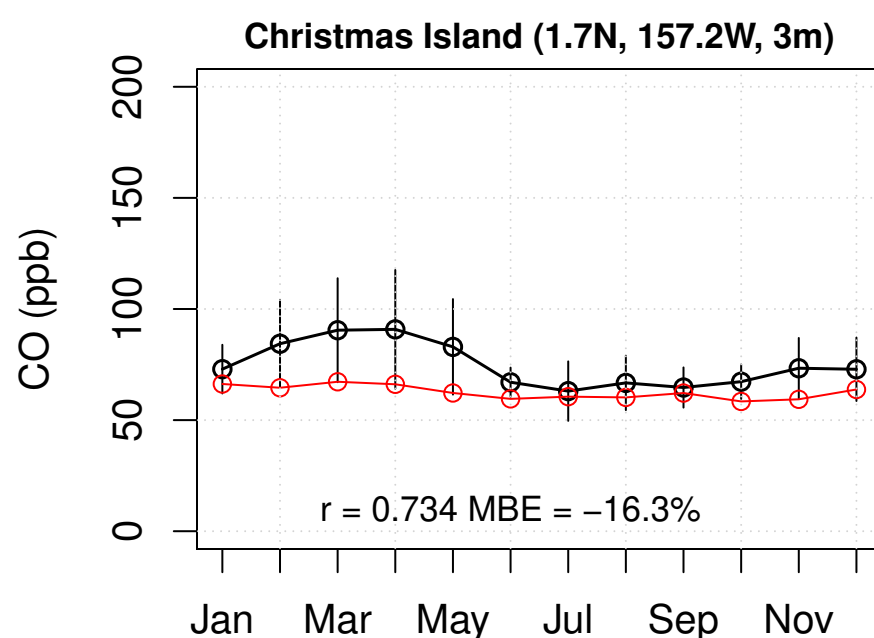
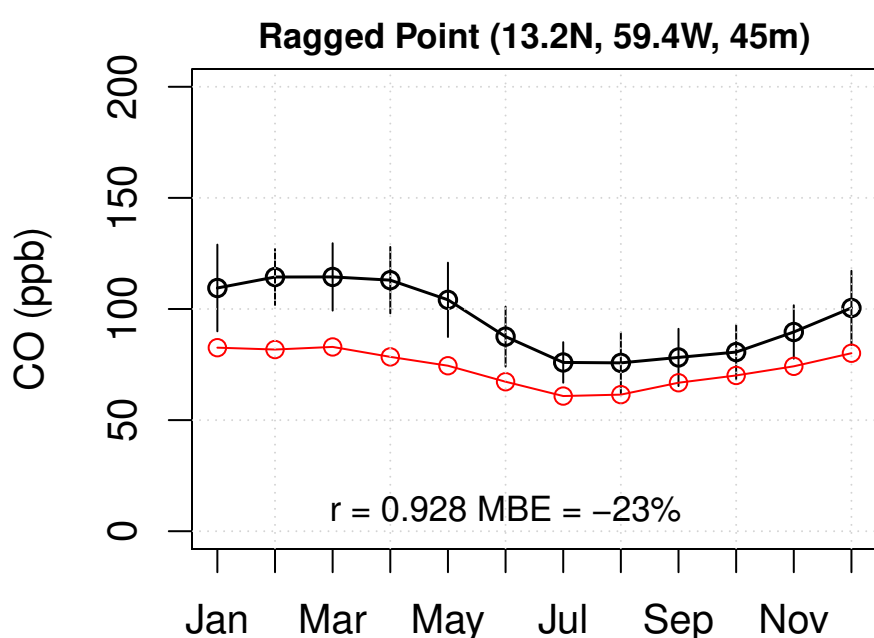
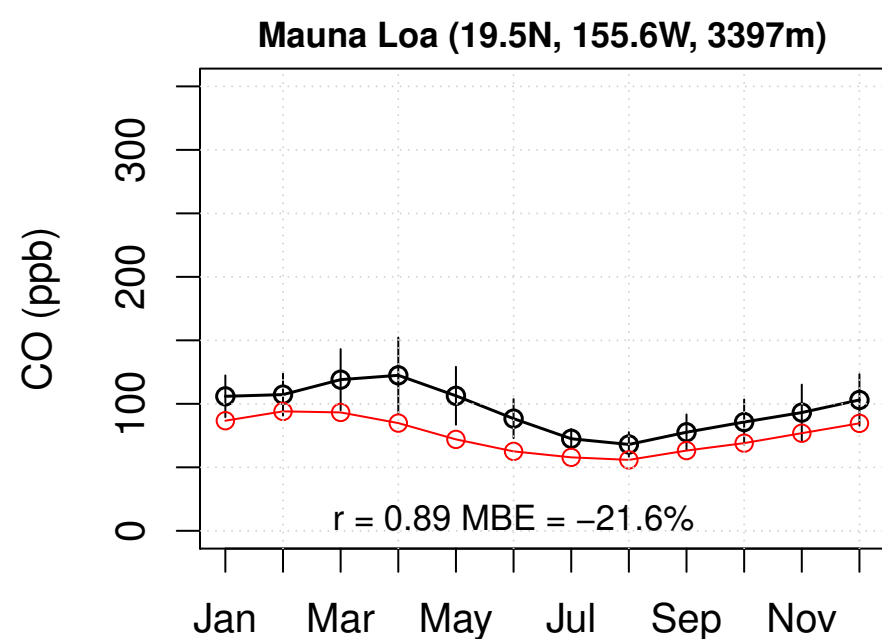
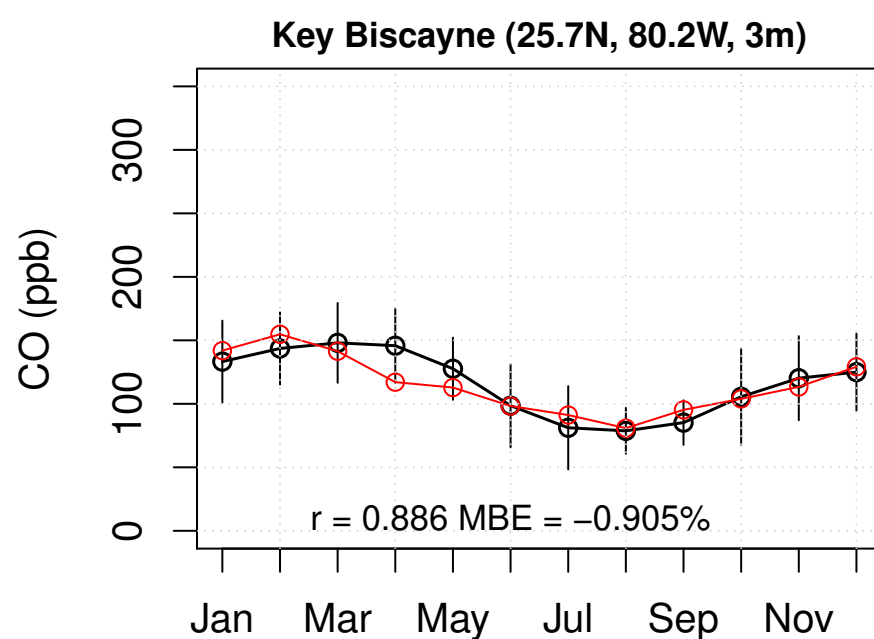
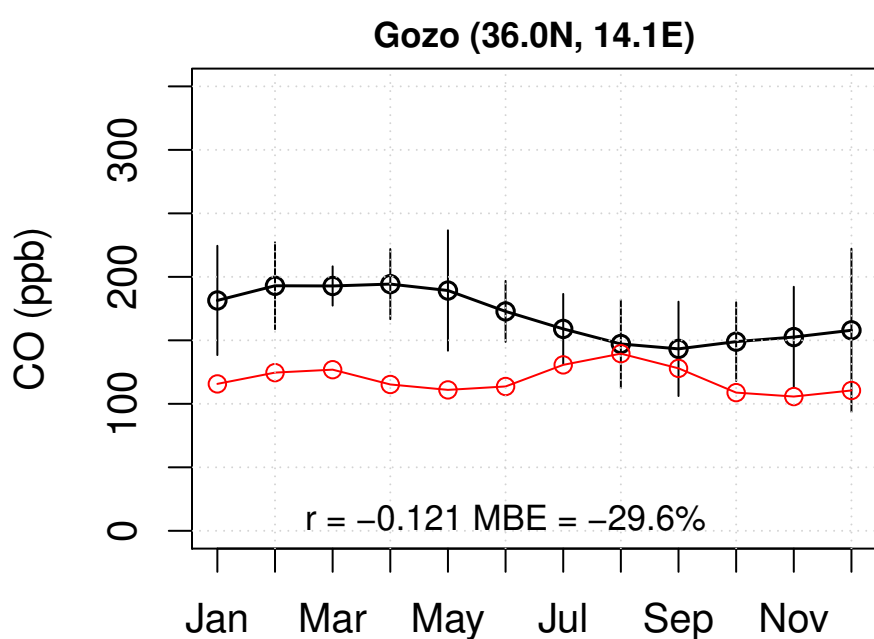
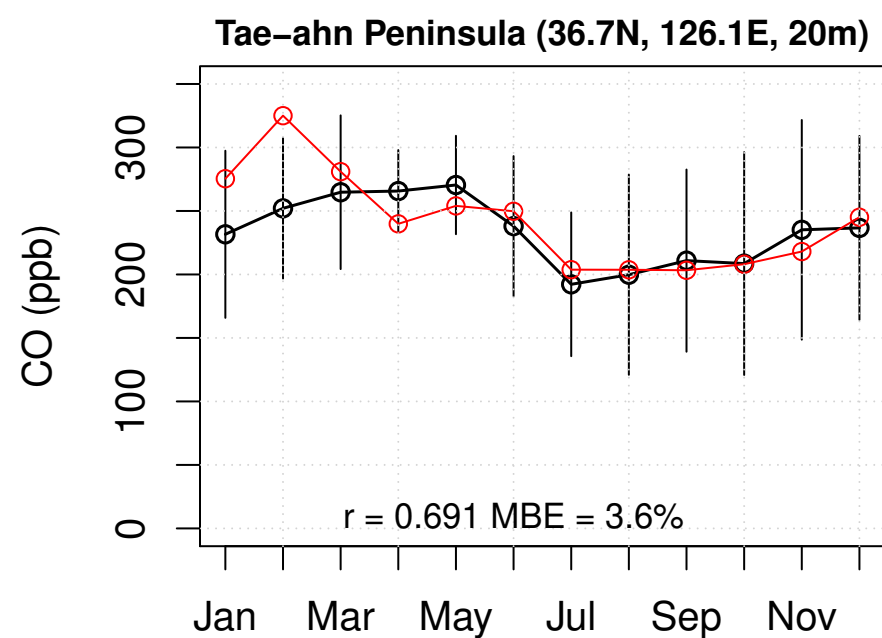
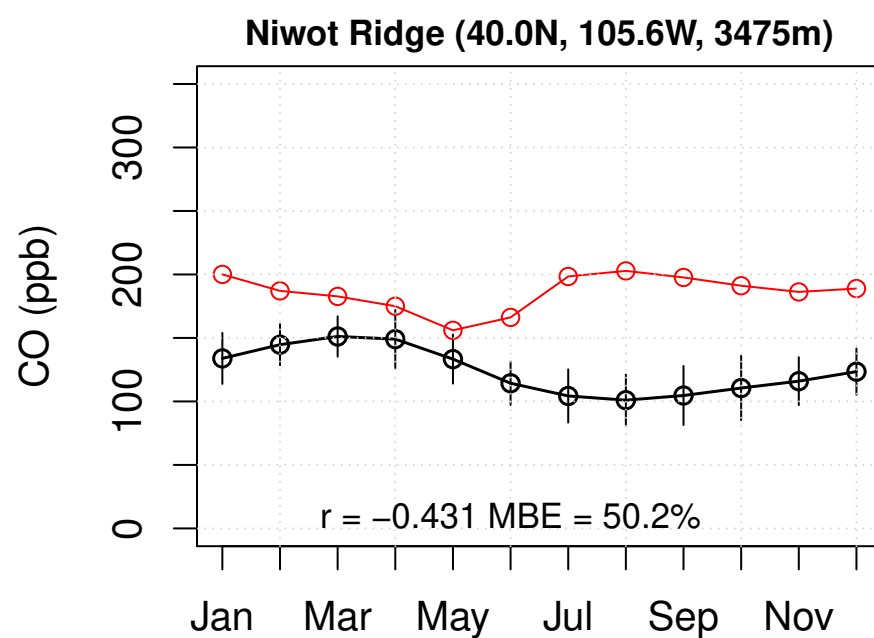
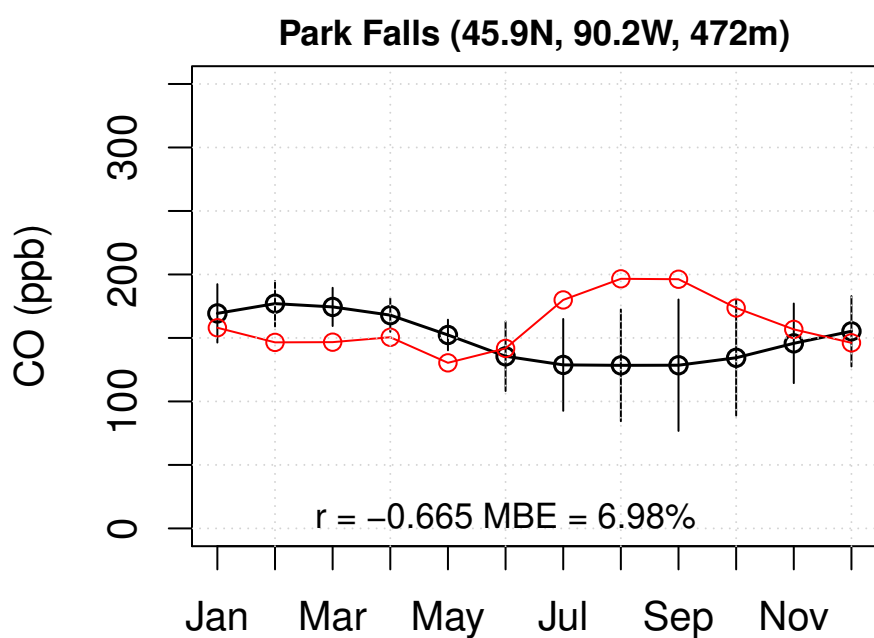
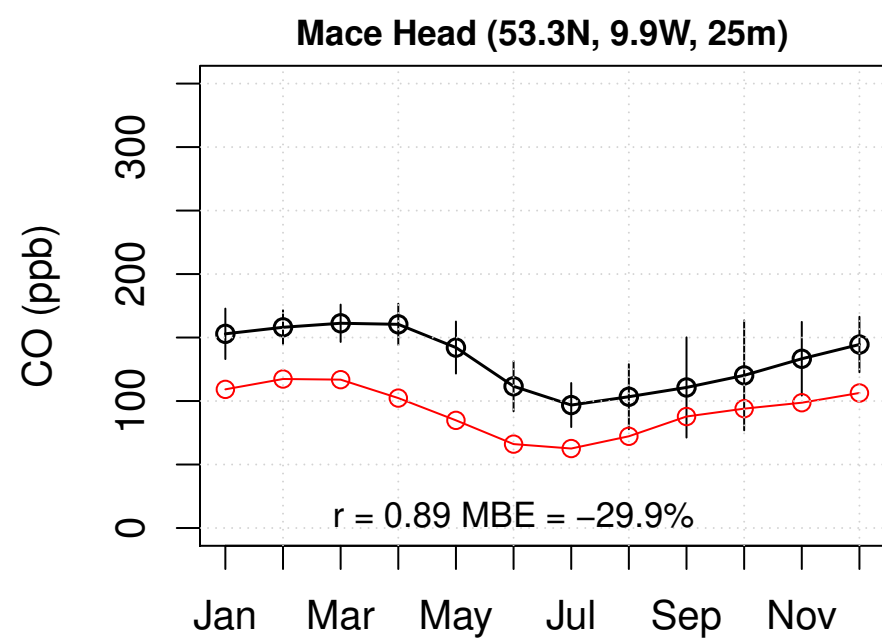
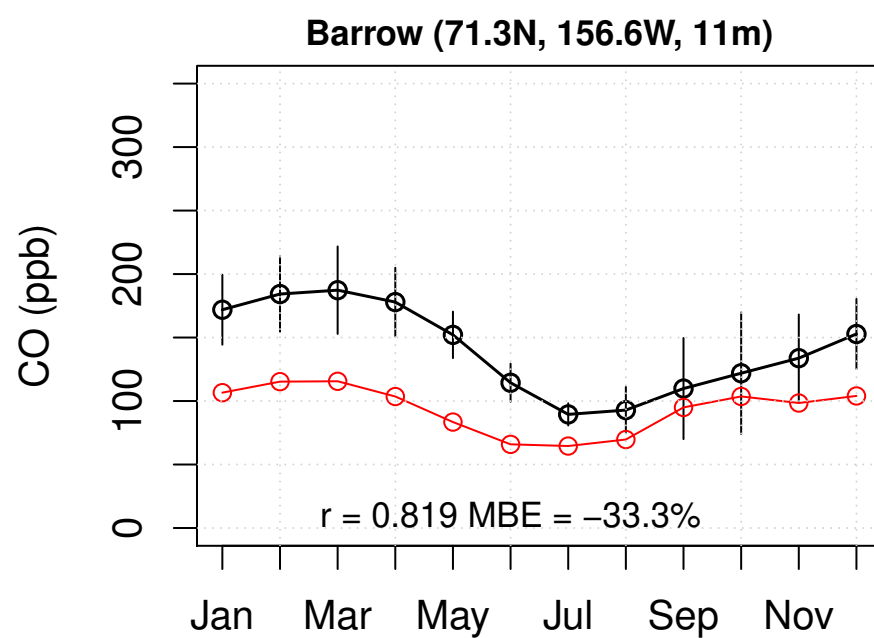
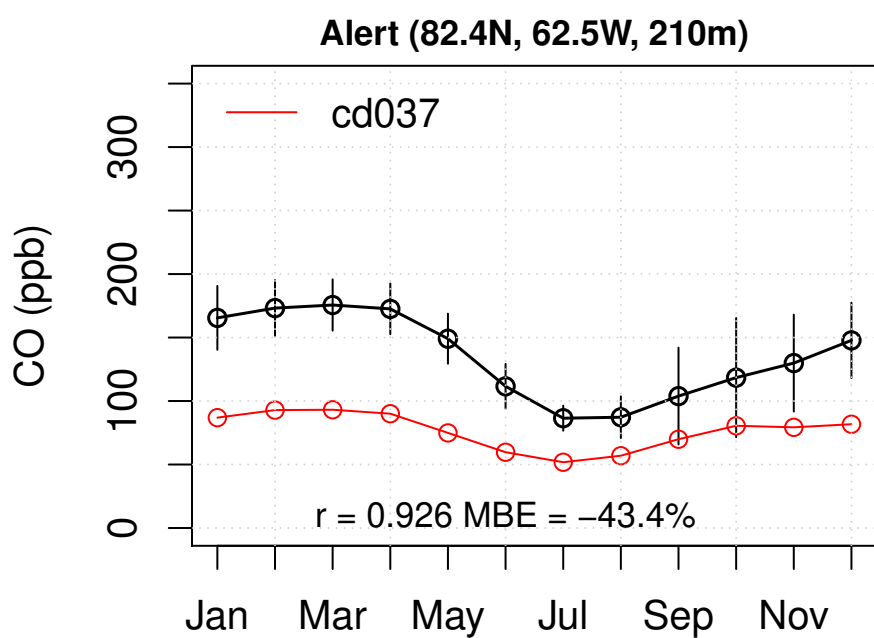
Min = -34.8 Mean = 14.5 Max = 111

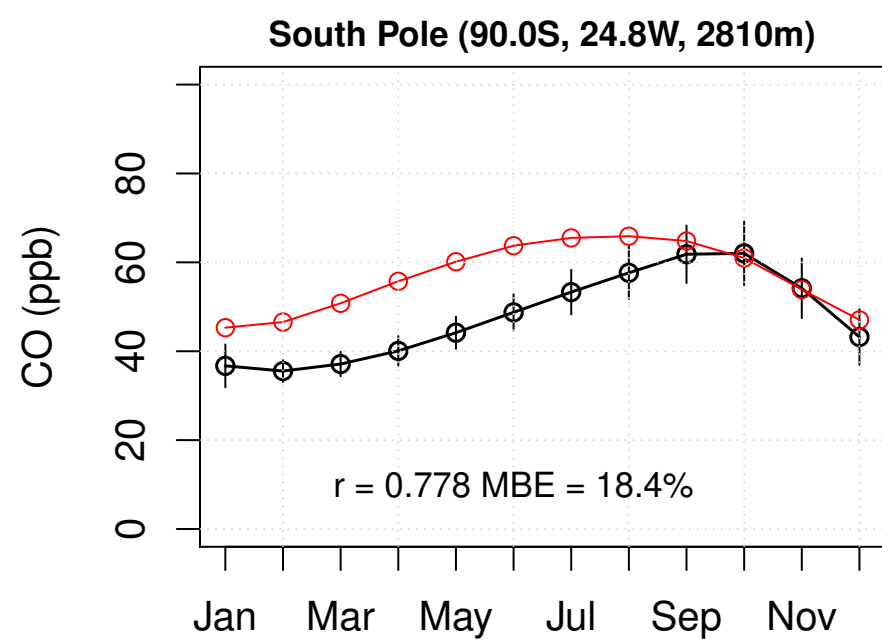
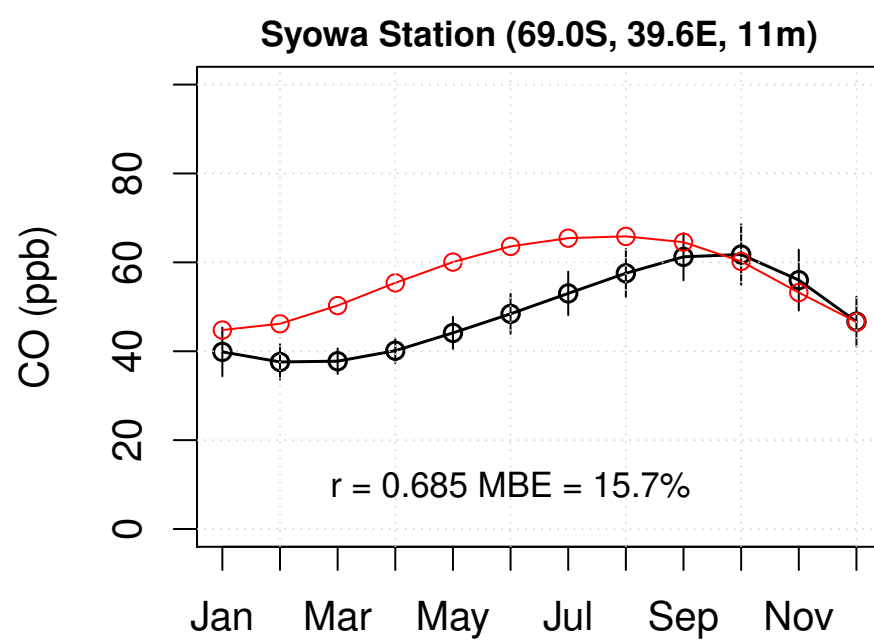
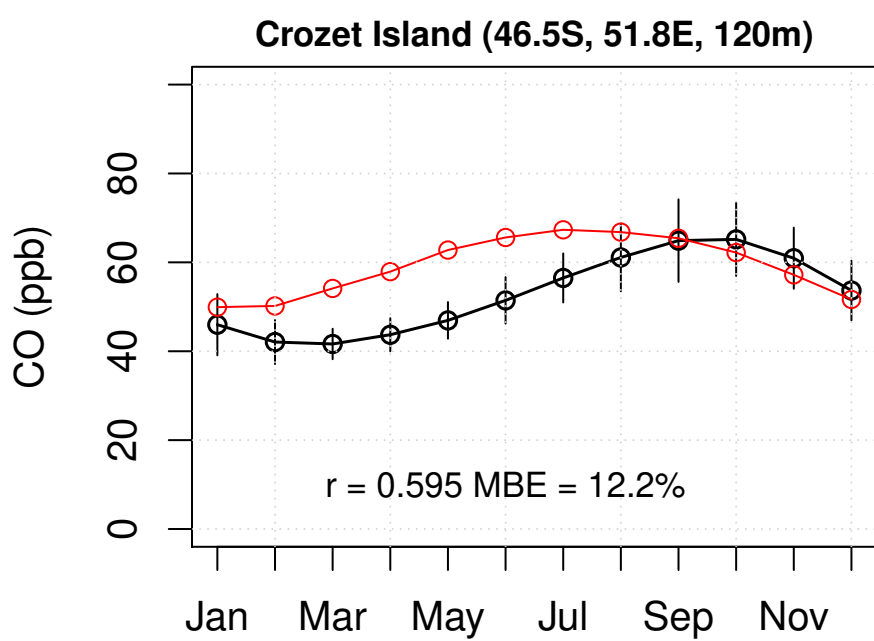
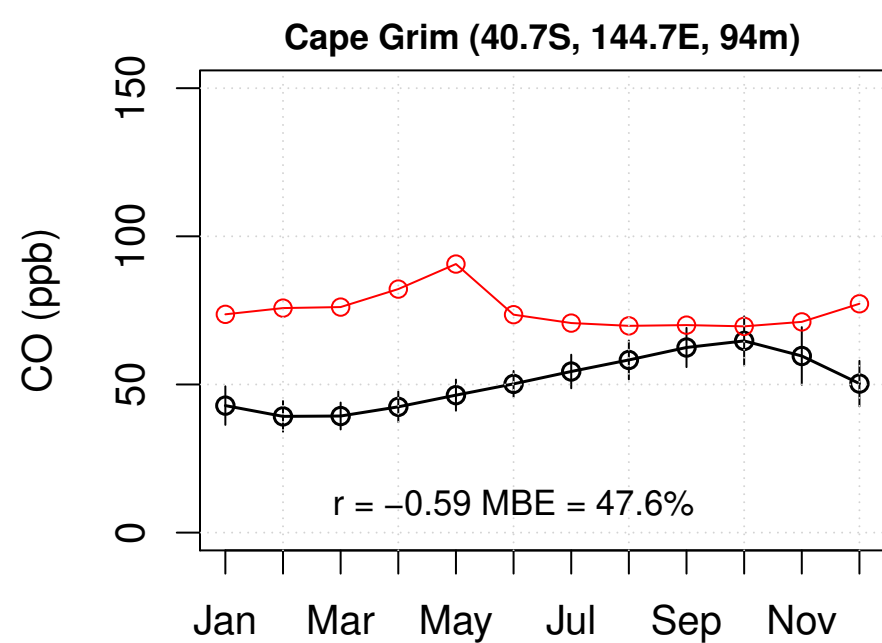
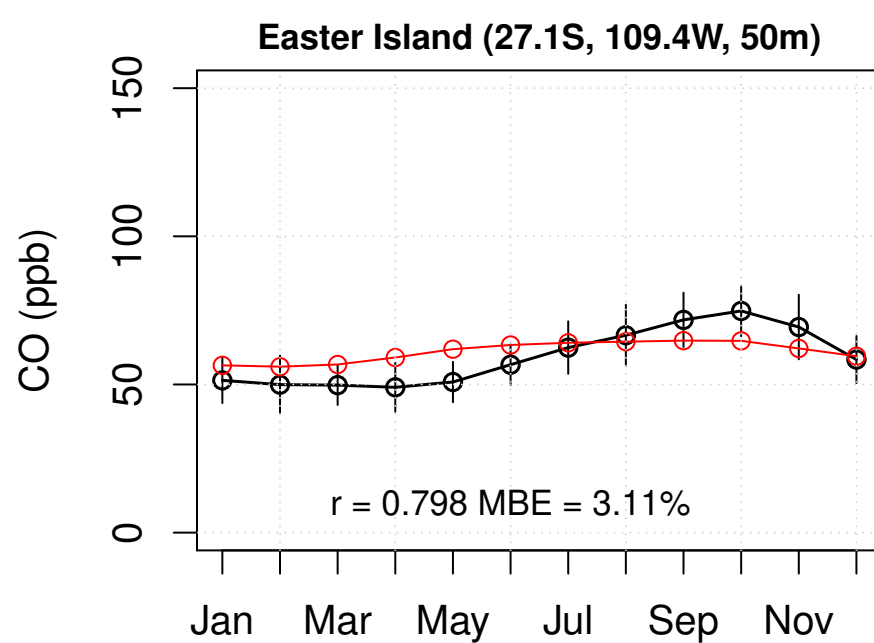
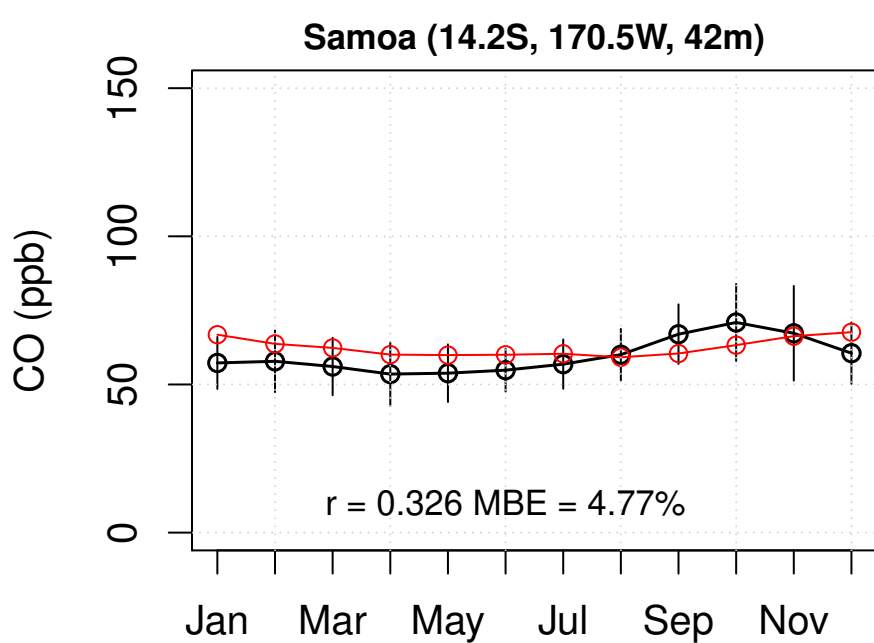
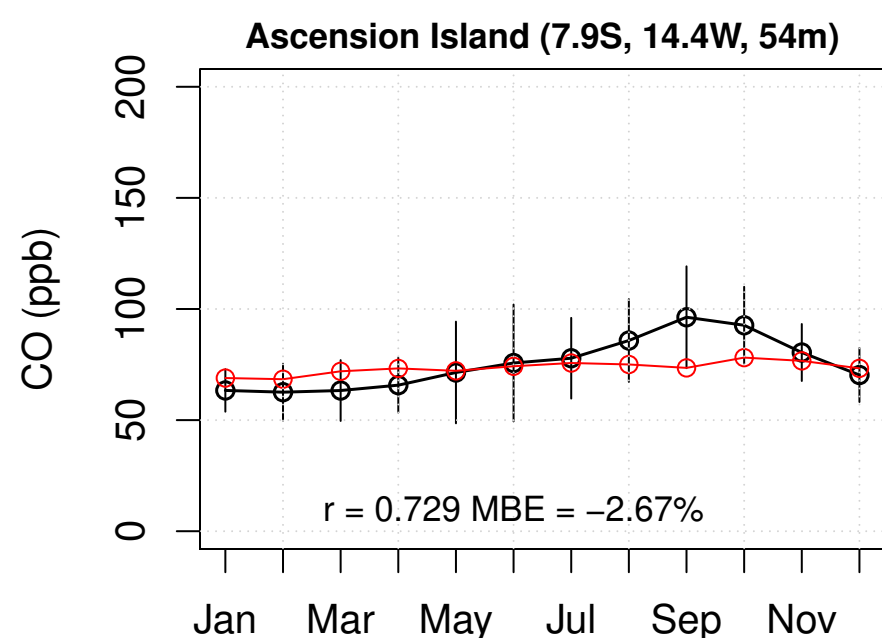
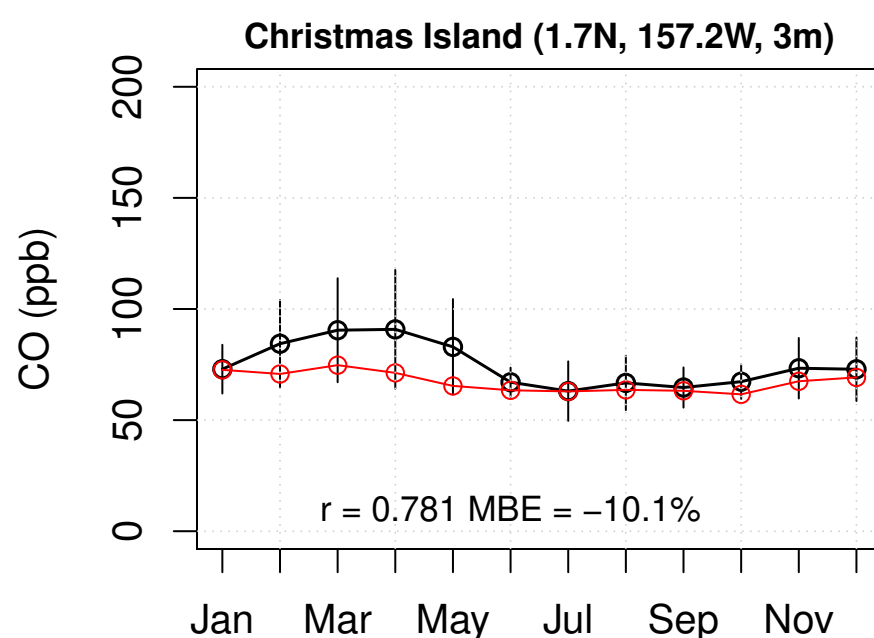
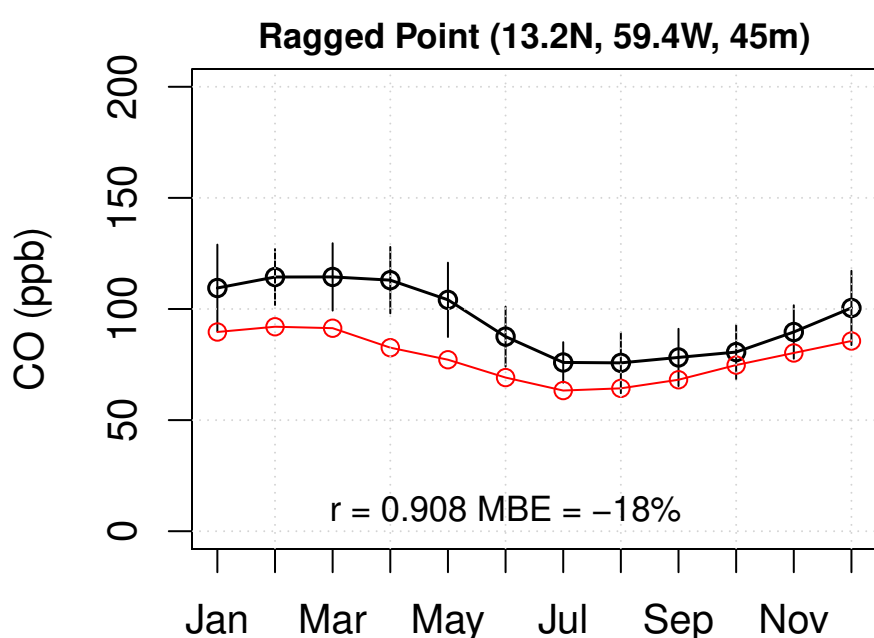
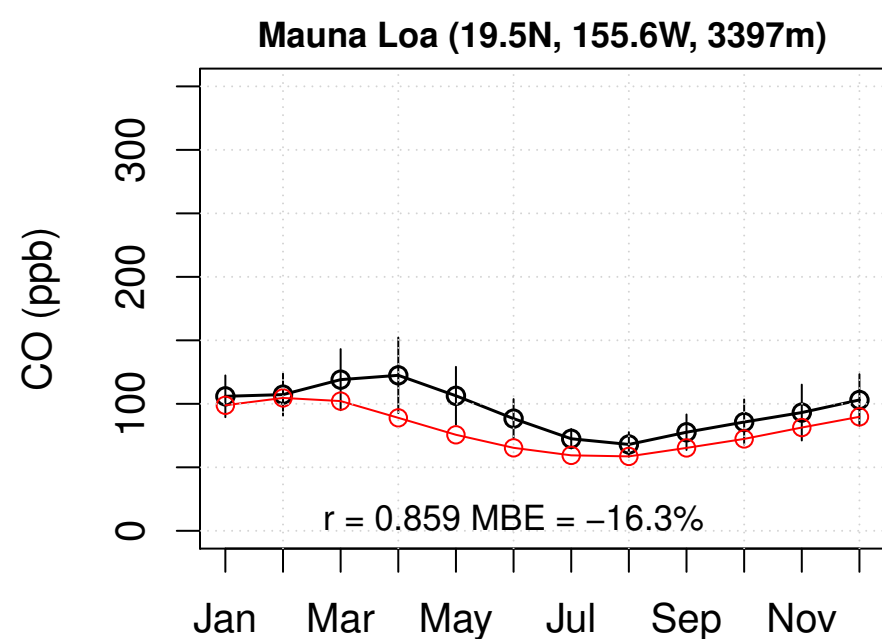
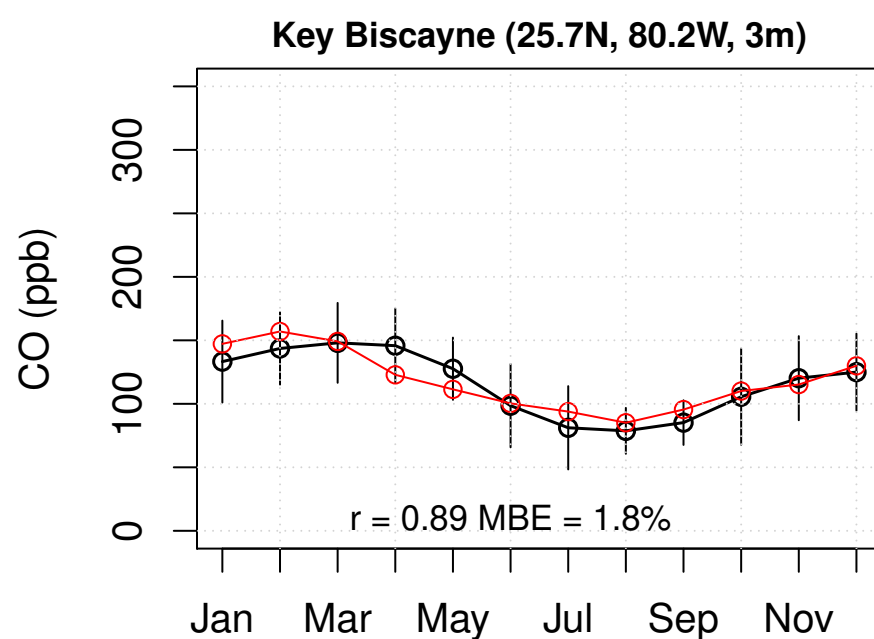
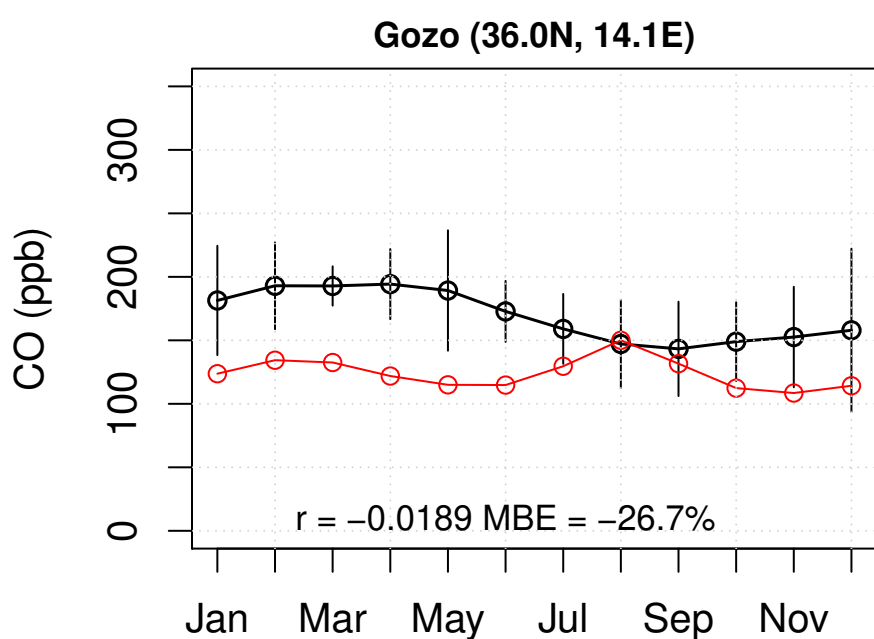
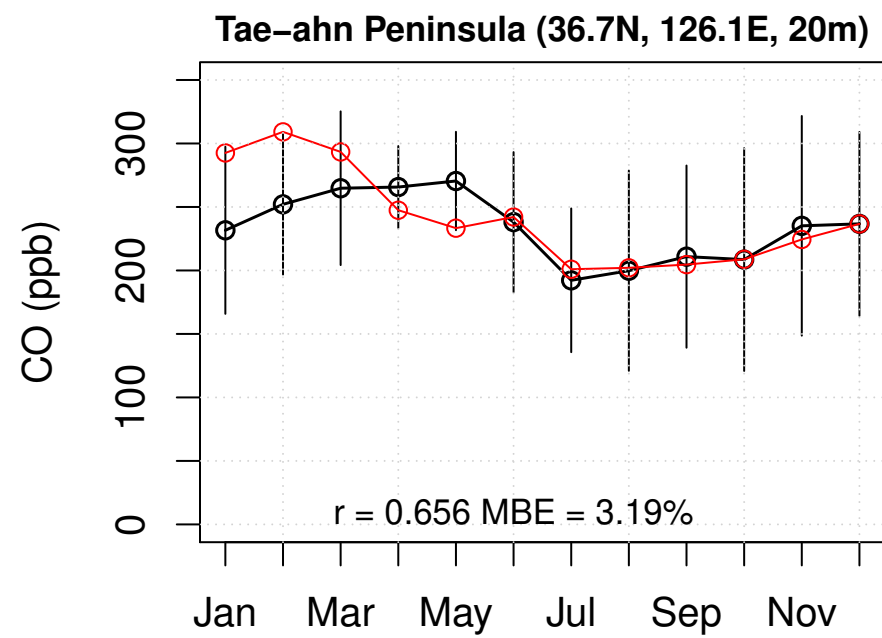
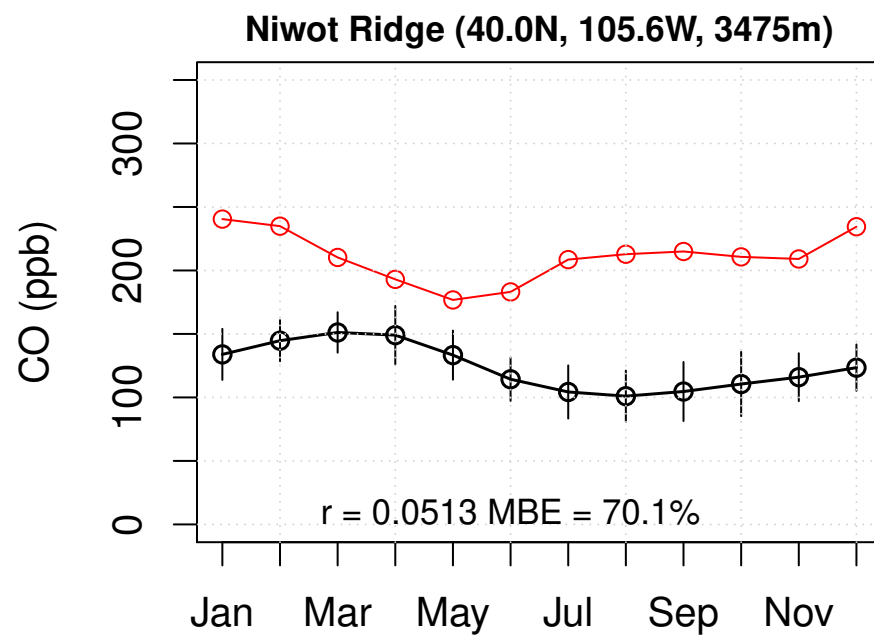
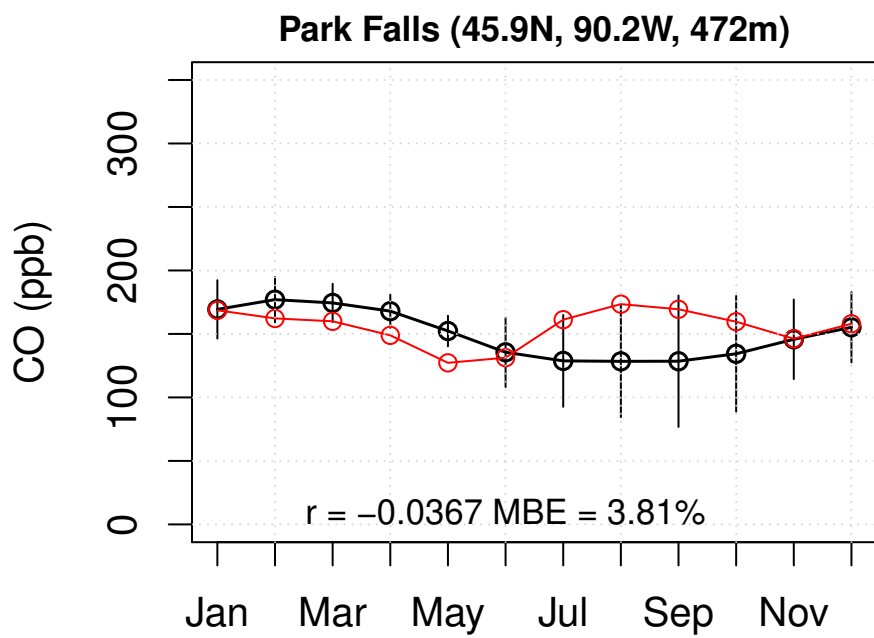
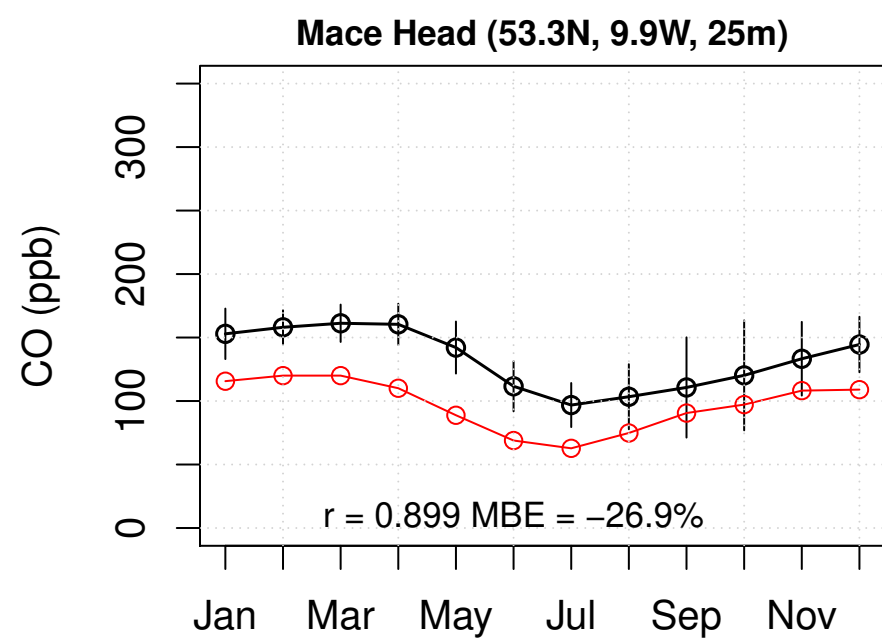
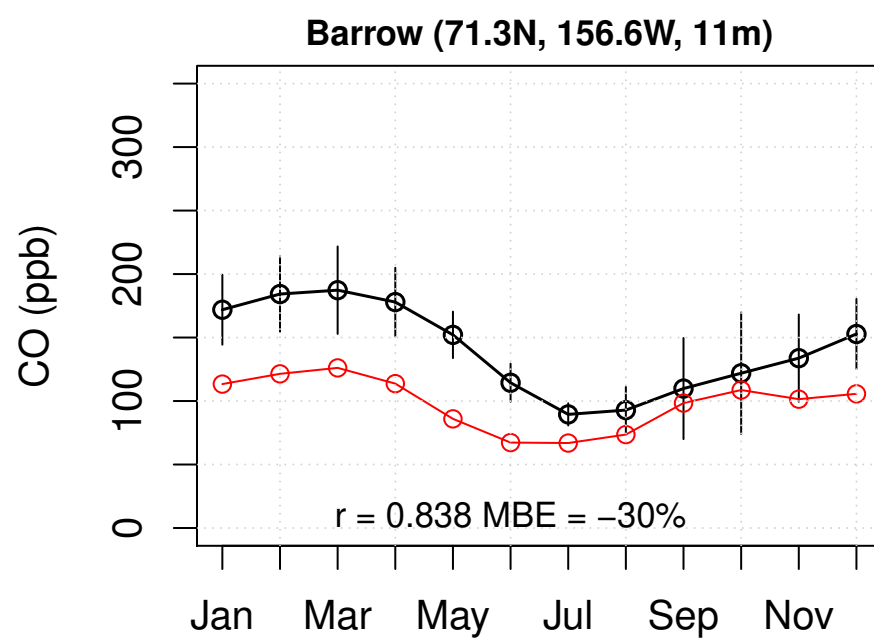
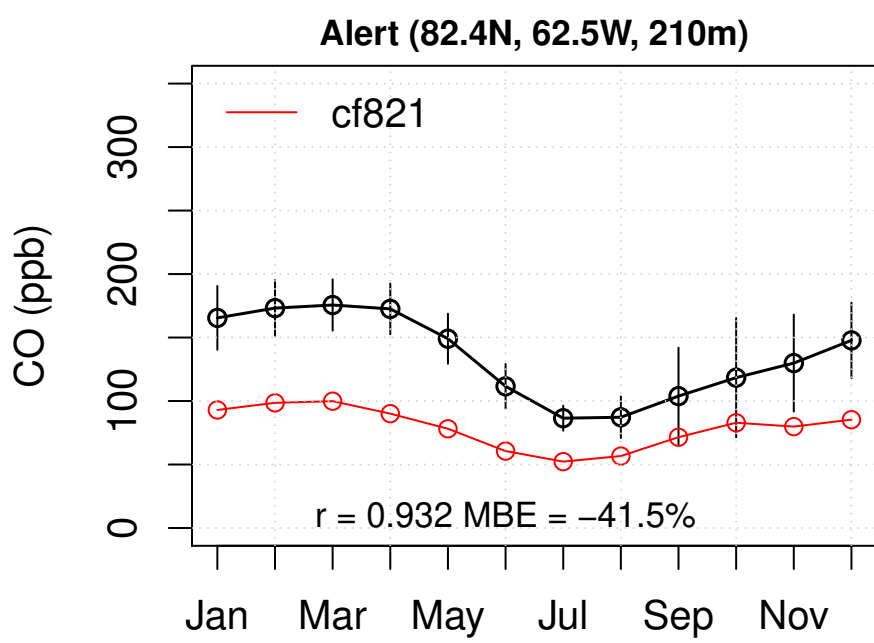


