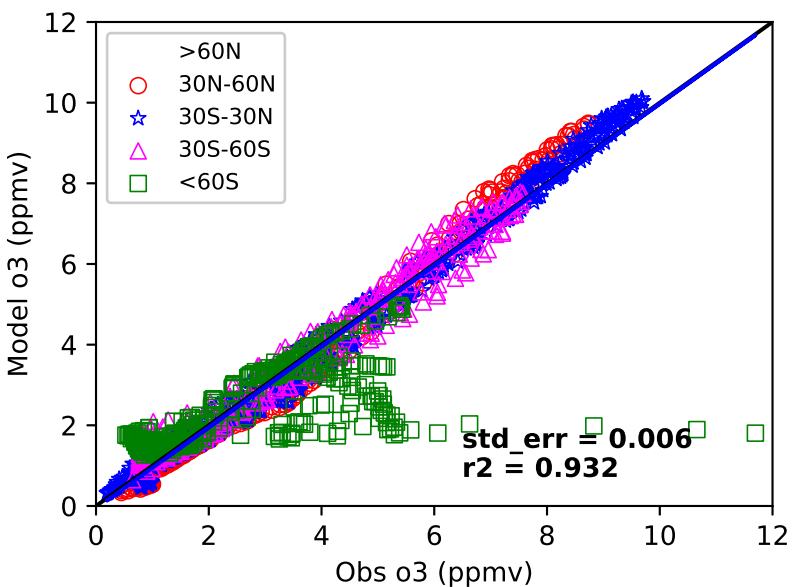
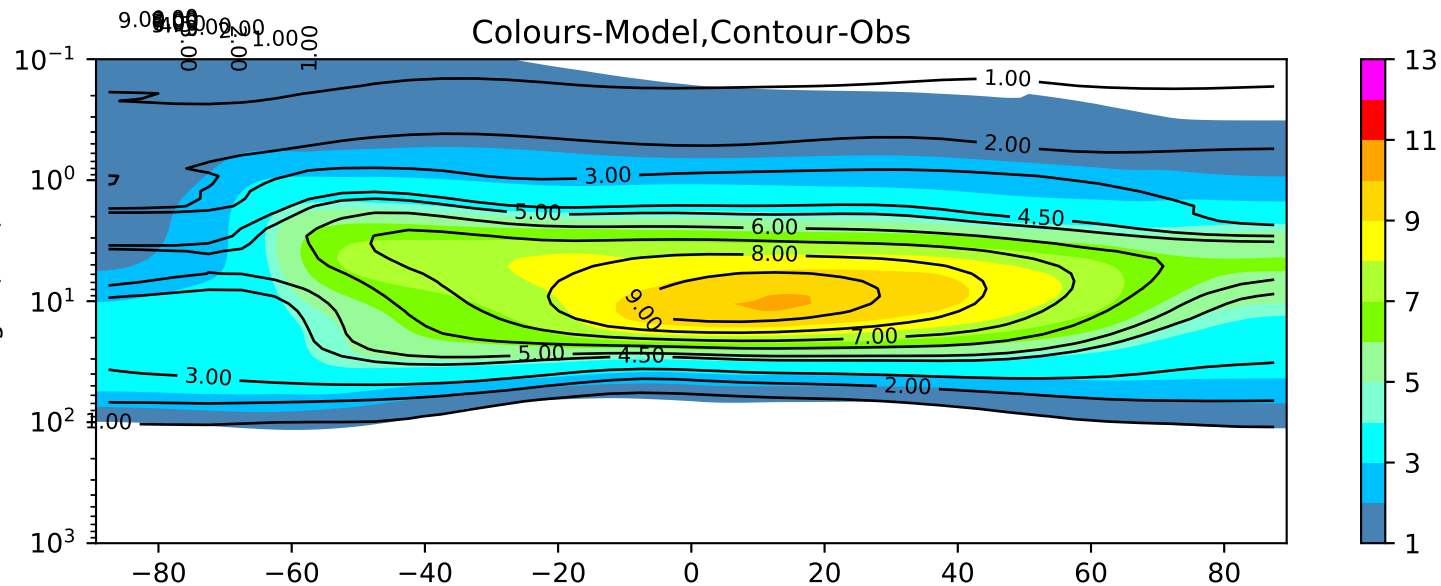
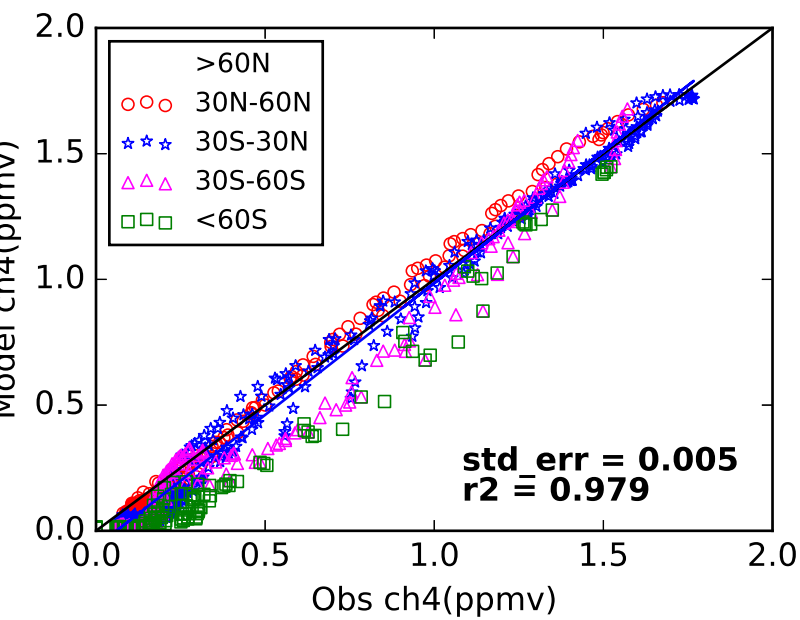
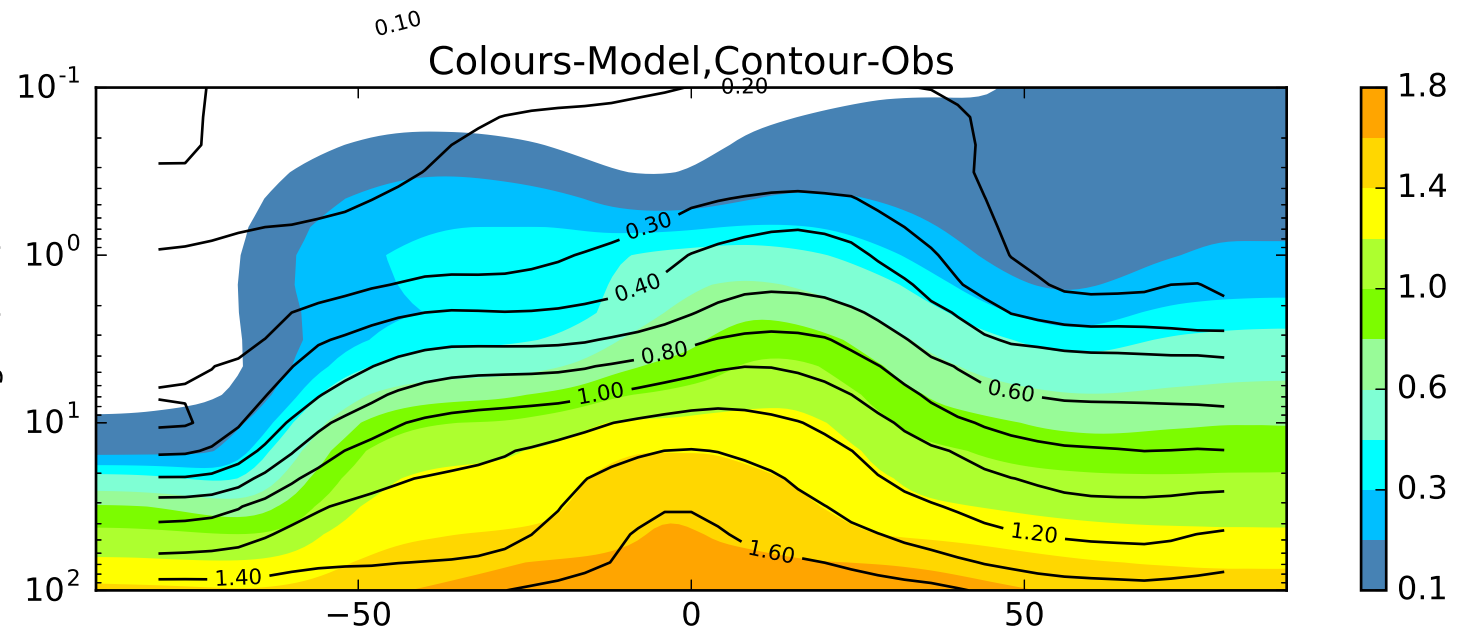


UKCA bo717 vs NIWA-CCMVal:  
O3 (ppmv) Jul

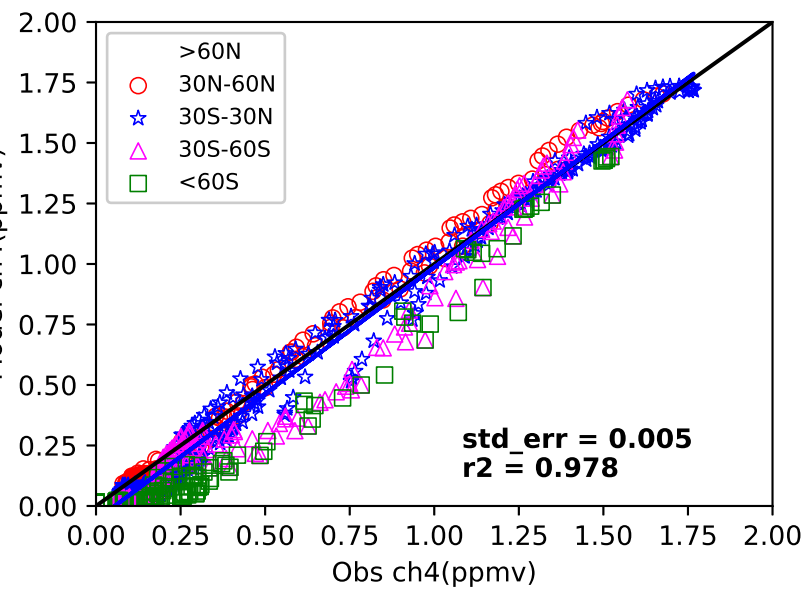
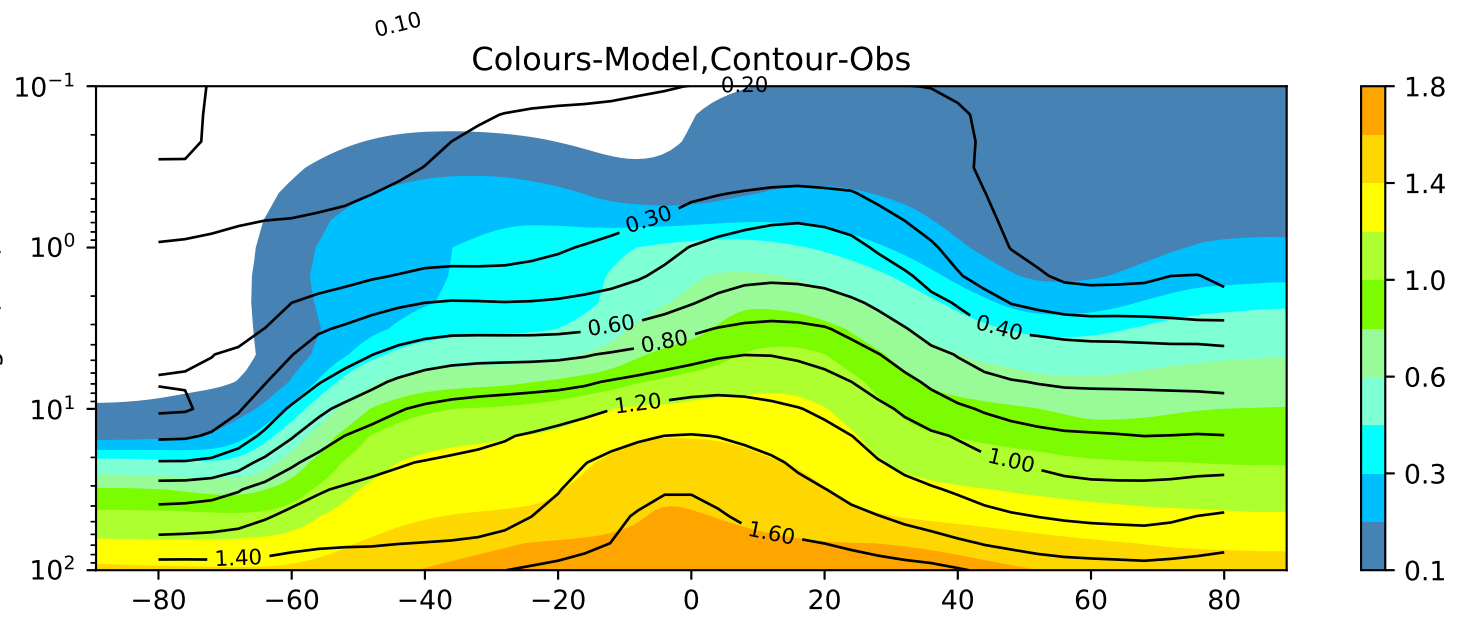
Colours-Model,Contour-Obs



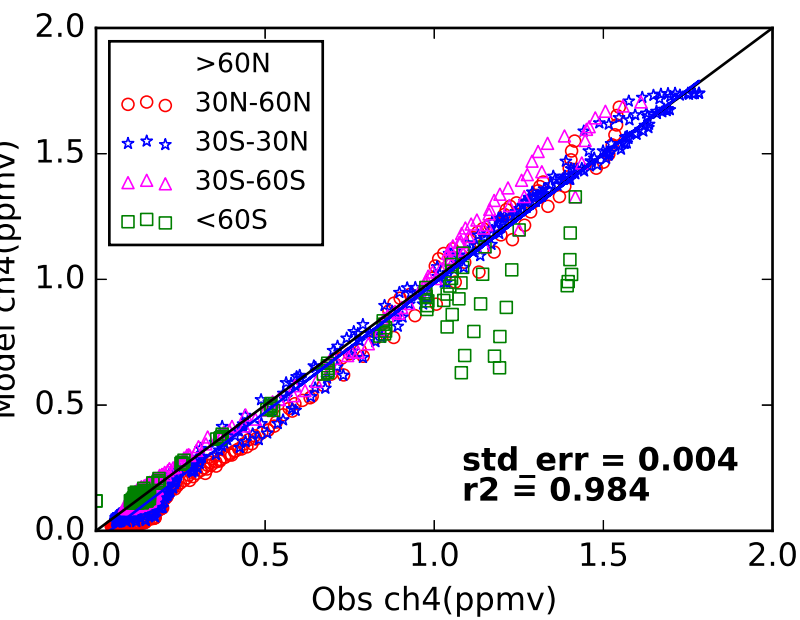
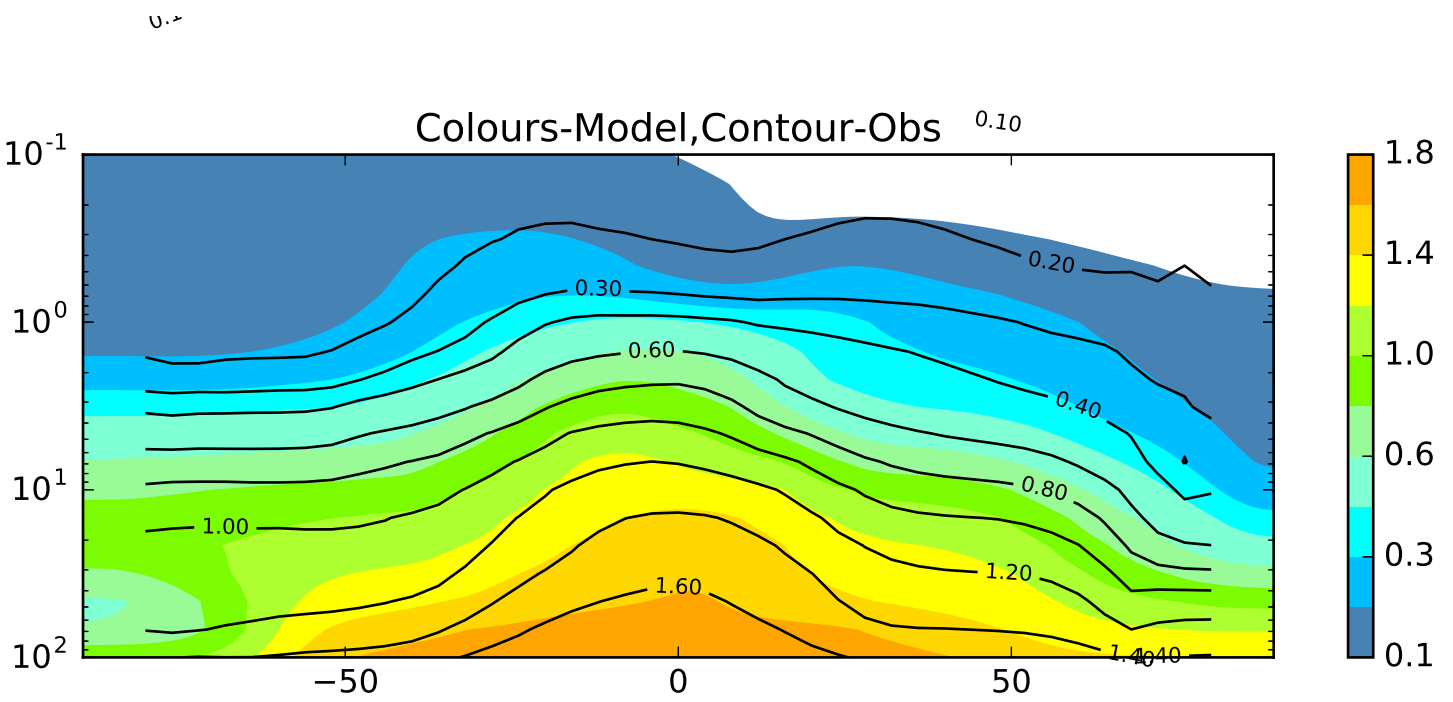
UKCA bs395 vs NIWA-CCMVal:  
O3 (ppmv) Jul



UKCA bo717 vs HALOE:  
CH<sub>4</sub> (ppmv) Jul



UKCA bs395 vs HALOE:  
CH4 (ppmv) Jul

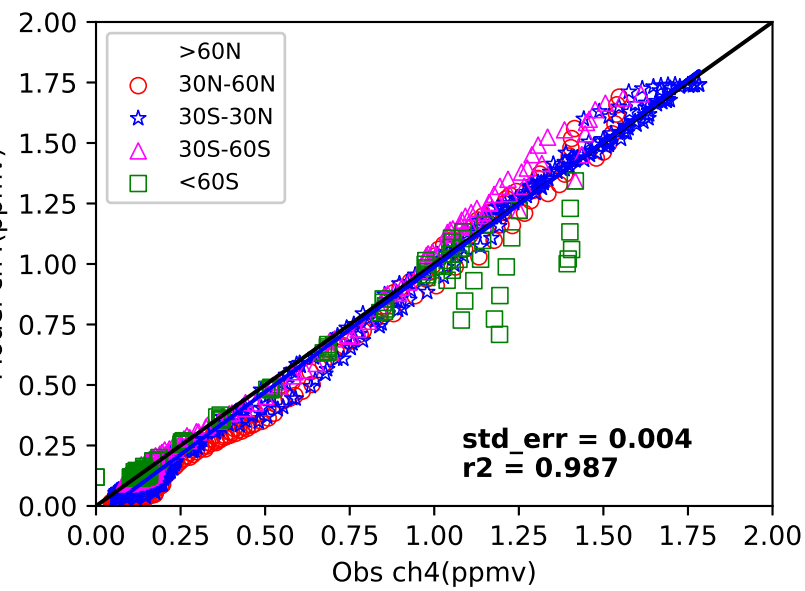
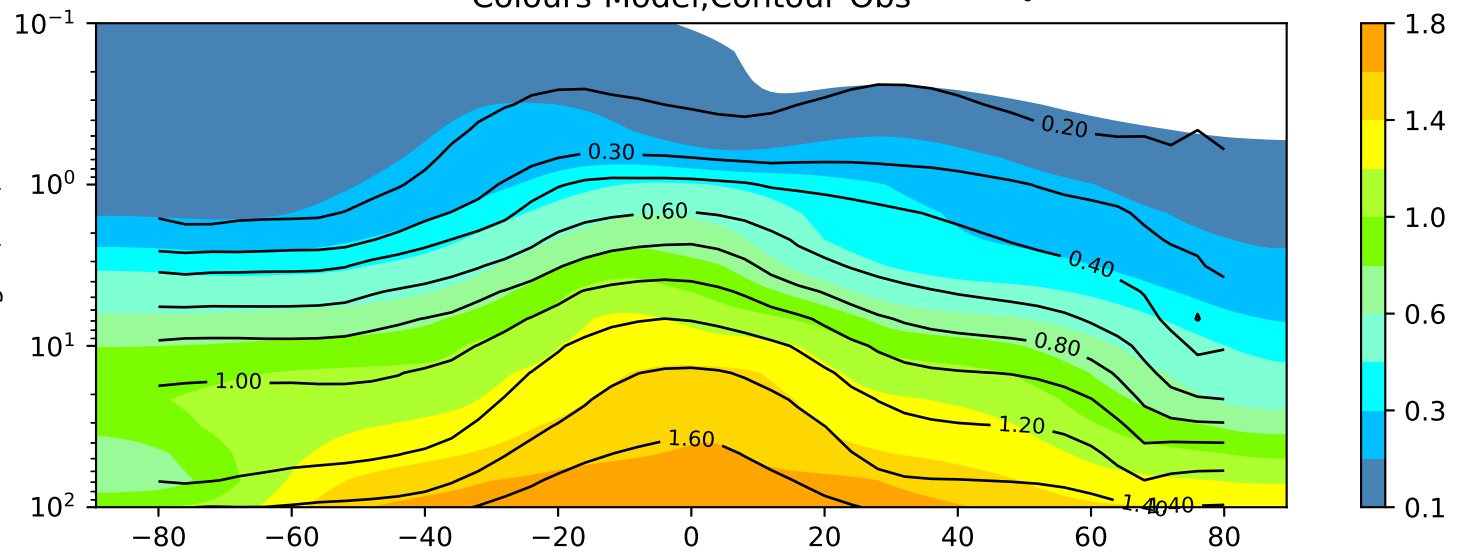


UKCA bo717 vs HALOE:  
CH4 (ppmv) Jan

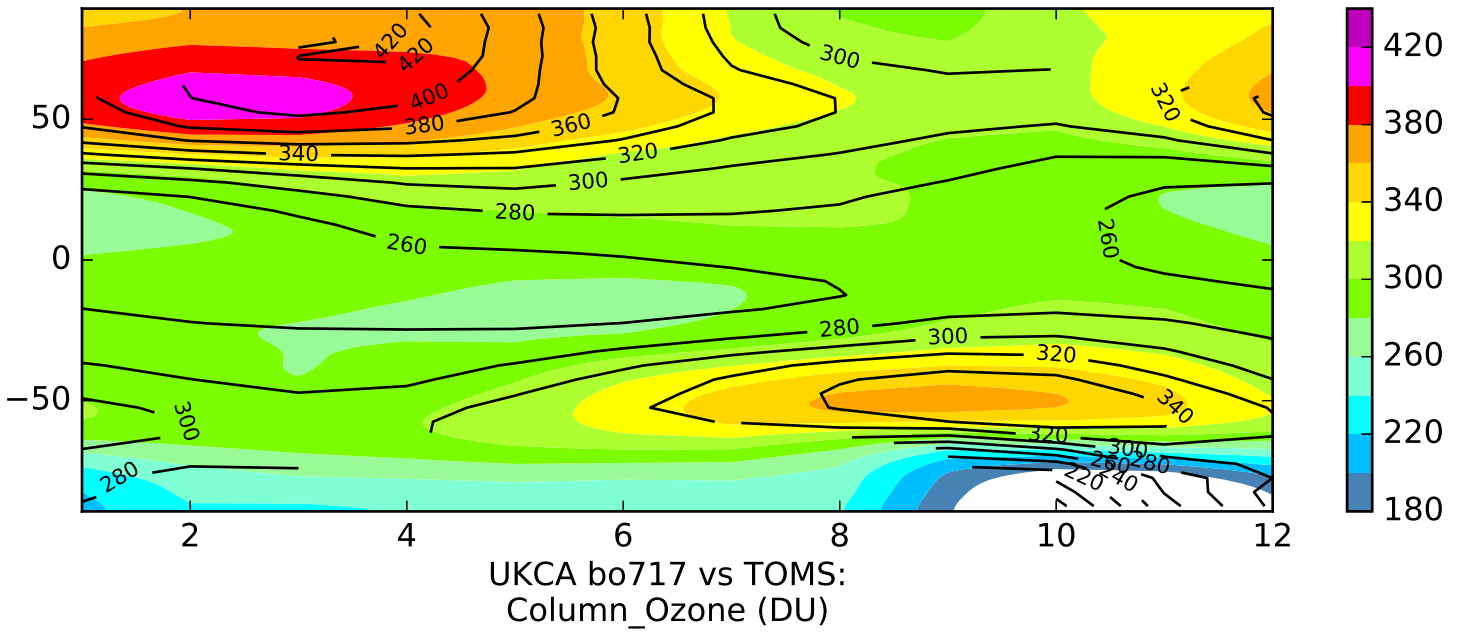
0.10

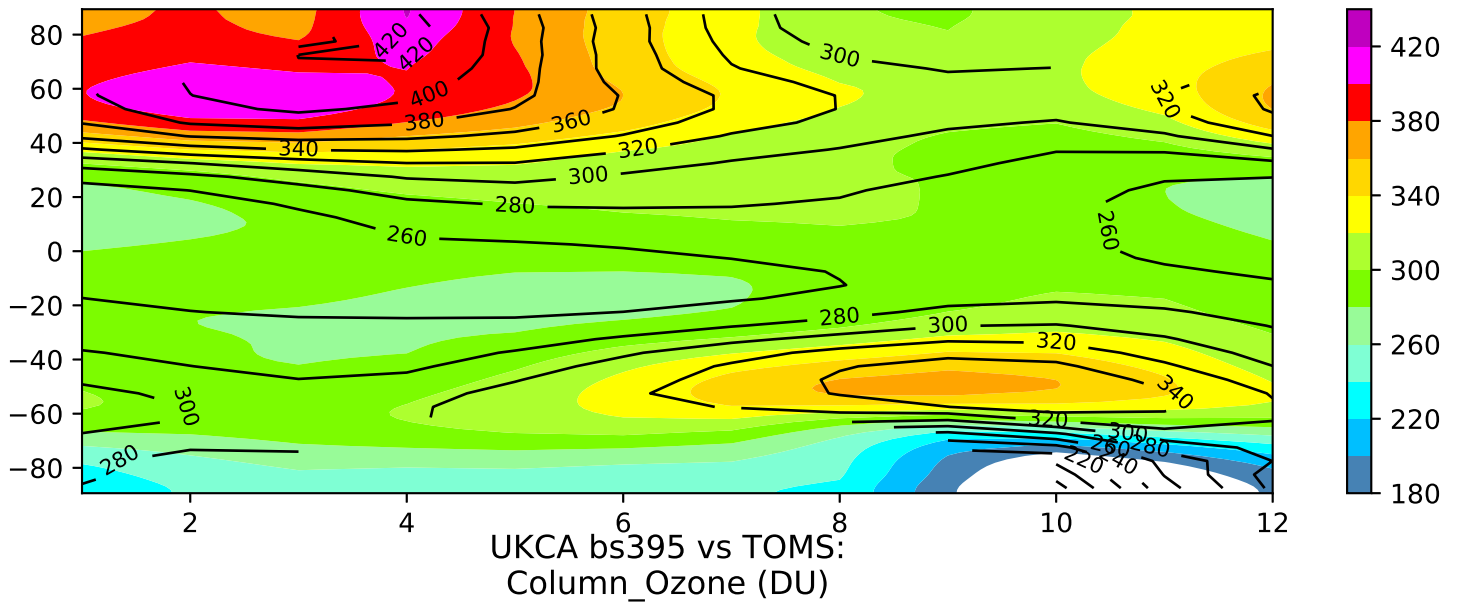
Colours-Model,Contour-Obs

0.10



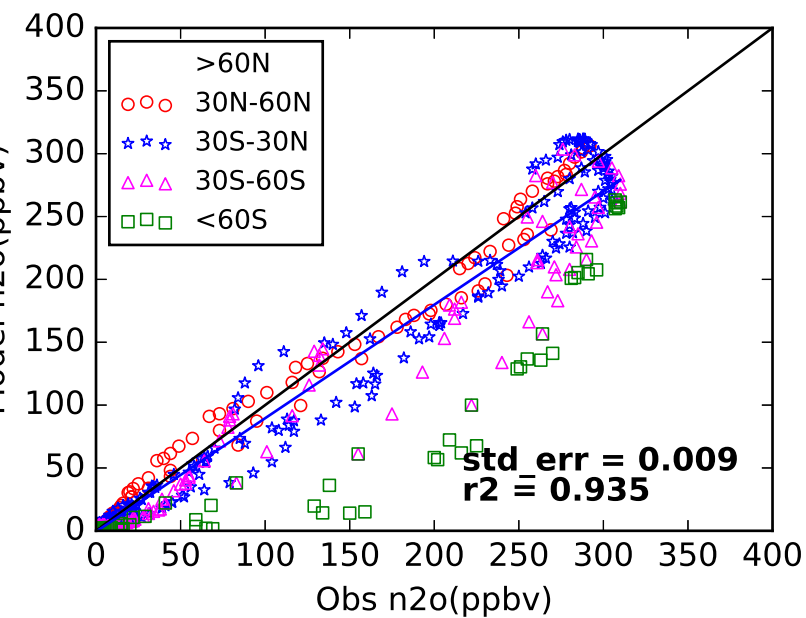
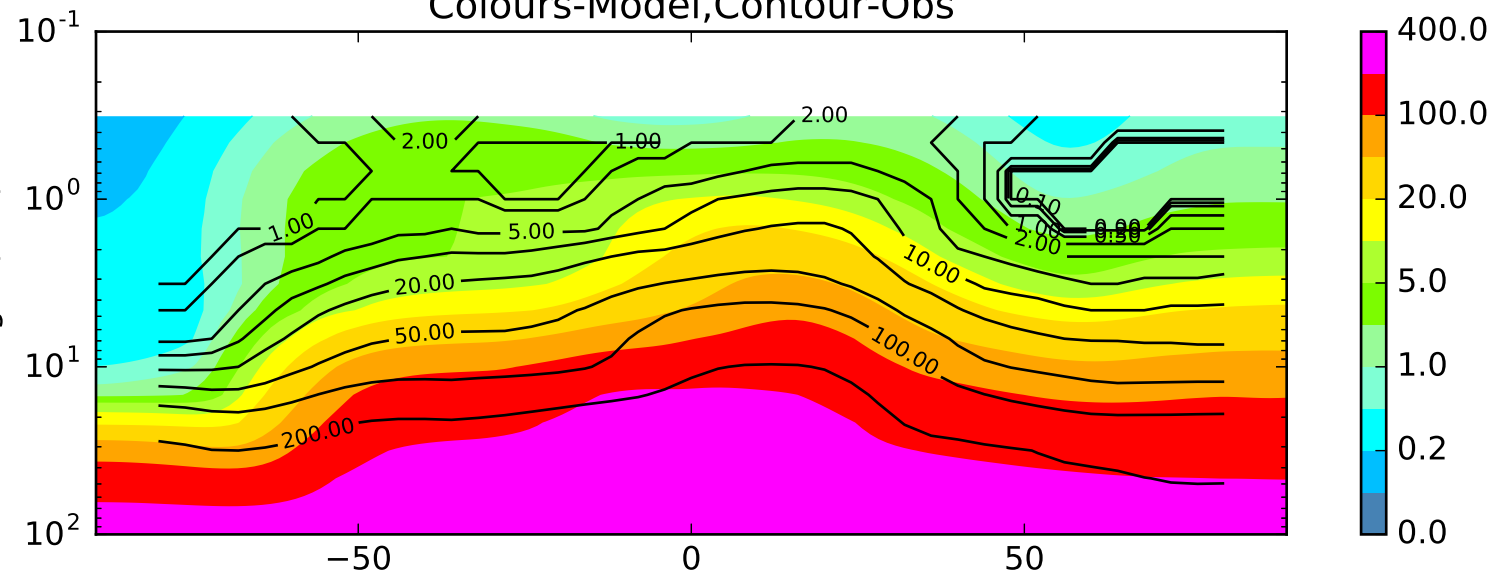
UKCA bs395 vs HALOE:  
CH4 (ppmv) Jan





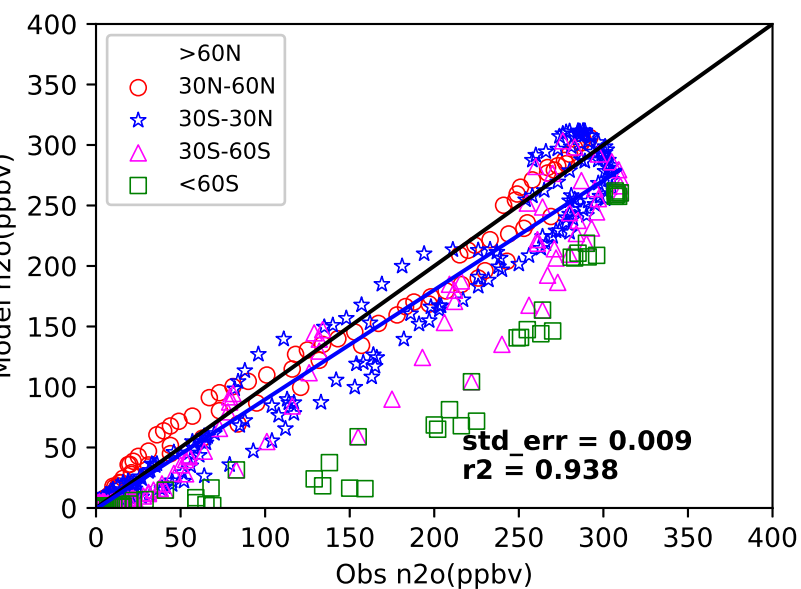
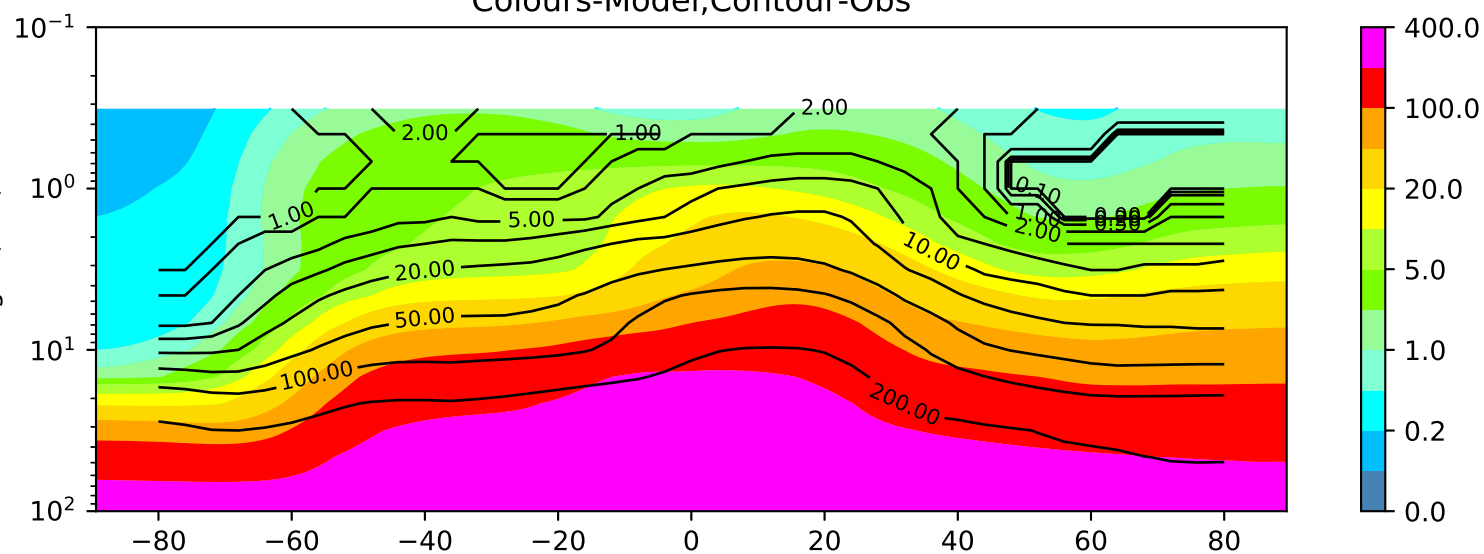


Colours-Model,Contour-Obs



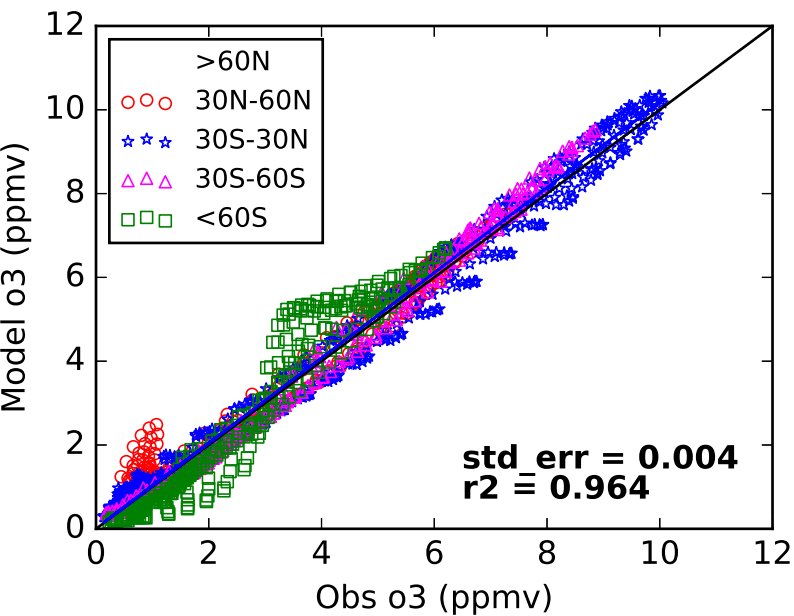
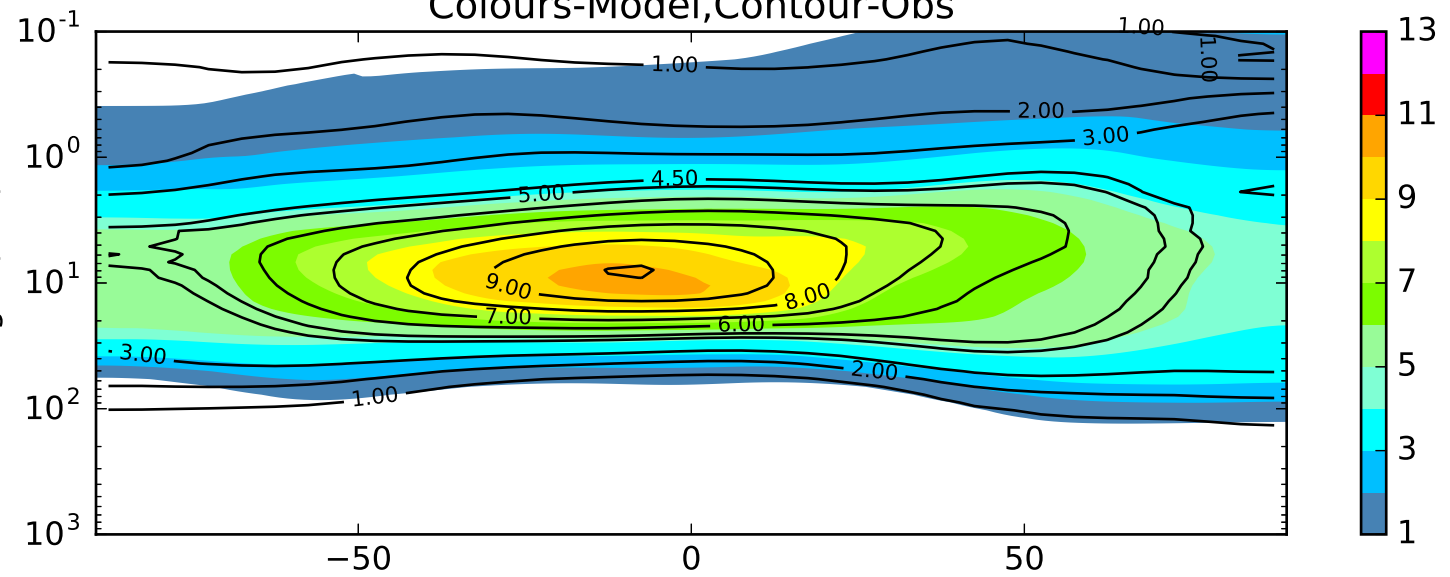
UKCA bo717 vs HALOE:  
N<sub>2</sub>O (ppmv) Jul

Colours-Model,Contour-Obs



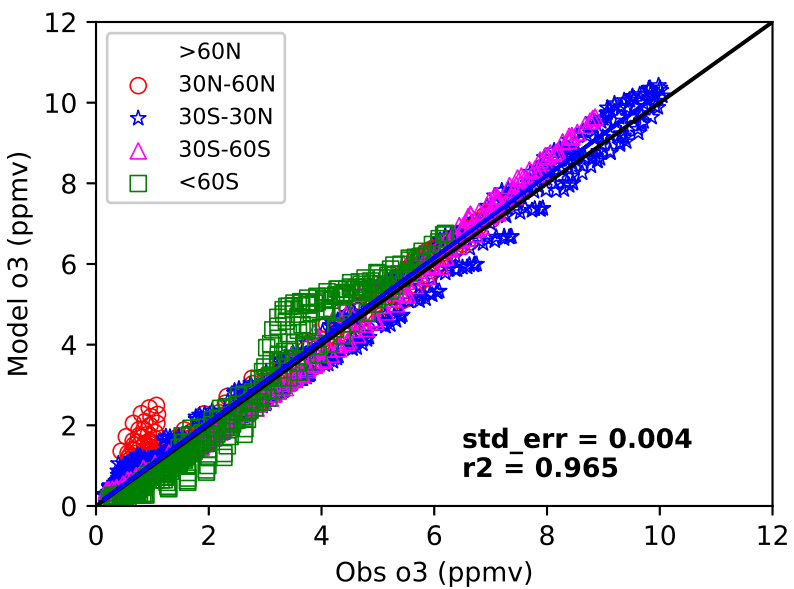
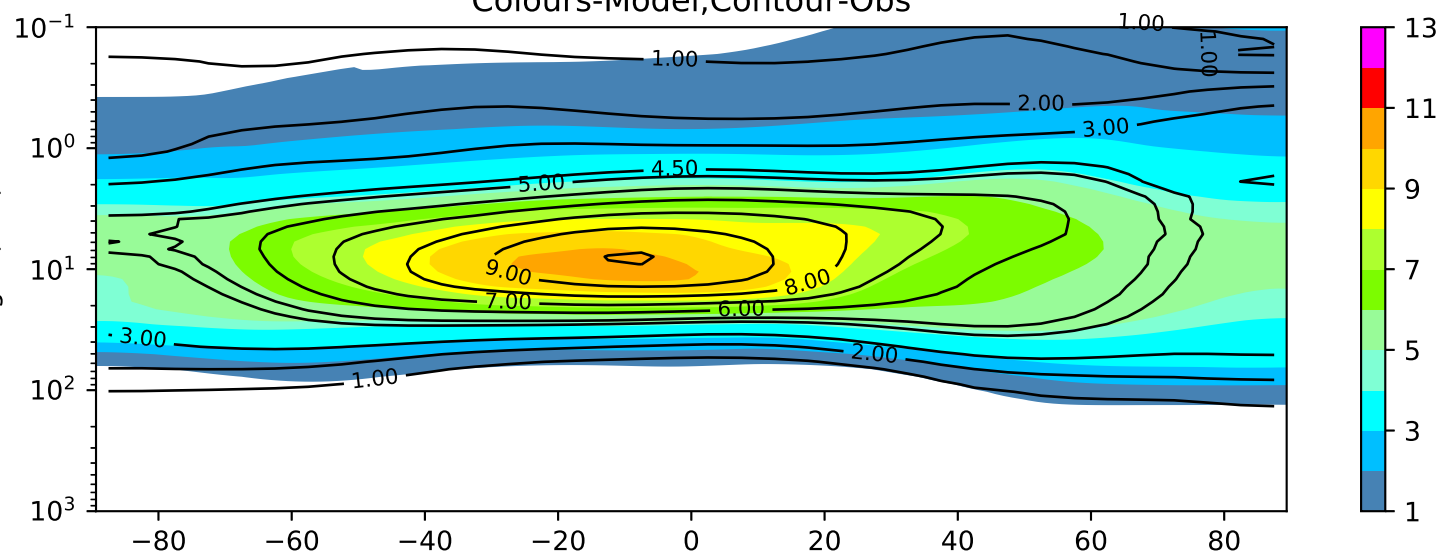
UKCA bs395 vs HALOE:  
N2O (ppmv) Jul

Colours-Model,Contour-Obs



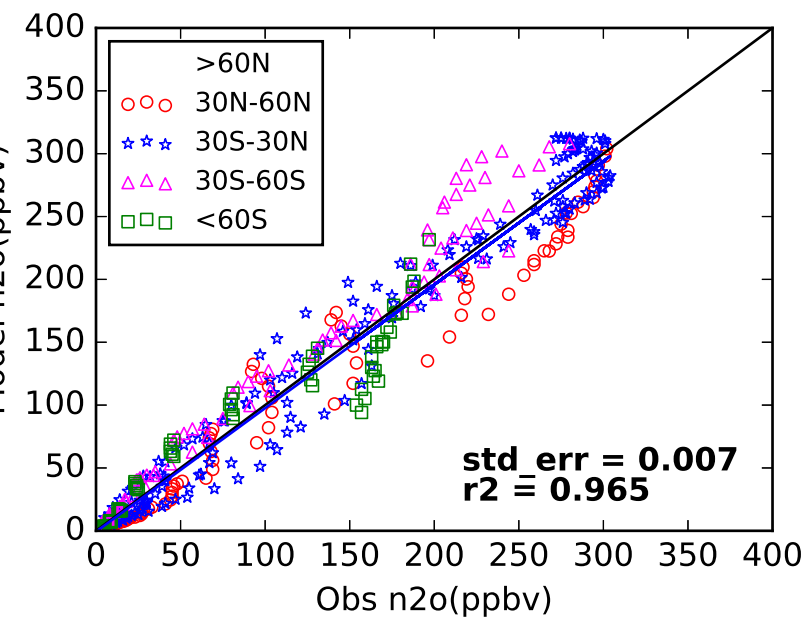
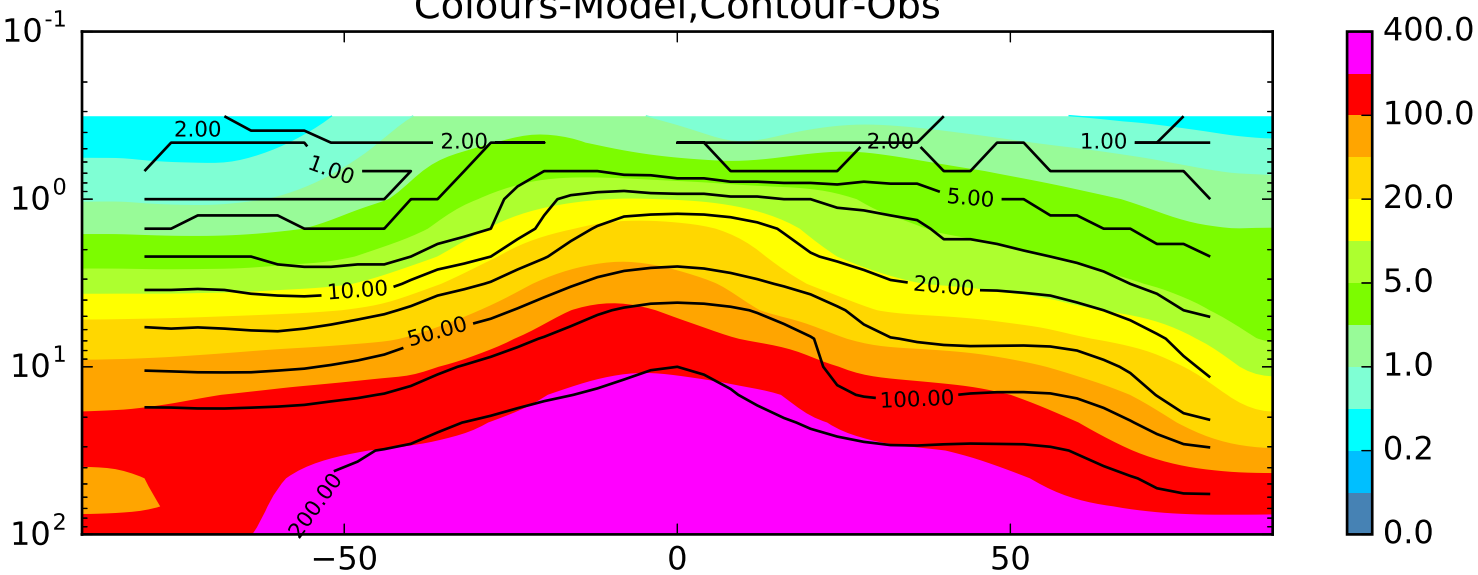
UKCA bo717 vs NIWA-CCMVal:  
O<sub>3</sub> (ppmv) Jan

Colours-Model,Contour-Obs



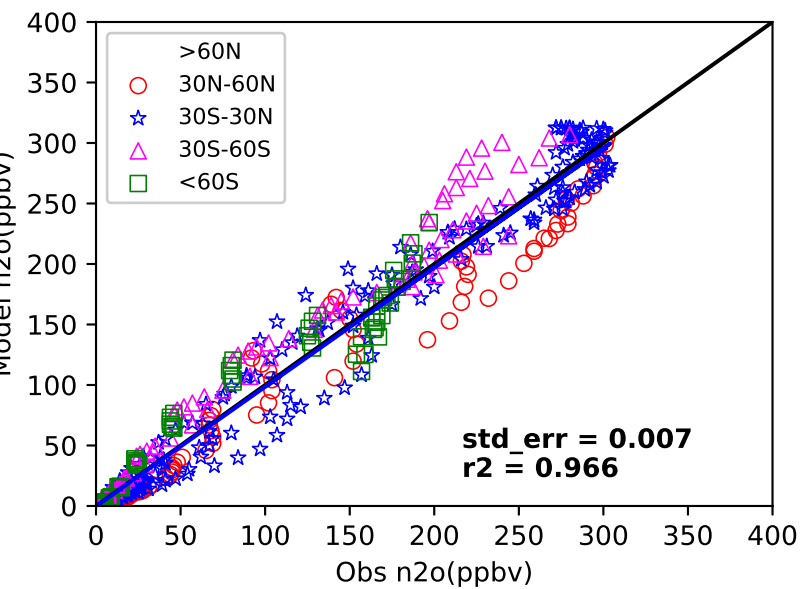
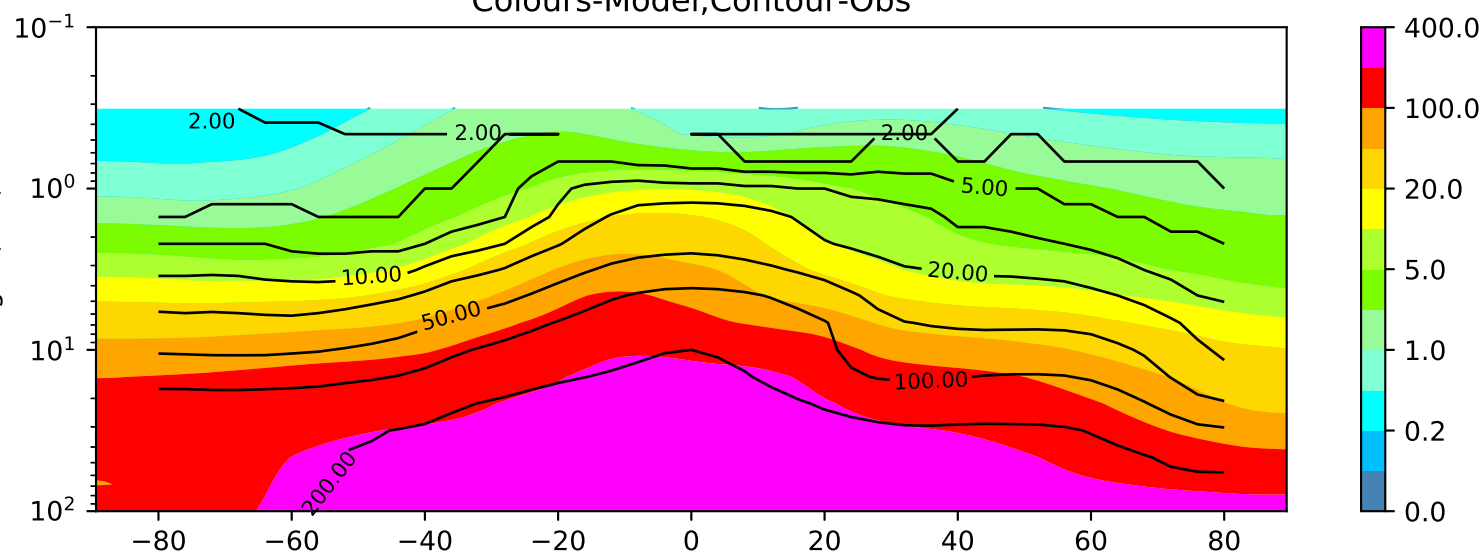
UKCA bs395 vs NIWA-CCMVal:  
O<sub>3</sub> (ppmv) Jan

Colours-Model,Contour-Obs



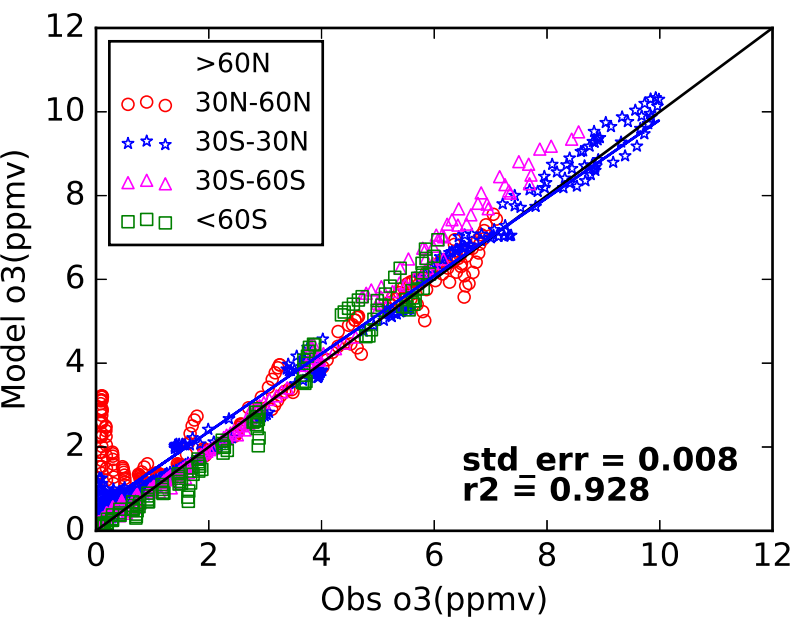
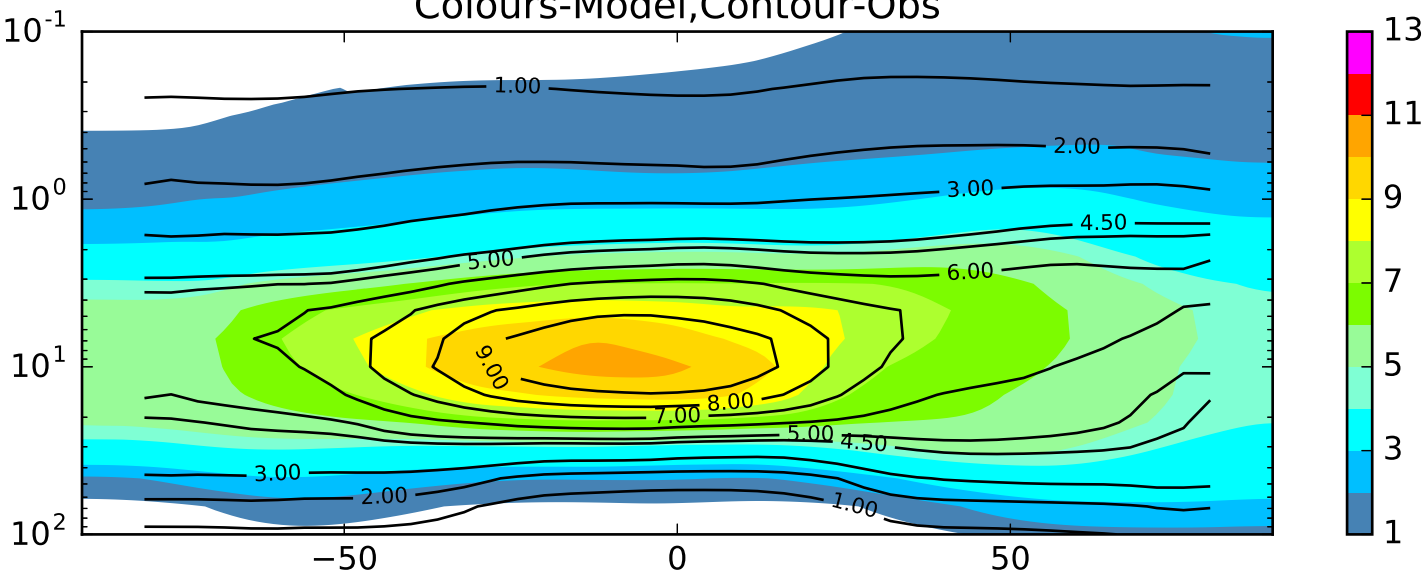
UKCA bo717 vs HALOE:  
N<sub>2</sub>O (ppmv) Jan

Colours-Model,Contour-Obs



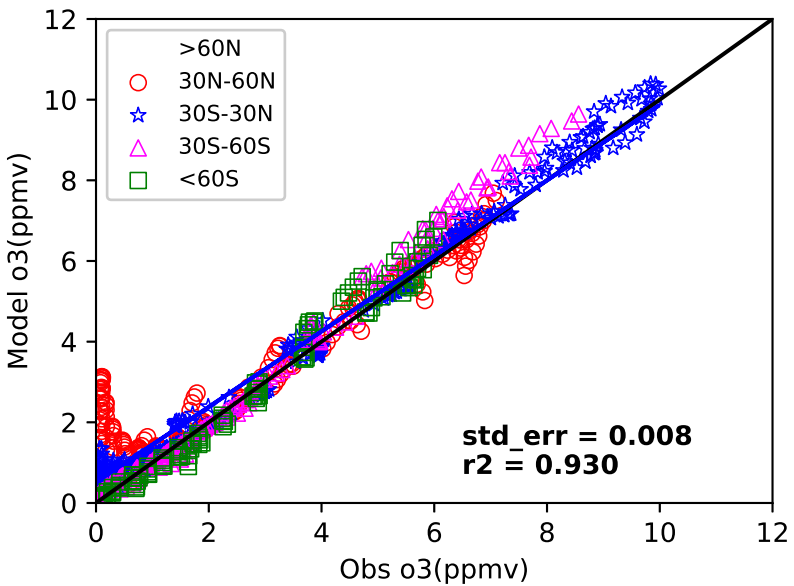
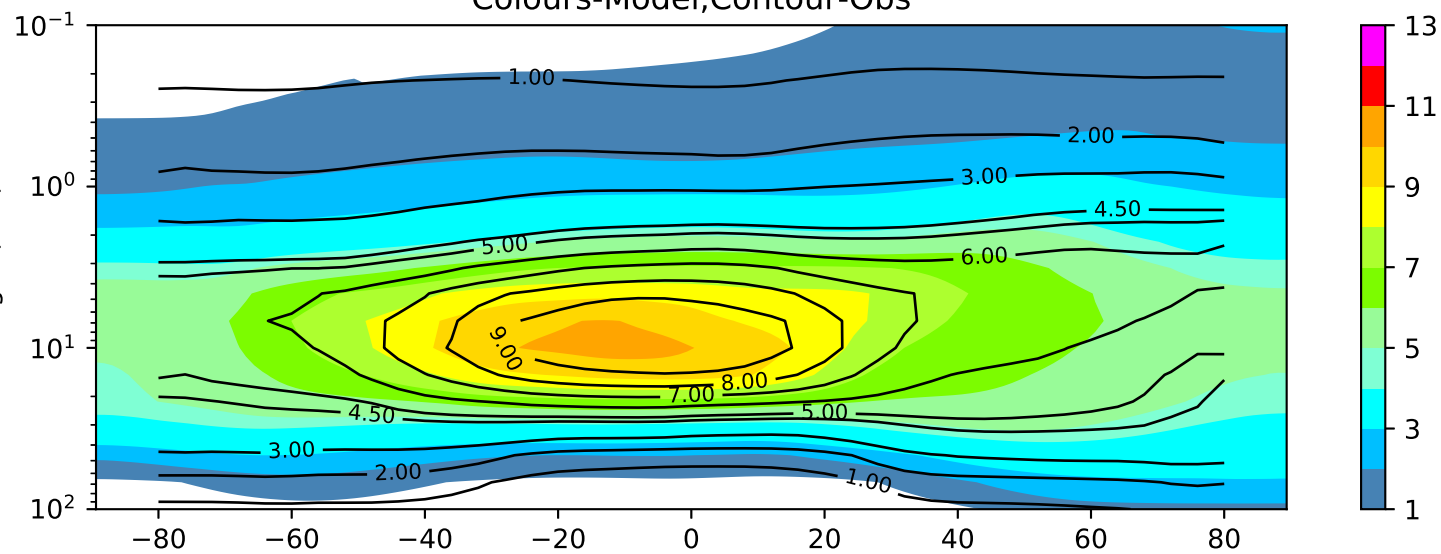
UKCA bs395 vs HALOE:  
N2O (ppmv) Jan

Colours-Model,Contour-Obs



UKCA bo717 vs HALOE:  
O<sub>3</sub> (ppmv) Jan

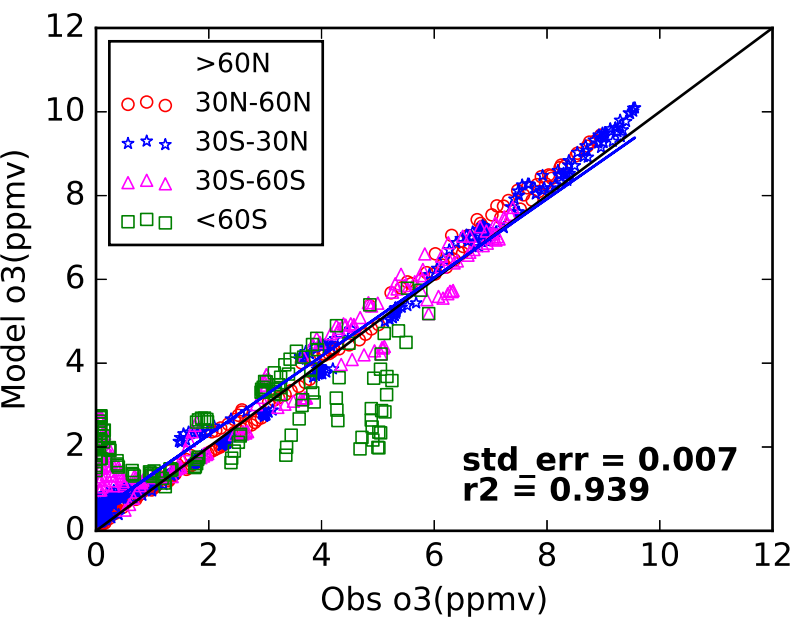
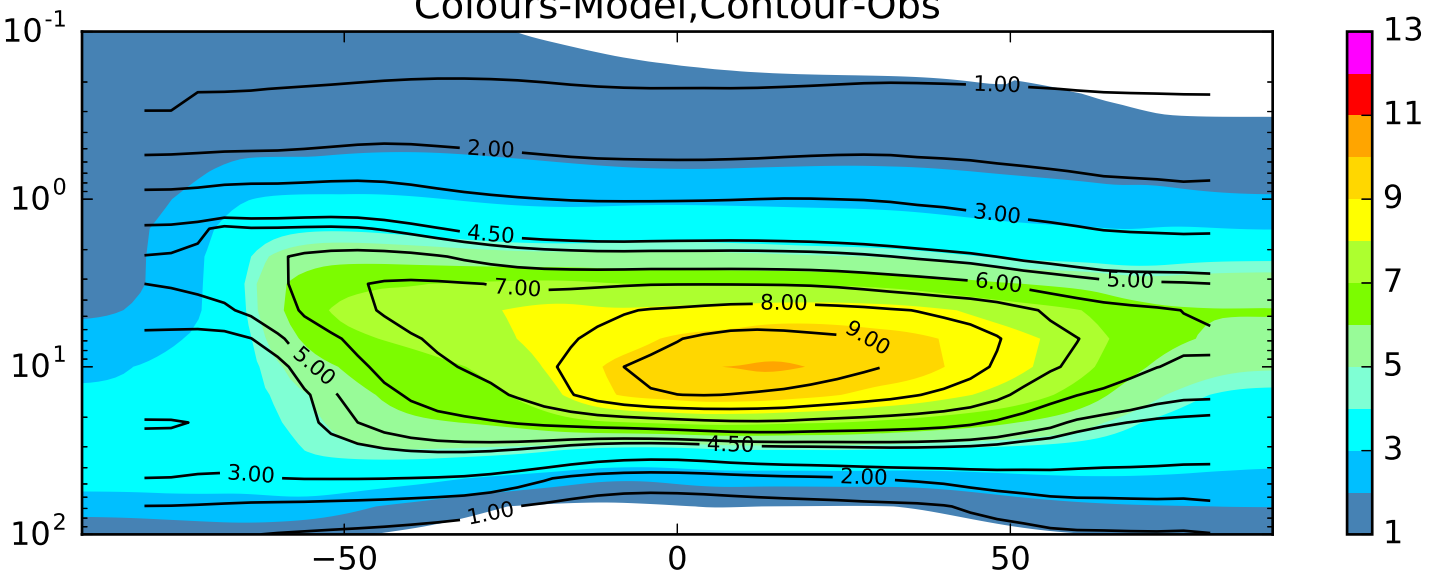
Colours-Model,Contour-Obs



UKCA bs395 vs HALOE:  
O3 (ppmv) Jan

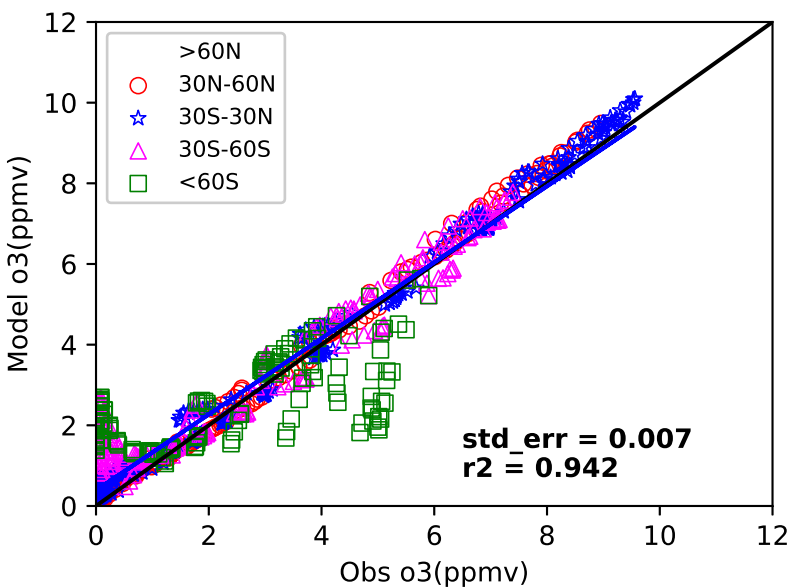
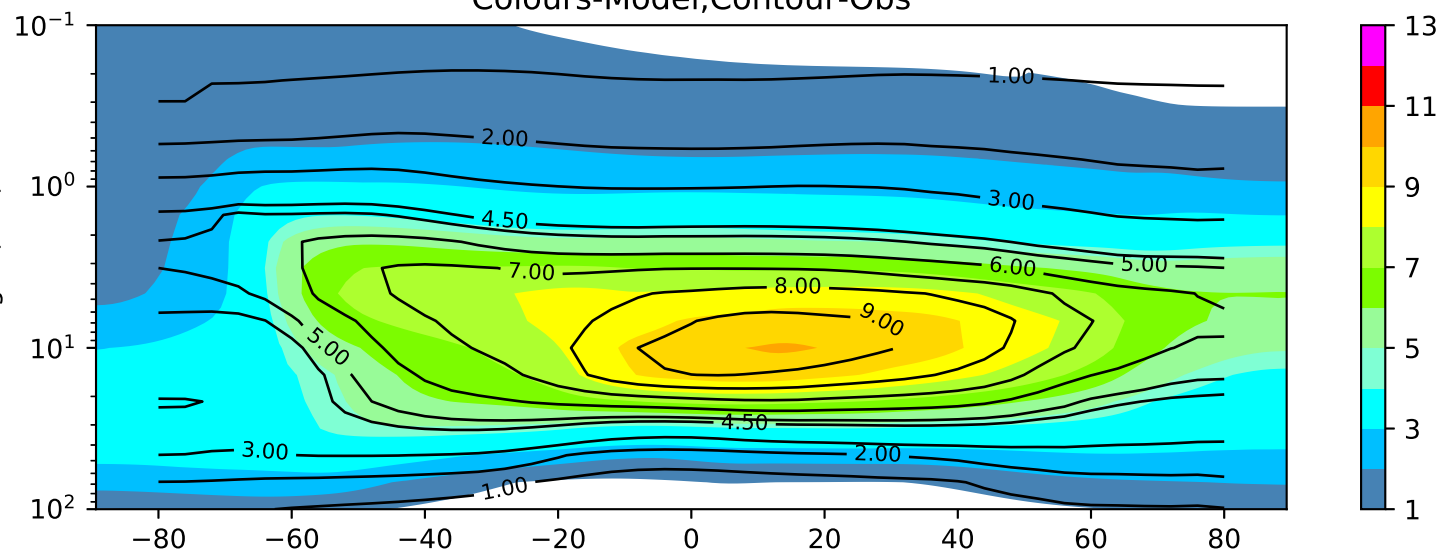


Colours-Model,Contour-Obs



UKCA bo717 vs HALOE:  
O3 (ppmv) Jul

Colours-Model,Contour-Obs



UKCA bs395 vs HALOE:  
O3 (ppmv) Jul

# UKCA bo717

[OH] Air mass weighted ( $10^6$  molecules  $\text{cm}^{-3}$ )

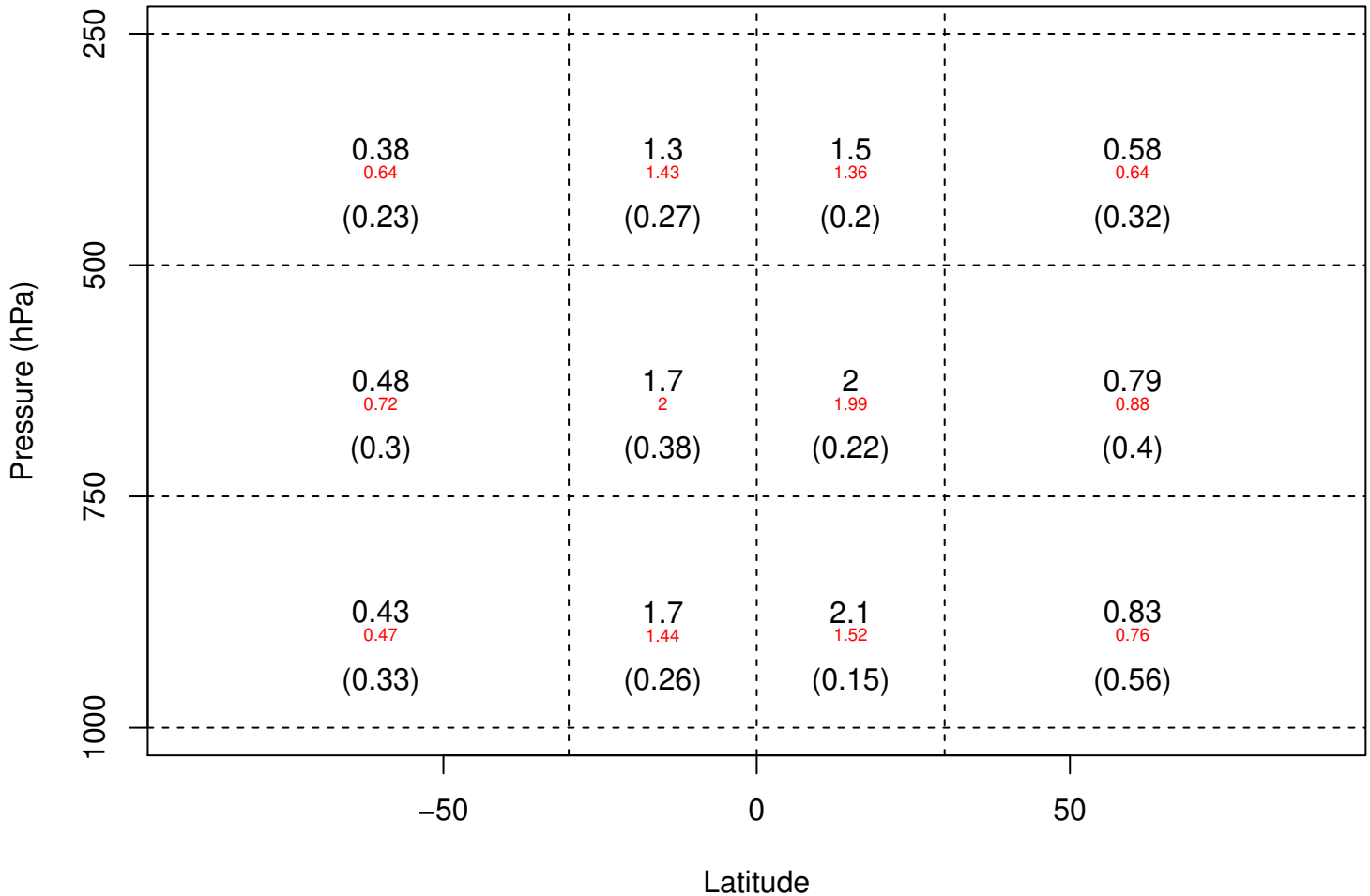
Mean OH=  $1.23\text{e}+06$  molec/cm<sup>3</sup>

ACCMIP Multi-model Mean=  $1.17 (+/- 0.1) \text{e}+06$  molec/cm<sup>3</sup>

NH:SH ratio= 1.38 Patra et al 2014:  $0.97 +/- 0.12$

Red: Spivakovsky values

Values in ( ): Std dev



# UKCA bs395

[OH] Air mass weighted ( $10^6$  molecules  $\text{cm}^{-3}$ )

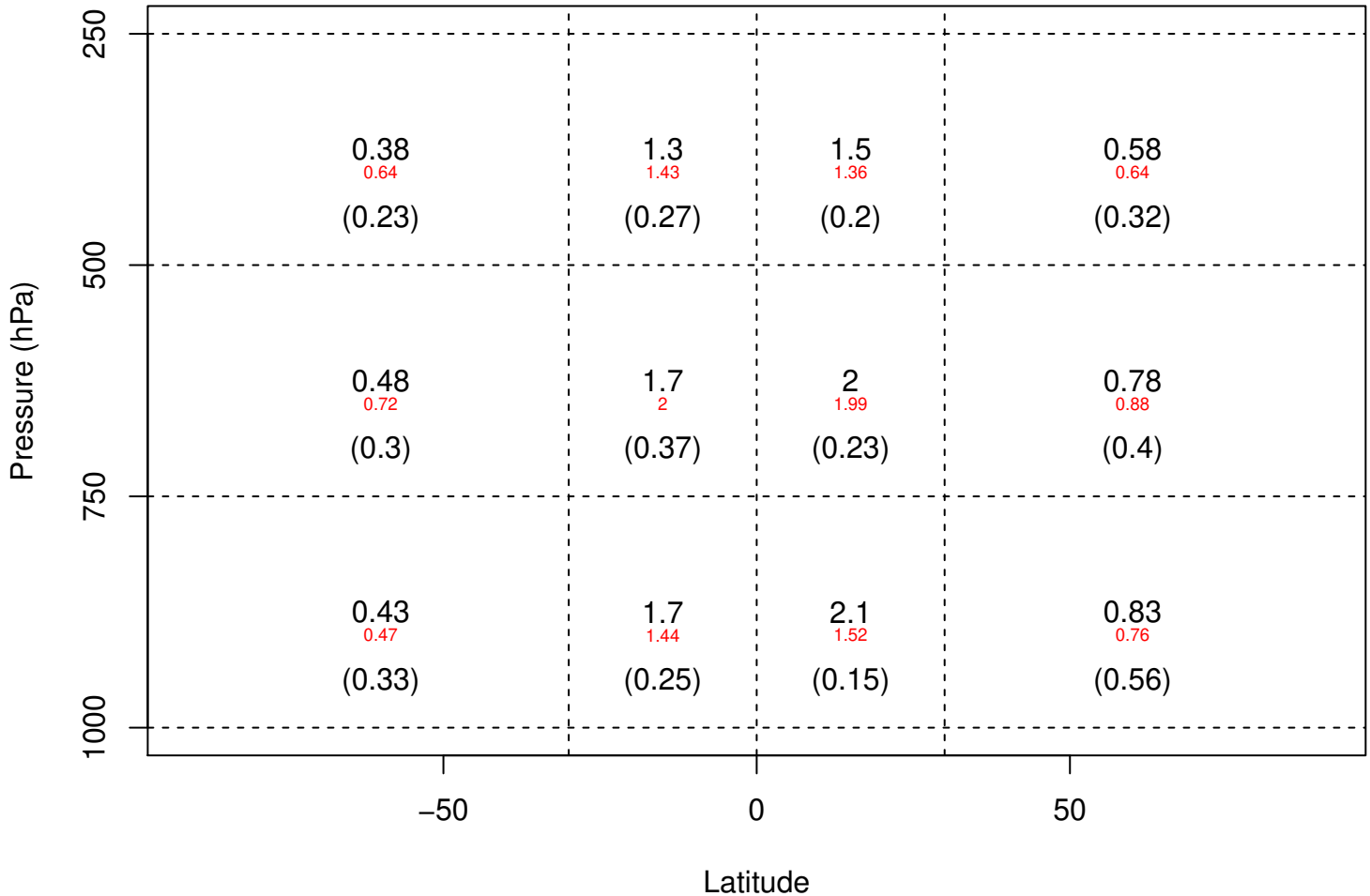
Mean OH=  $1.23\text{e}+06$  molec/cm<sup>3</sup>

ACCMIP Multi-model Mean=  $1.17 (+/- 0.1) \text{e}+06$  molec/cm<sup>3</sup>

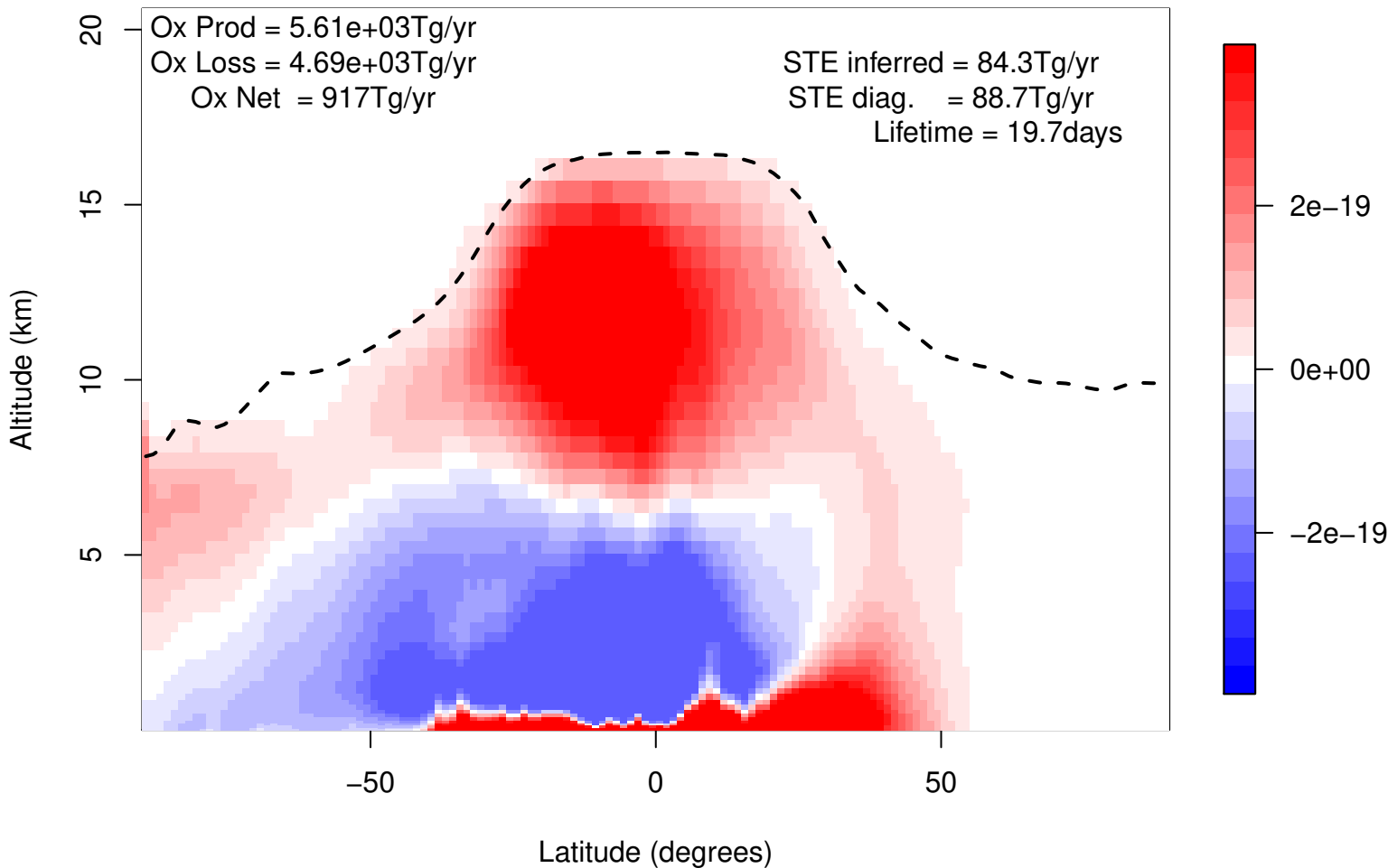
NH:SH ratio= 1.37 Patra et al 2014:  $0.97 +/- 0.12$

Red: Spivakovsky values

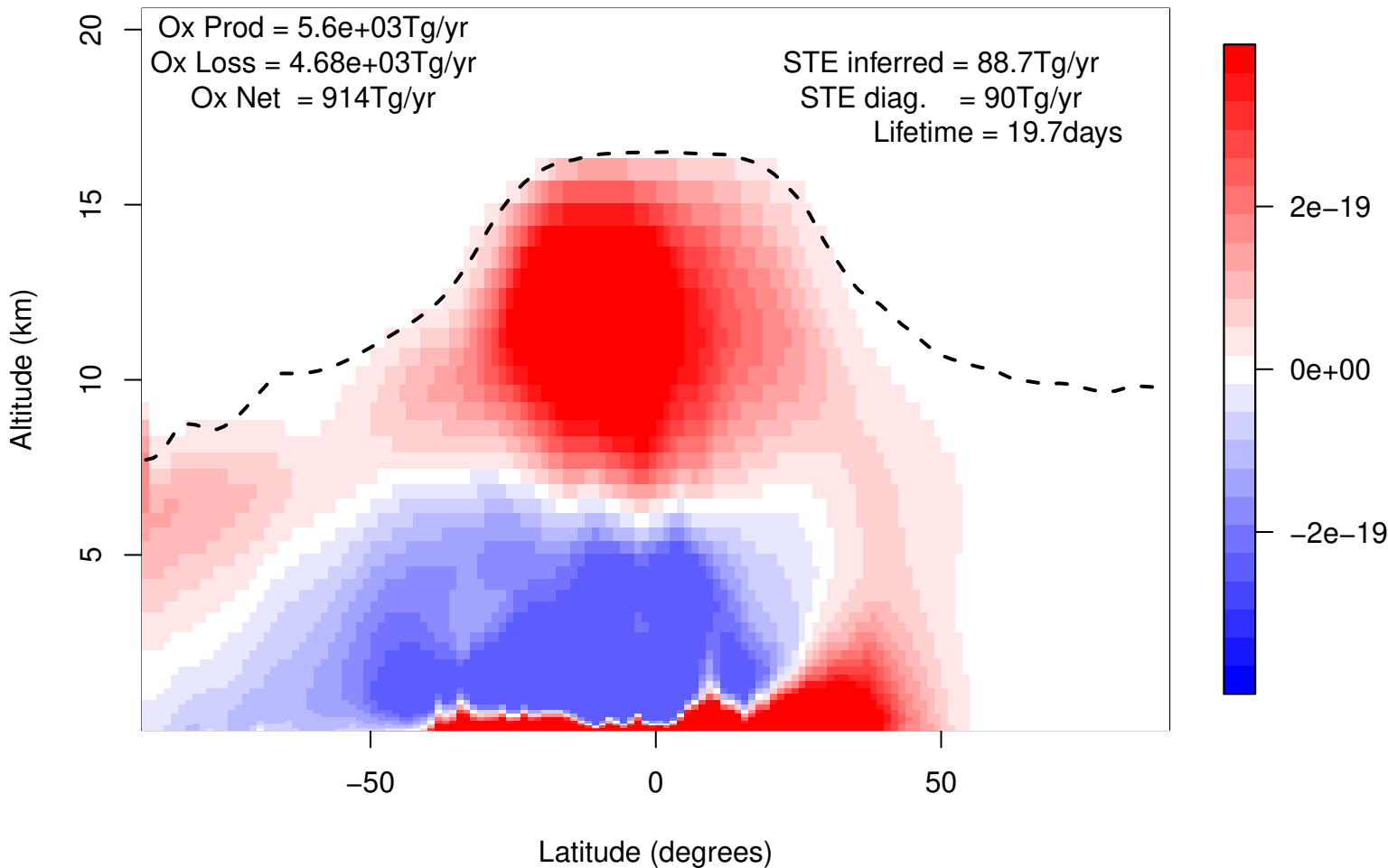
Values in ( ): Std dev



# UKCA bo717 Ox Net Chemical Production

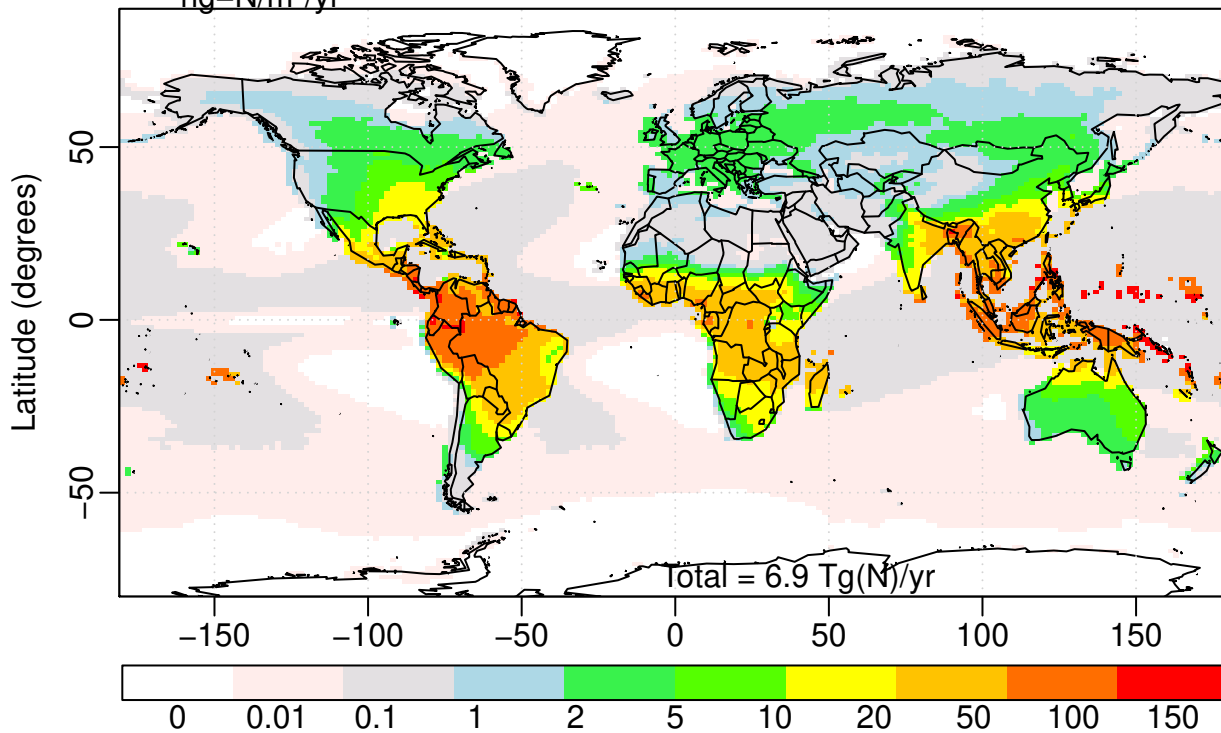


# UKCA bs395 Ox Net Chemical Production



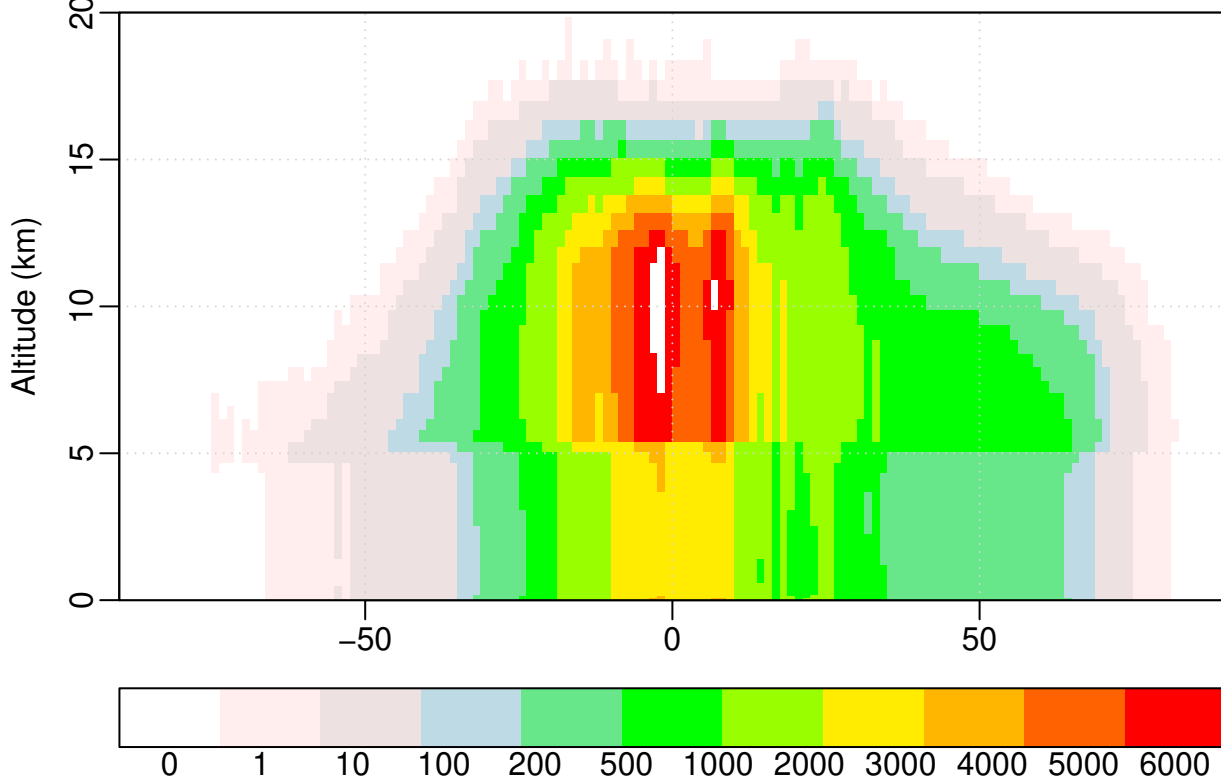
### bo717 total column

ng-N/m<sup>2</sup>/yr



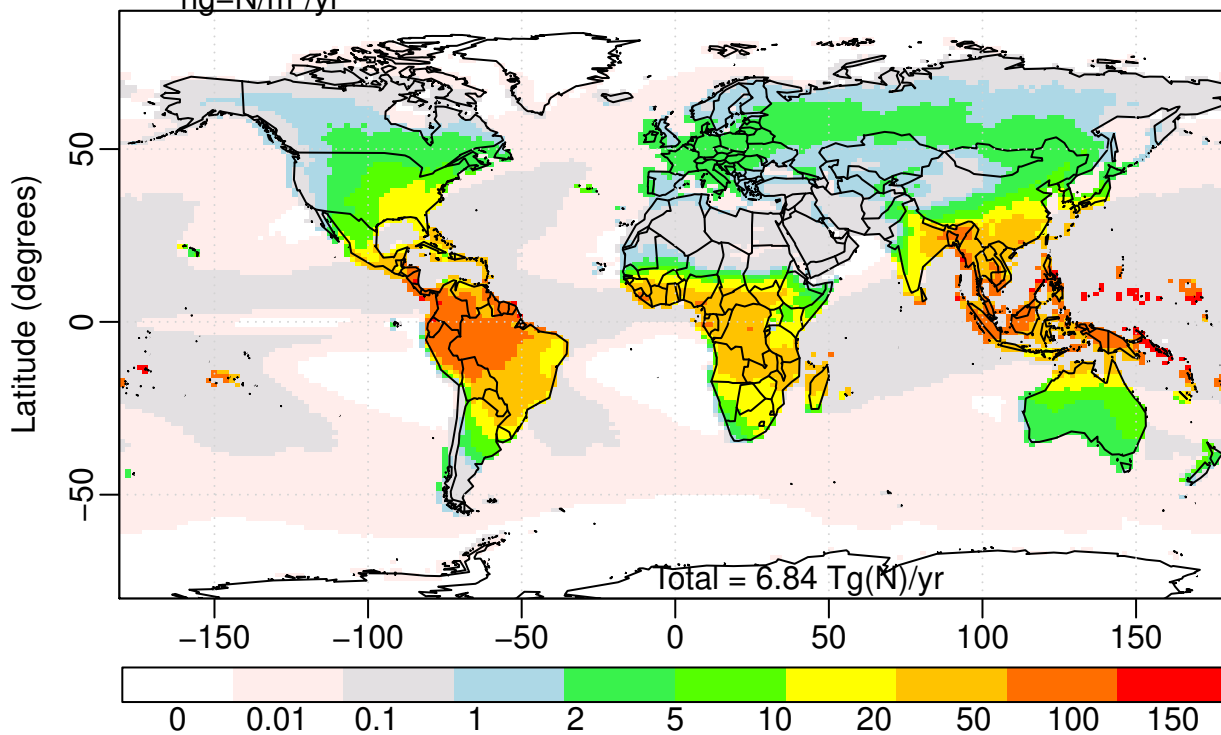
### bo717 zonal mean

molecules cm<sup>-3</sup> s<sup>-1</sup>



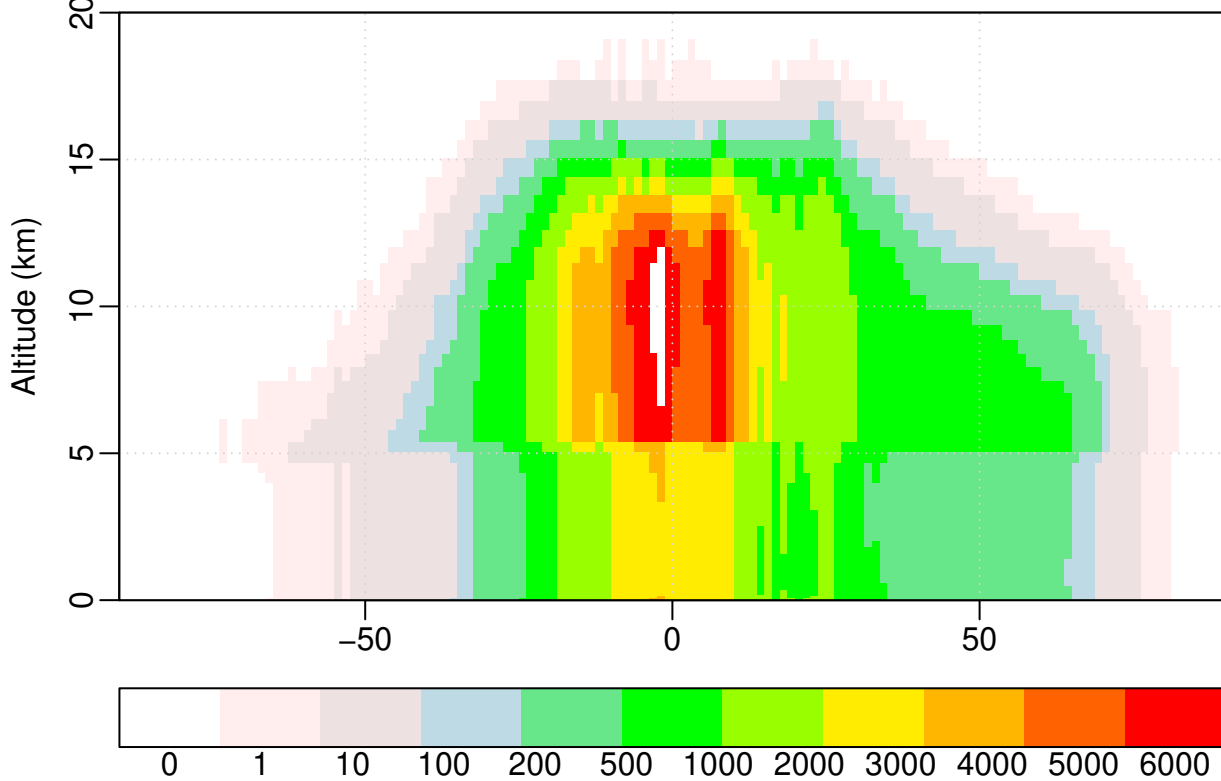
### bs395 total column

ng-N/m<sup>2</sup>/yr



### bs395 zonal mean

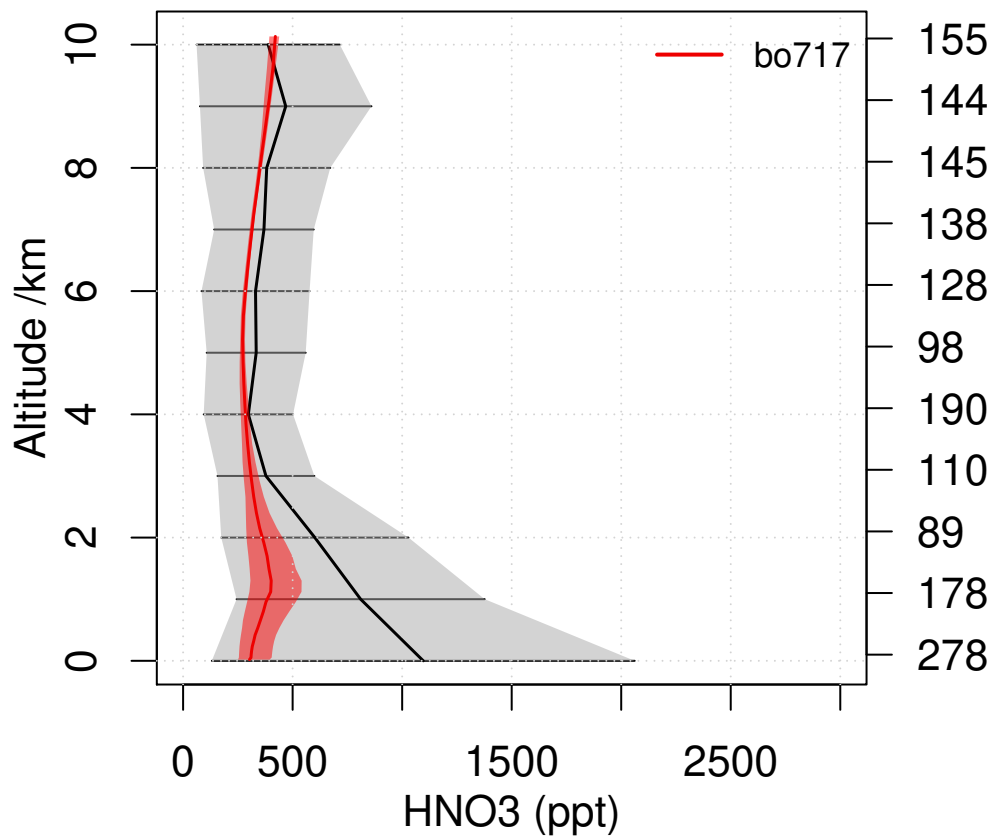
molecules cm<sup>-3</sup> s<sup>-1</sup>



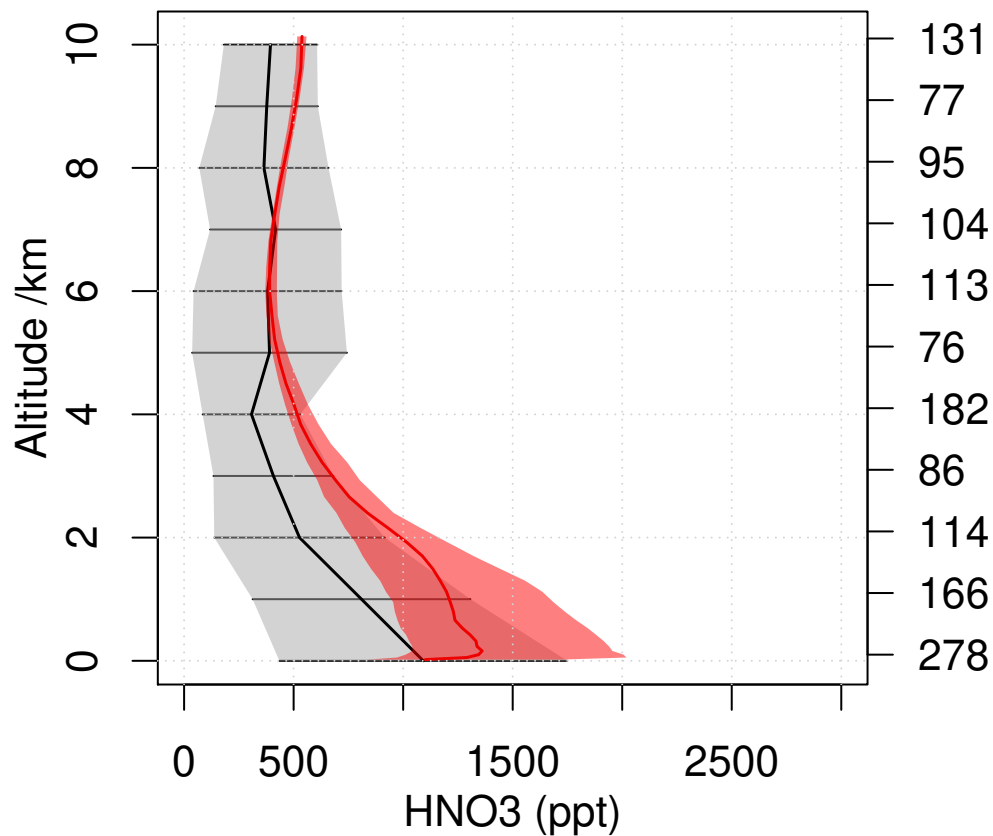


**Emmons HNO3 comparison**

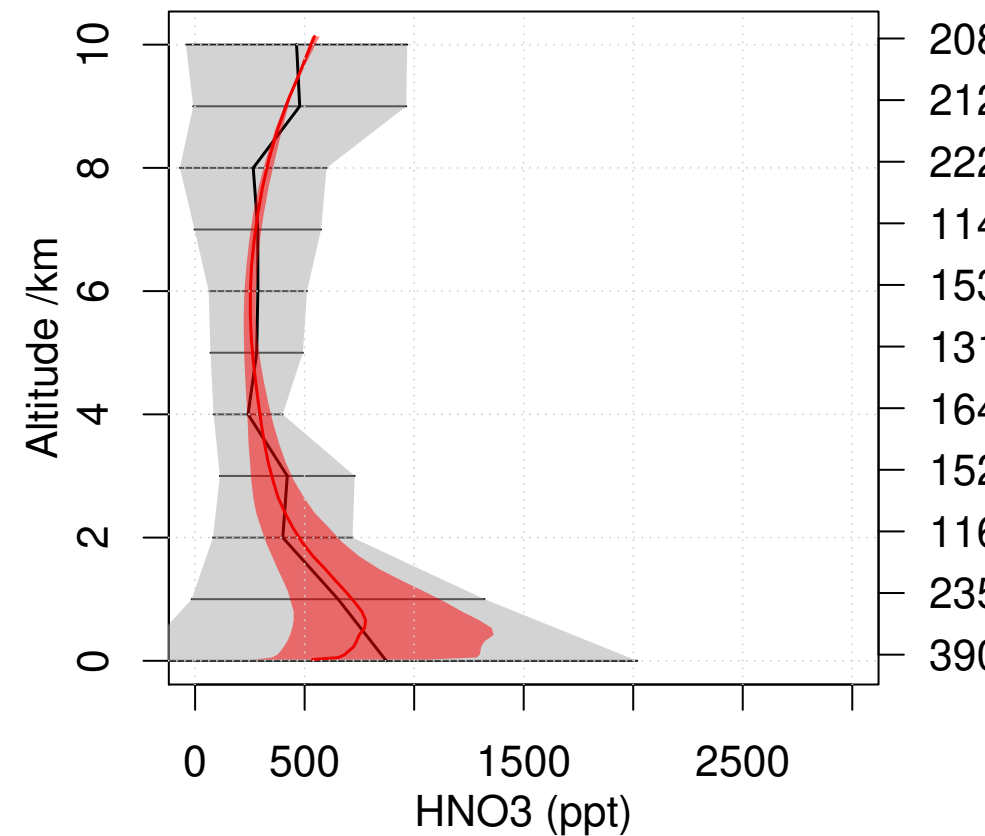
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



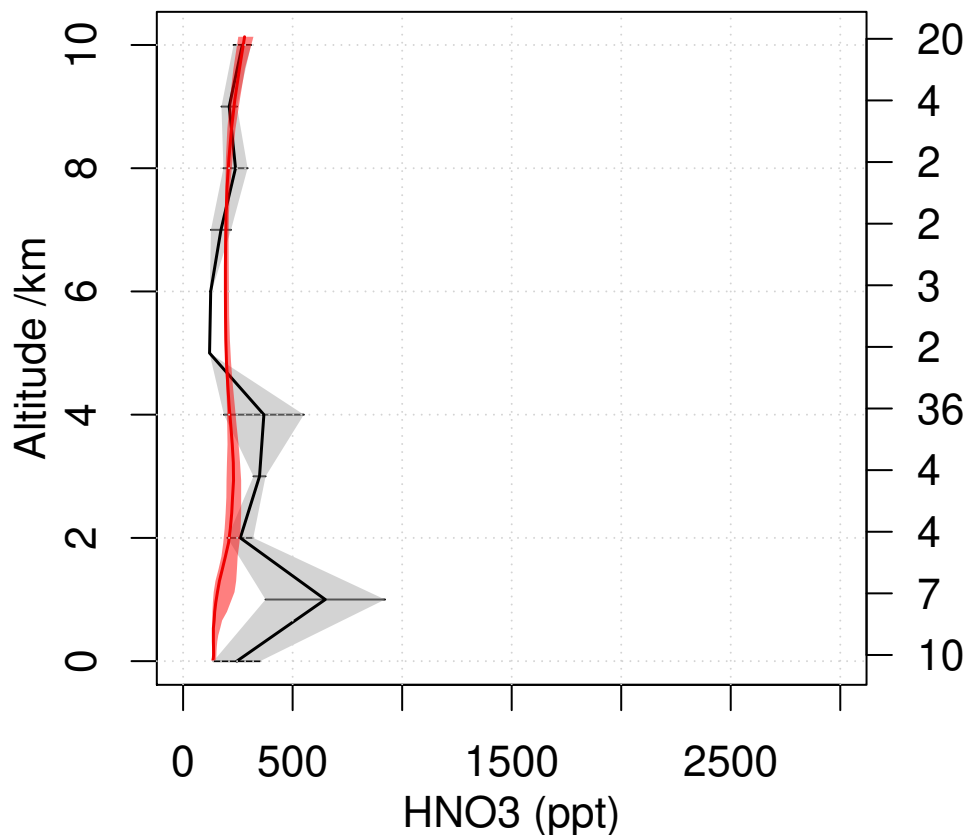
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



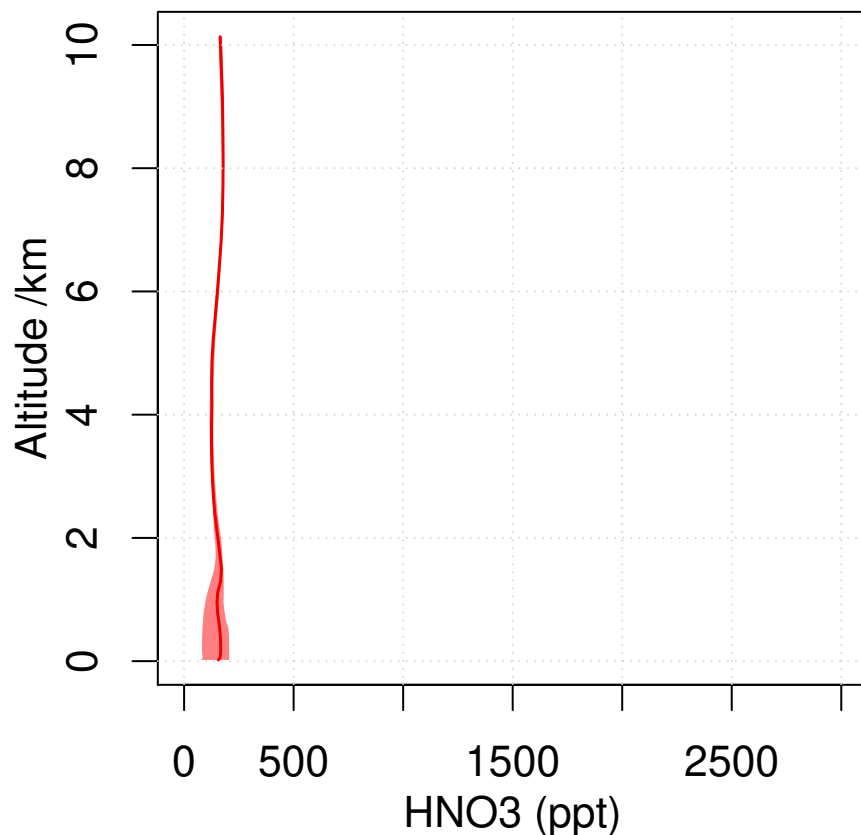
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



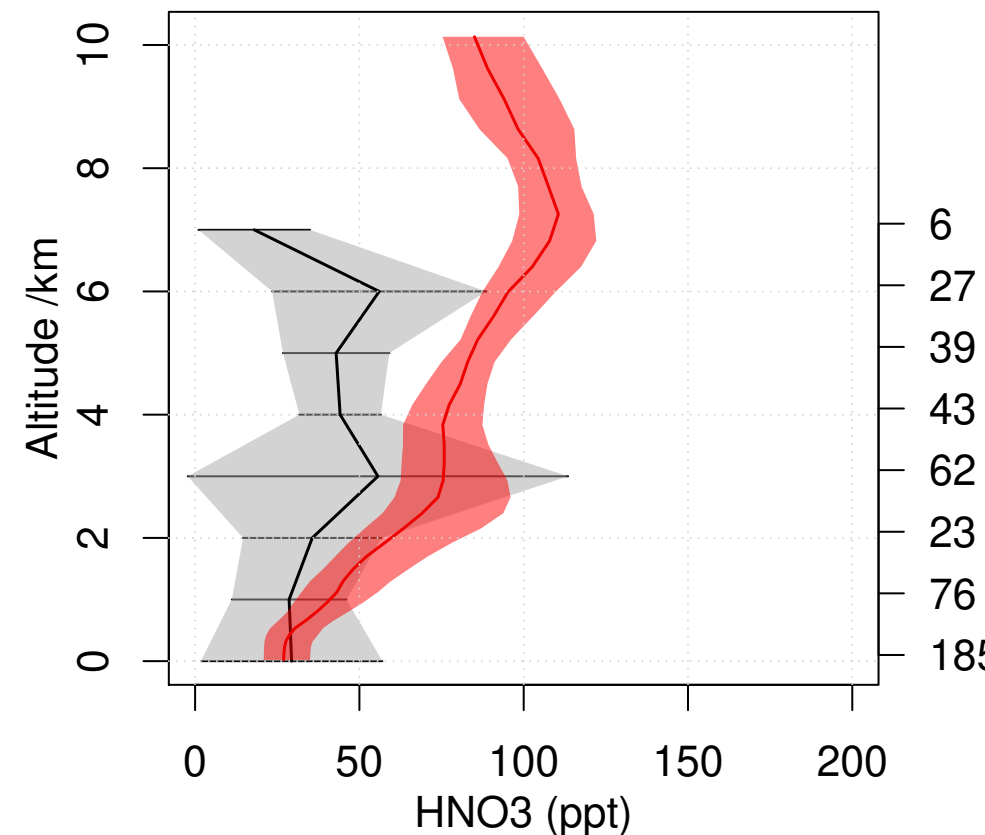
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



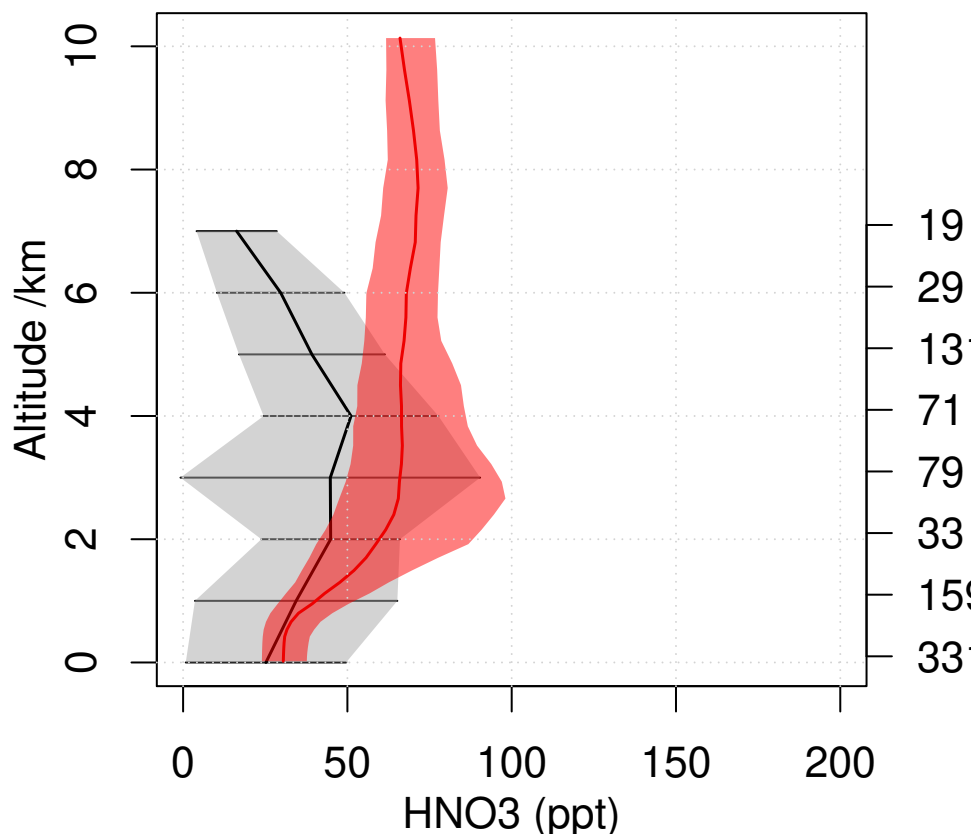
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



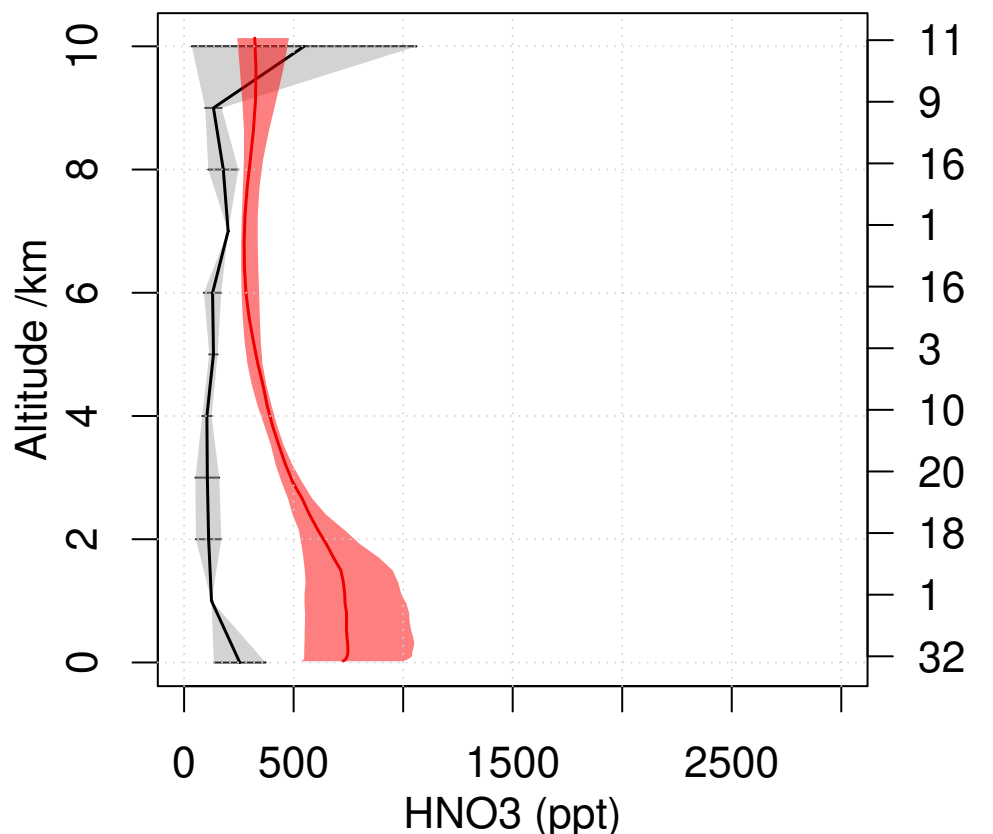
**PEM-Tropics-B Christmas-Island 1999 07**  
Lat 0 – 10 Lon 200 – 220



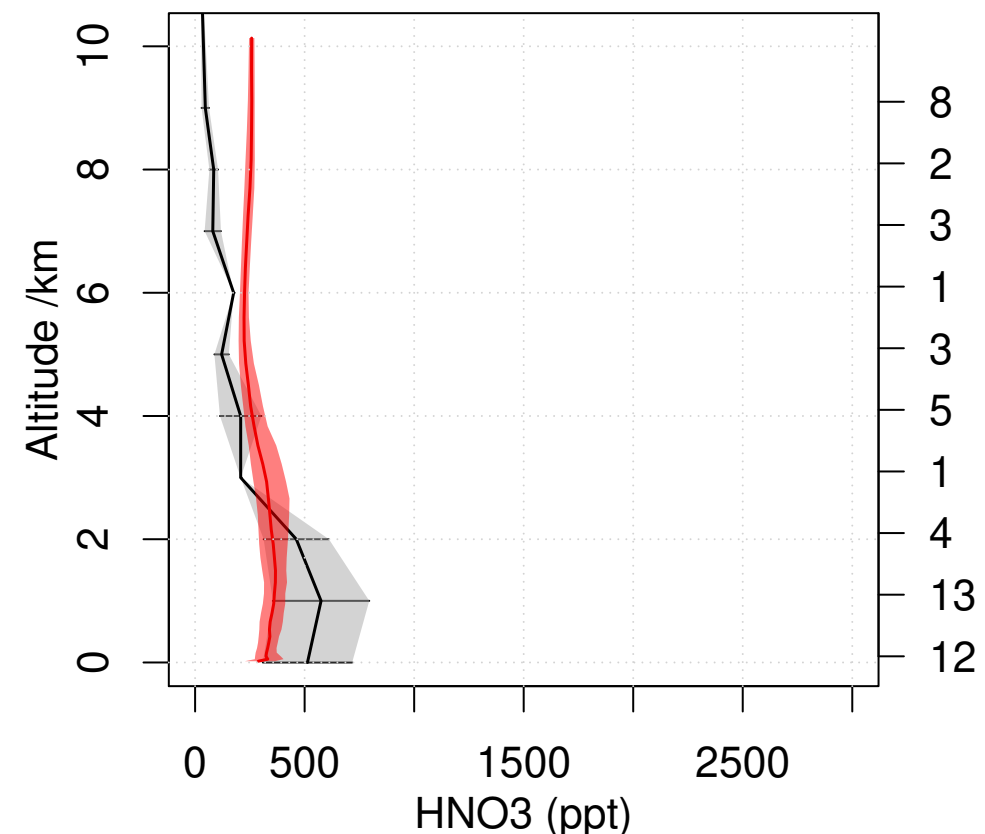
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



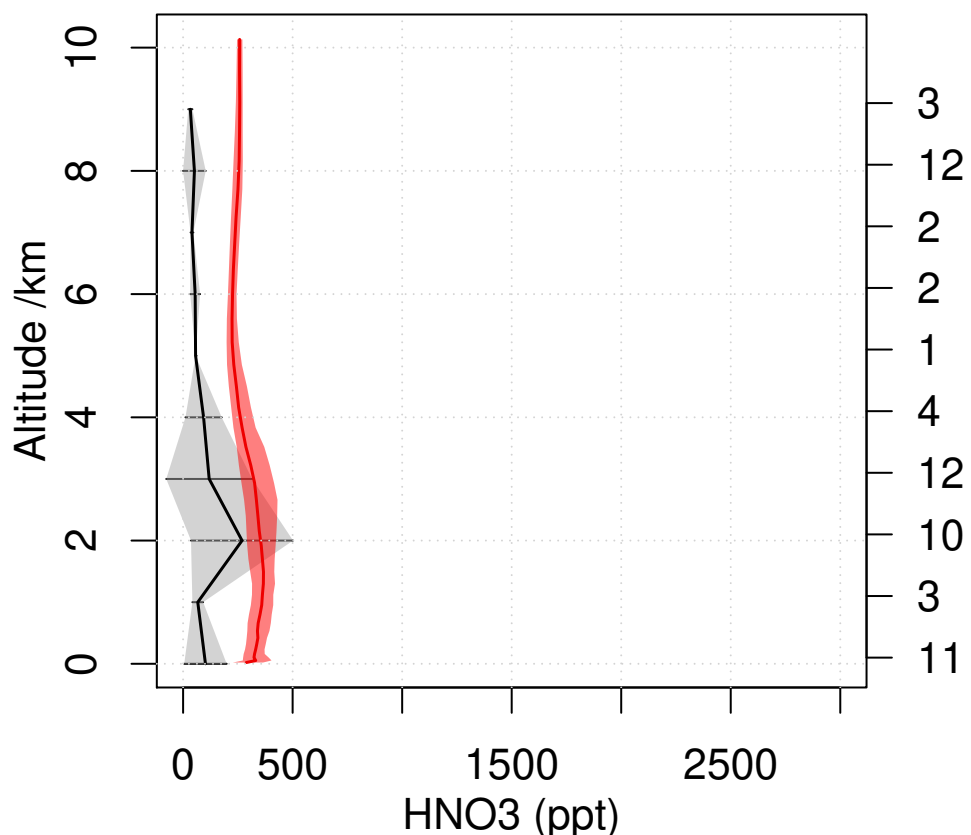
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



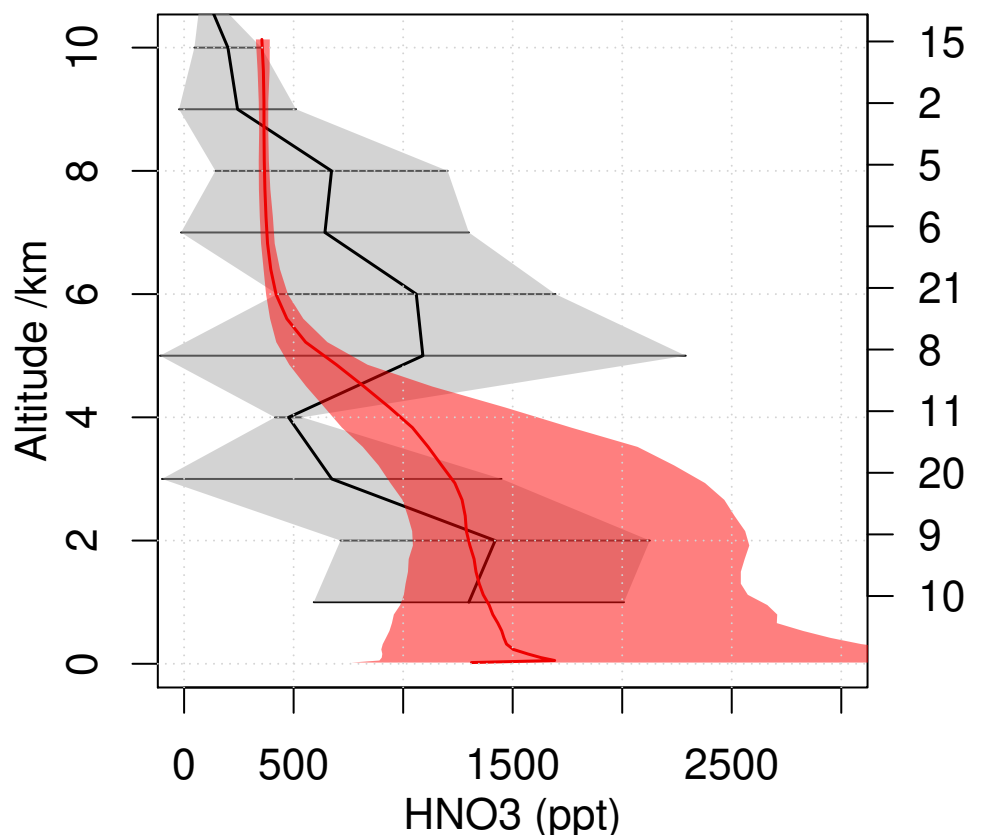
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



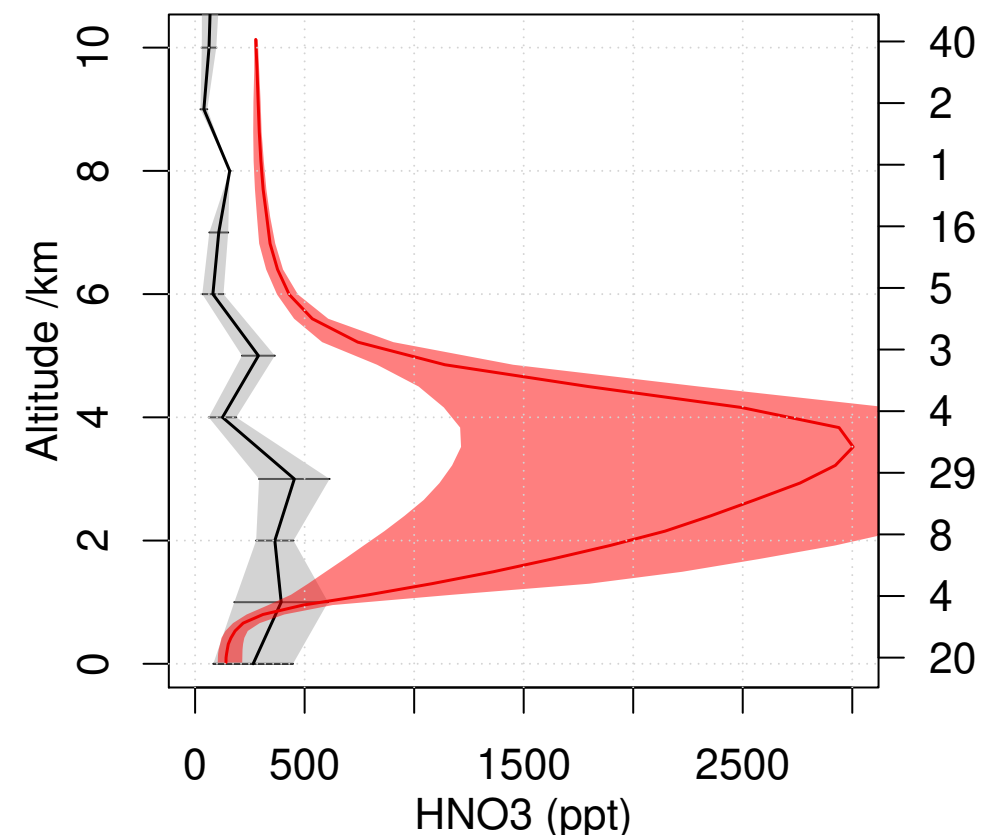
**TRACE-A E-Brazil Coast 1992 09**  
Lat -35 – -25 Lon 310 – 320