# cf821 – ERA Q bias

Min = -35 Mean = 15.1 Max = 91.7



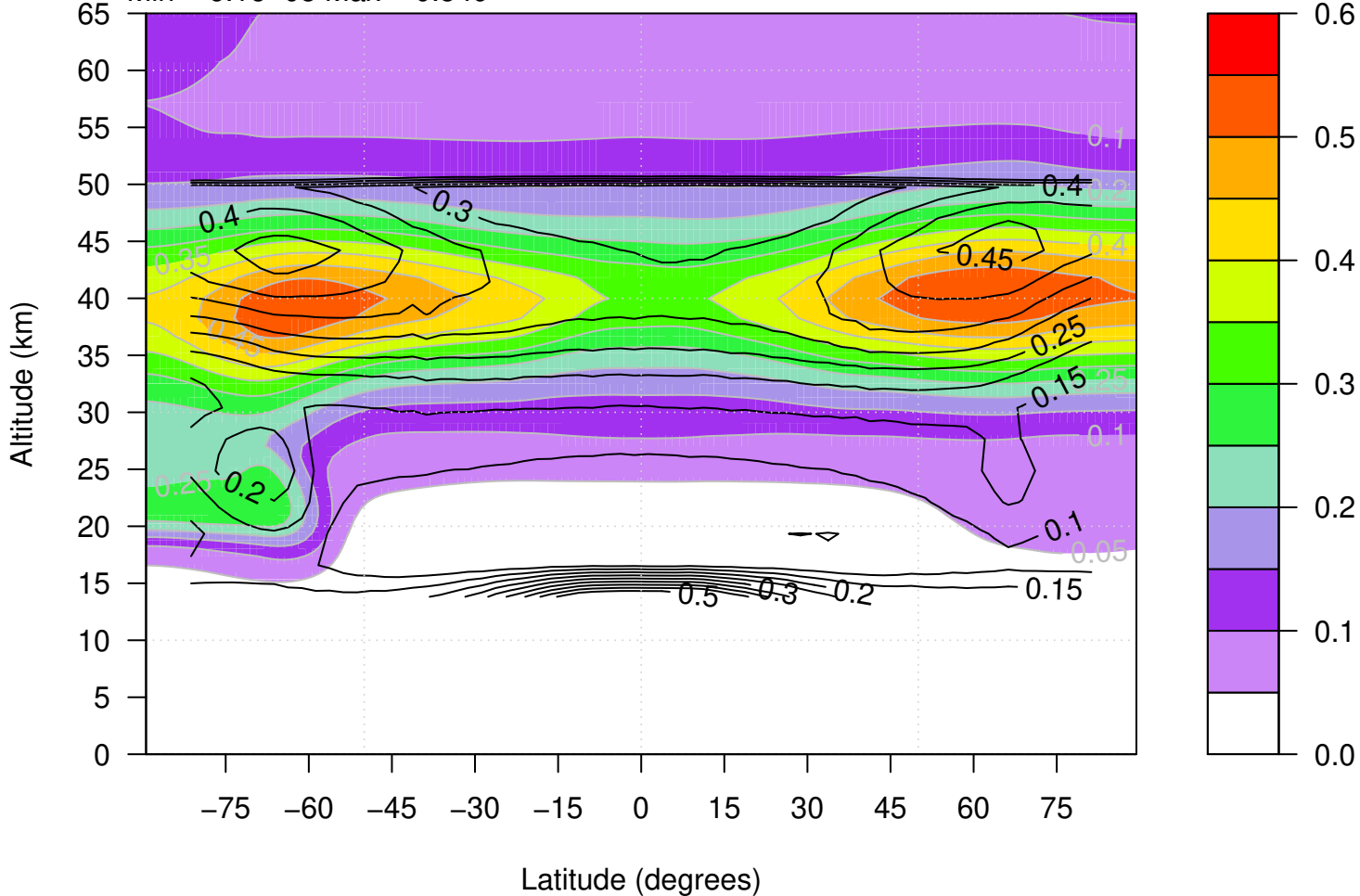




# MLS – UKCA cd037 ClO comparison

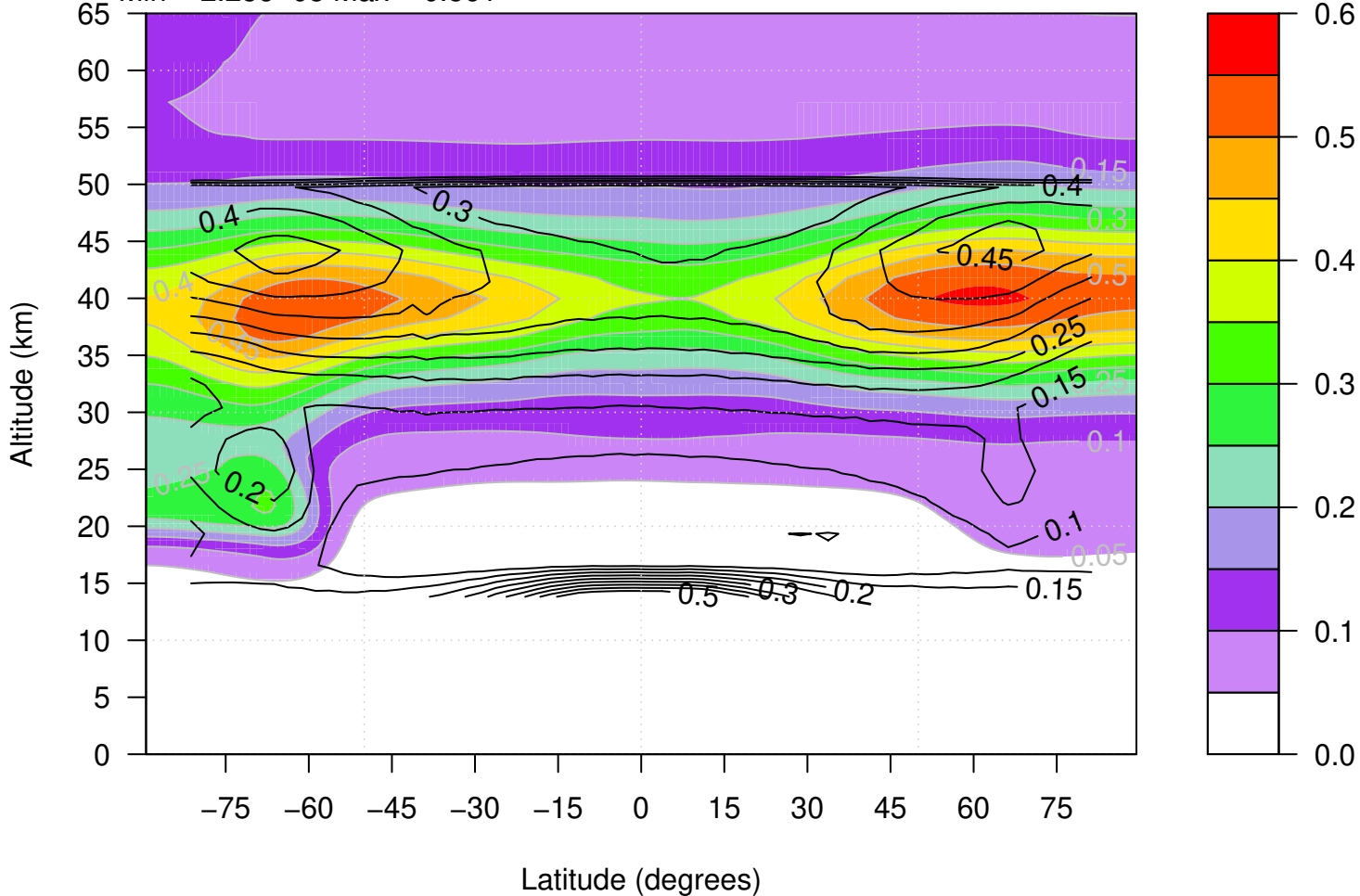
ppm

Min = 6.1e-08 Max = 0.549



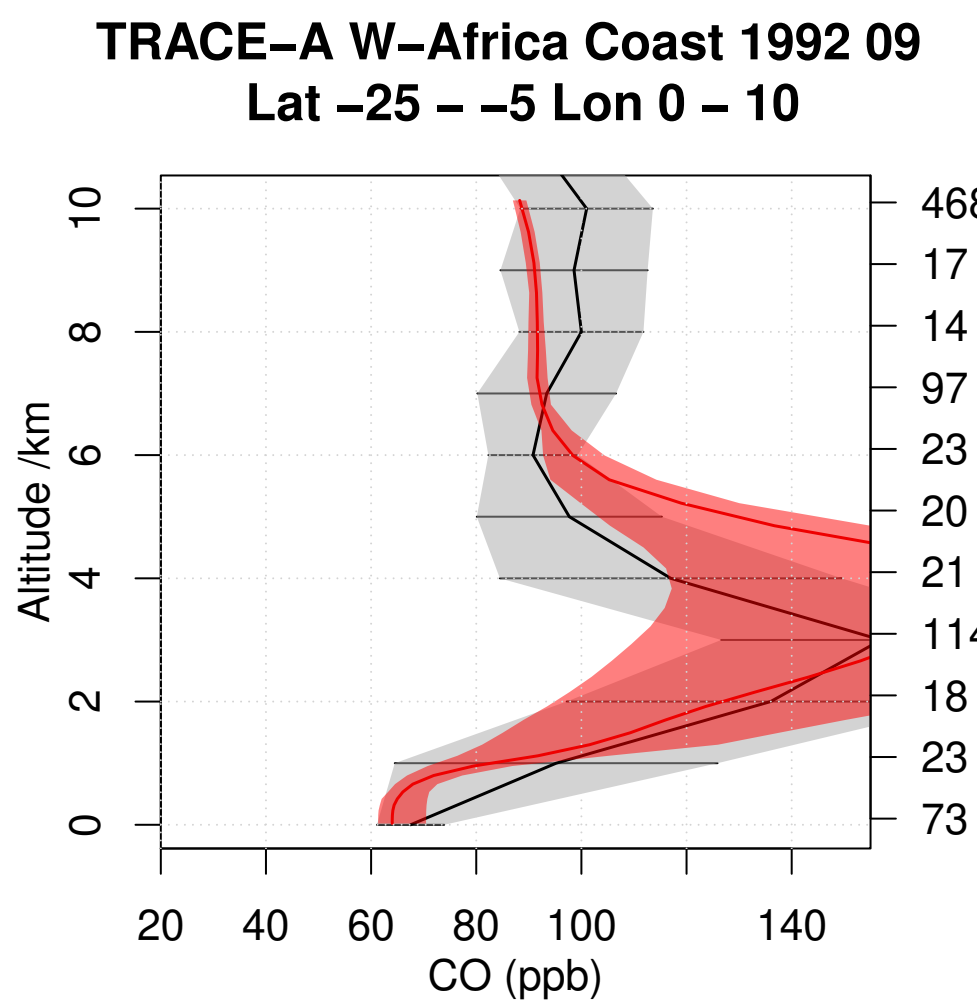
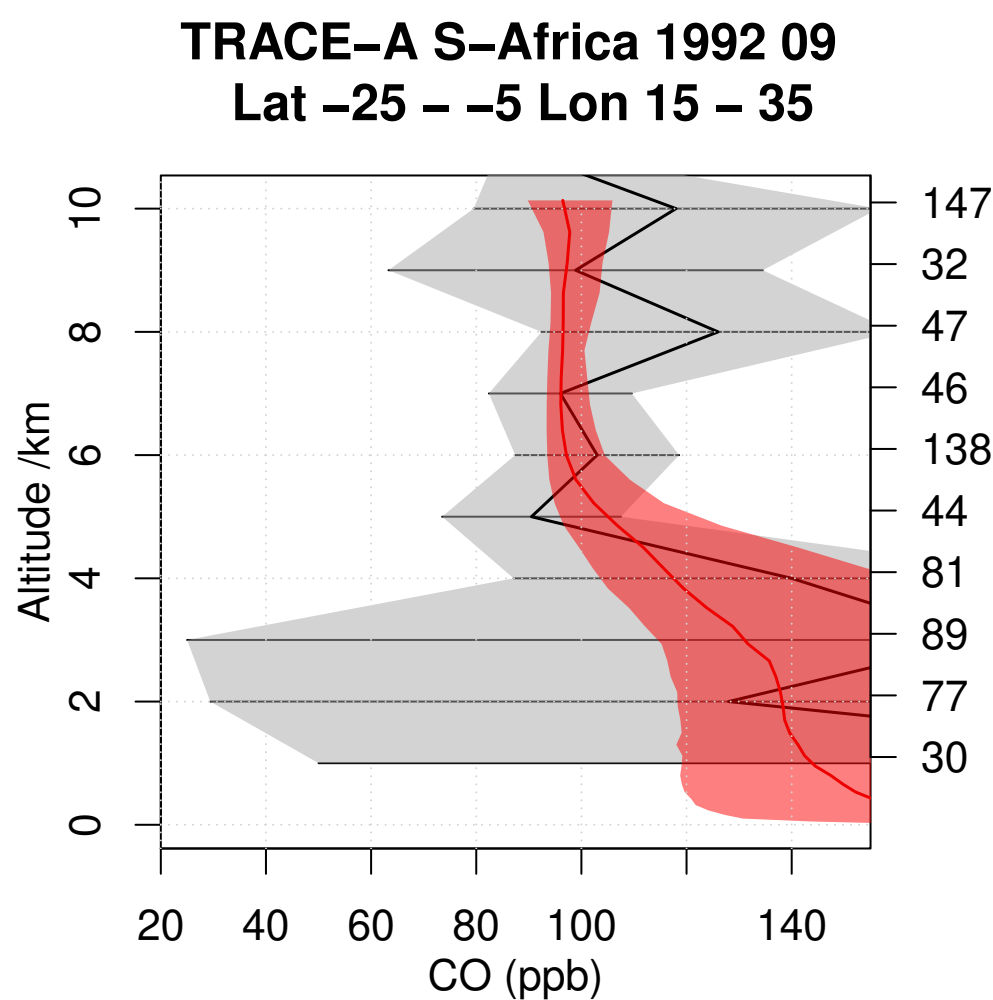
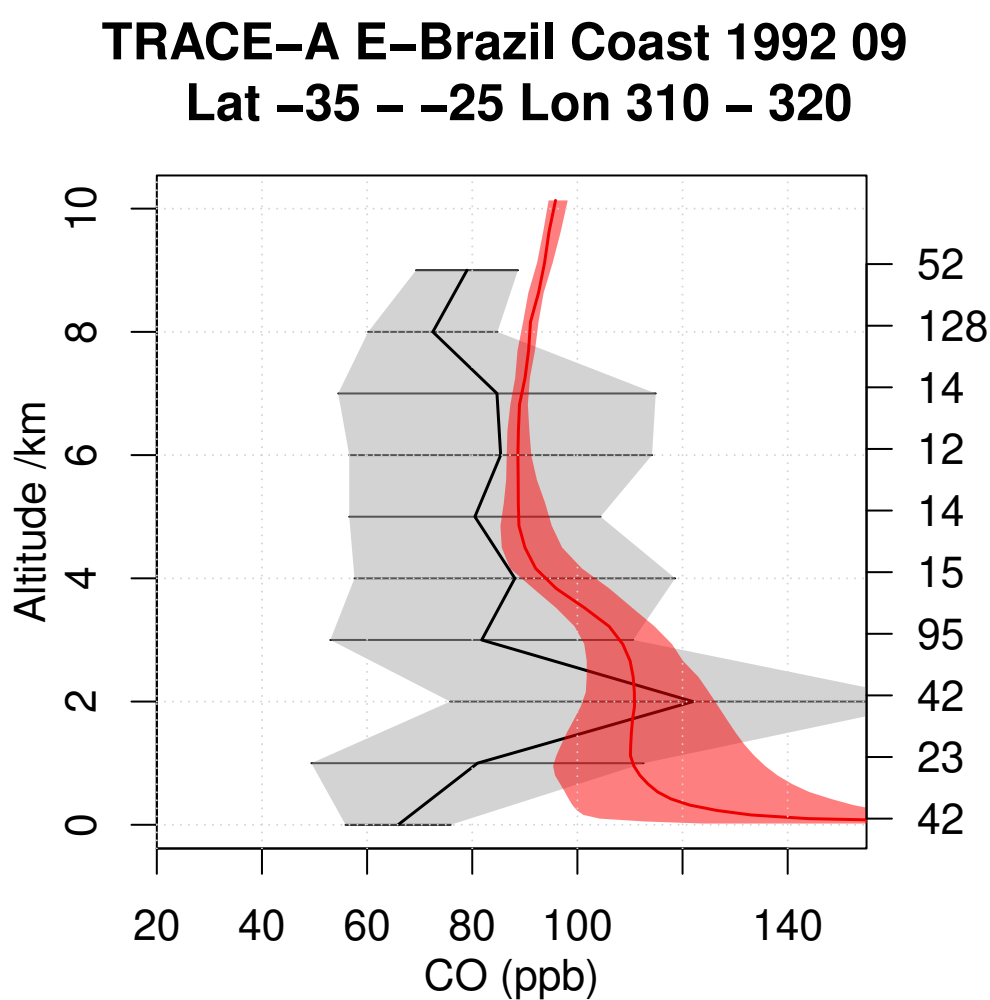
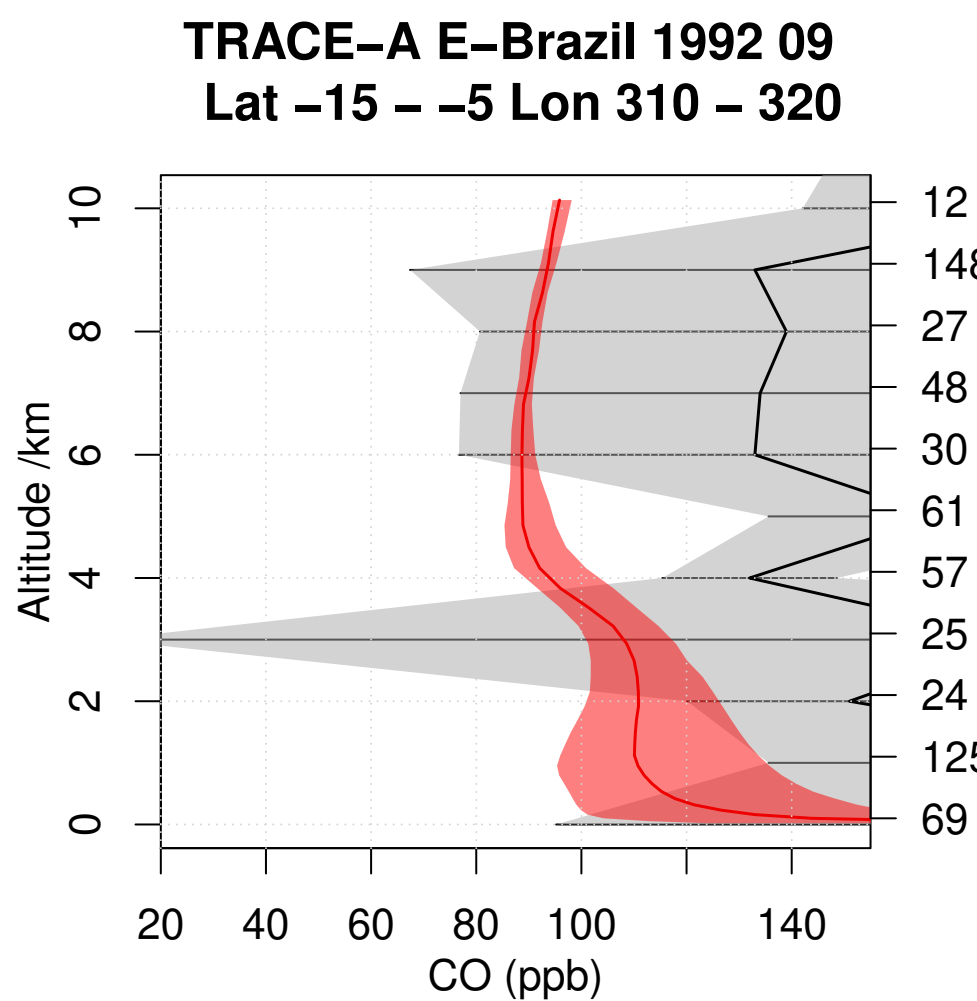
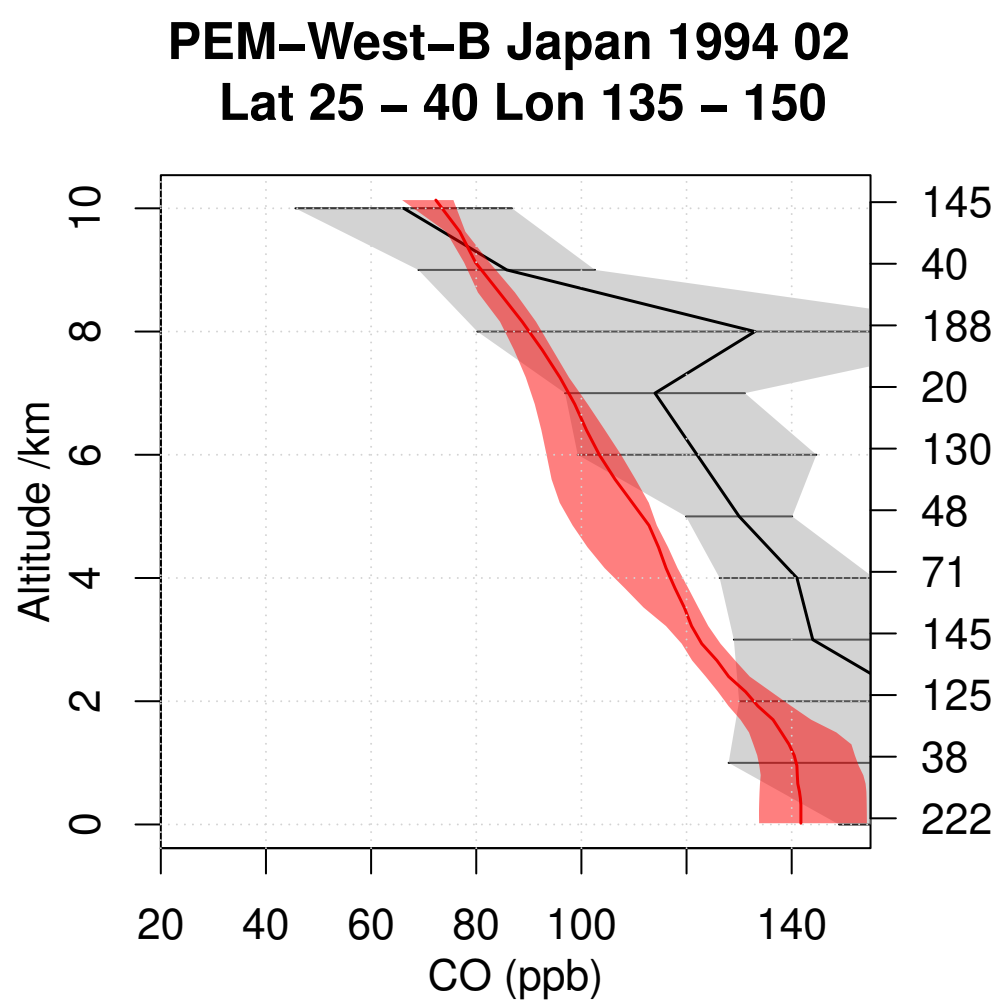
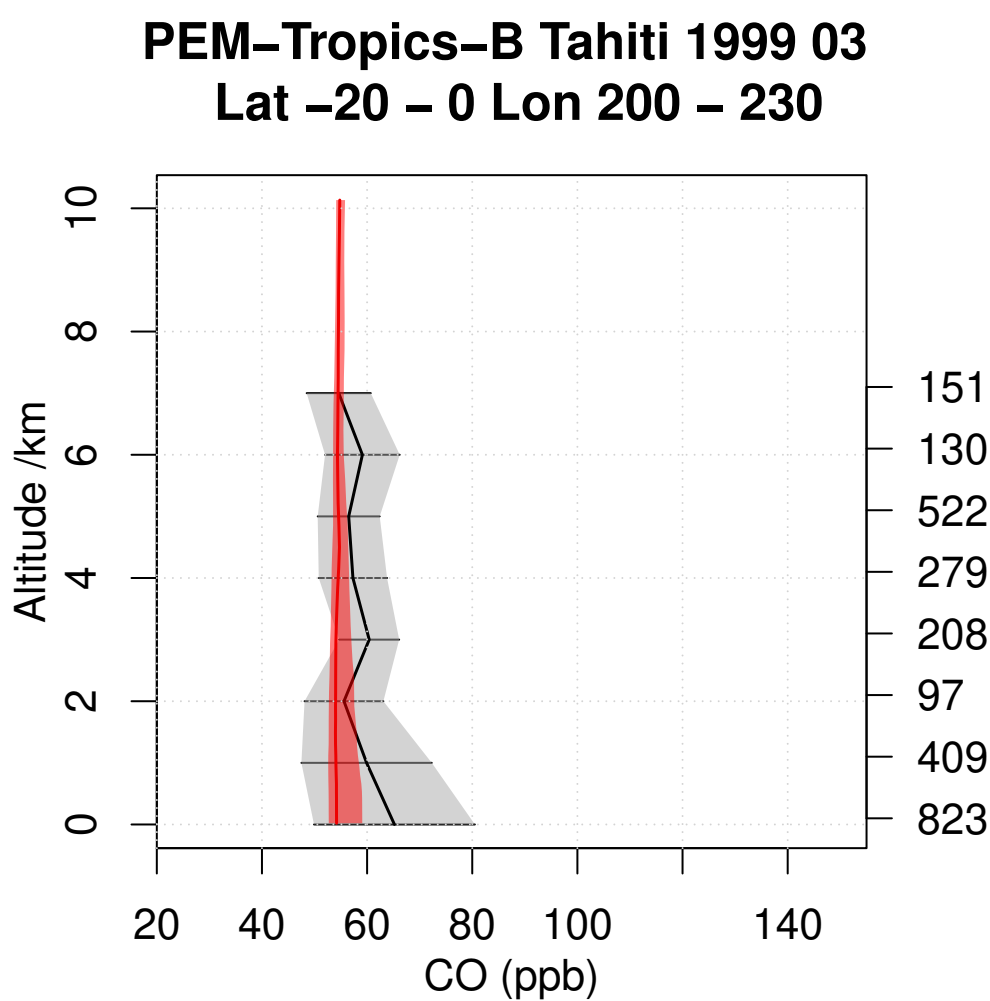
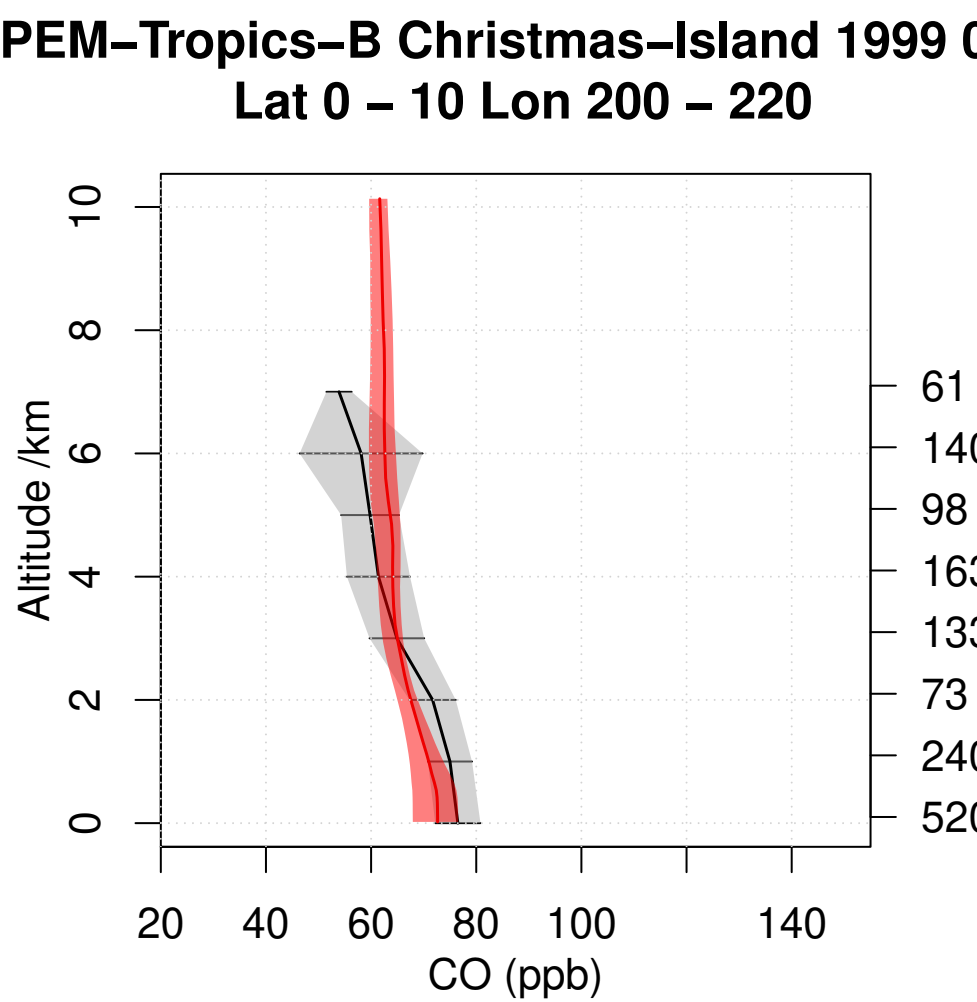
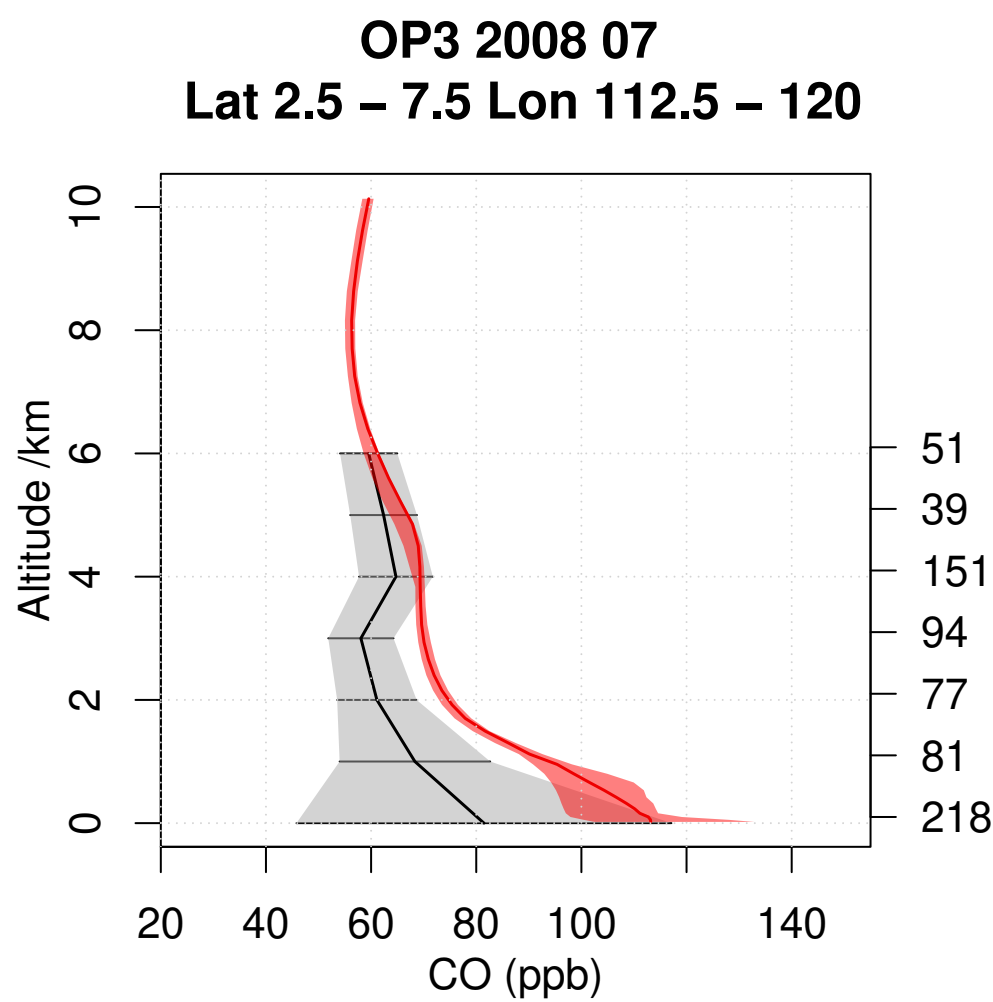
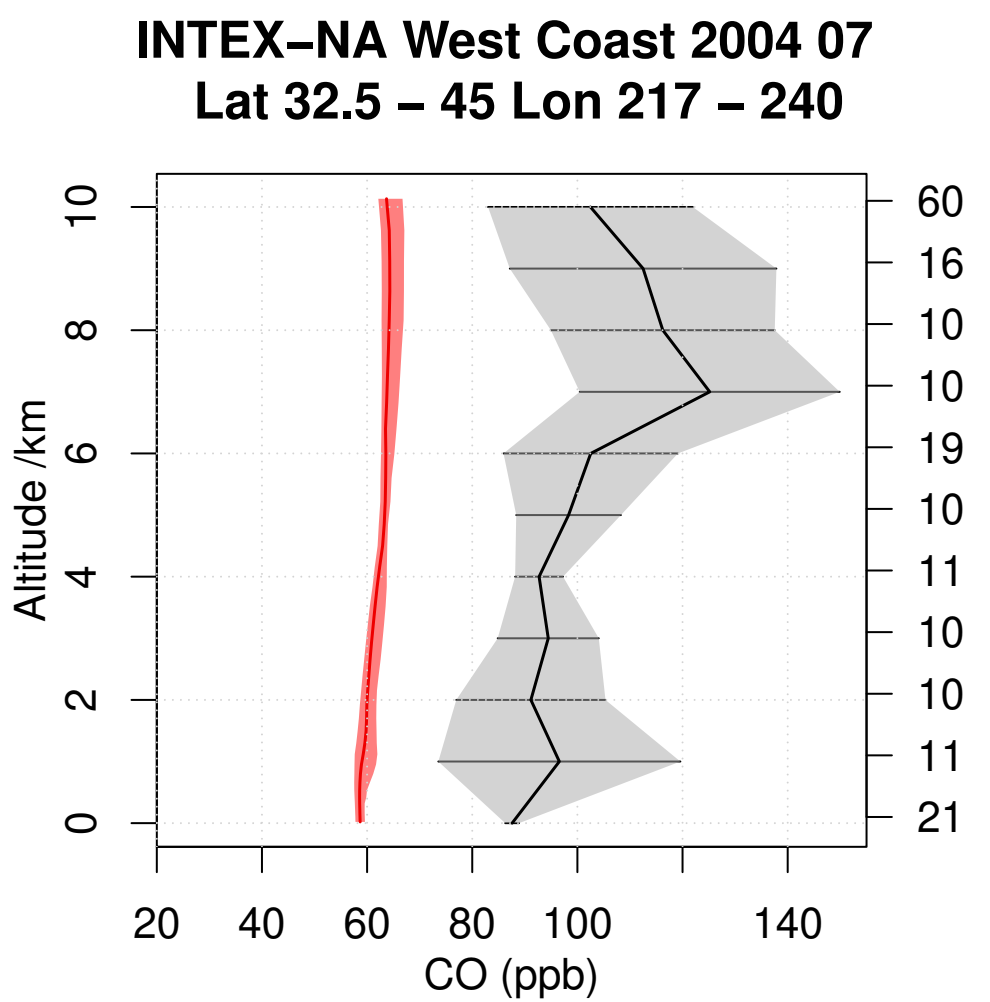
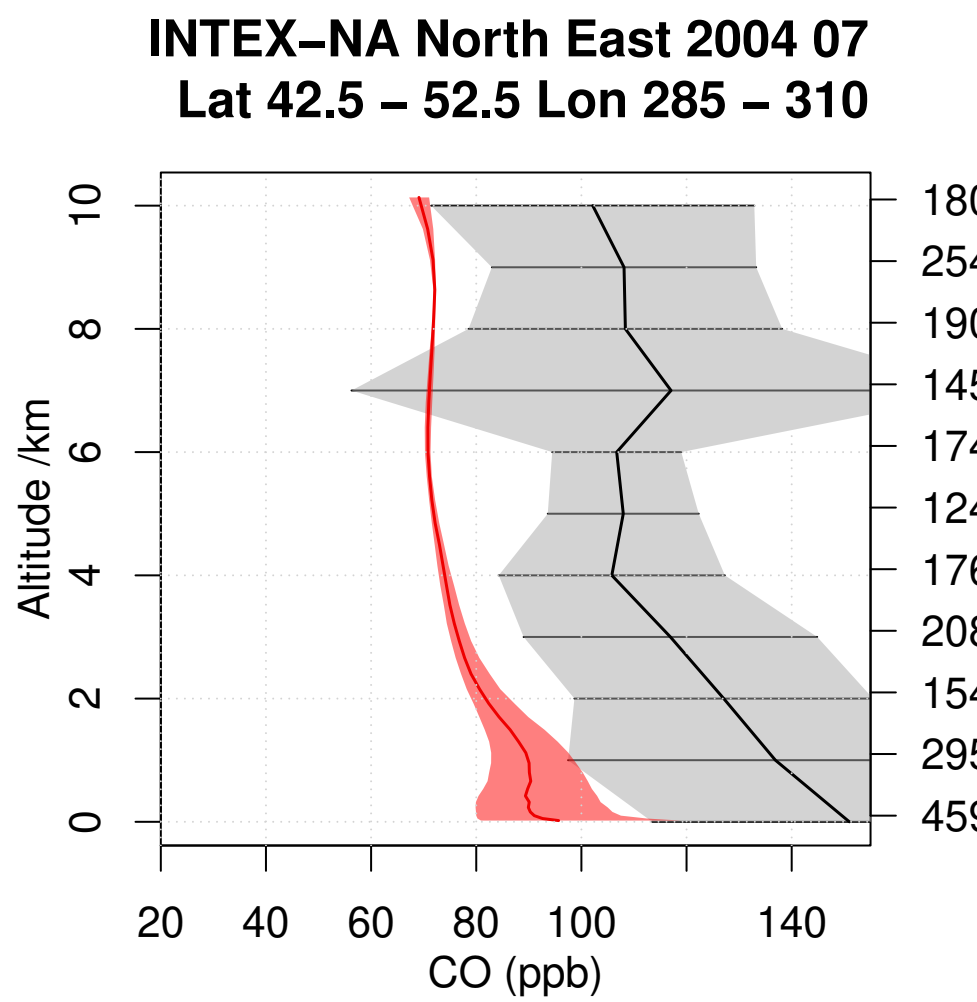
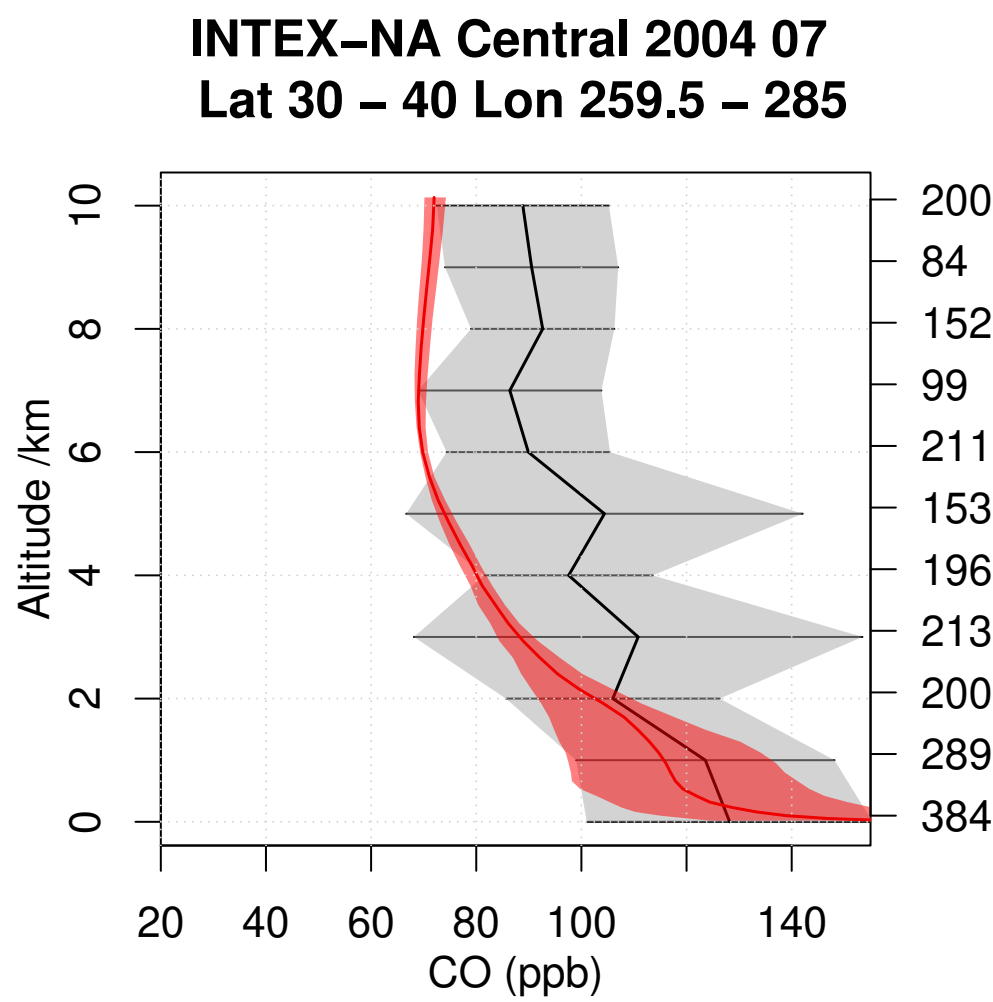
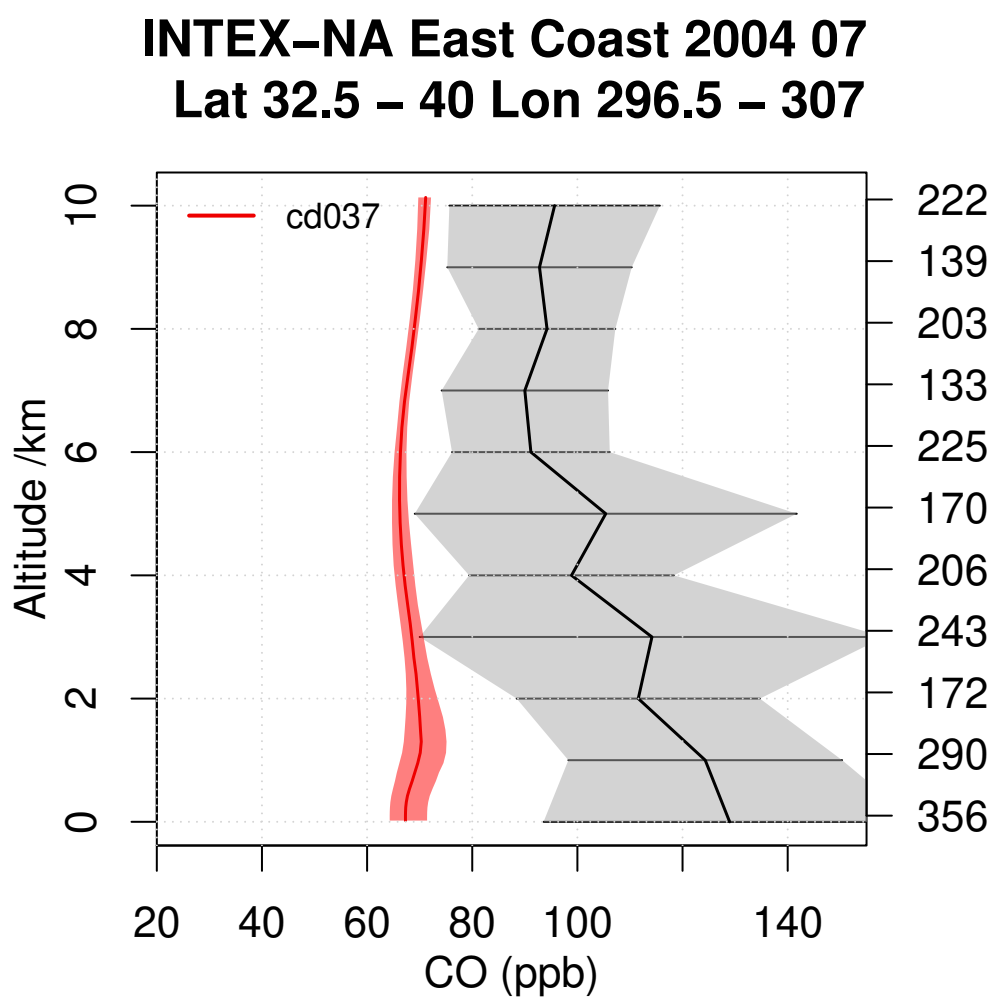
# MLS – UKCA cf821 ClO comparison