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

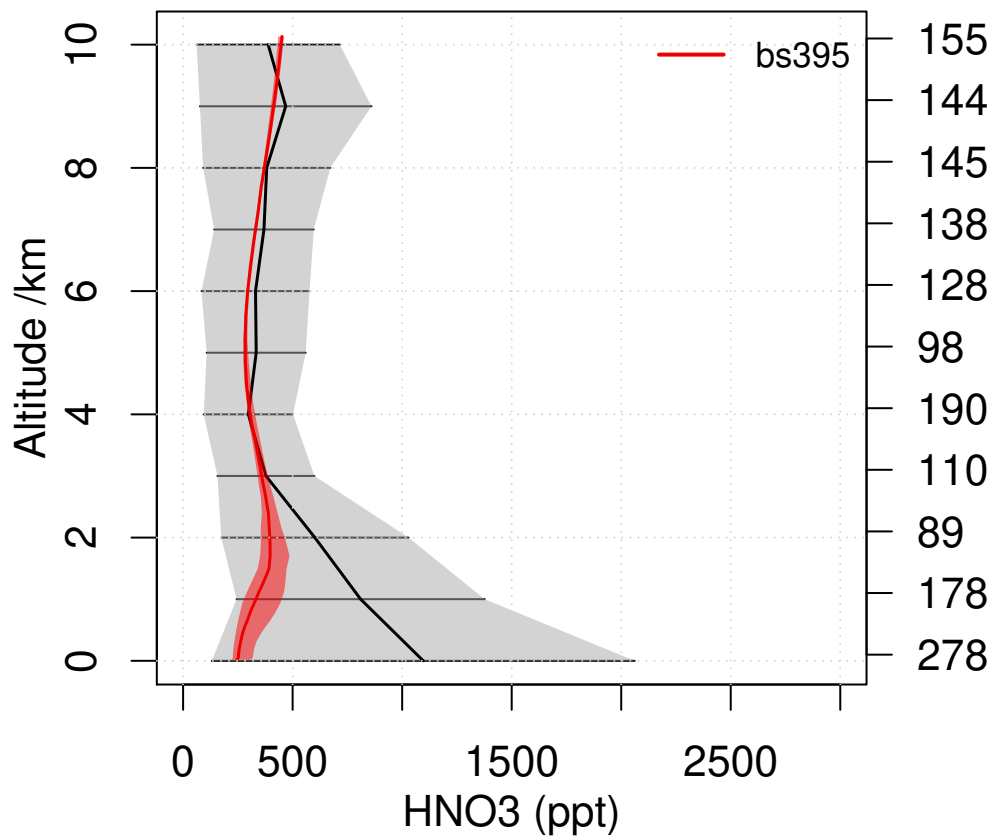


**TRACE-A W-Africa Coast 1992 09**  
Lat -25 – -5 Lon 0 – 10

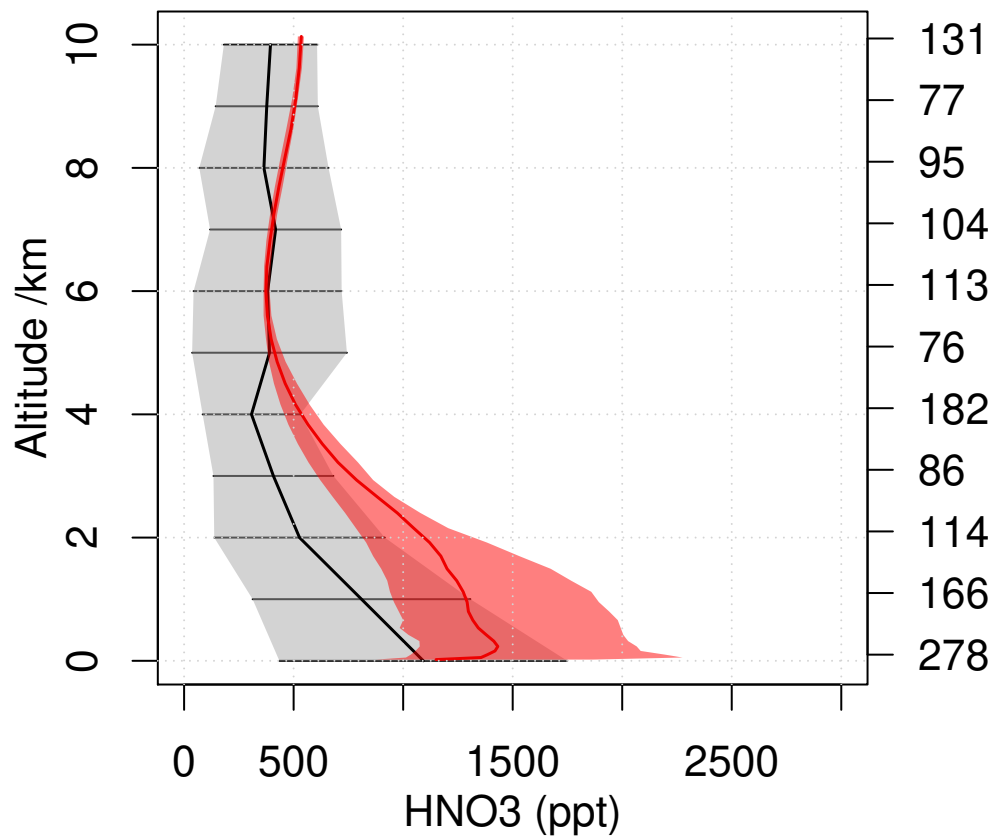


**Emmons HNO3 comparison**

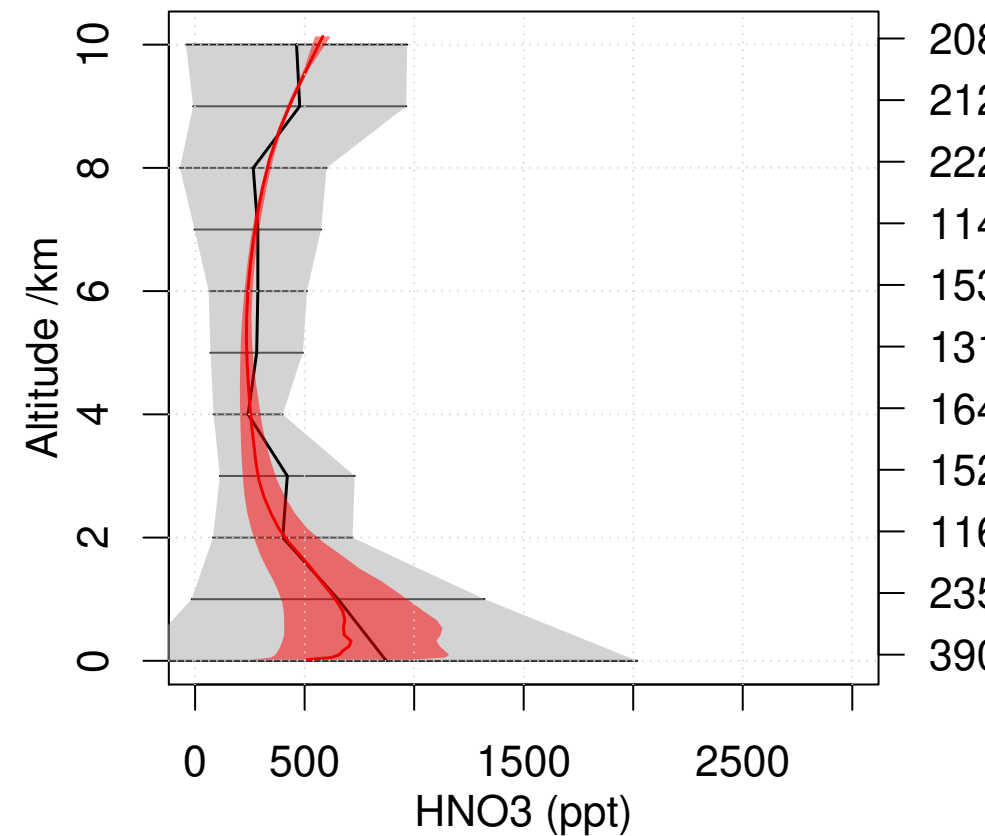
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



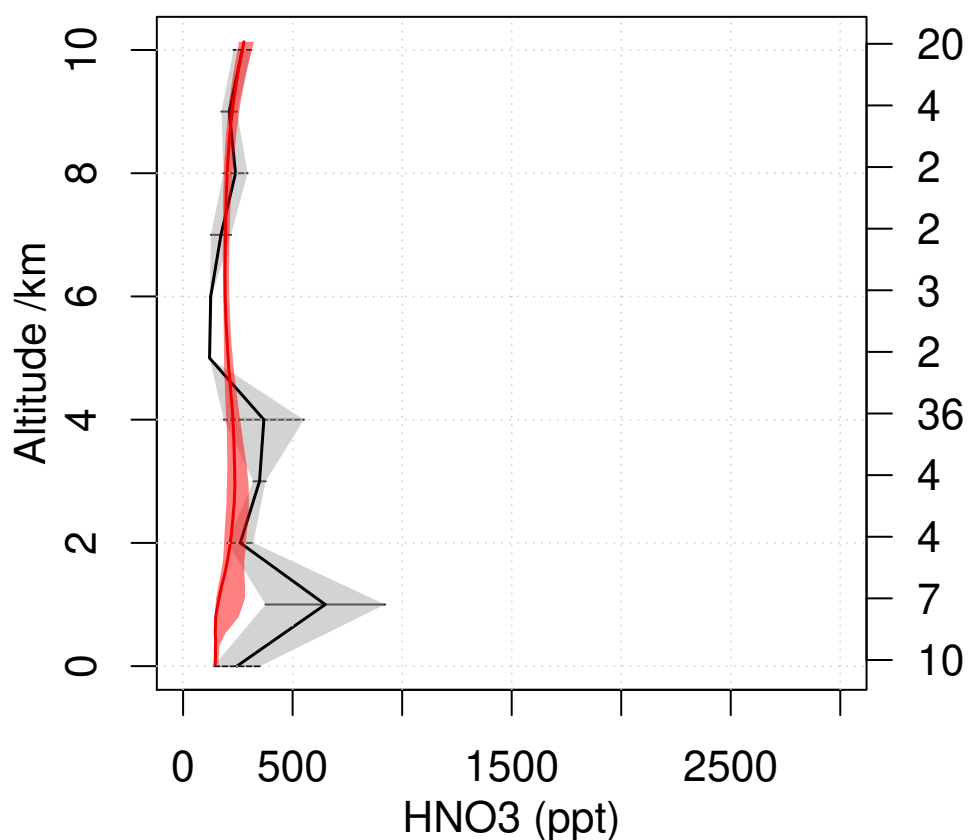
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



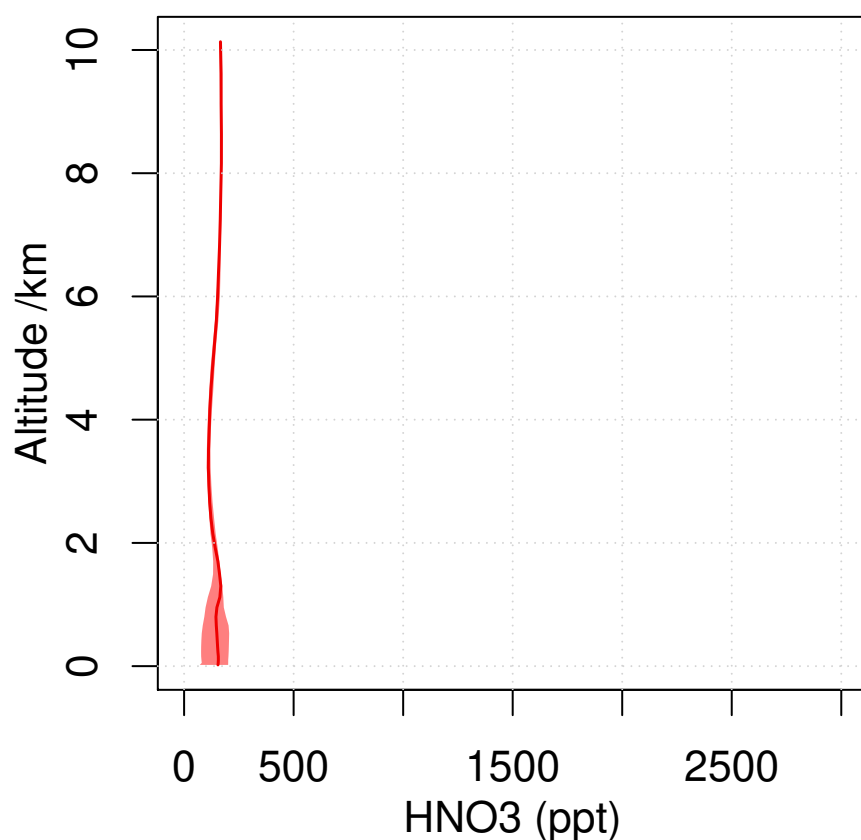
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



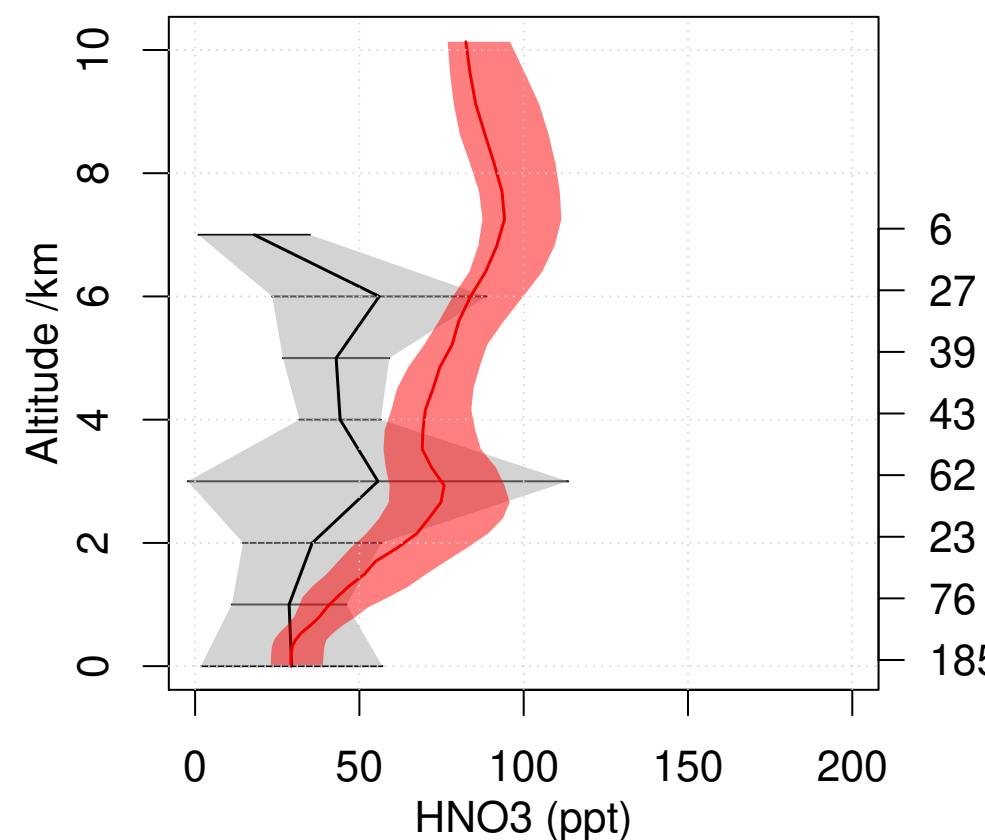
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



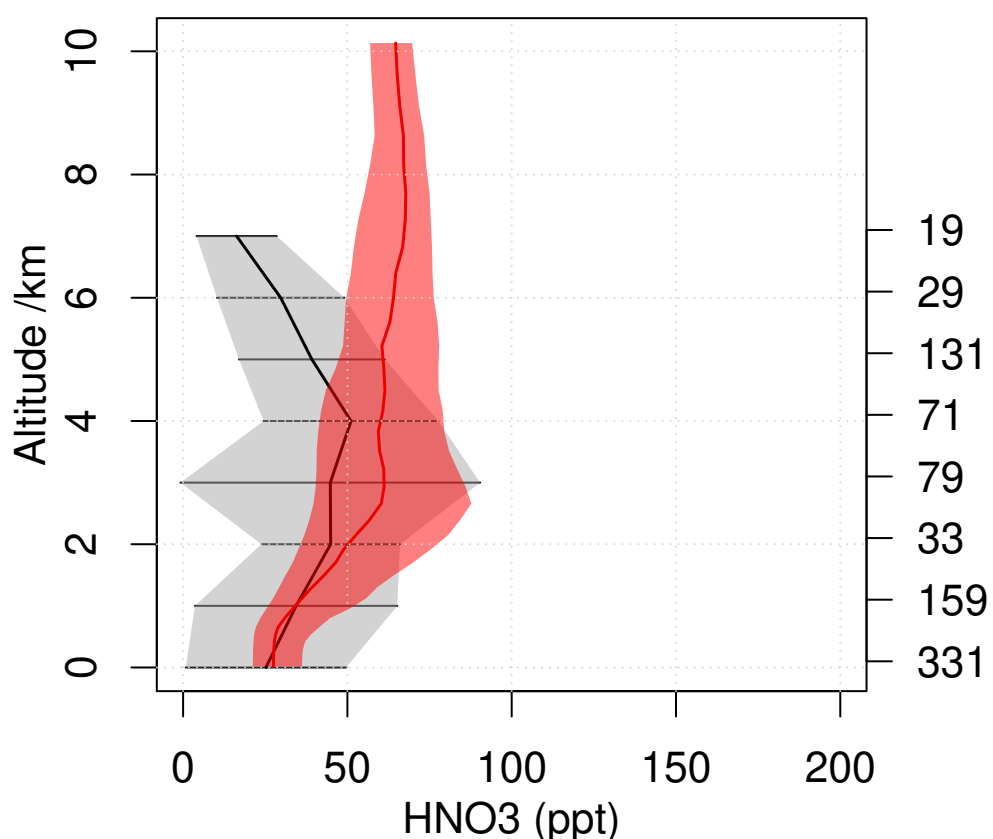
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



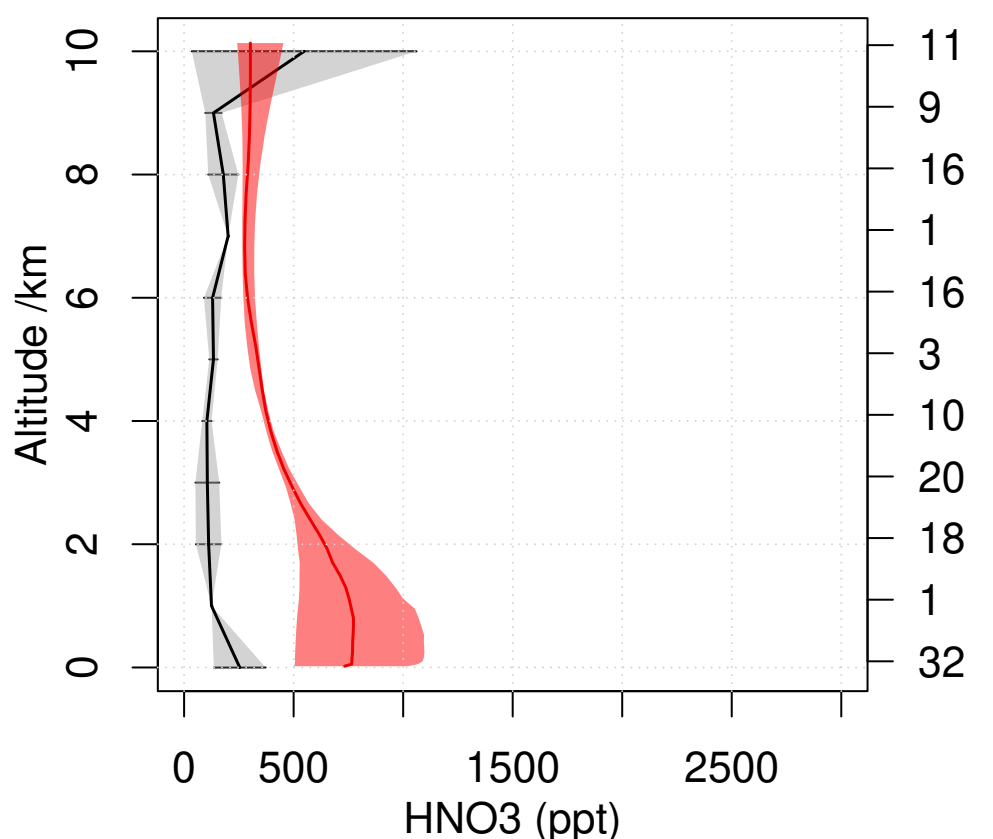
**PEM-Tropics-B Christmas-Island 1999 07**  
Lat 0 – 10 Lon 200 – 220



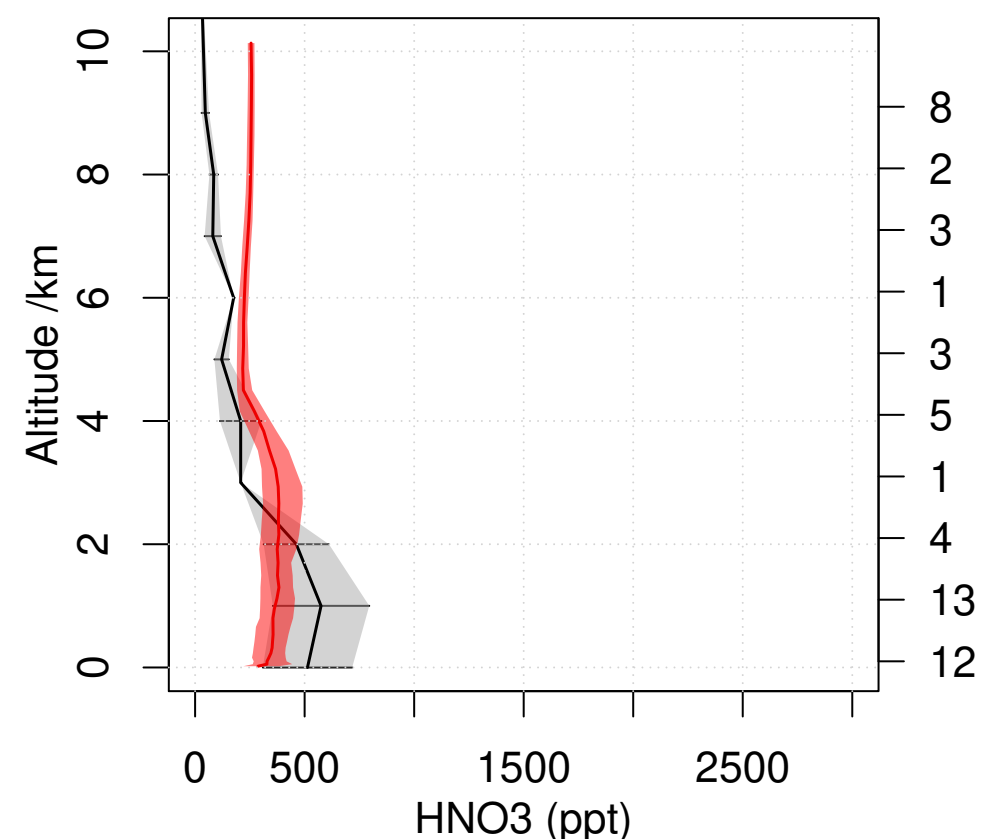
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



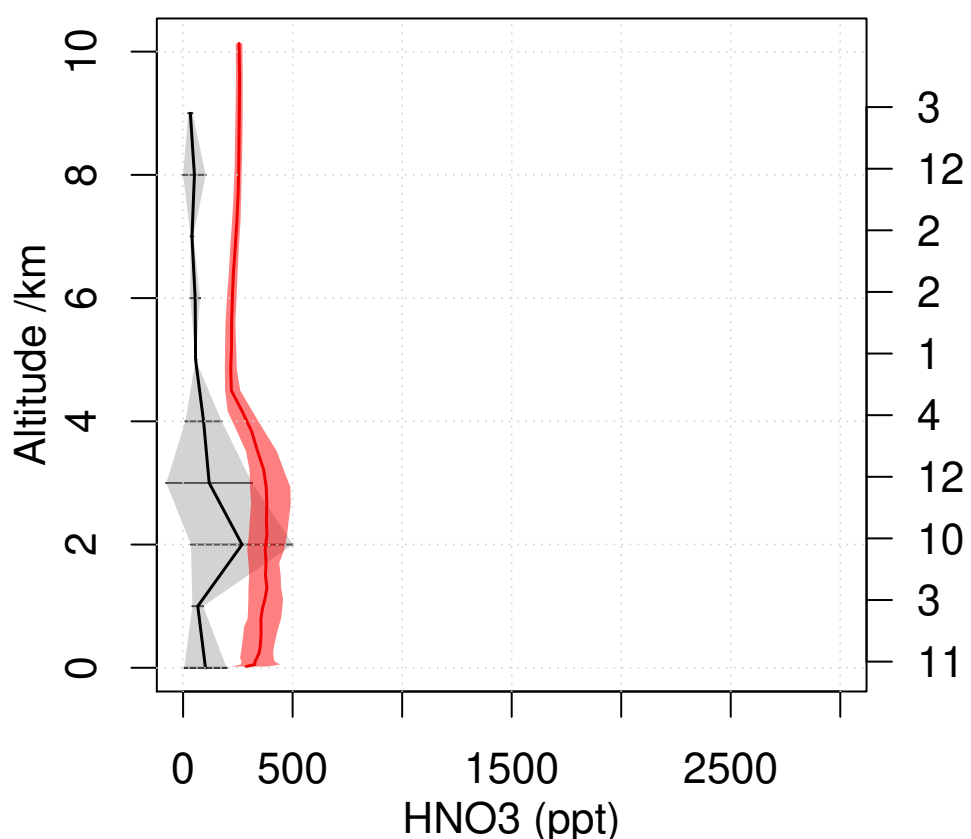
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



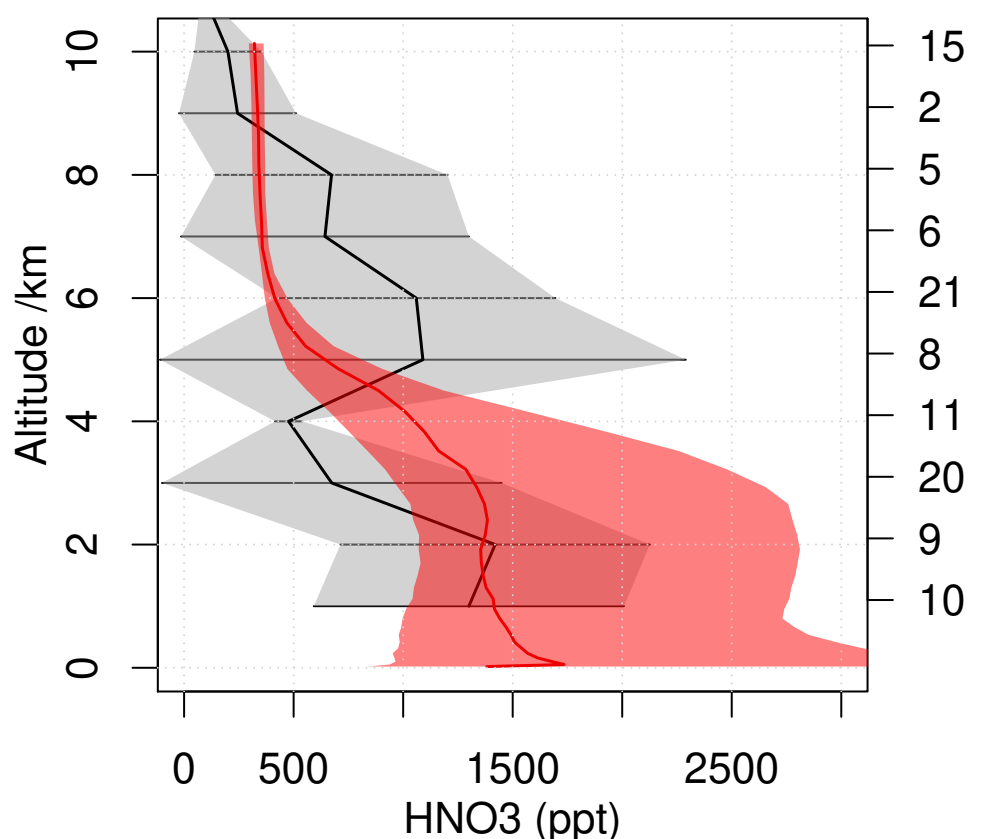
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



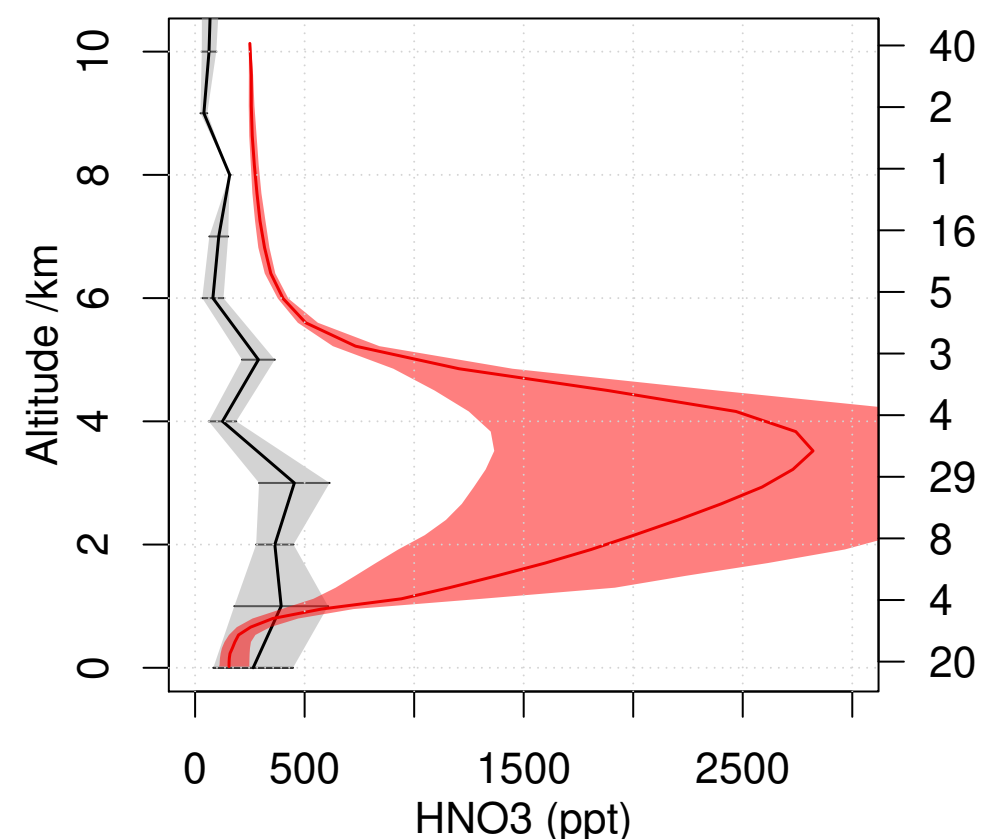
**TRACE-A E-Brazil Coast 1992 09**  
Lat -35 – -25 Lon 310 – 320



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



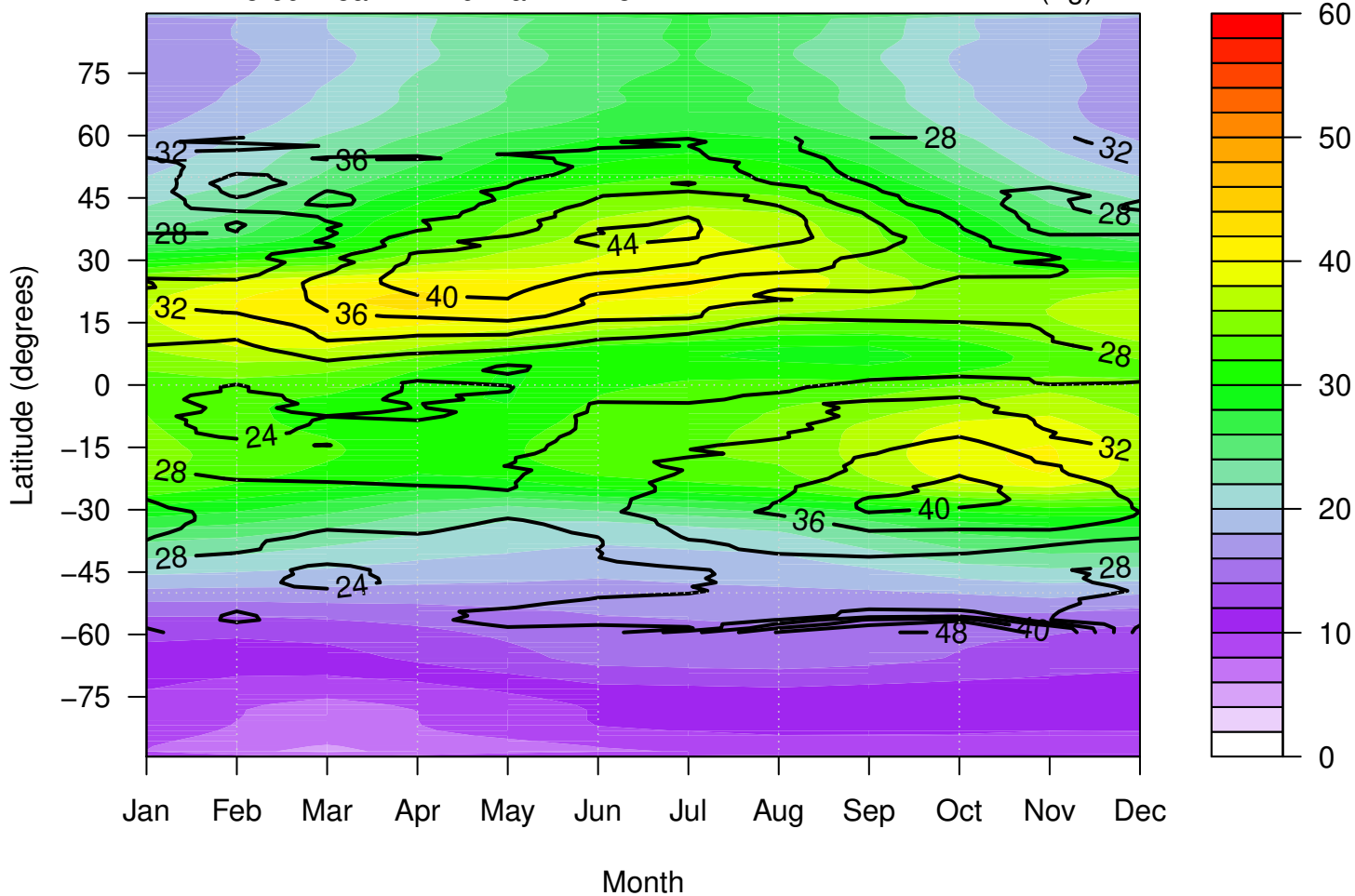
**TRACE-A W-Africa Coast 1992 09**  
Lat -25 – -5 Lon 0 – 10



# bo717 tropospheric O<sub>3</sub> column

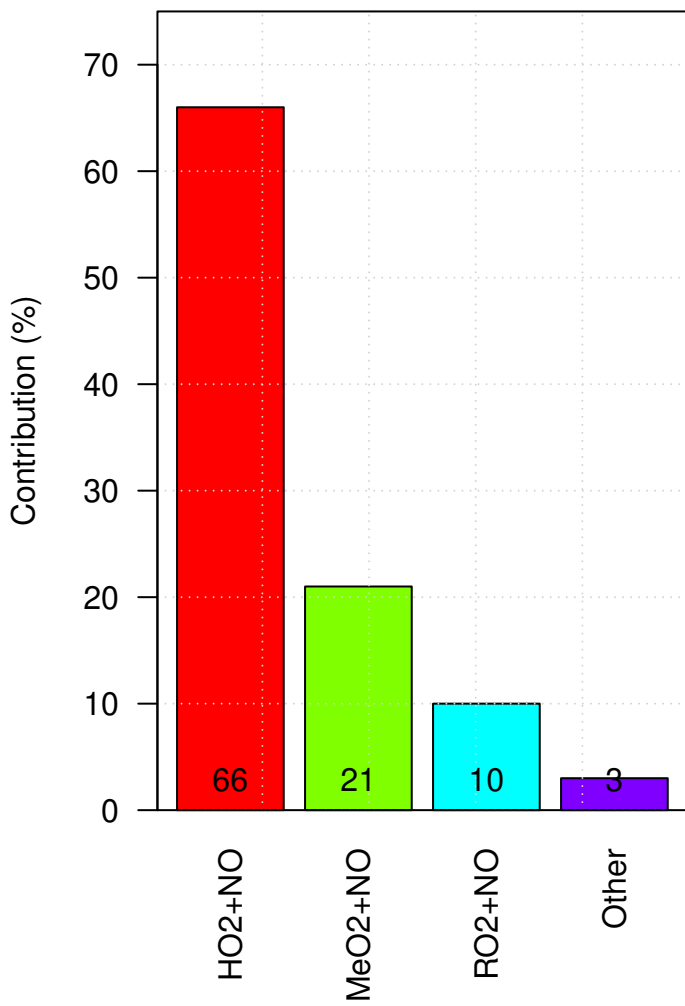
Min = 5.69 Mean = 24.9 Max = 42.5

Burden (Tg) = 312

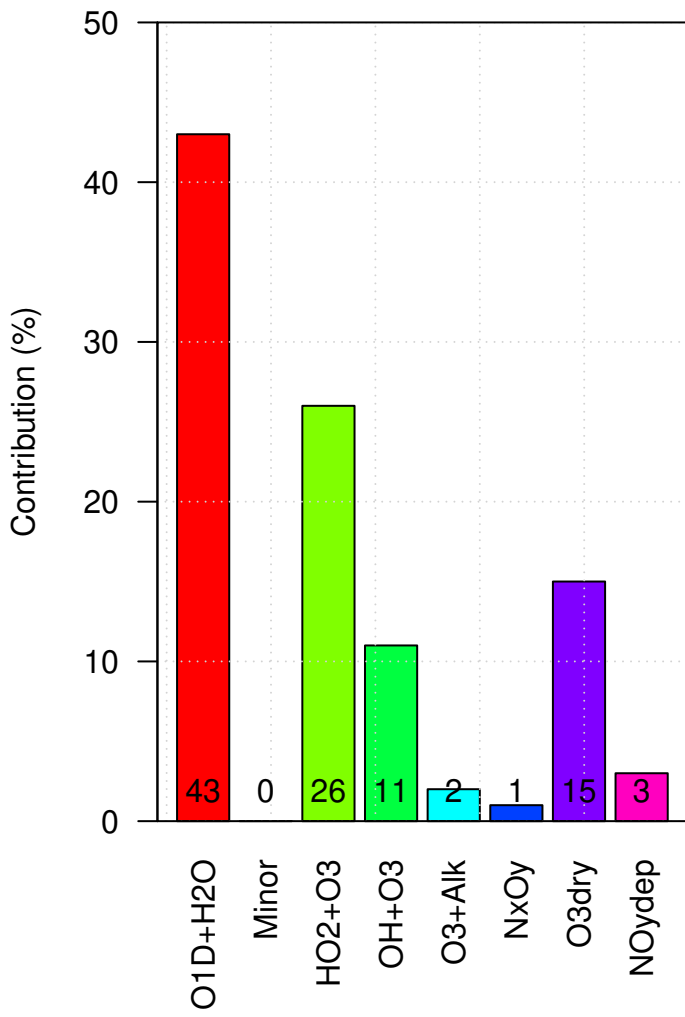




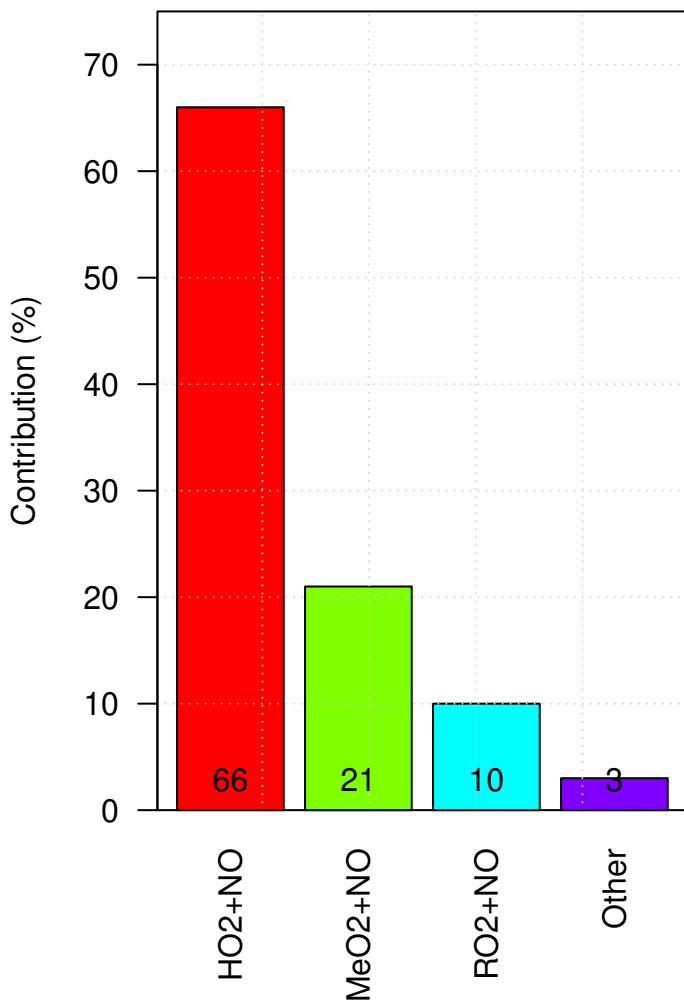
### bo717 Production of Tropospheric Ox



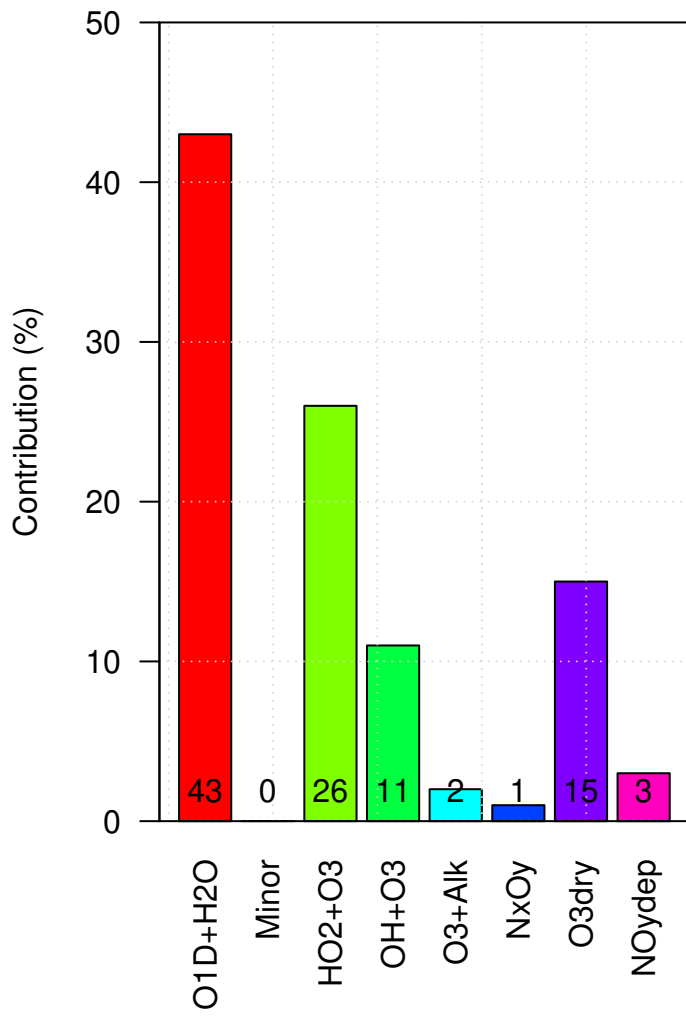
### bo717 Loss of Tropospheric Ox



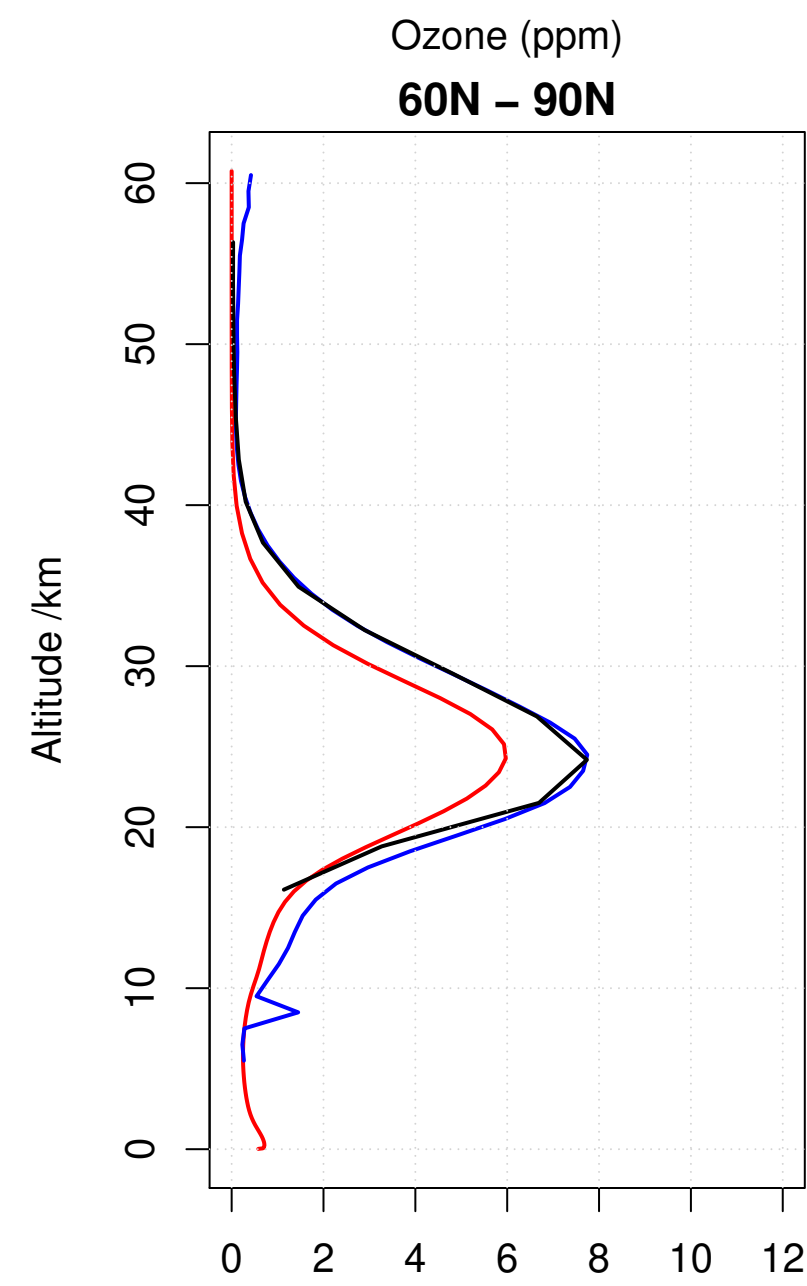
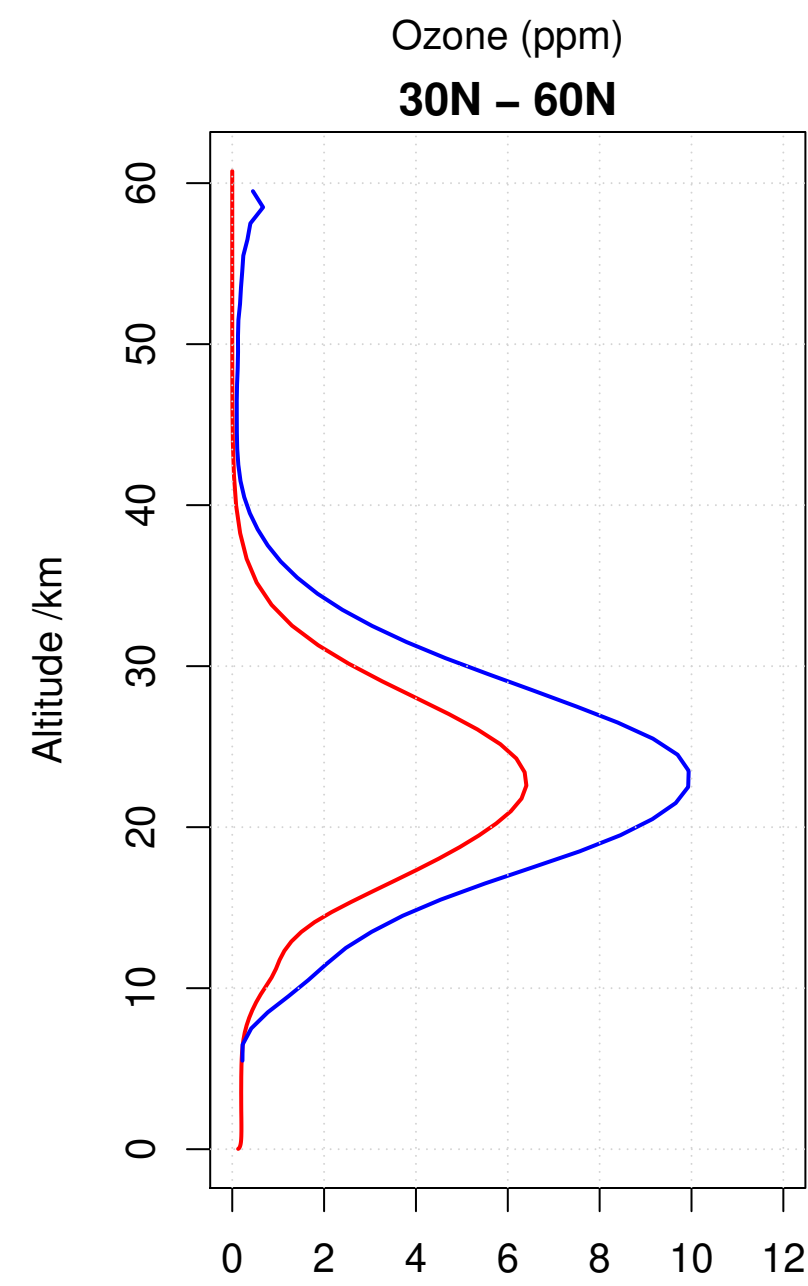
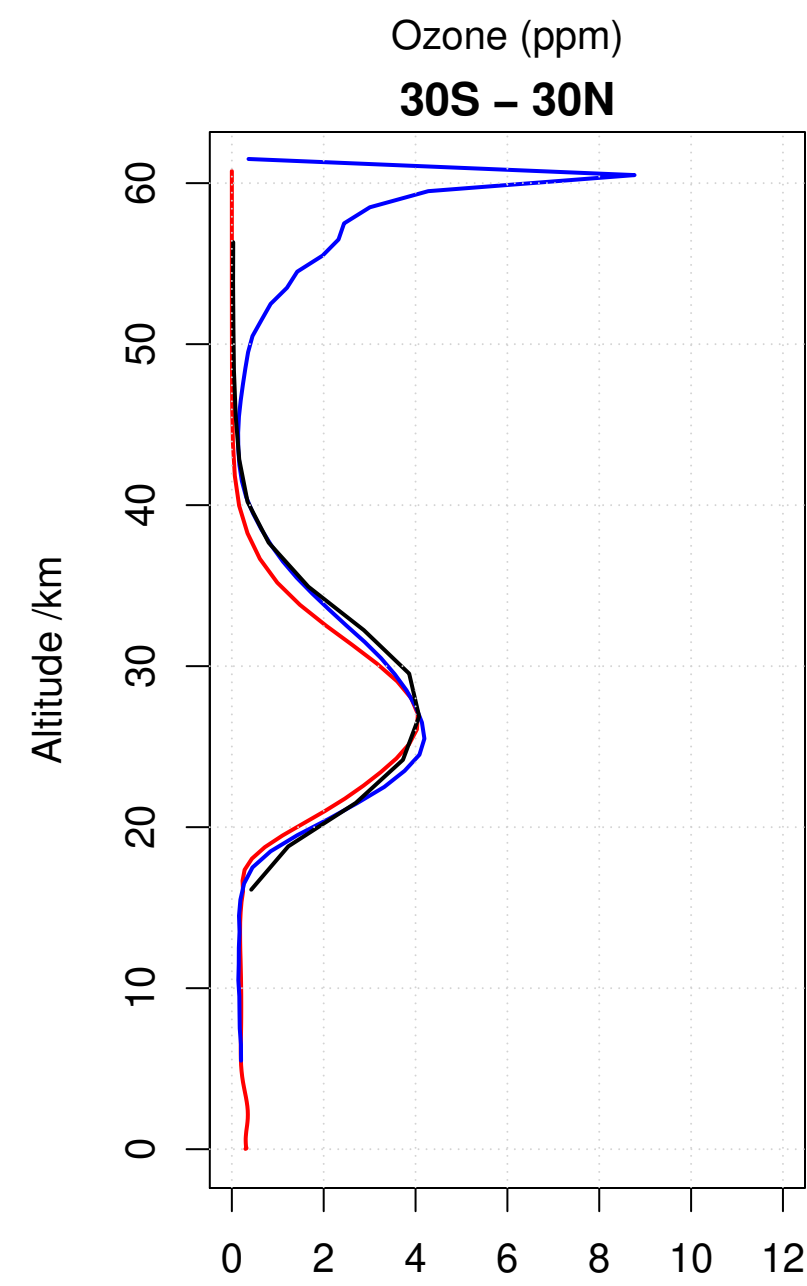
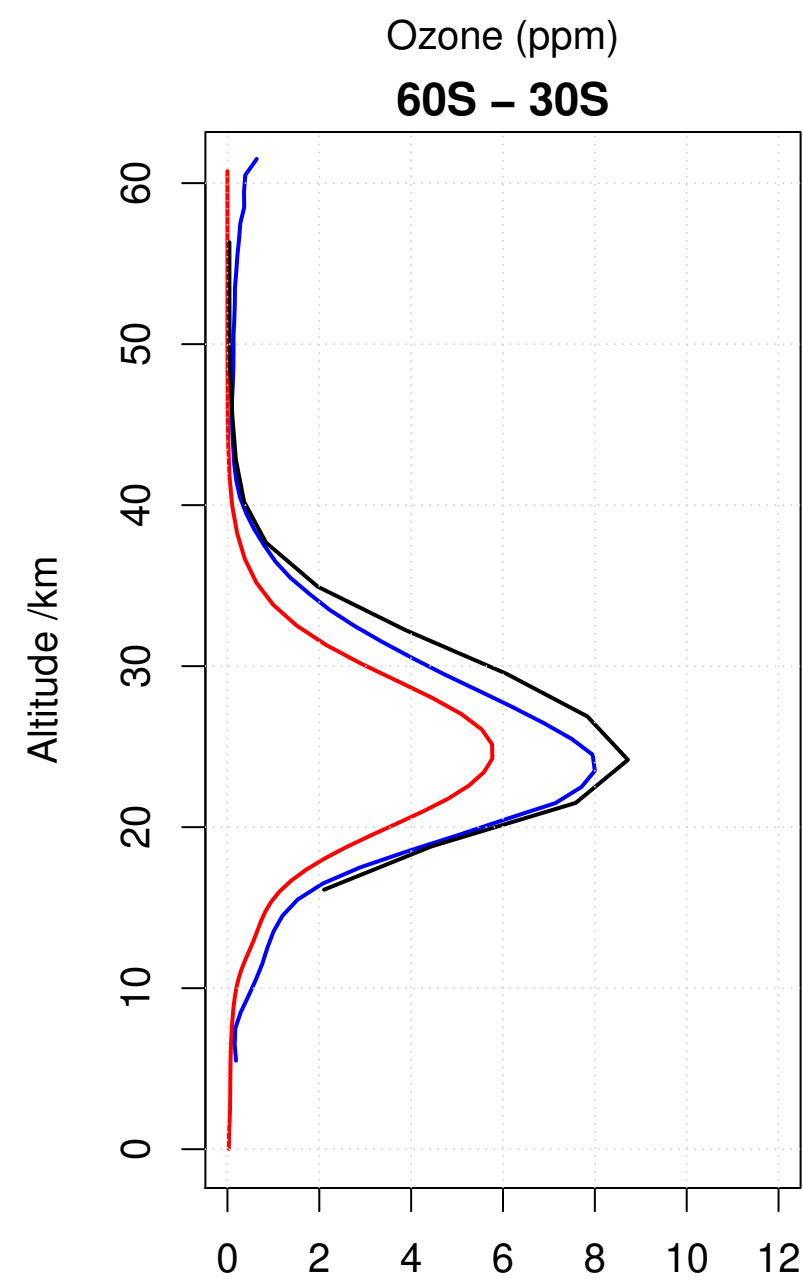
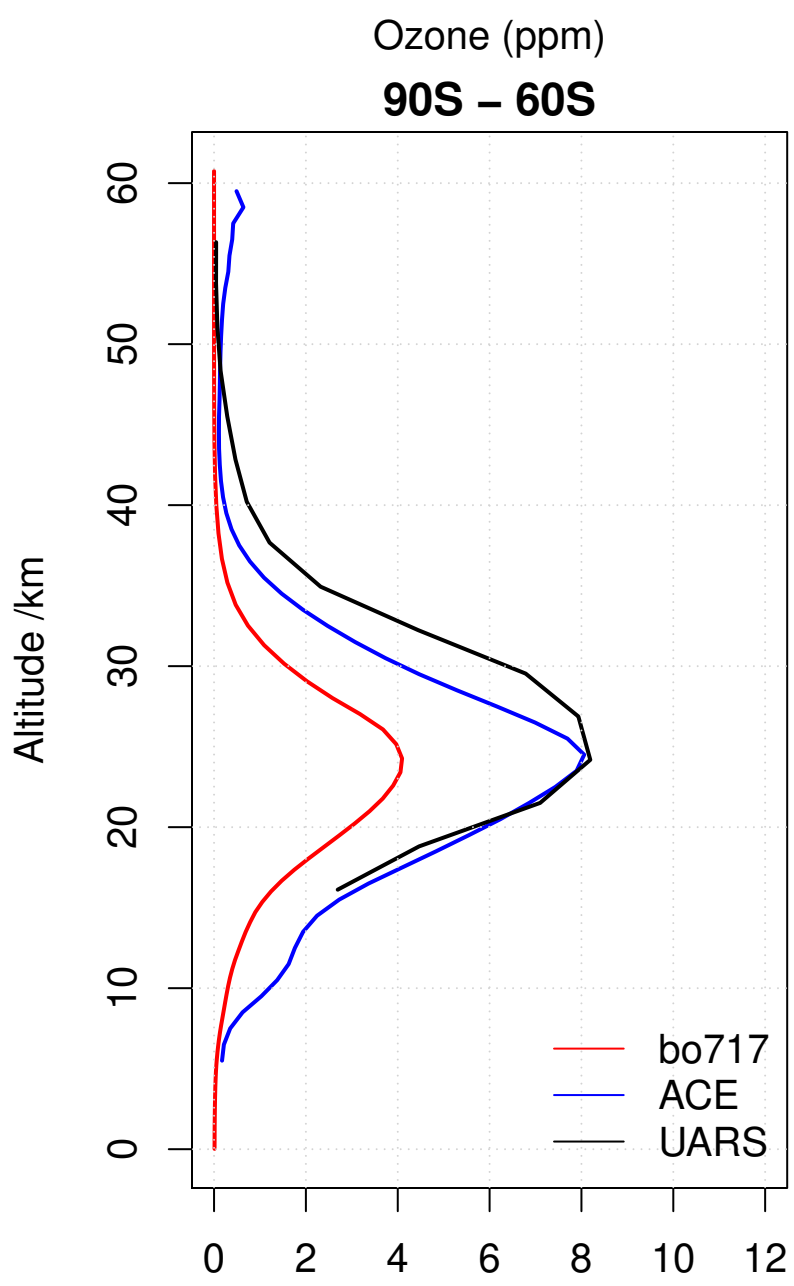
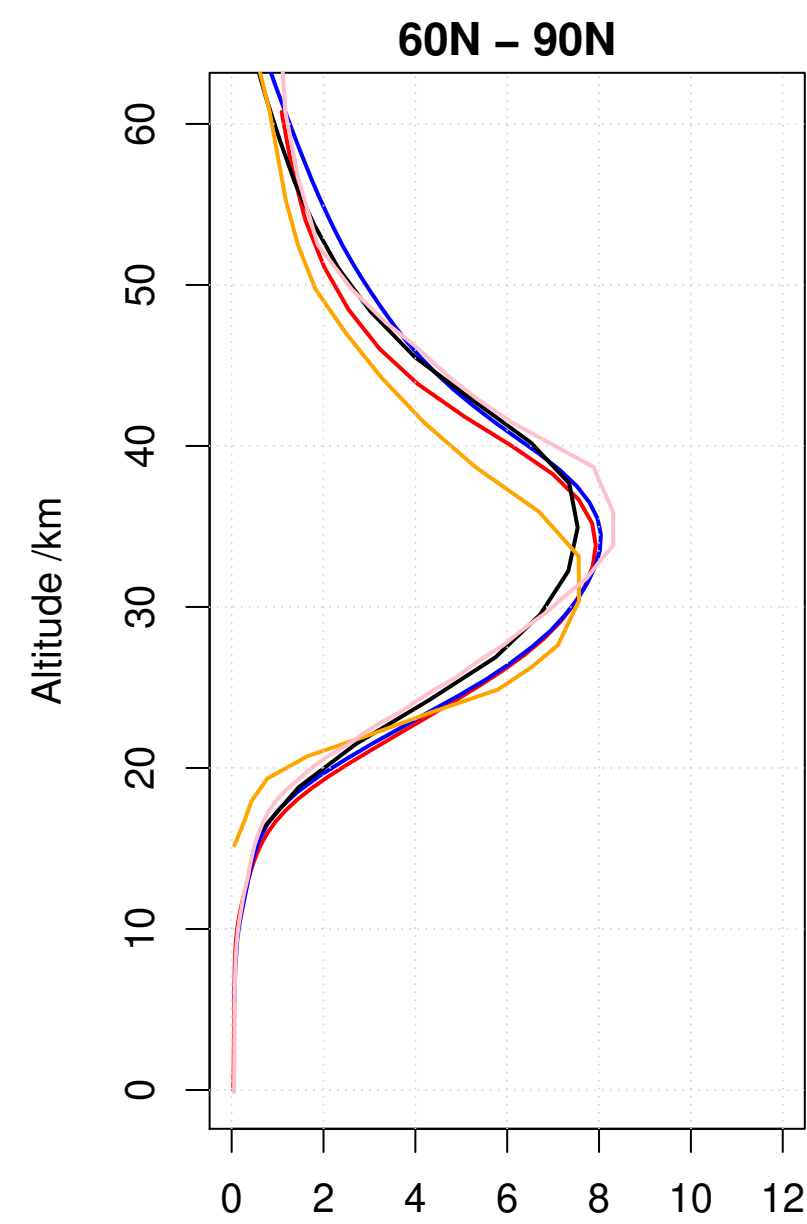
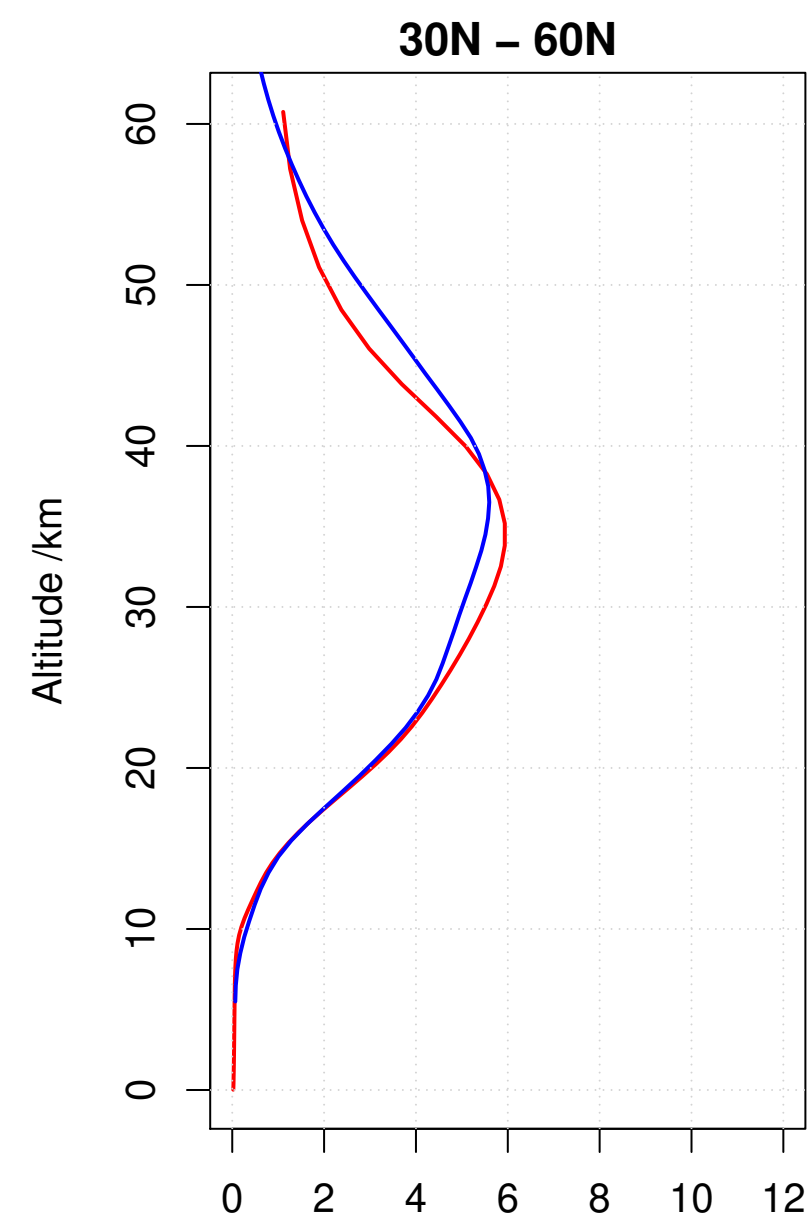
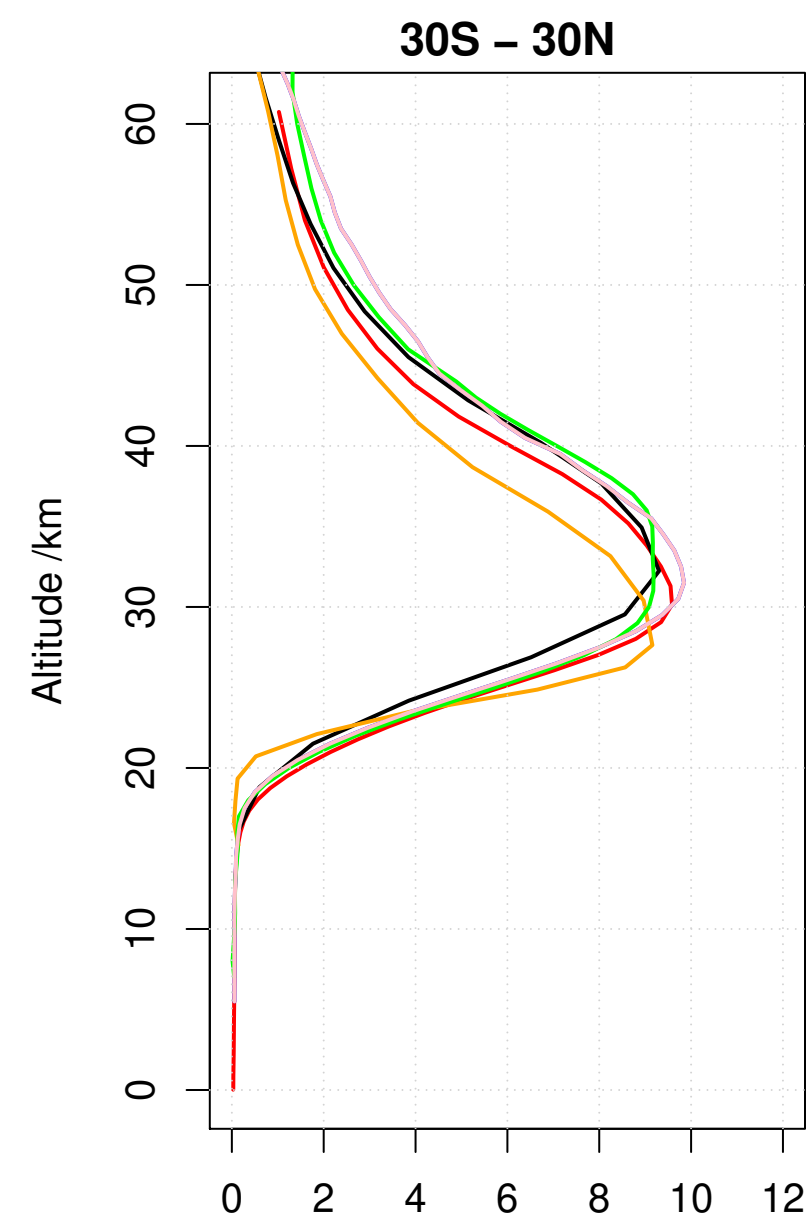
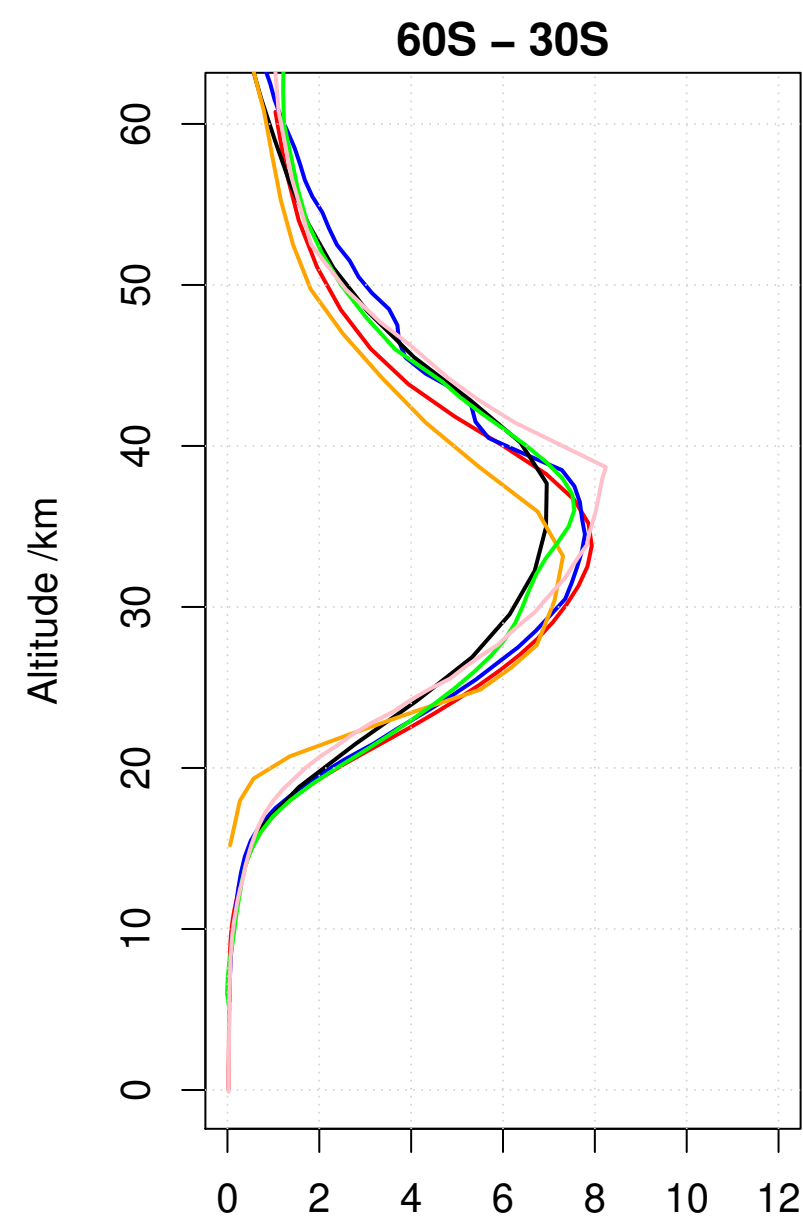
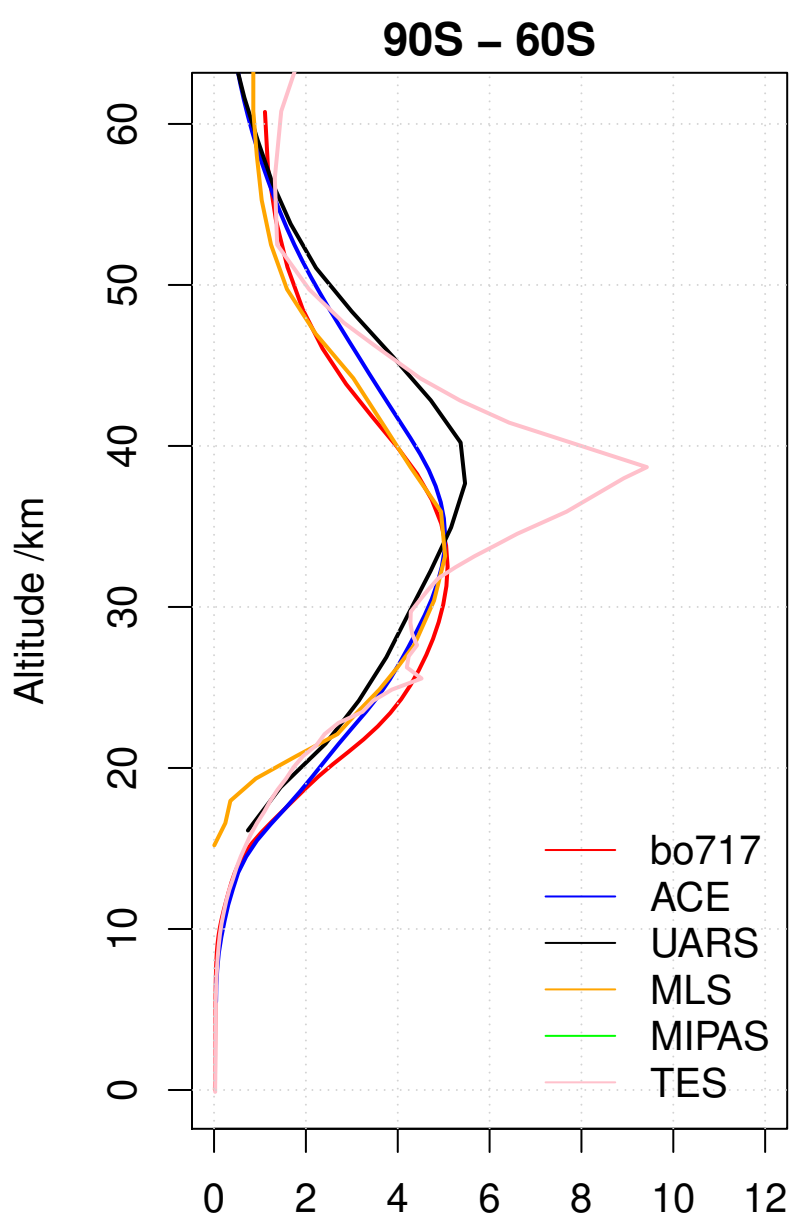
### bs395 Production of Tropospheric Ox

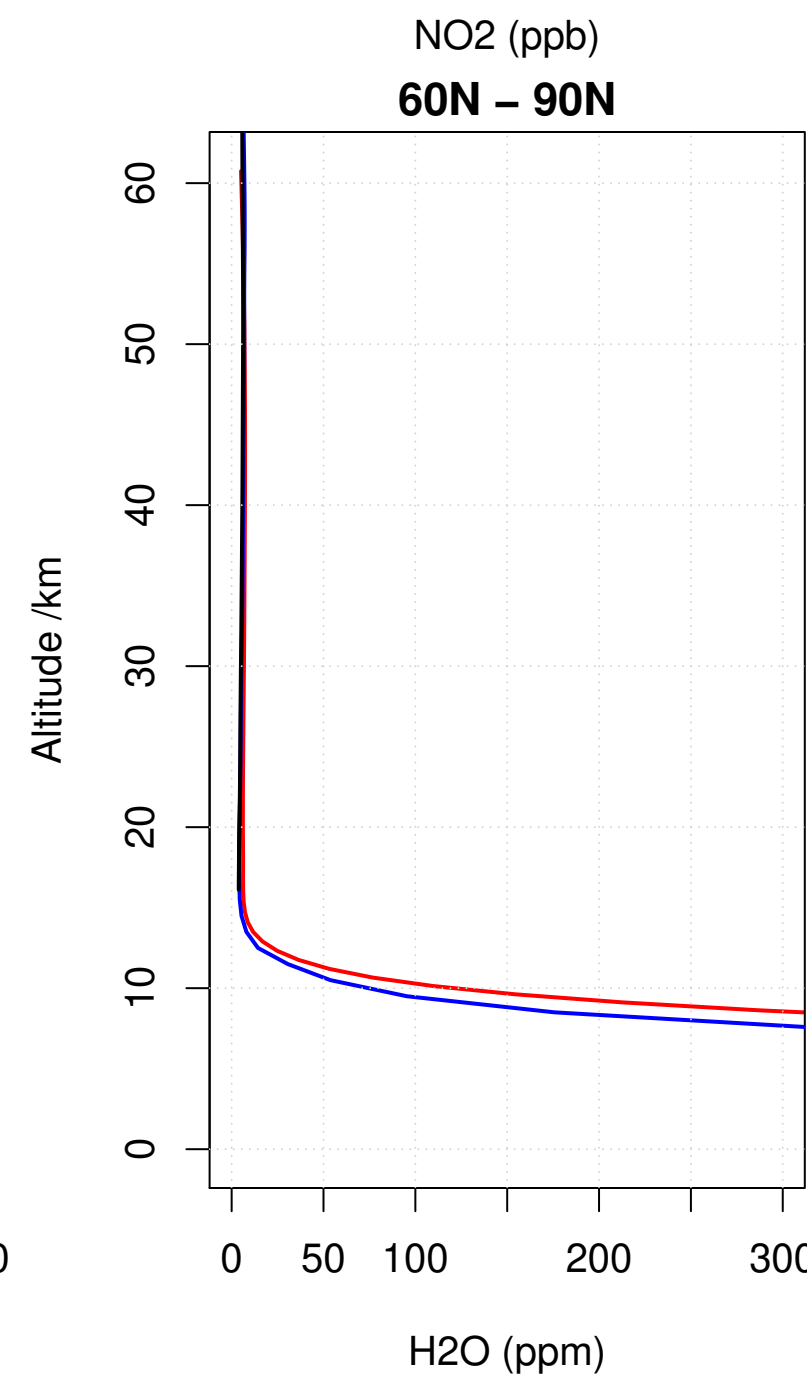
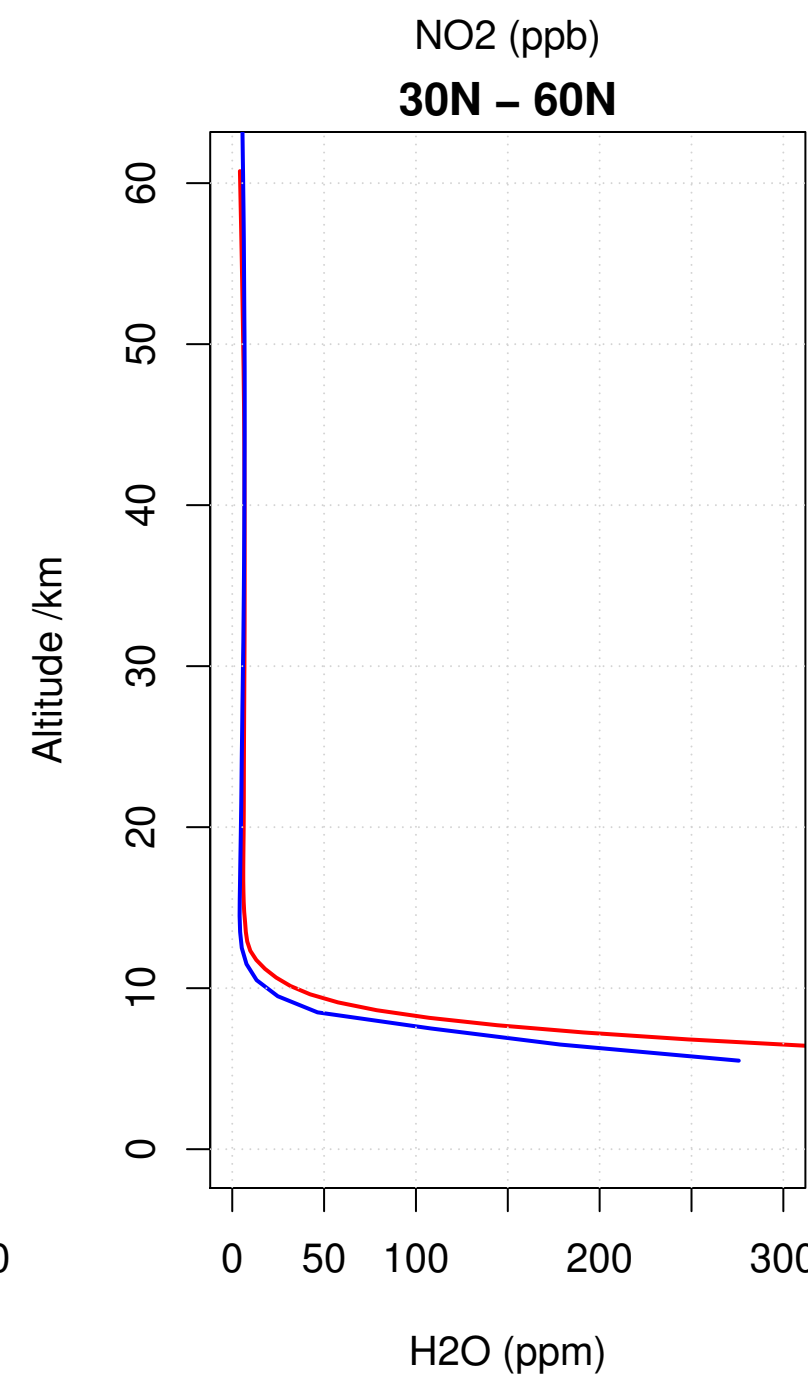
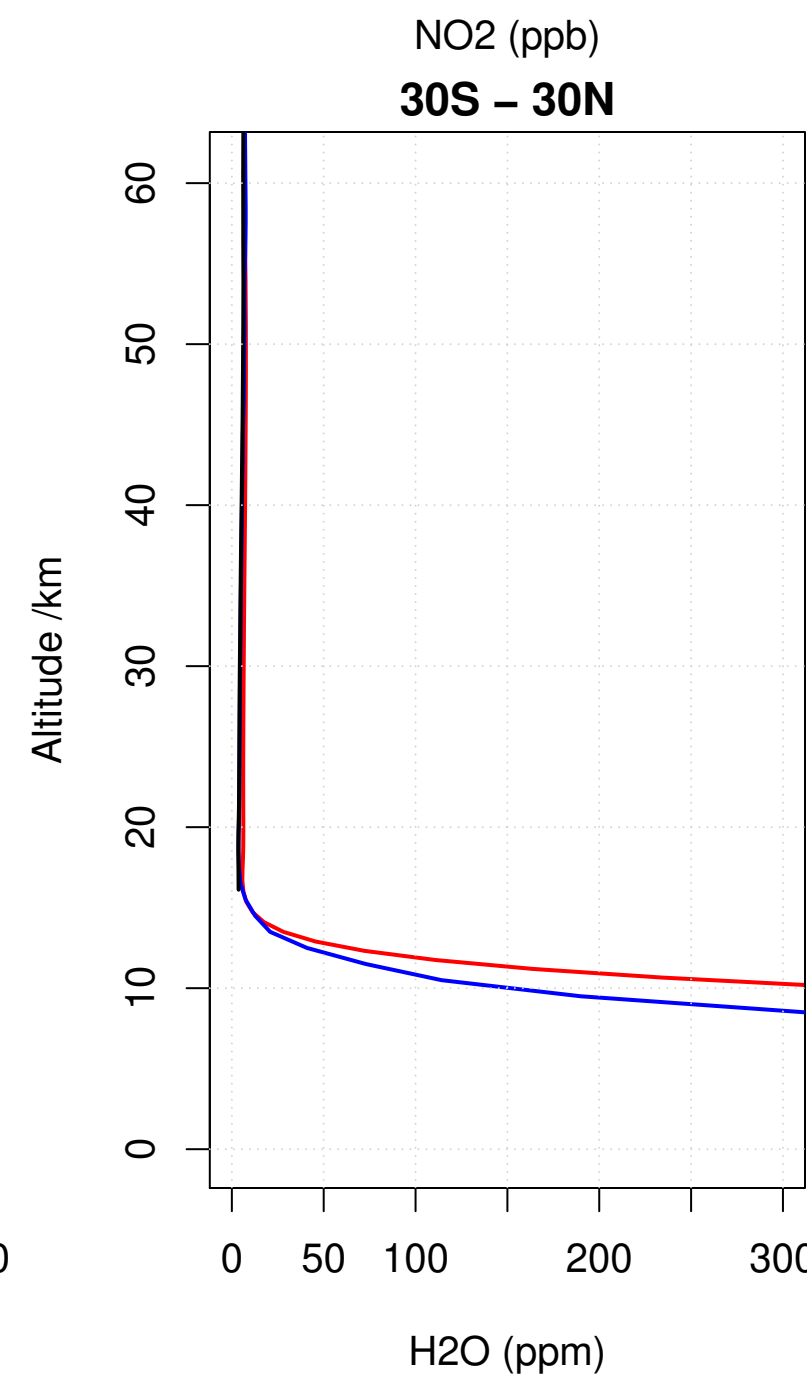
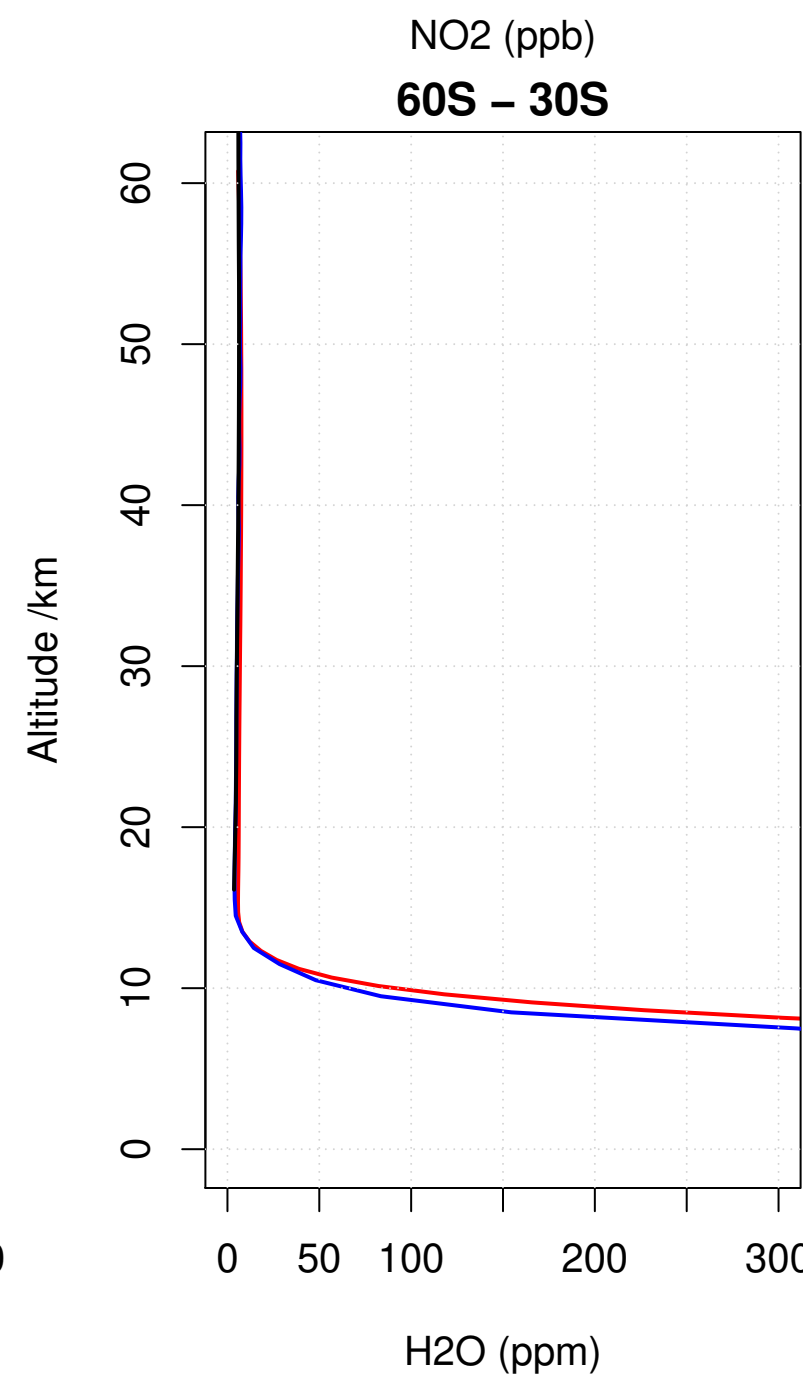
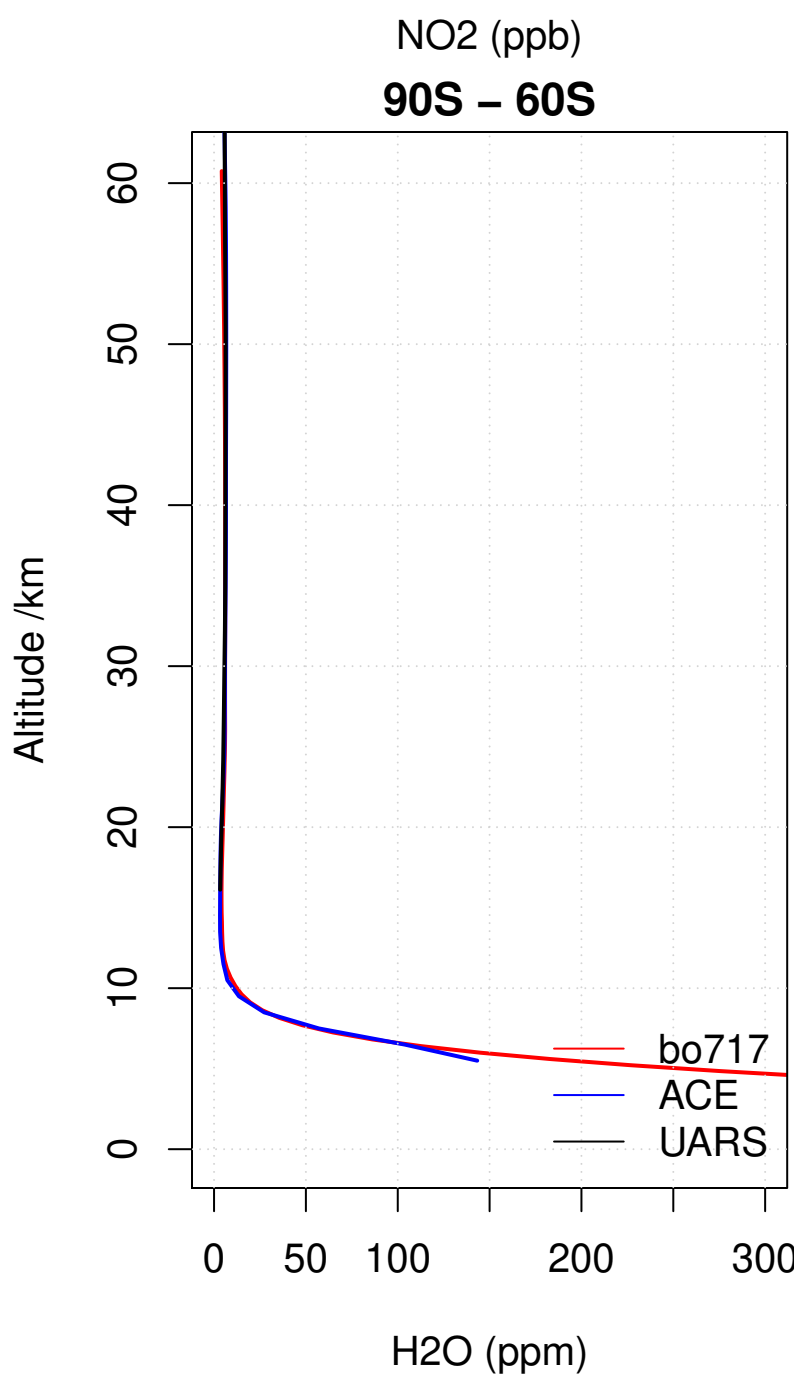
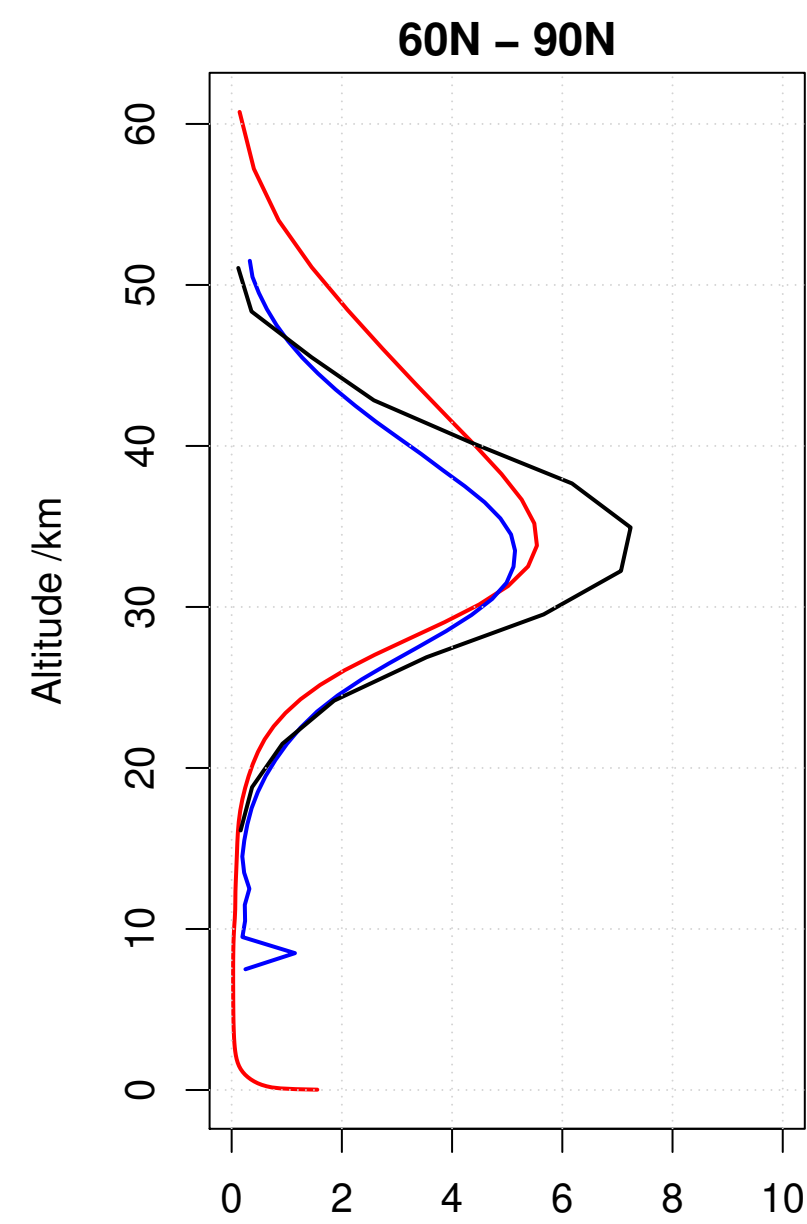
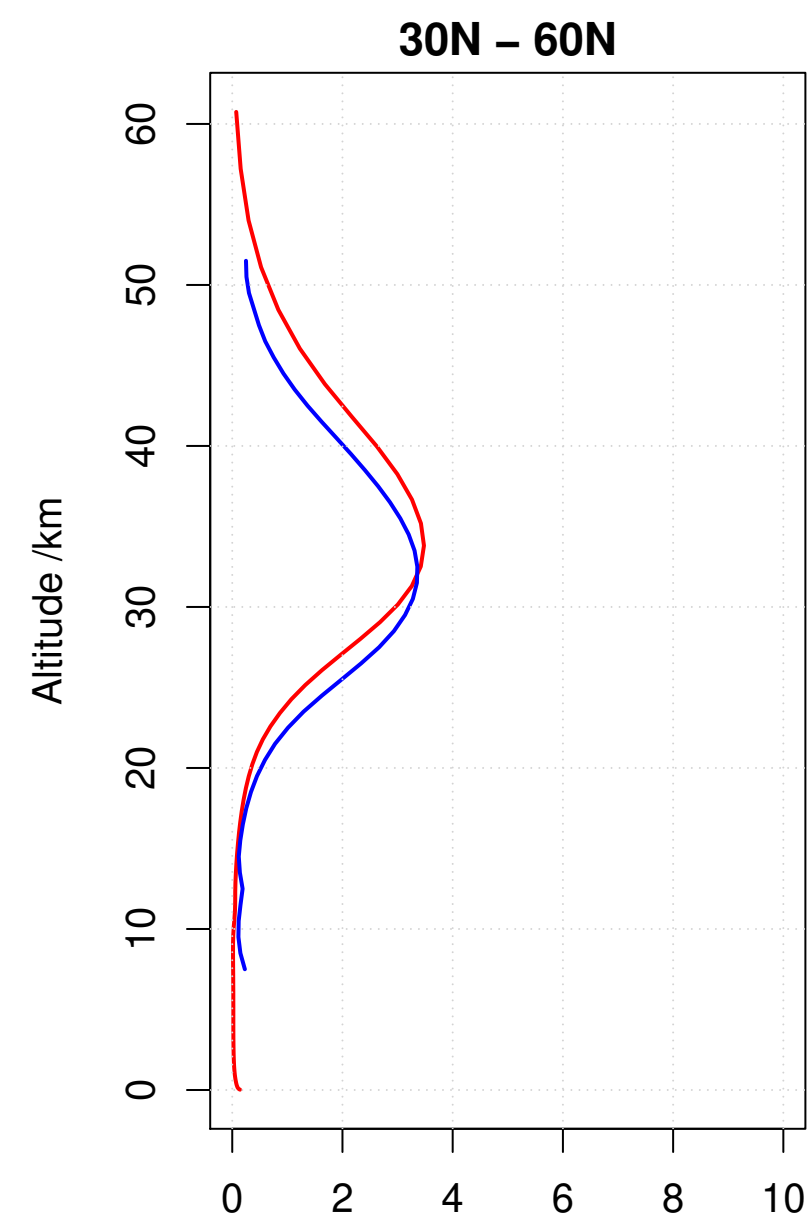
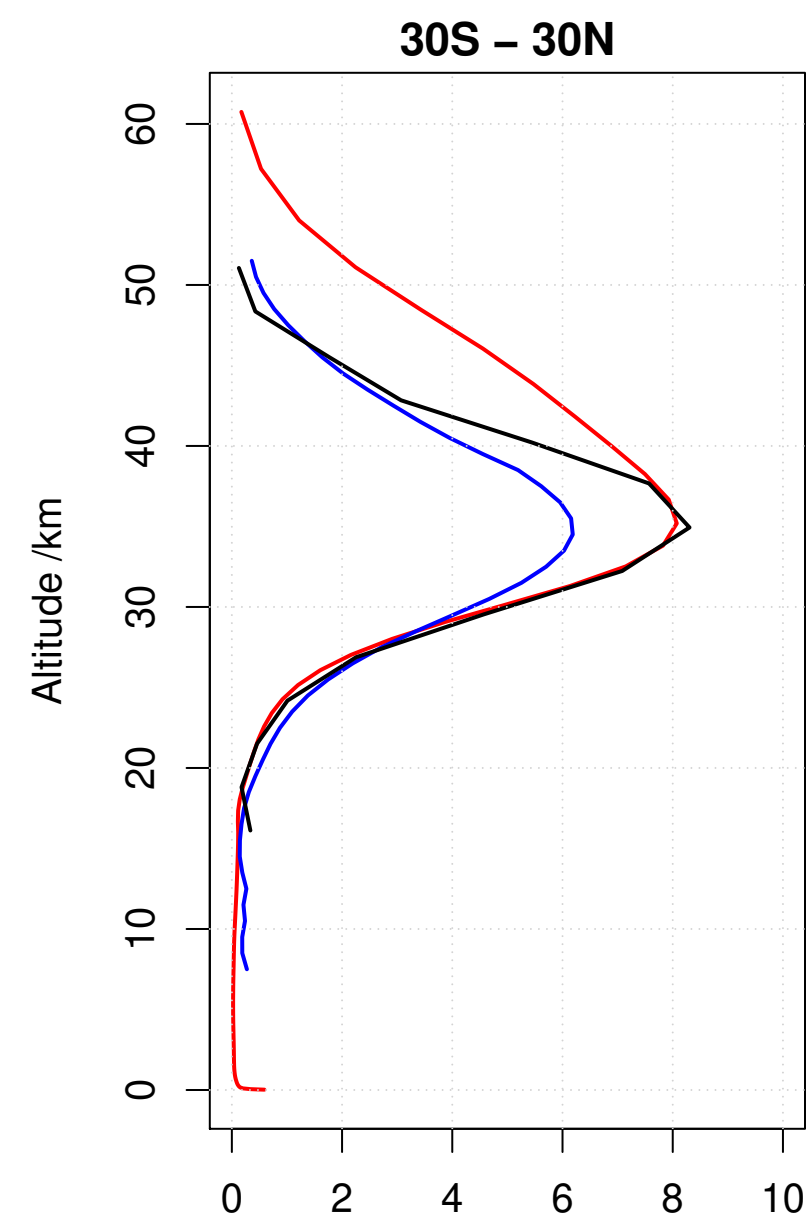
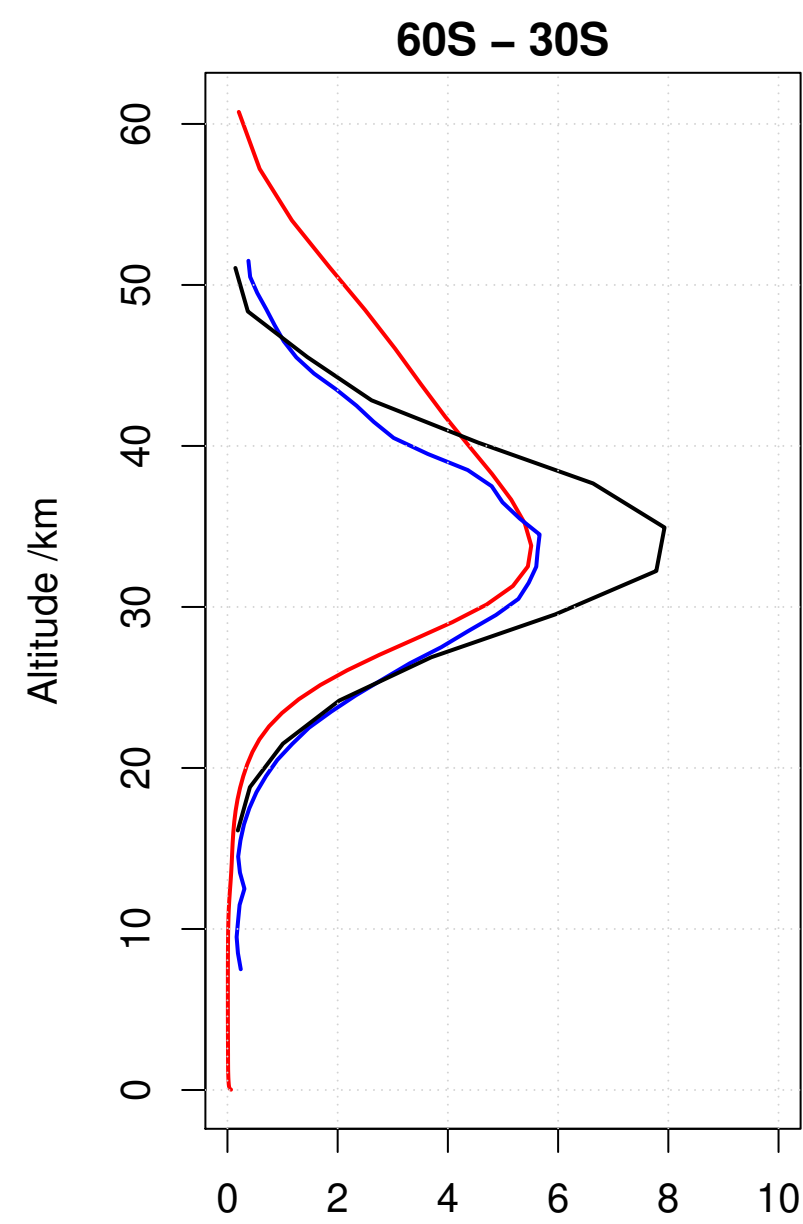
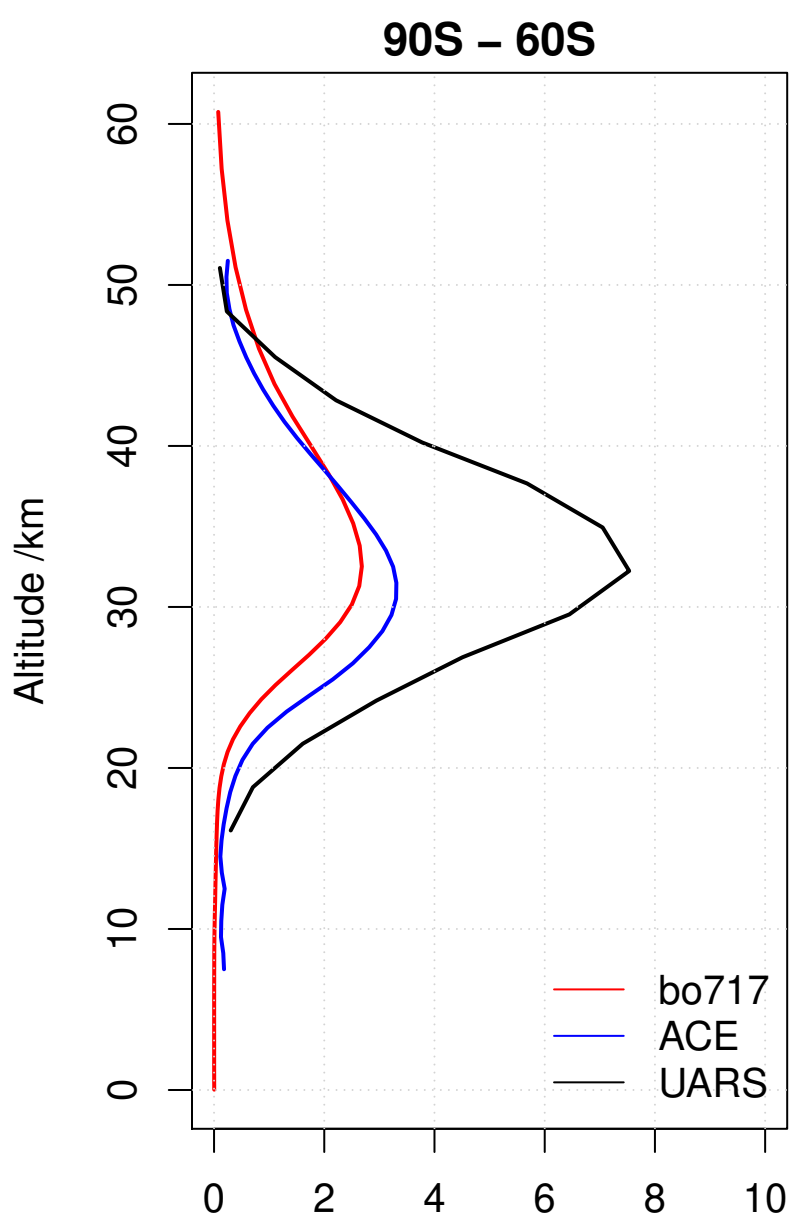


### bs395 Loss of Tropospheric Ox

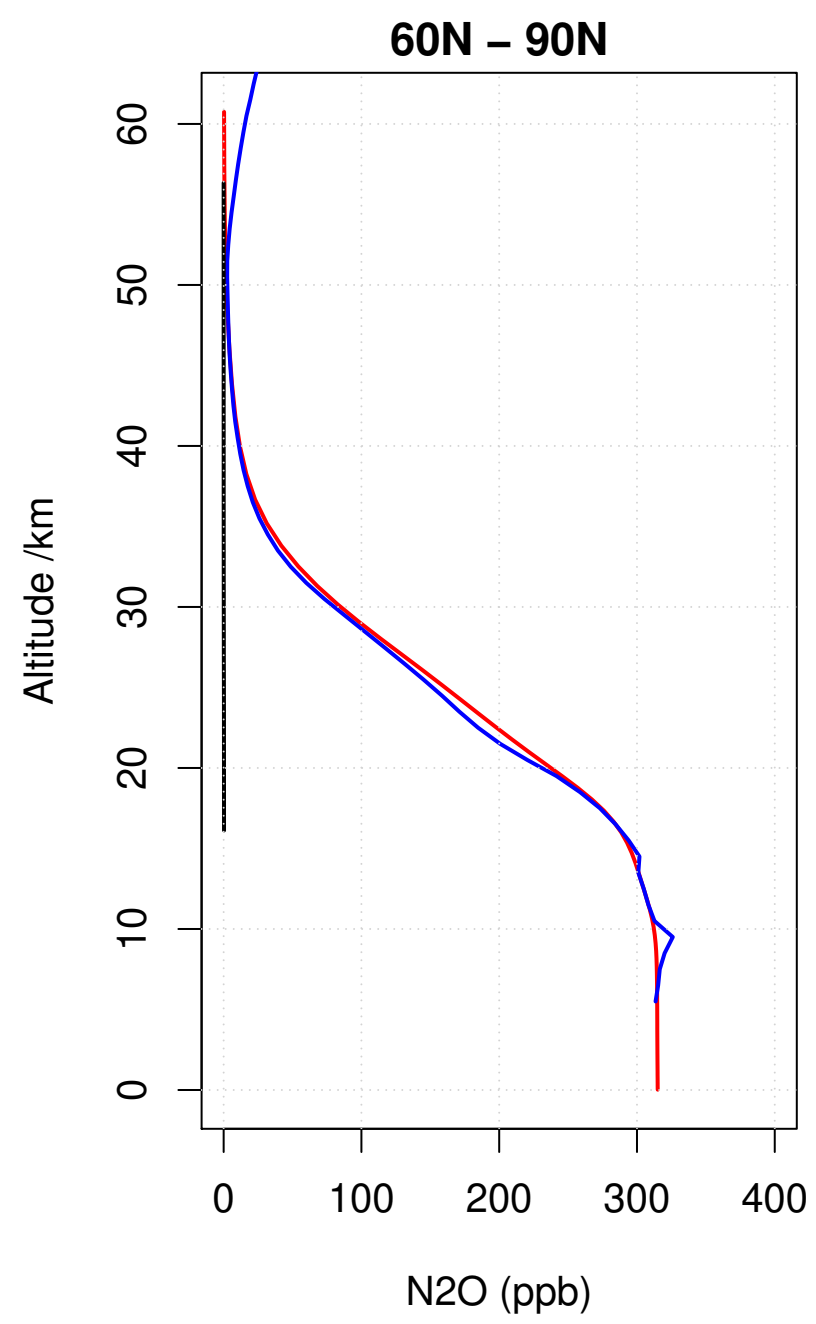
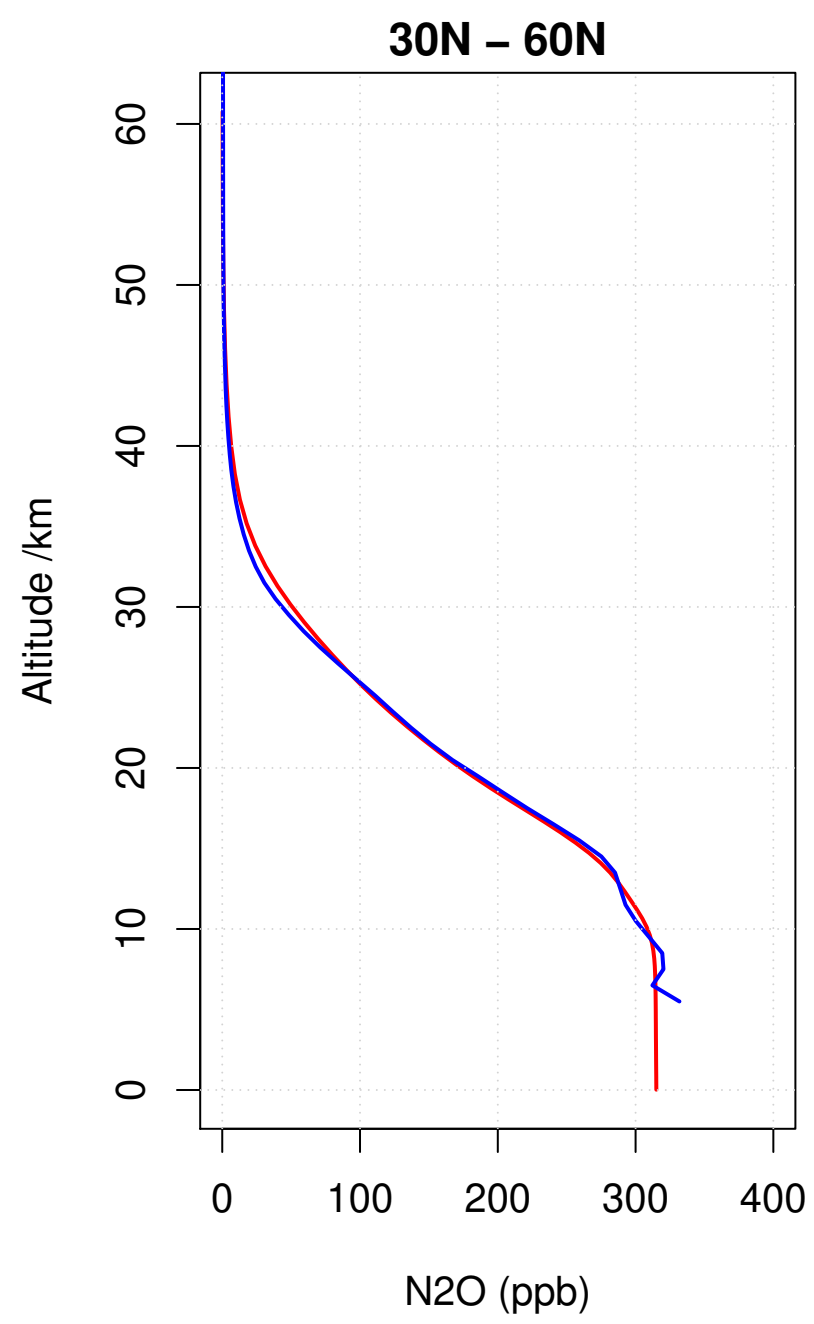
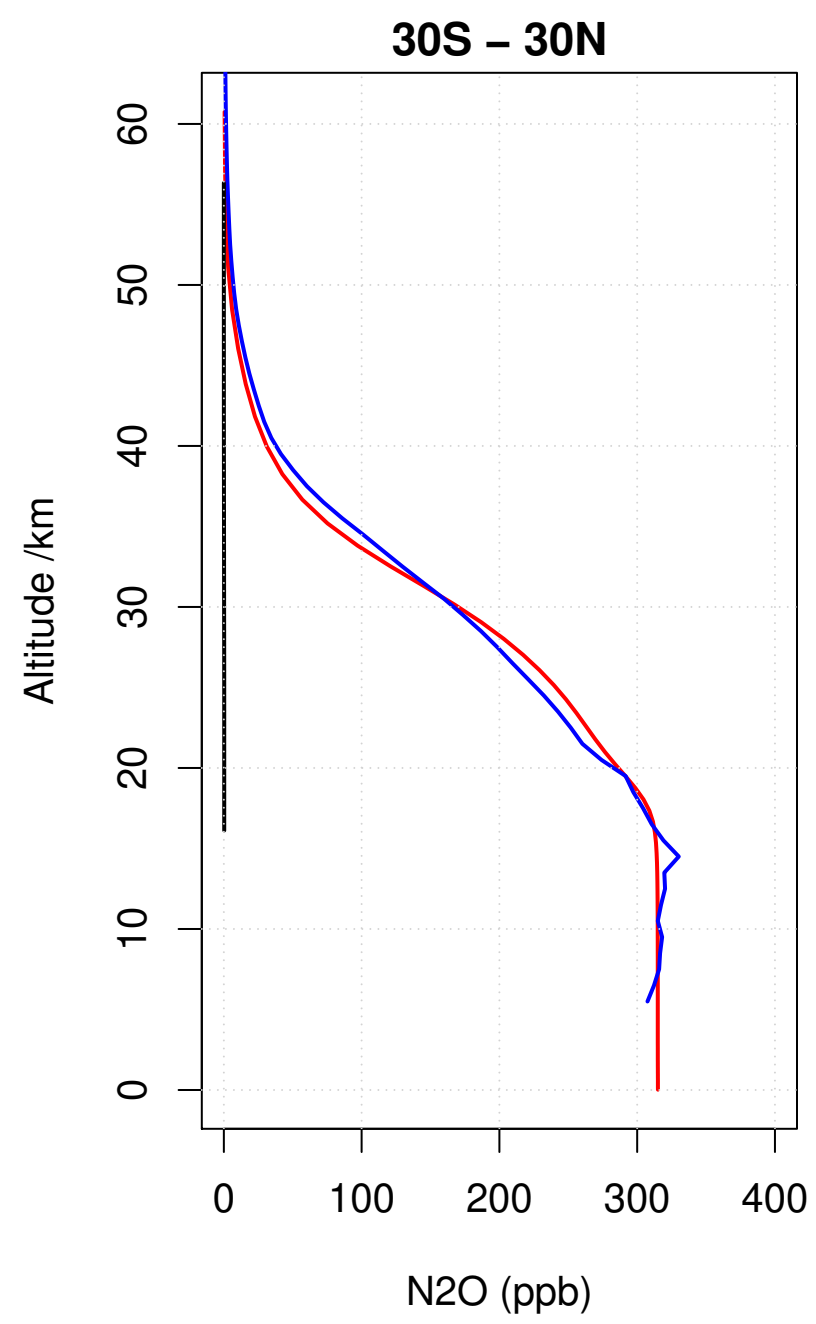
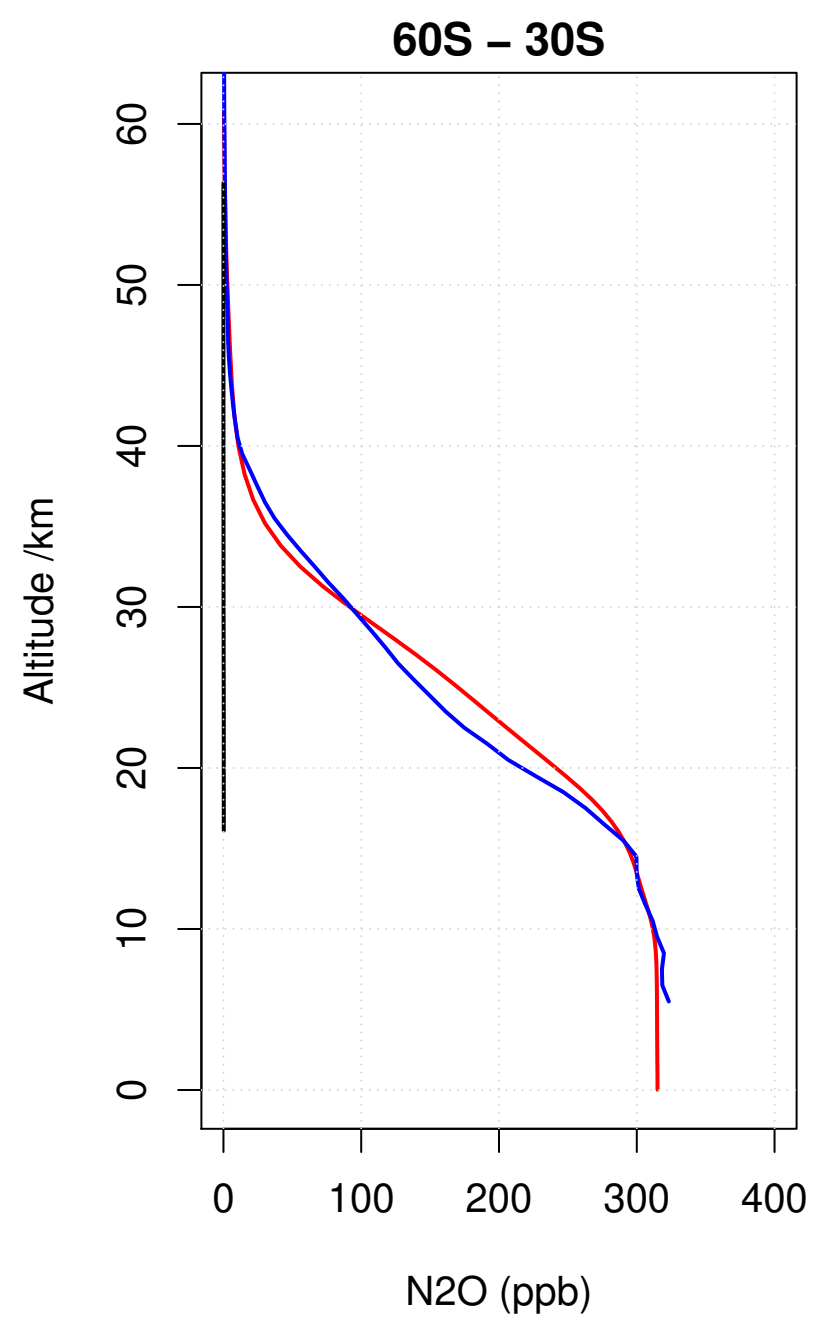
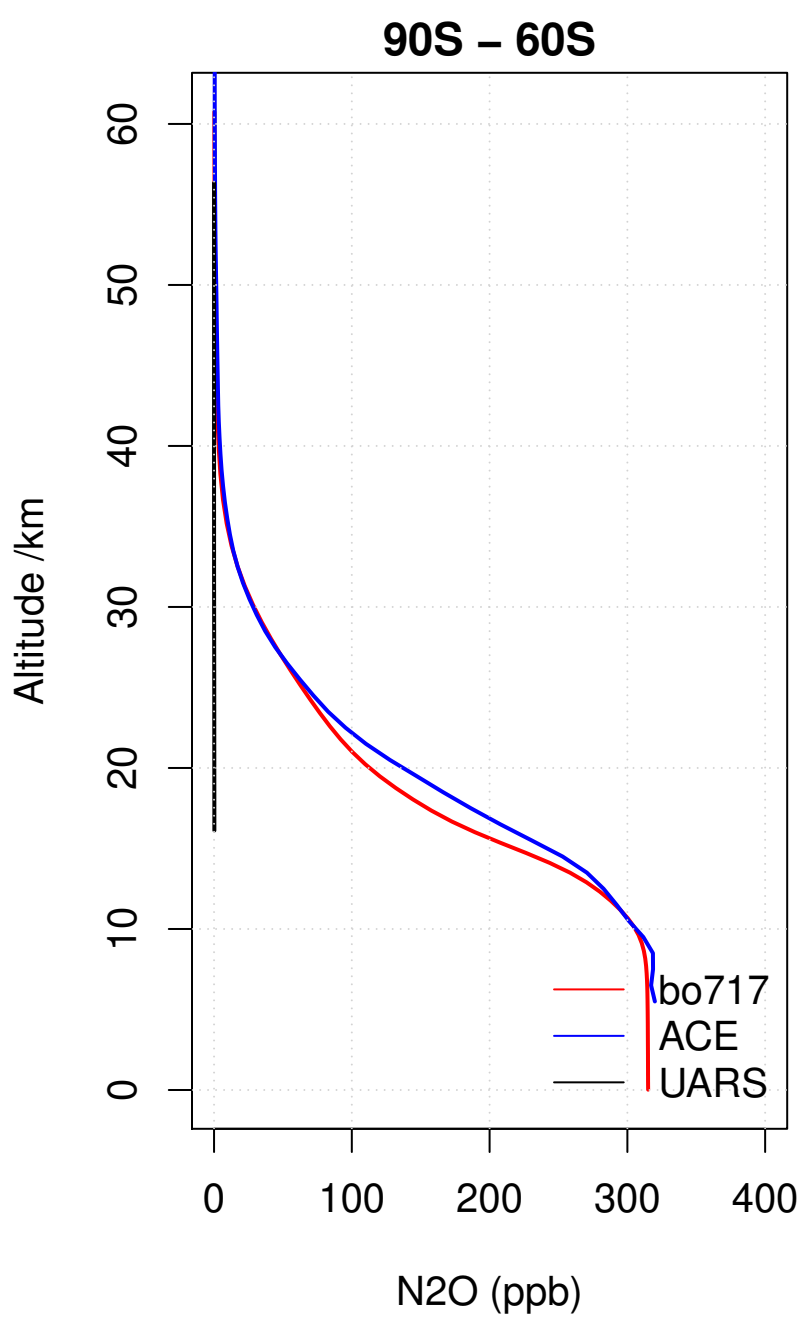