Min = 2.25e-08 Max = 0.561

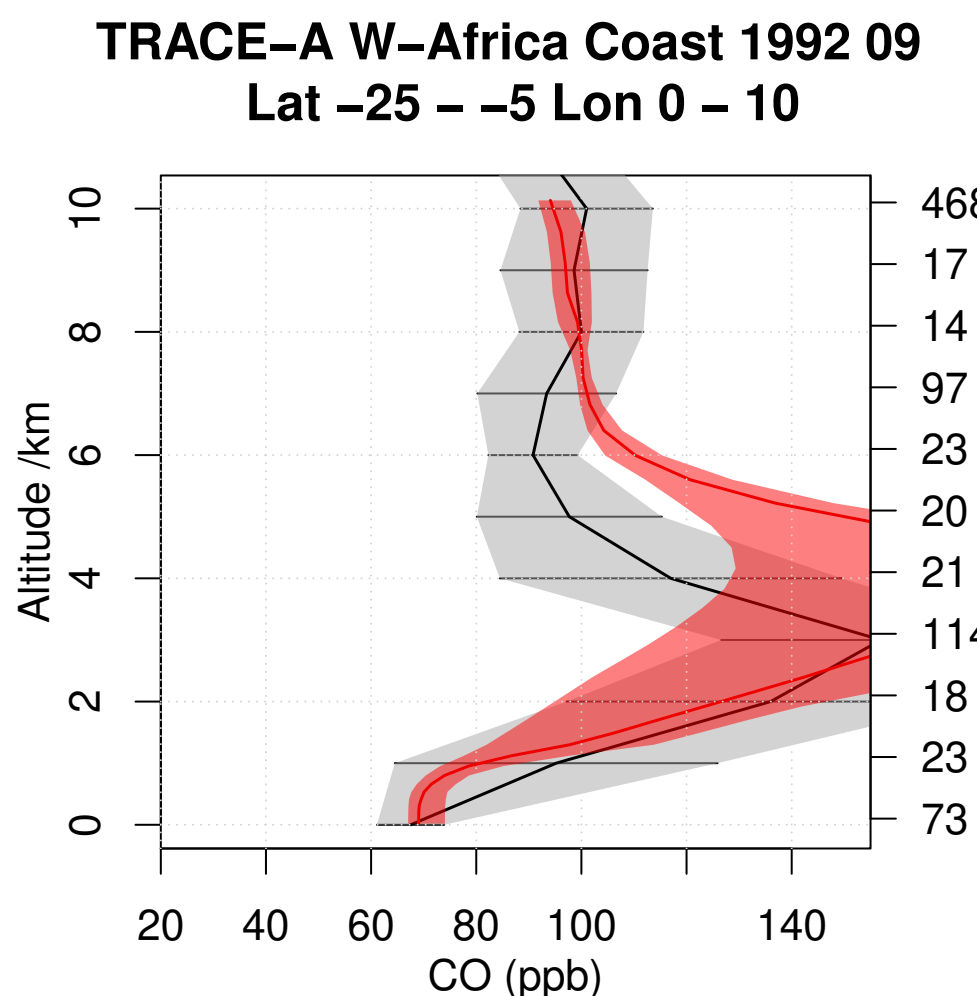
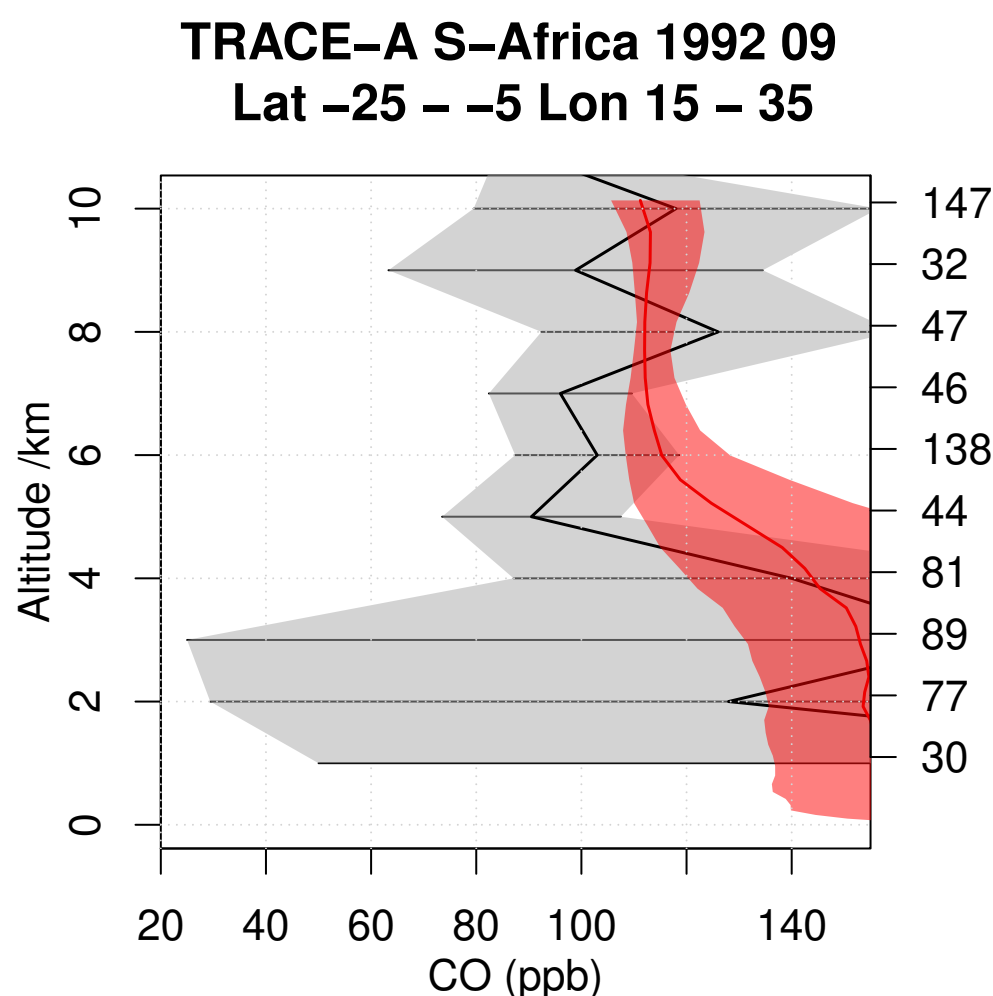
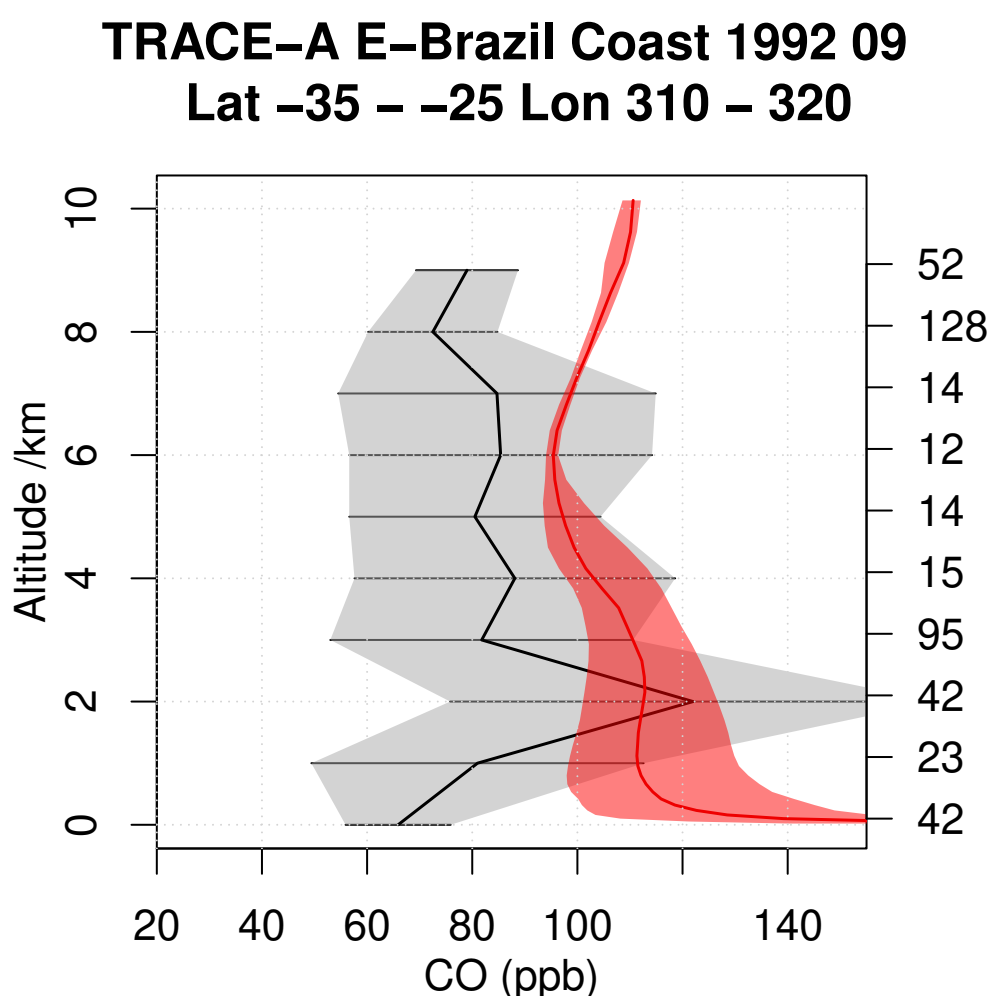
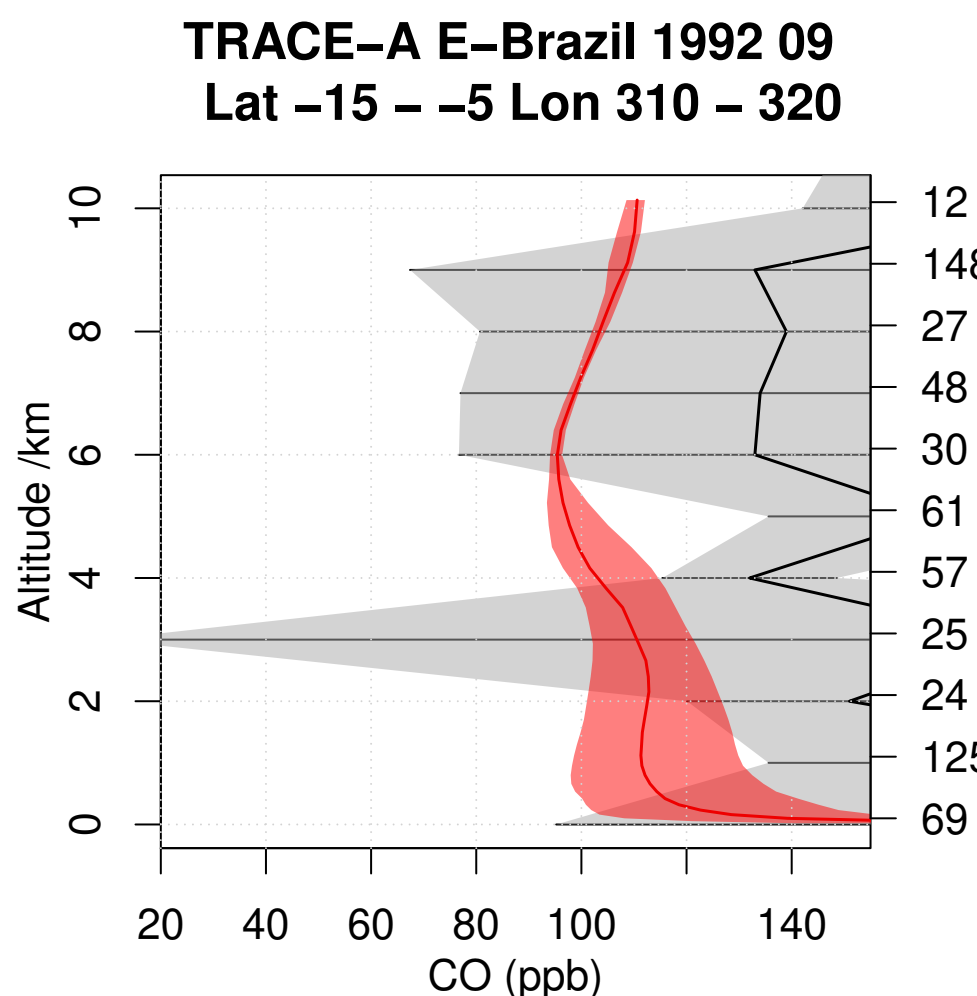
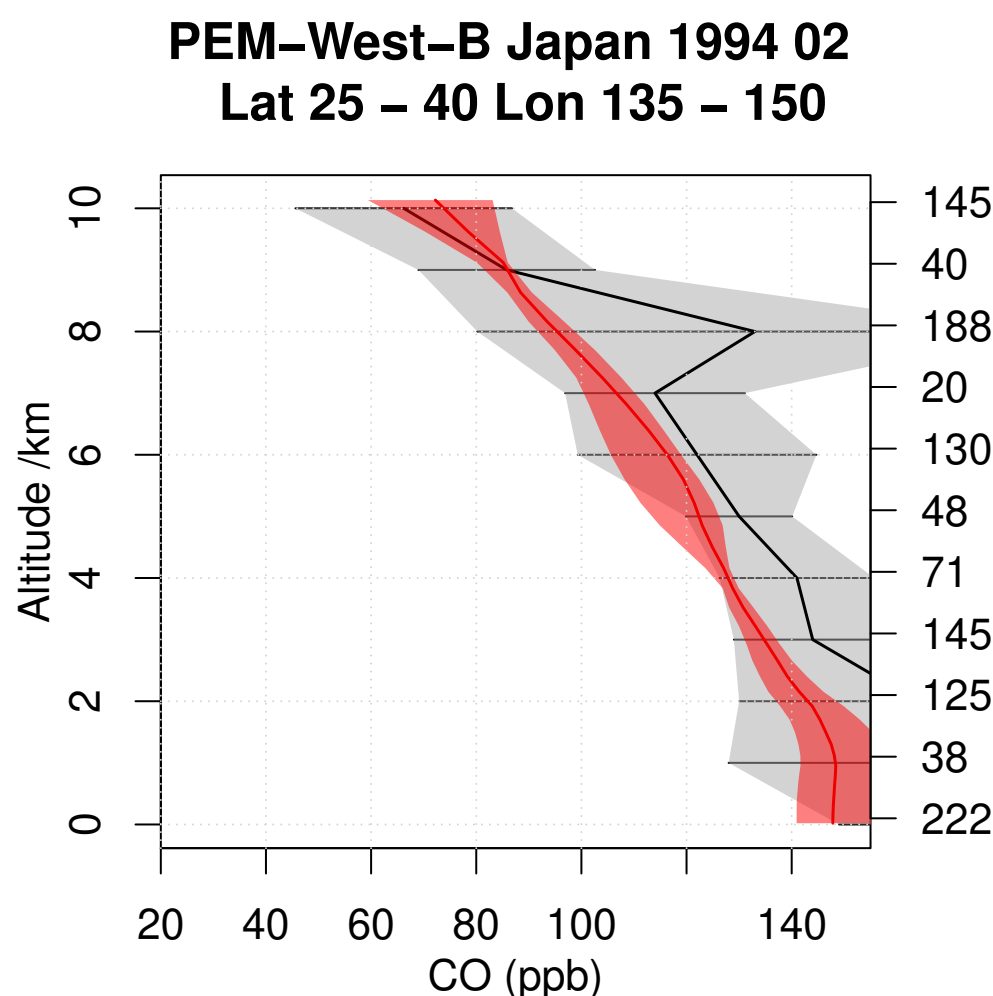
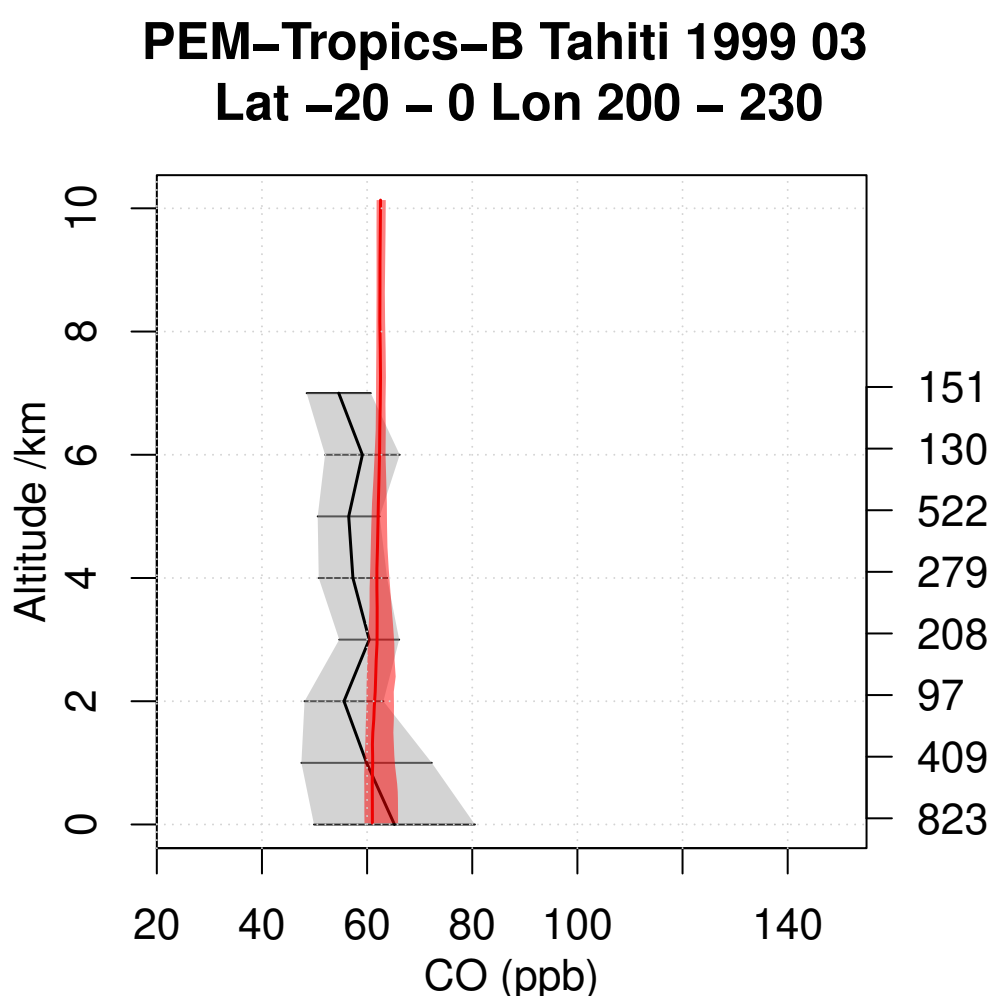
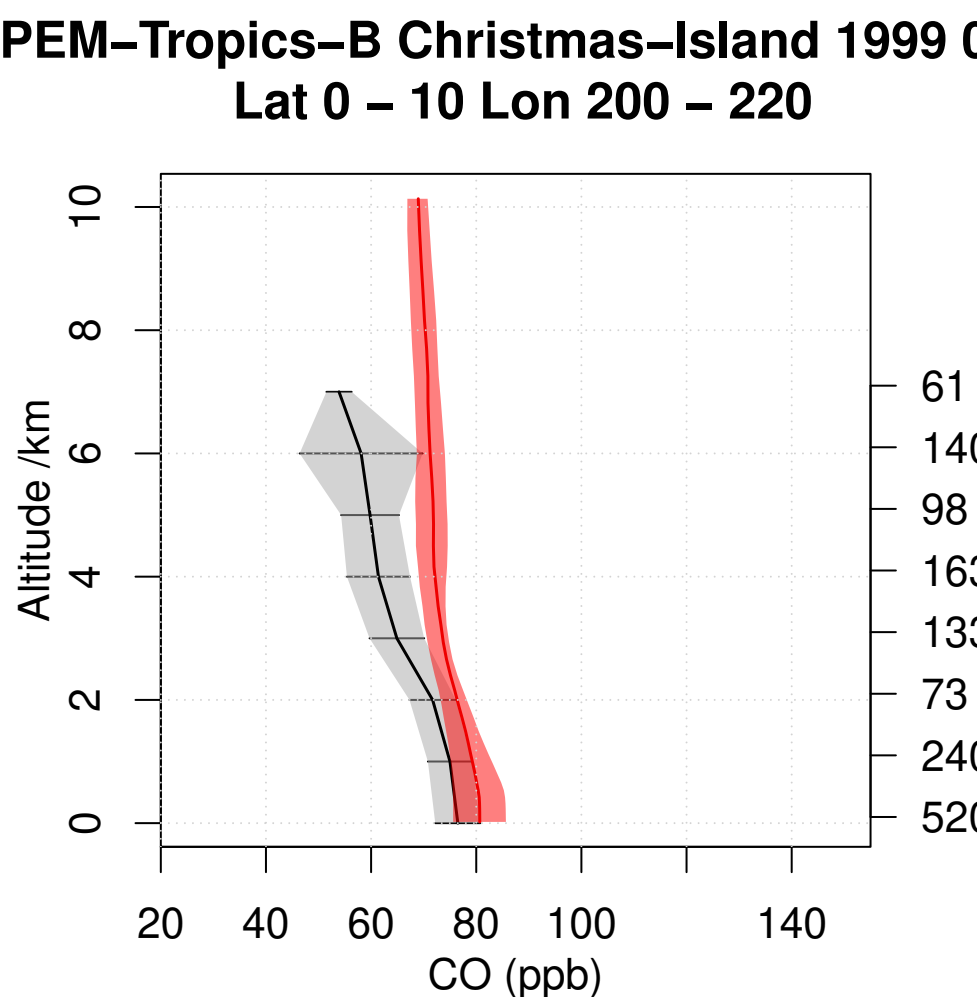
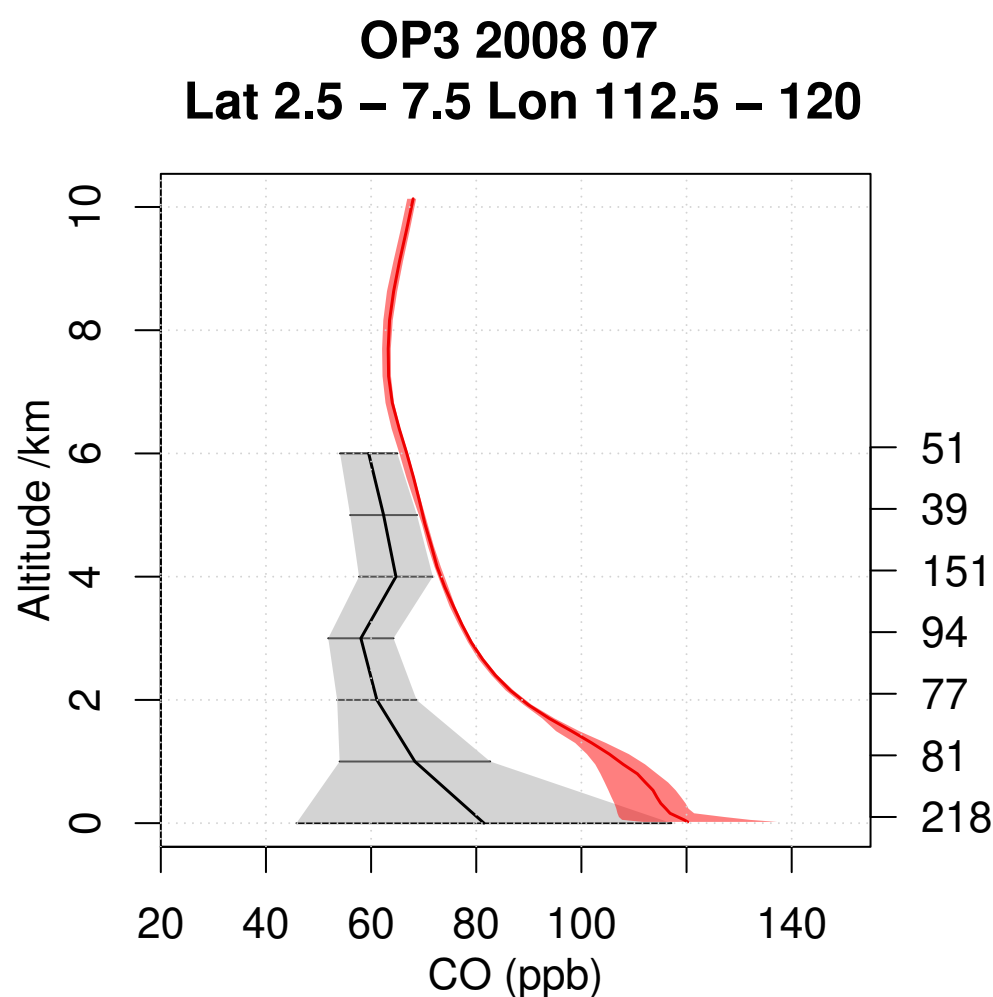
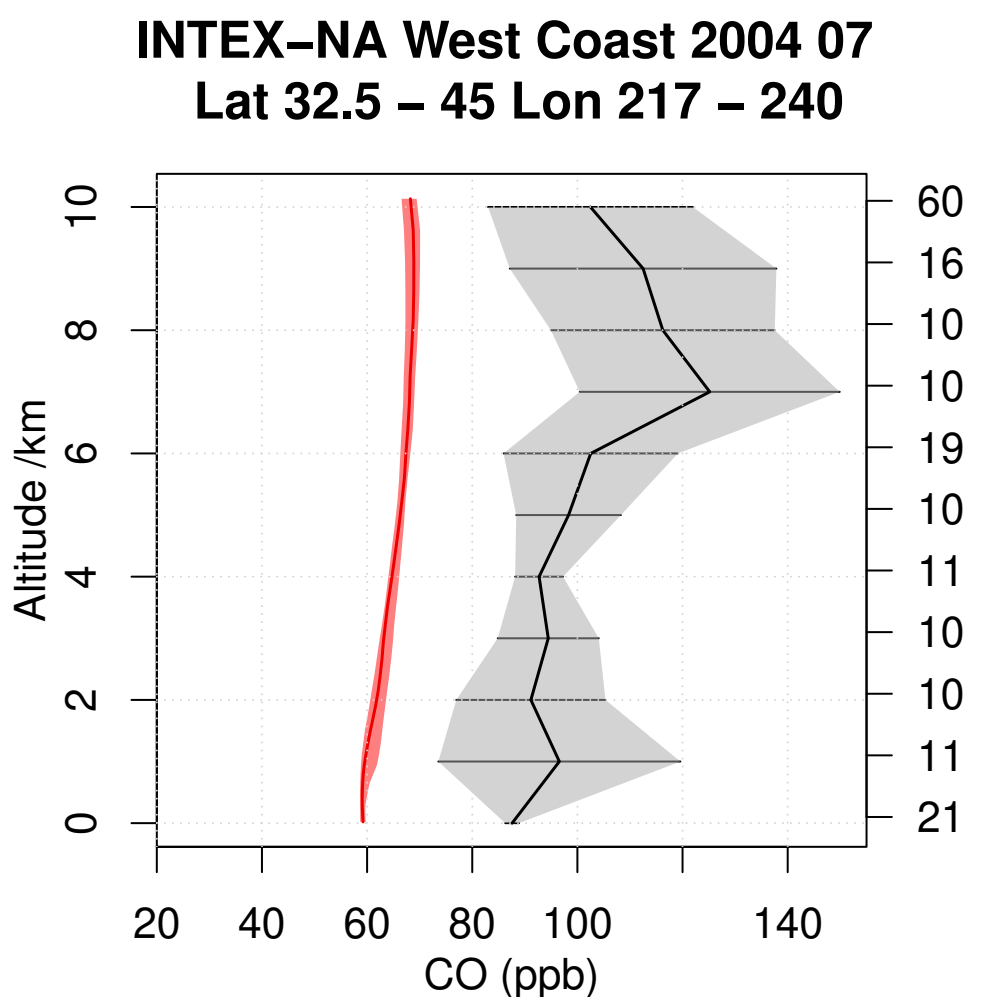
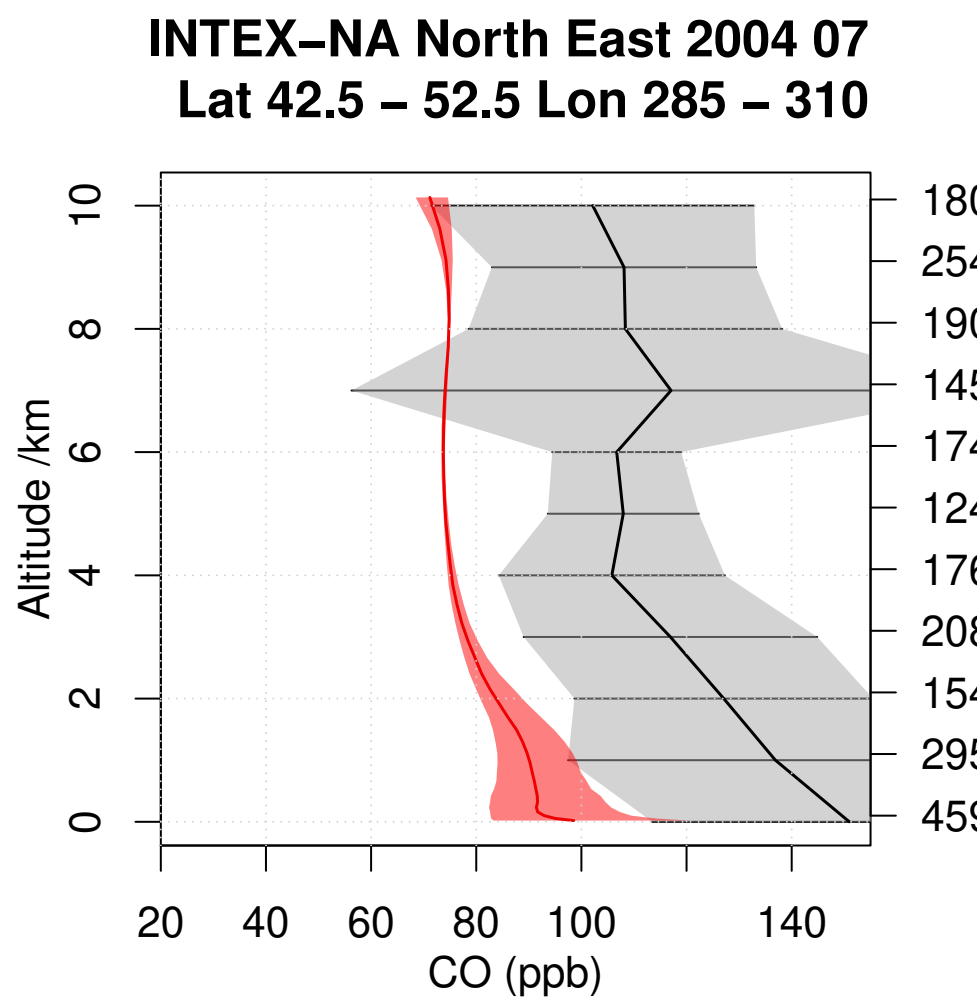
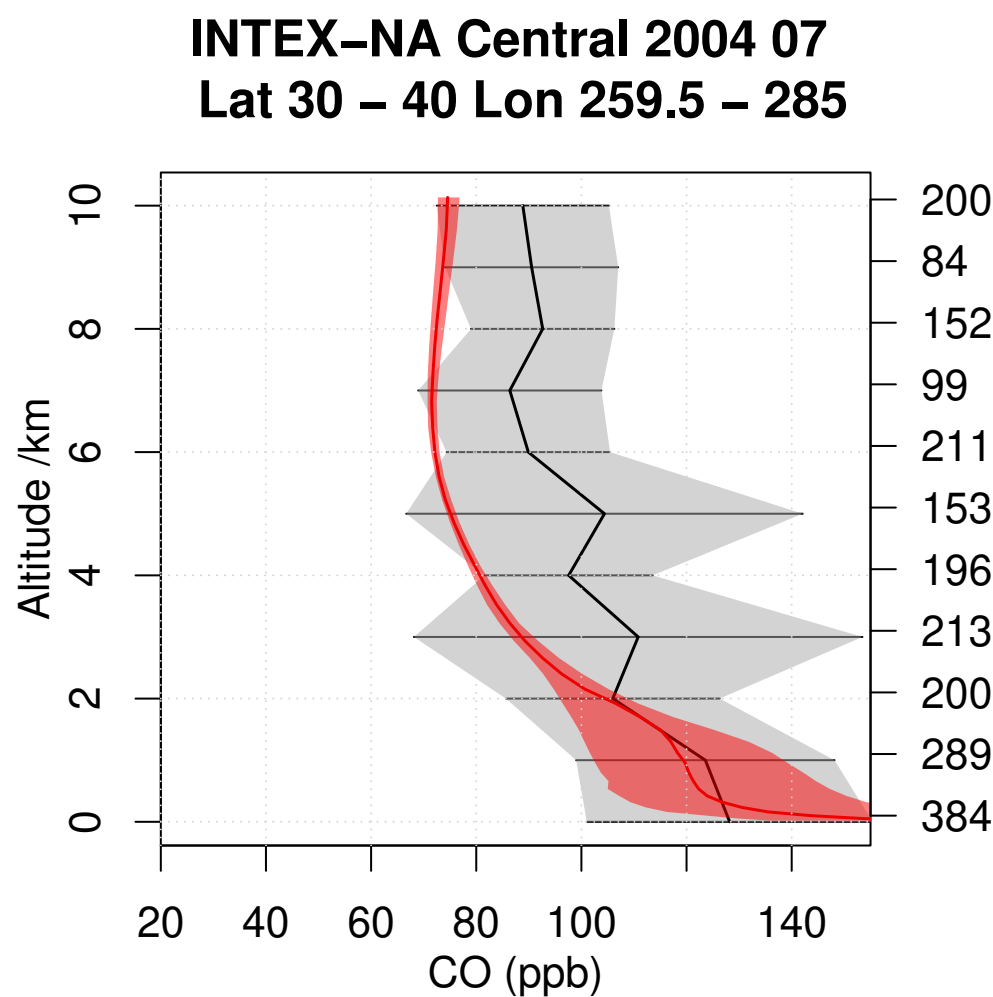
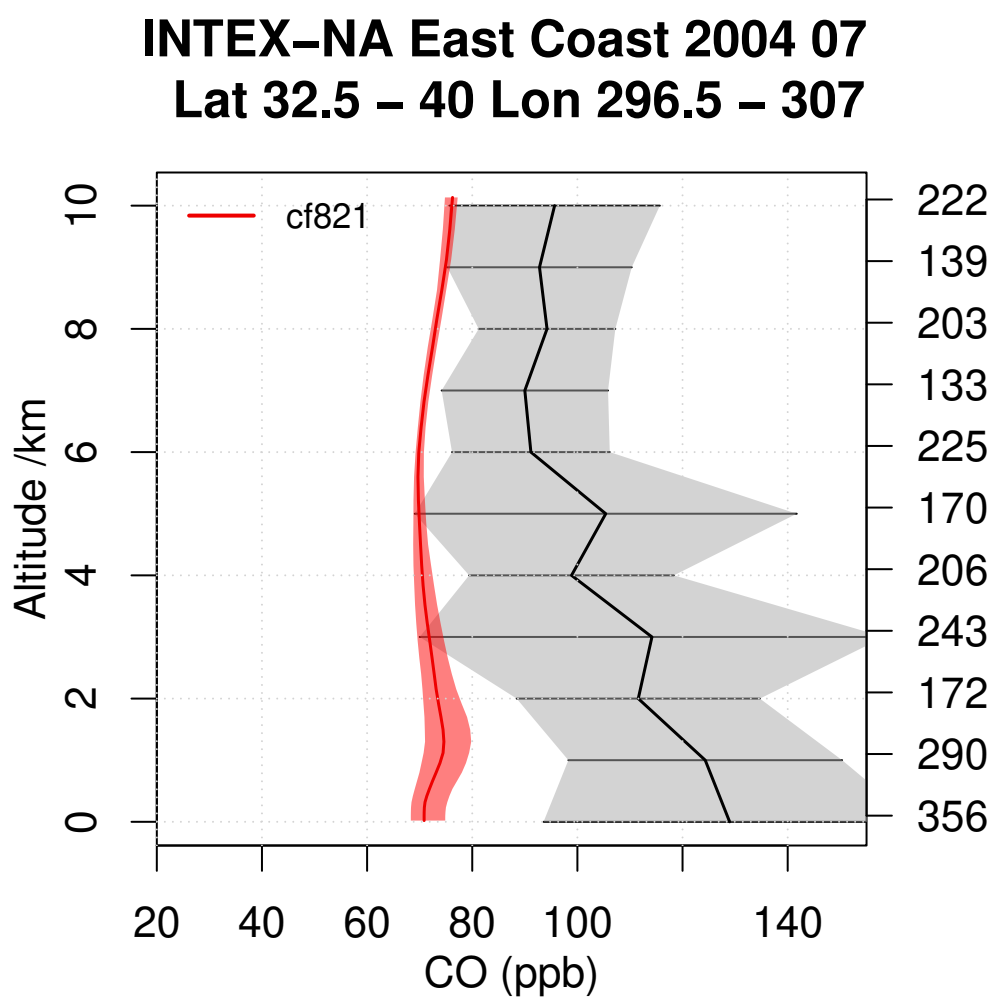




**Emmons CO comparison**

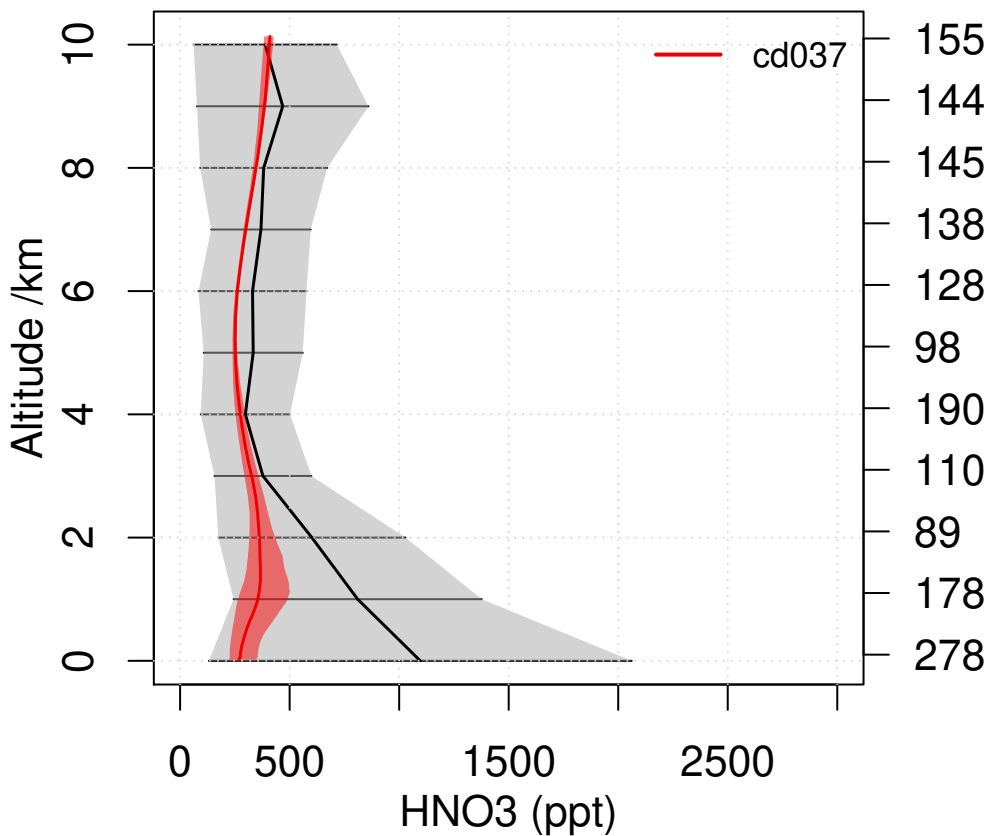


**Emmons CO comparison**

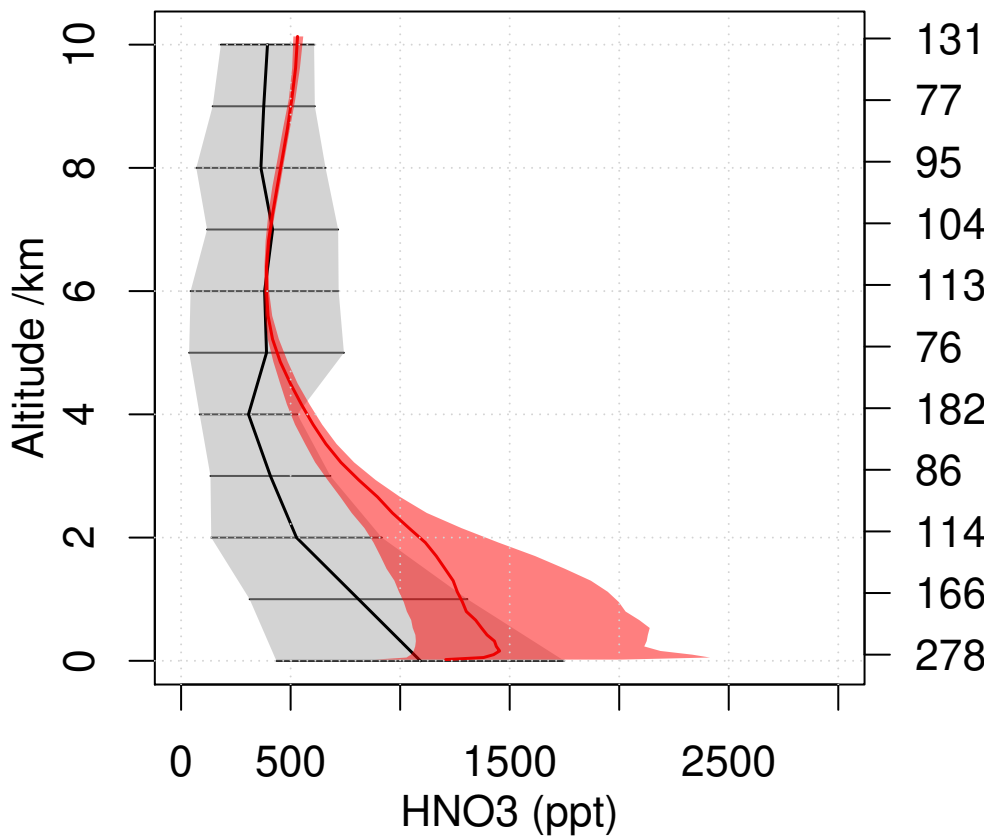


**Emmons HNO3 comparison**

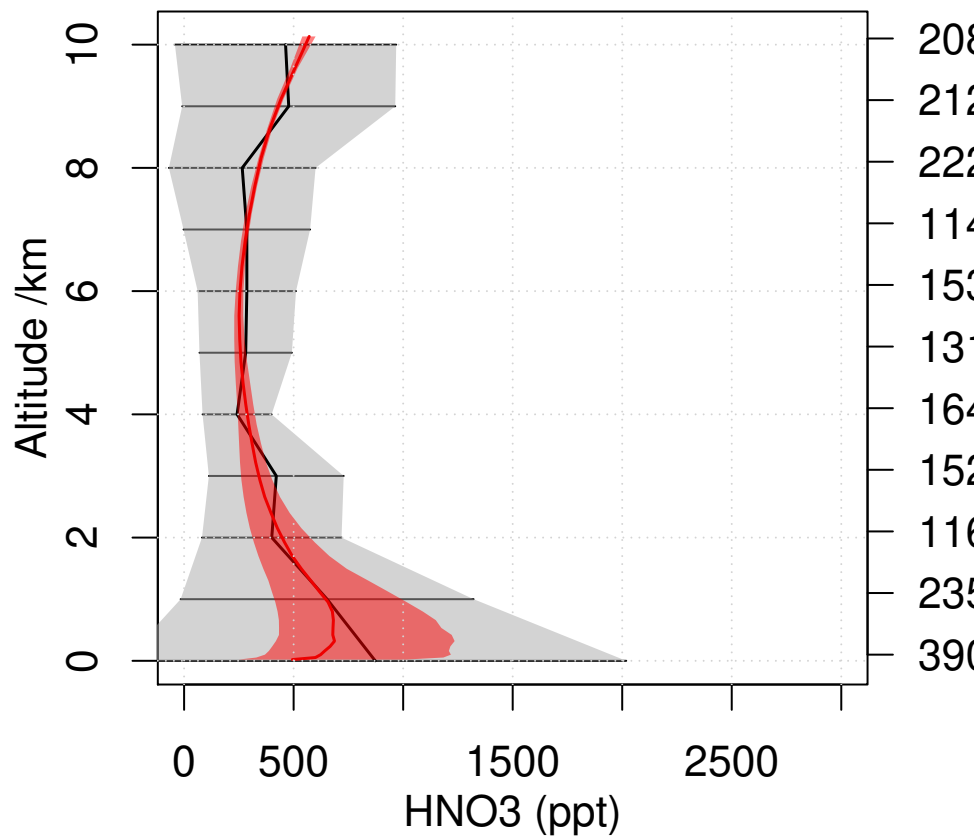
**INTEX-NA East Coast 2004 07**  
**Lat 32.5 – 40 Lon 296.5 – 307**



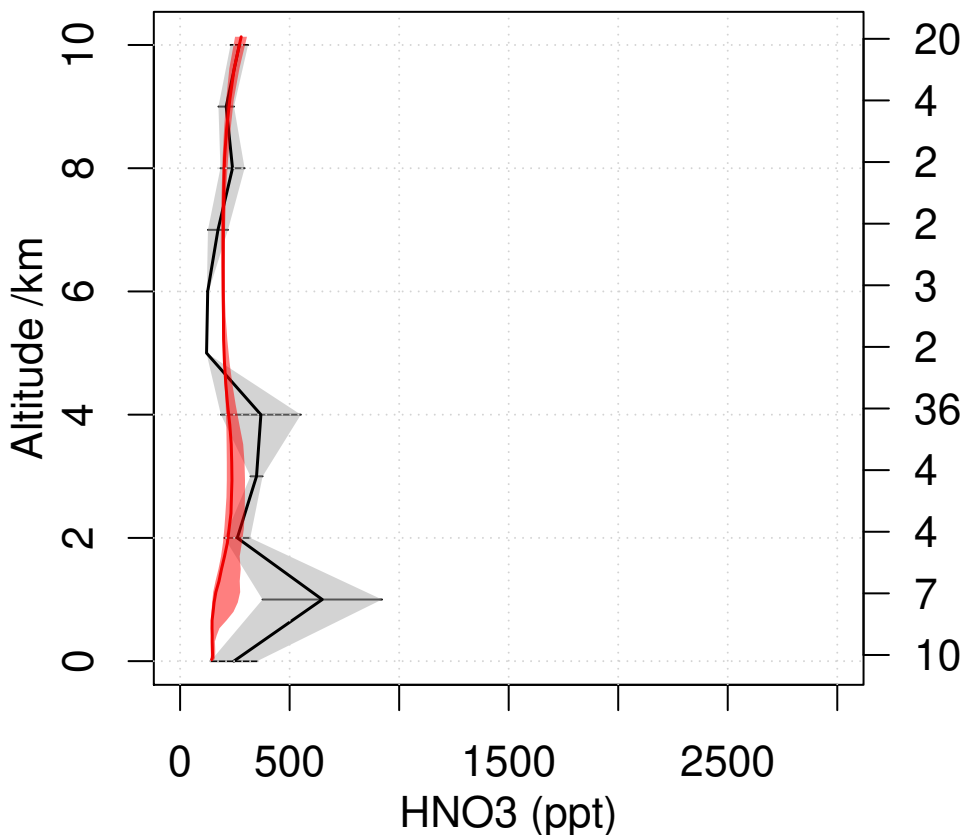
**INTEX-NA Central 2004 07**  
**Lat 30 – 40 Lon 259.5 – 285**



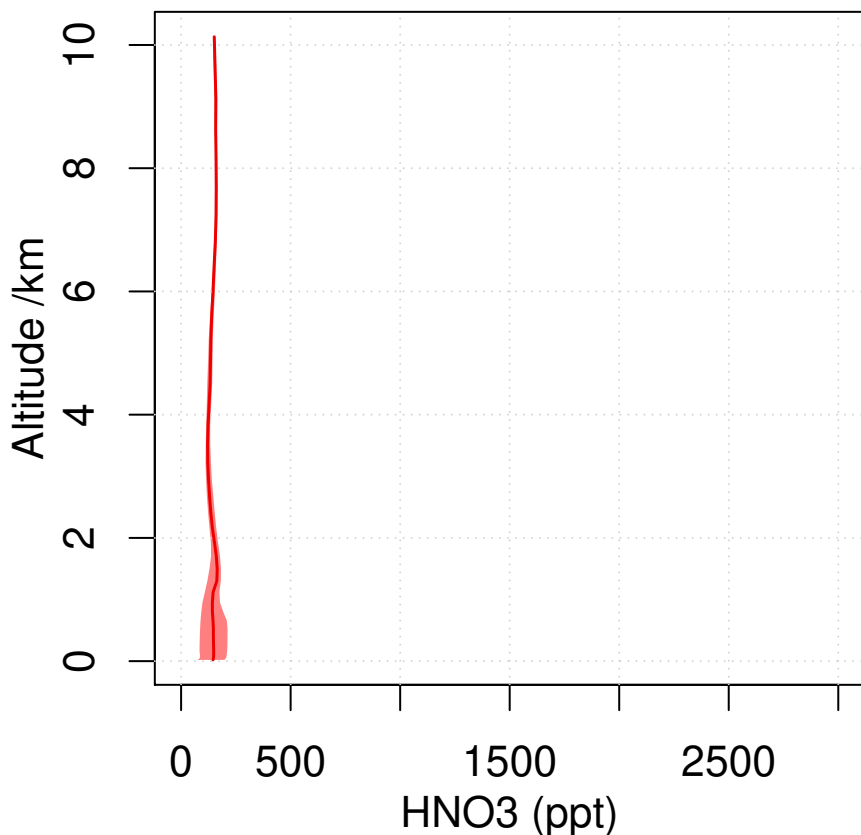
**INTEX-NA North East 2004 07**  
**Lat 42.5 – 52.5 Lon 285 – 310**



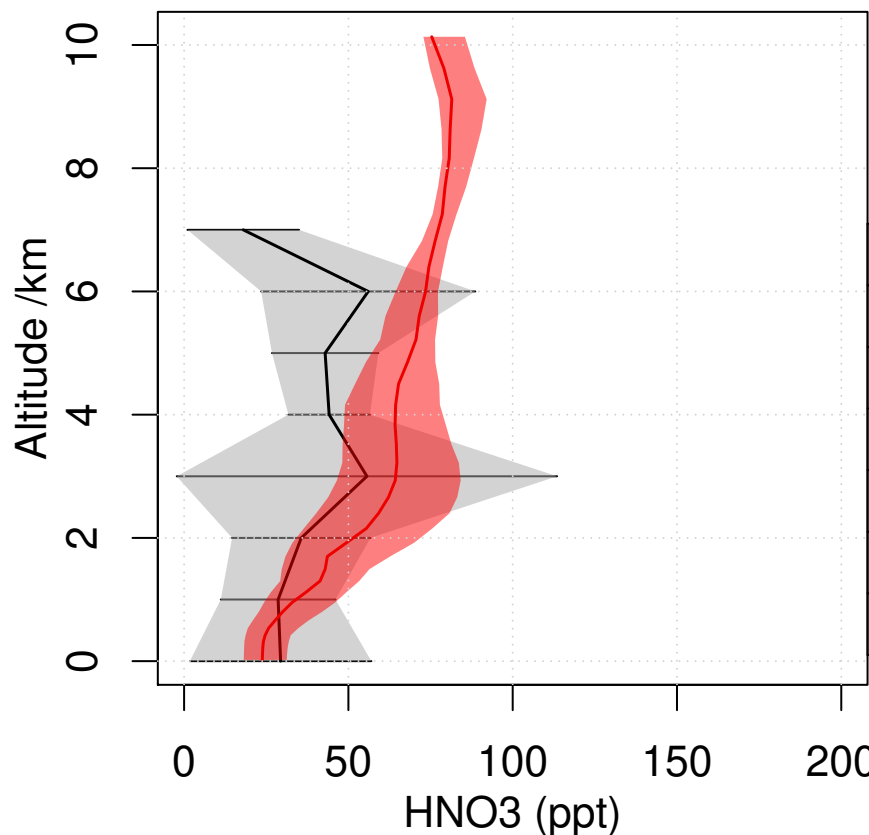
**INTEX-NA West Coast 2004 07**  
**Lat 32.5 – 45 Lon 217 – 240**



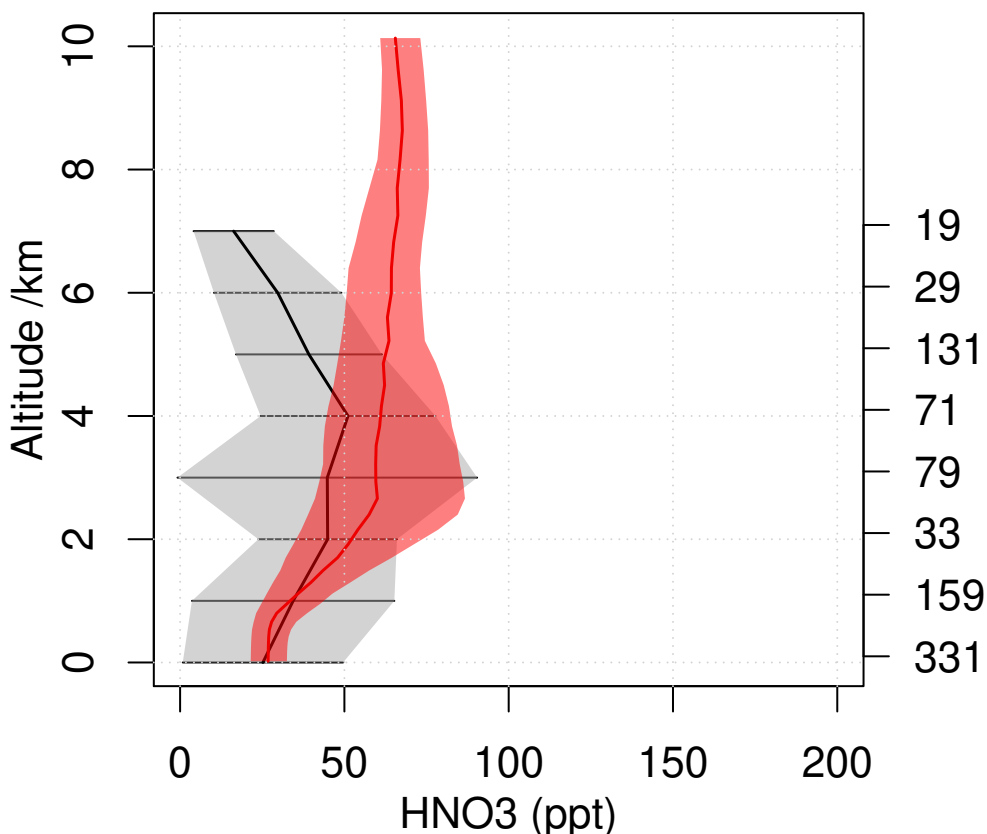
**OP3 2008 07**  
**Lat 2.5 – 7.5 Lon 112.5 – 120**



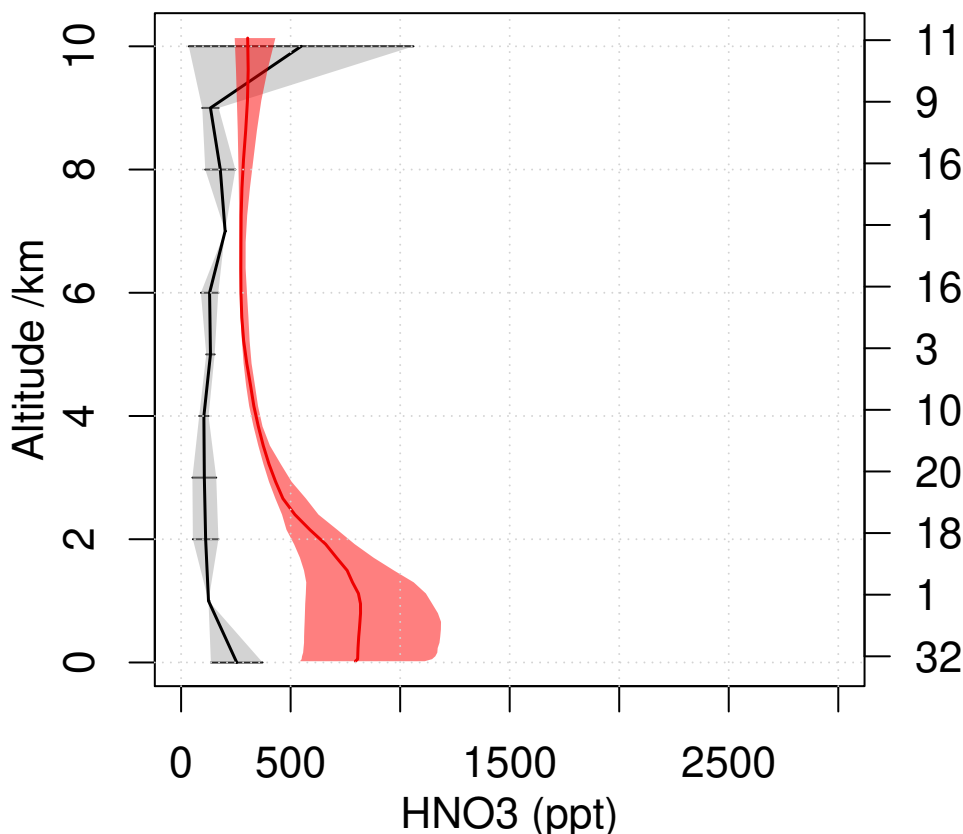
**PEM-Tropics-B Christmas-Island 1999 0**  
**Lat 0 – 10 Lon 200 – 220**



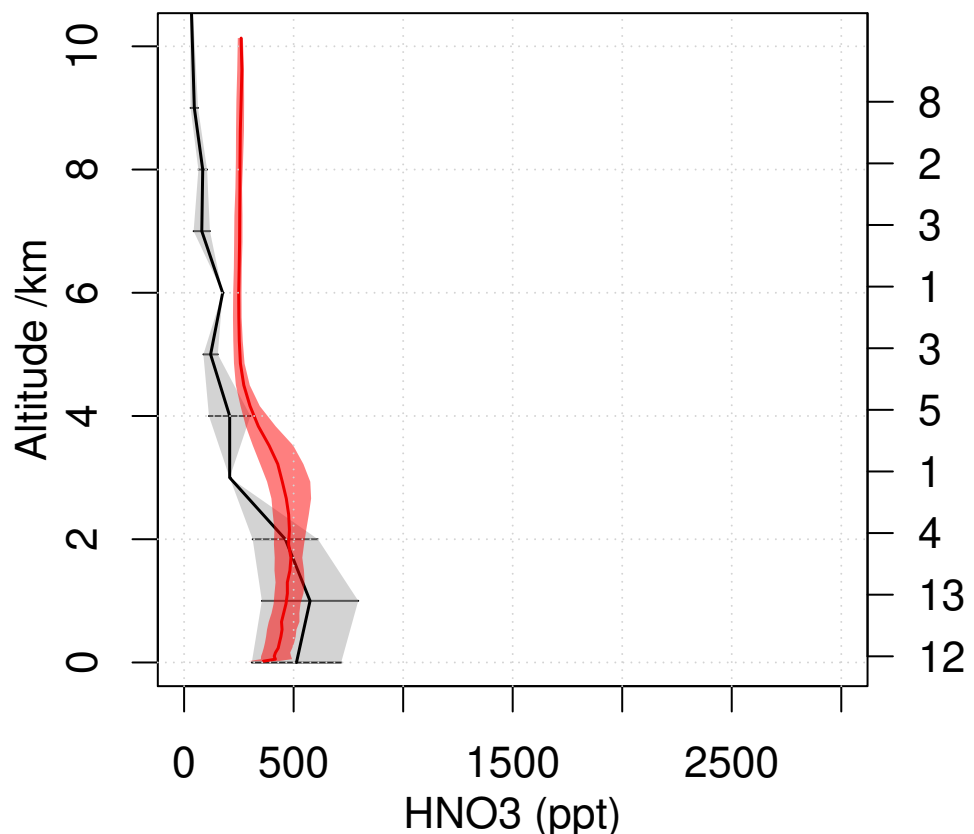
**PEM-Tropics-B Tahiti 1999 03**  
**Lat -20 – 0 Lon 200 – 230**



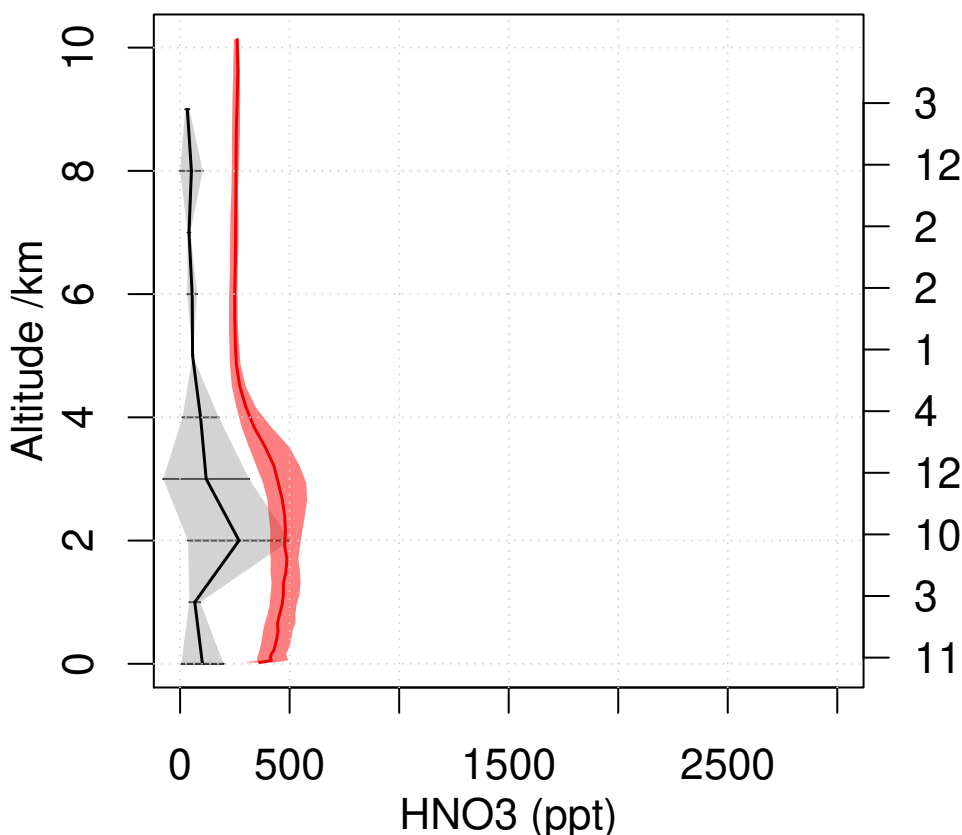
**PEM-West-B Japan 1994 02**  
**Lat 25 – 40 Lon 135 – 150**



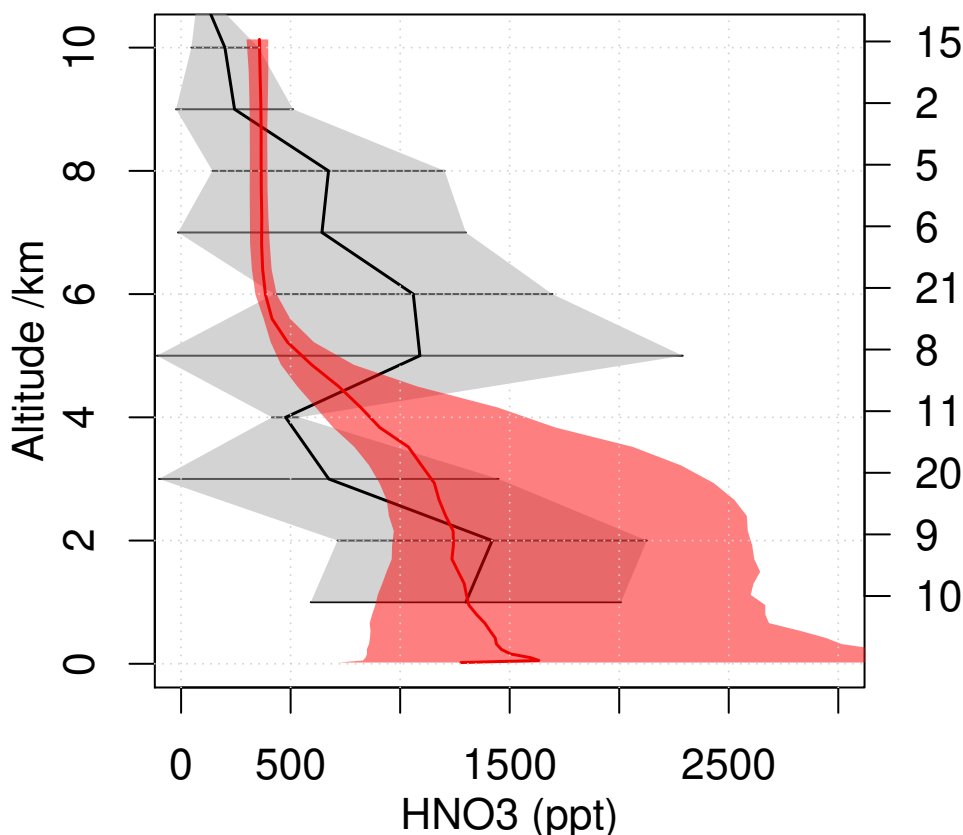
**TRACE-A E-Brazil 1992 09**  
**Lat -15 – -5 Lon 310 – 320**



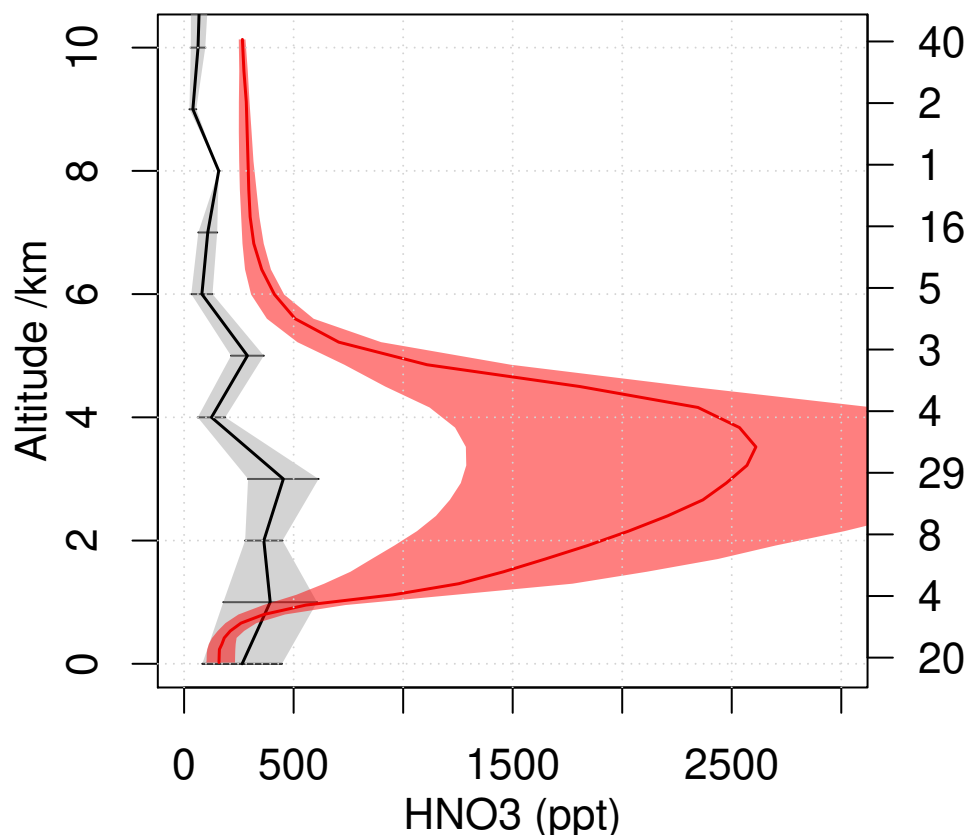
**TRACE-A E-Brazil Coast 1992 09**  
**Lat -35 – -25 Lon 310 – 320**



**TRACE-A S-Africa 1992 09**  
**Lat -25 – -5 Lon 15 – 35**

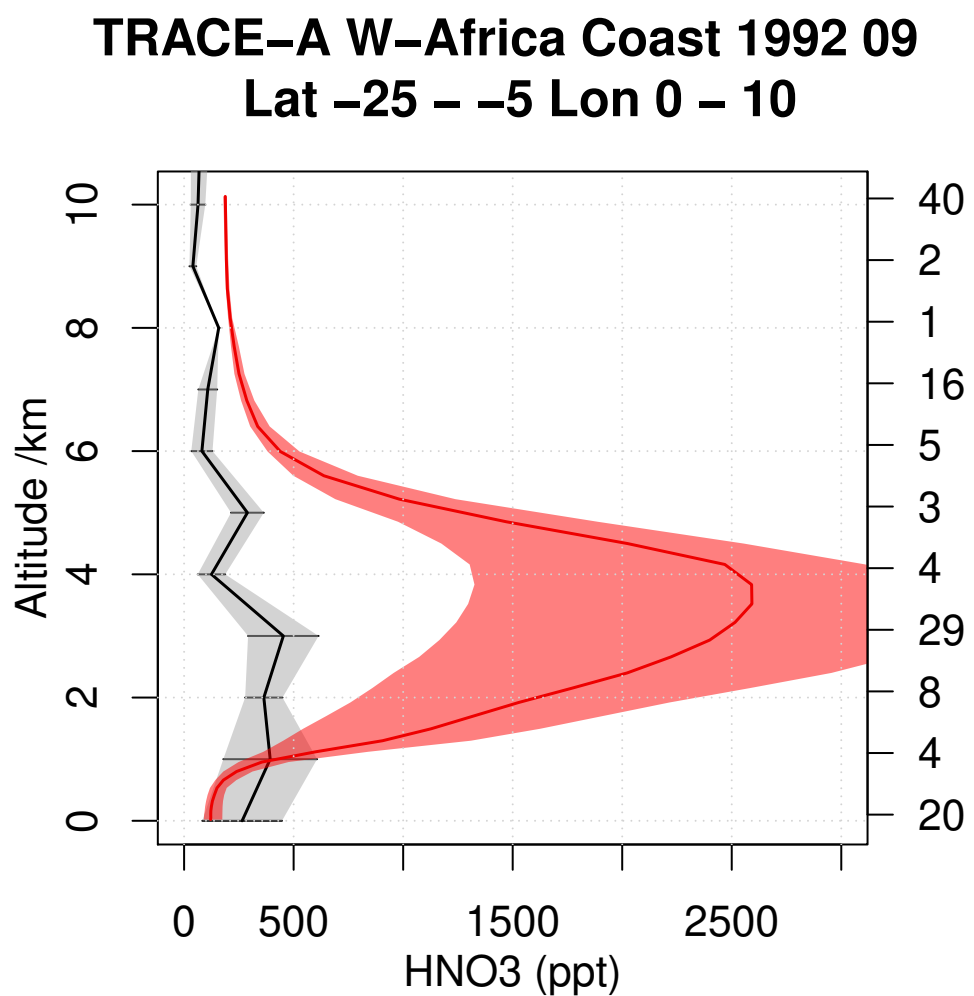
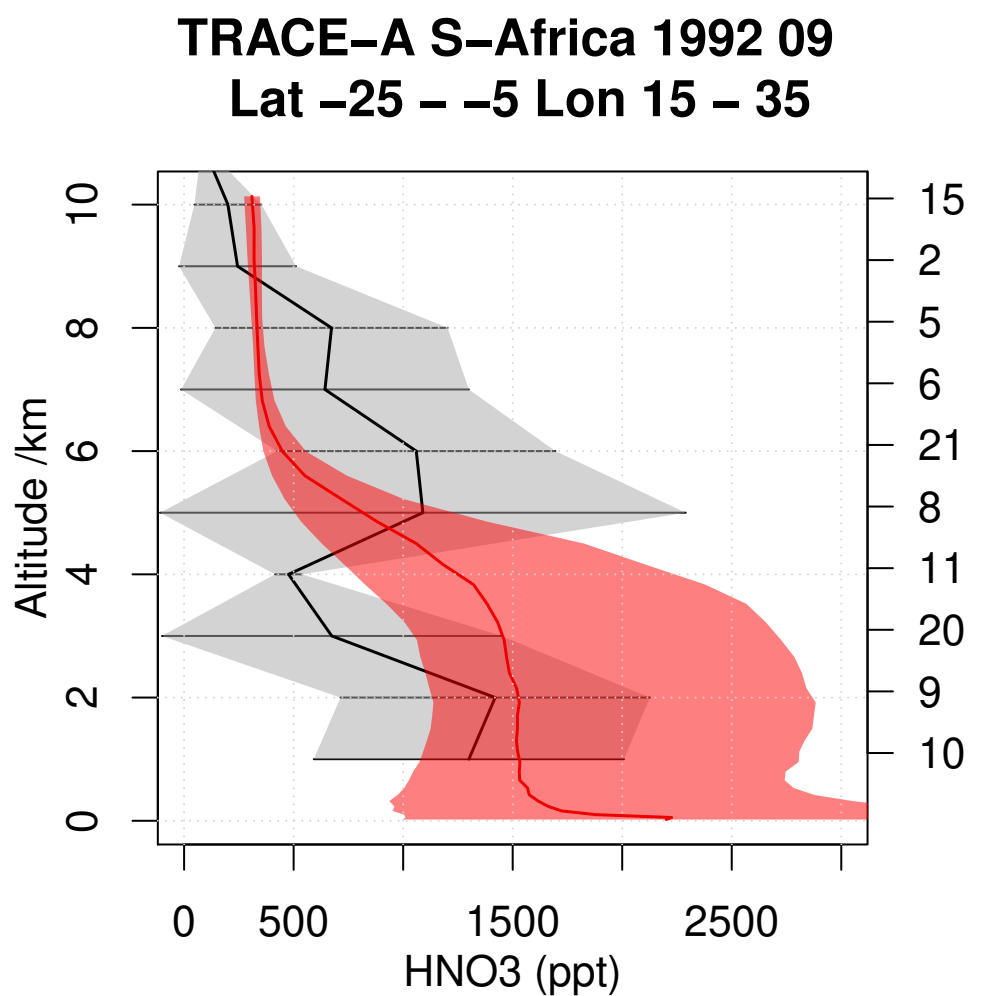
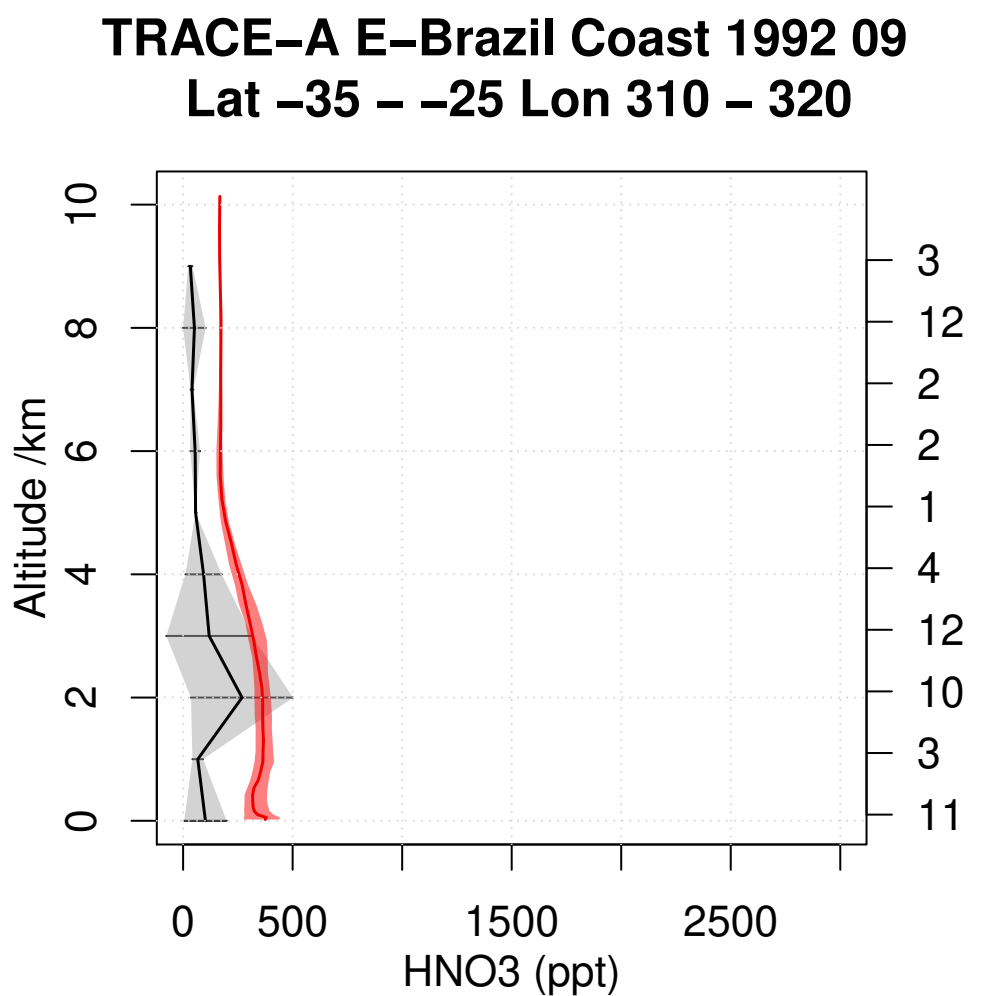
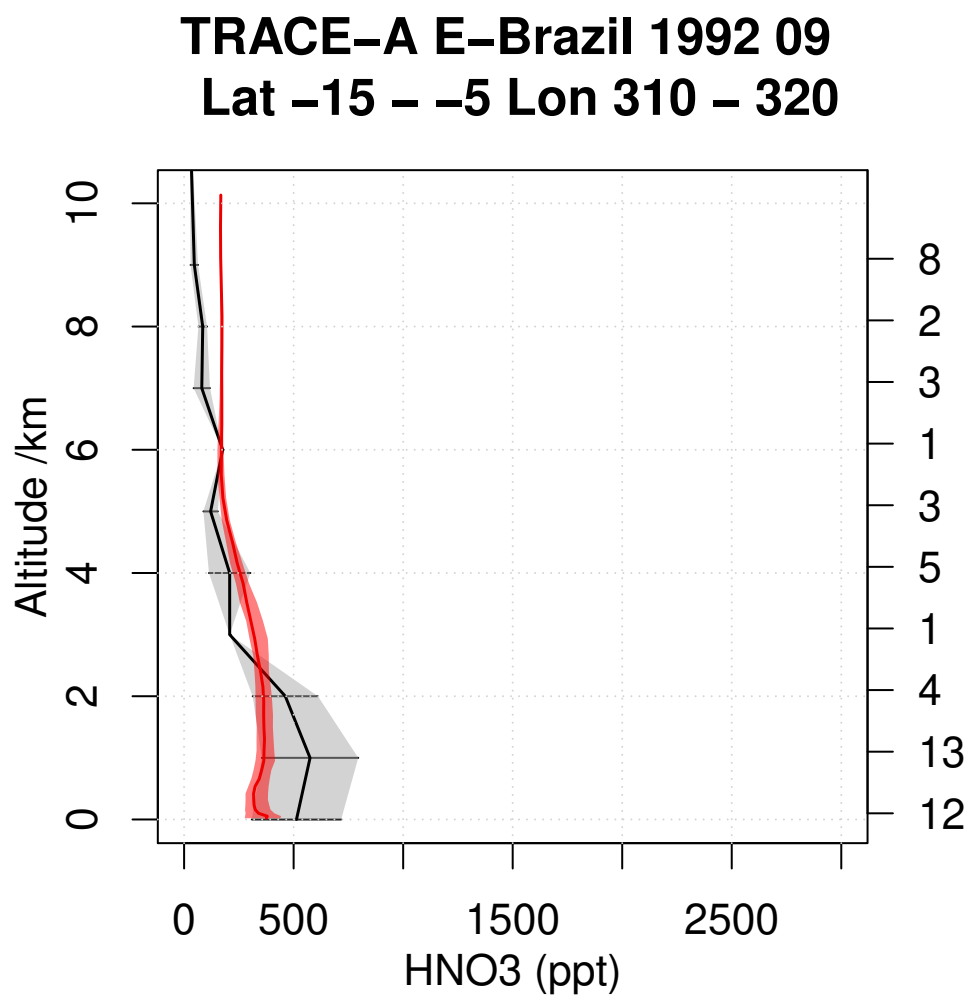
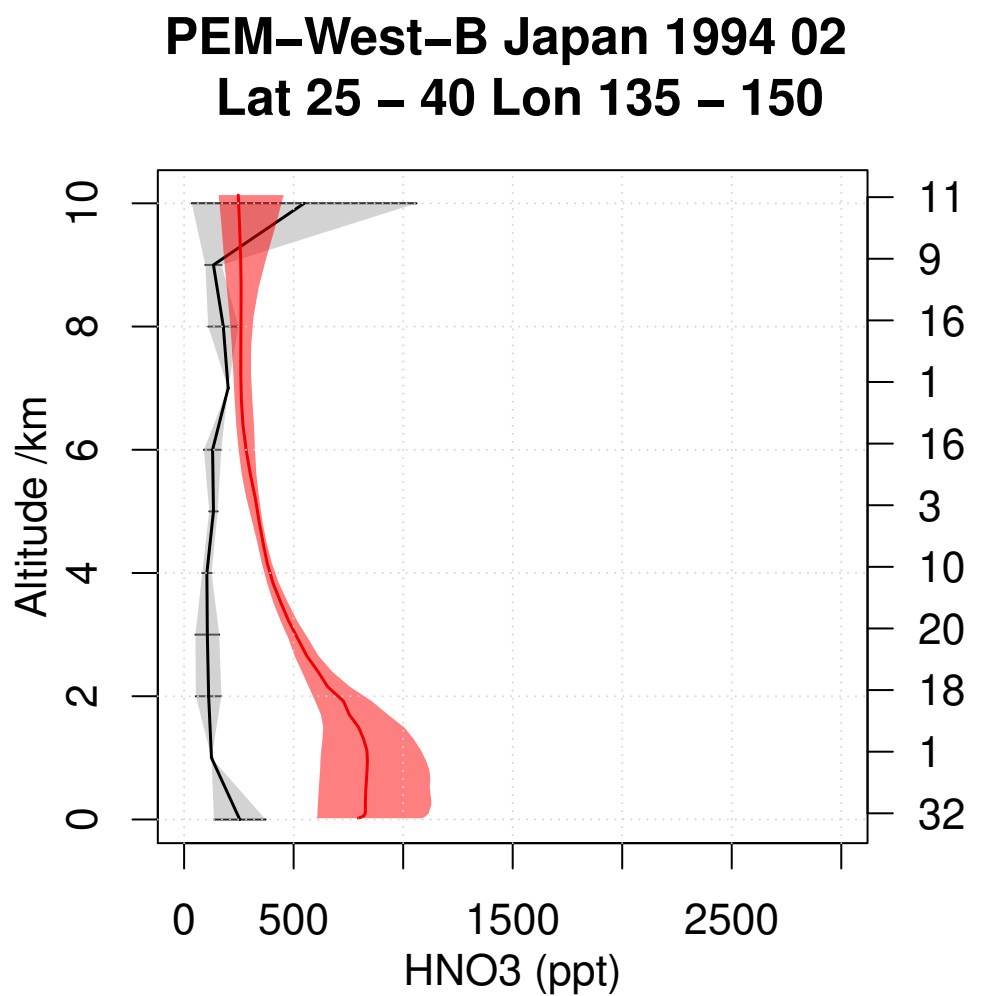
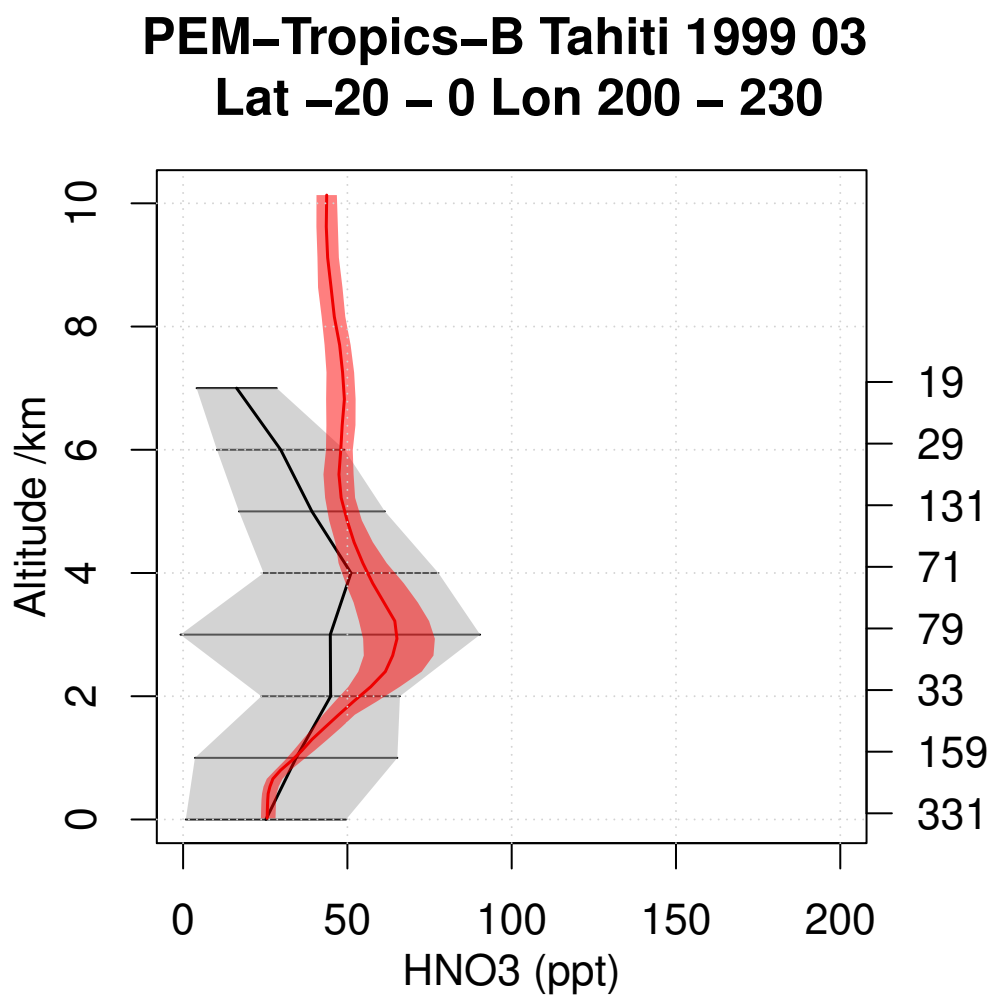
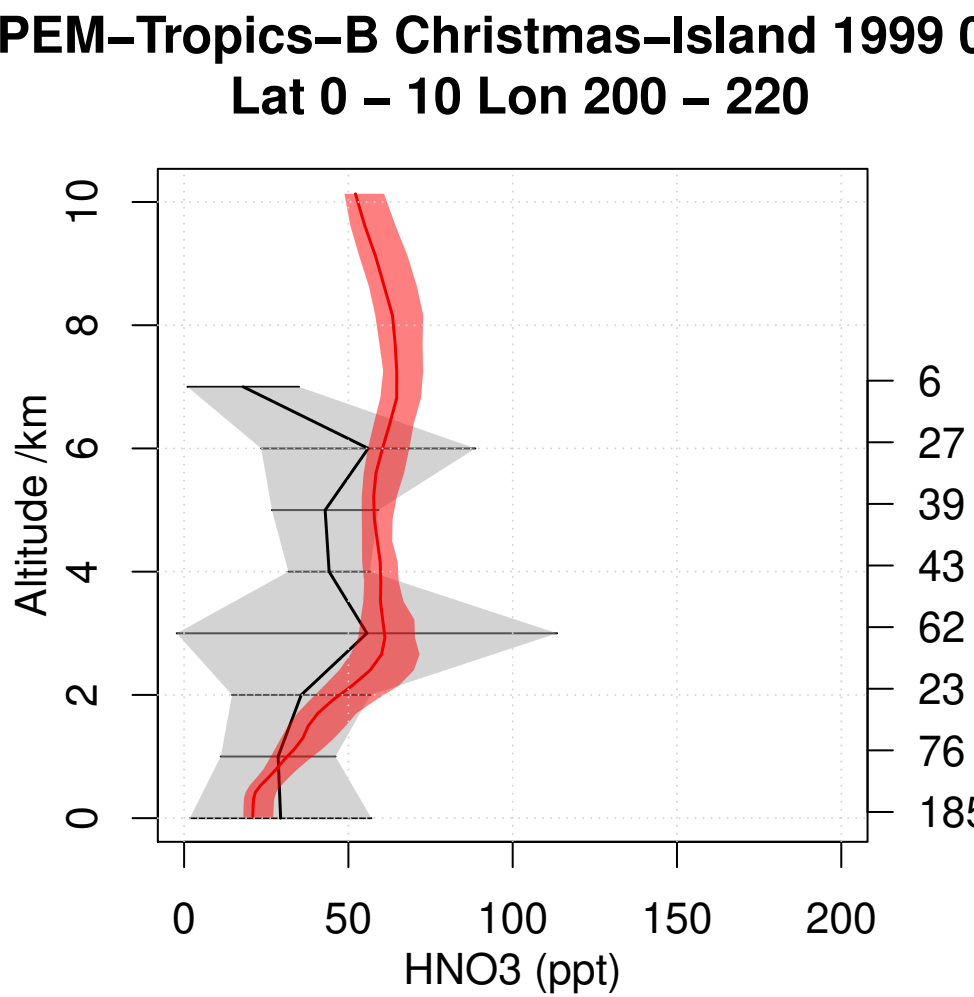
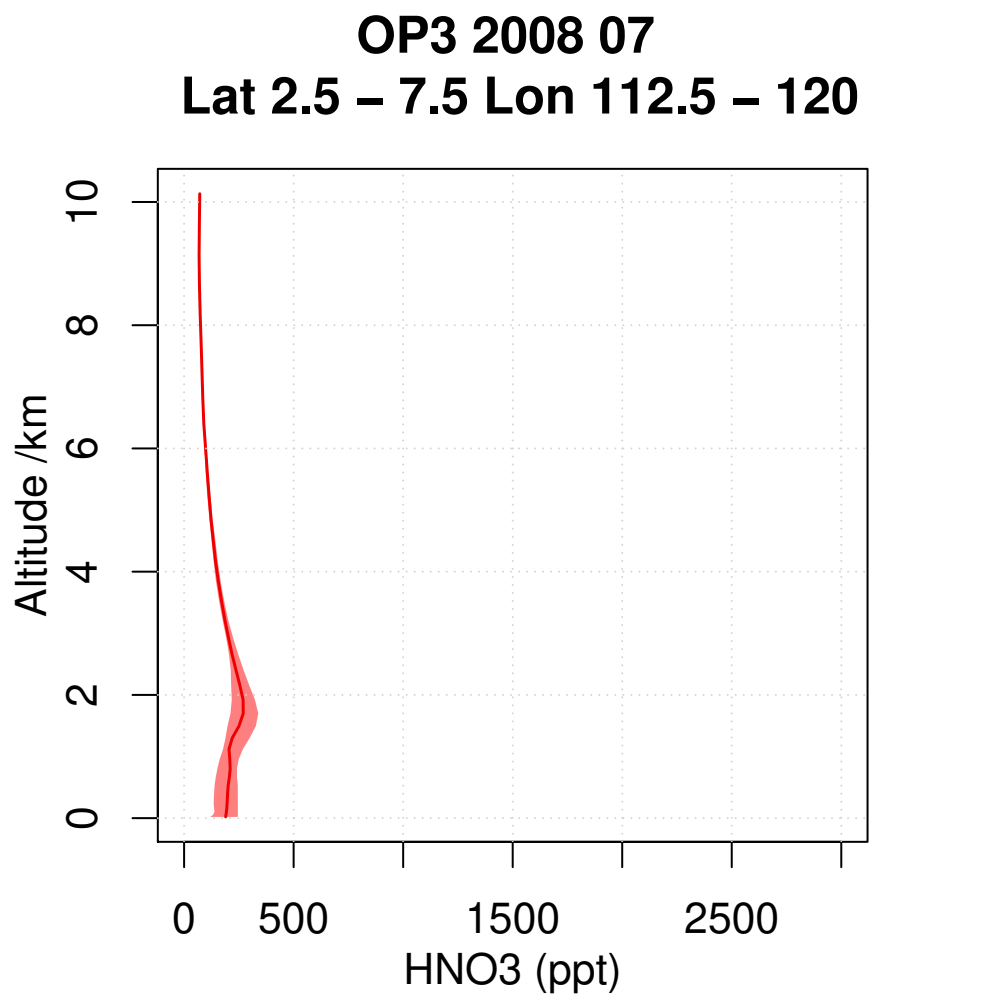
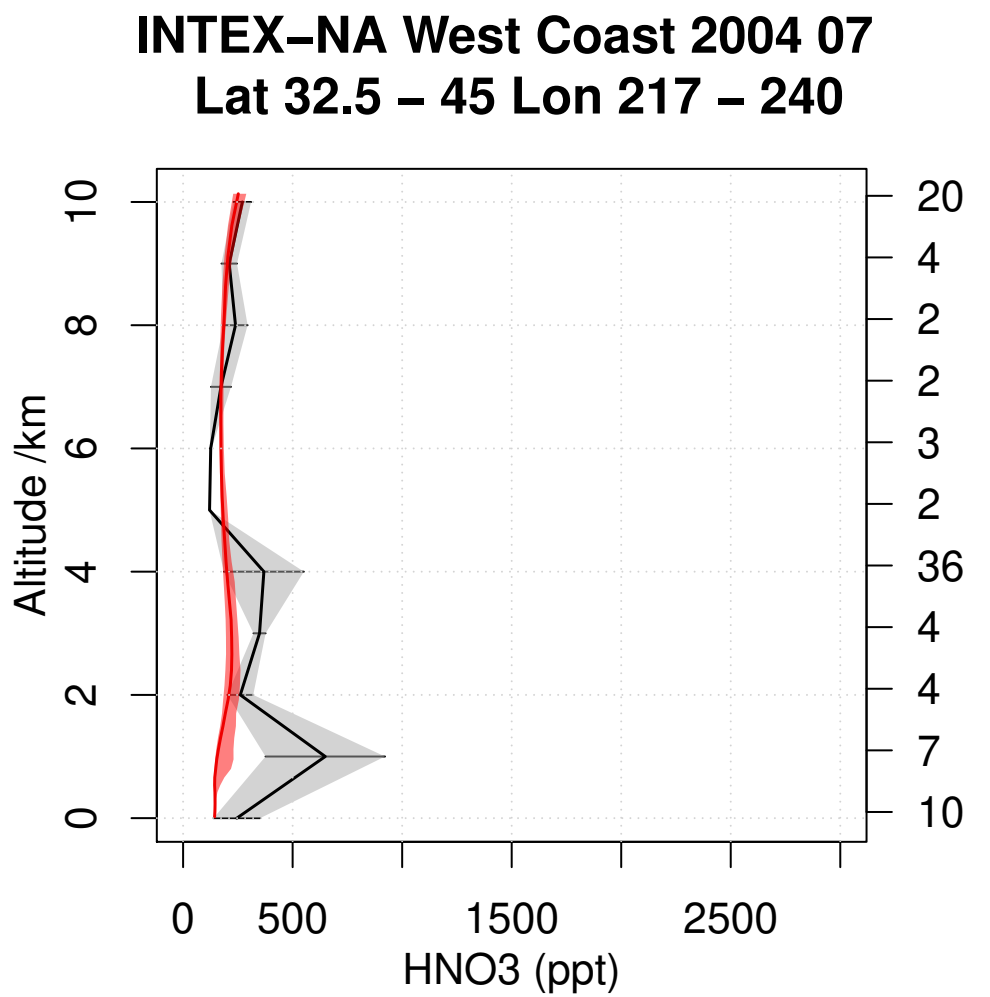
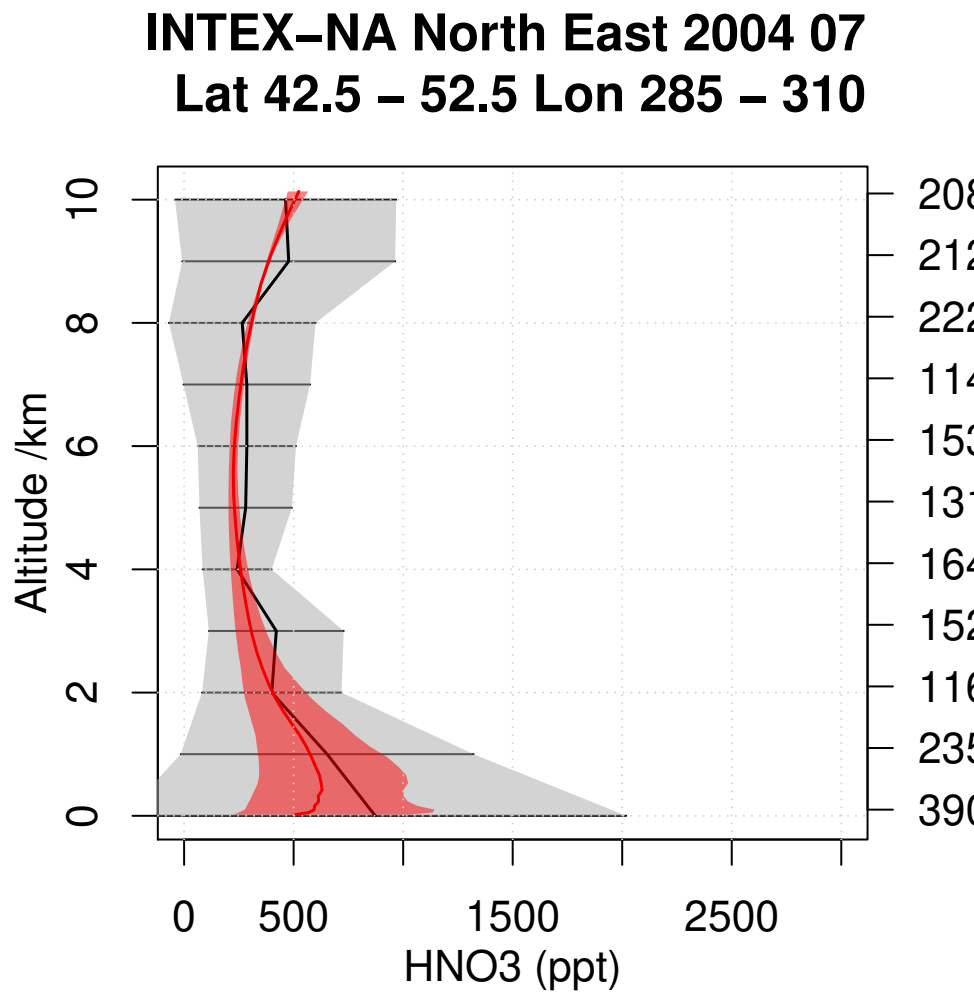
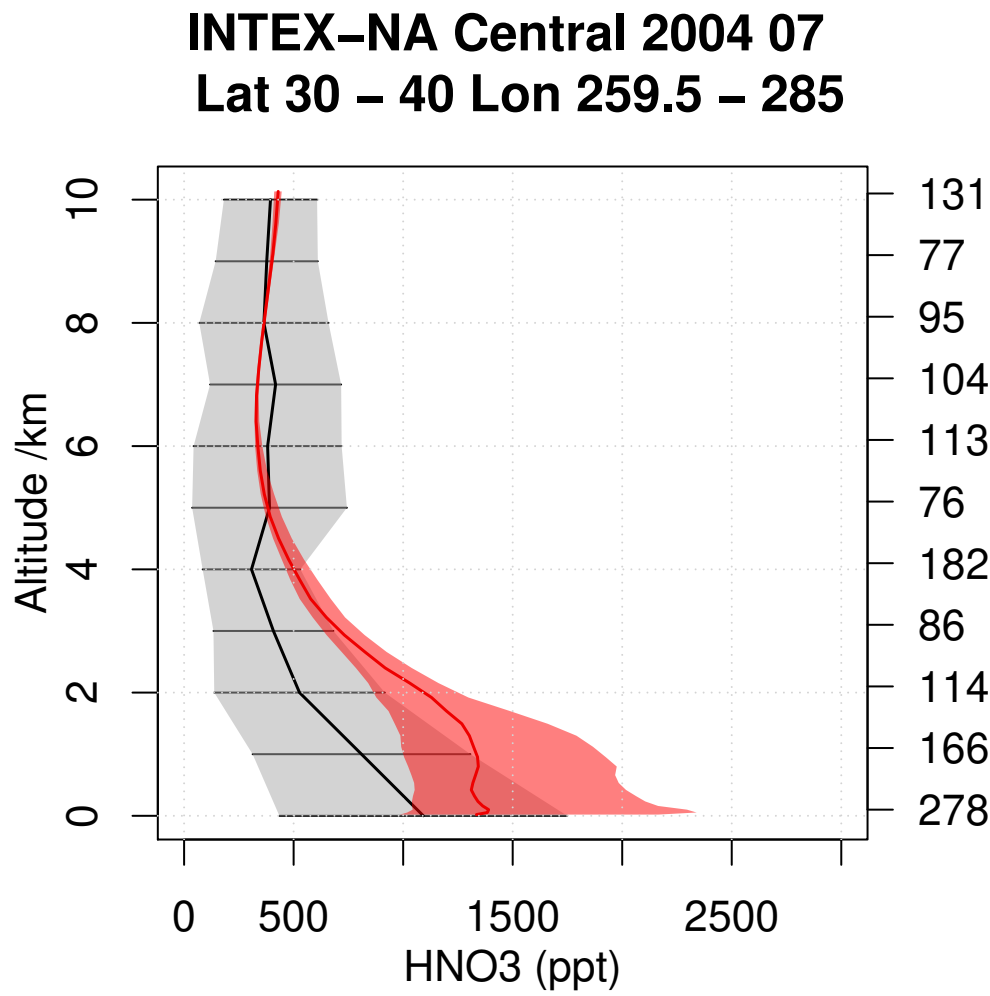
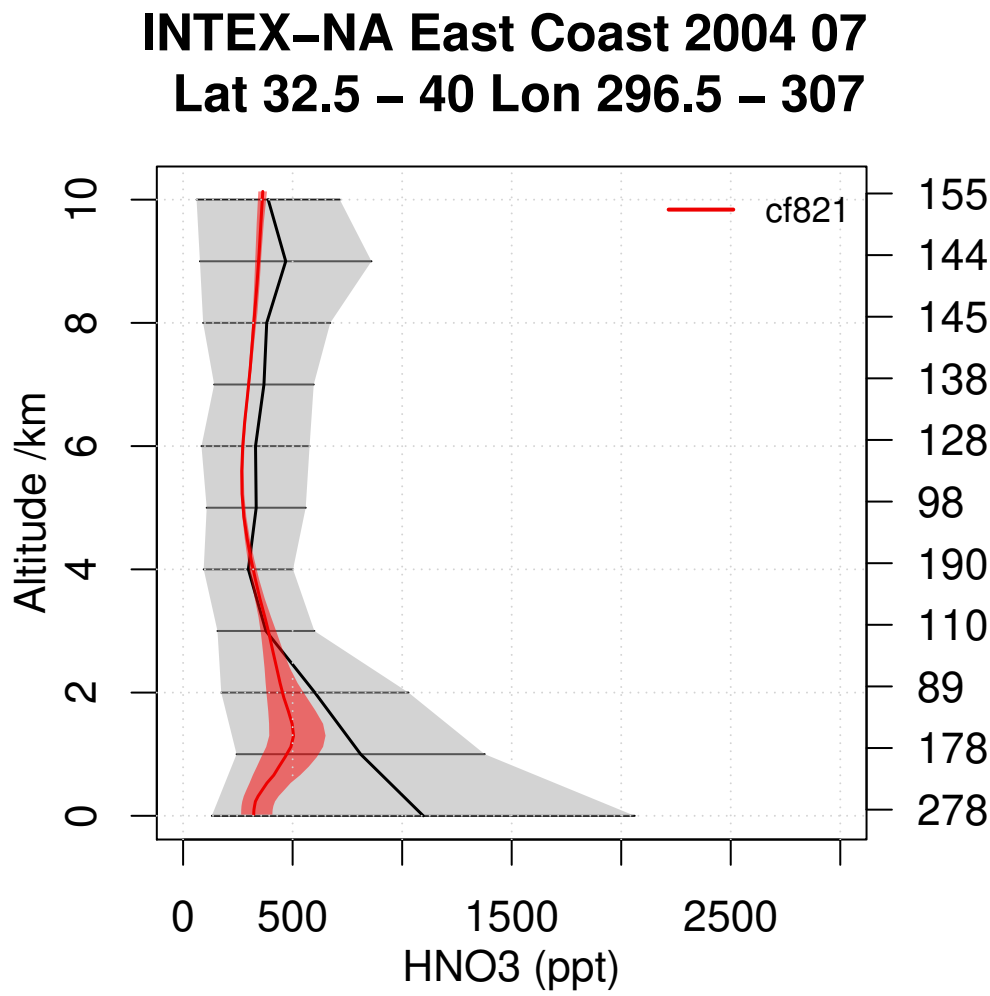