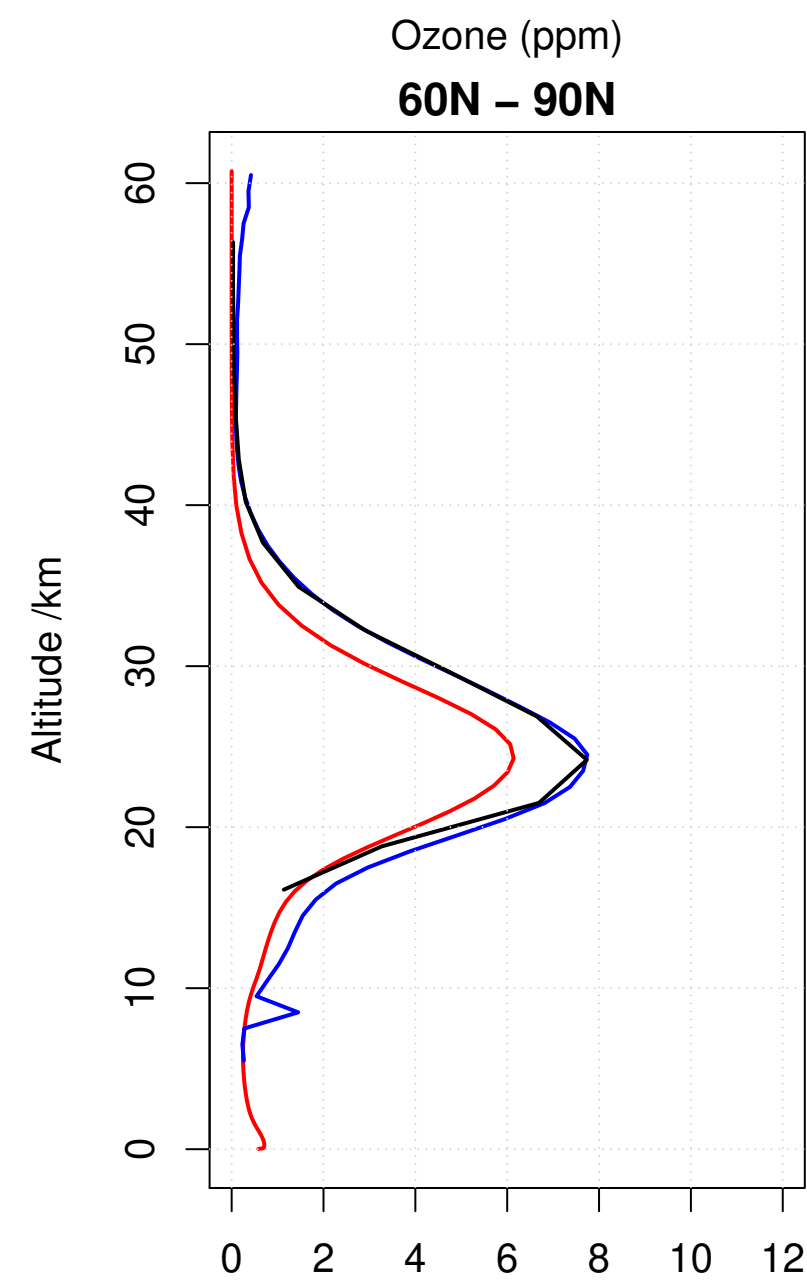
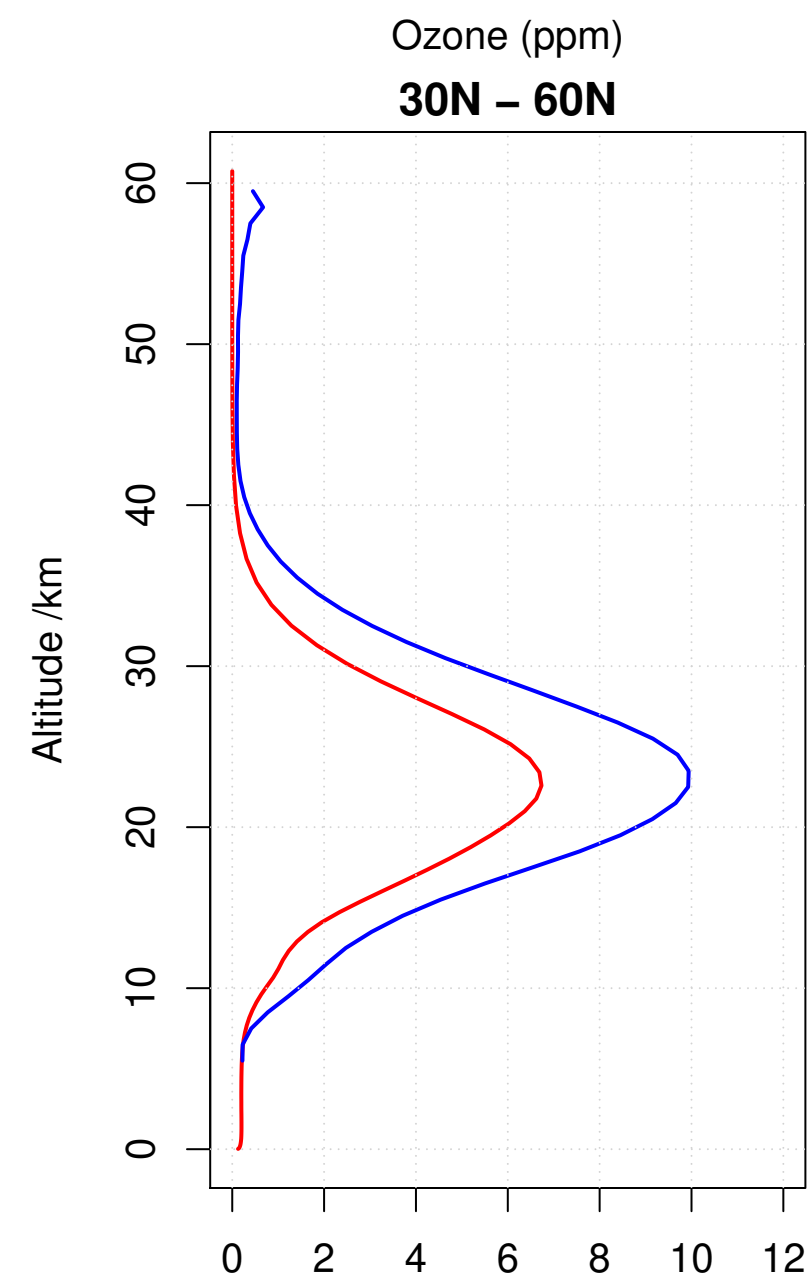
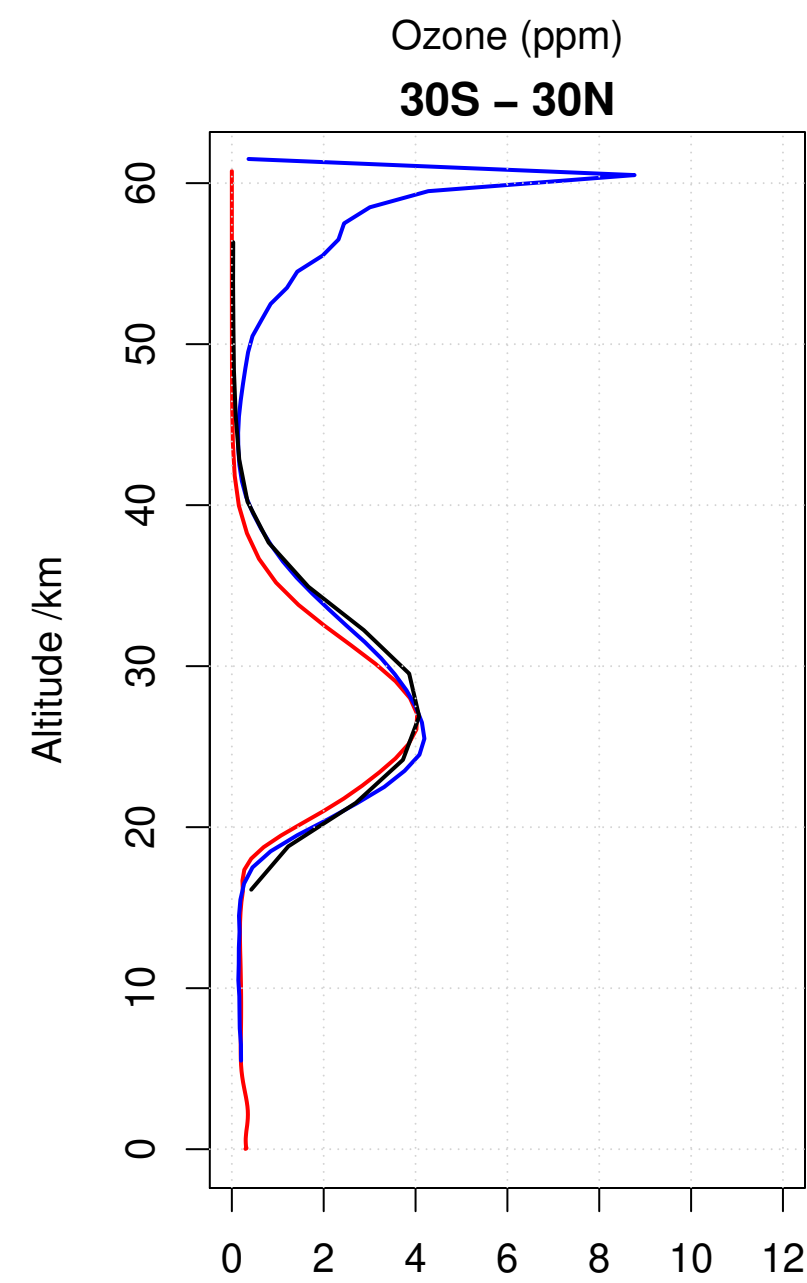
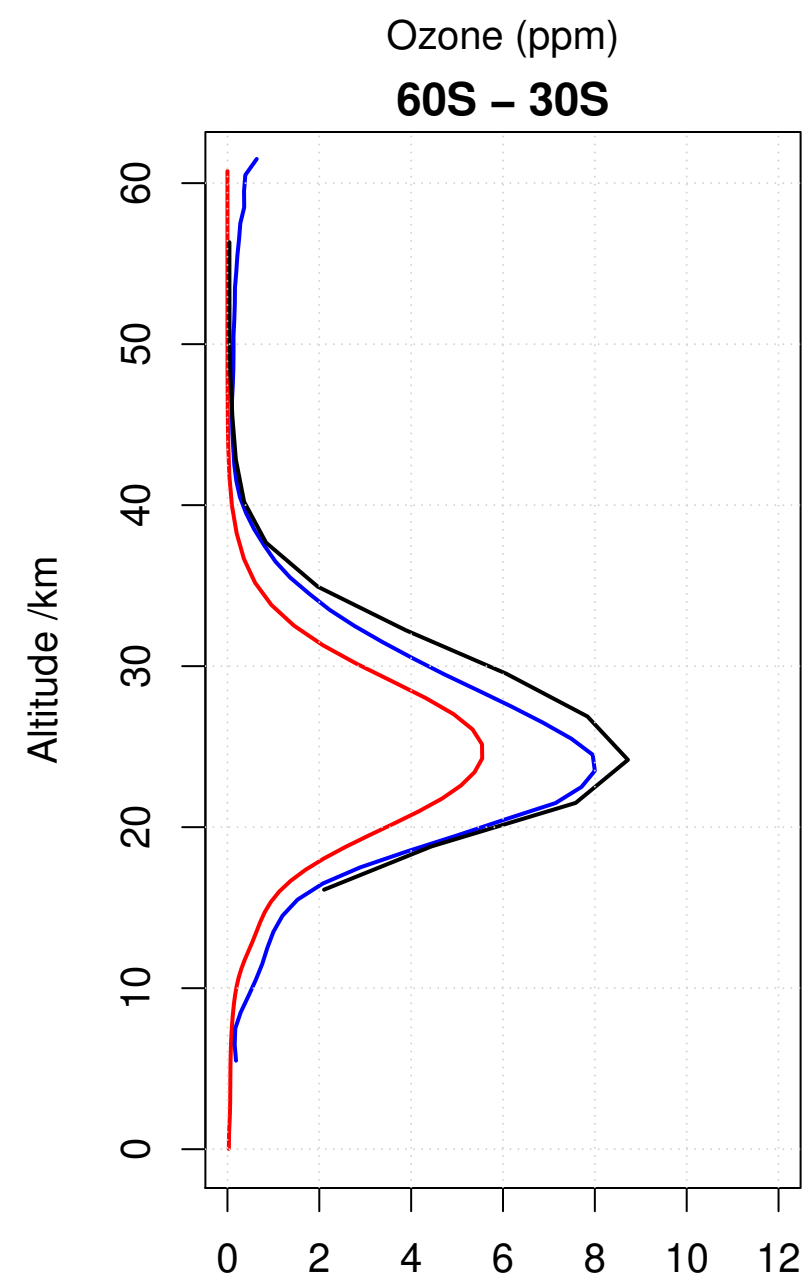
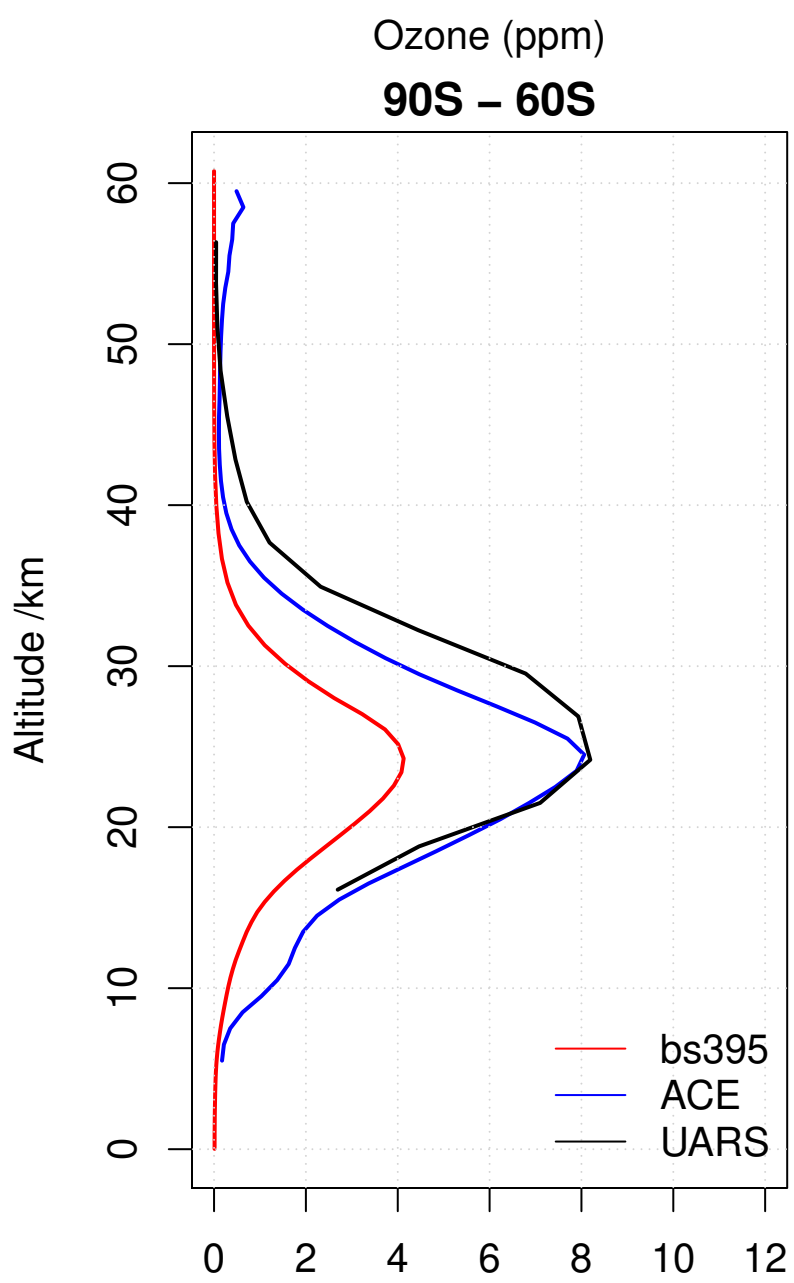
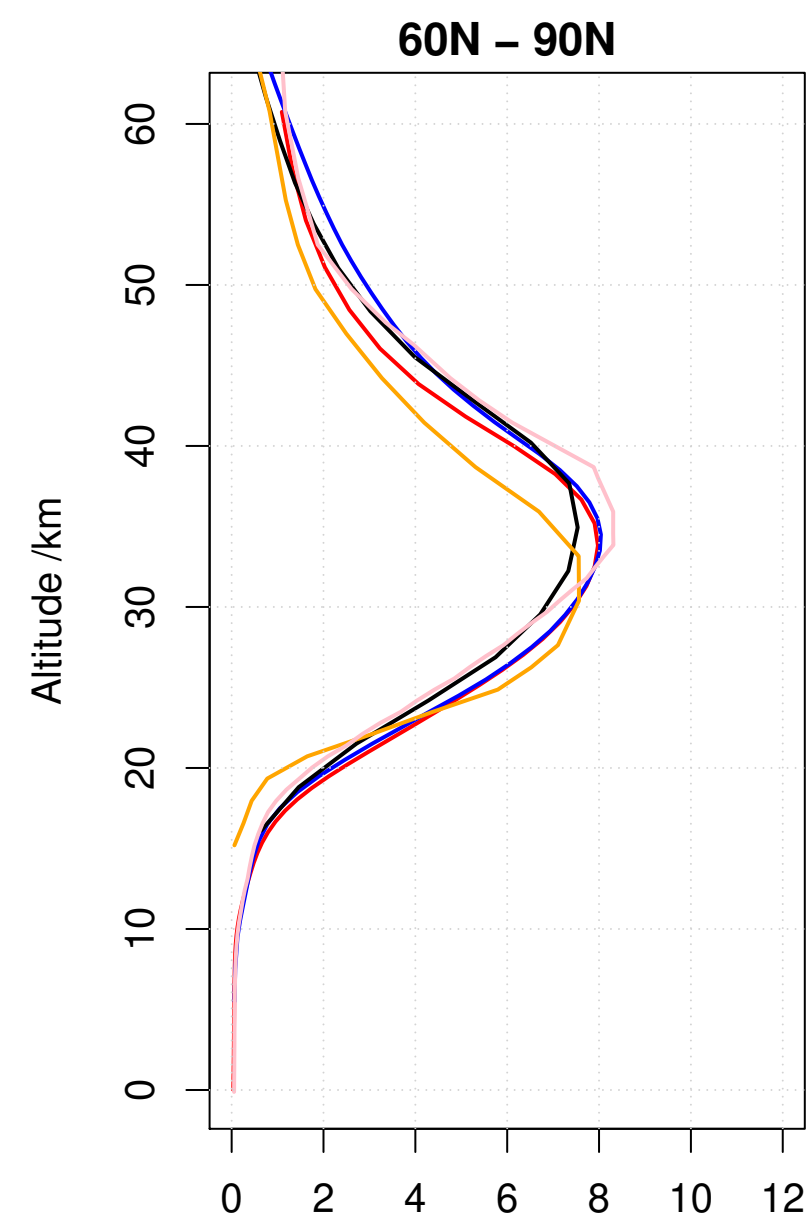
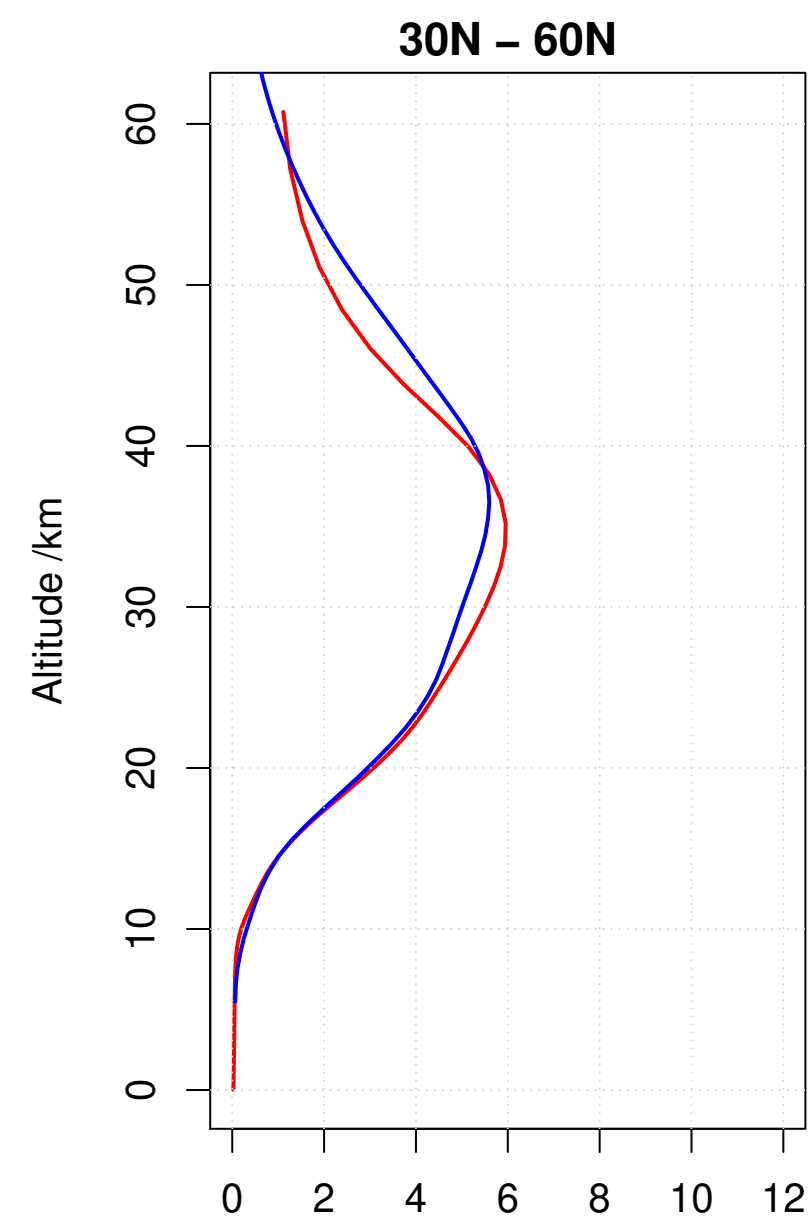
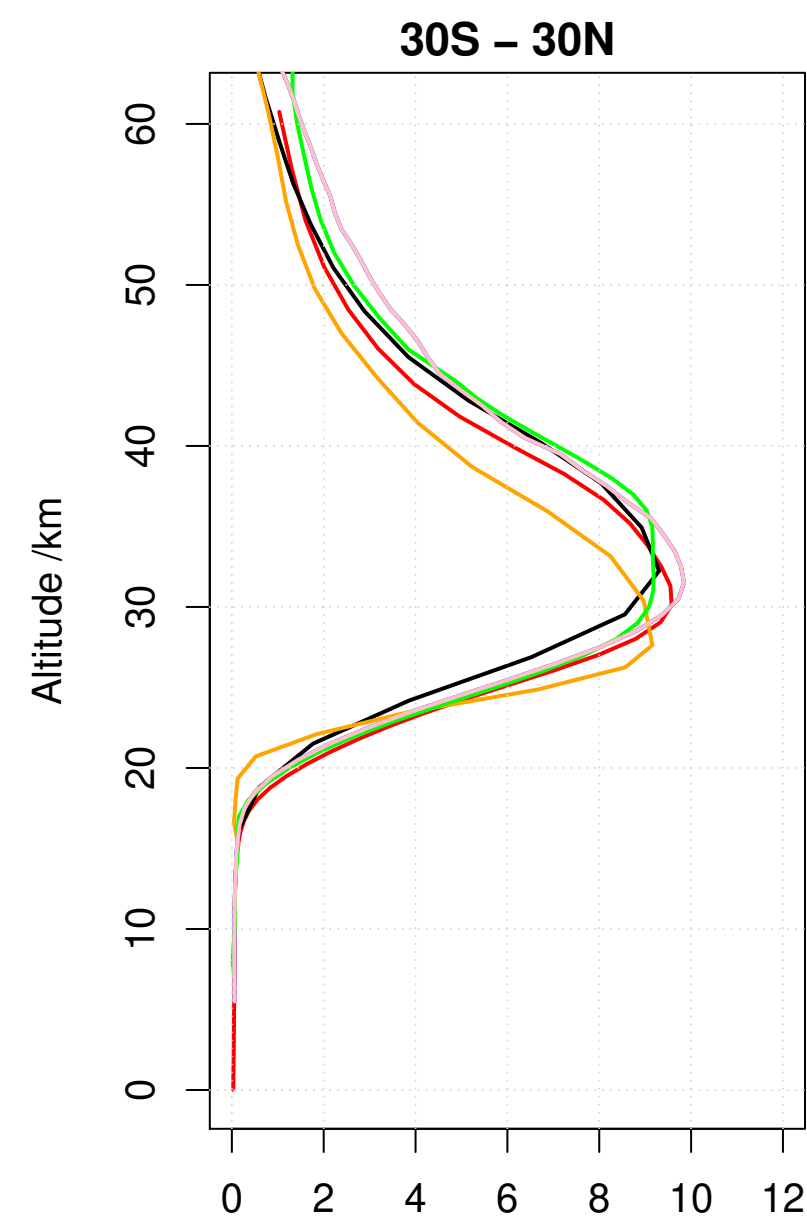
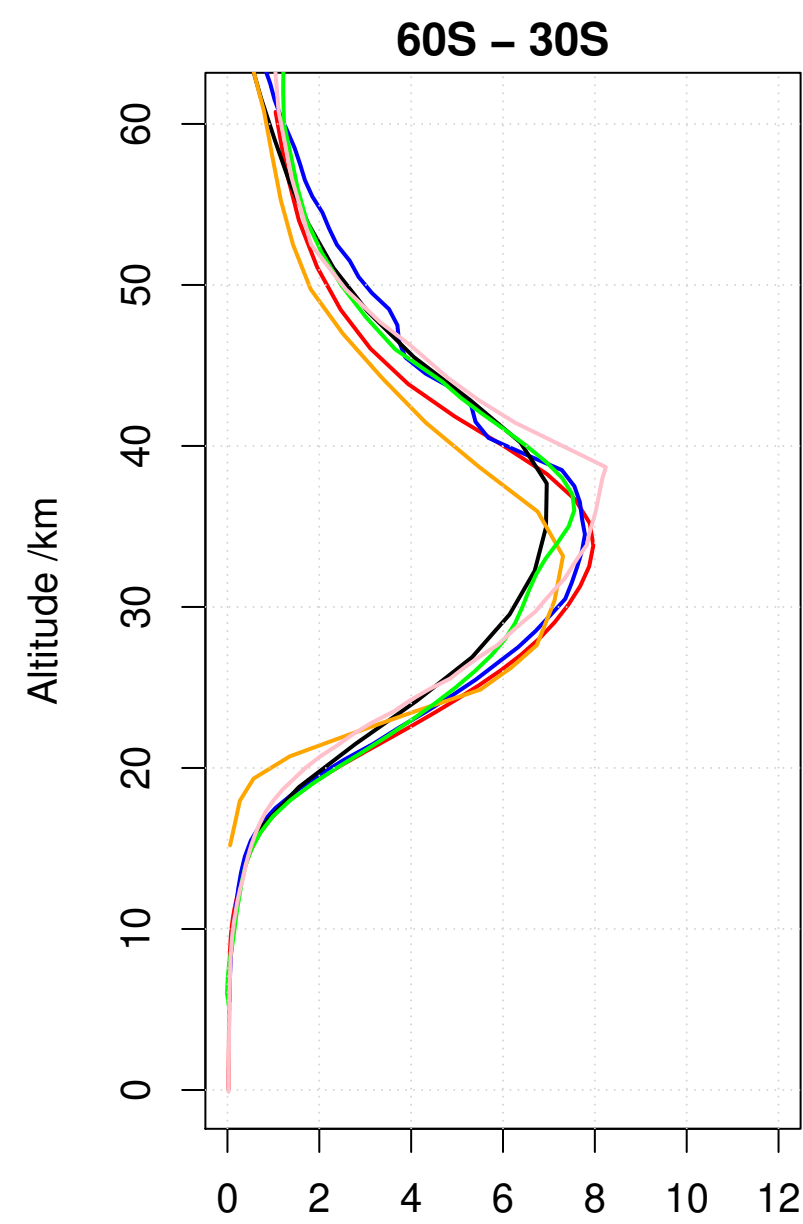
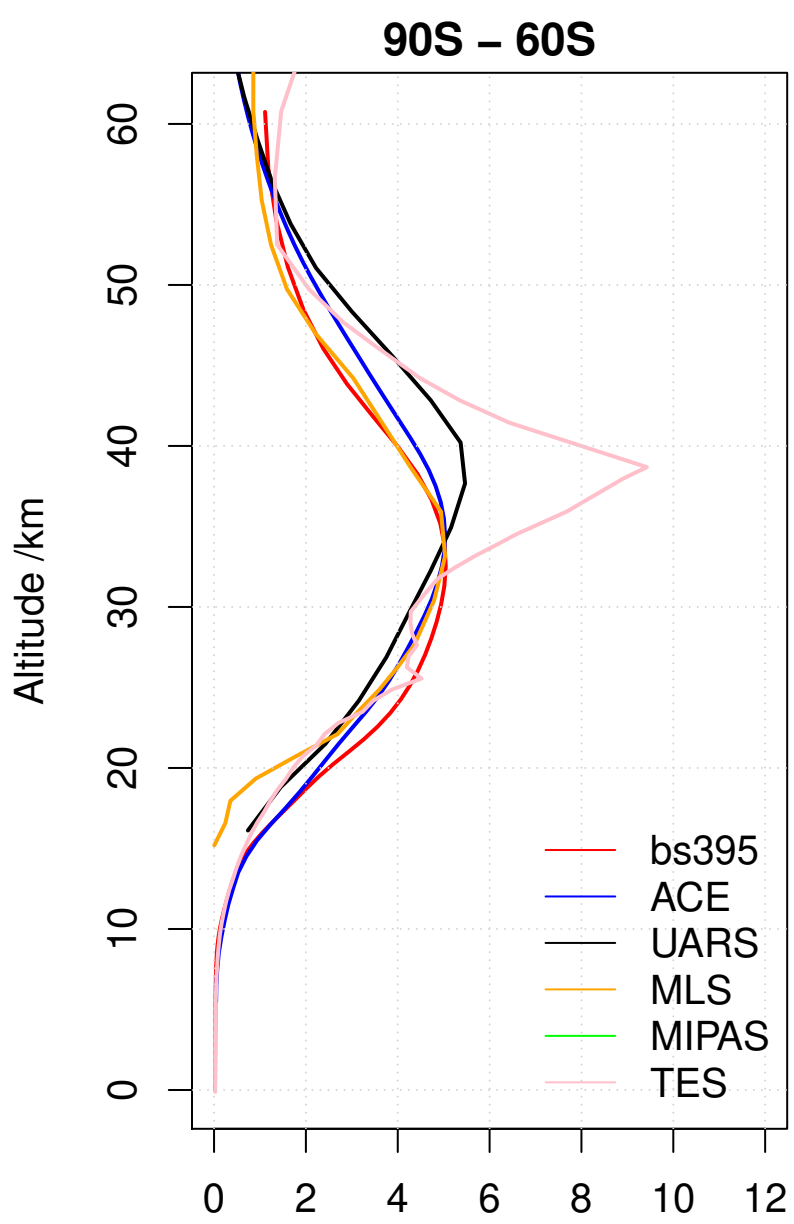


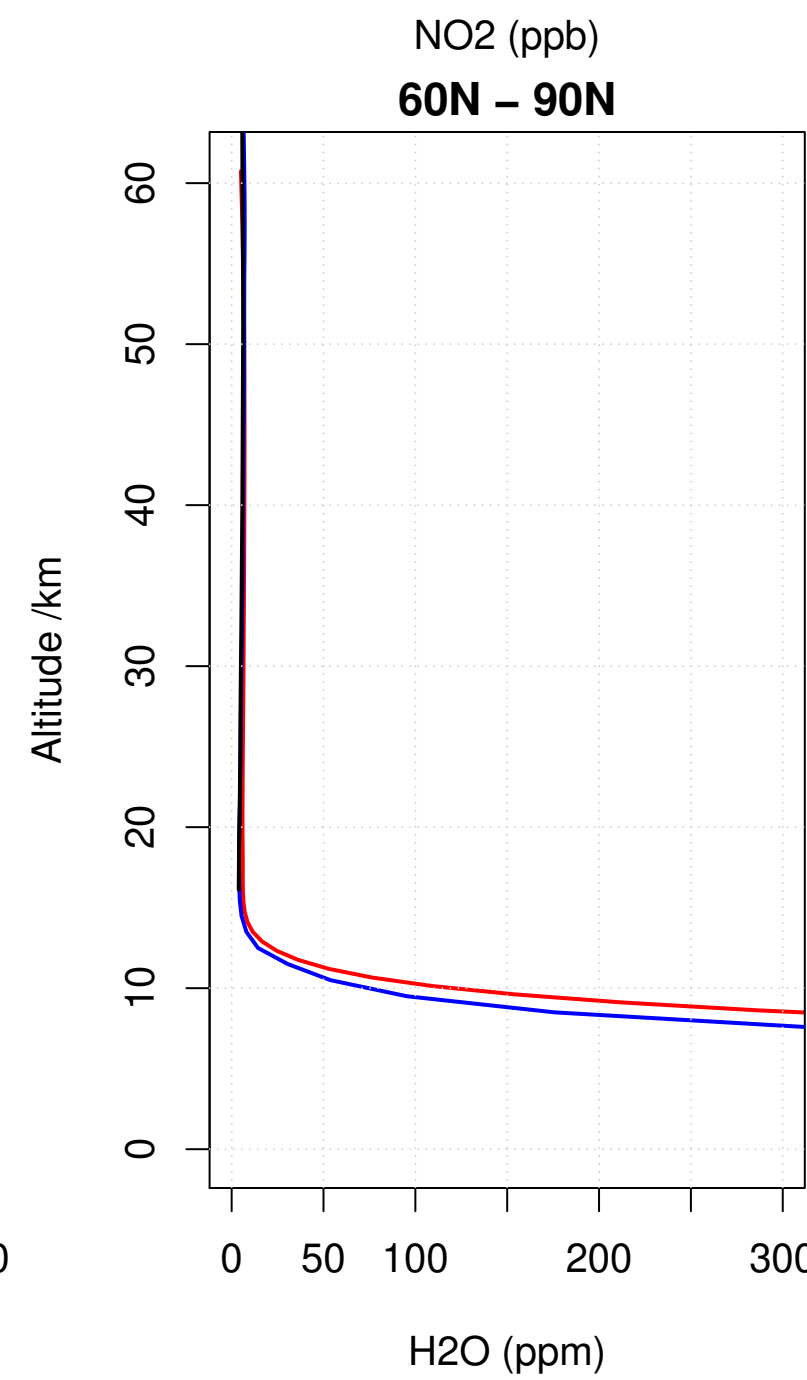
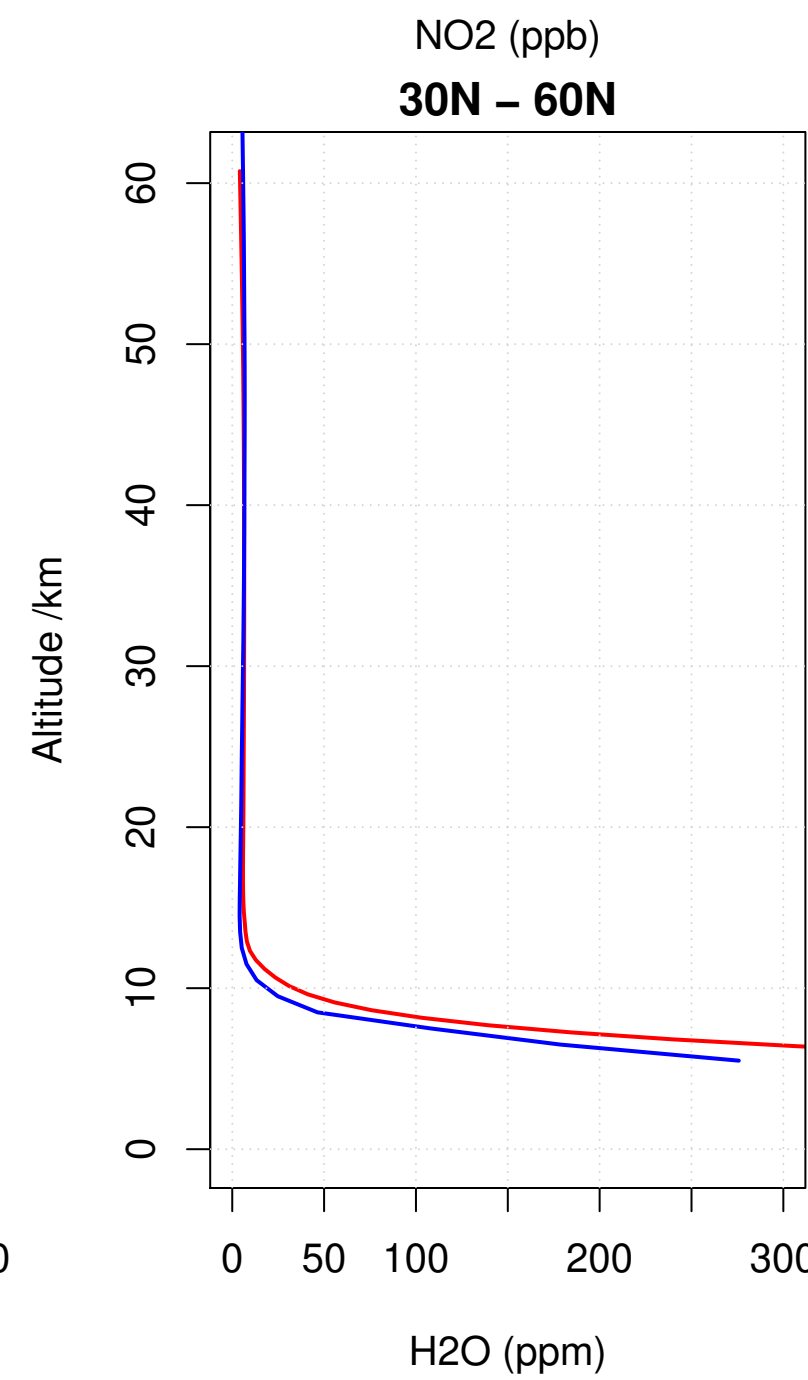
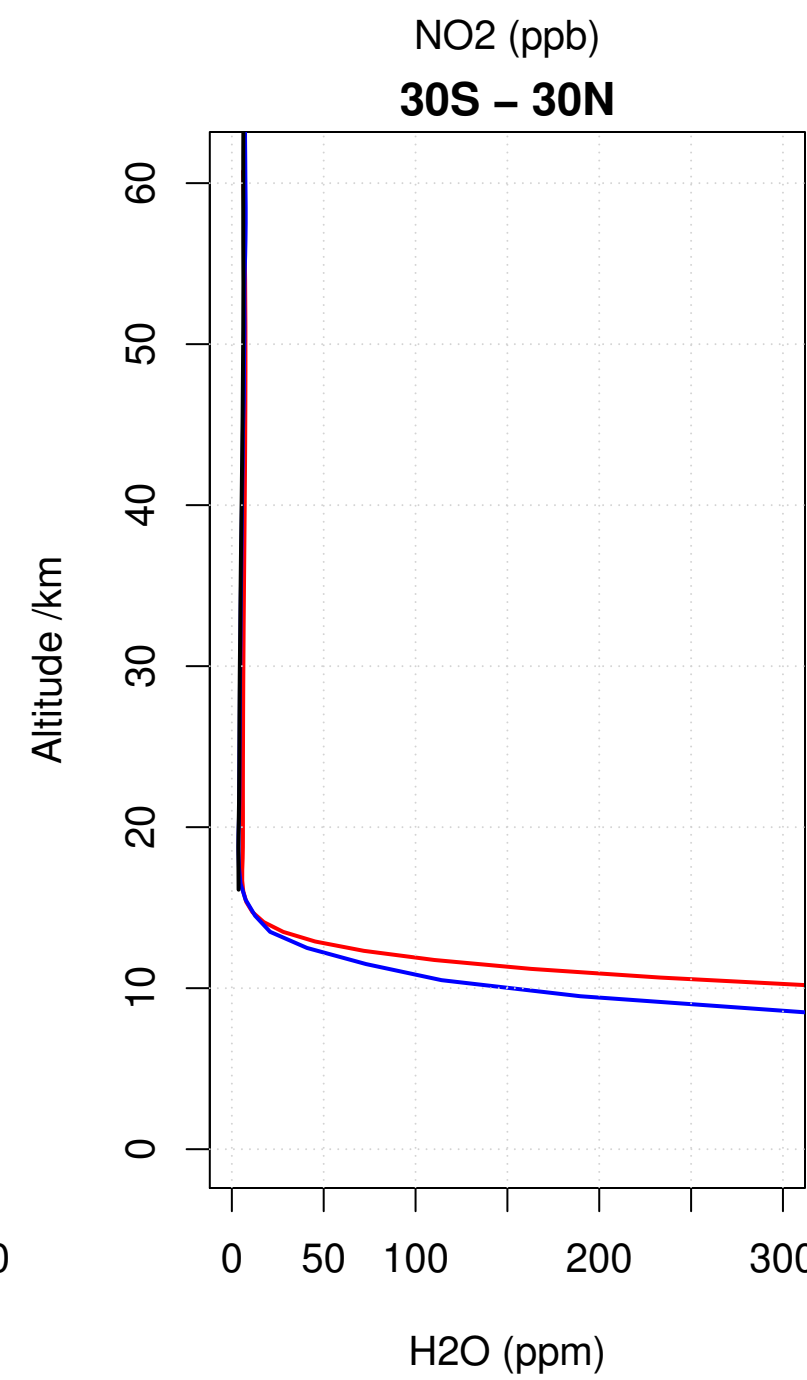
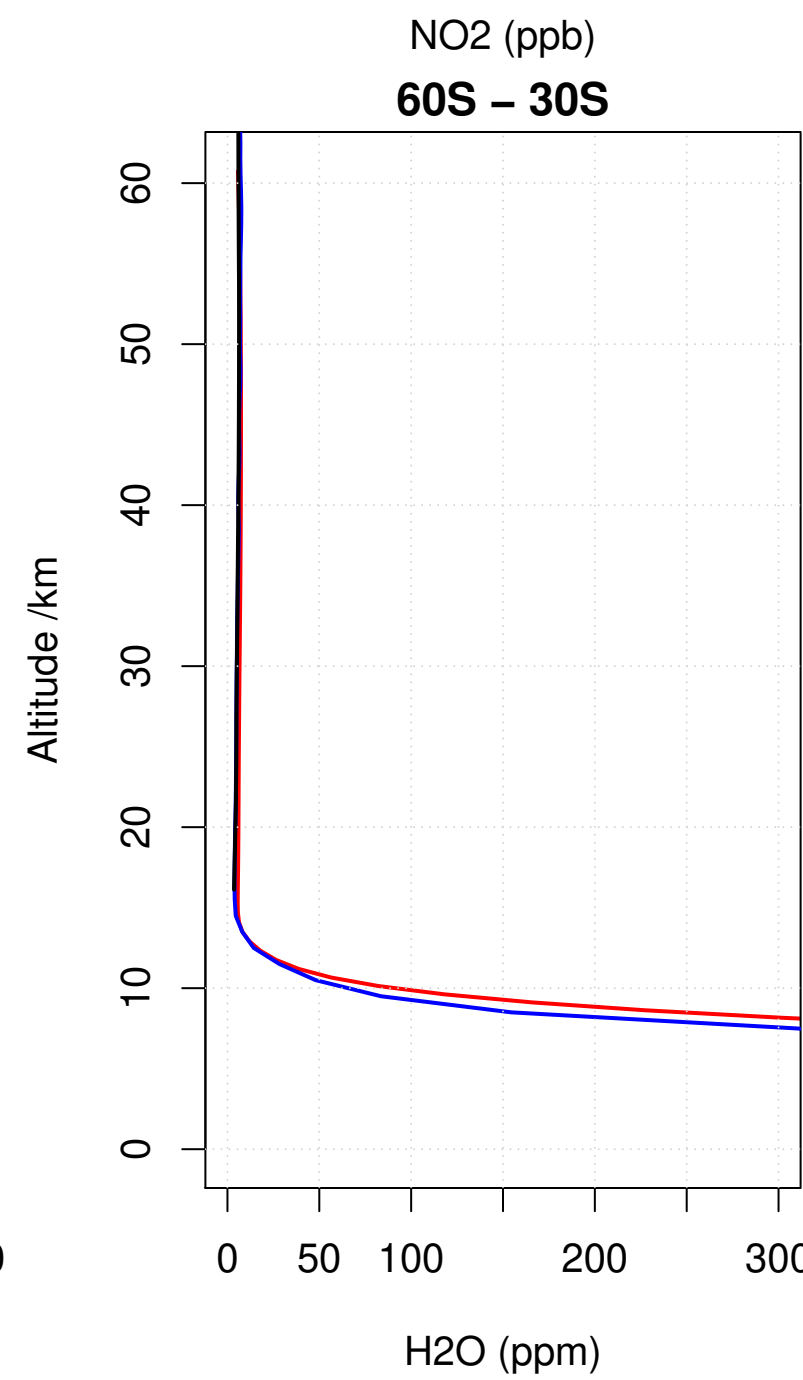
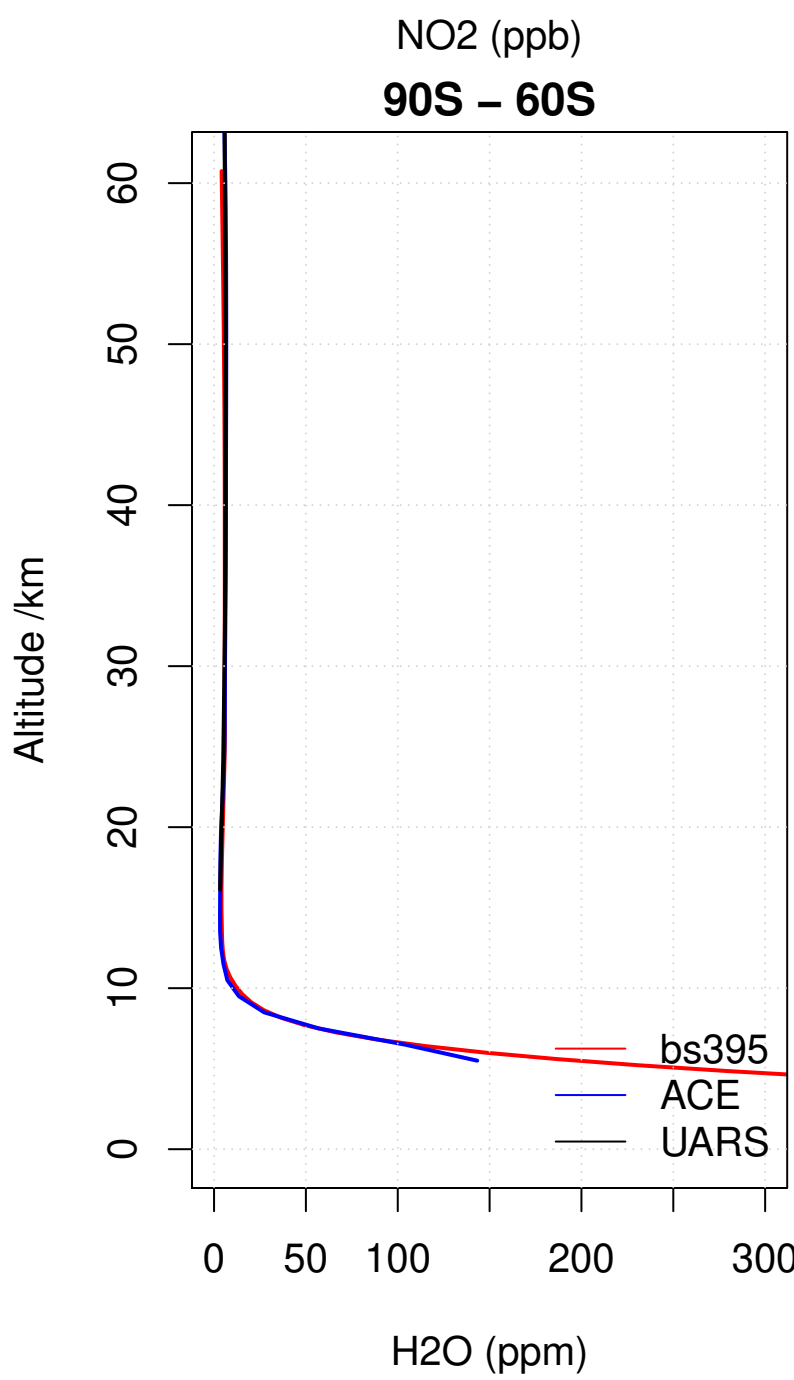
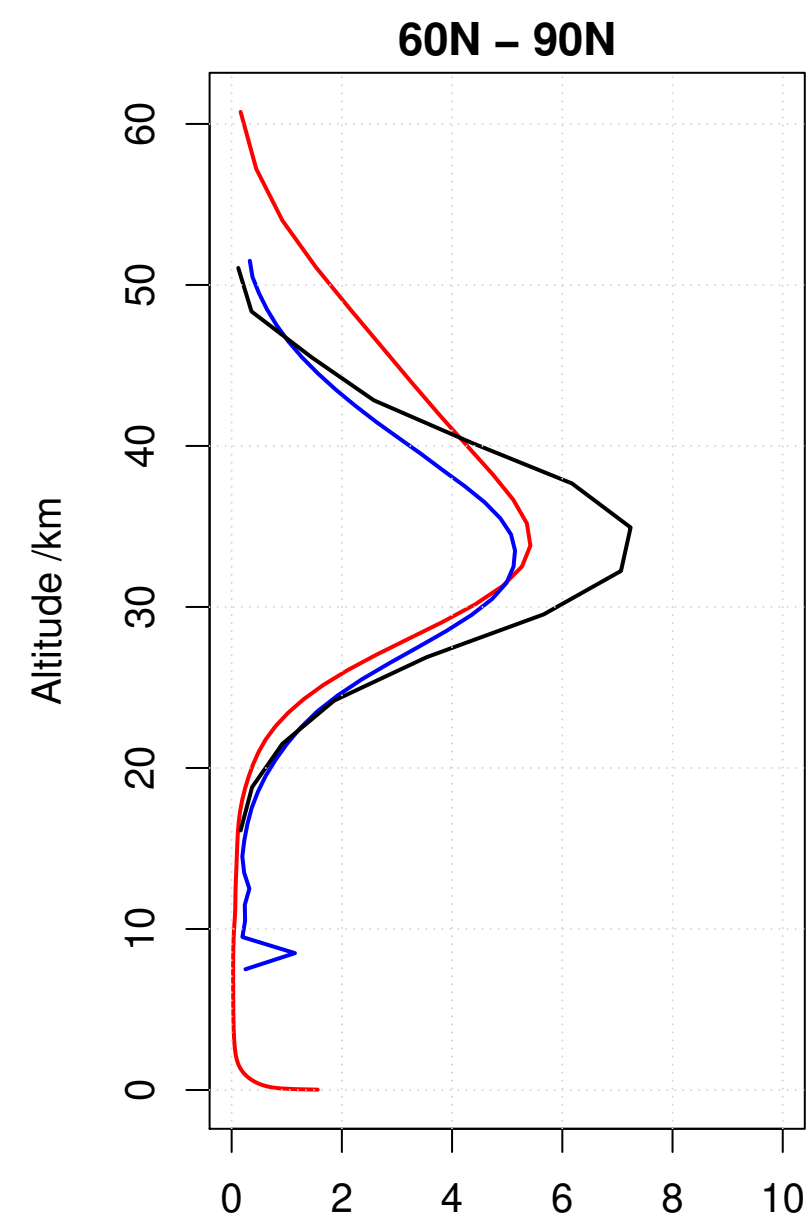
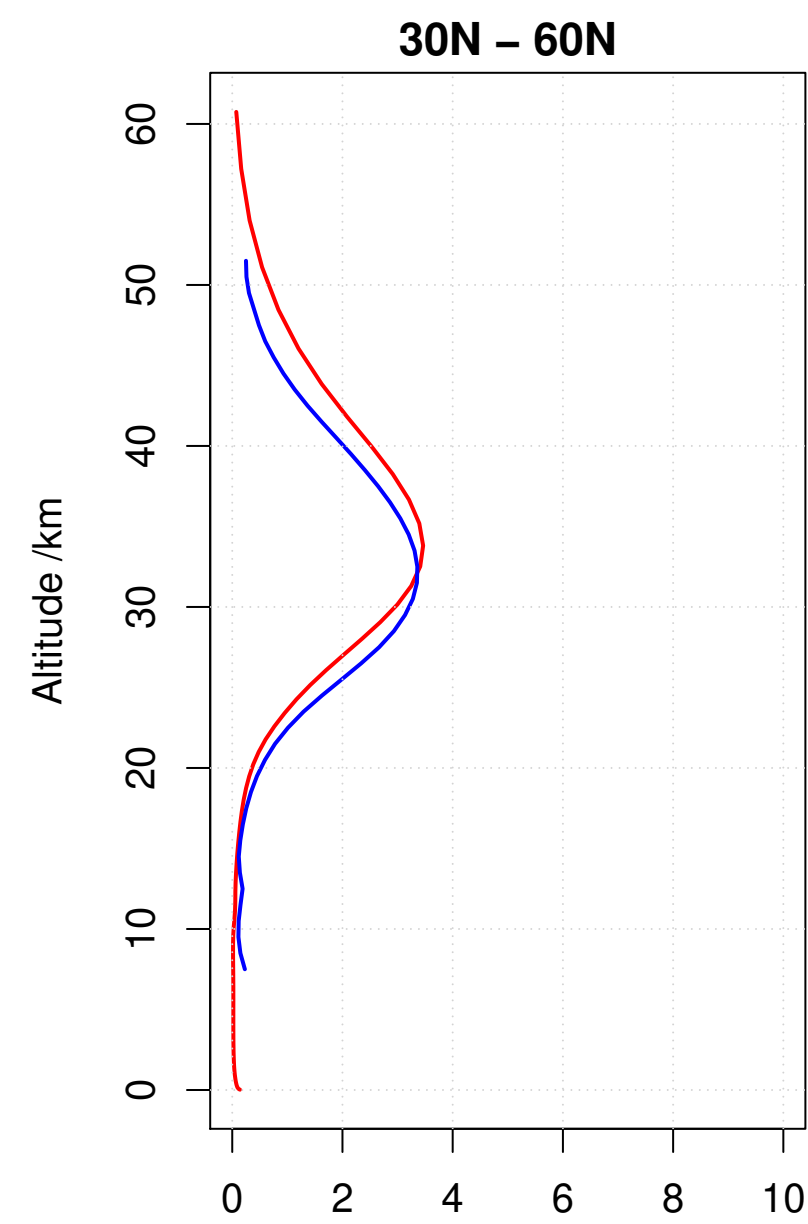
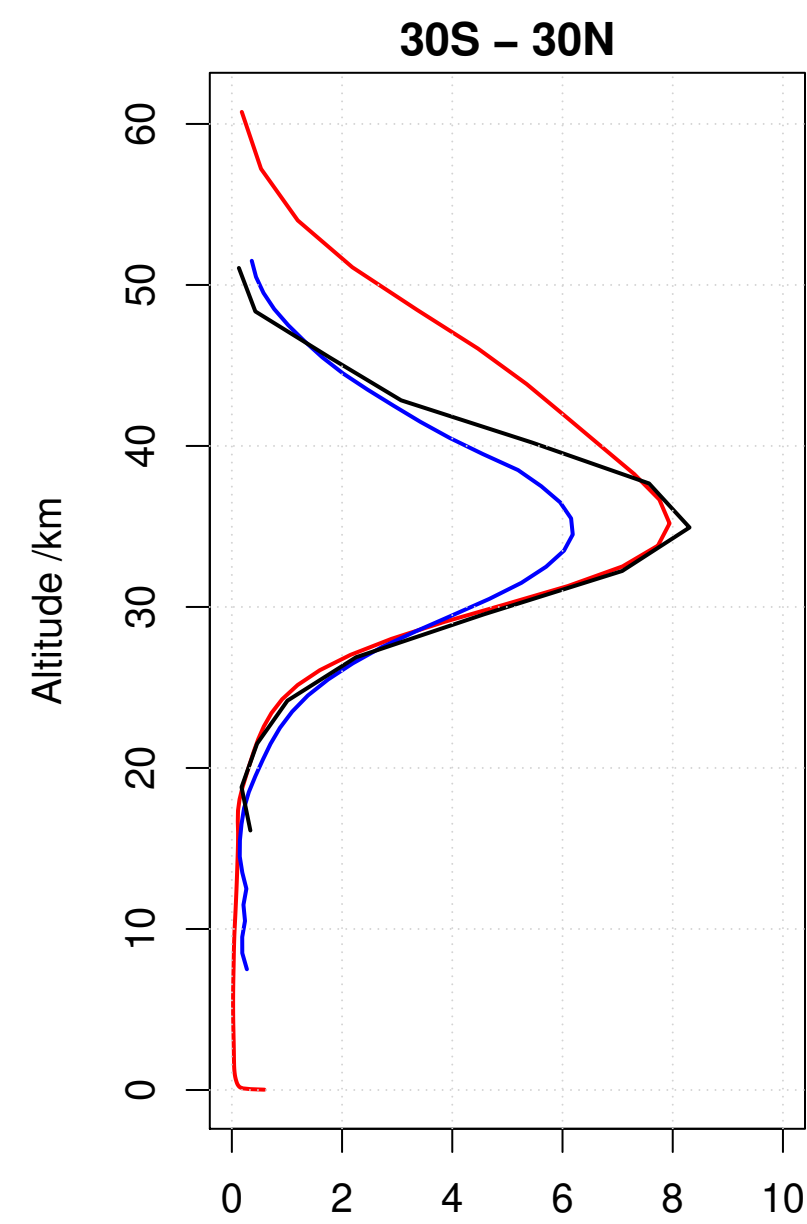
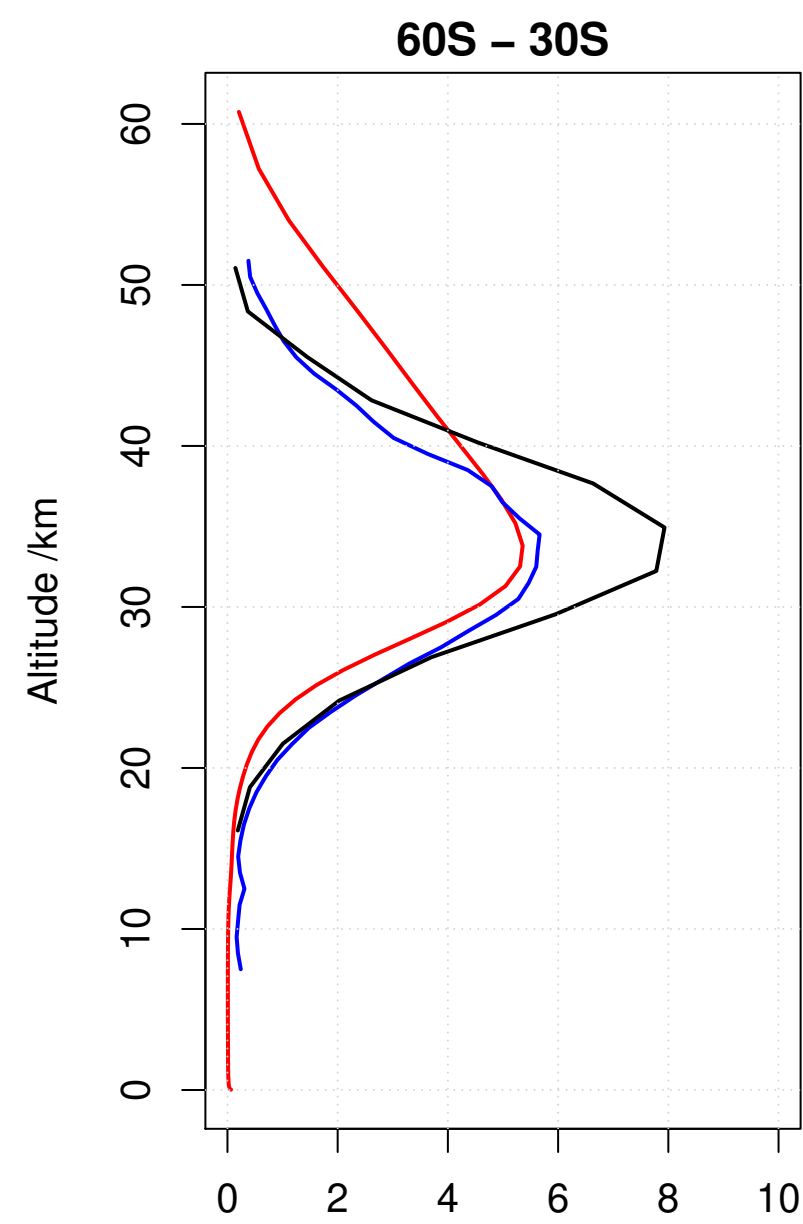
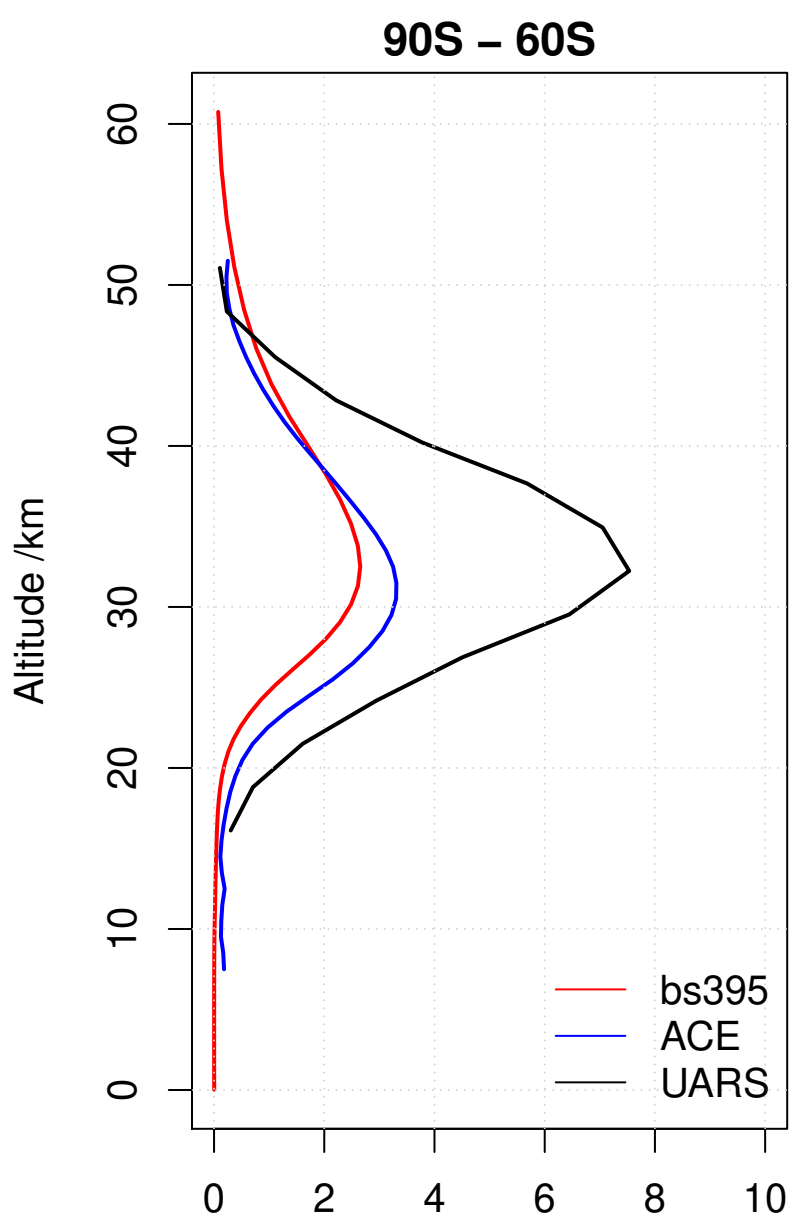