**TRACE-A W-Africa Coast 1992 09**  
**Lat -25 – -5 Lon 0 – 10**



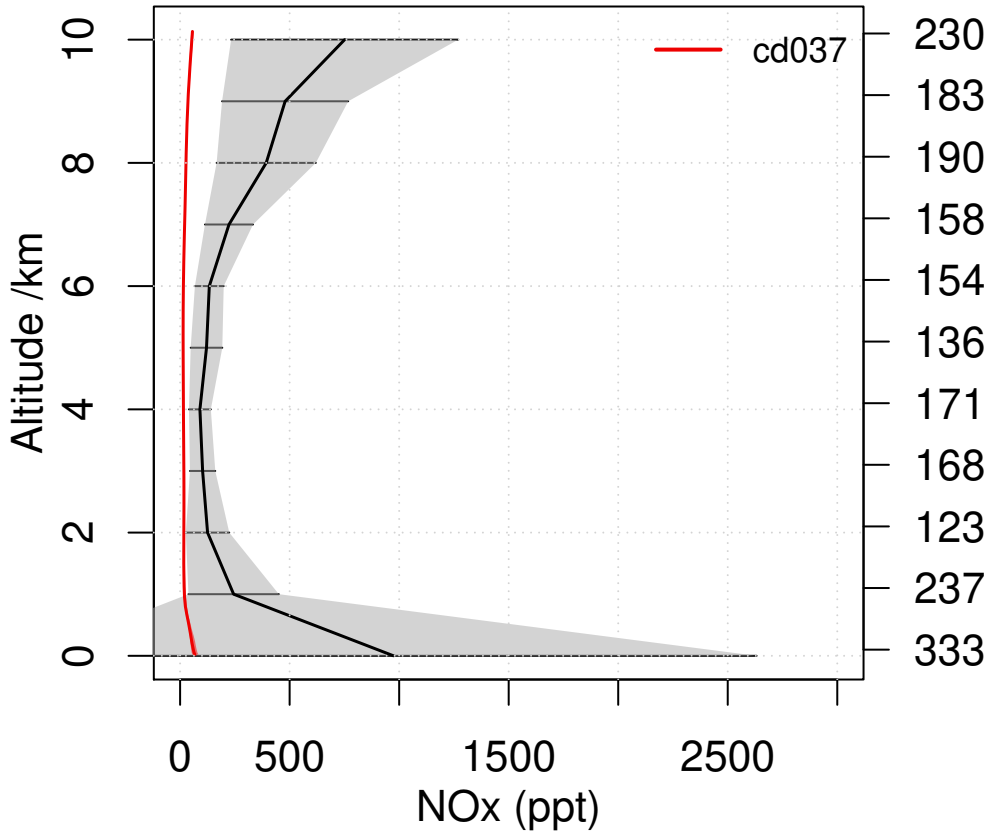


**Emmons HNO<sub>3</sub> comparison**

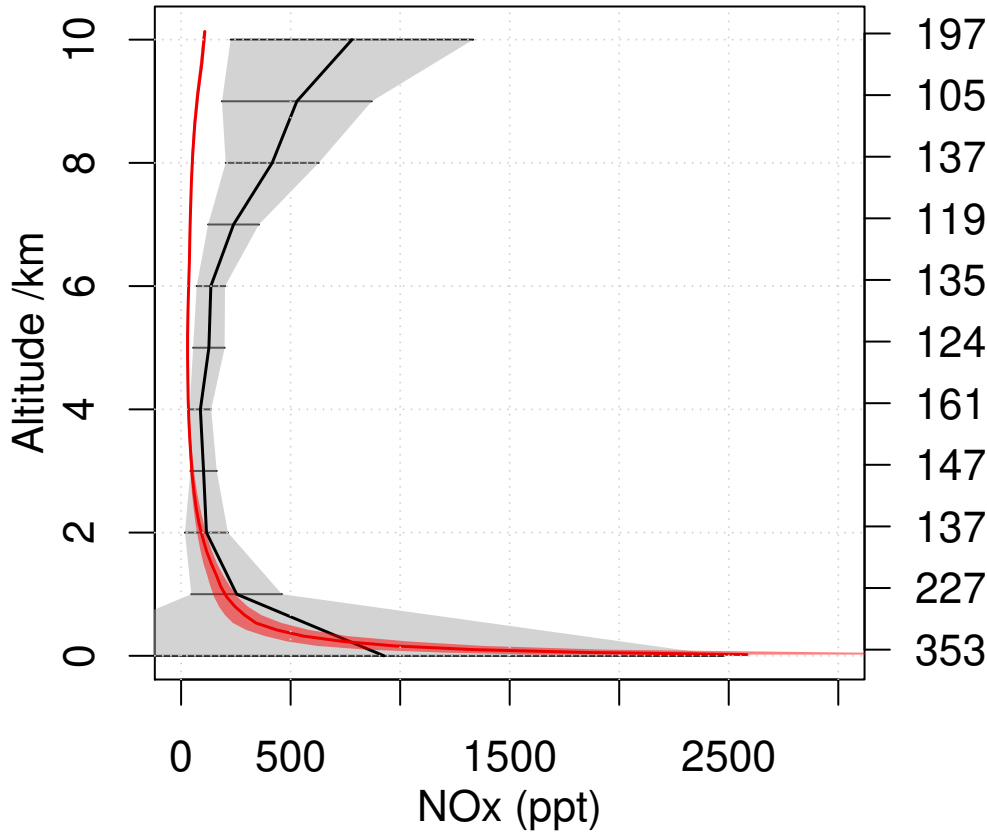


# Emmons NOx comparison

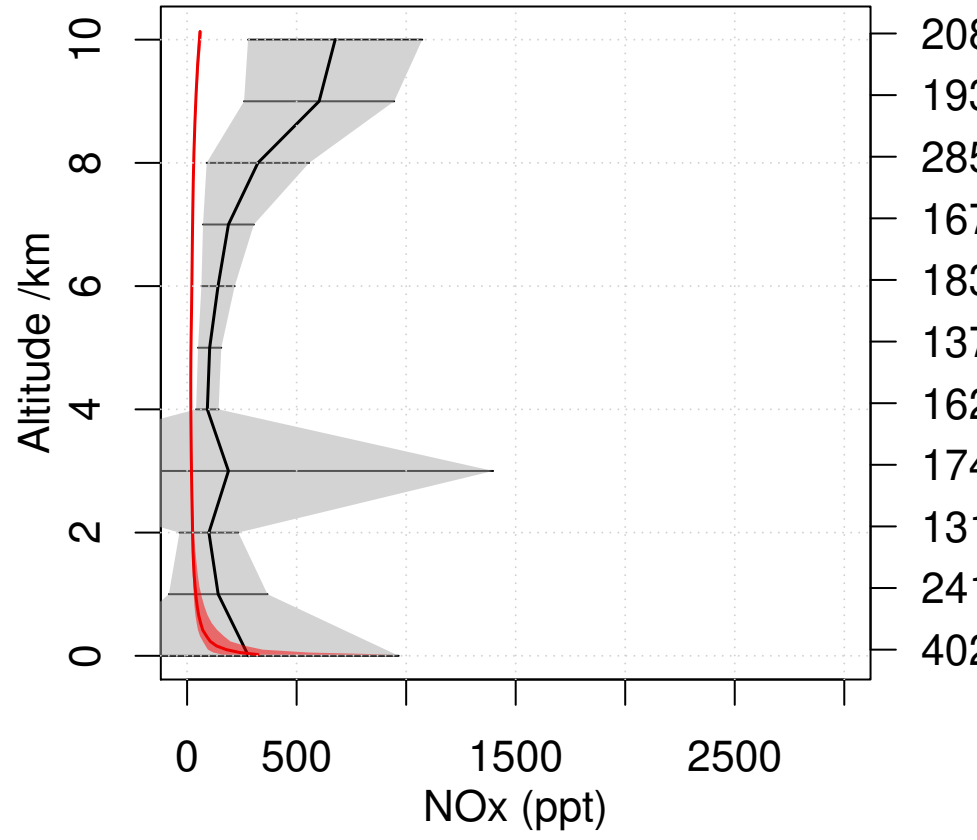
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



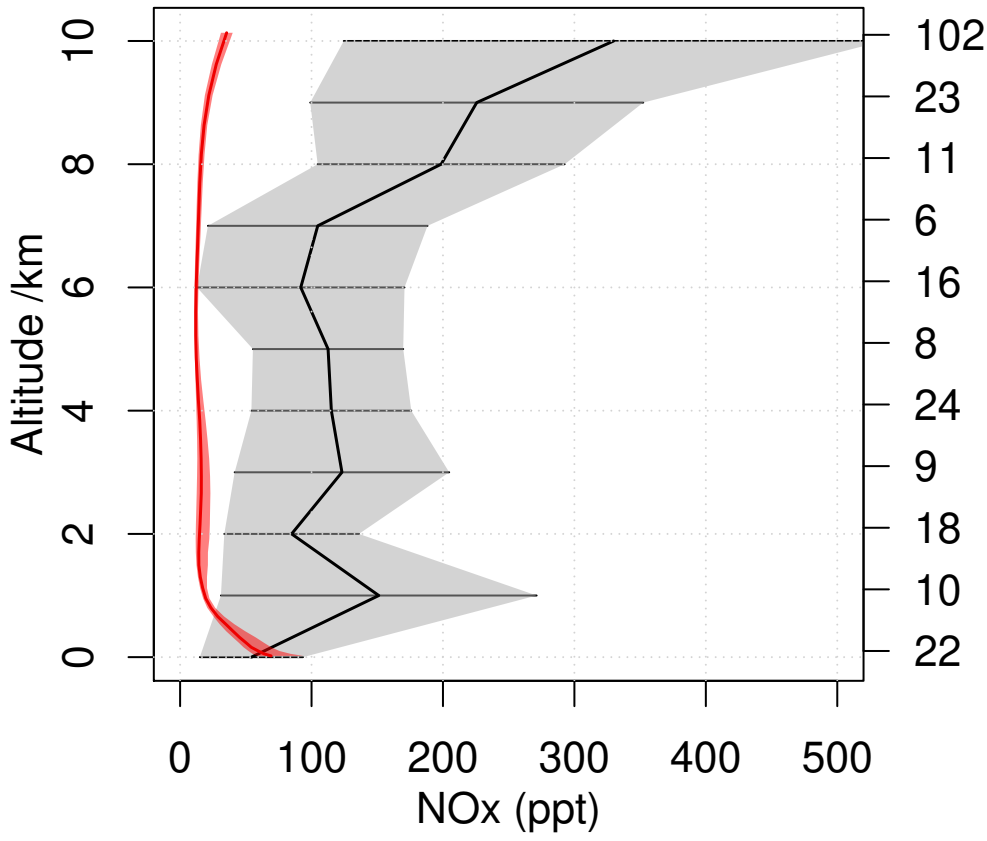
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



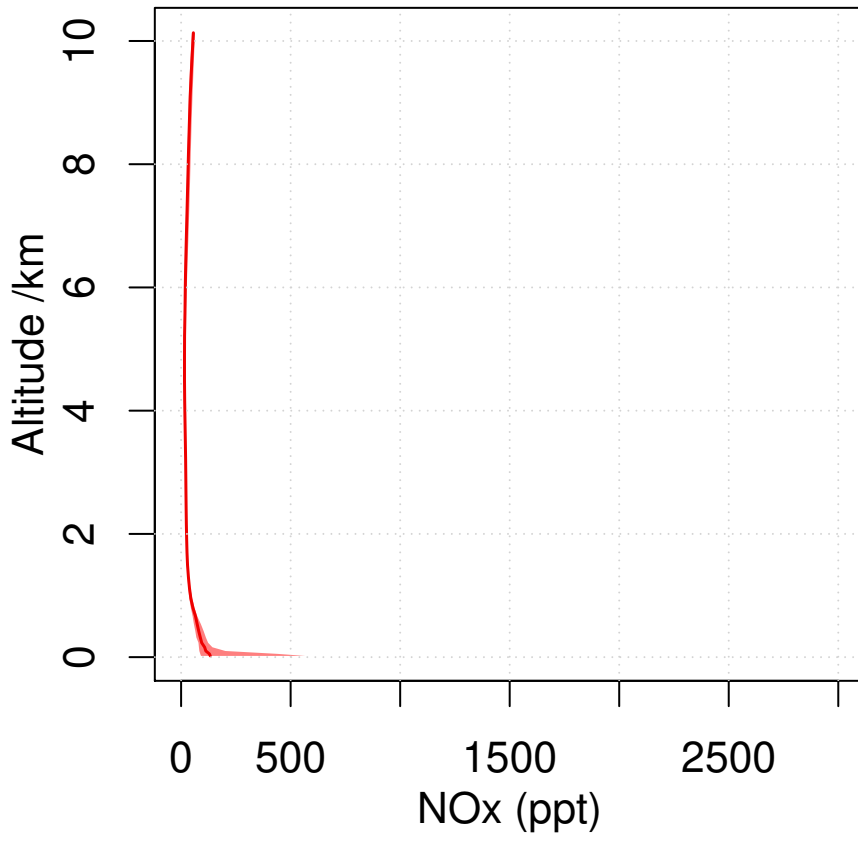
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



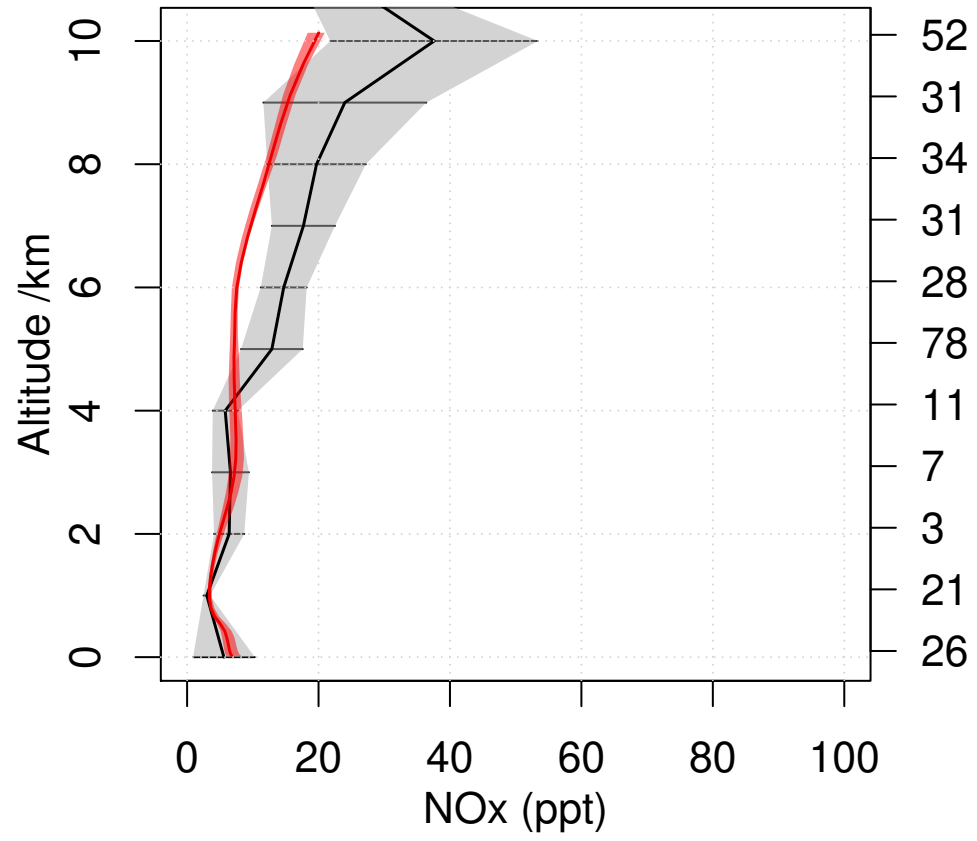
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



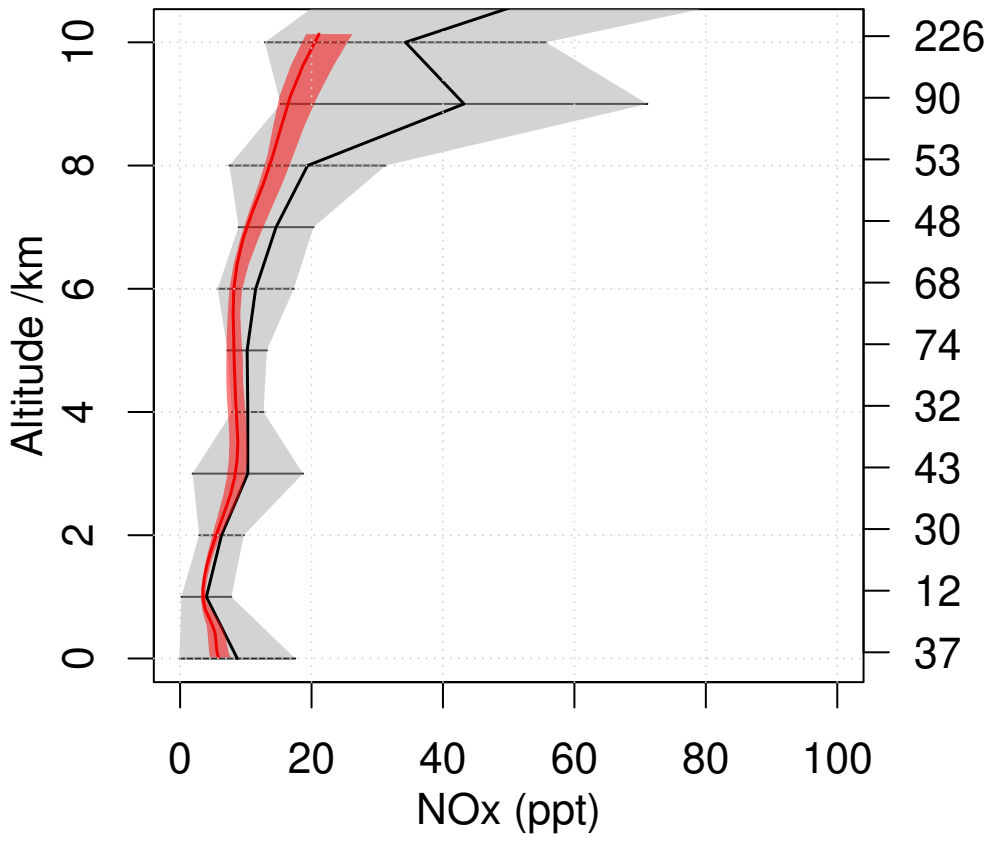
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



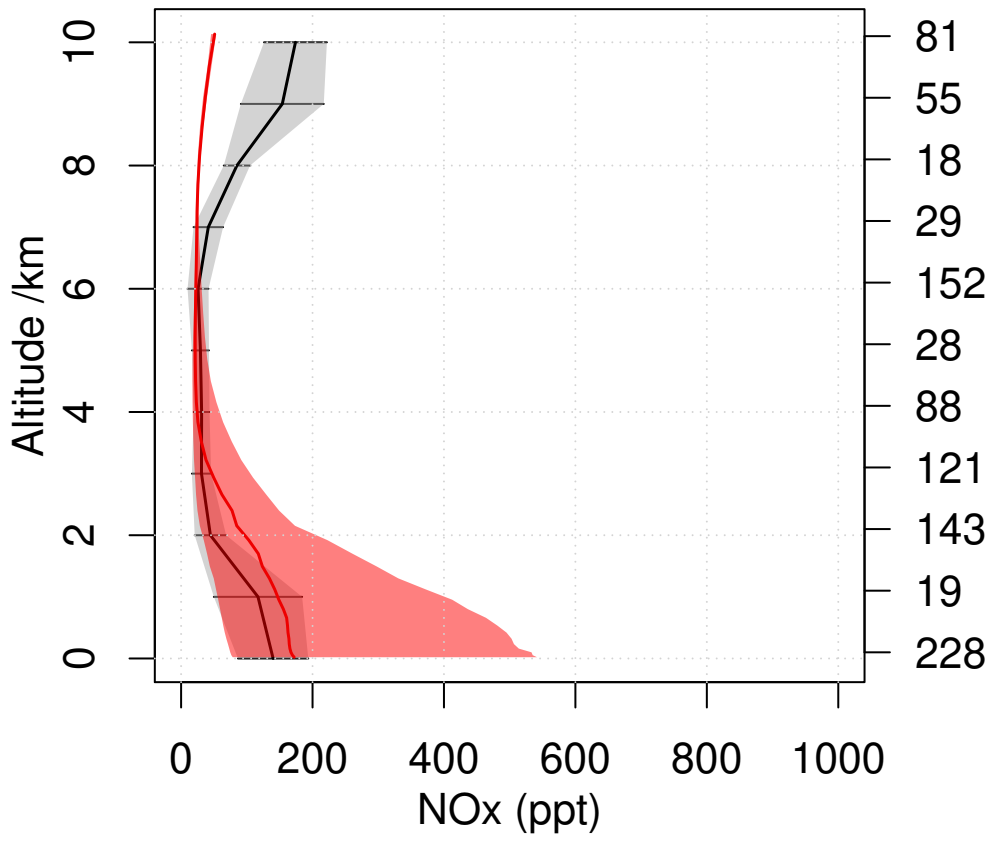
**PEM-Tropics-B Christmas-Island 1999 07**  
Lat 0 – 10 Lon 200 – 220



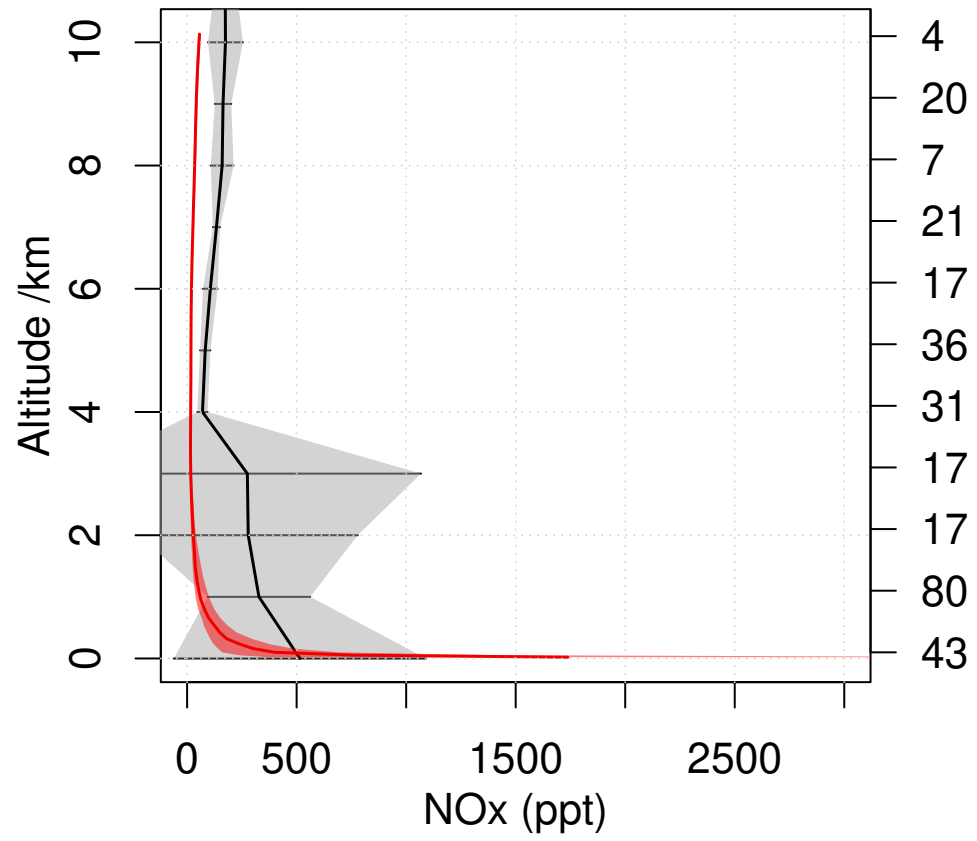
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



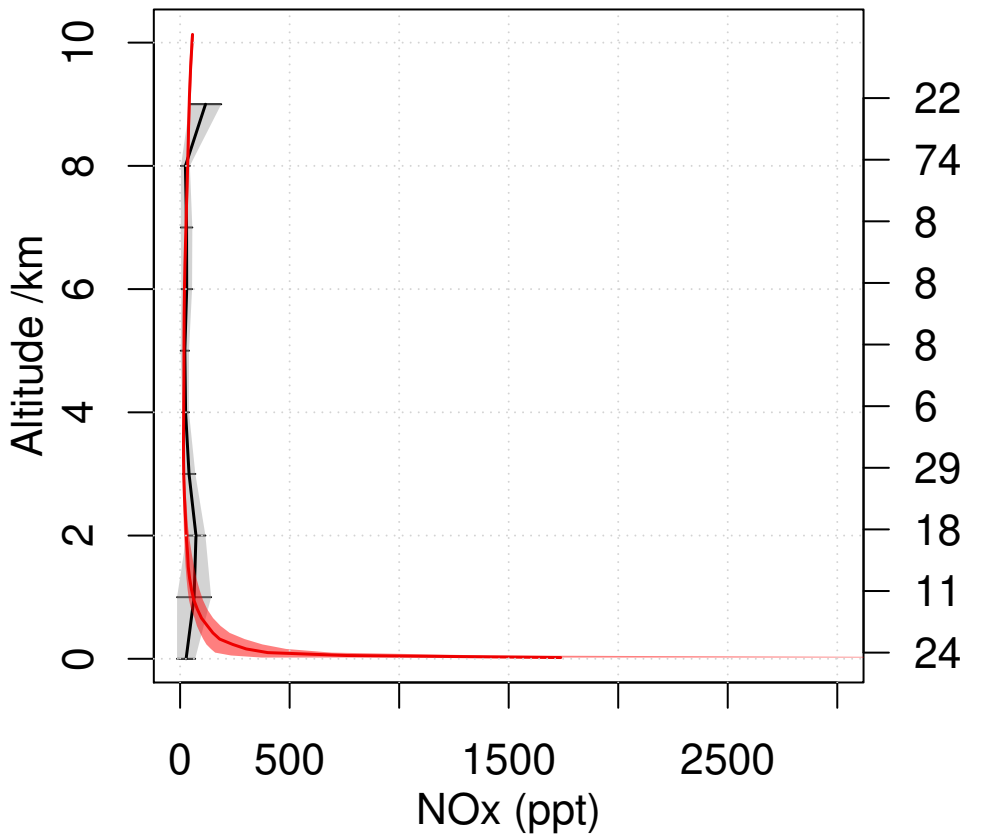
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



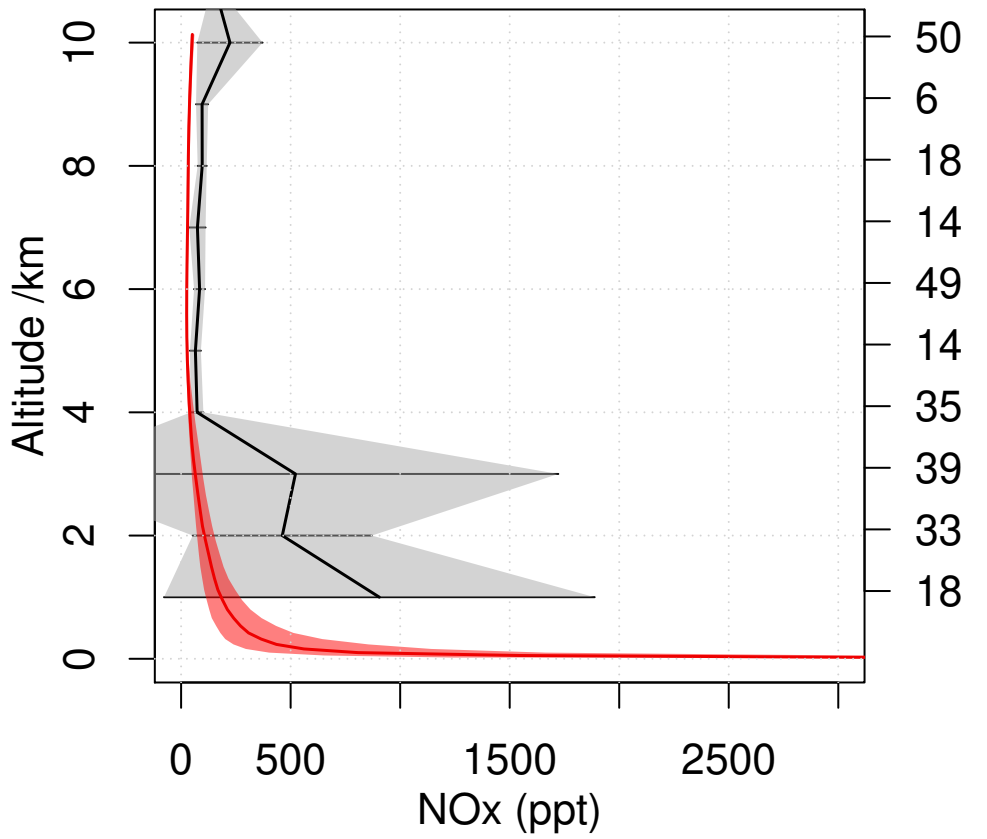
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



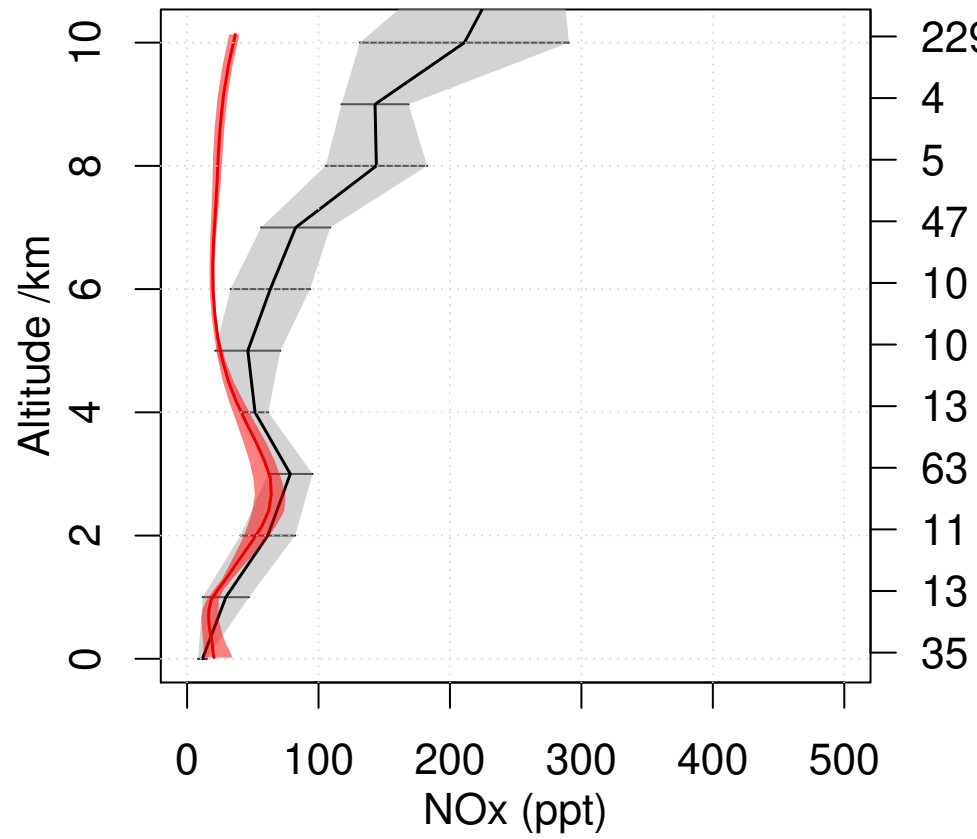
**TRACE-A E-Brazil Coast 1992 09**  
Lat -35 – -25 Lon 310 – 320



**TRACE-A S-Africa 1992 09**  
Lat -25 – -5 Lon 15 – 35

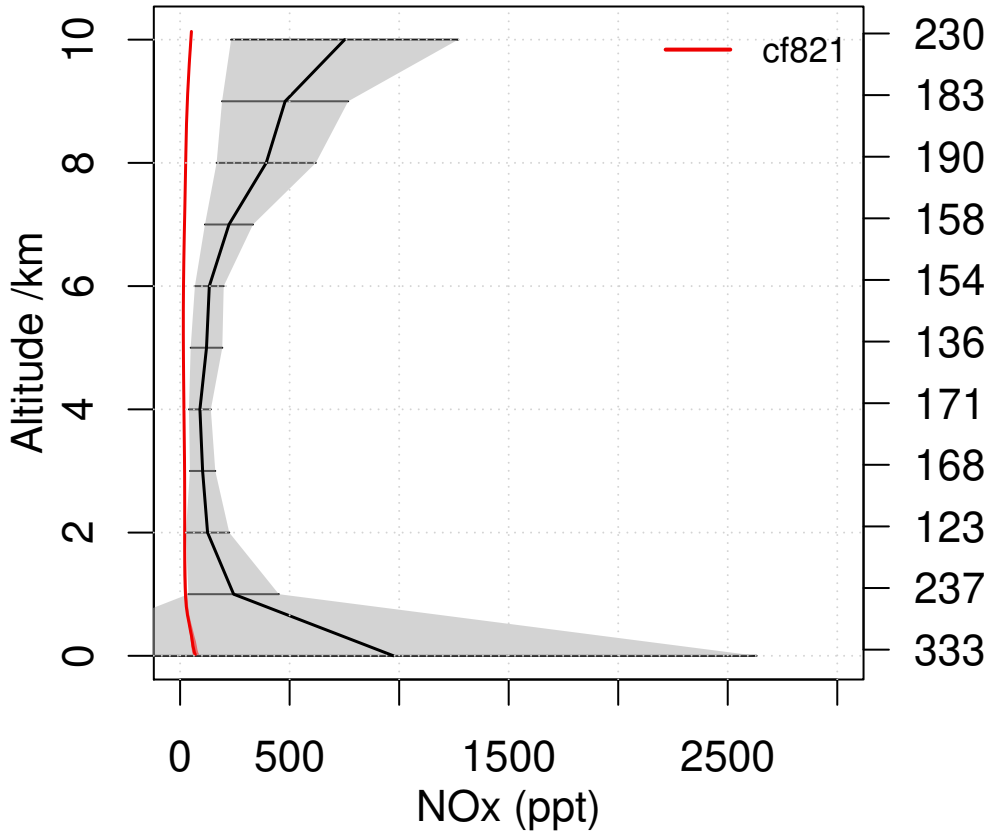


**TRACE-A W-Africa Coast 1992 09**  
Lat -25 – -5 Lon 0 – 10

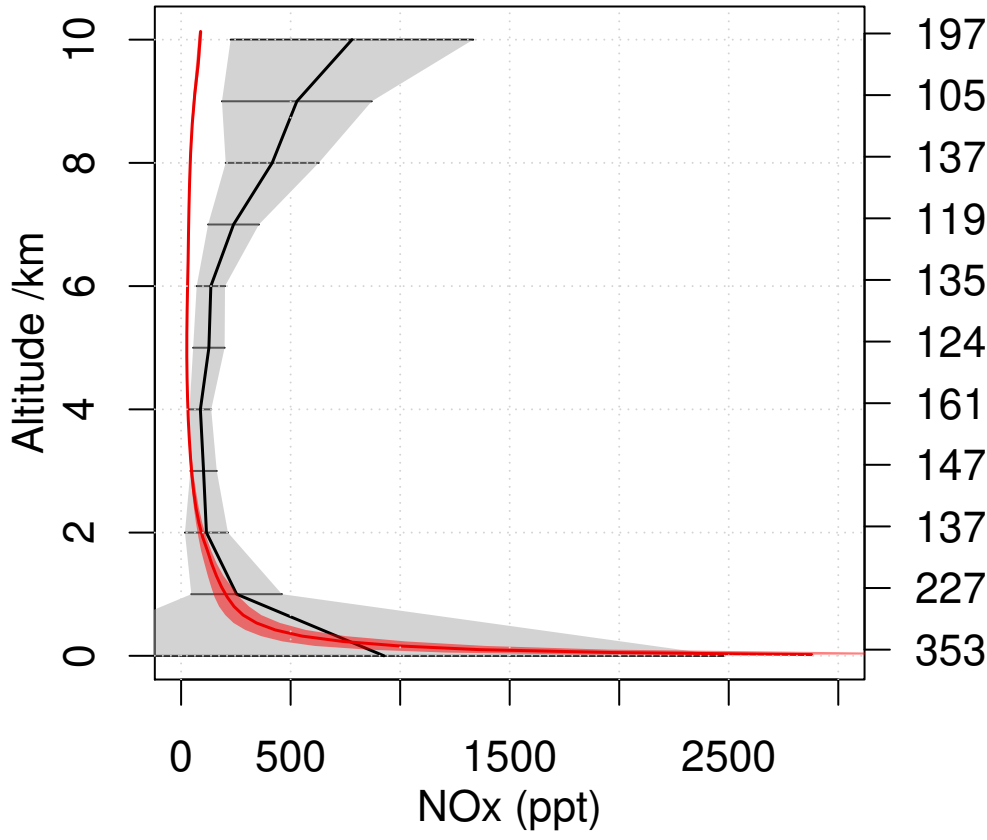


# Emmons NOx comparison

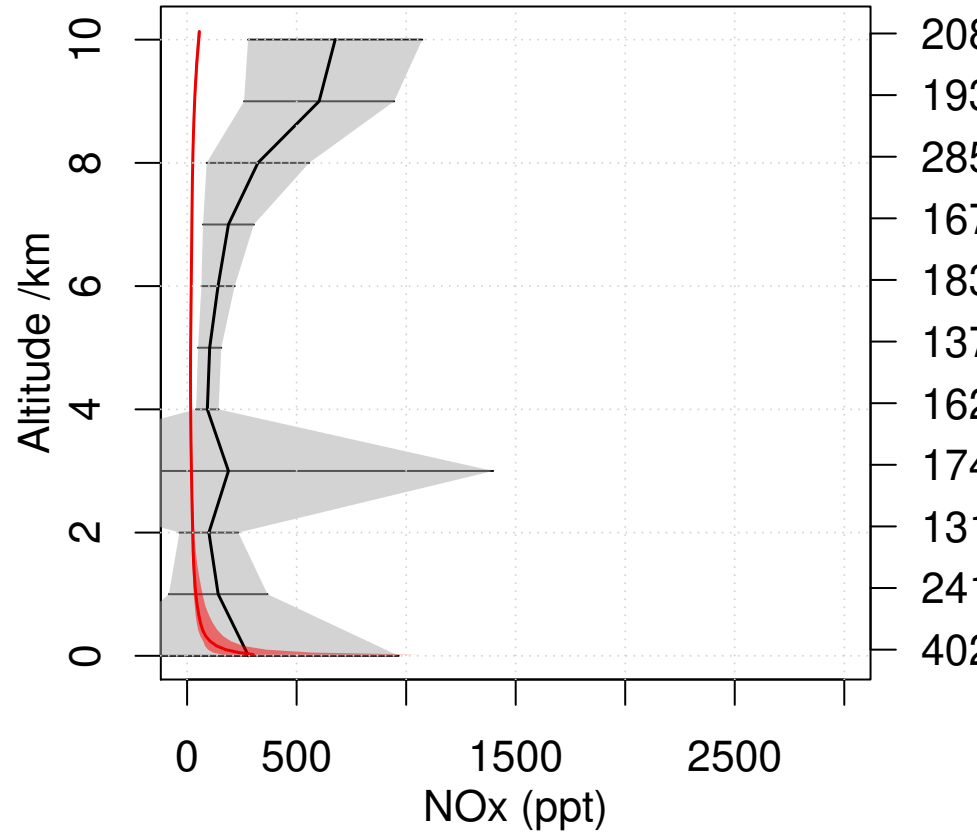
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



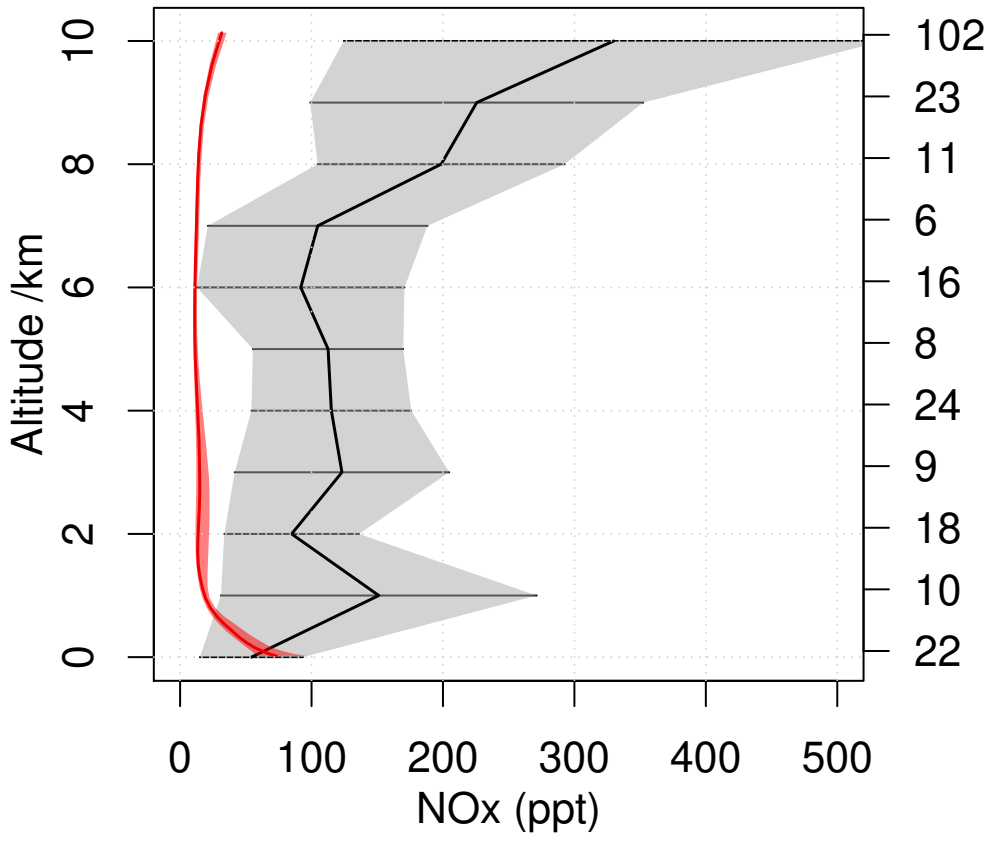
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



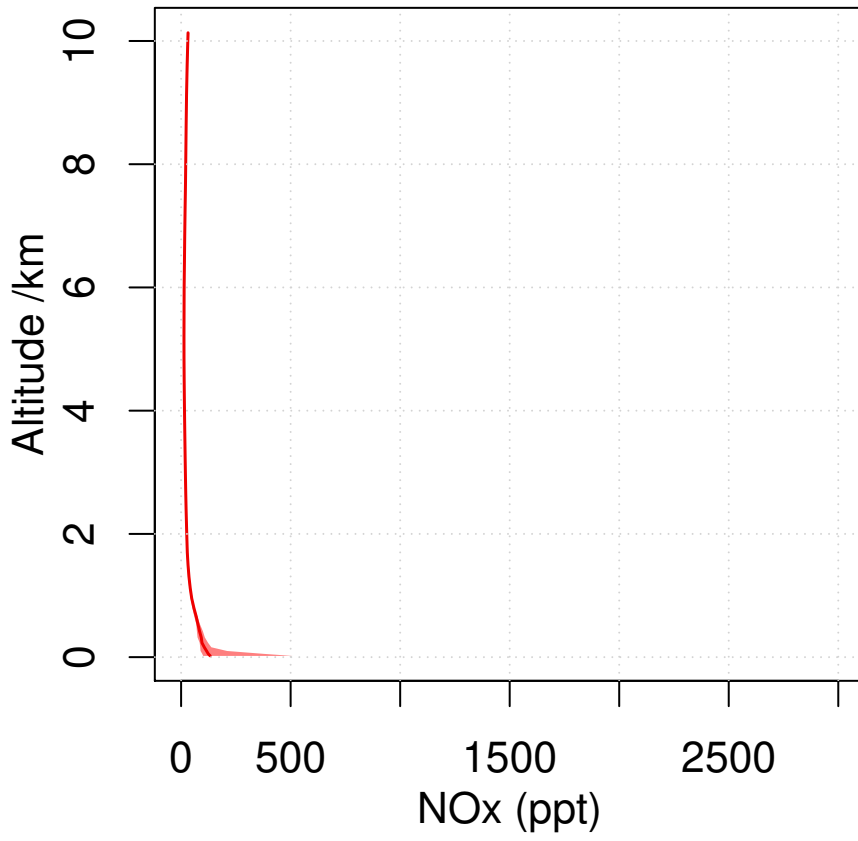
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



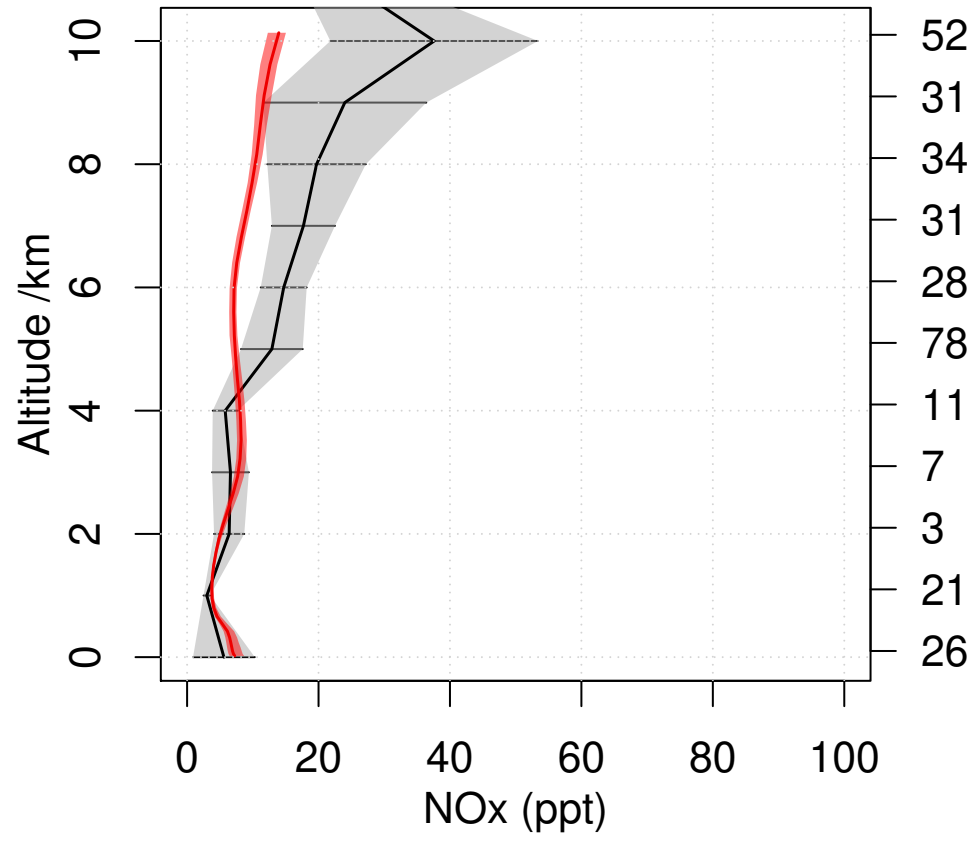
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



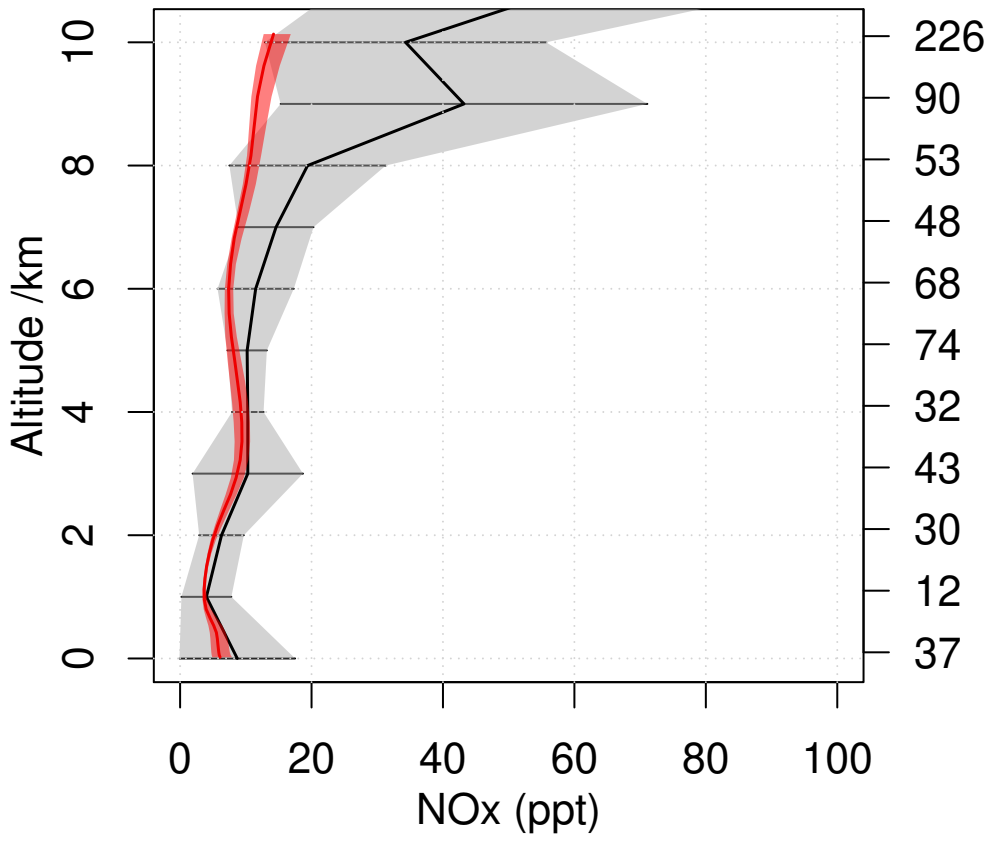
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



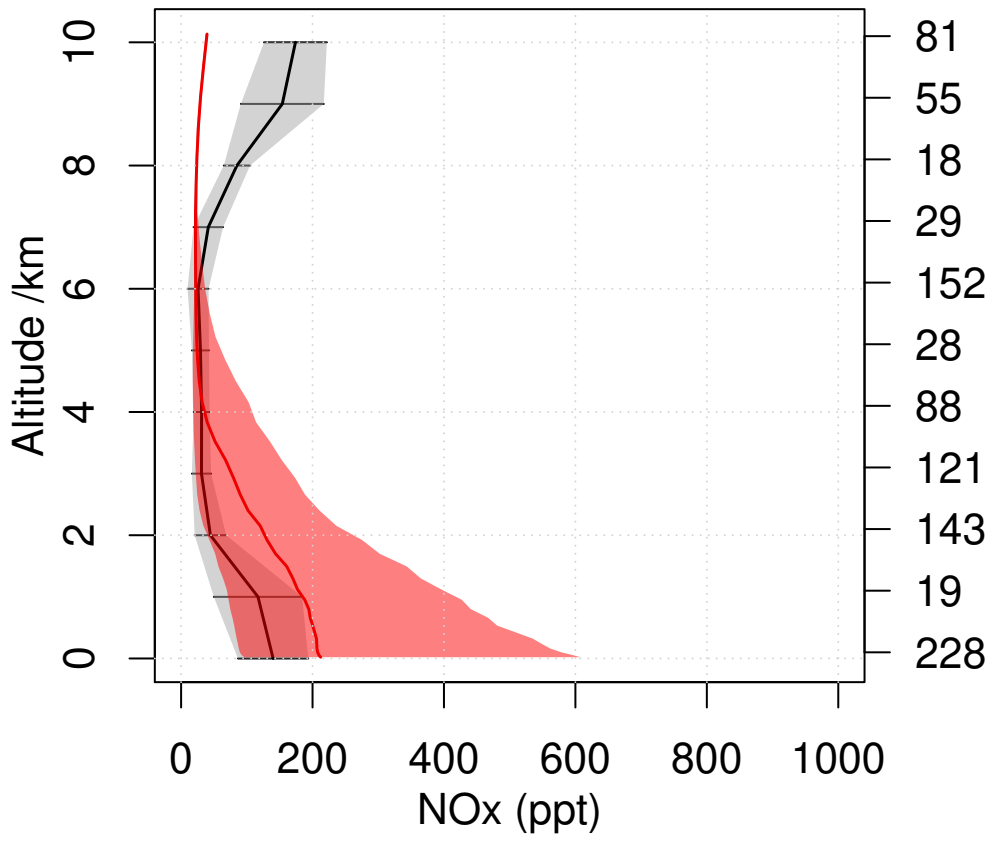
**PEM-Tropics-B Christmas-Island 1999 07**  
Lat 0 – 10 Lon 200 – 220



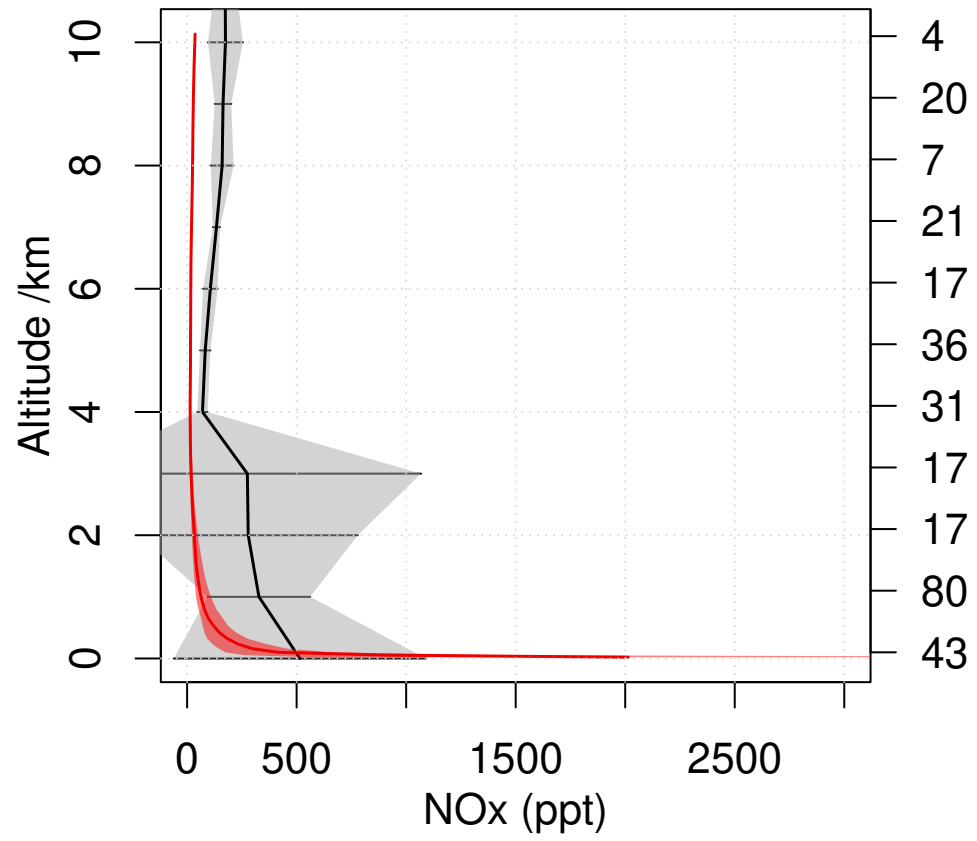
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



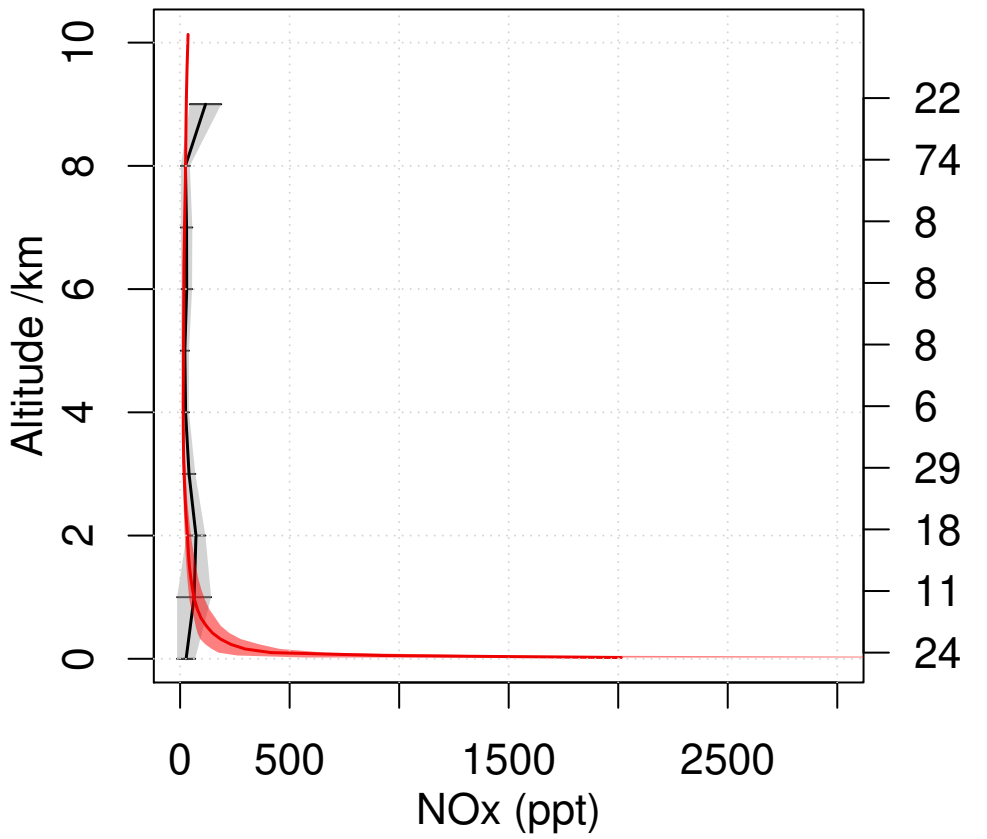
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



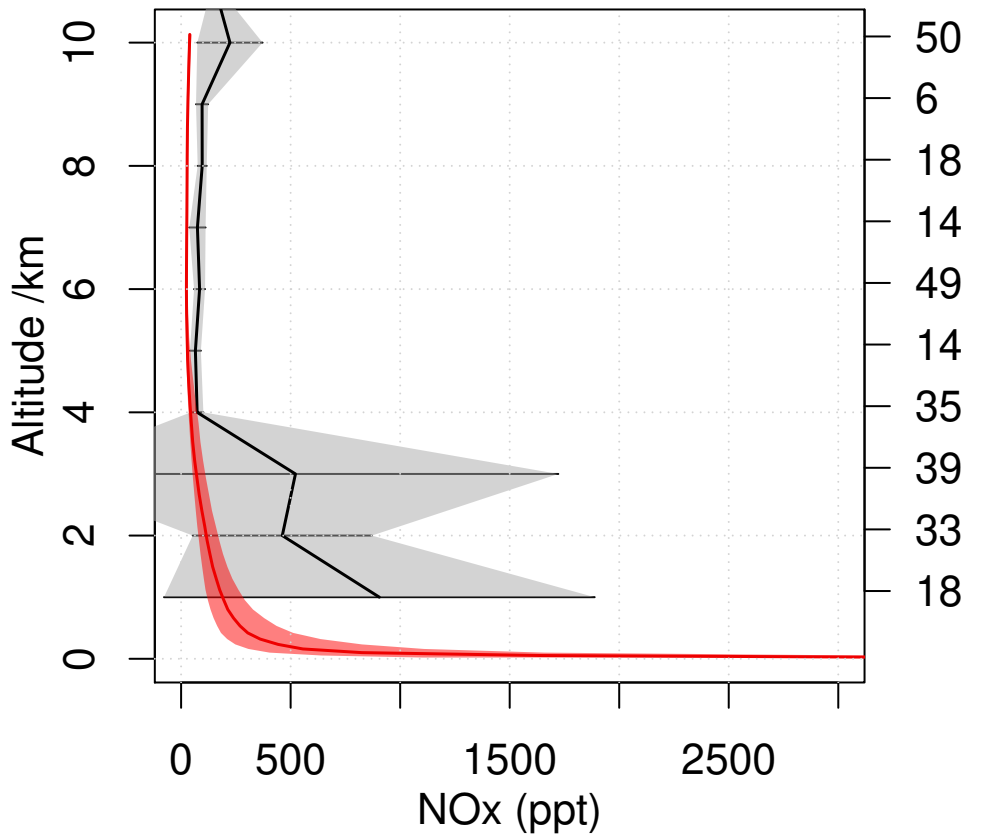
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



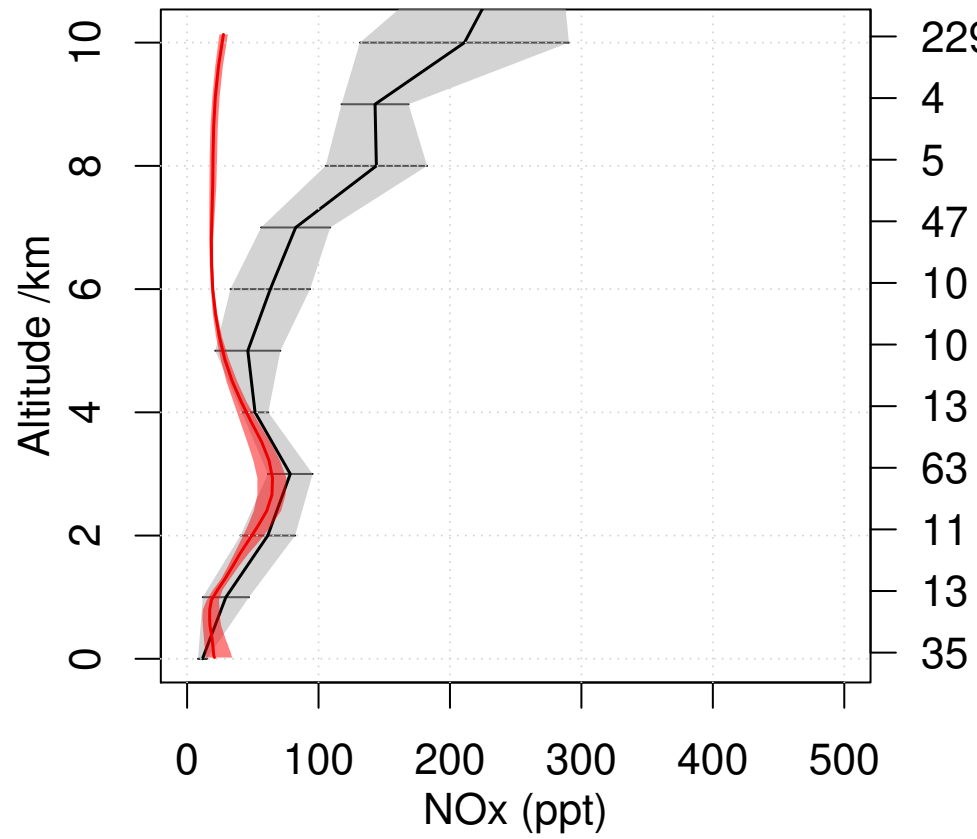
**TRACE-A E-Brazil Coast 1992 09**  
Lat -35 – -25 Lon 310 – 320



**TRACE-A S-Africa 1992 09**  
Lat -25 – -5 Lon 15 – 35



**TRACE-A W-Africa Coast 1992 09**  
Lat -25 – -5 Lon 0 – 10



# UKCA cd037

[OH] Air mass weighted (10<sup>6</sup> molecules cm<sup>-3</sup>)

Red: Spivakovsky values

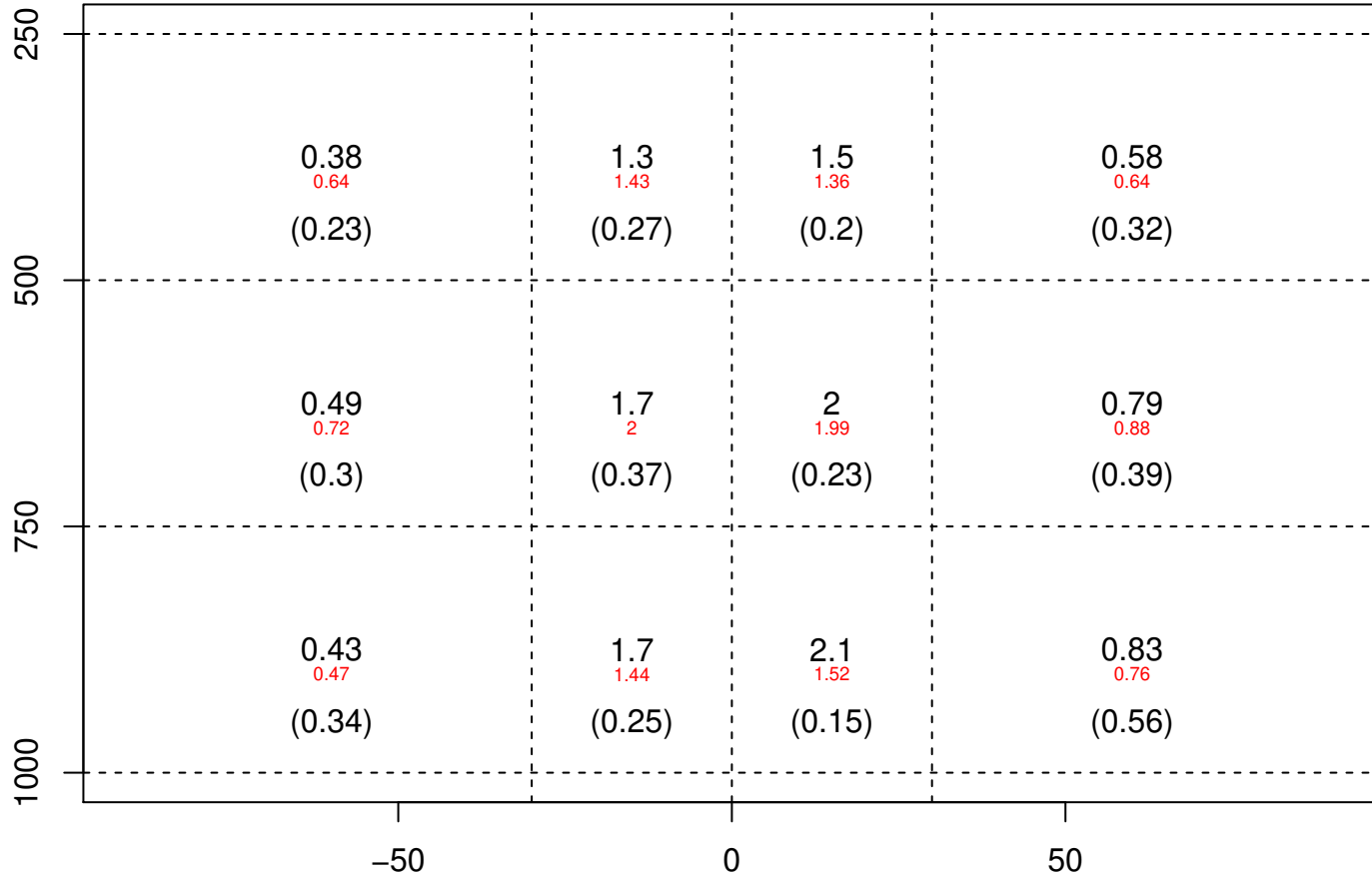
Mean OH= 1.23e+06 molec/cm3

Values in ( ): Std dev

ACCMIP Multi-model Mean= 1.17 (+/- 0.1) e+06 molec/cm3

NH:SH ratio= 1.37 Patra et al 2014: 0.97 +/- 0.12

Pressure (hPa)



Latitude



# UKCA cf821

[OH] Air mass weighted (10<sup>6</sup> molecules cm<sup>-3</sup>)

Mean OH= 1.1e+06 molec/cm3

ACCMIP Multi-model Mean= 1.17 (+/- 0.1) e+06 molec/cm3

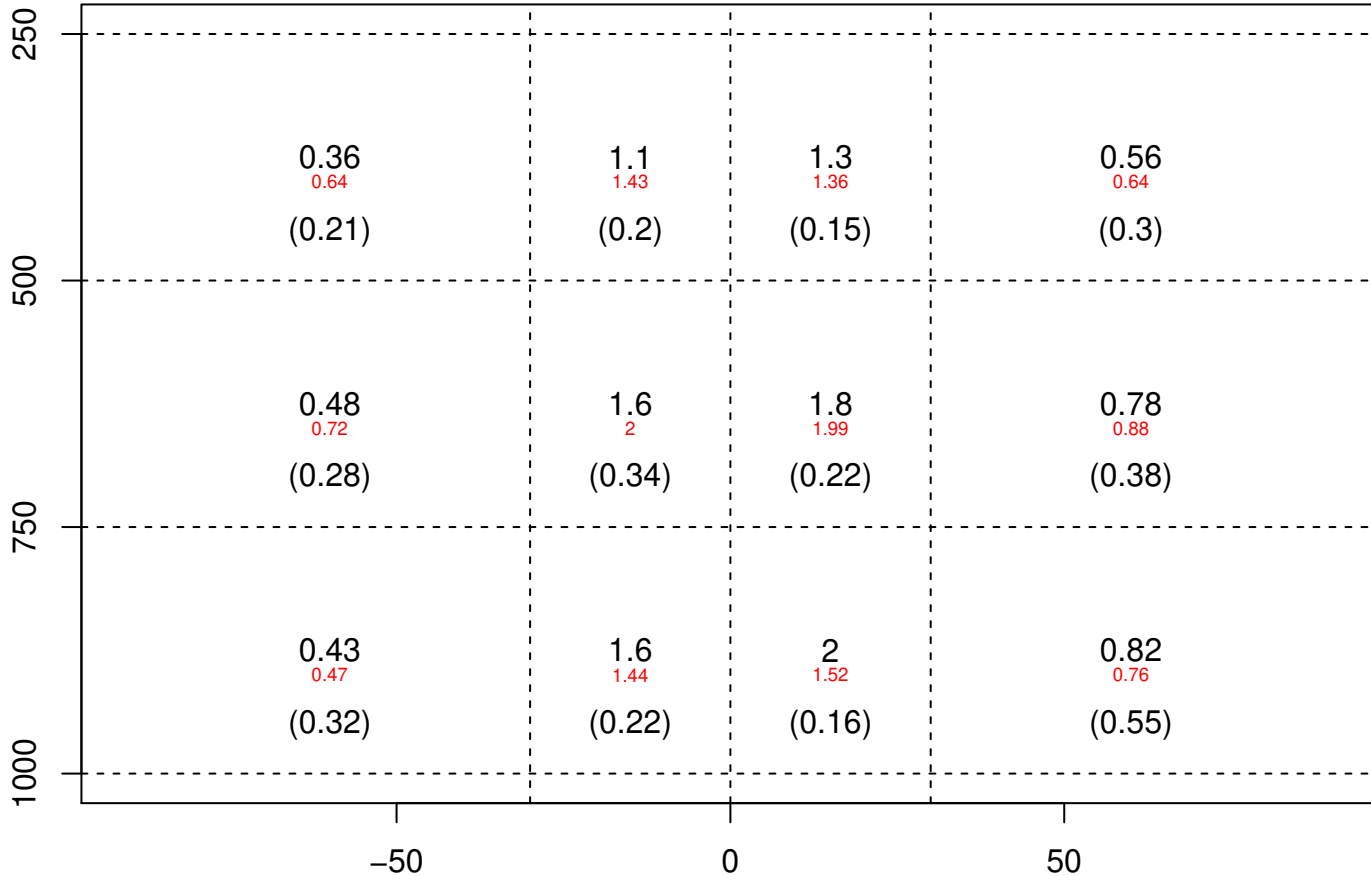
NH:SH ratio= 1.41 Patra et al 2014: 0.97 +/- 0.12

Red: Spivakovsky values

Values in ( ): Std dev

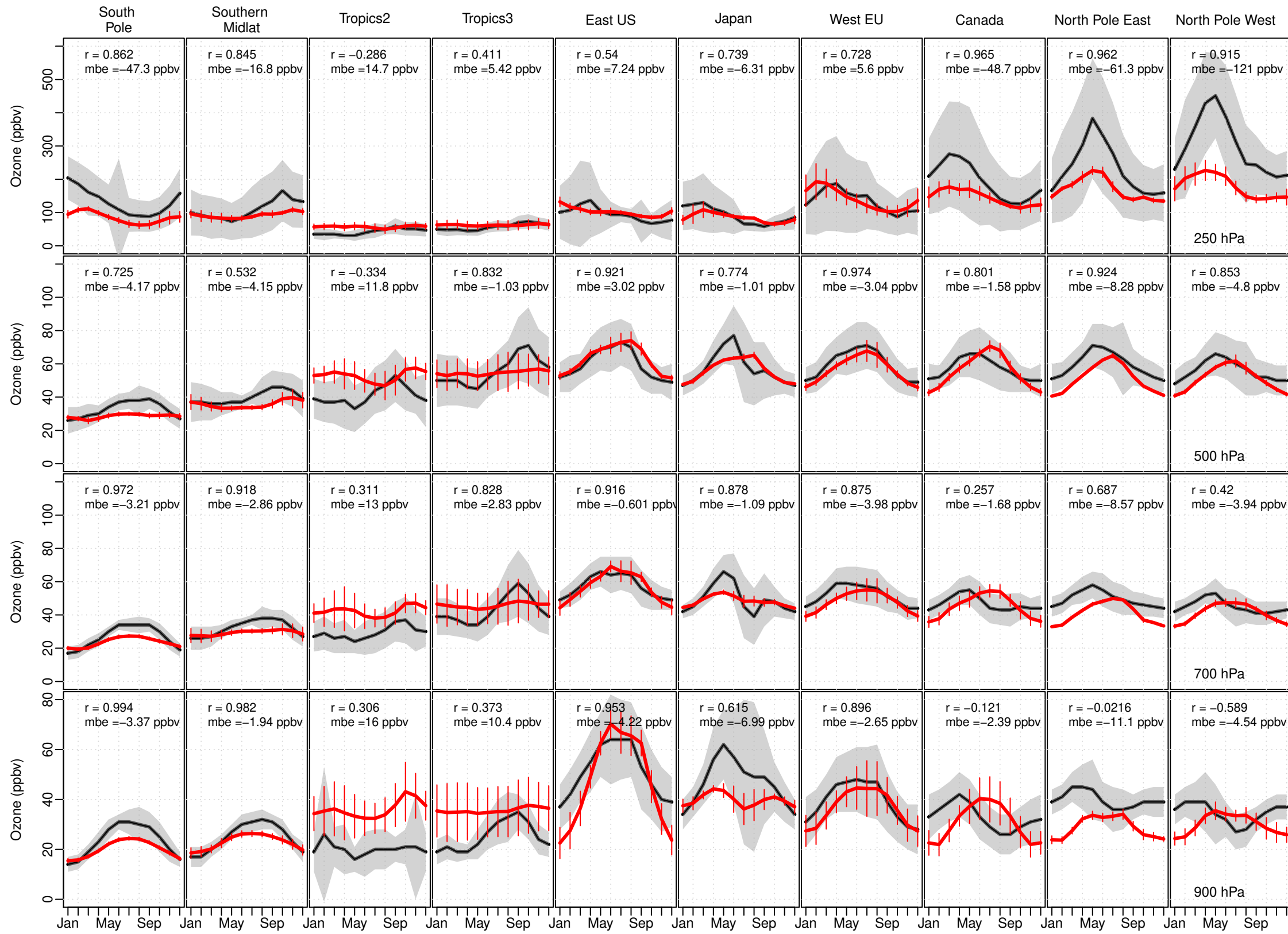
Pressure (hPa)