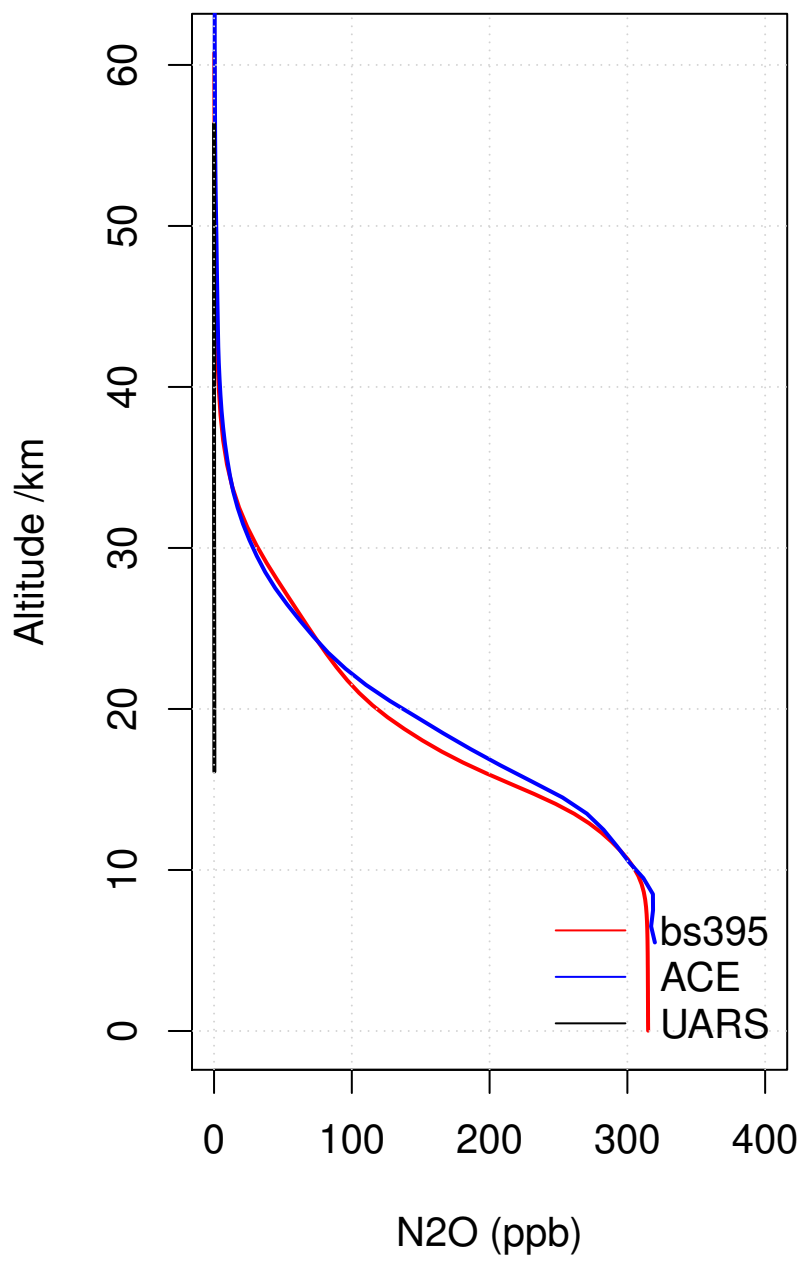




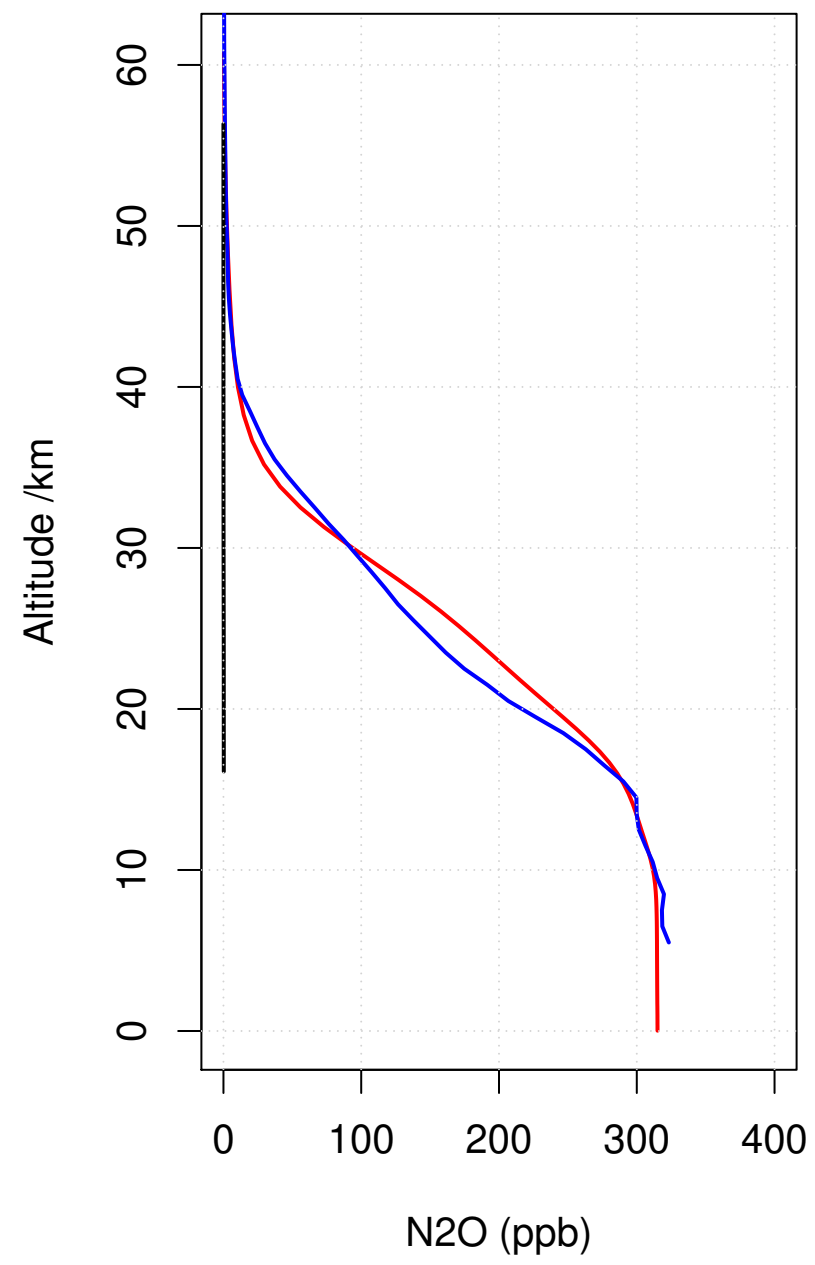




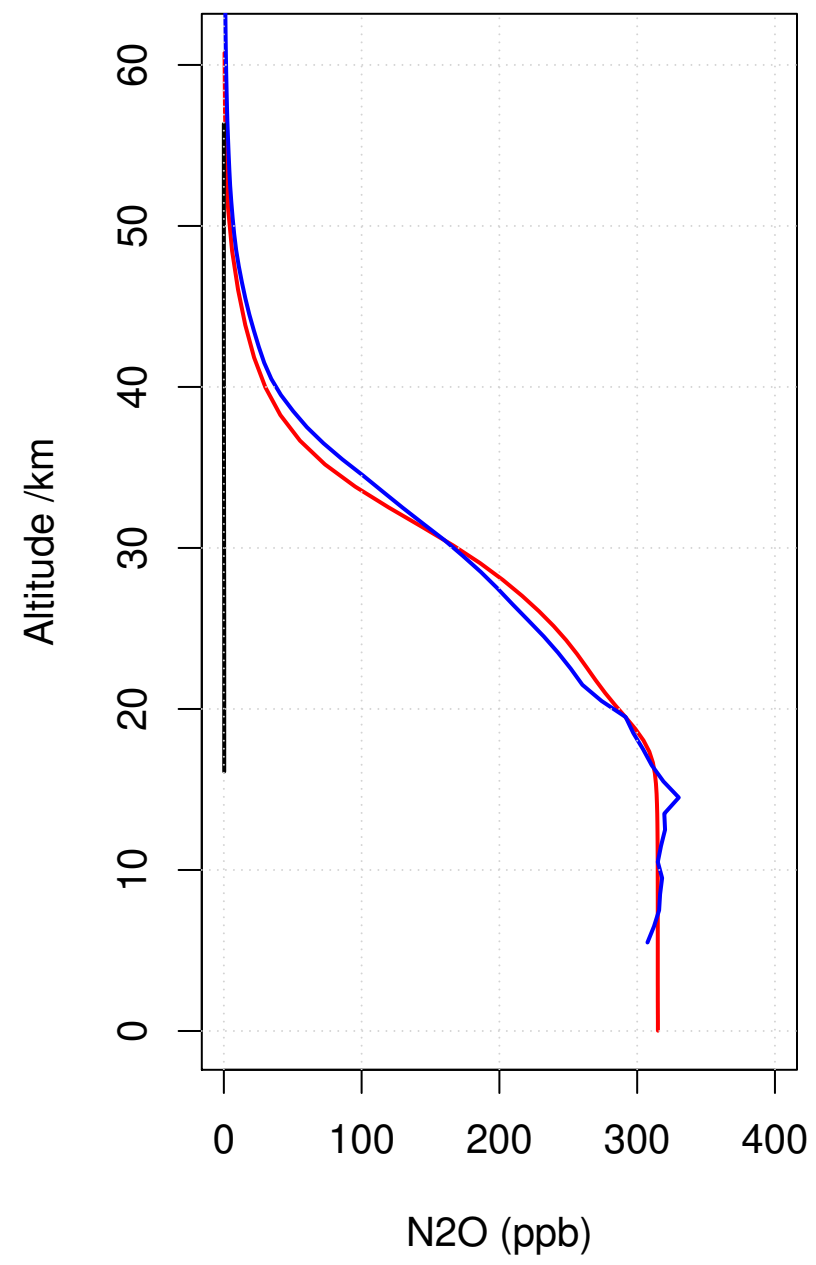
90S - 60S



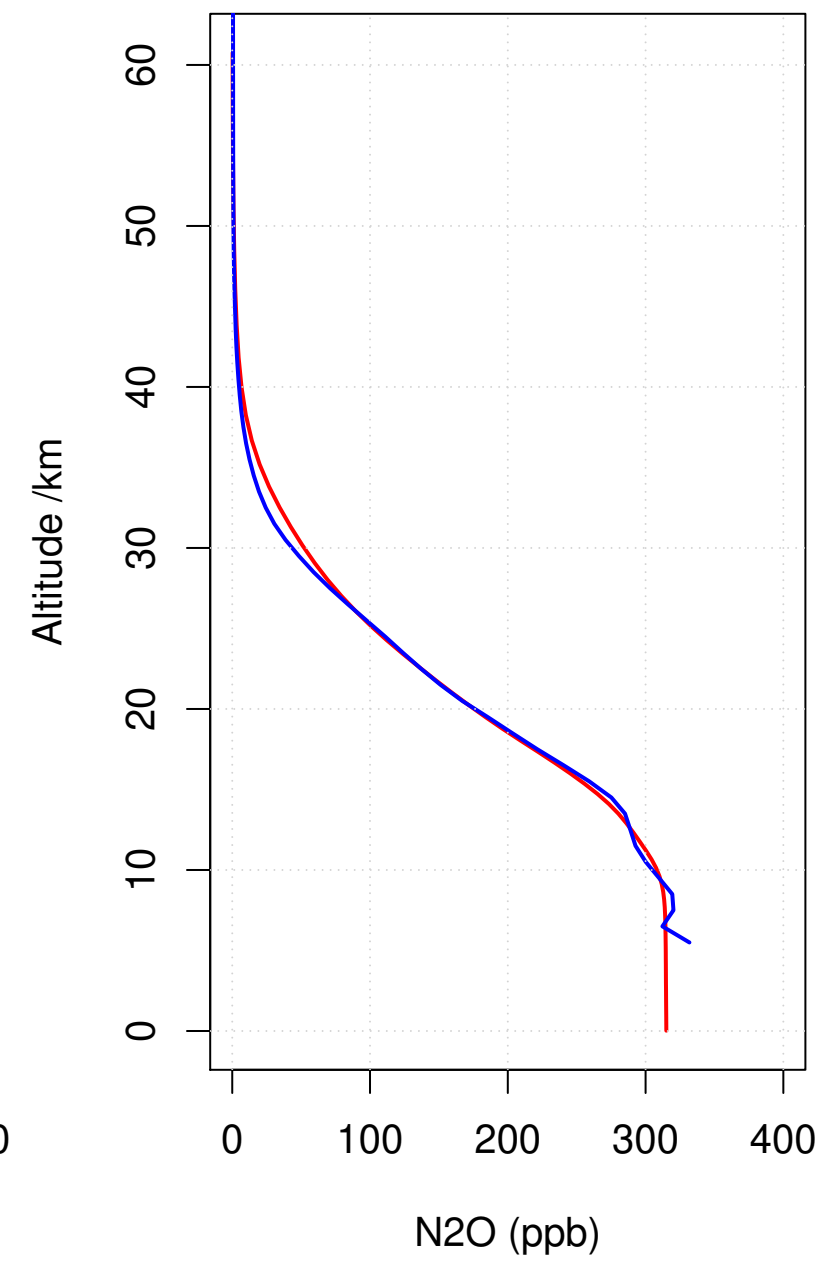
60S - 30S



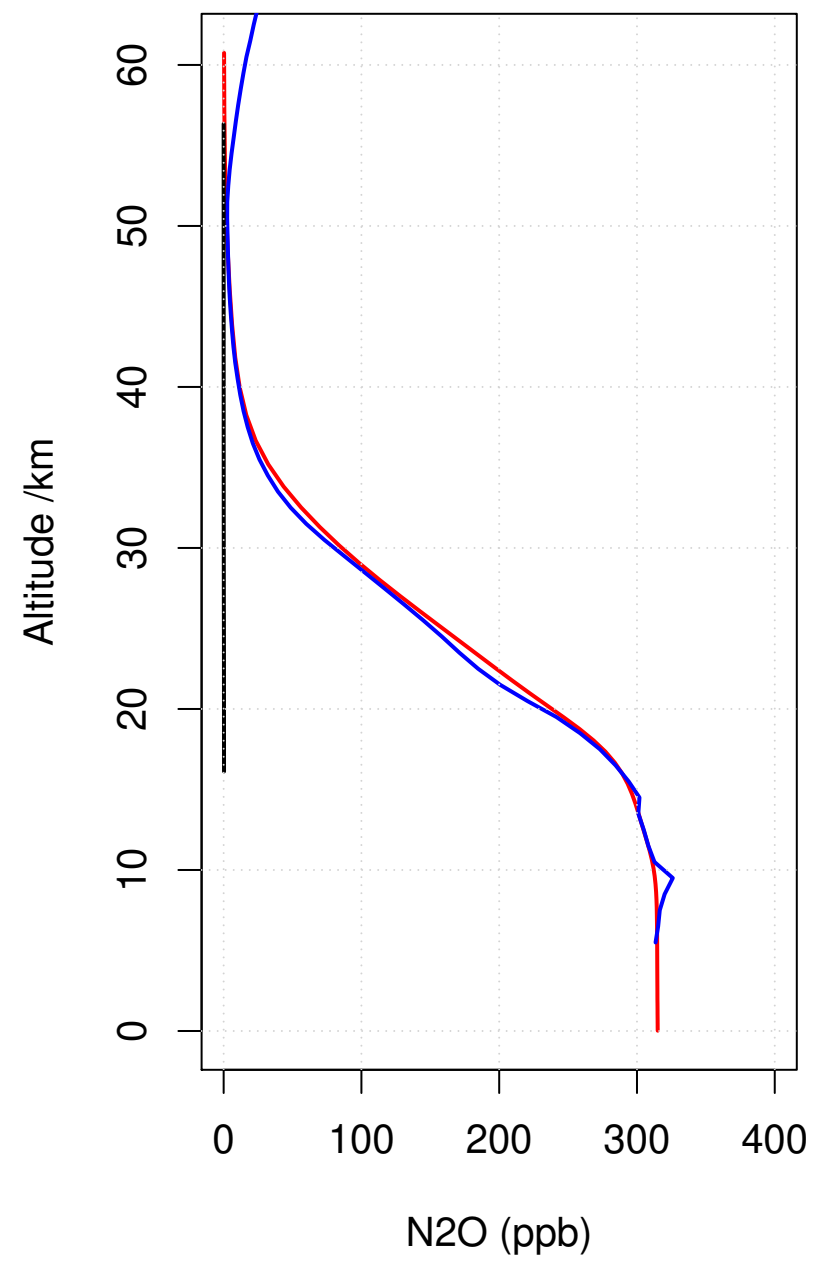
30S - 30N



30N - 60N

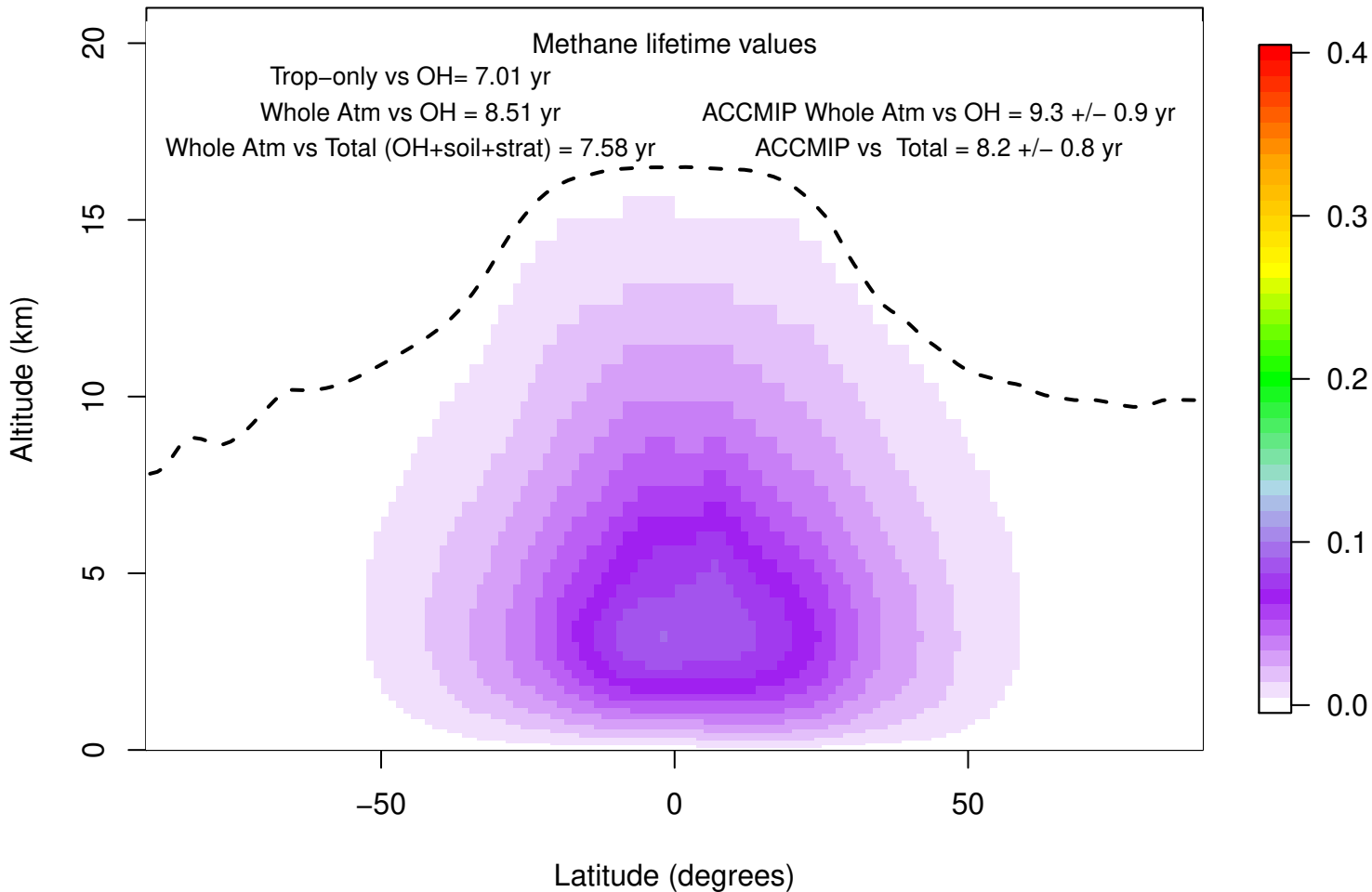


60N - 90N



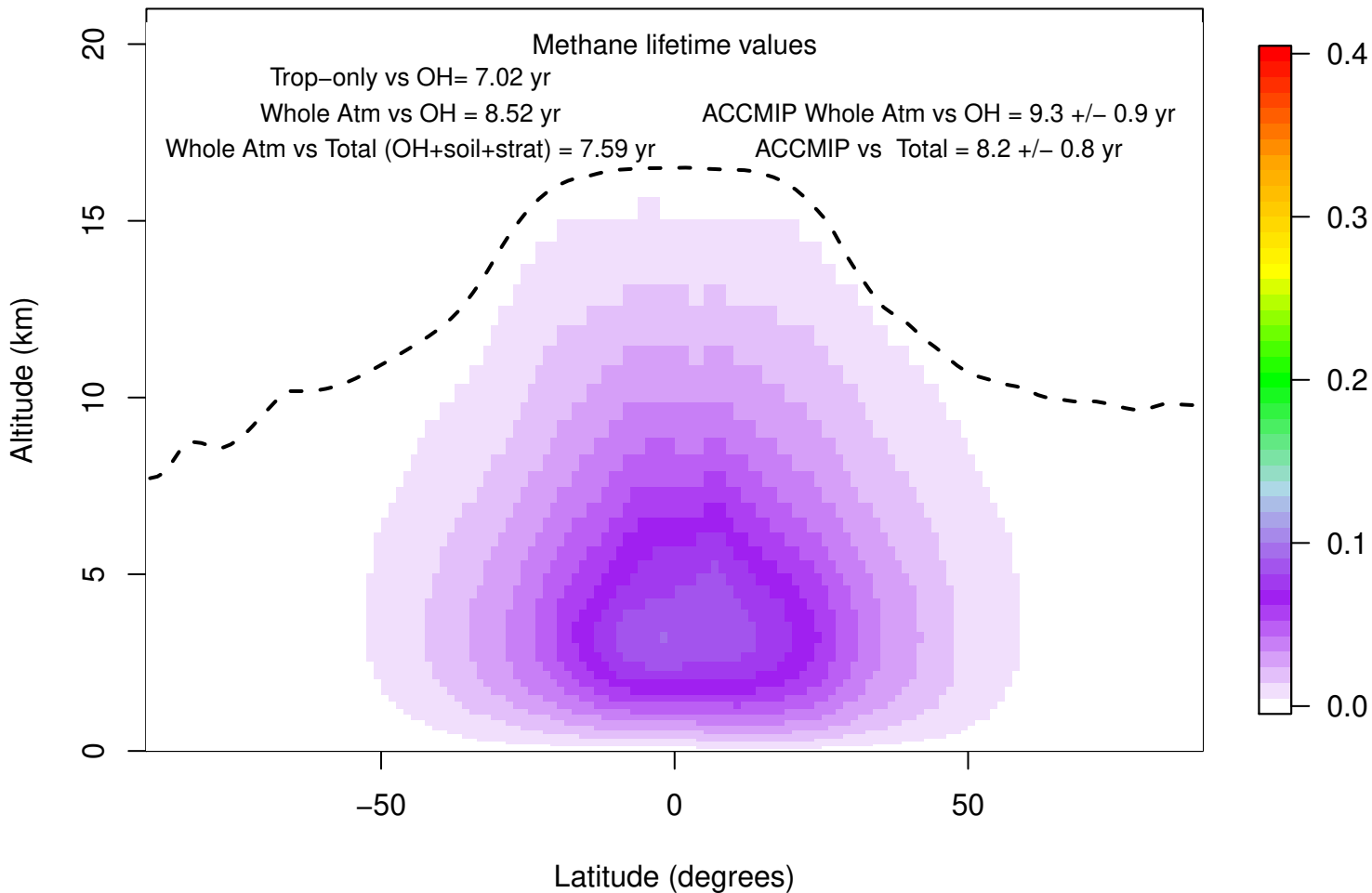
# UKCA bo717

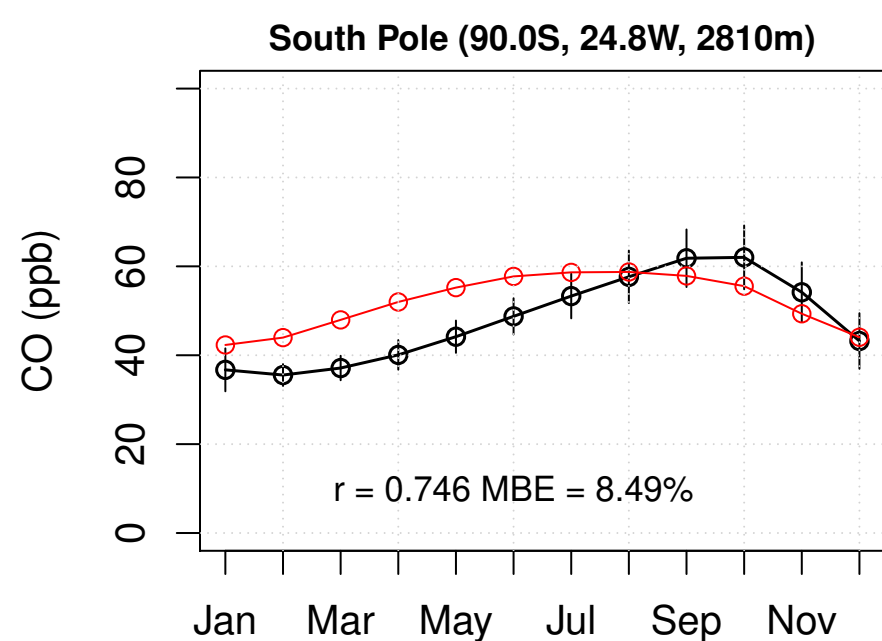
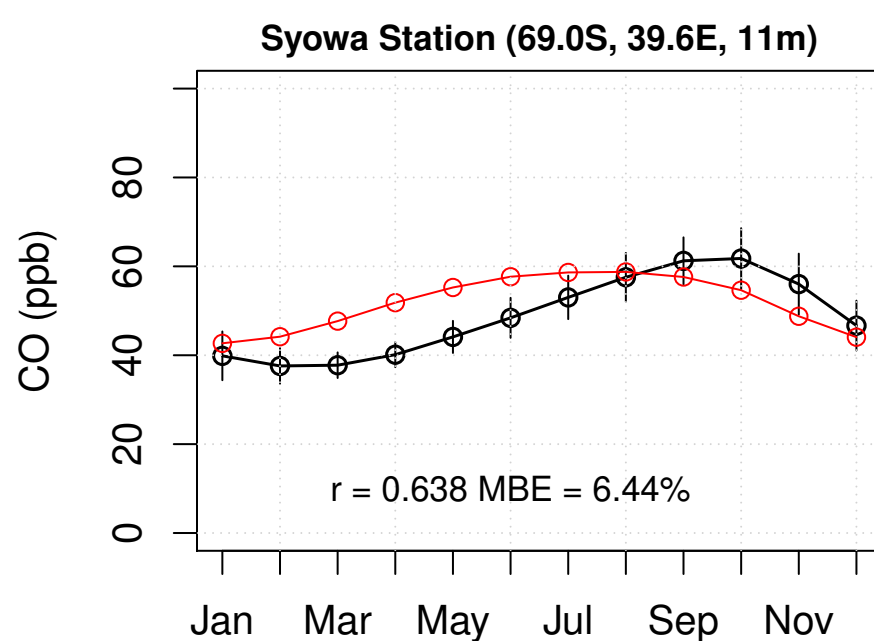
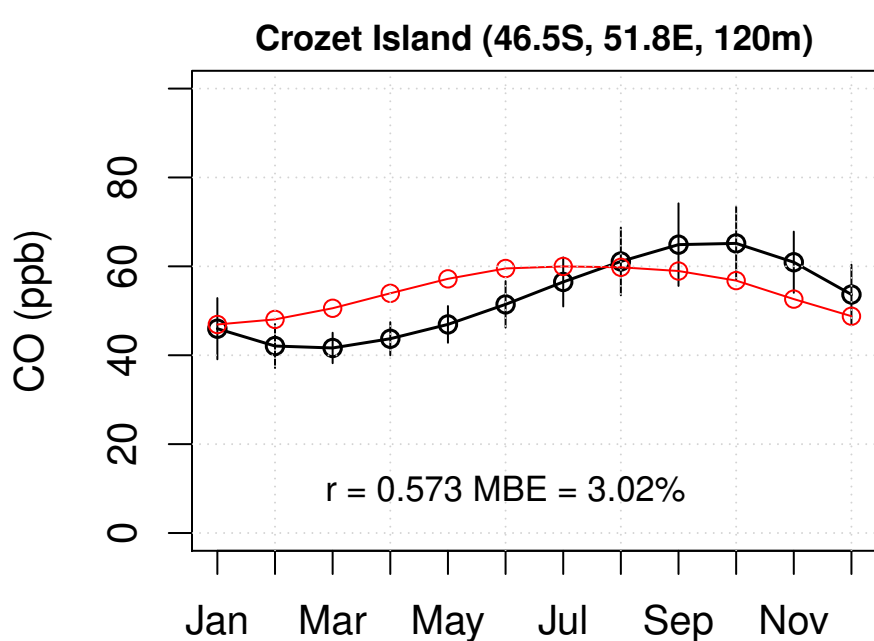
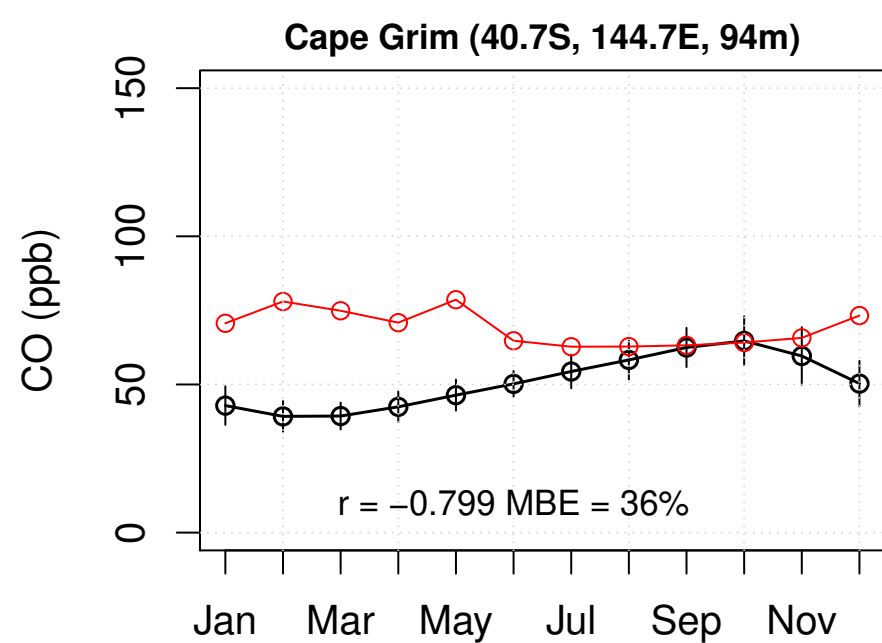
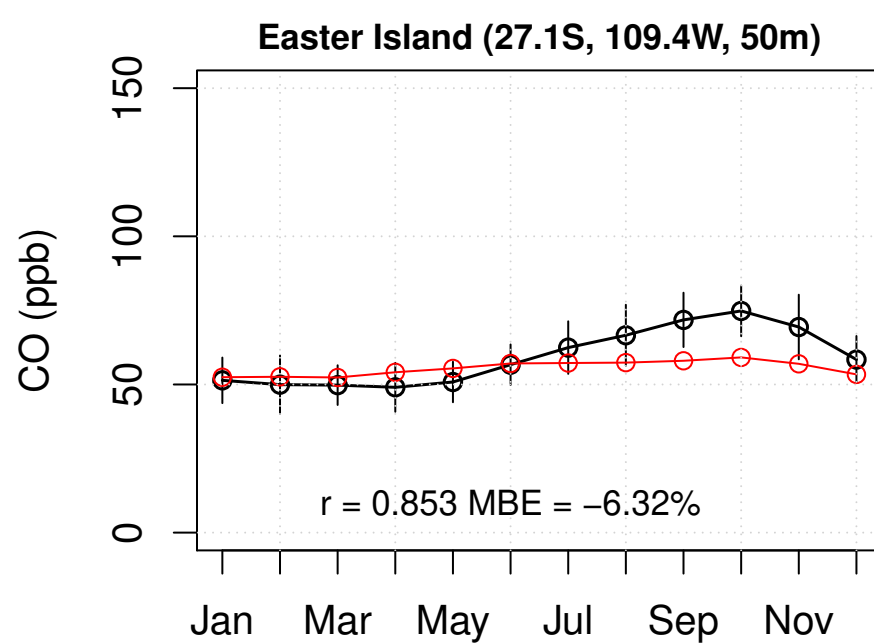
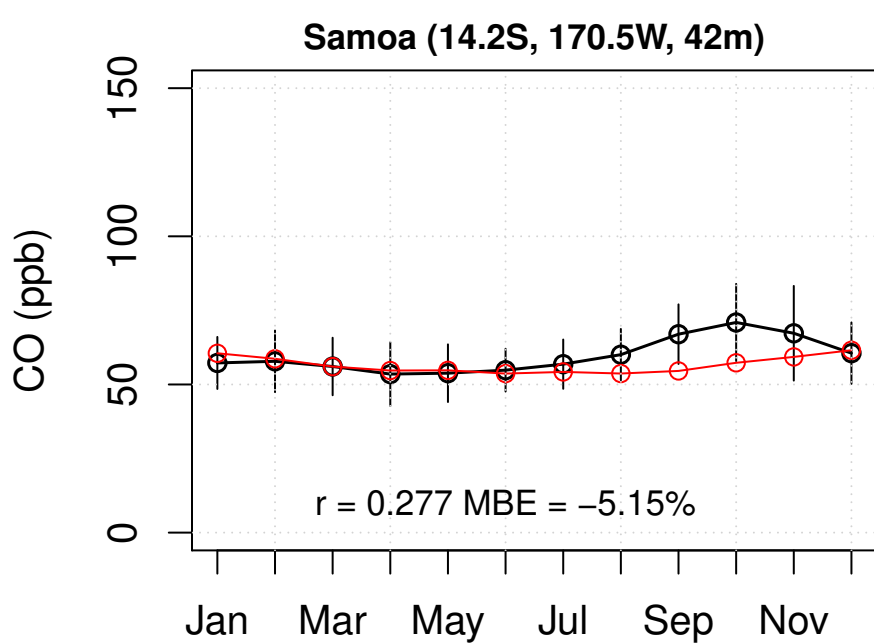
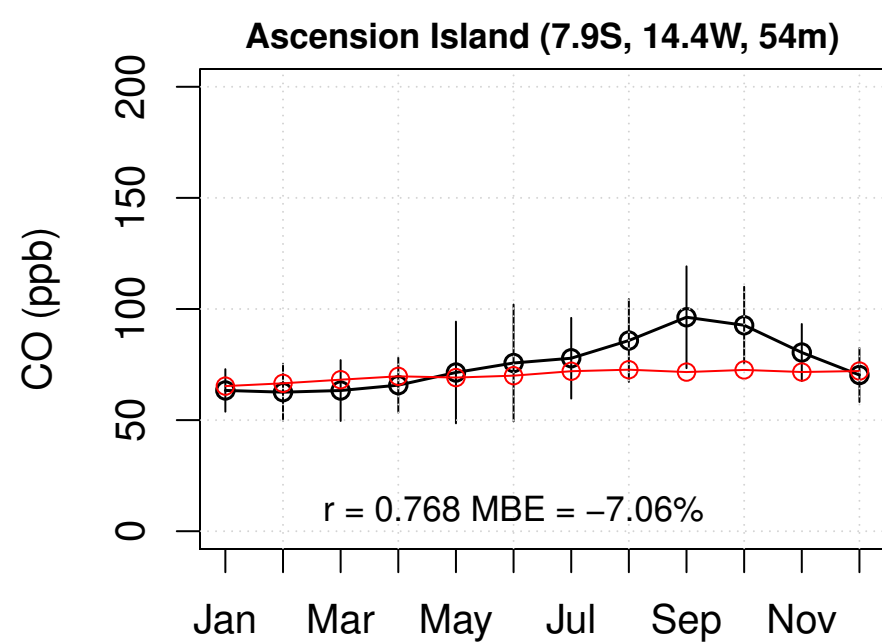
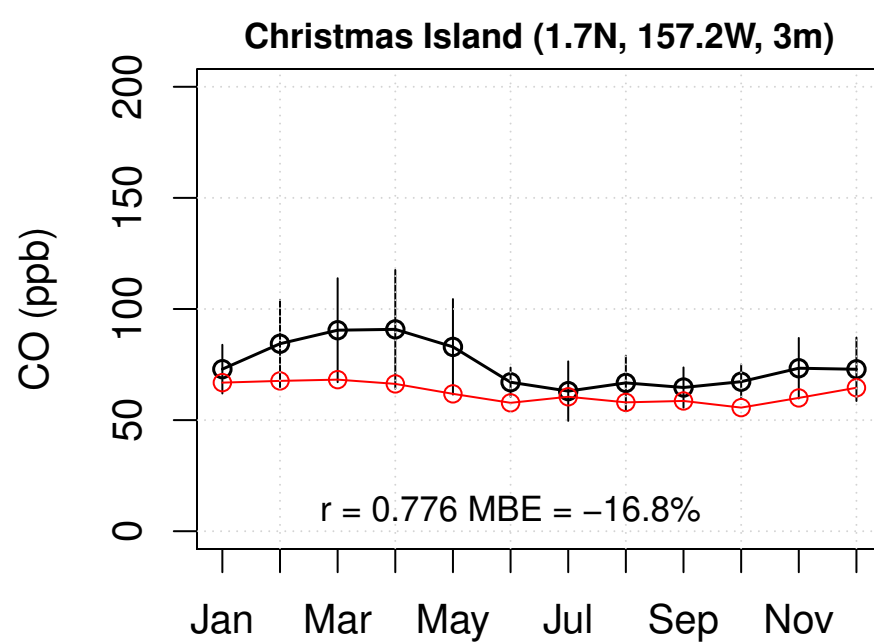
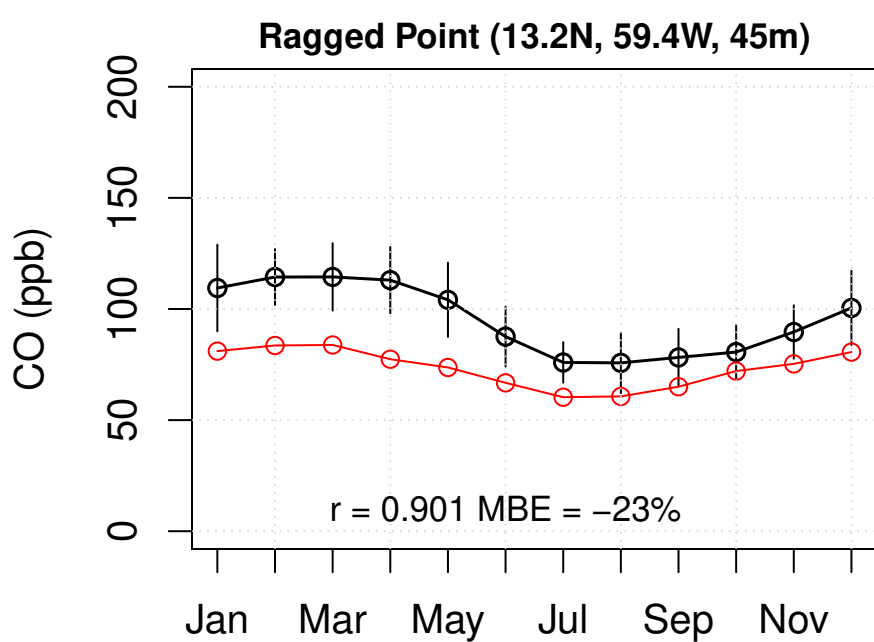
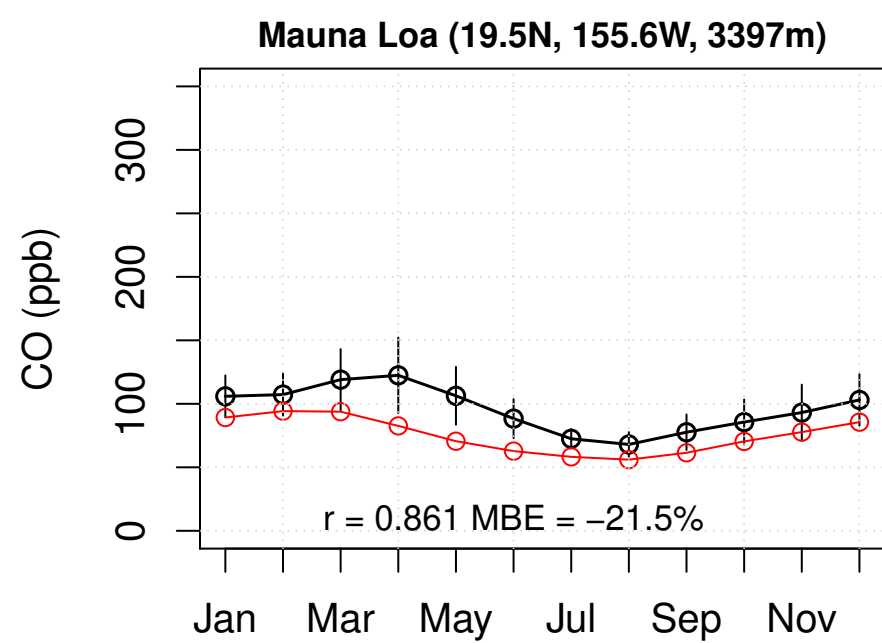
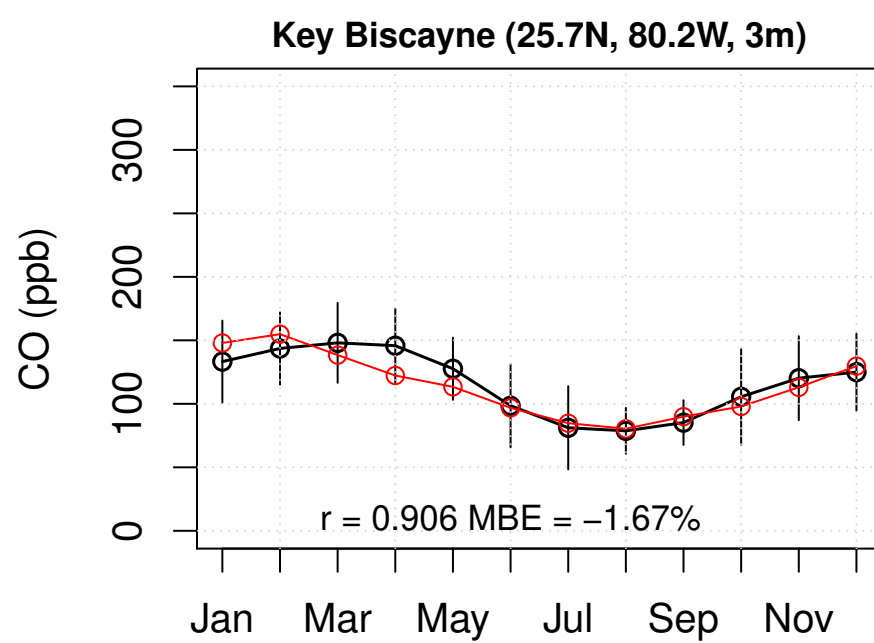
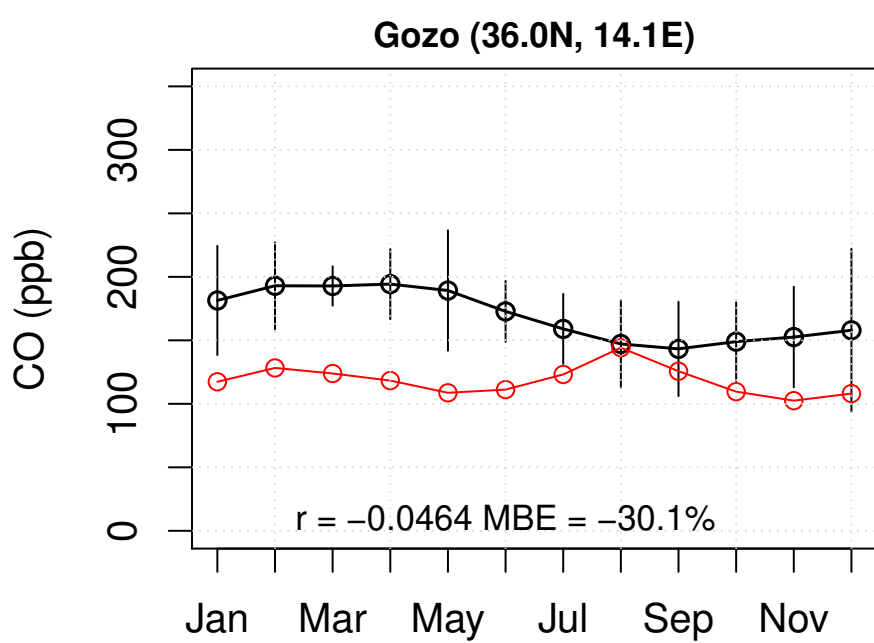
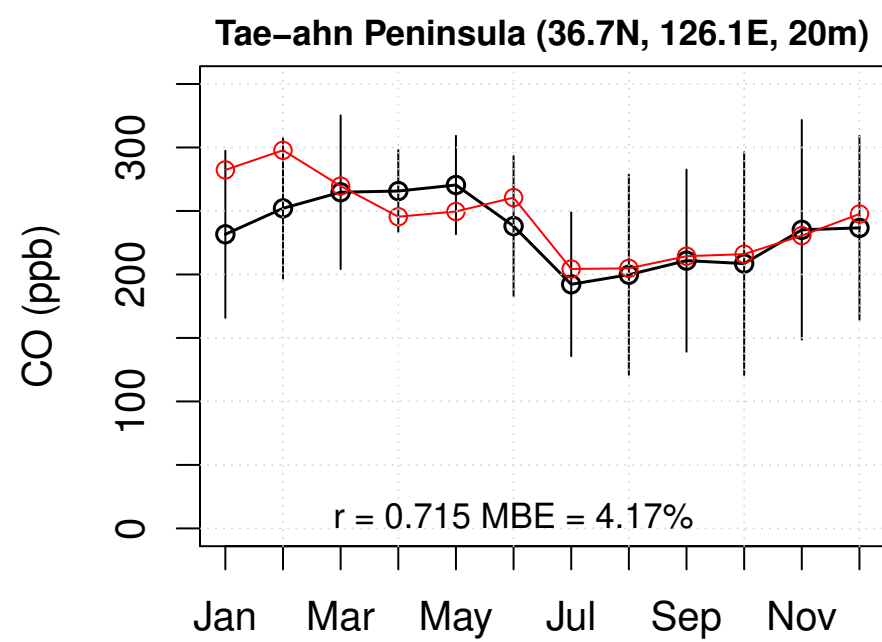
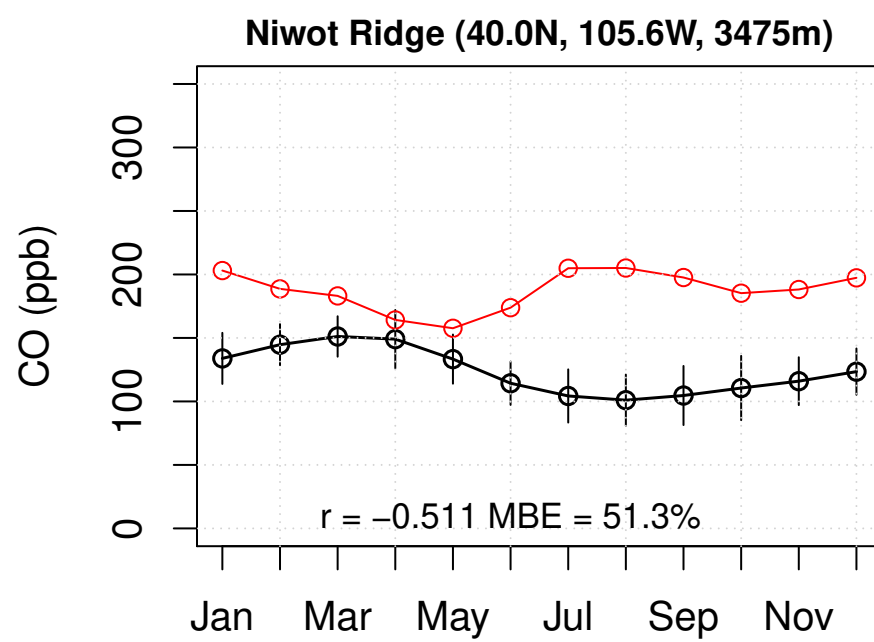
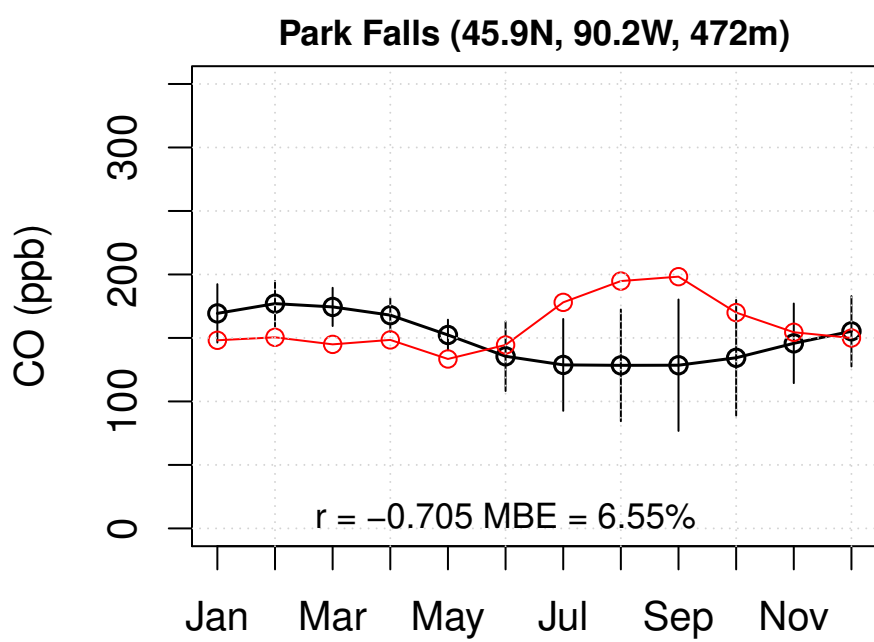
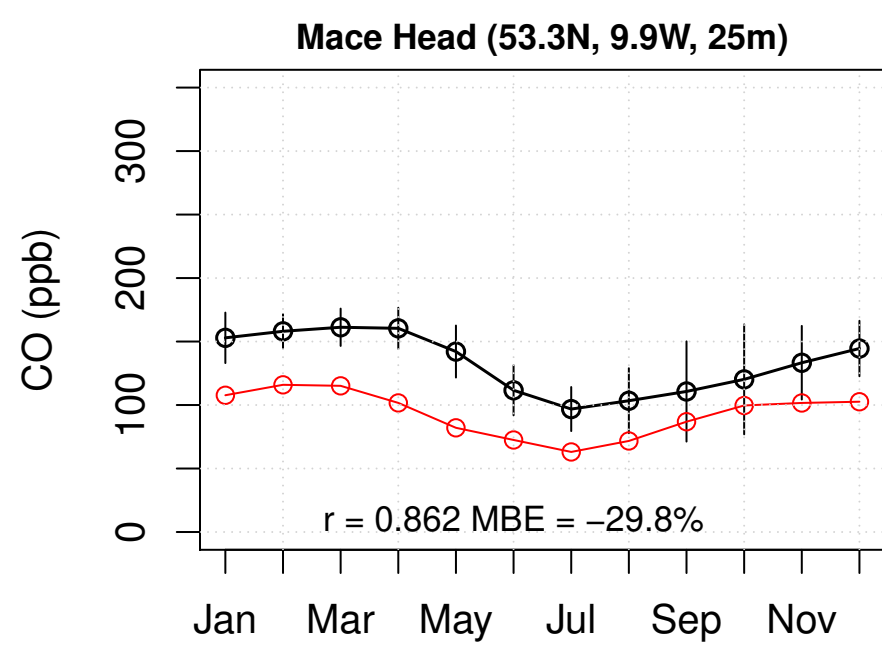
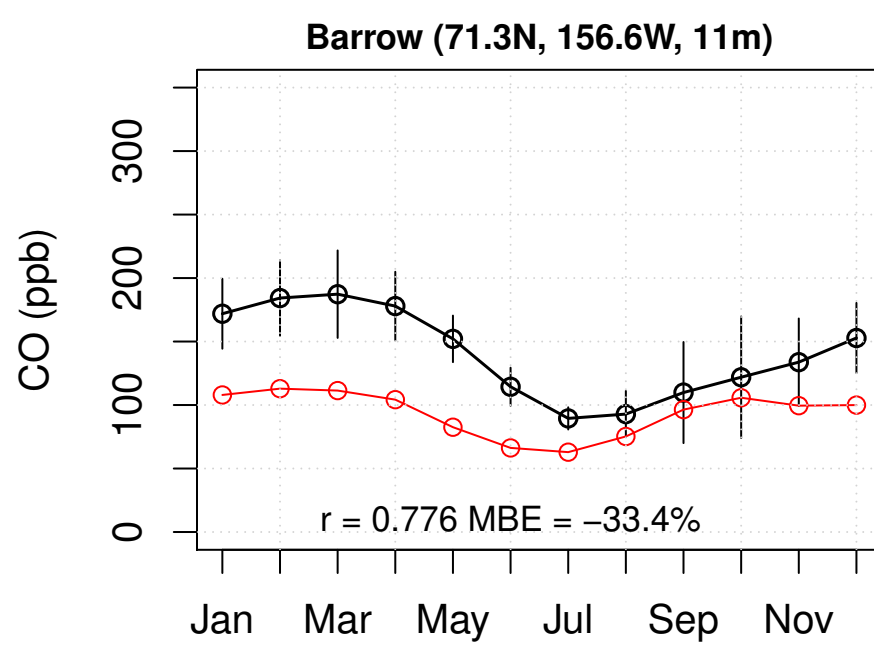
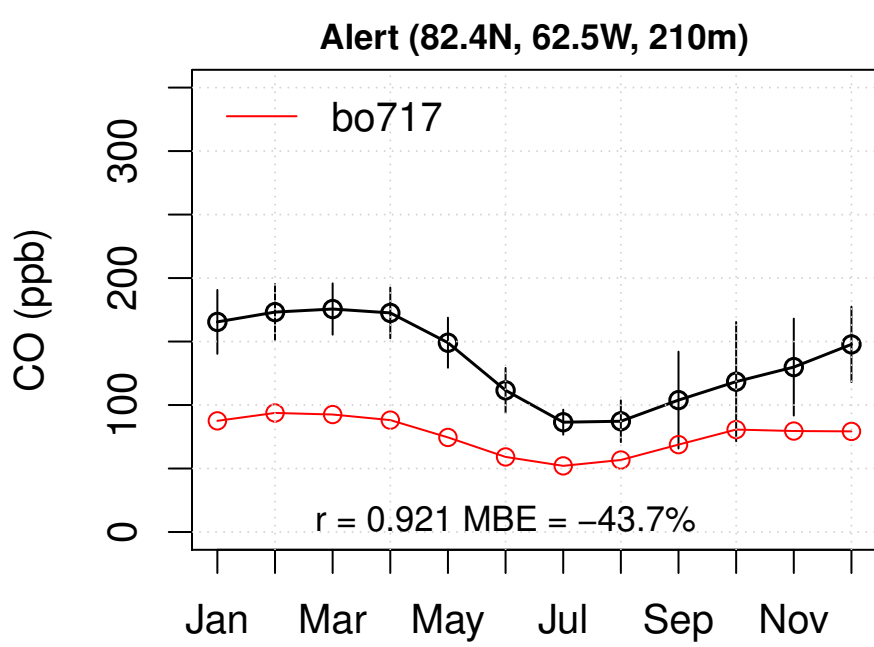
% CH<sub>4</sub> + OH flux (moles cm<sup>-3</sup> s<sup>-1</sup>)



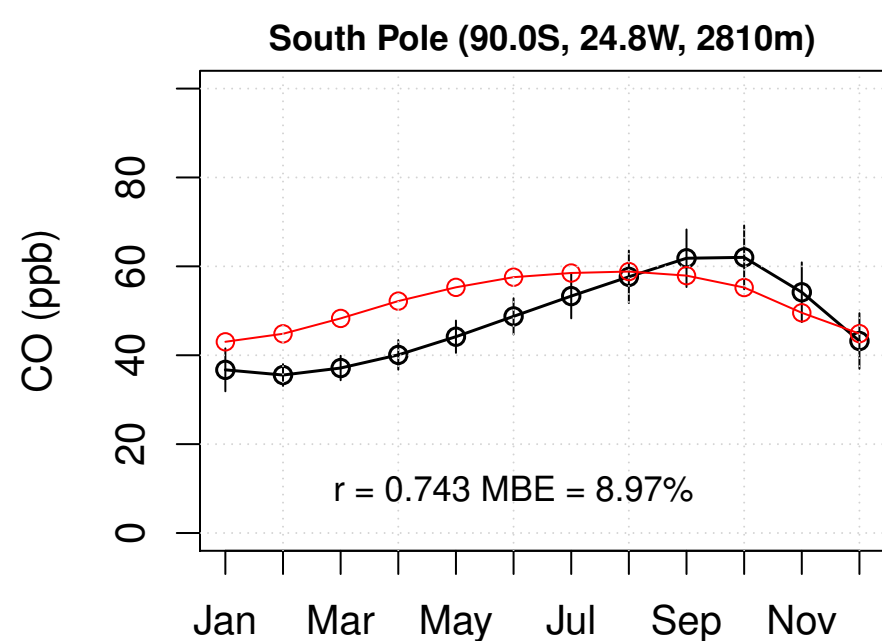
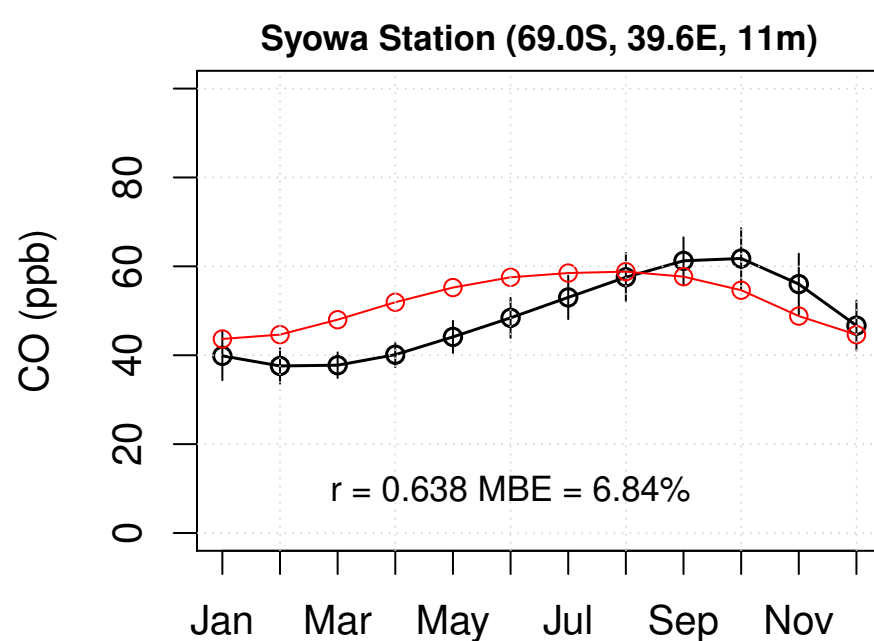
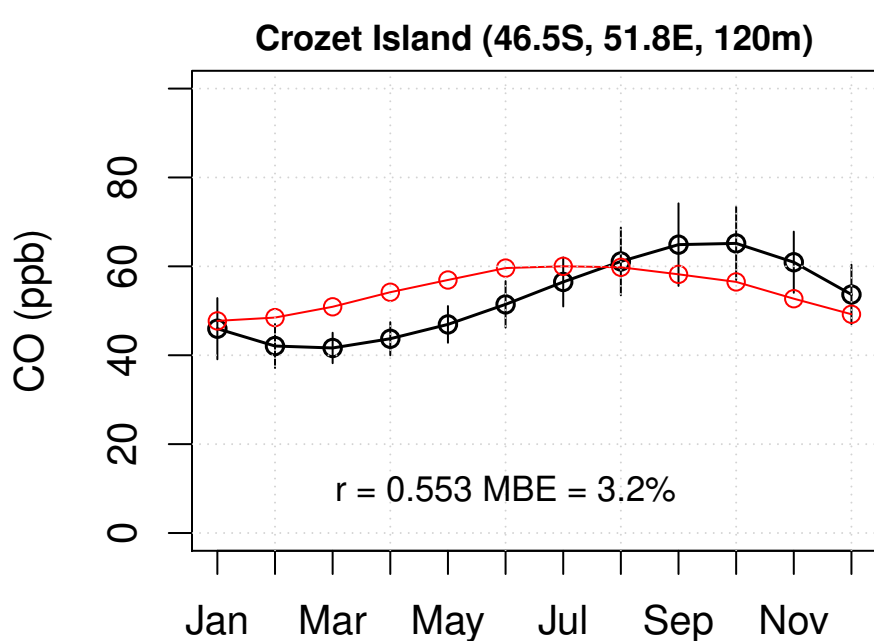
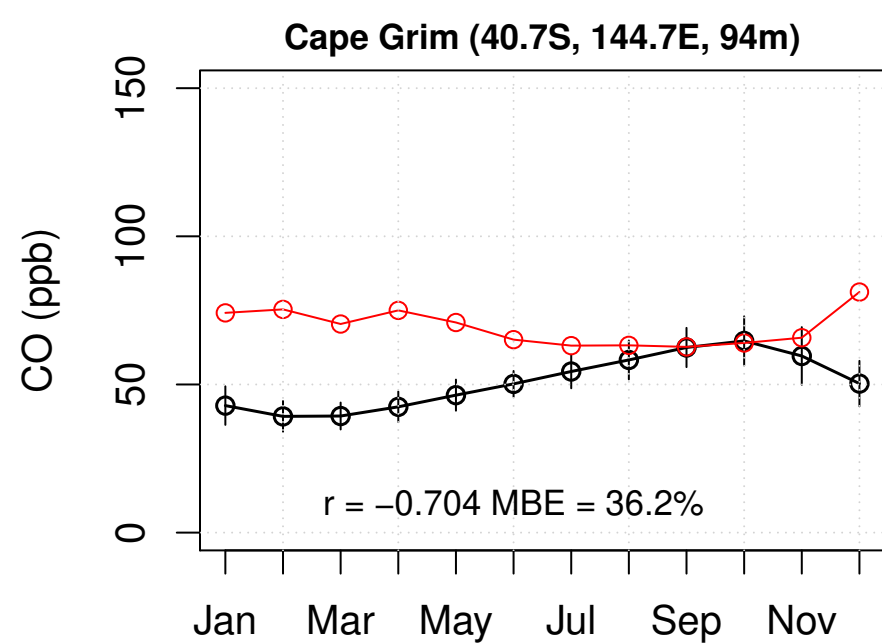
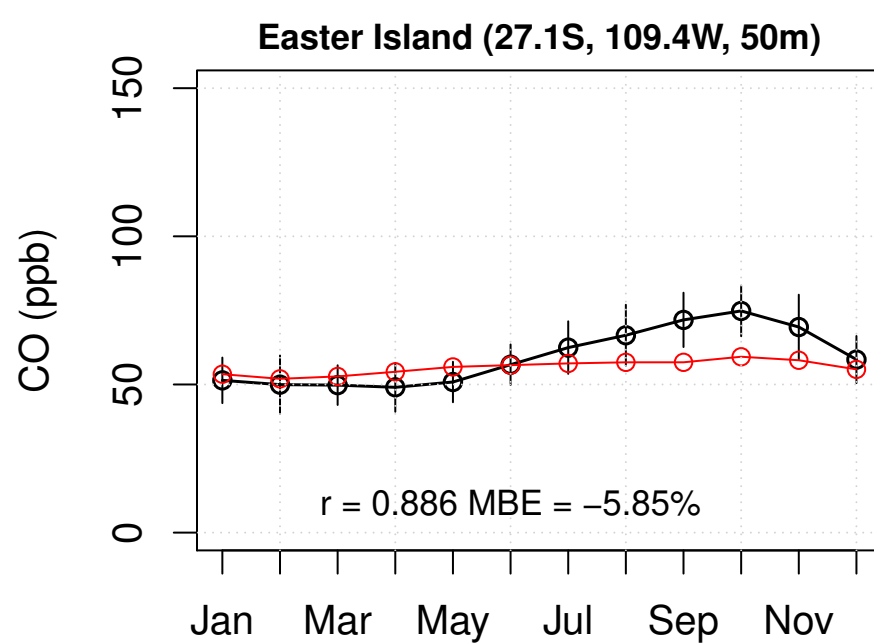
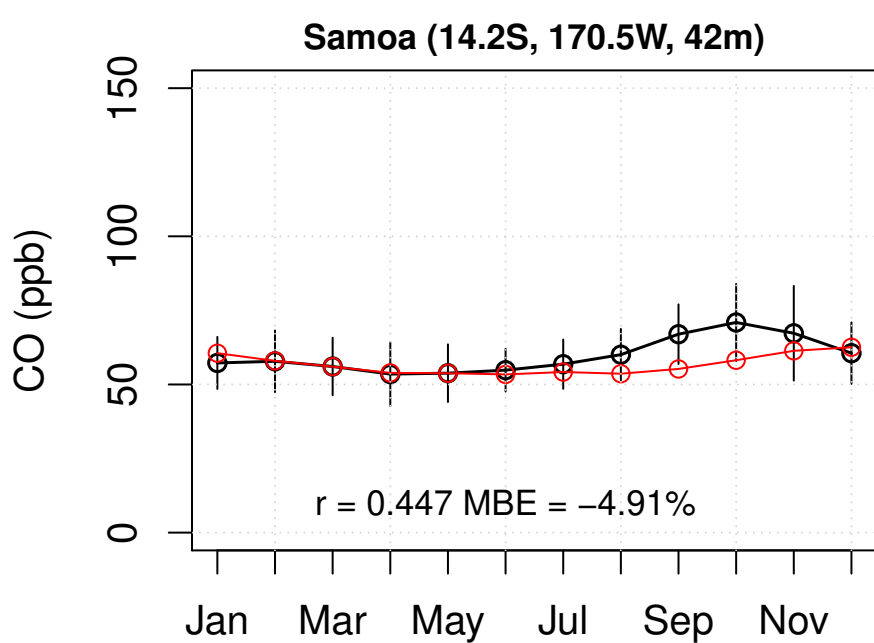
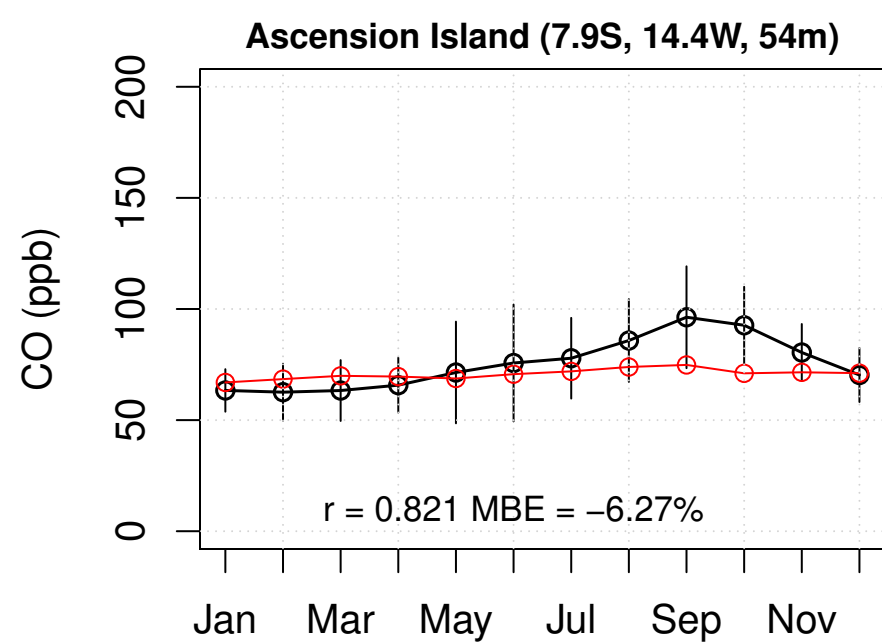
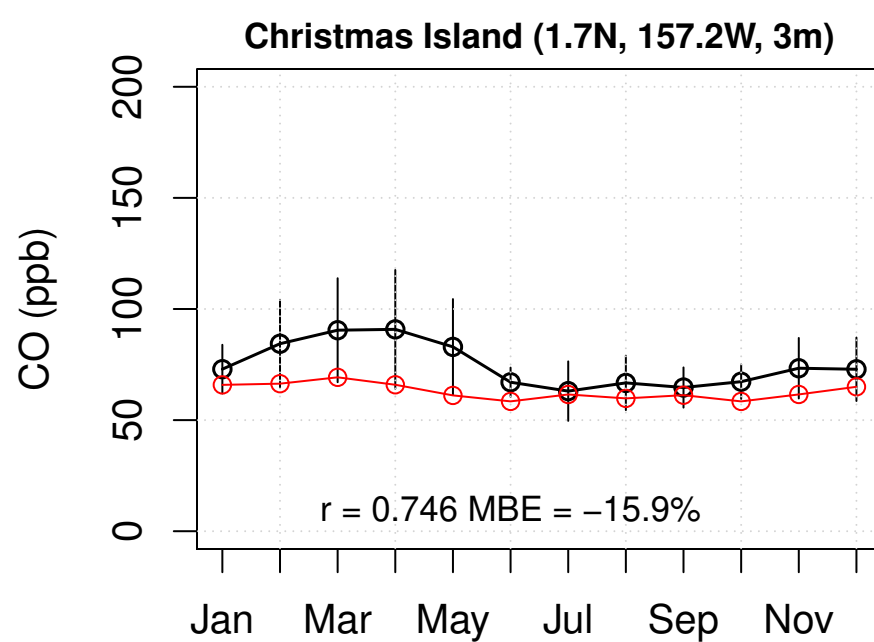
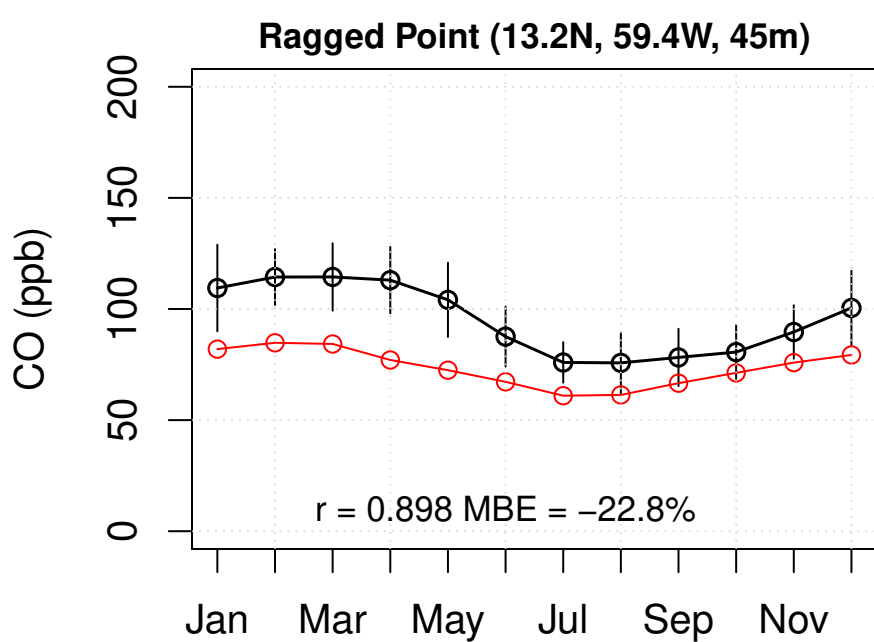
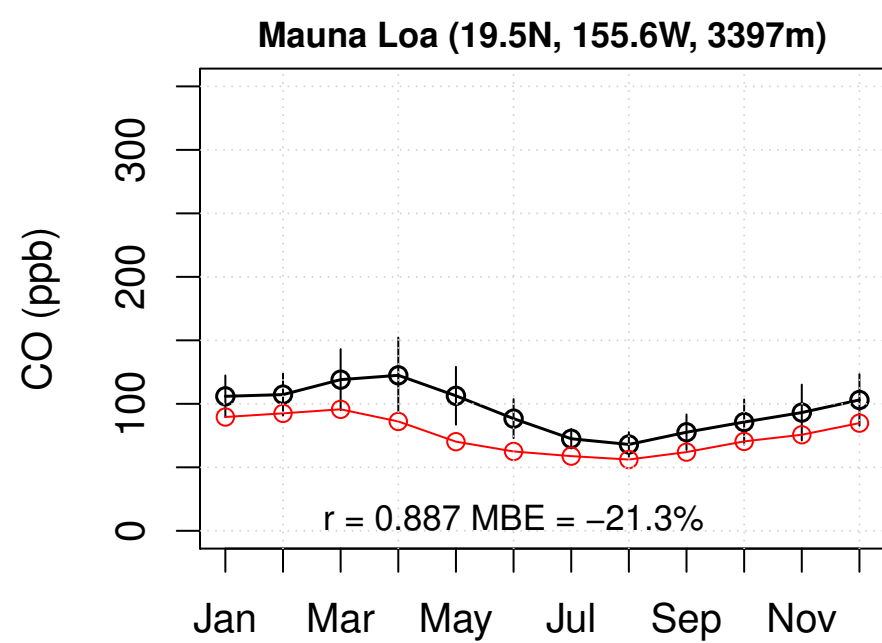
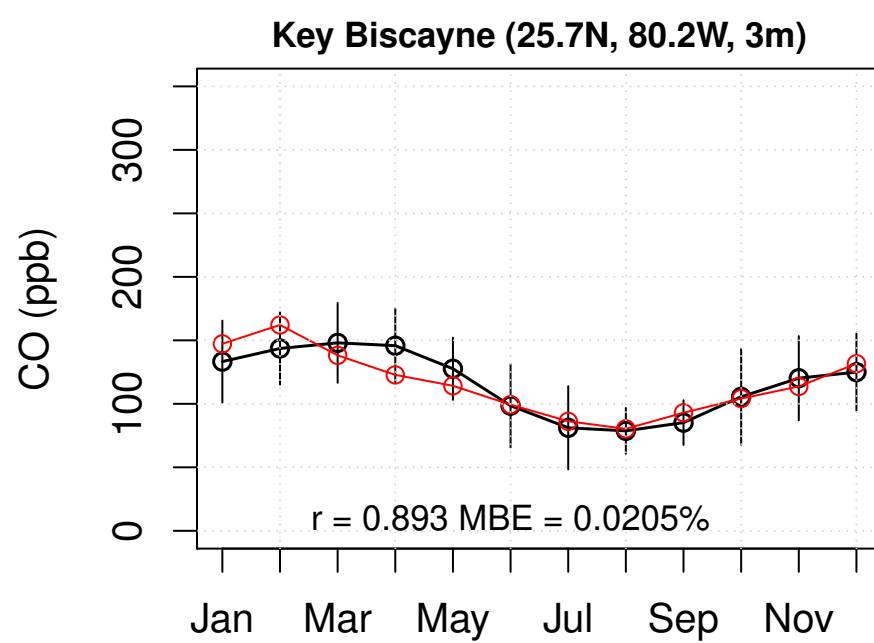
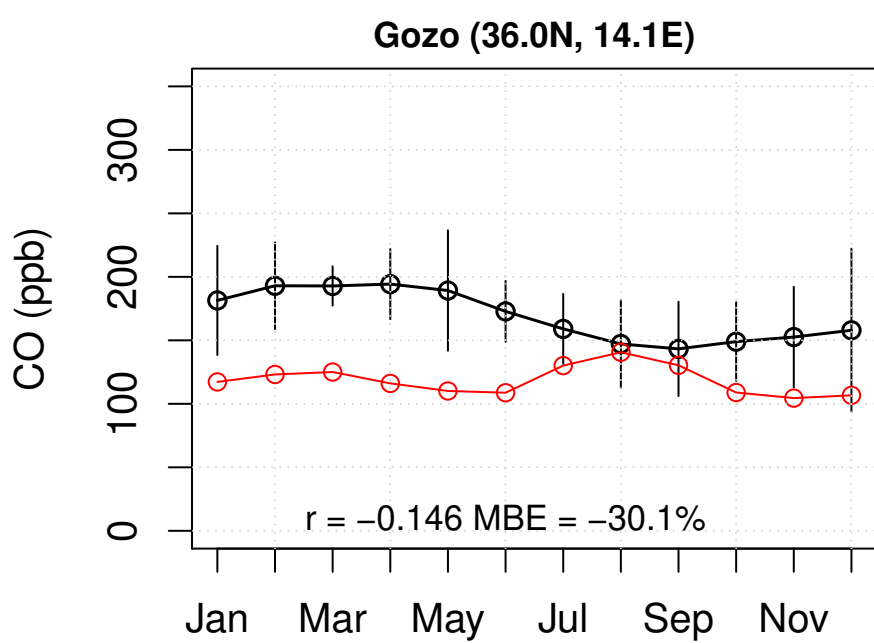
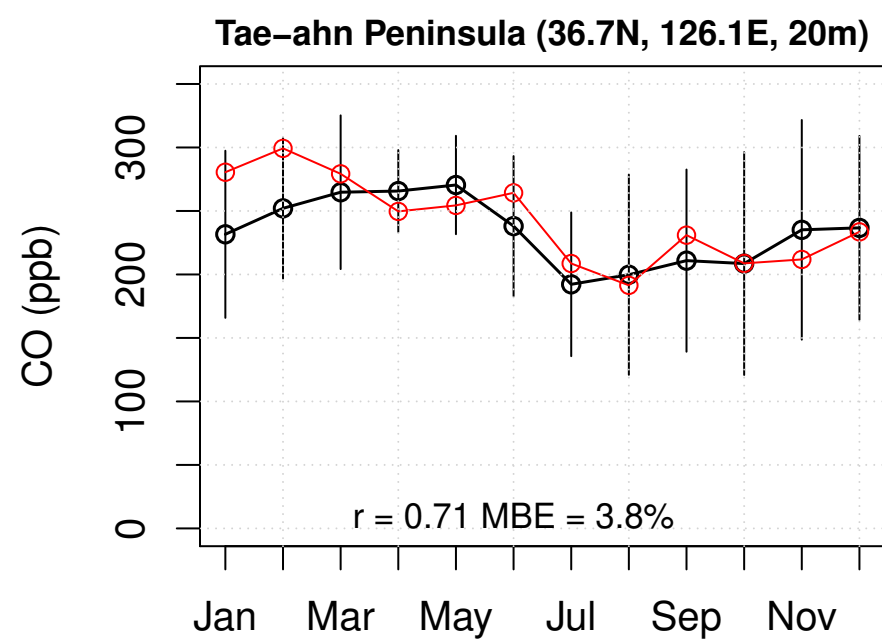
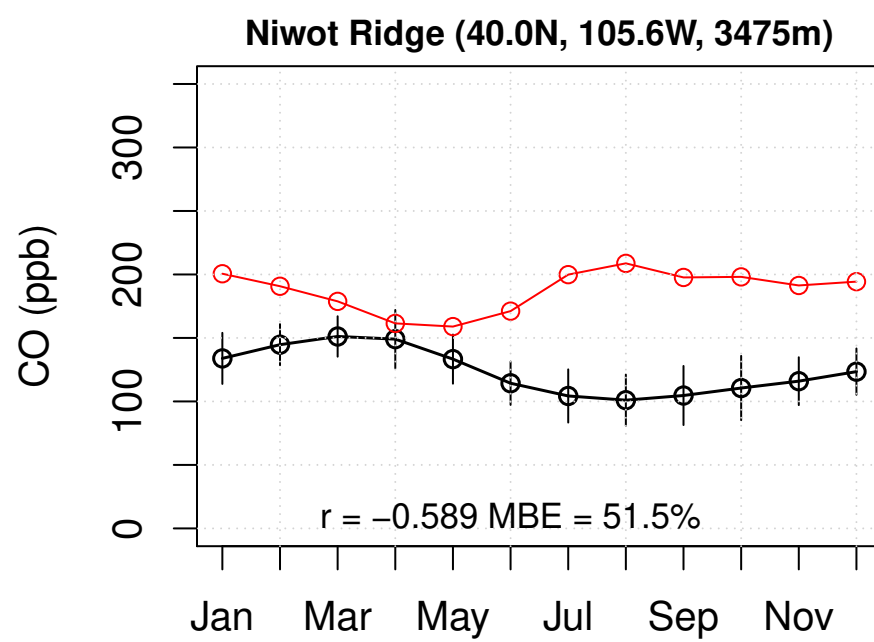
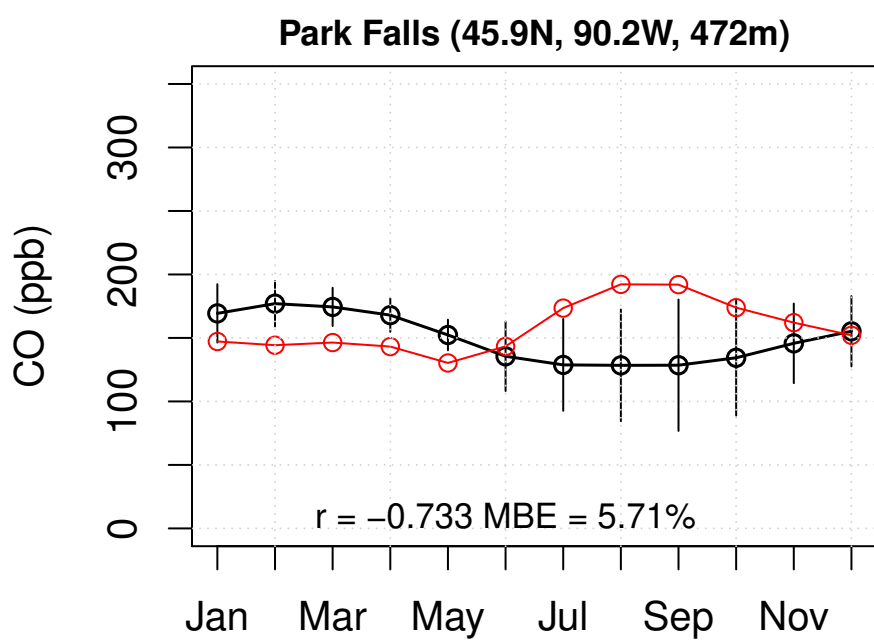
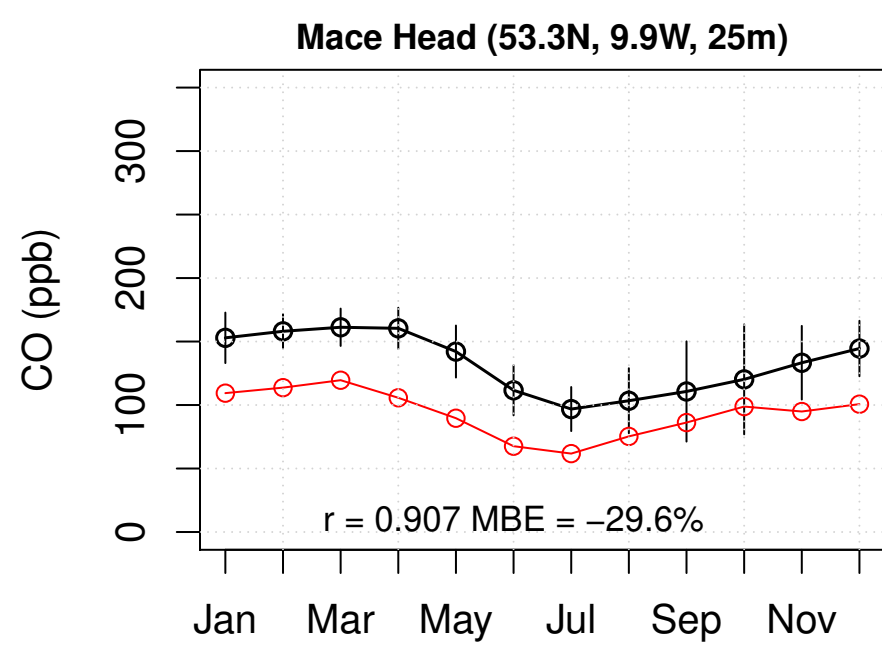
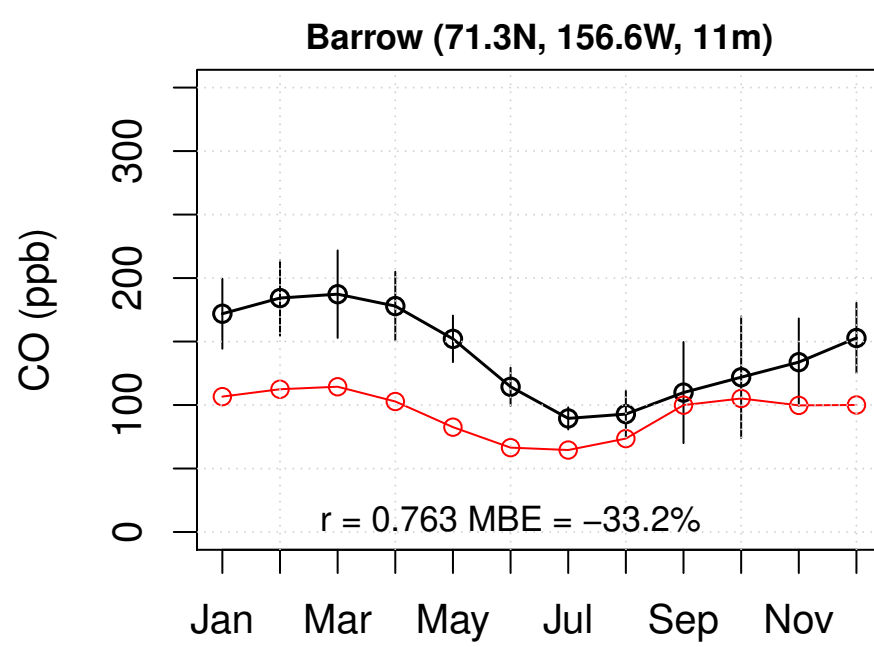
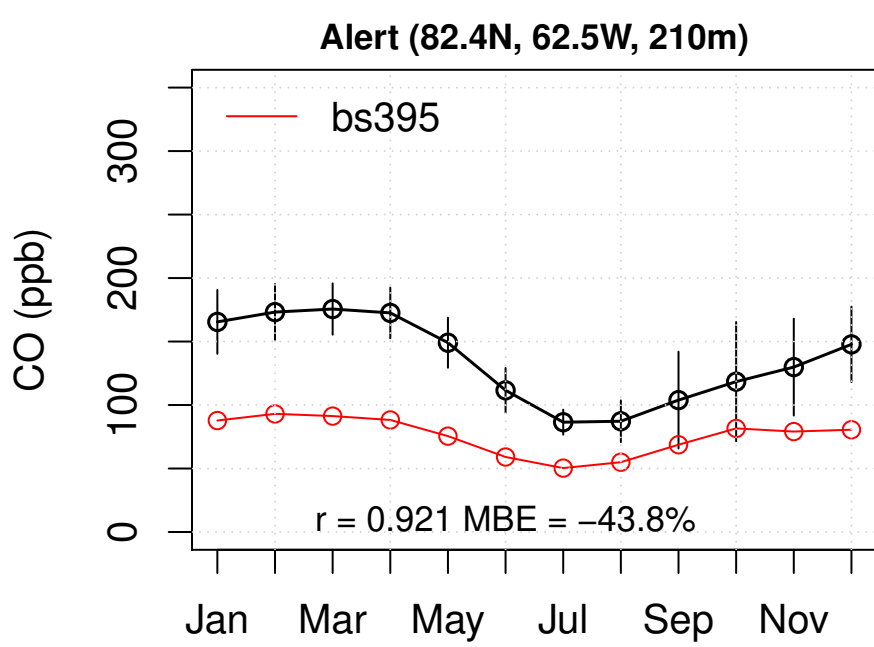
# UKCA bs395

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





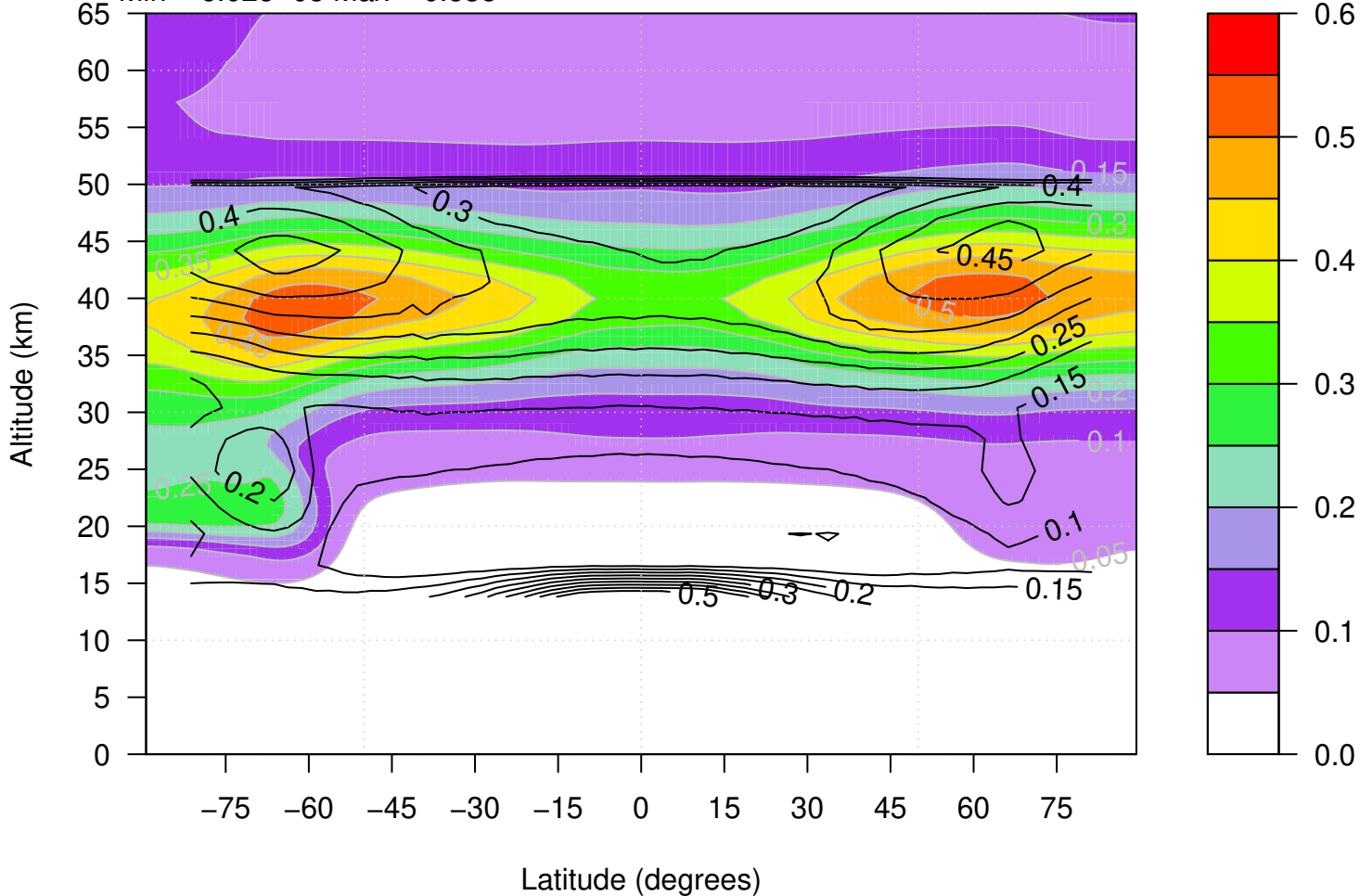






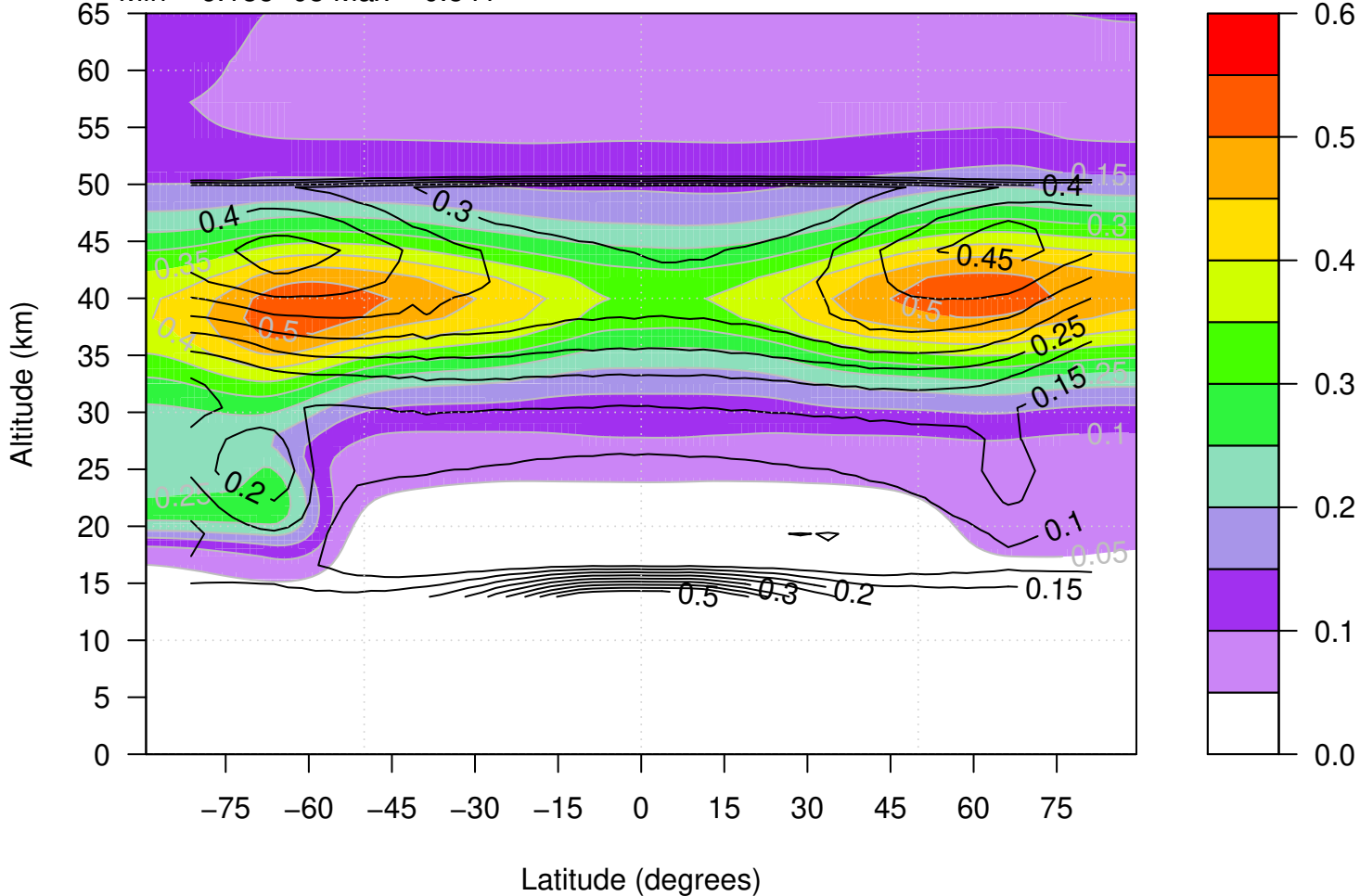
# MLS – UKCA bo717 ClO comparison

Min =  $6.02 \times 10^{-8}$  Max = 0.535



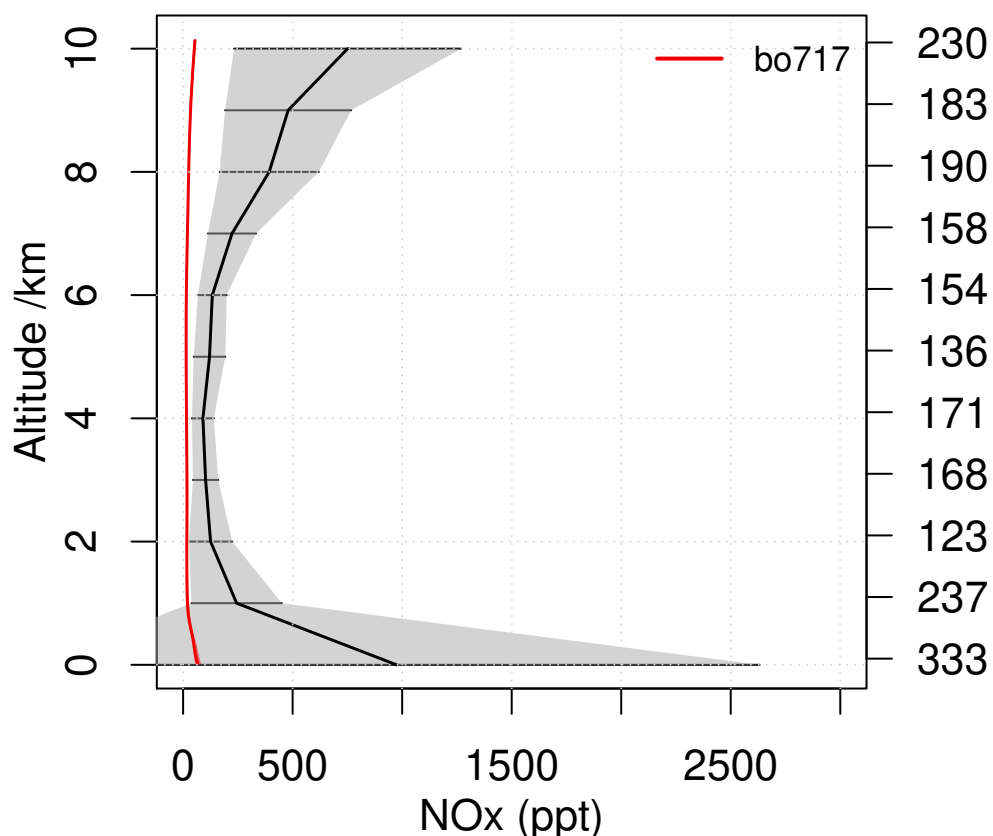
# MLS – UKCA bs395 ClO comparison

Min =  $6.18 \times 10^{-8}$  Max = 0.541

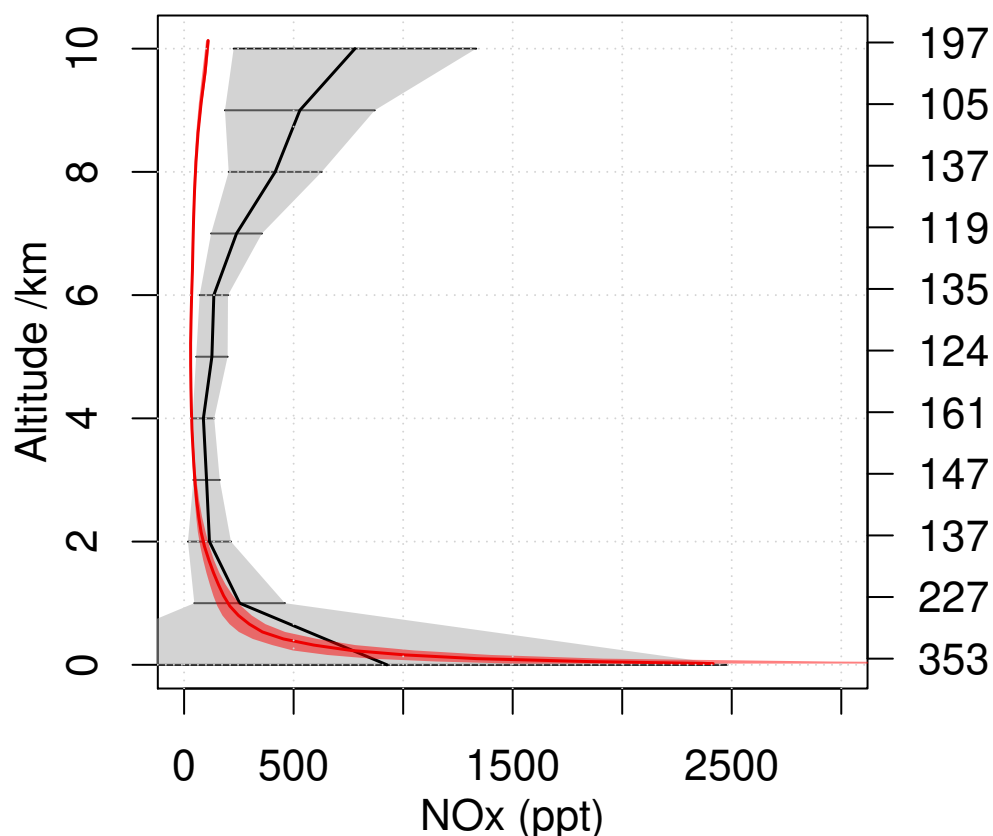


**Emmons NOx comparison**

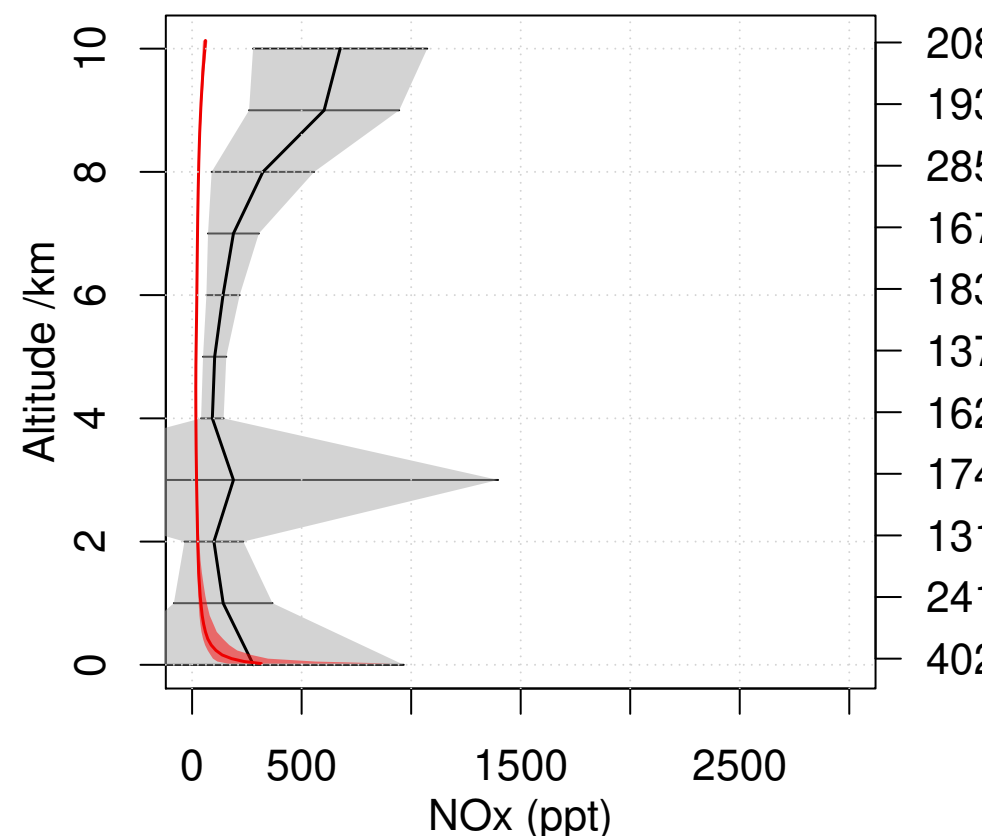
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



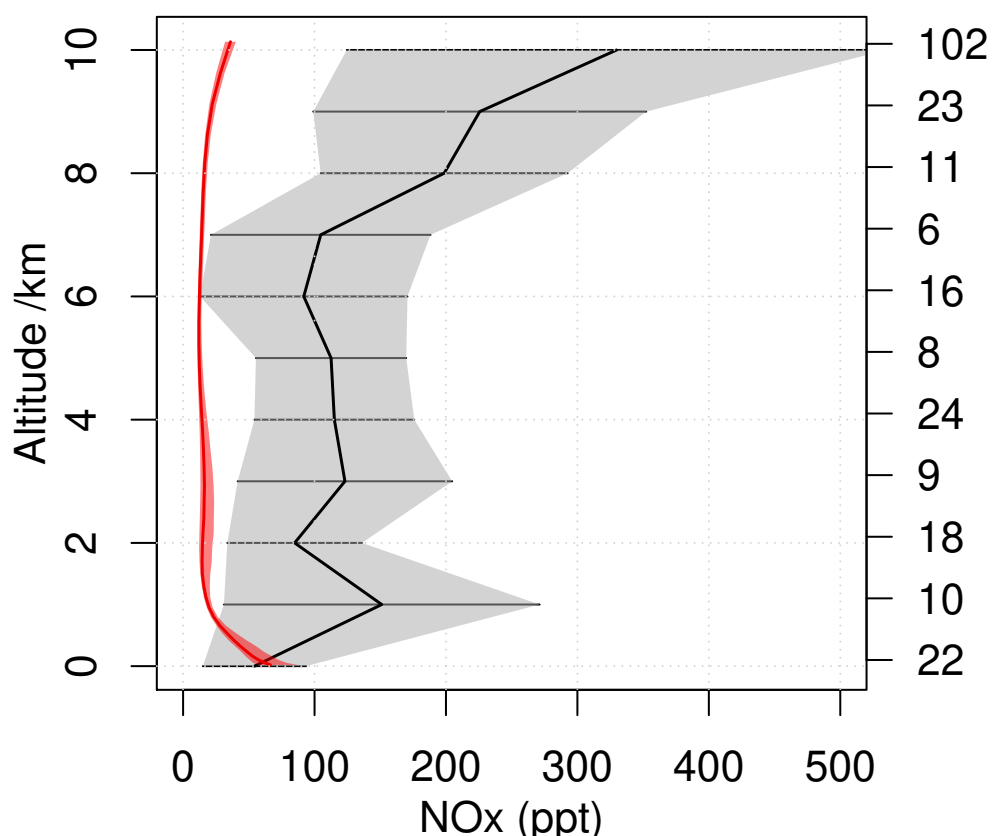
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



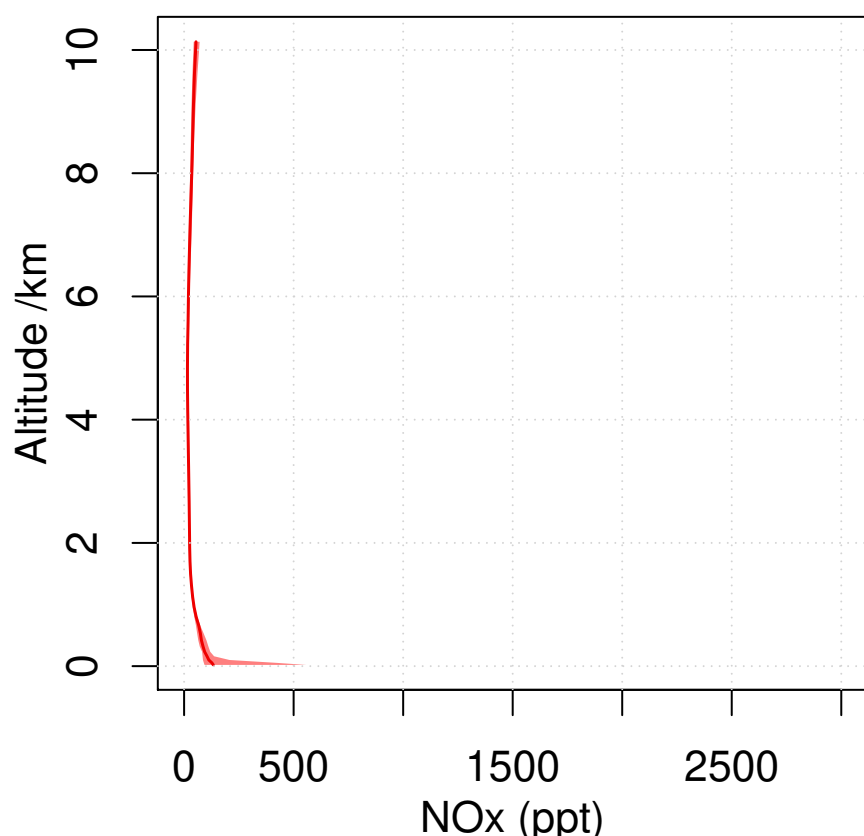
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



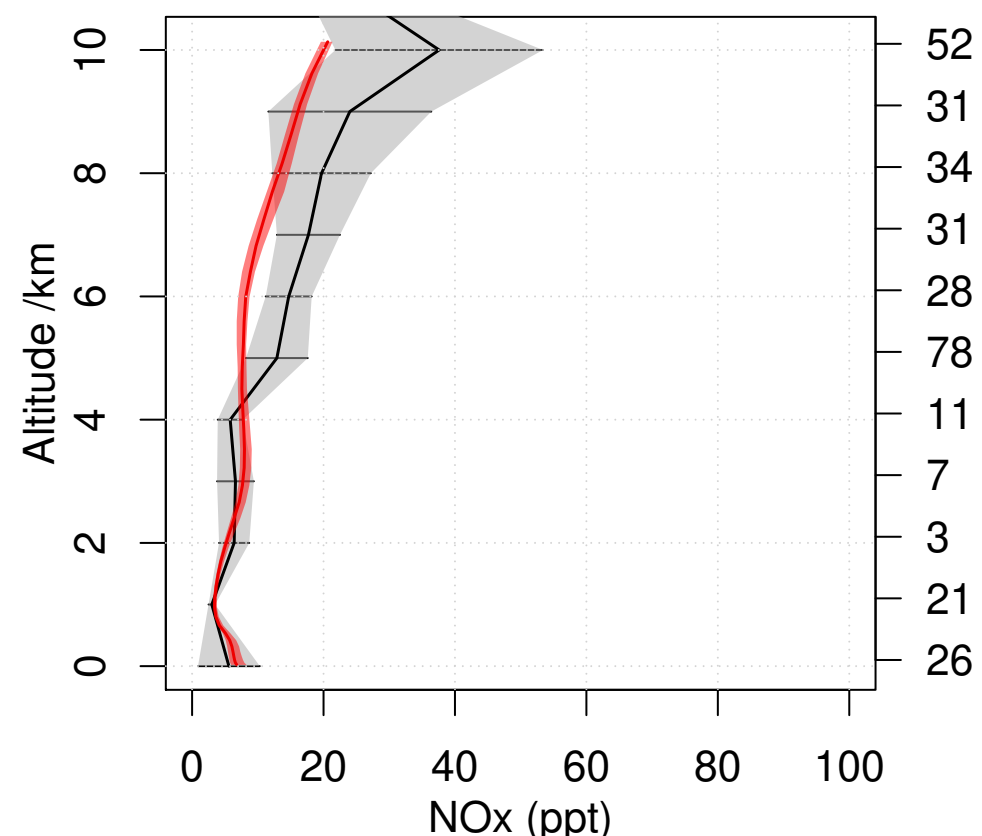
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



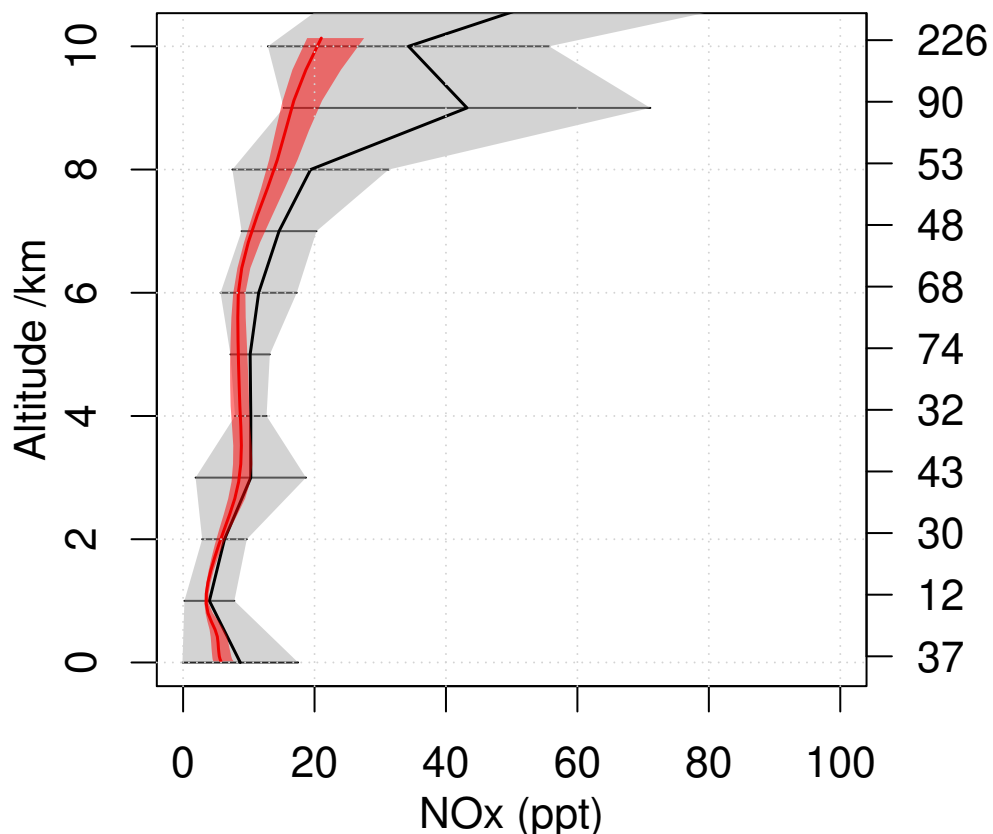
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



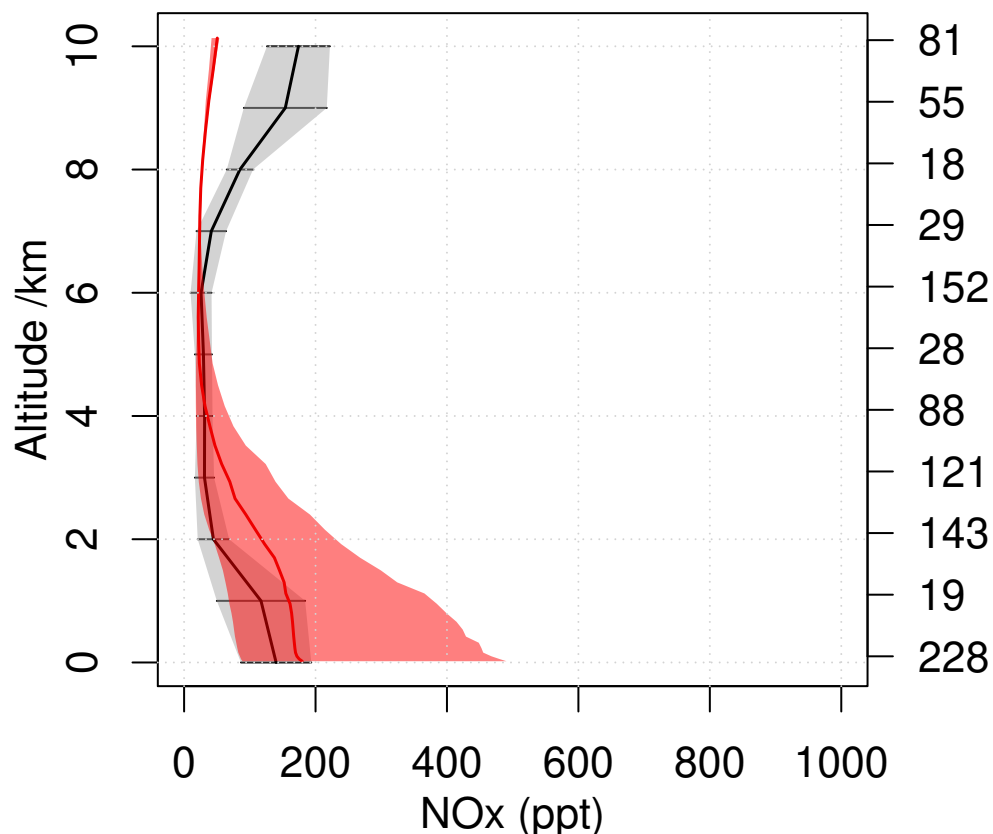
**PEM-Tropics-B Christmas-Island 1999 07**  
Lat 0 – 10 Lon 200 – 220



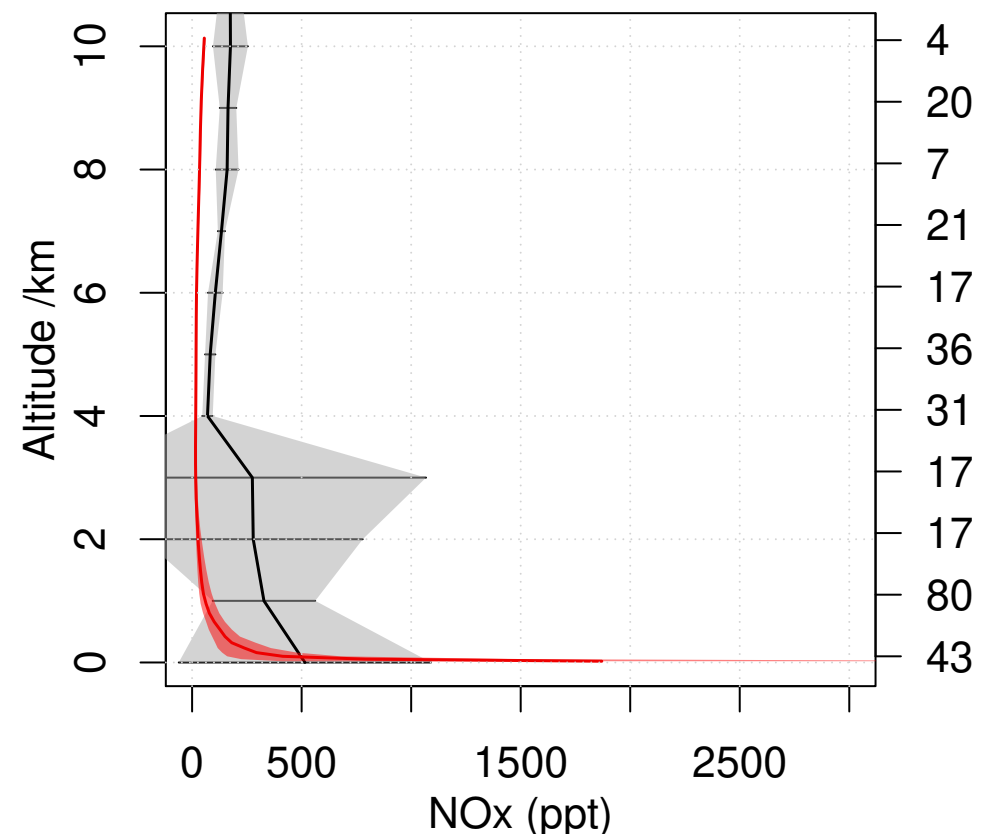
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



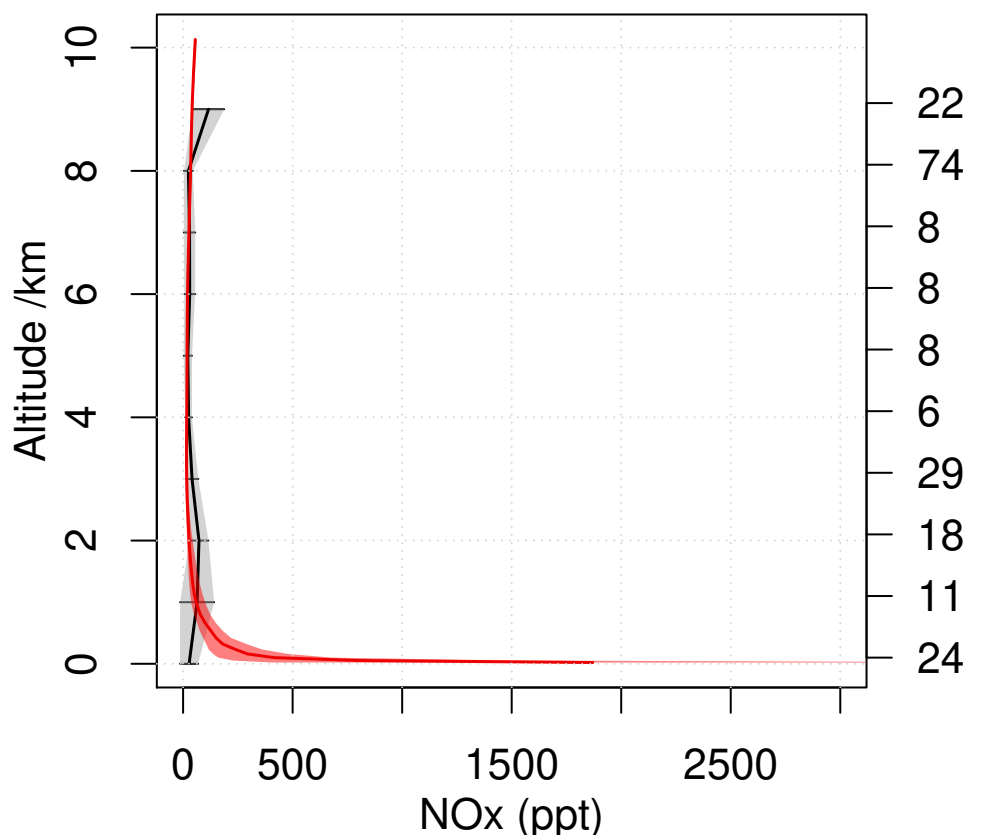
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



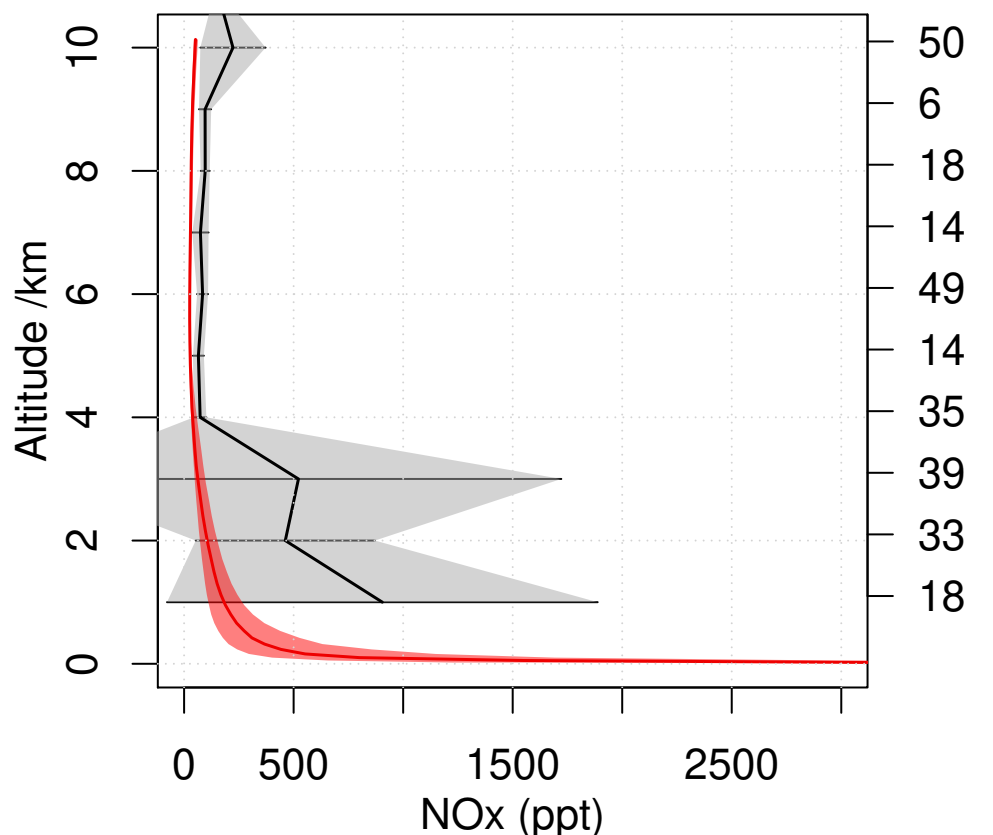
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



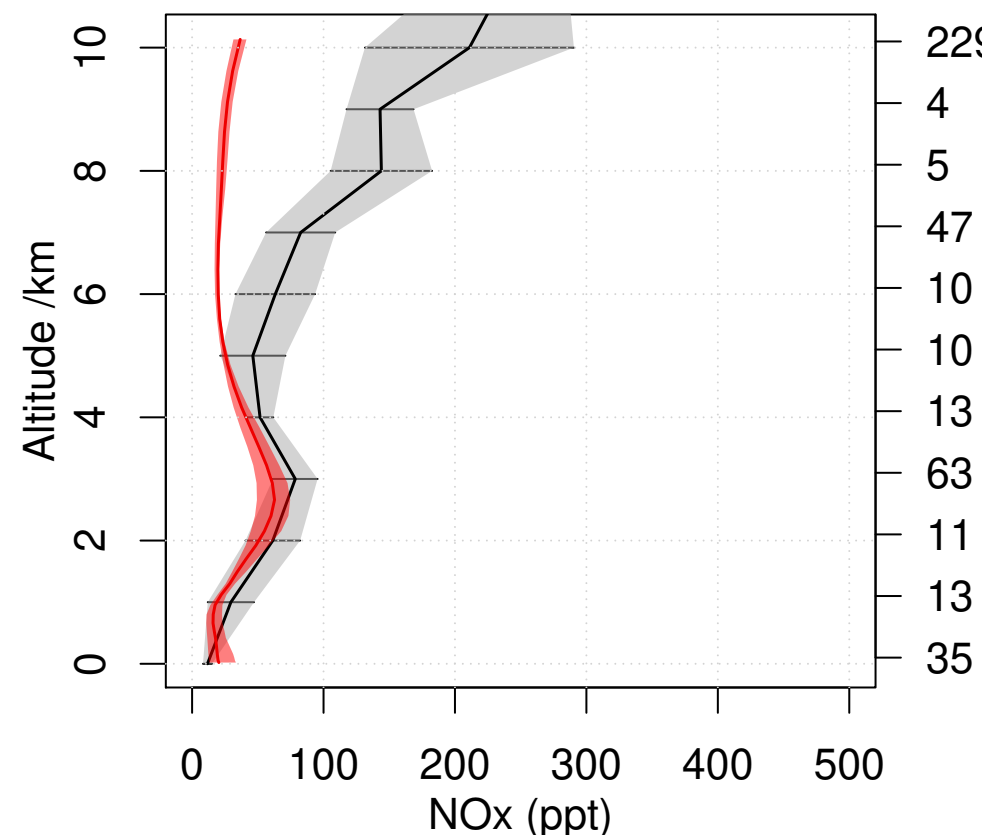
**TRACE-A E-Brazil Coast 1992 09**  
Lat -35 – -25 Lon 310 – 320



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

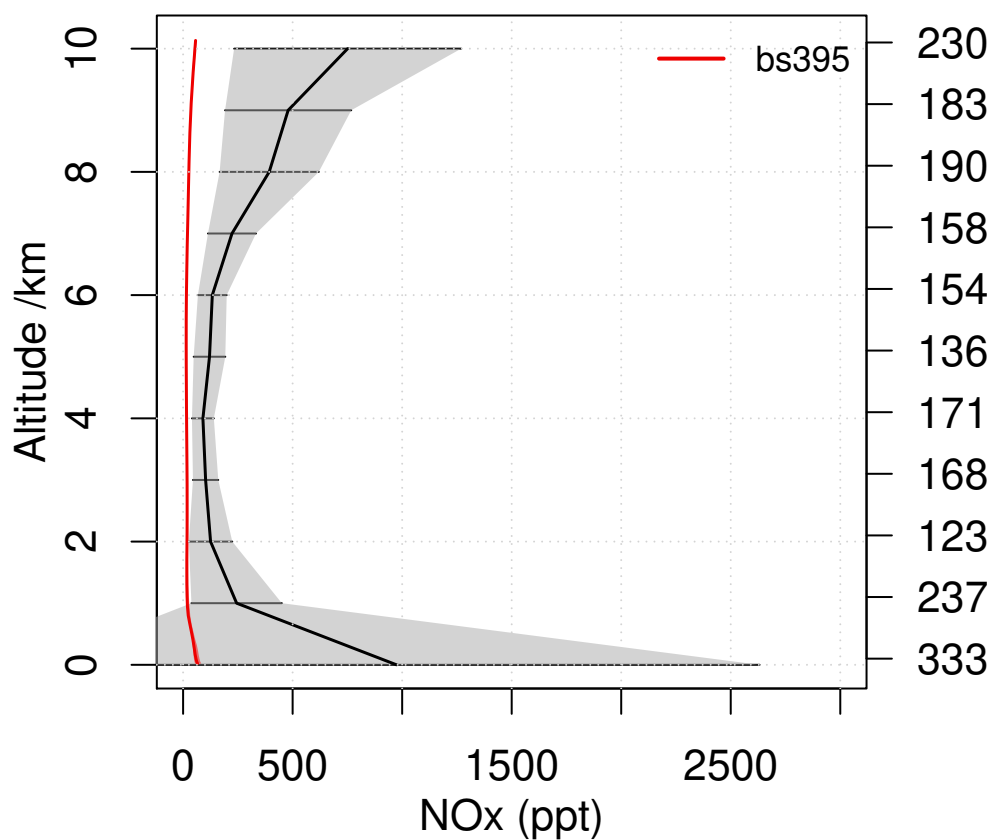


**TRACE-A W-Africa Coast 1992 09**  
Lat -25 – -5 Lon 0 – 10

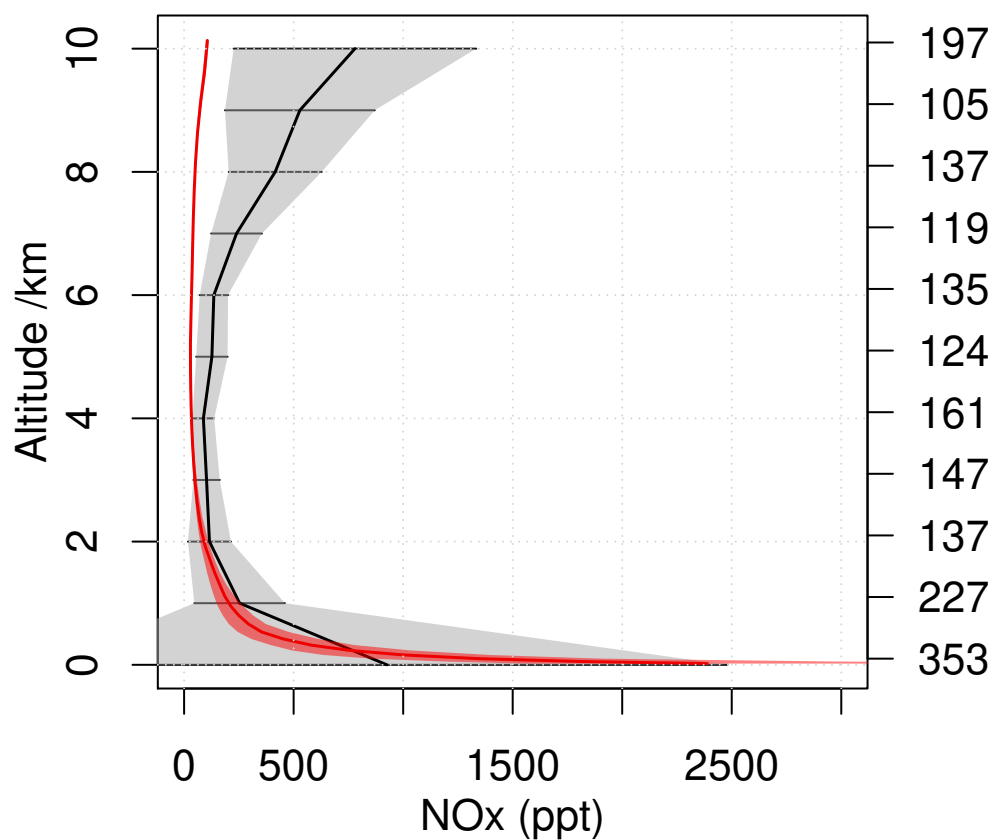


### Emmons NOx comparison

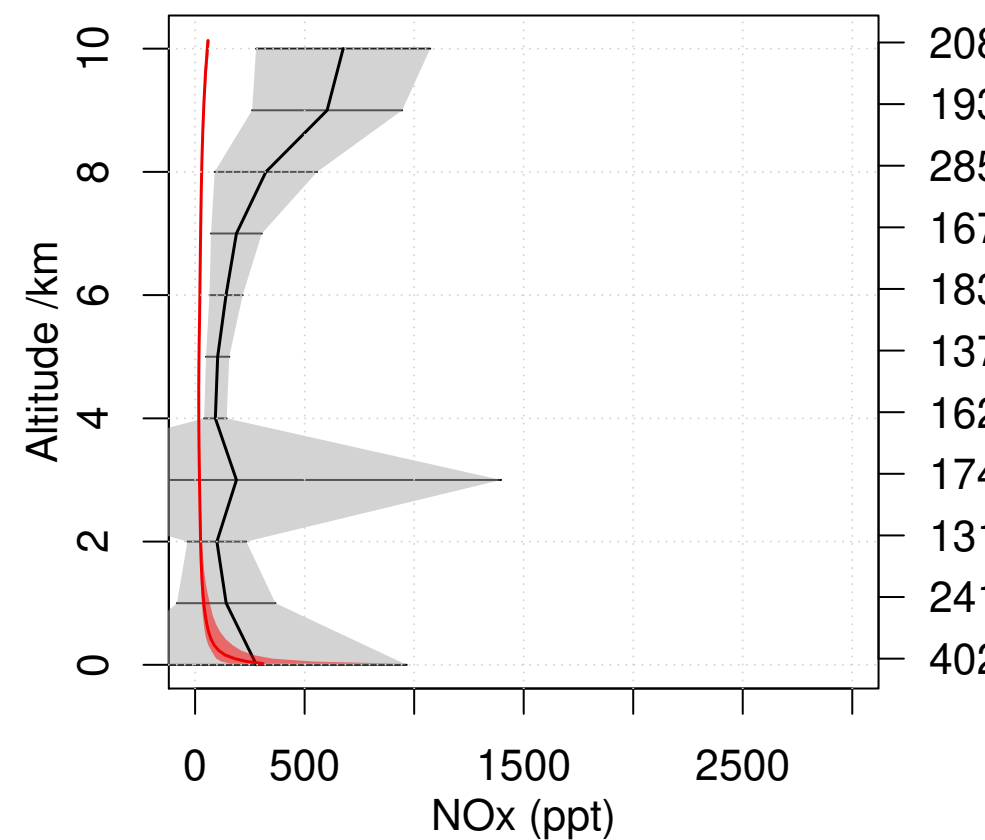
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



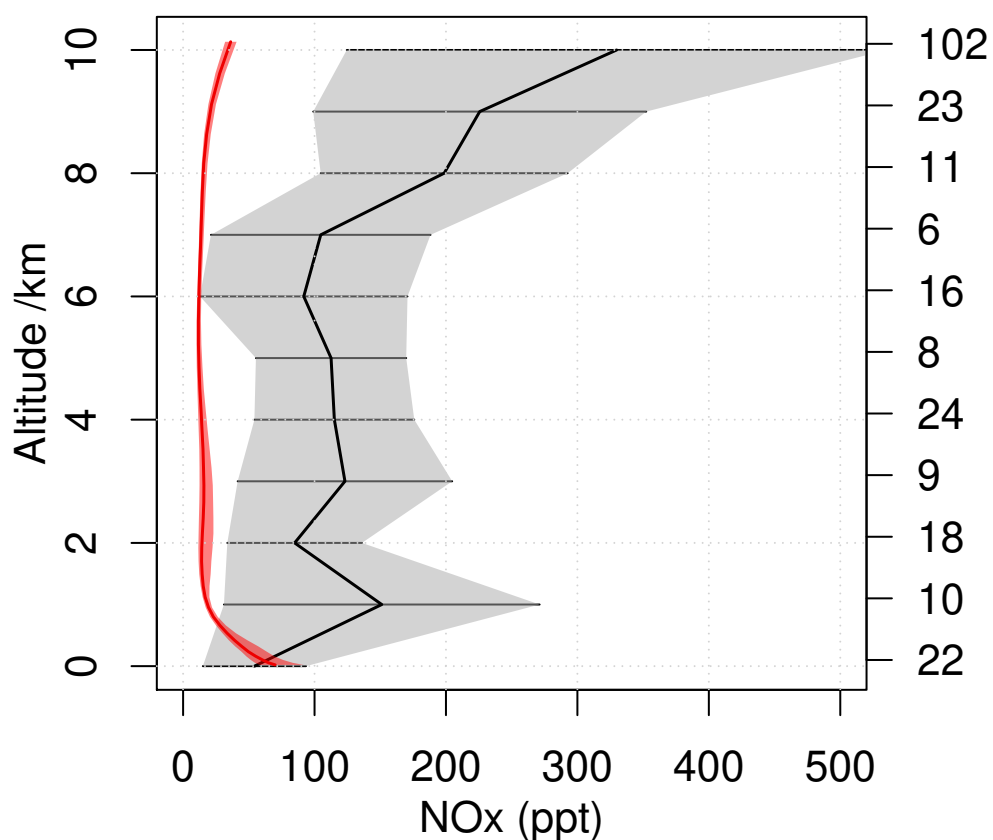
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



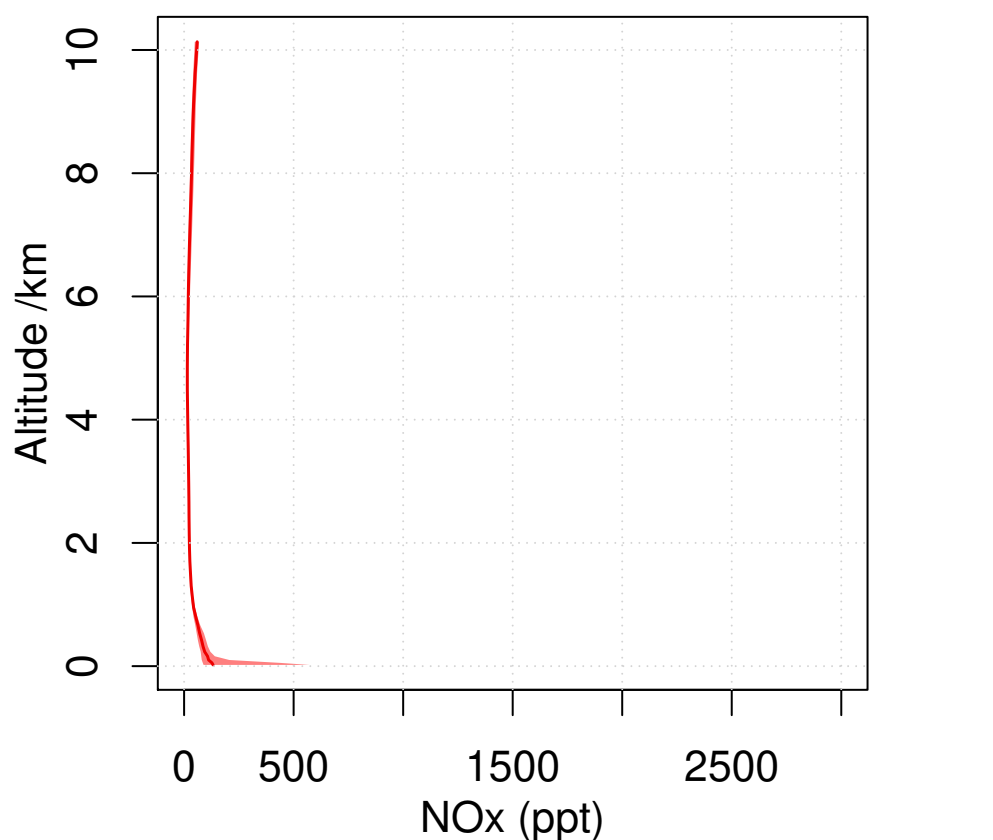
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



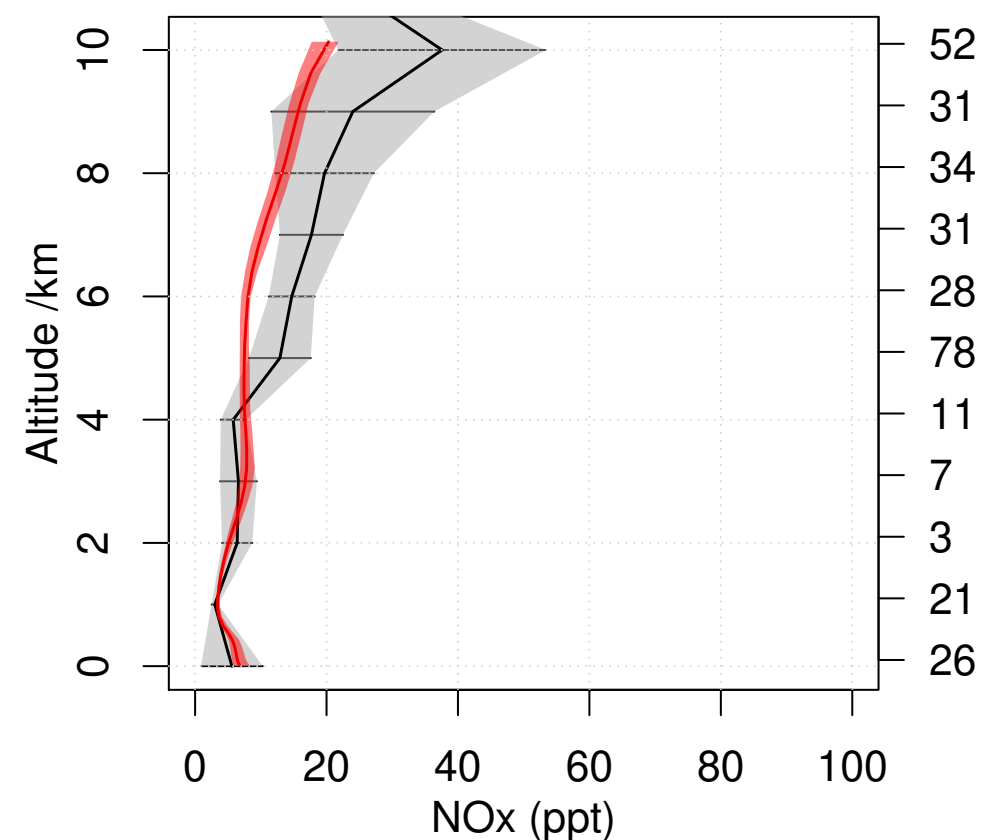
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