Latitude

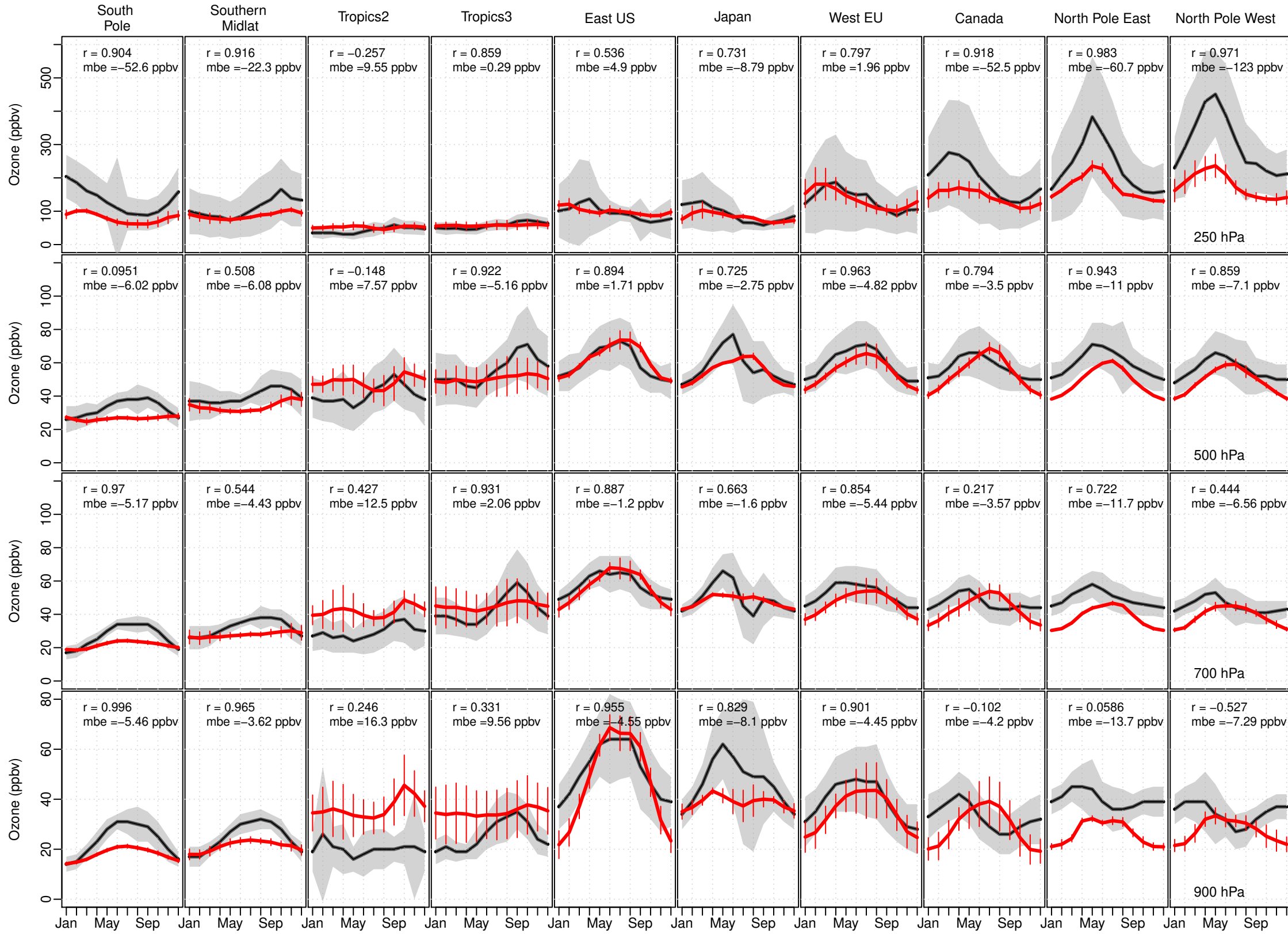




# cd037 Tilmes ozone sonde comparison



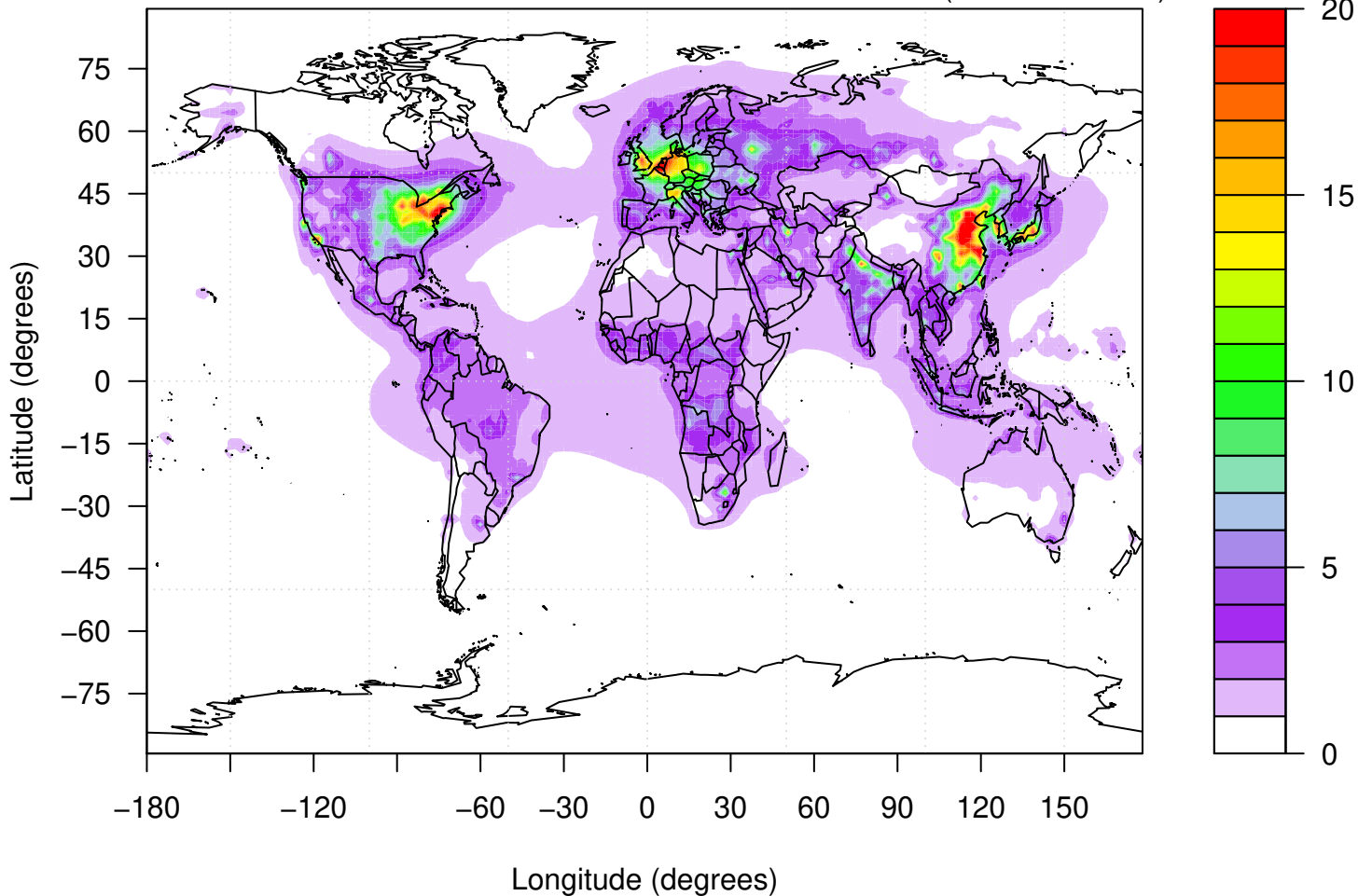
# cf821 Tilmes ozone sonde comparison



# cd037 tropospheric NO<sub>2</sub> column

Min = 0.0153 Mean = 1.17 Max = 42.8

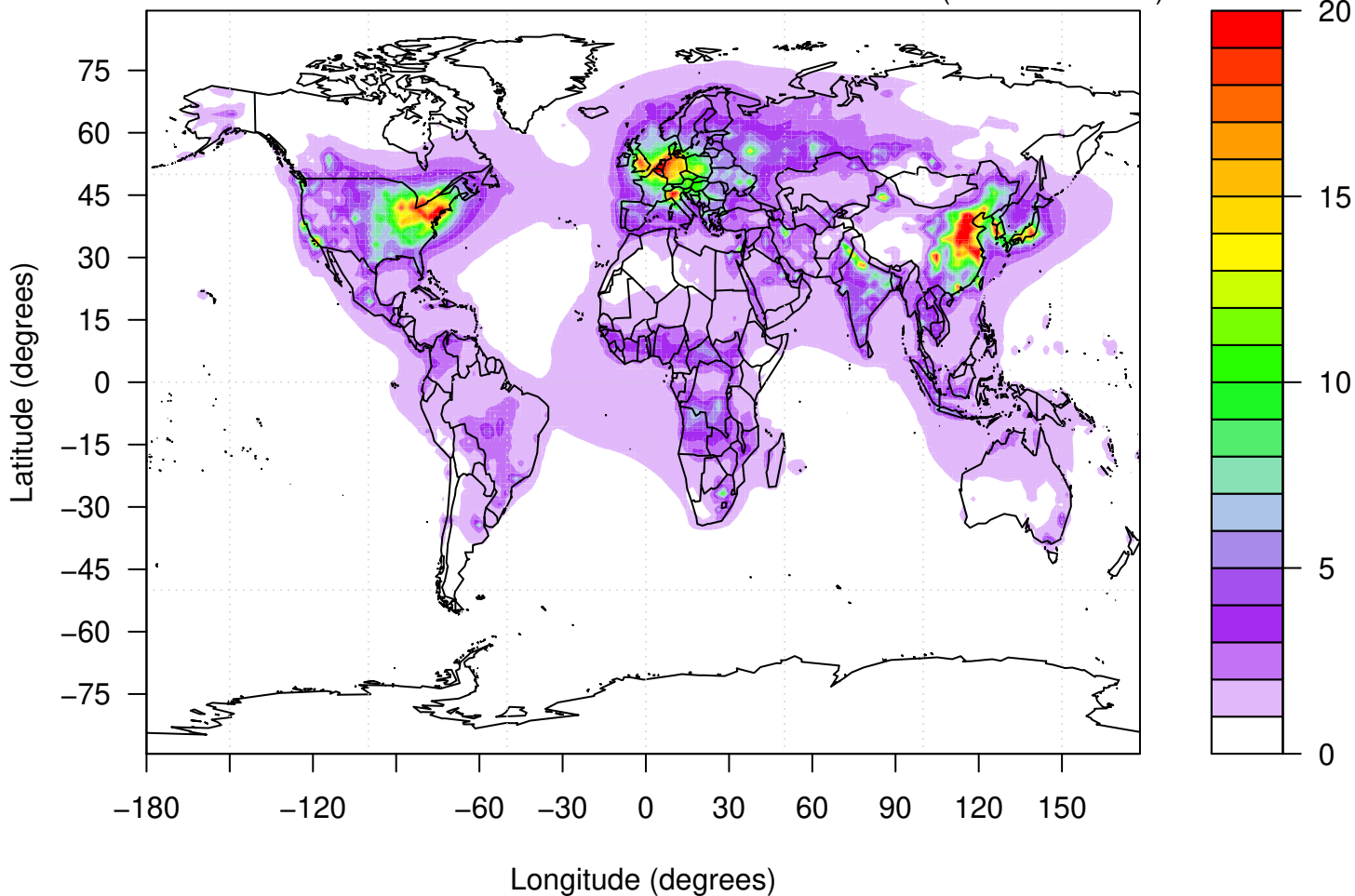
10<sup>15</sup> (molecules cm<sup>-2</sup>)



# cf821 tropospheric NO<sub>2</sub> column

Min = 0.0151 Mean = 1.14 Max = 46.2

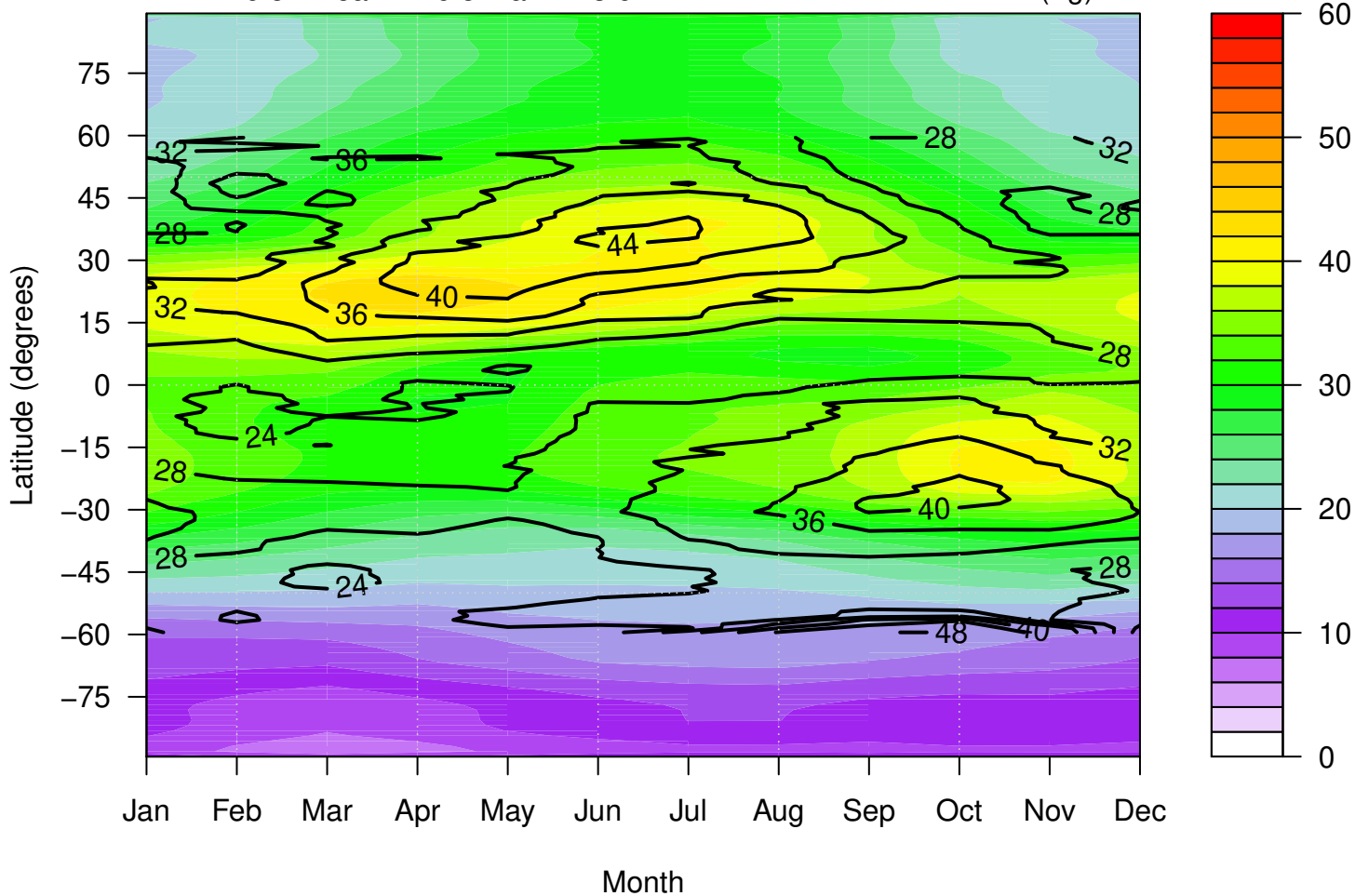
10<sup>15</sup> (molecules cm<sup>-2</sup>)



# cd037 tropospheric O<sub>3</sub> column

Min = 6.84 Mean = 26.8 Max = 43.6

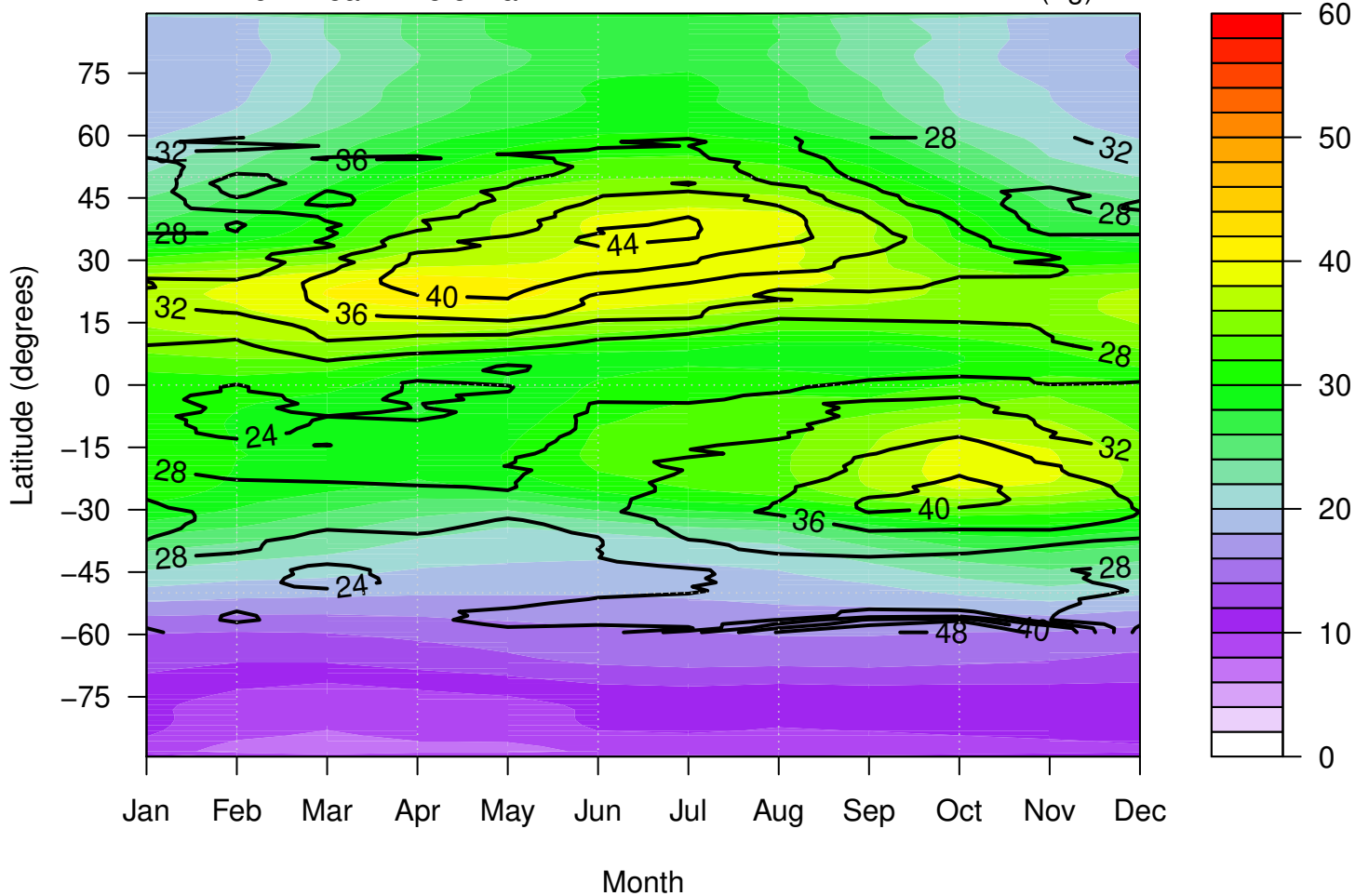
Burden (Tg) = 330



# cf821 tropospheric O<sub>3</sub> column

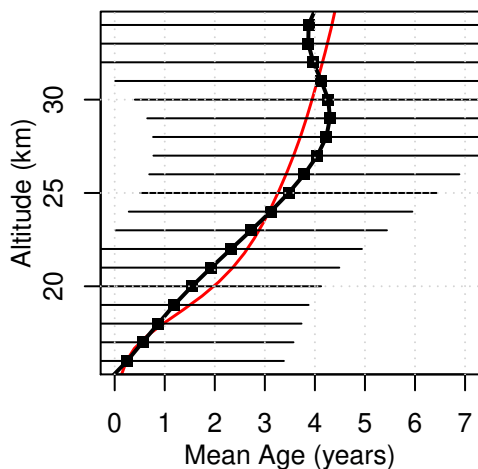
Min = 6.7 Mean = 25.5 Max = 41.2

Burden (Tg) = 314

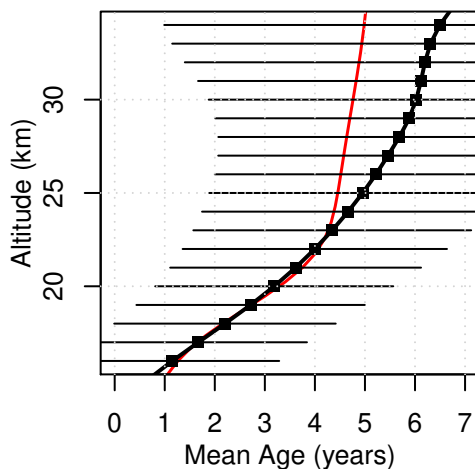


# UKCA cd037 Mean Age of Air

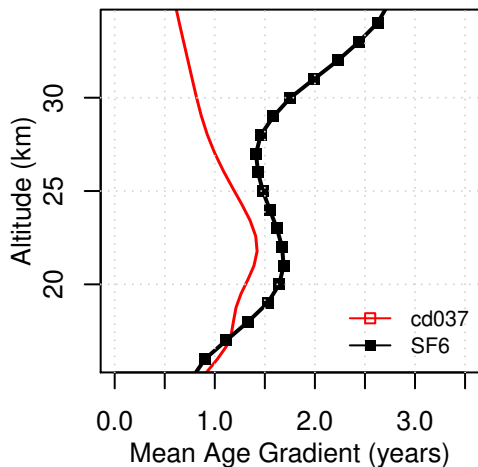
## Tropical Mean Age Profile



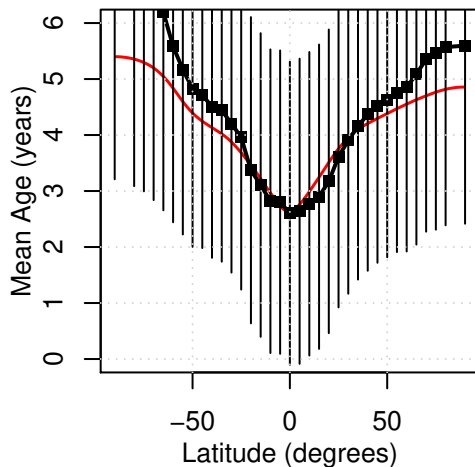
## Midlatitude Mean Age Profile



## Trop-Midlat Mean Age Gradient Prof

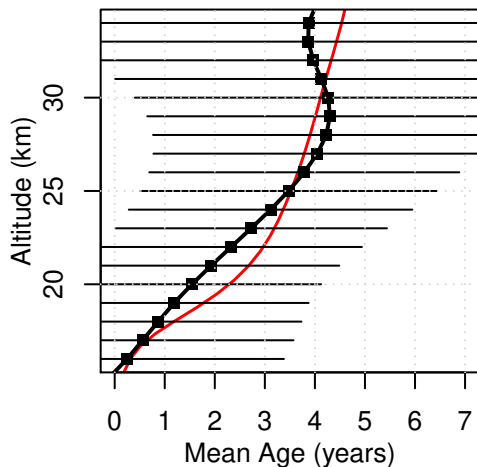


## Mean Age, 23km (~50hPa)

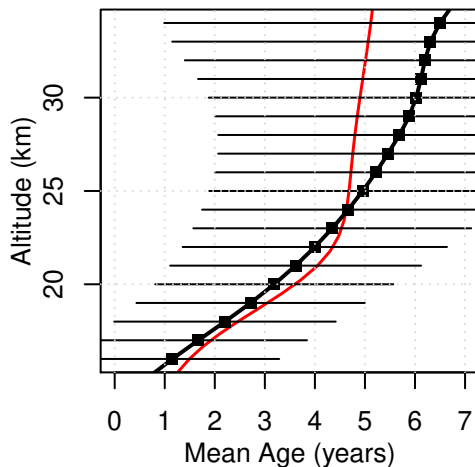


# UKCA cf821 Mean Age of Air

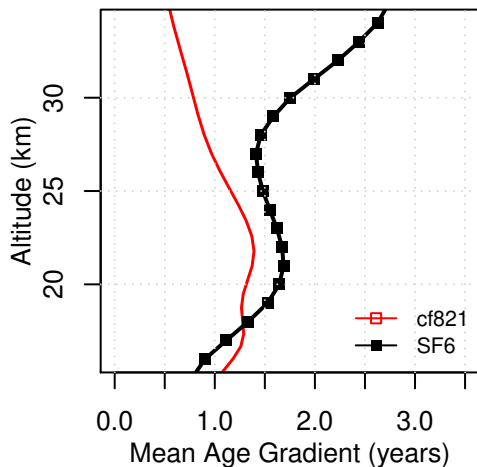
## Tropical Mean Age Profile



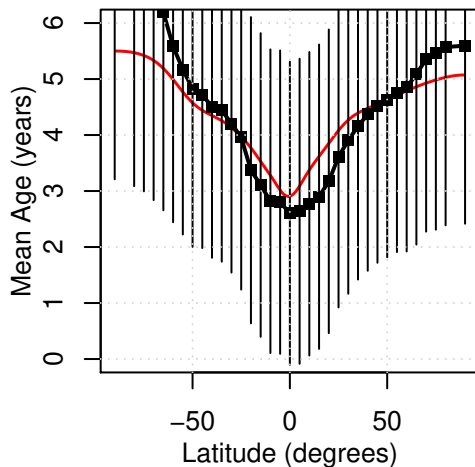
## Midlatitude Mean Age Profile



## Trop-Midlat Mean Age Gradient Prof

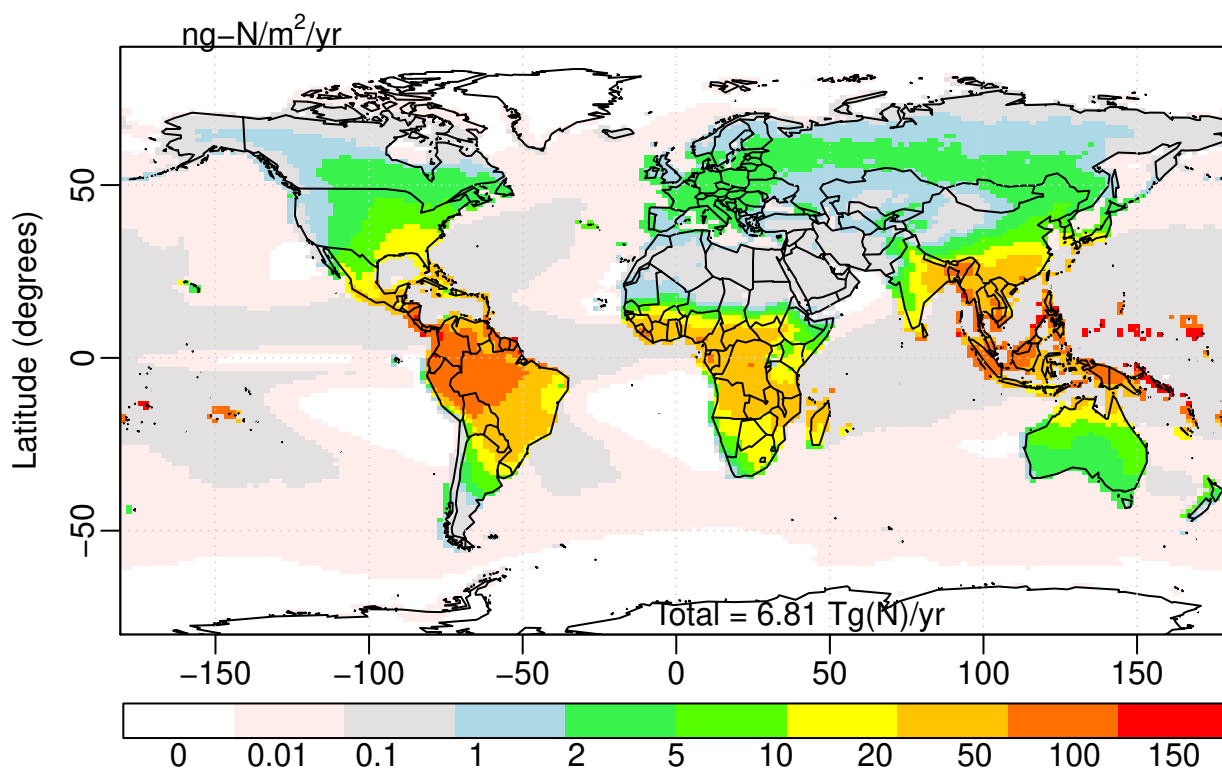


## Mean Age, 23km (~50hPa)

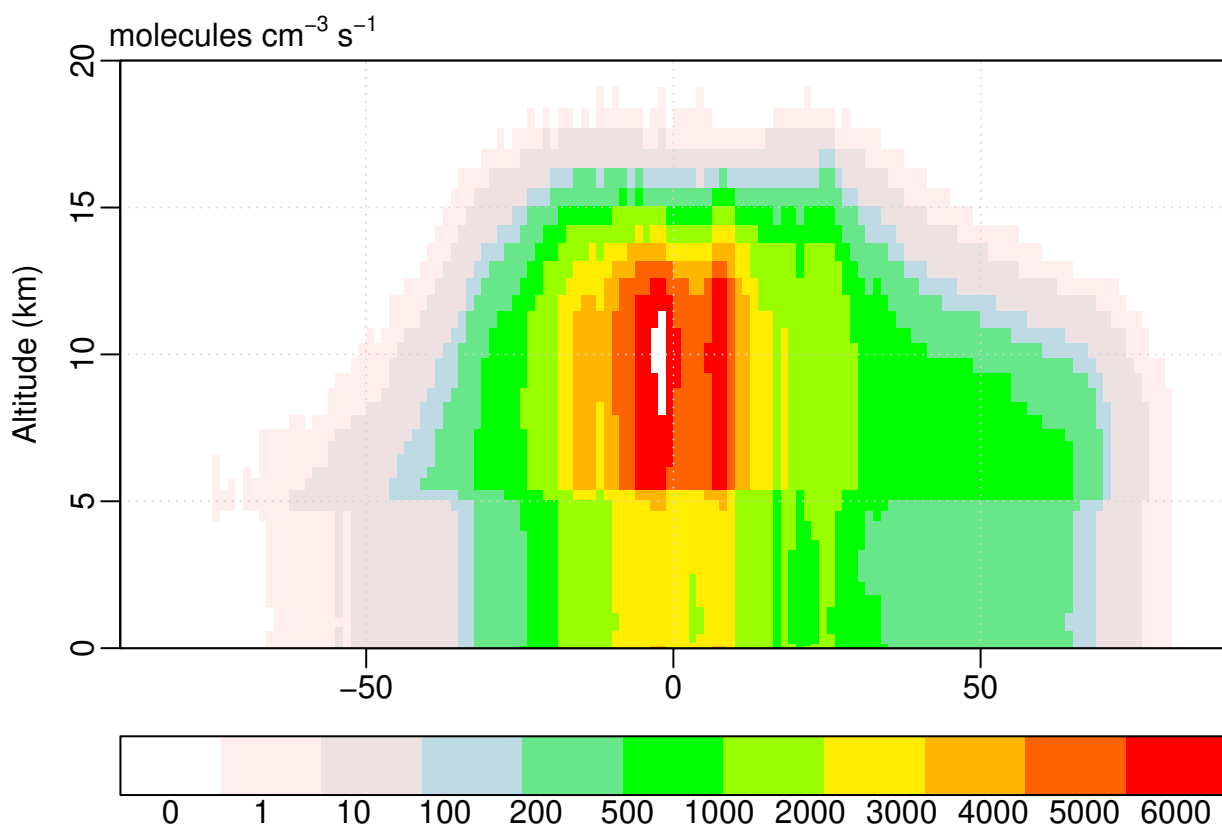




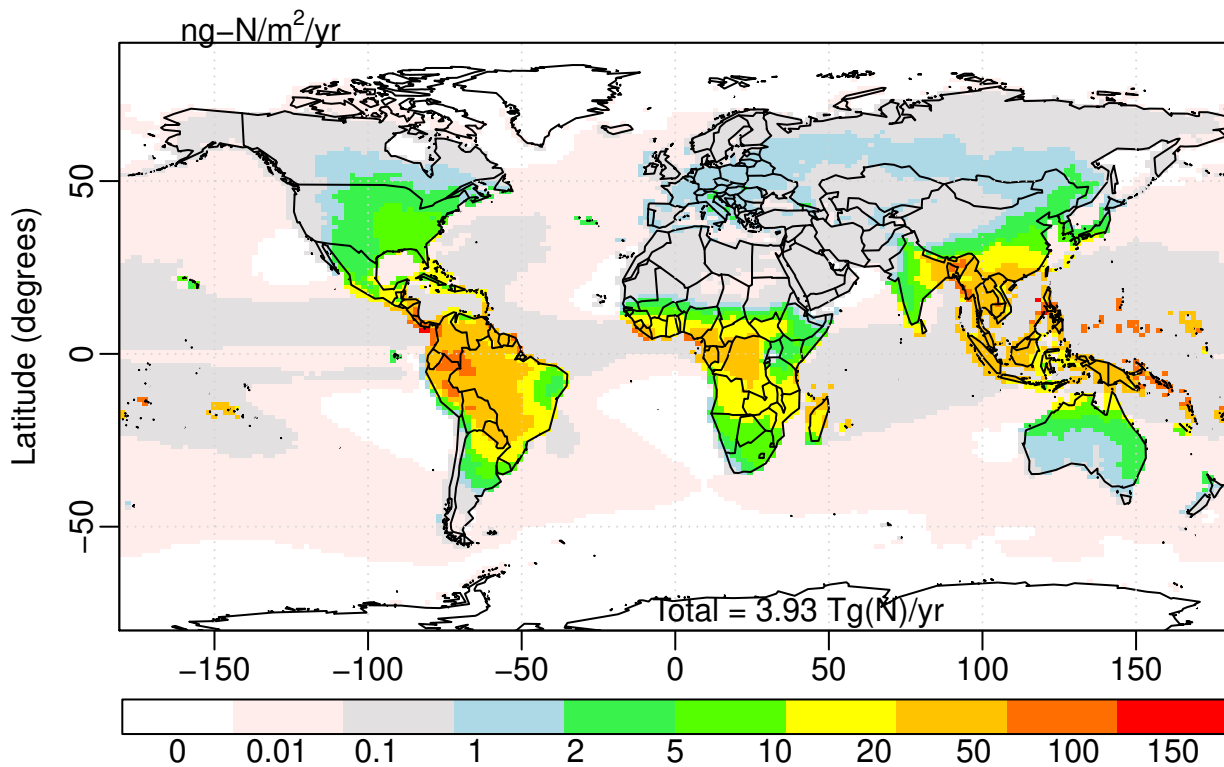
## cd037 total column



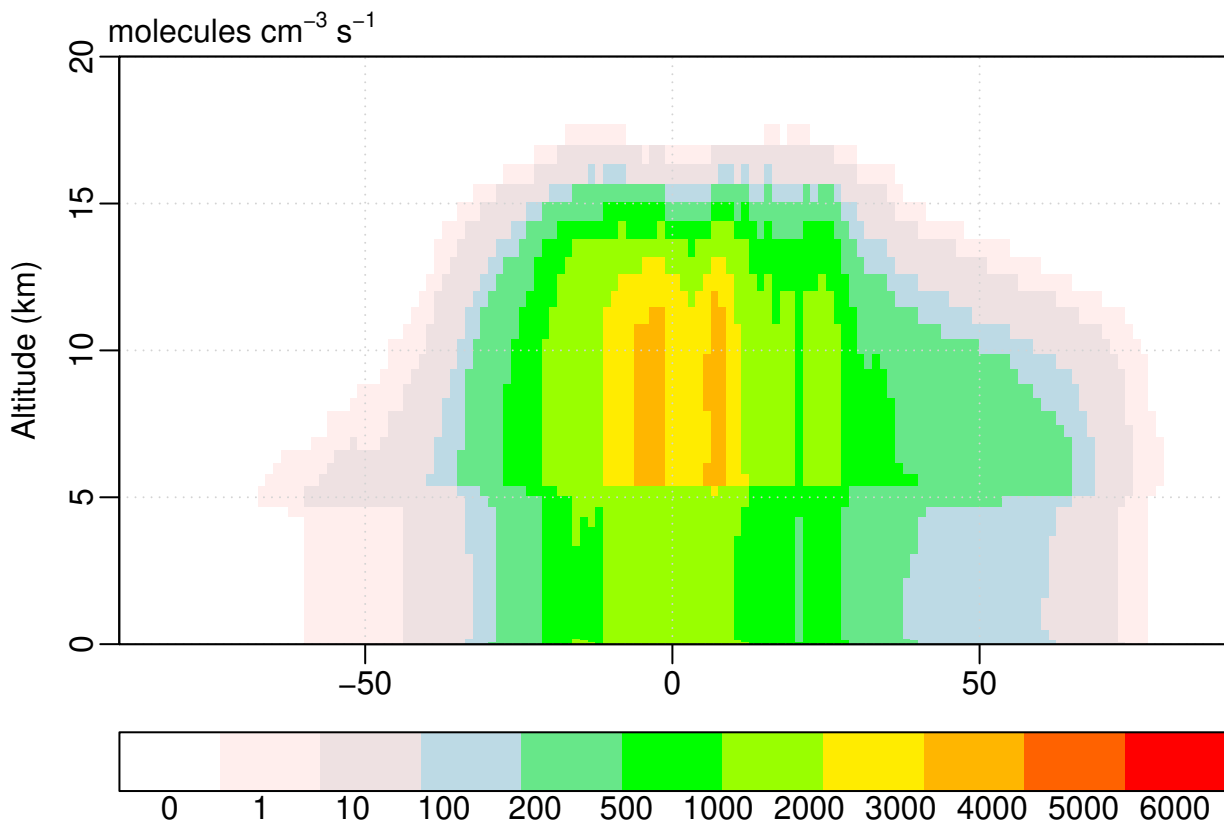
## cd037 zonal mean



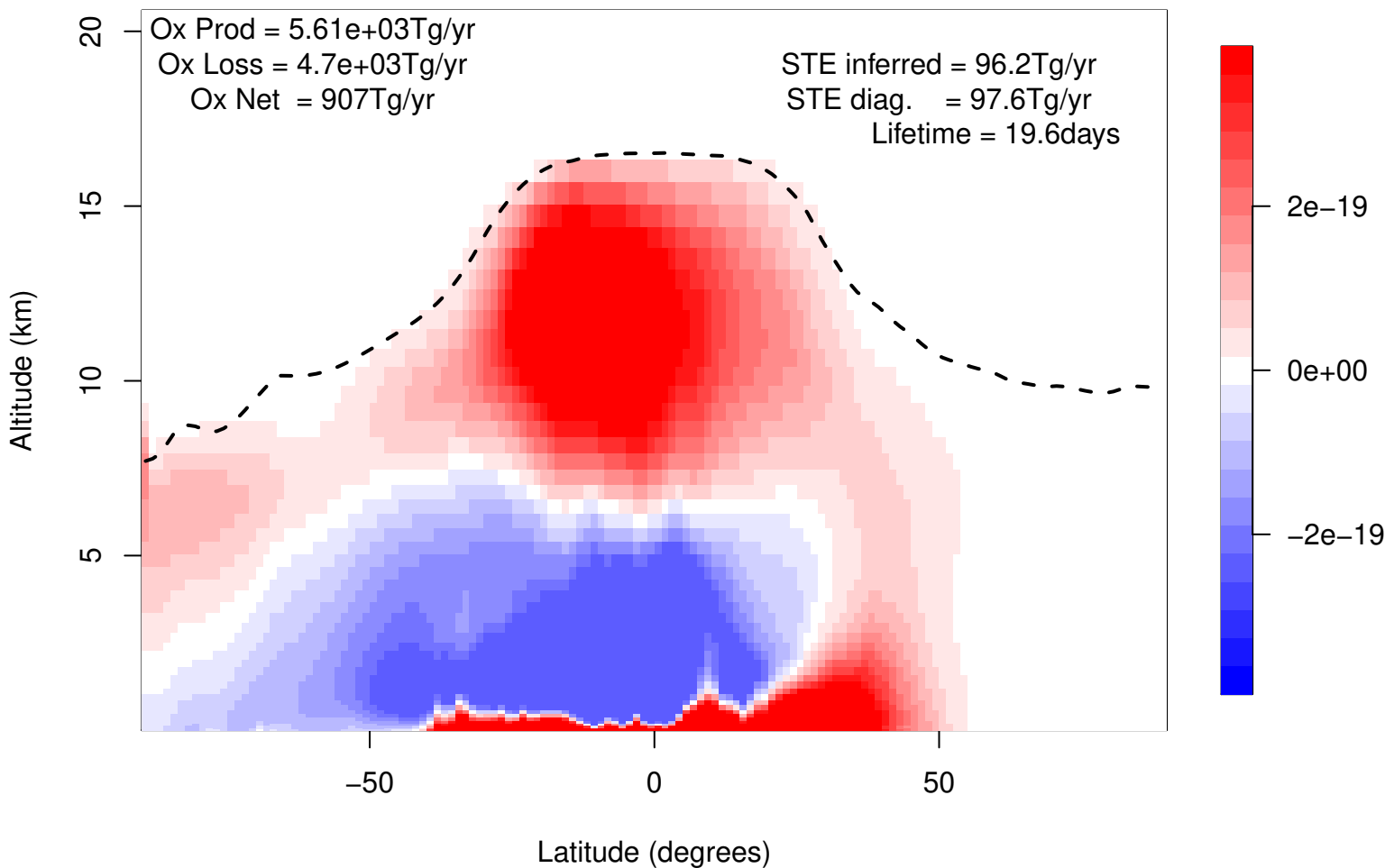
## cf821 total column



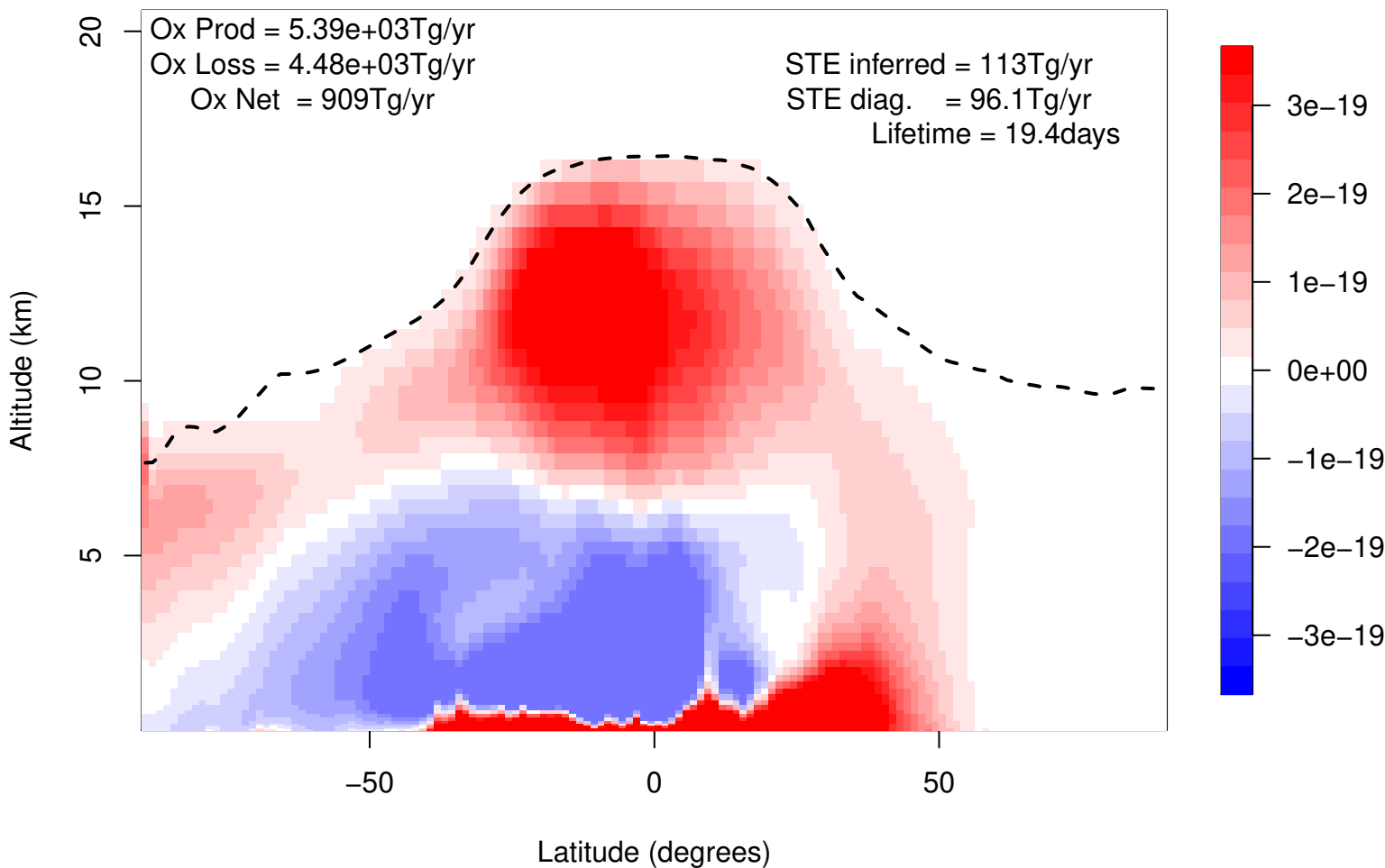
## cf821 zonal mean



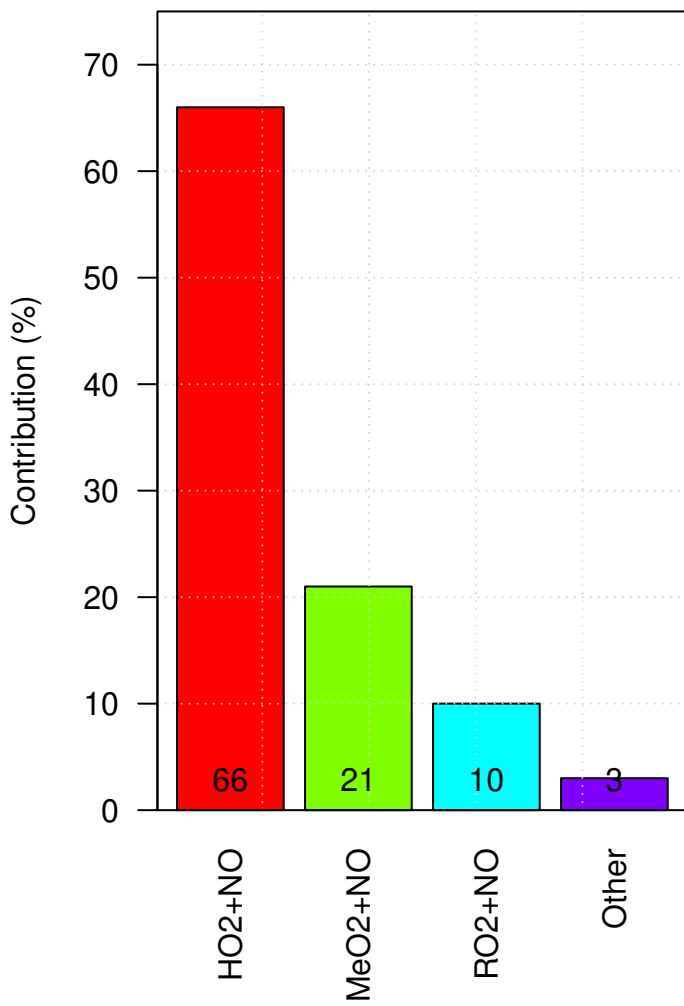
# UKCA cd037 Ox Net Chemical Production



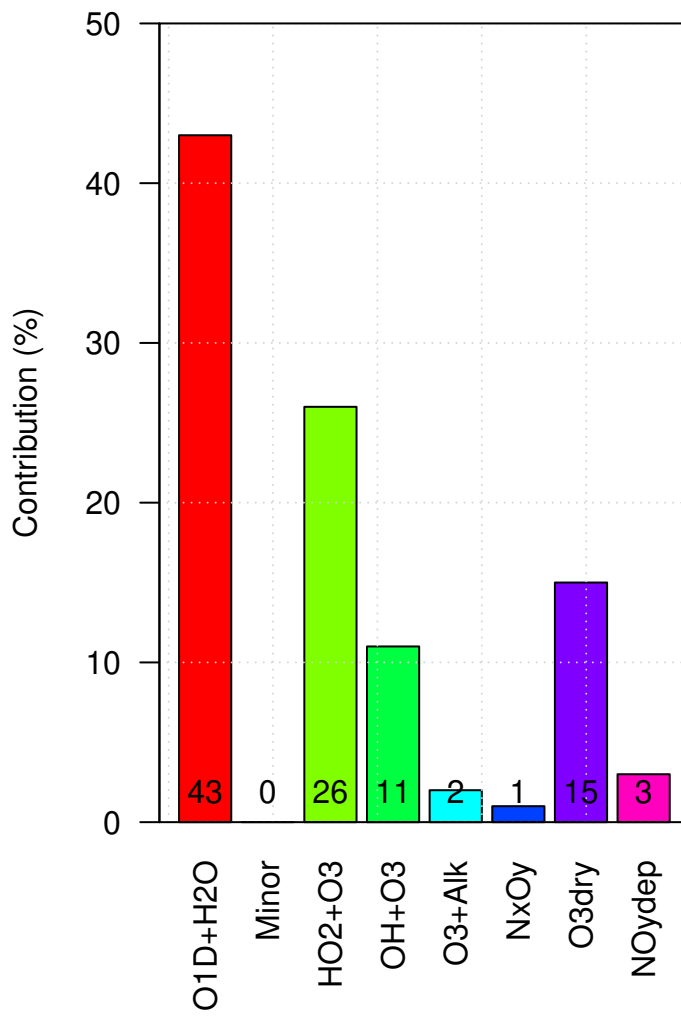
# UKCA cf821 Ox Net Chemical Production



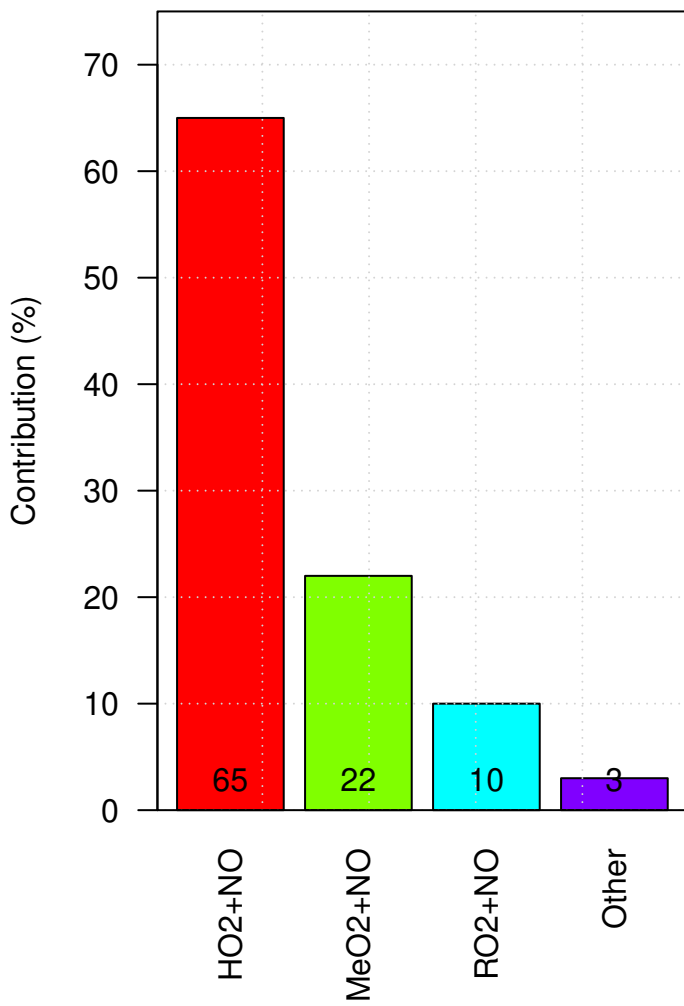
**cd037 Production of Tropospheric Ox**



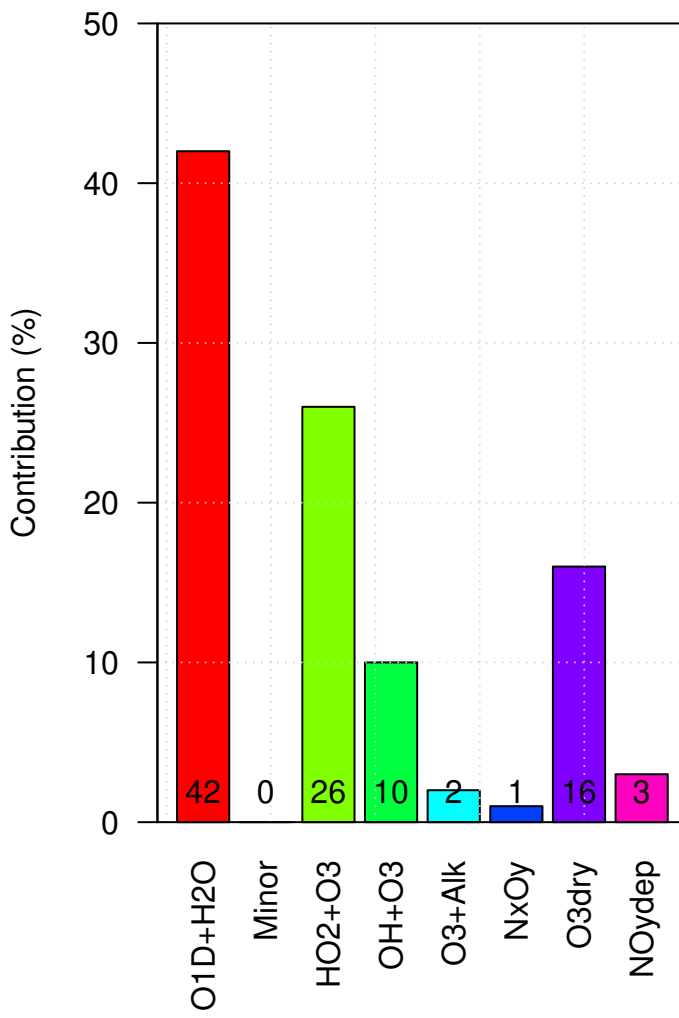
**cd037 Loss of Tropospheric Ox**



**cf821 Production of Tropospheric Ox**

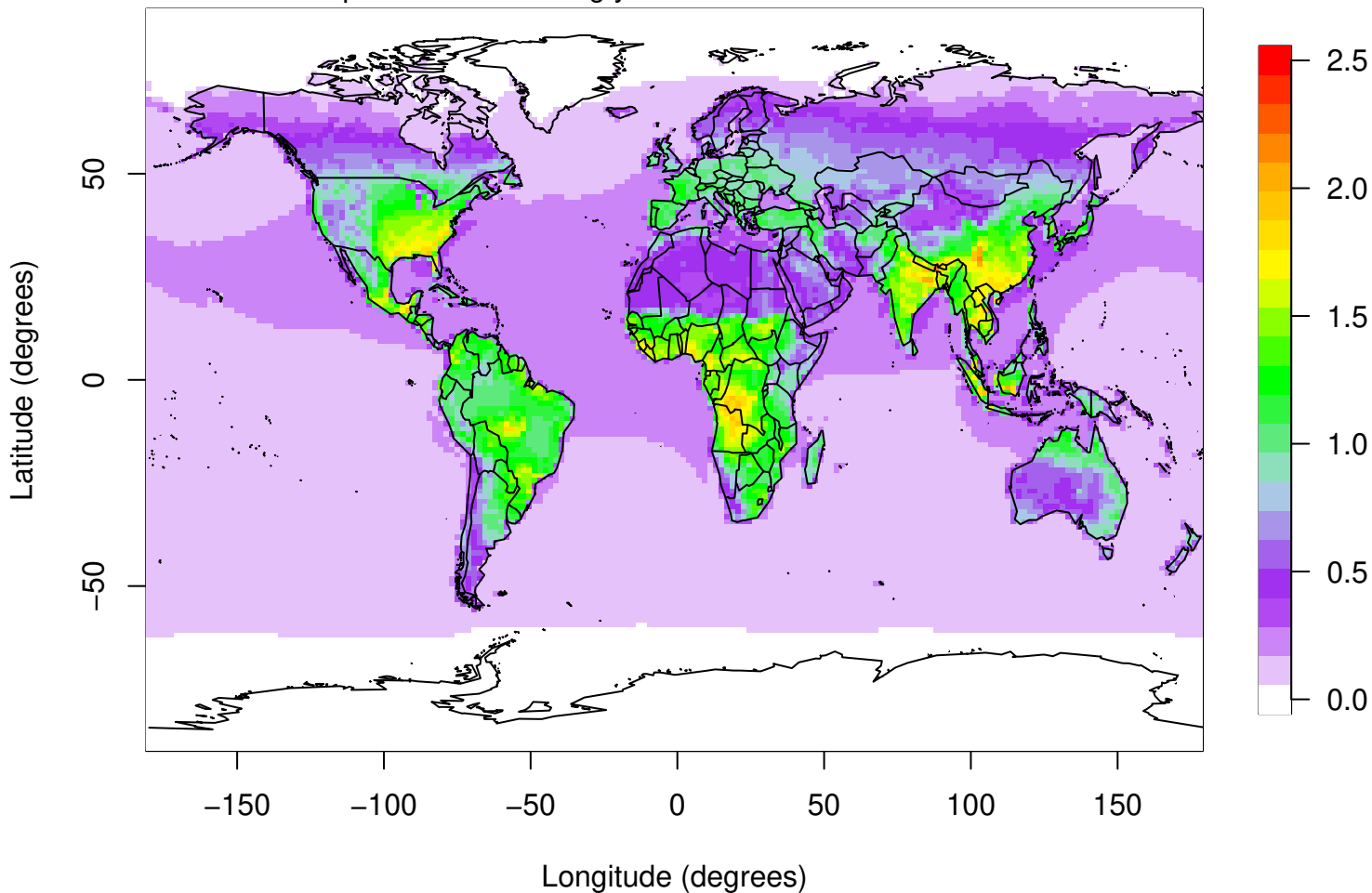


**cf821 Loss of Tropospheric Ox**



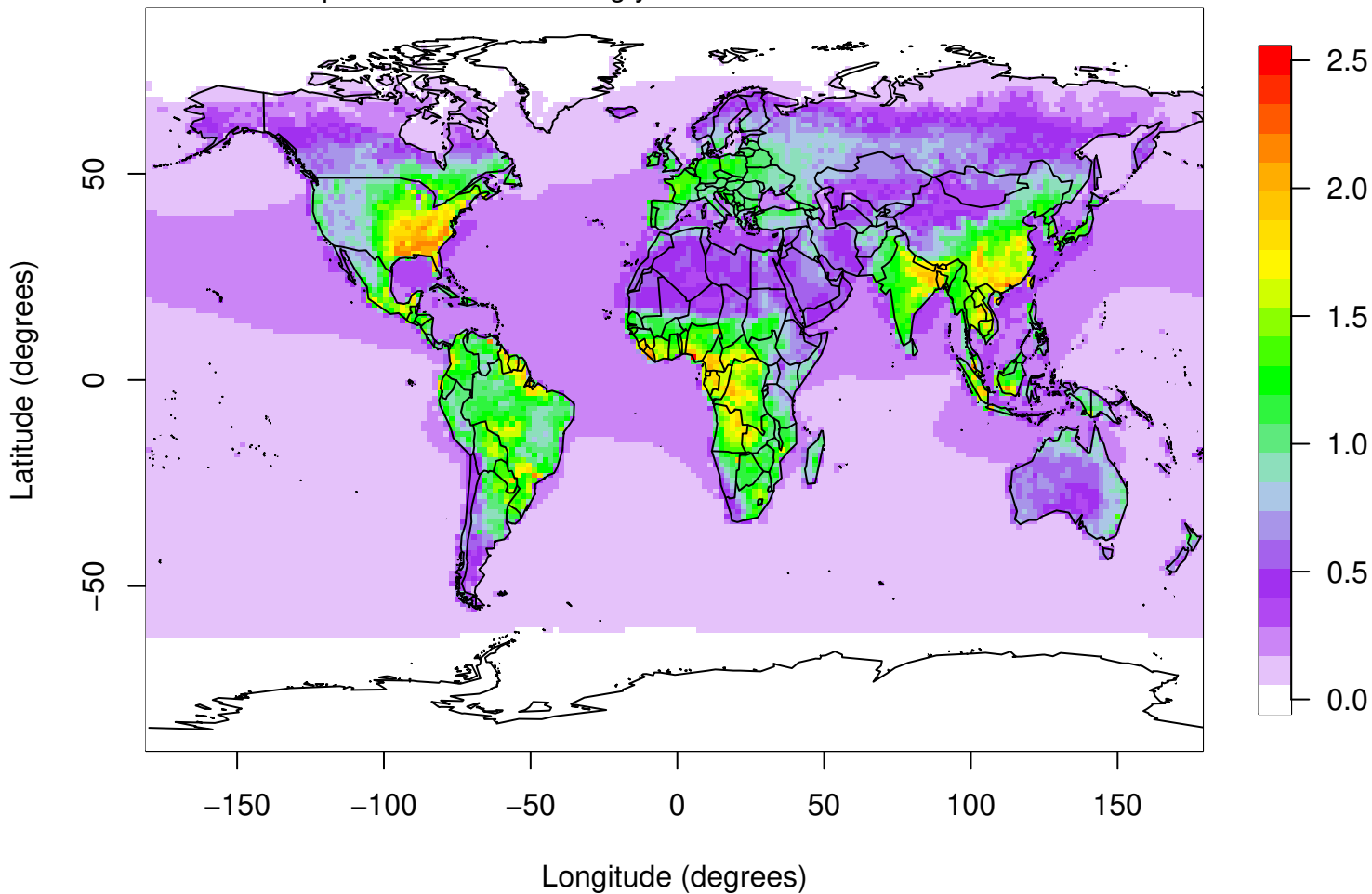
# UKCA Ox deposition cd037

Total Ox Deposition =  $1\text{e}+03$  Tg/yr

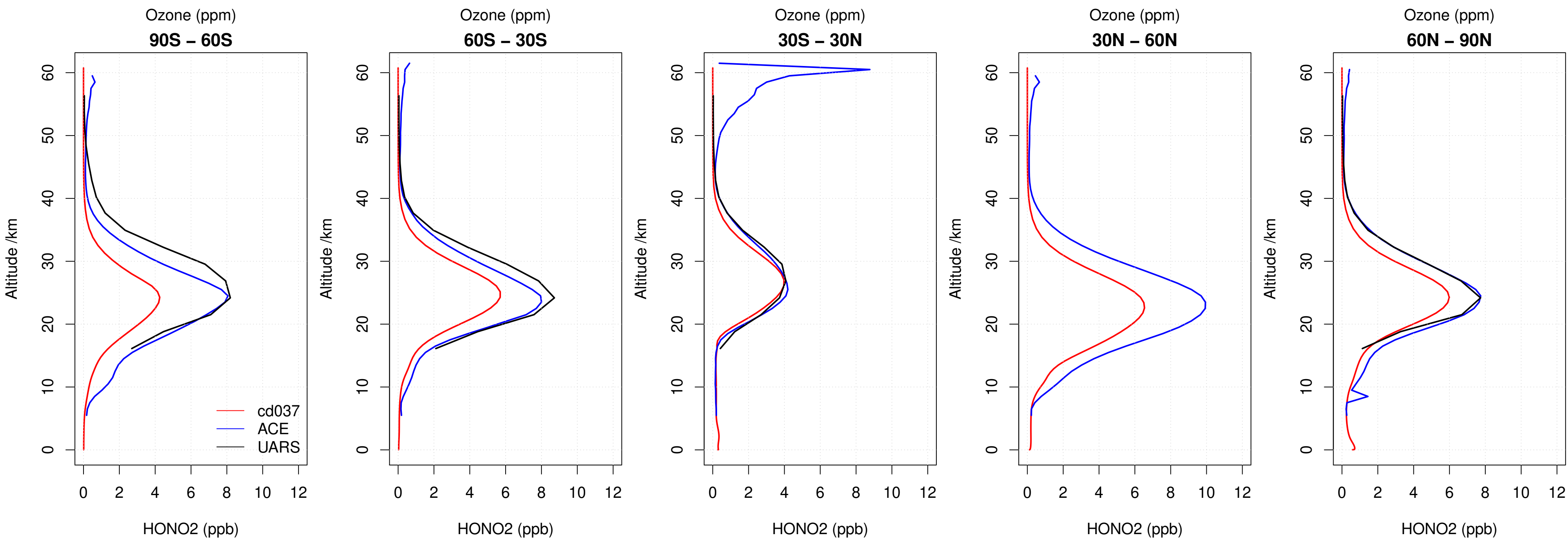
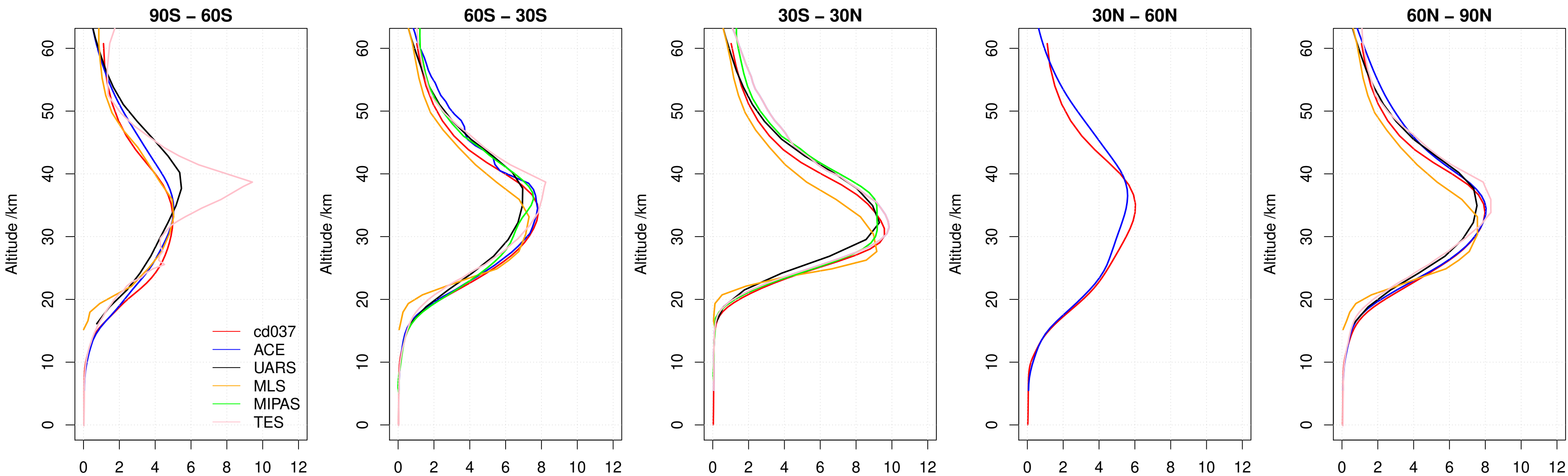


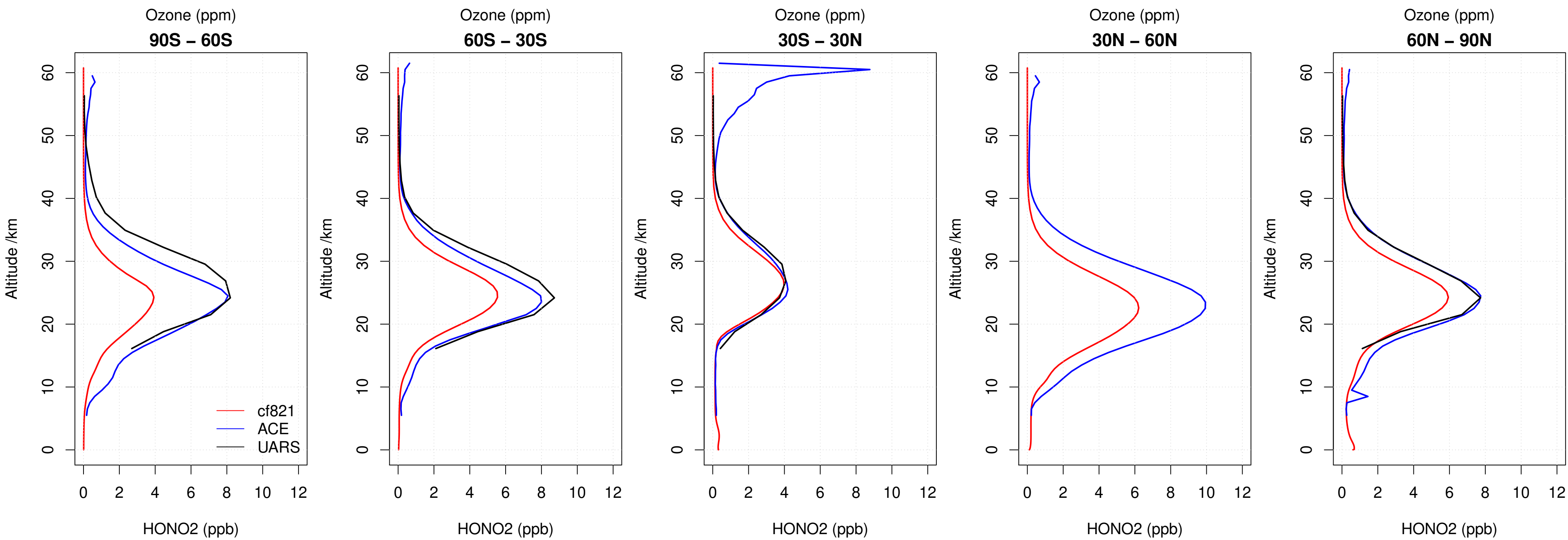
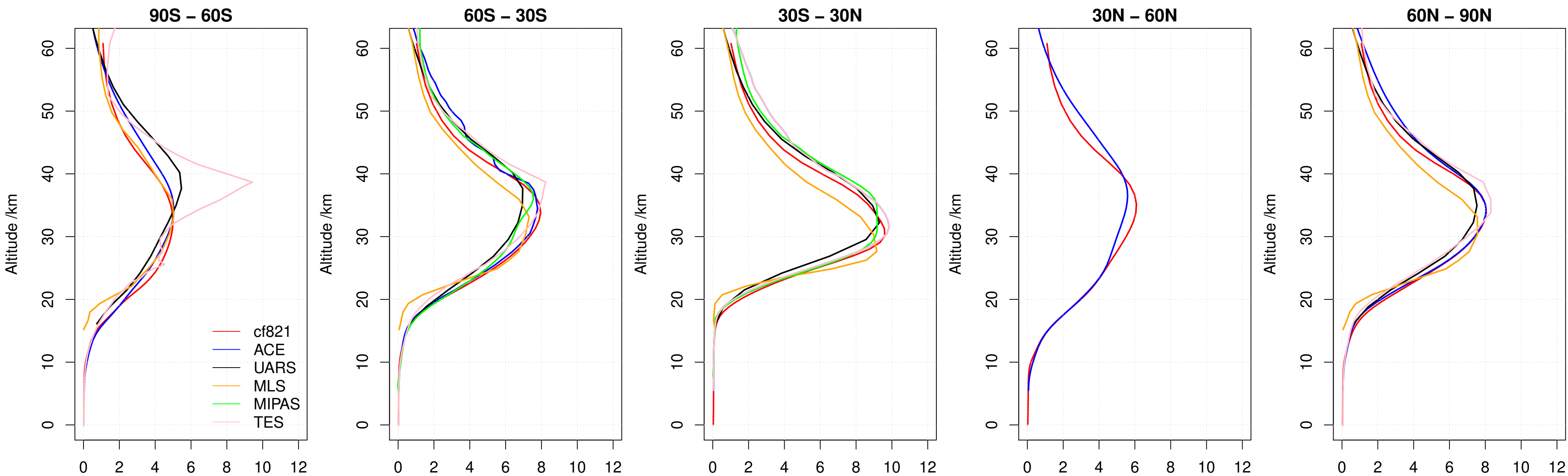
# UKCA Ox deposition cf821

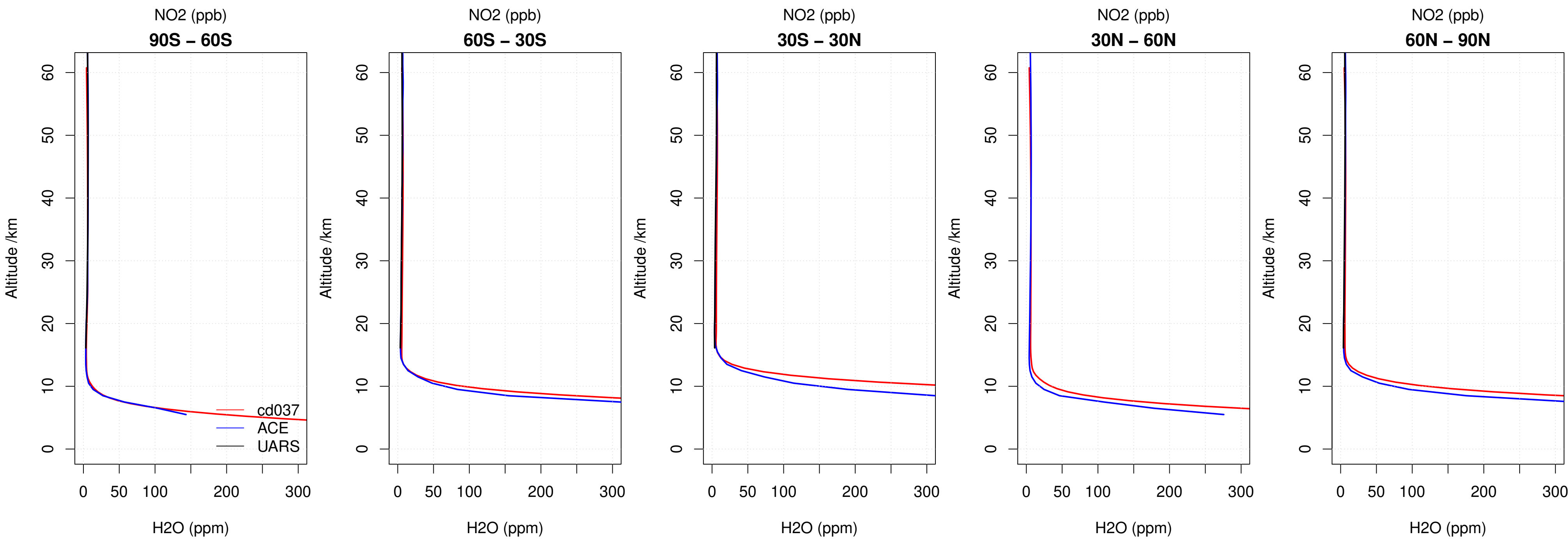
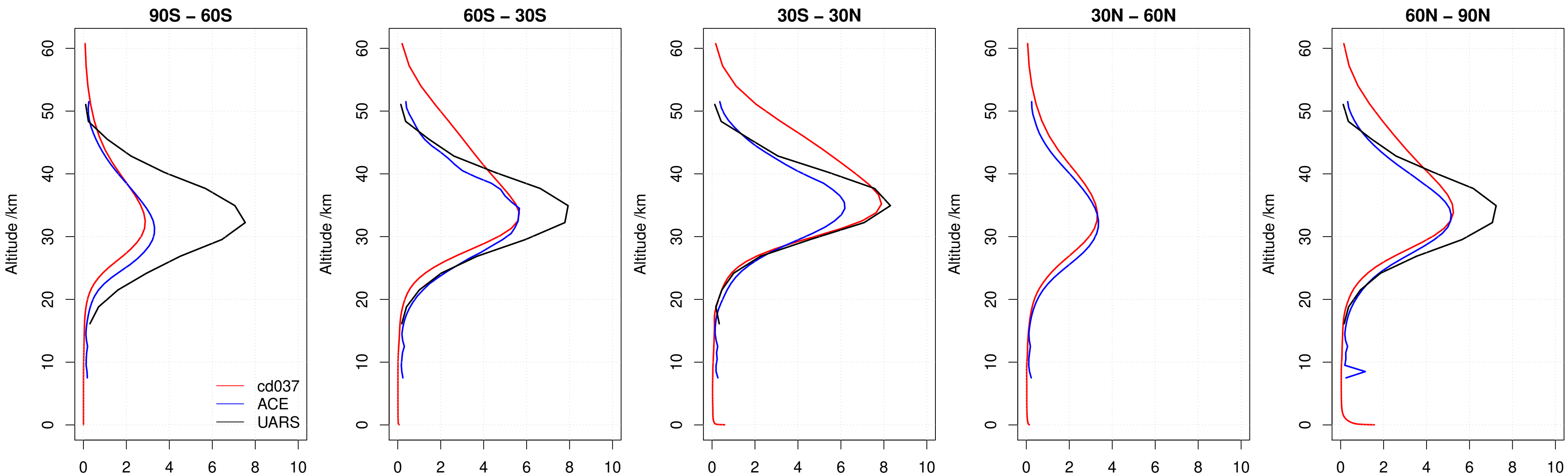
Total Ox Deposition =  $1.02\text{e}+03$  Tg/yr

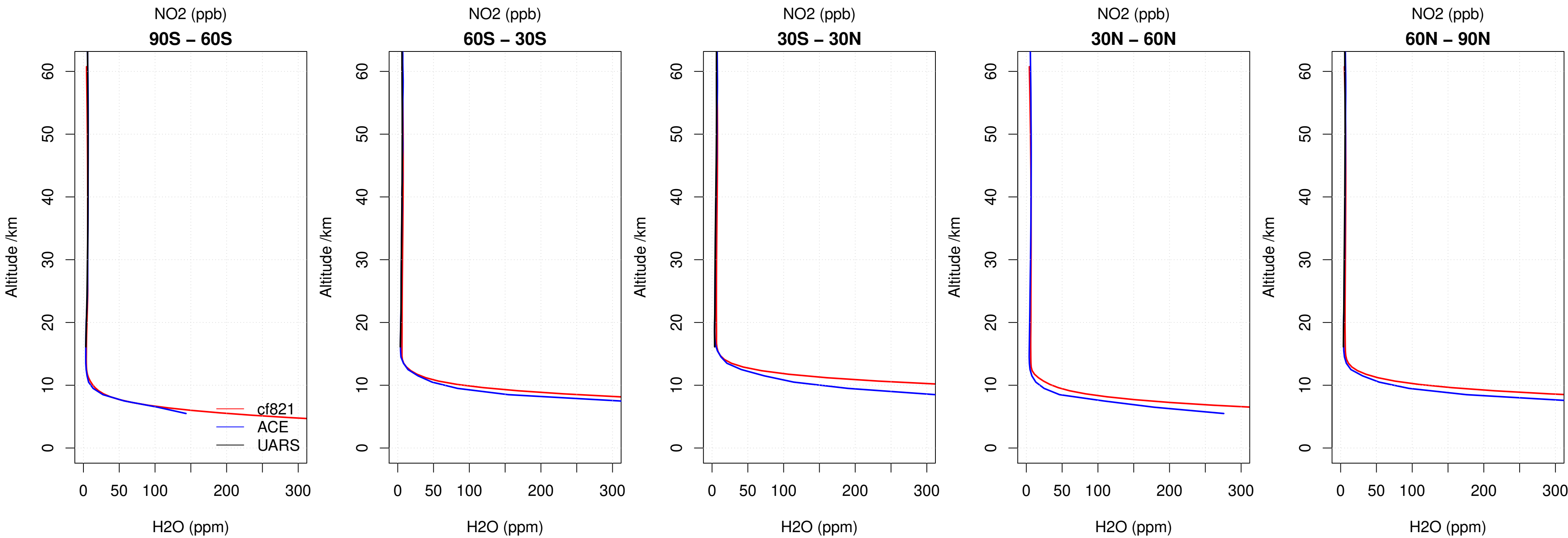
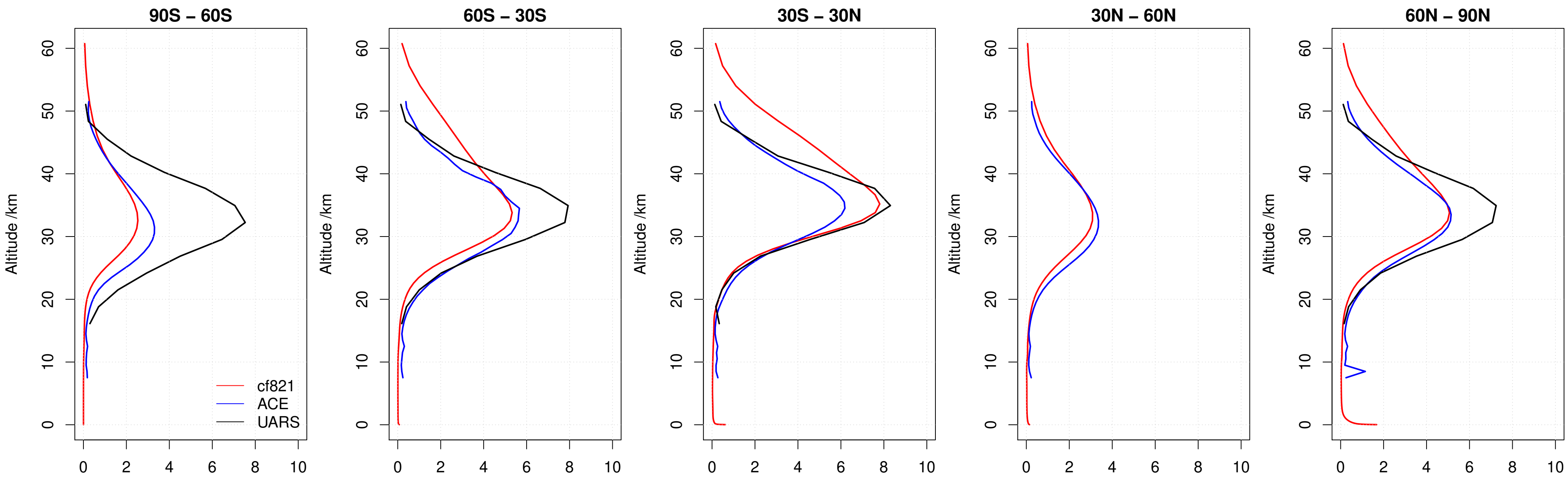




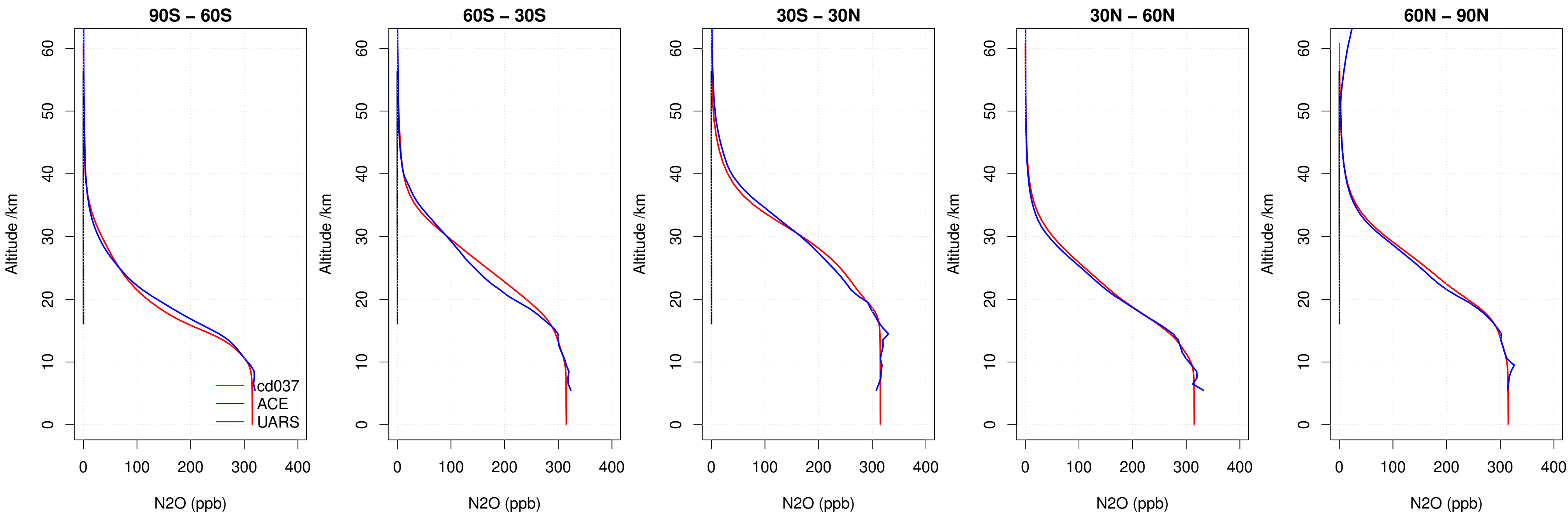




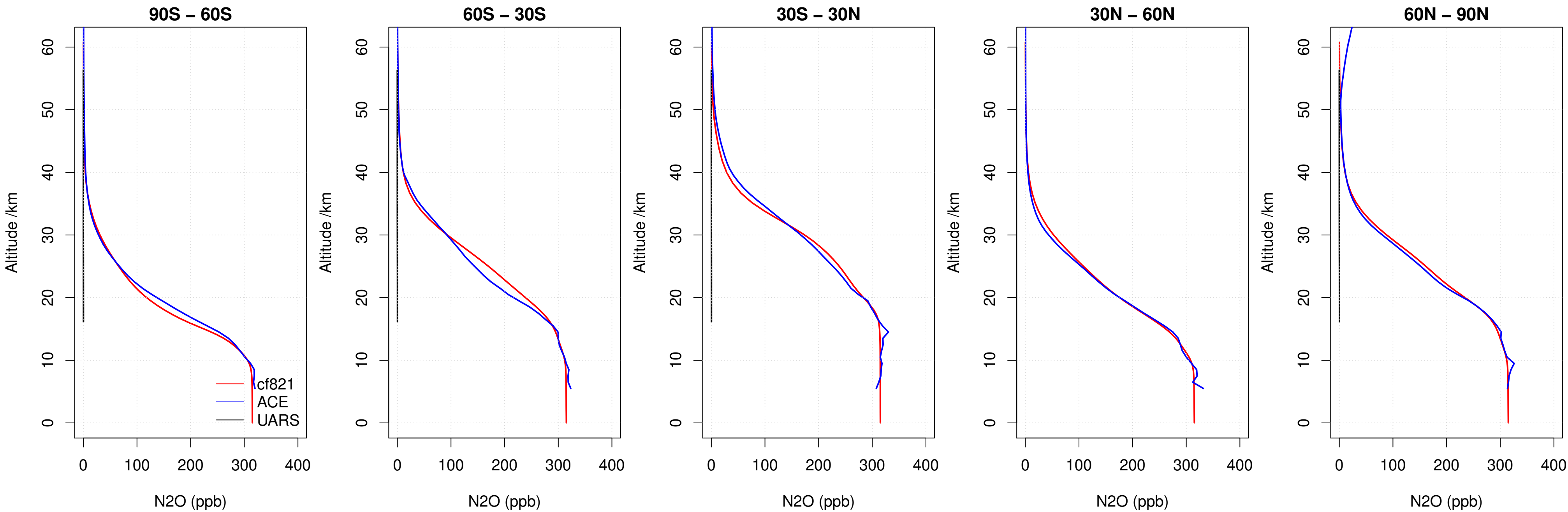






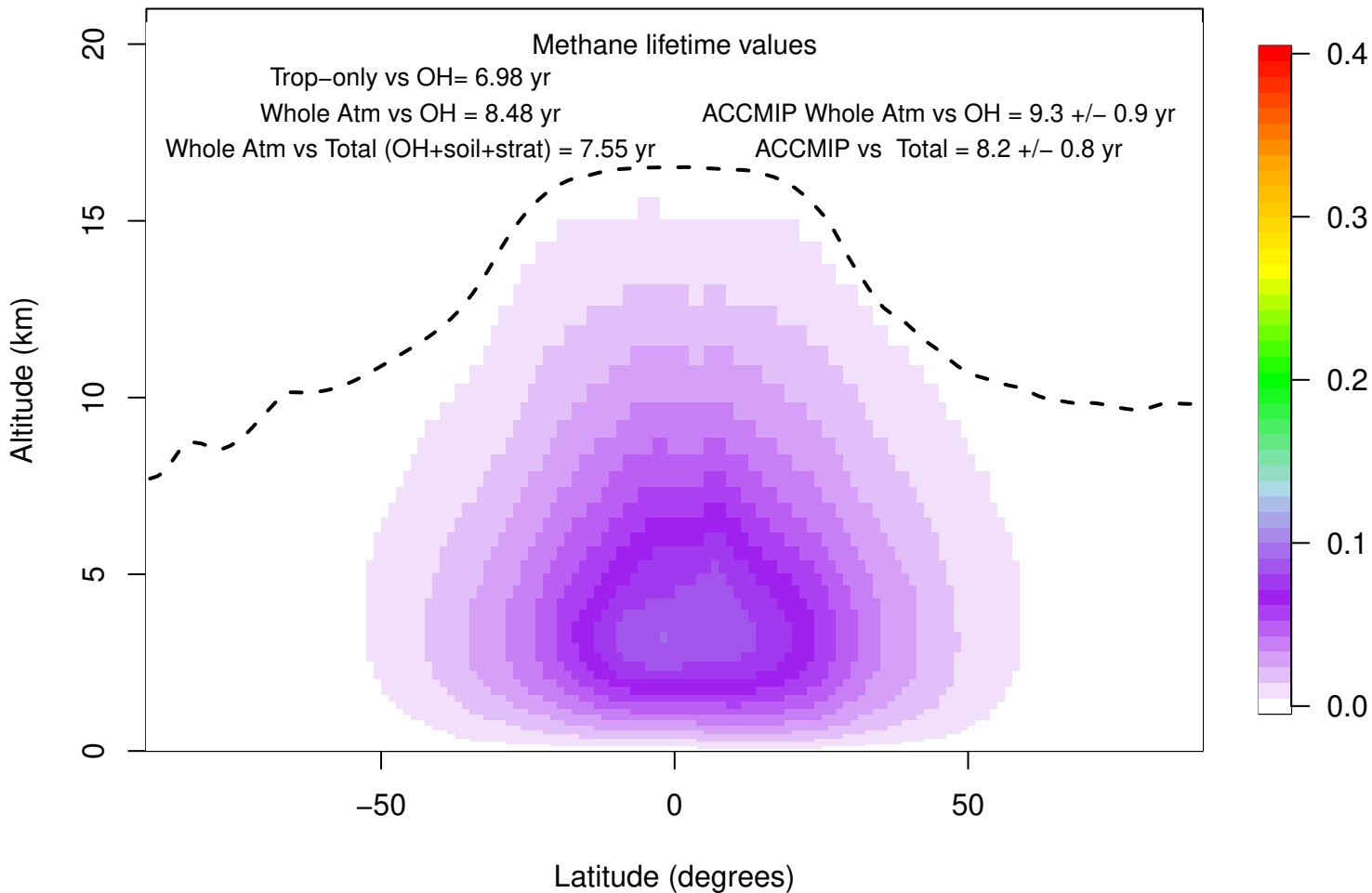






# UKCA cd037

% CH<sub>4</sub> + OH flux (moles cm<sup>-3</sup> s<sup>-1</sup>)



# UKCA cf821

% CH<sub>4</sub> + OH flux (moles cm<sup>-3</sup> s<sup>-1</sup>)