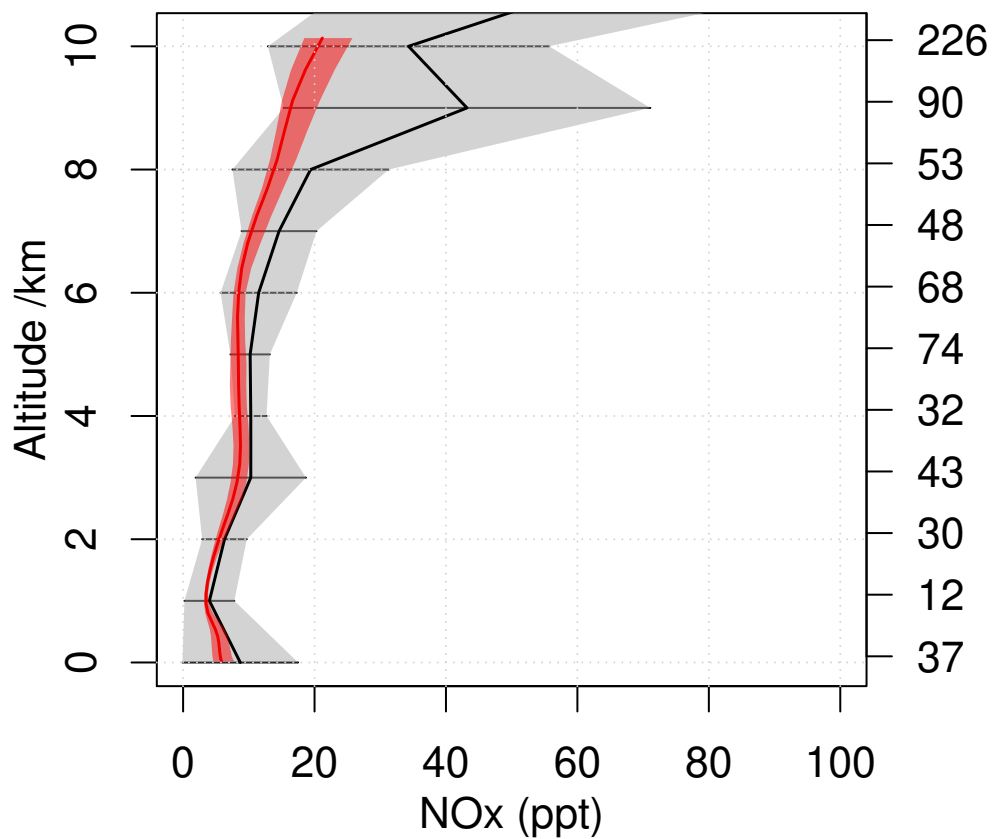
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



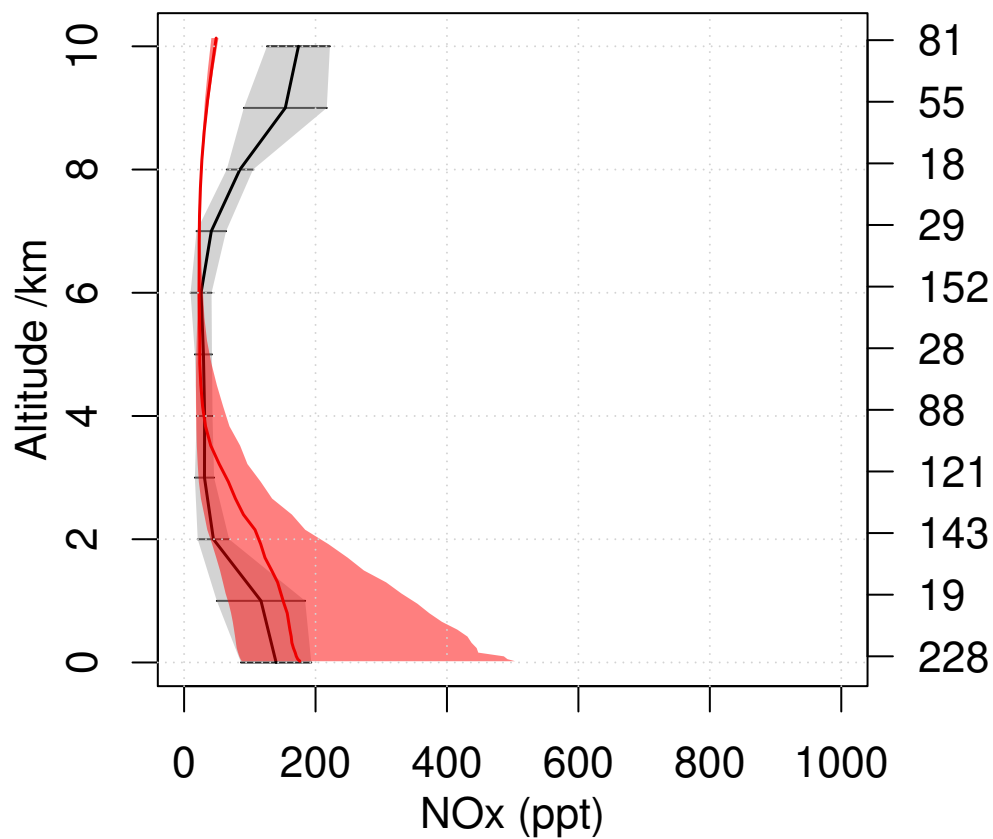
**PEM-Tropics-B Christmas-Island 1999 07**  
Lat 0 – 10 Lon 200 – 220



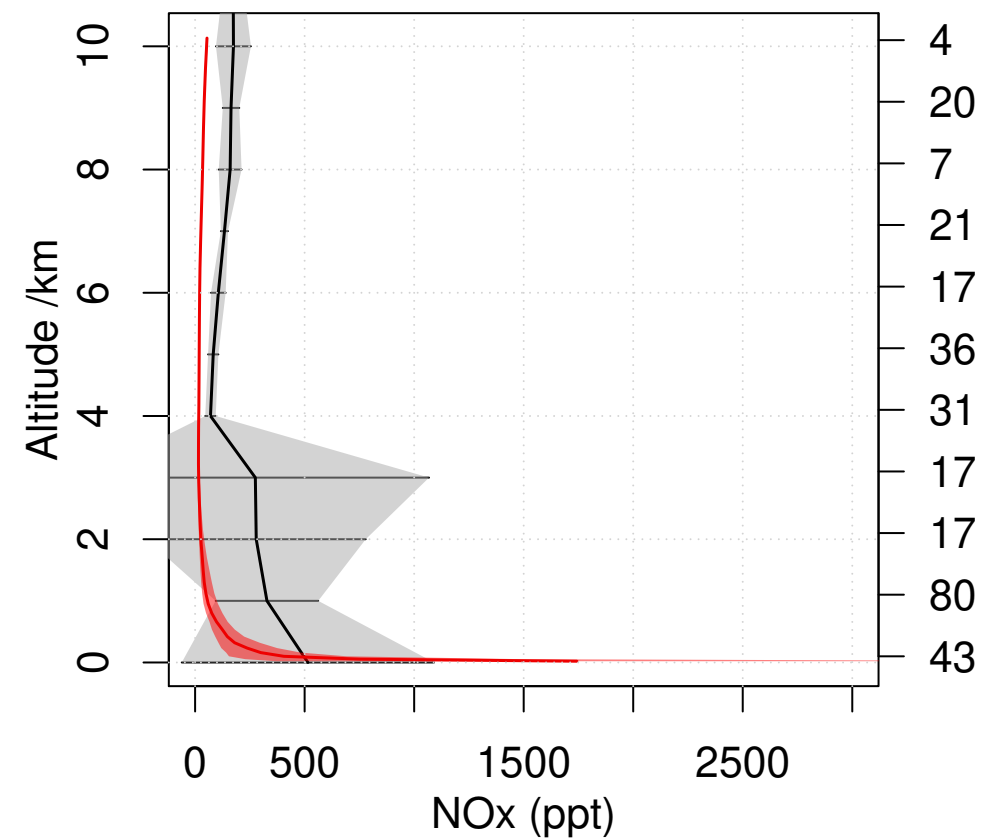
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



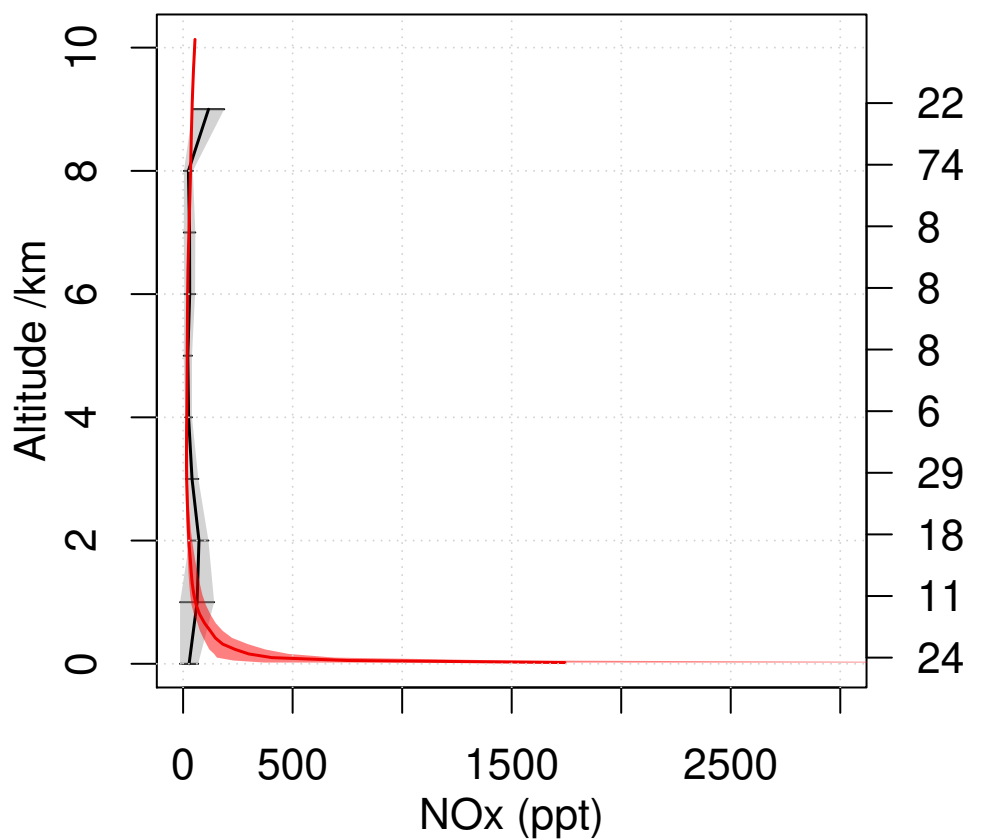
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



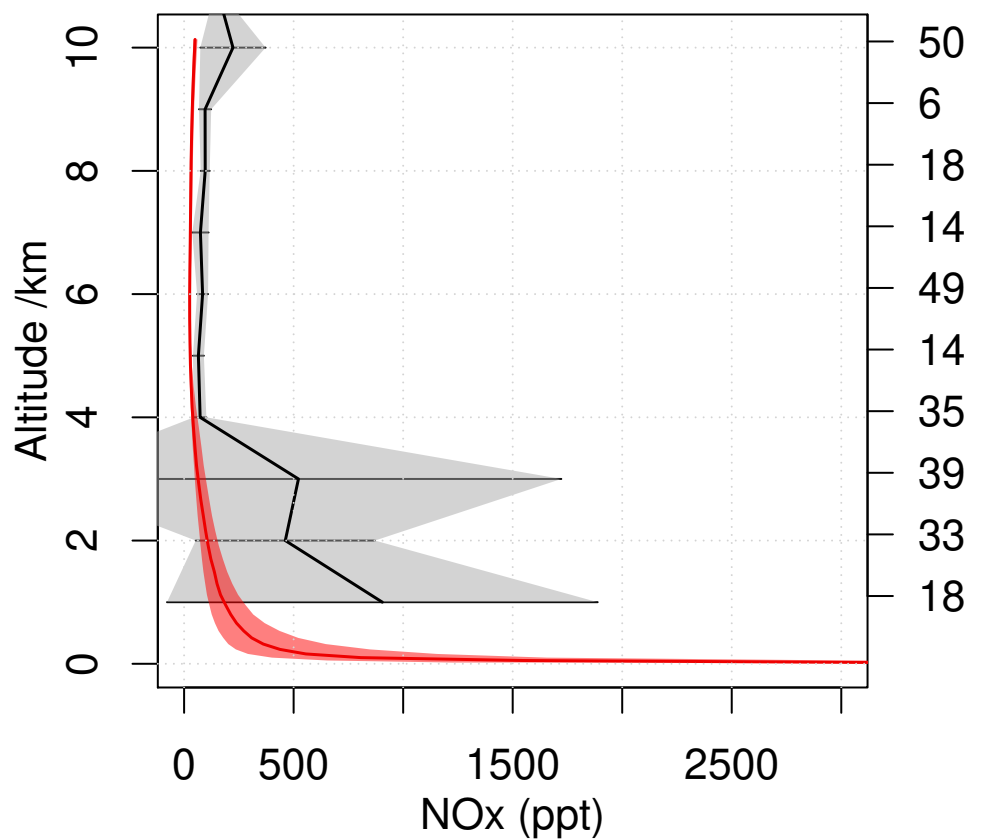
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



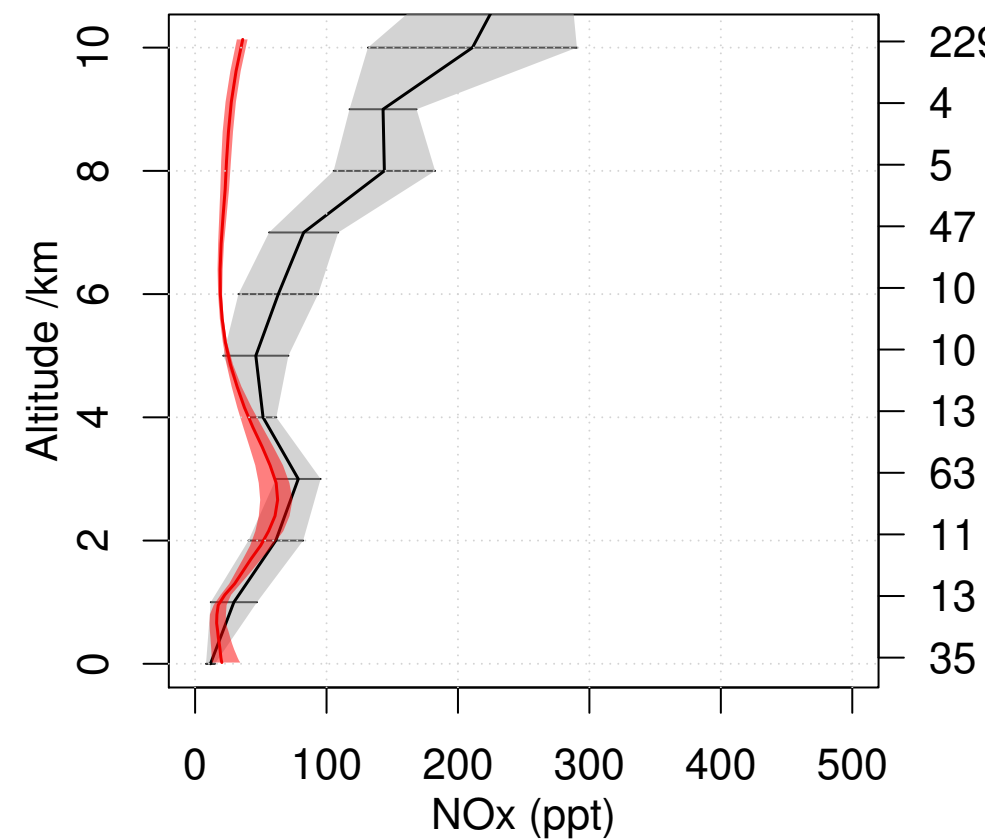
**TRACE-A E-Brazil Coast 1992 09**  
Lat -35 – -25 Lon 310 – 320



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



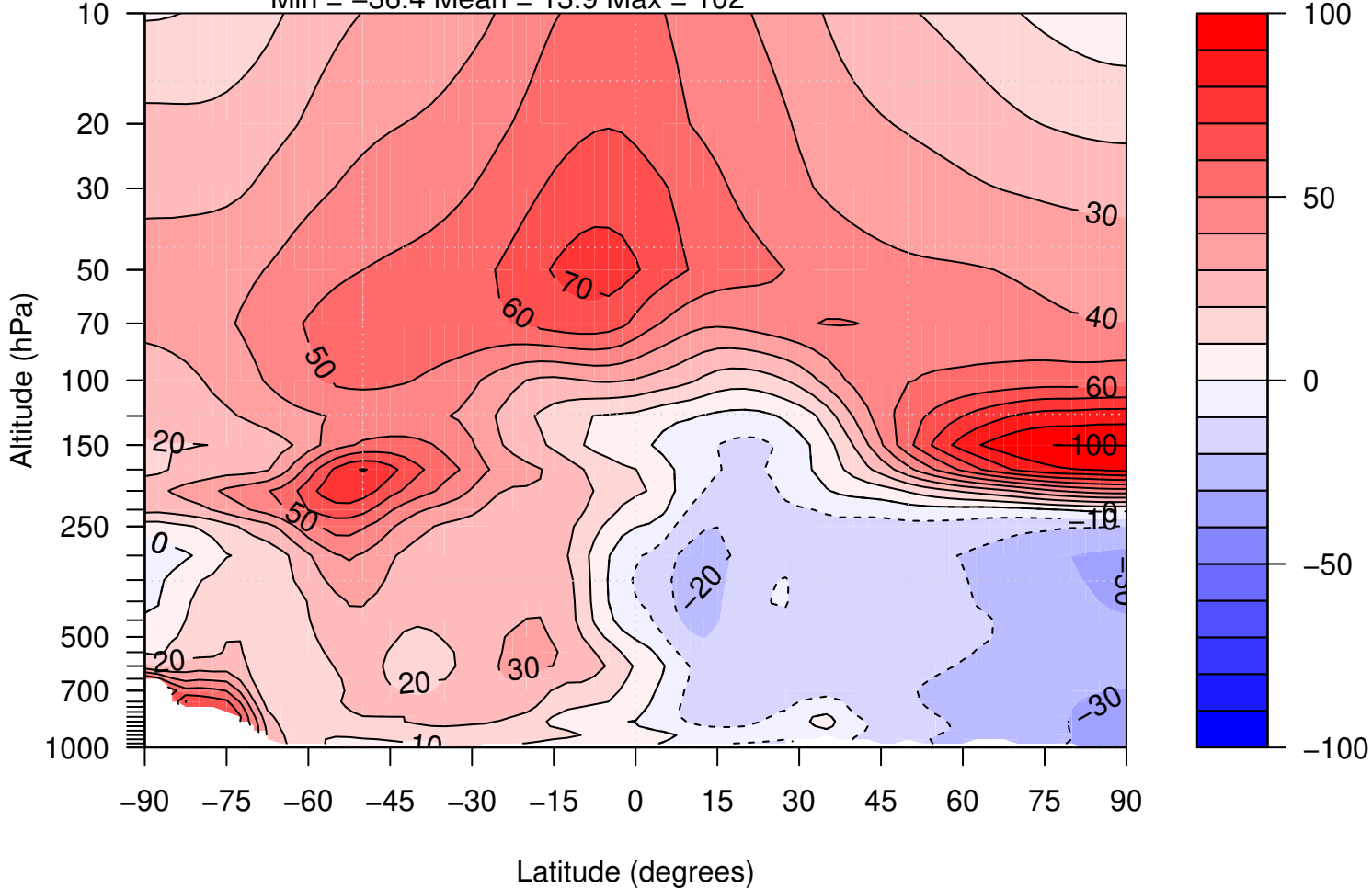
**TRACE-A W-Africa Coast 1992 09**  
Lat -25 – -5 Lon 0 – 10





# bs395 – ERA Q bias

Min = -36.4 Mean = 13.9 Max = 102

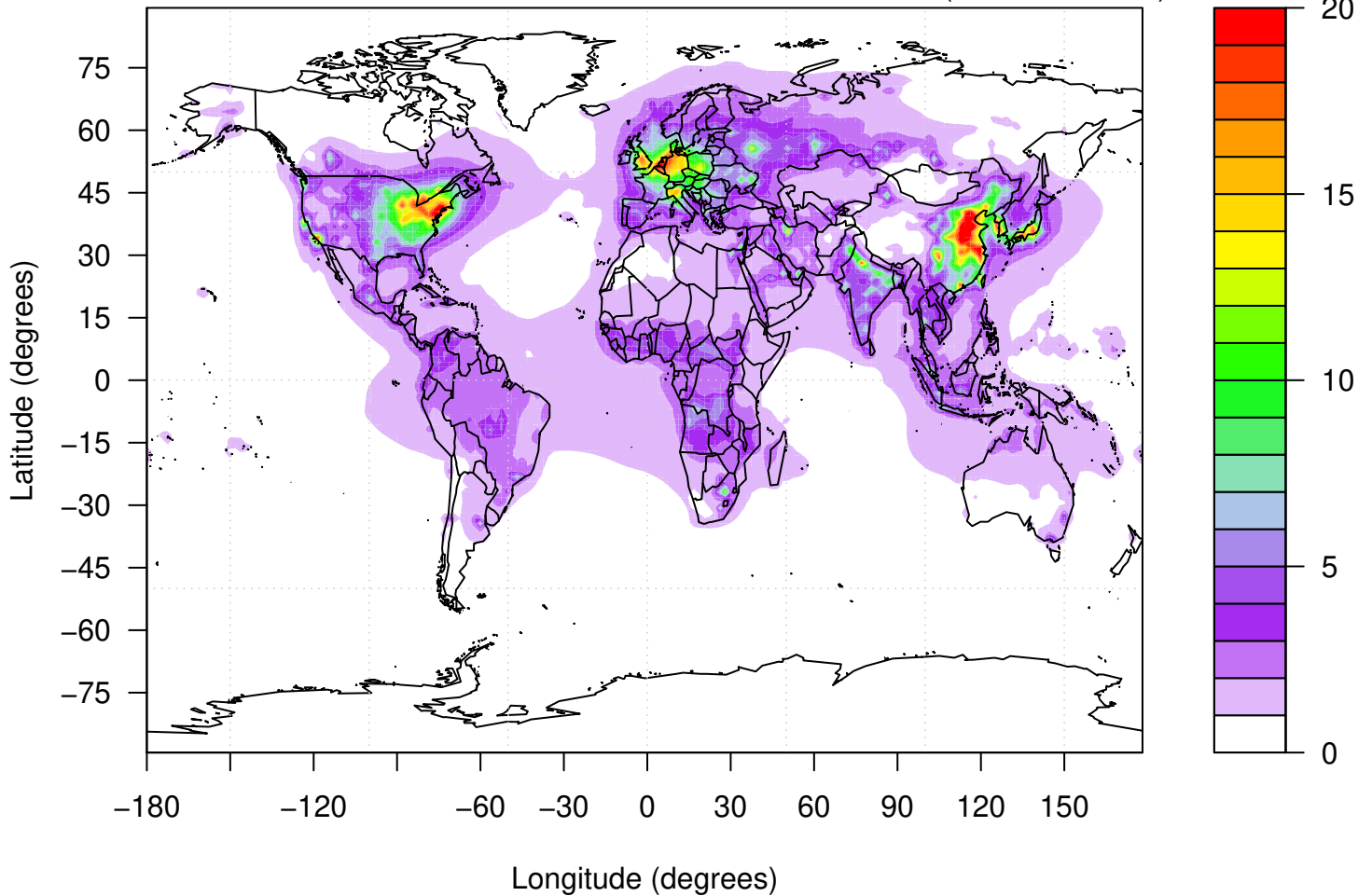




# bo717 tropospheric NO<sub>2</sub> column

Min = 0.0129 Mean = 1.14 Max = 41.5

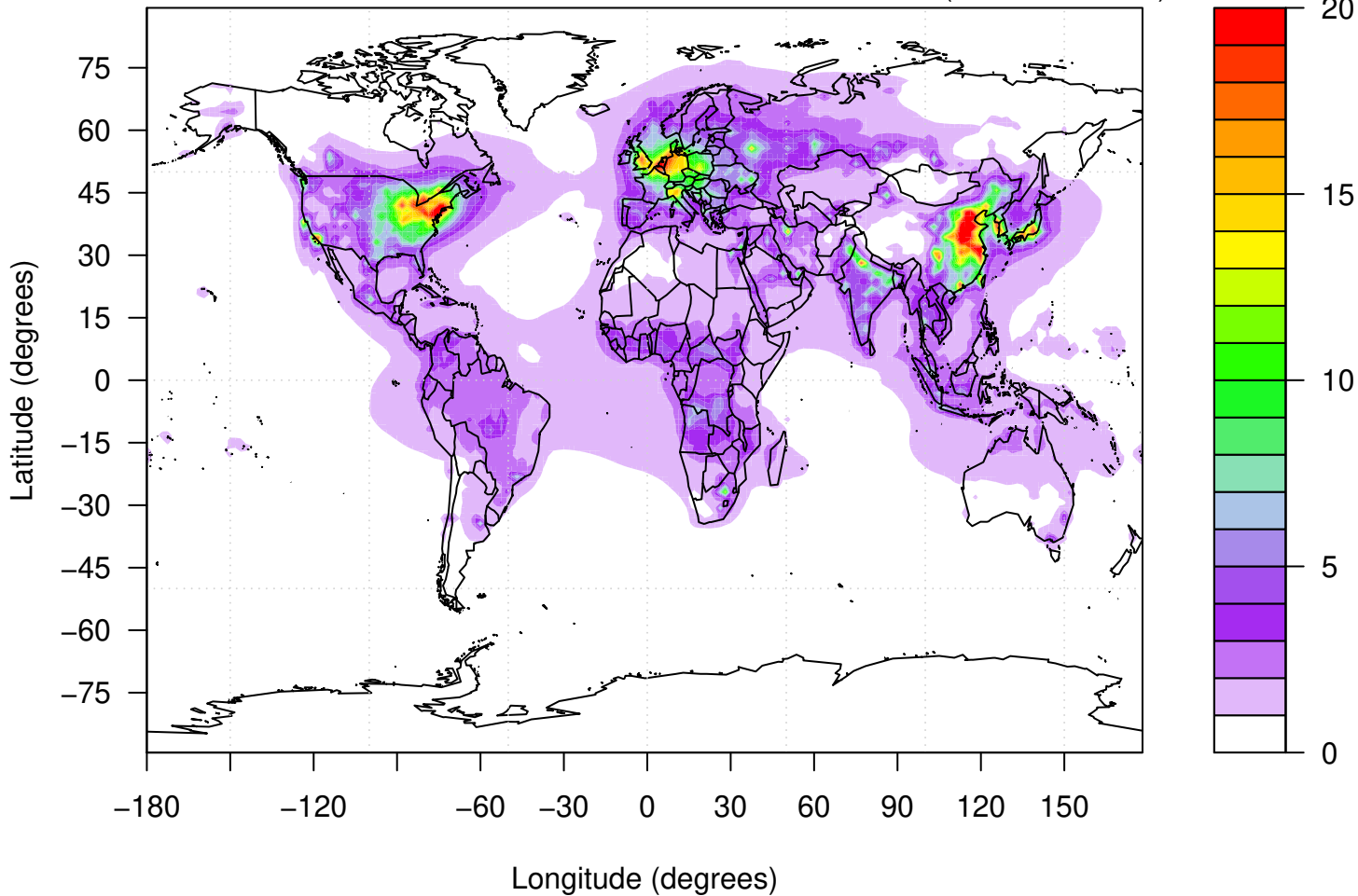
10<sup>15</sup> (molecules cm<sup>-2</sup>)



# bs395 tropospheric NO<sub>2</sub> column

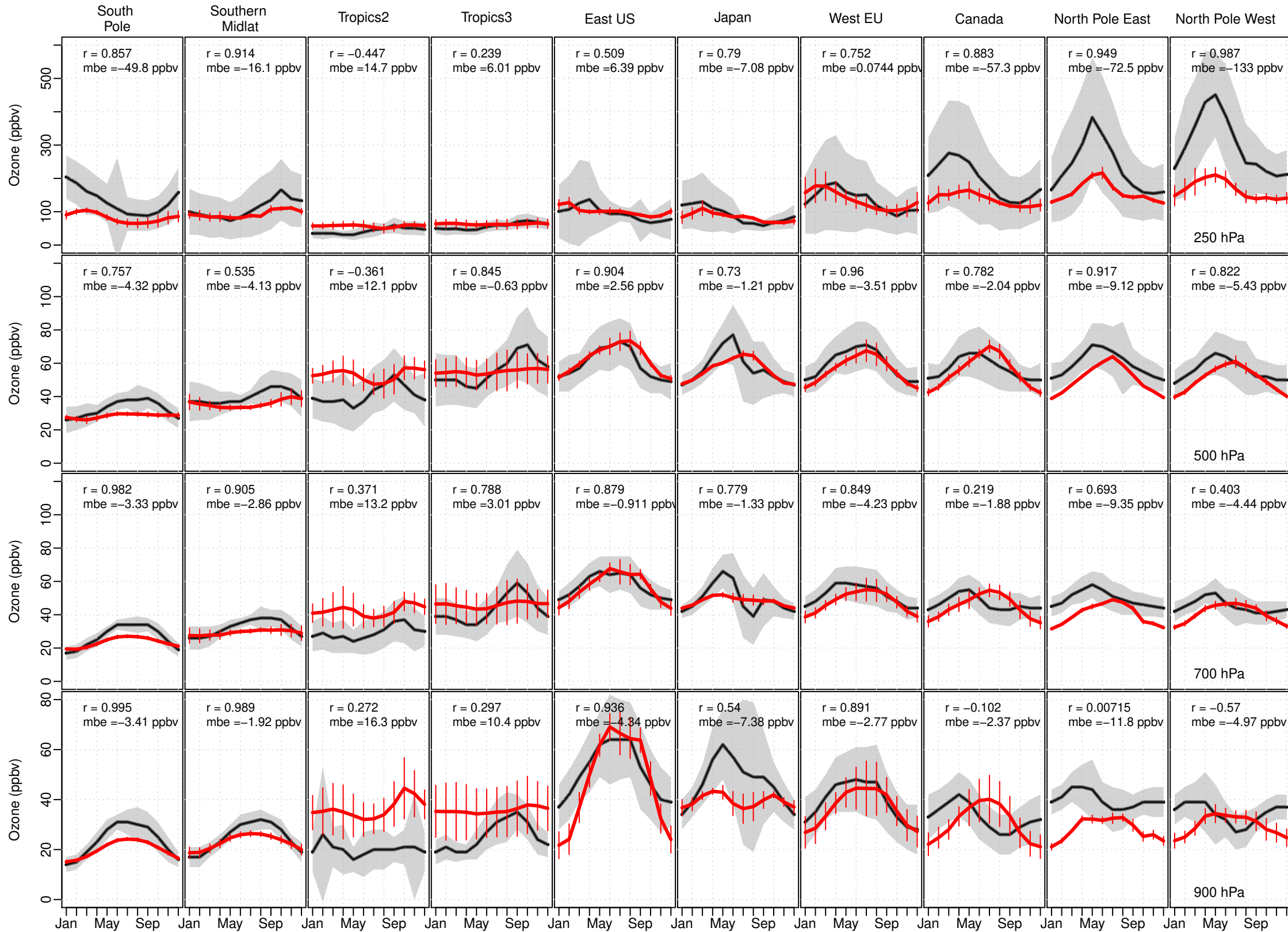
Min = 0.0131 Mean = 1.14 Max = 41.1

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

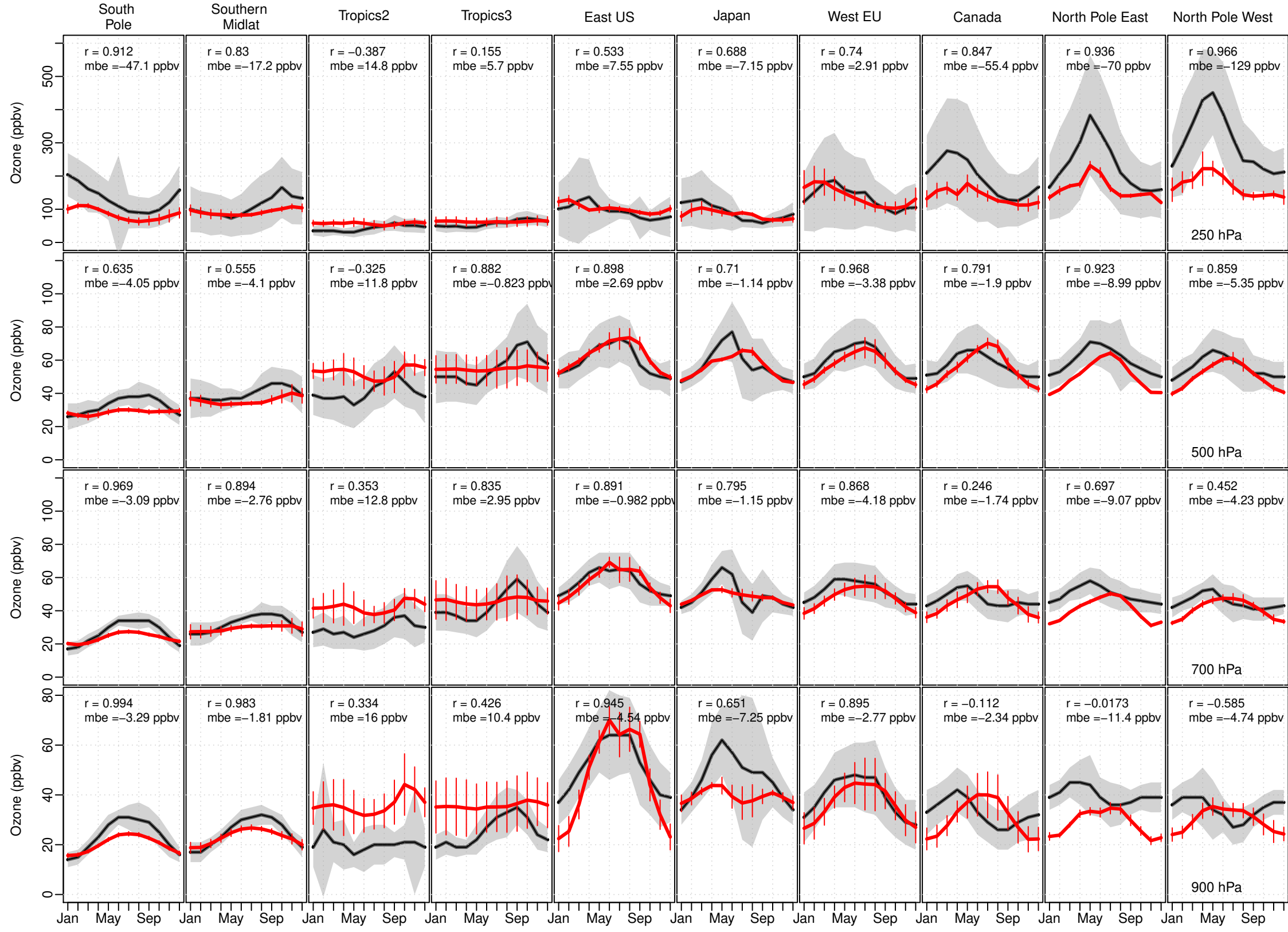




bo717 Tilmes ozone sonde comparison

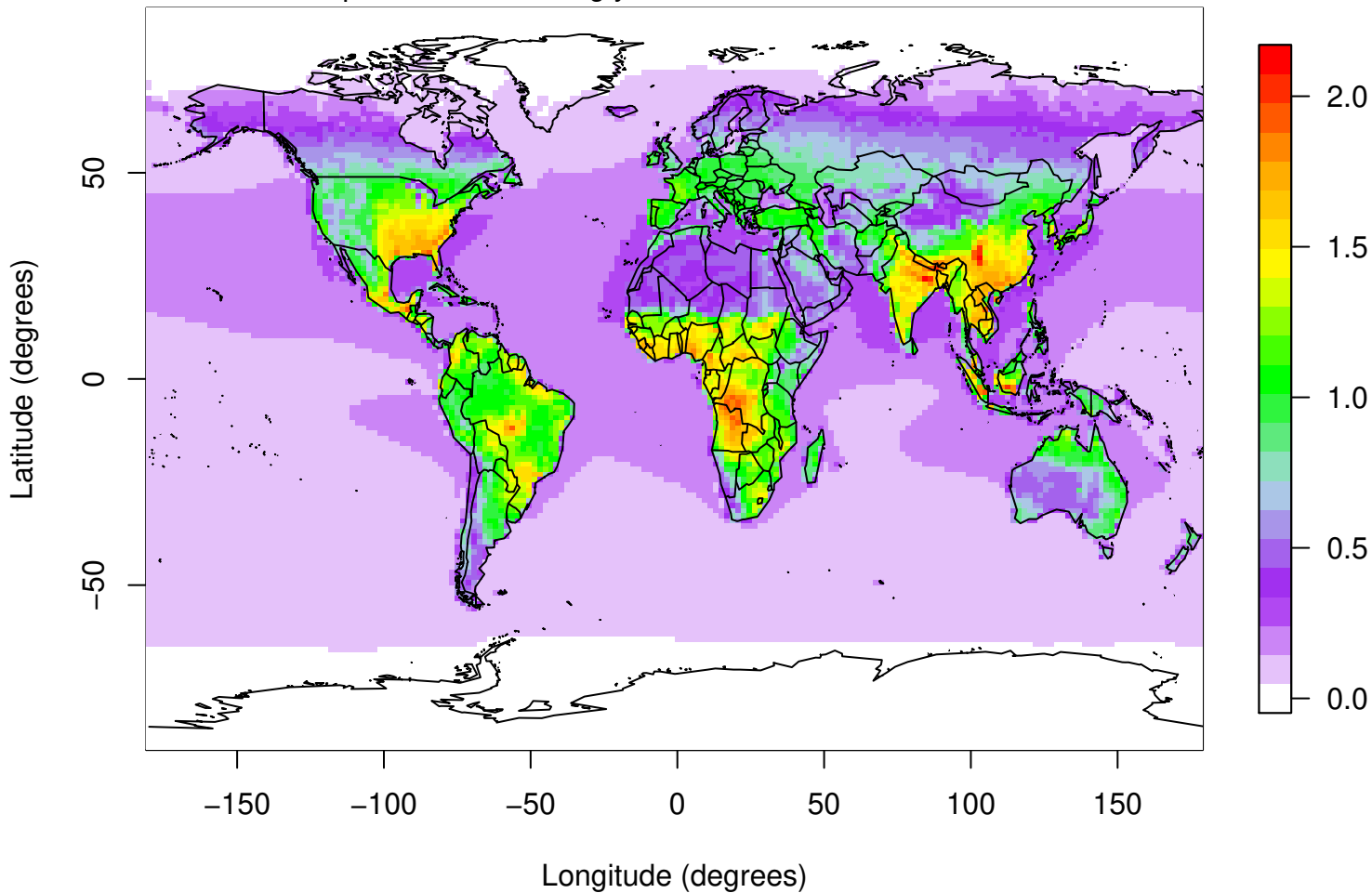


bs395 Tilmes ozone sonde comparison



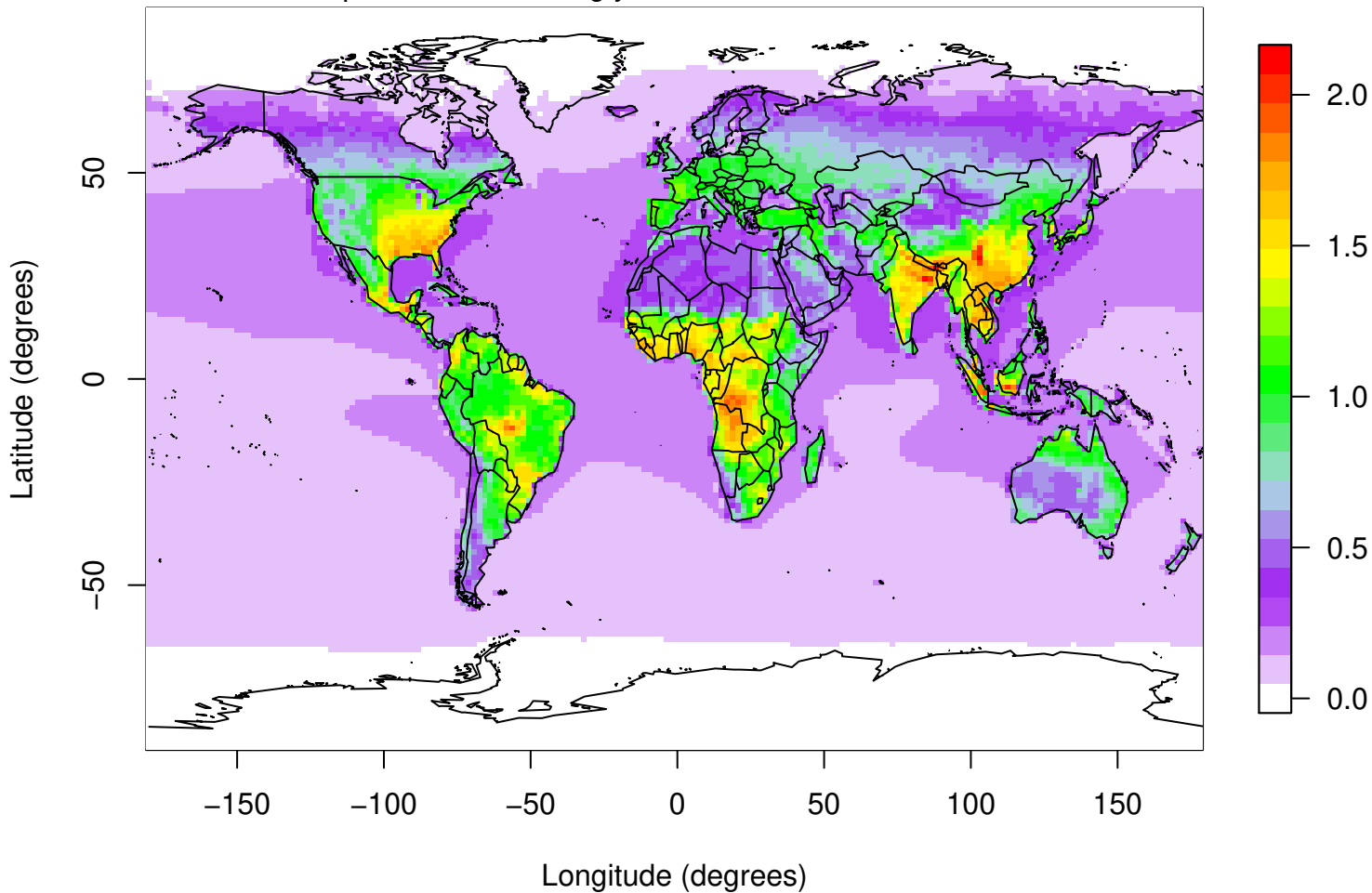
# UKCA Ox deposition bo717

Total Ox Deposition =  $1e+03$  Tg/yr



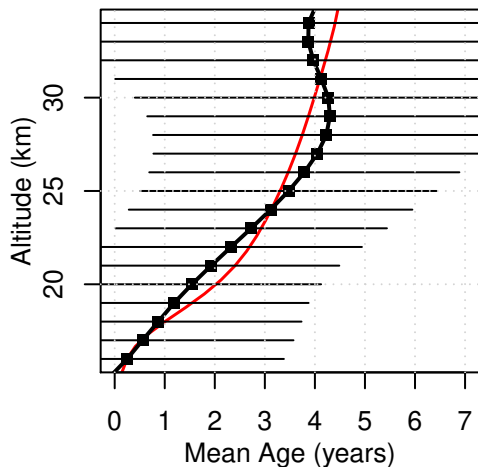
# UKCA Ox deposition bs395

Total Ox Deposition =  $1e+03$  Tg/yr

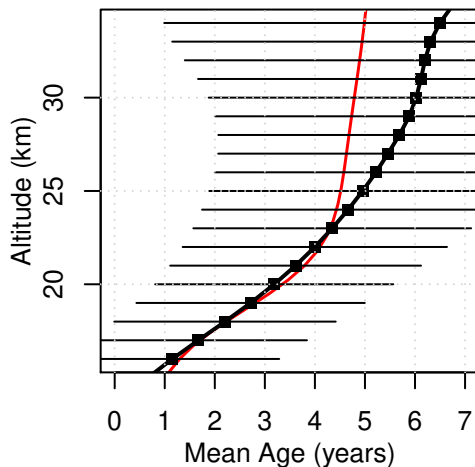


# UKCA bo717 Mean Age of Air

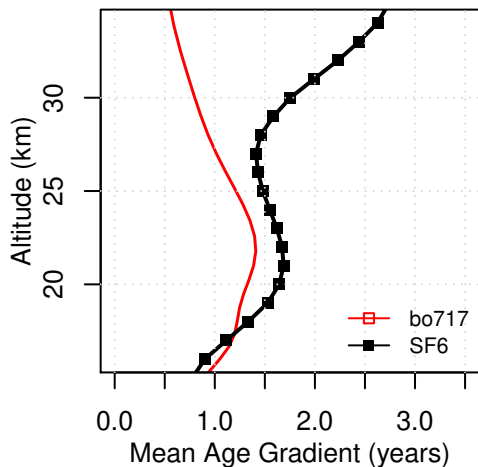
## Tropical Mean Age Profile



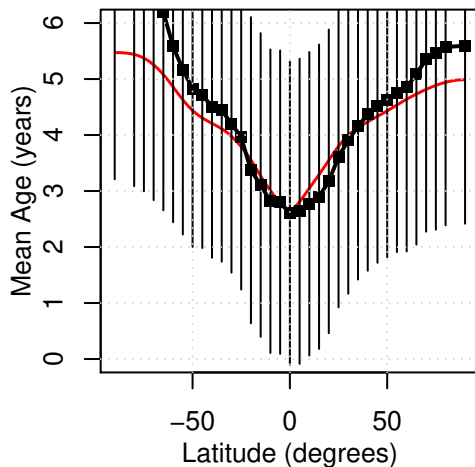
## Midlatitude Mean Age Profile



## Trop-Midlat Mean Age Gradient Prof

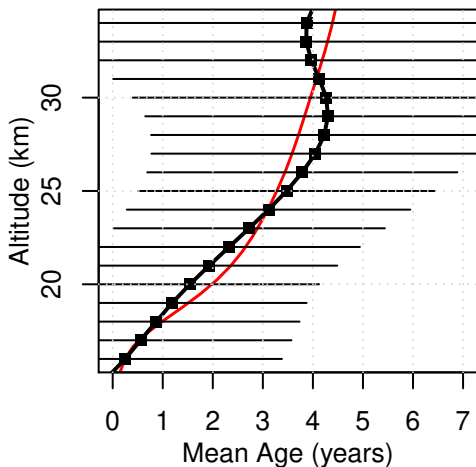


## Mean Age, 23km (~50hPa)

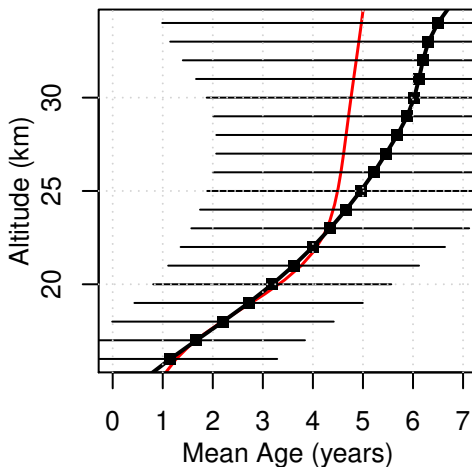


# UKCA bs395 Mean Age of Air

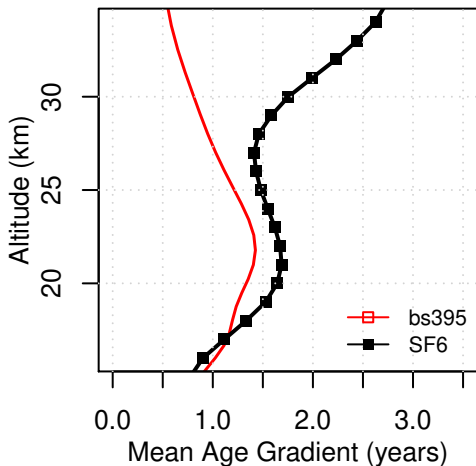
## Tropical Mean Age Profile



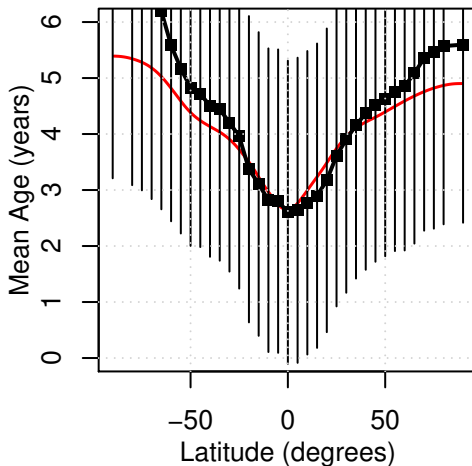
## Midlatitude Mean Age Profile



## Trop-Midlat Mean Age Gradient Prof

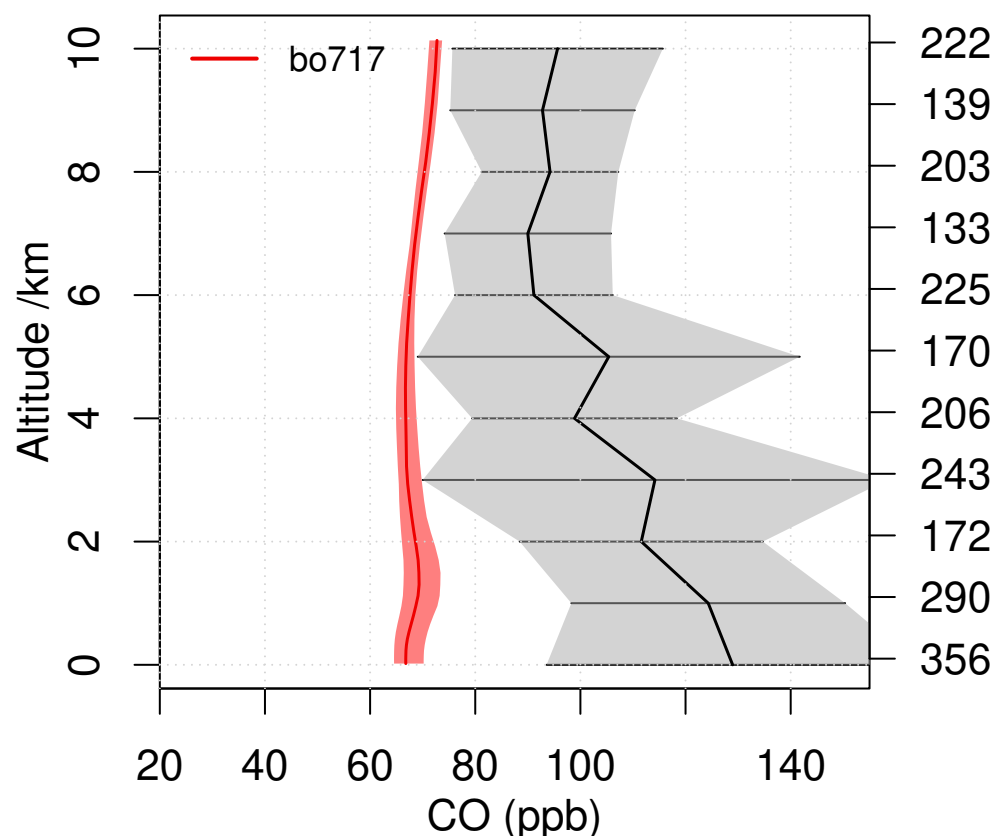


## Mean Age, 23km (~50hPa)

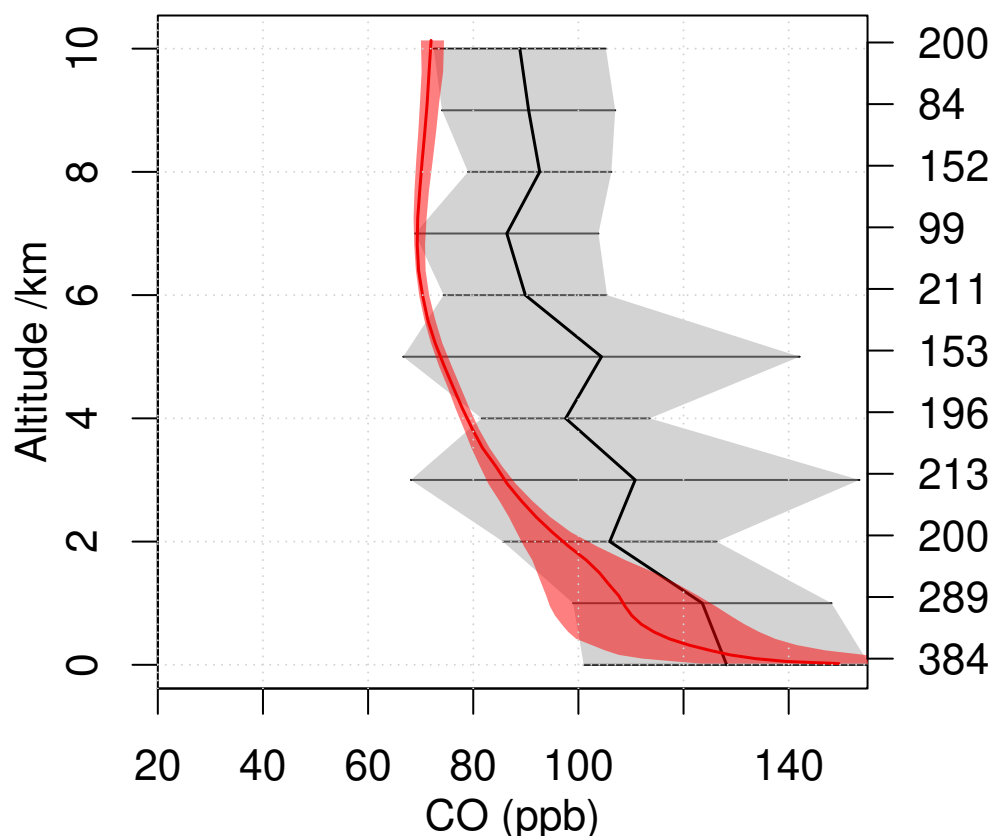


**Emmons CO comparison**

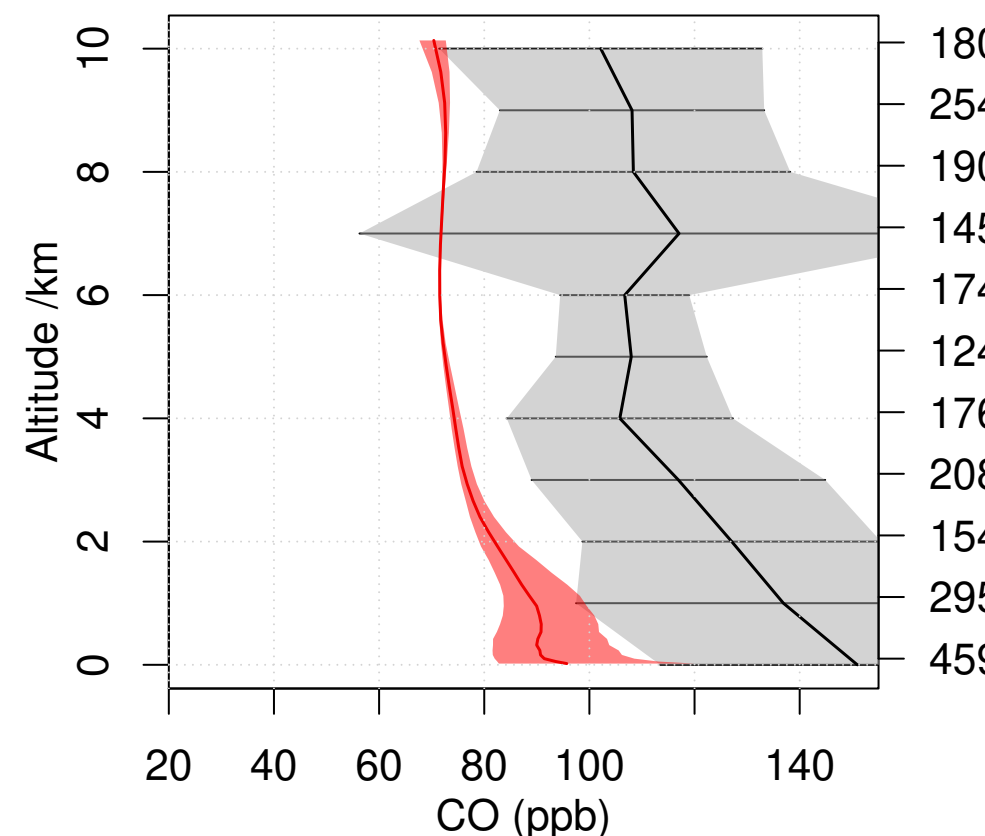
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



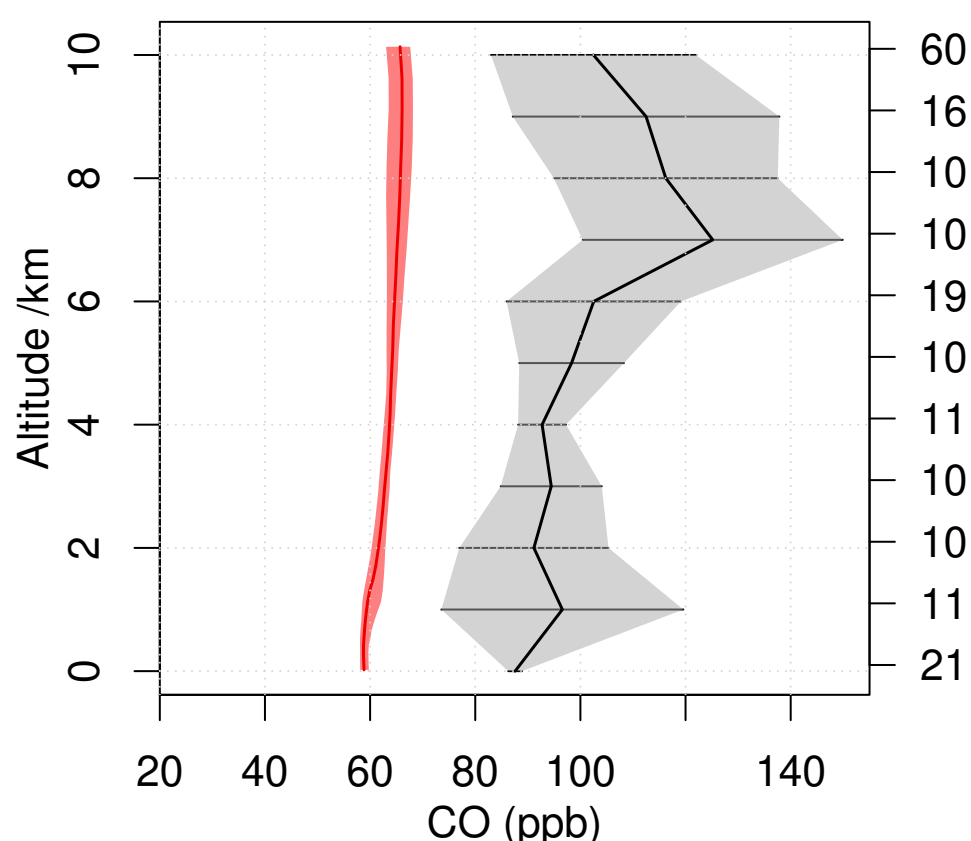
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



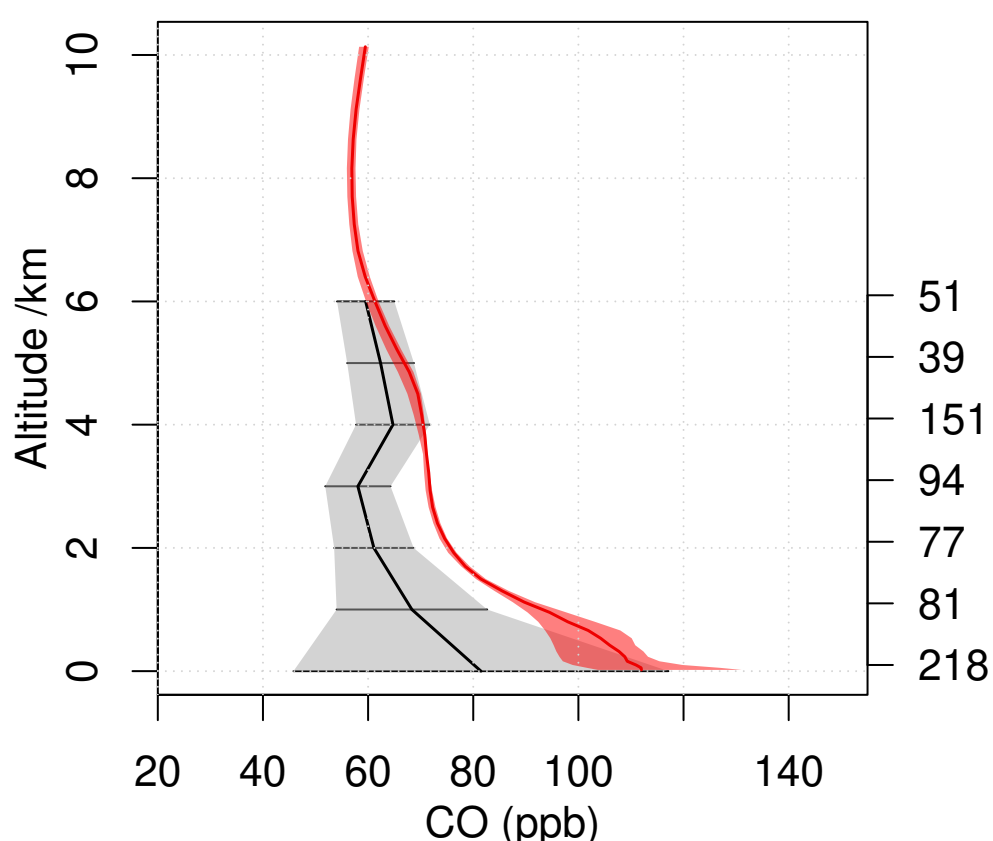
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



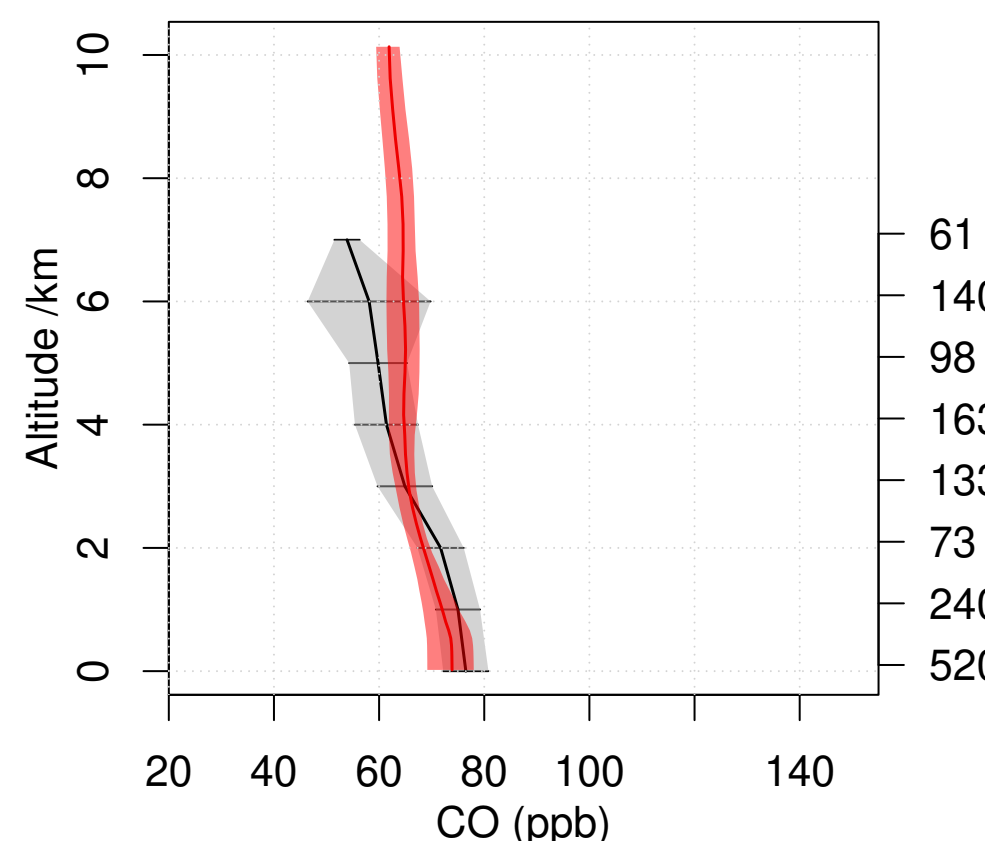
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



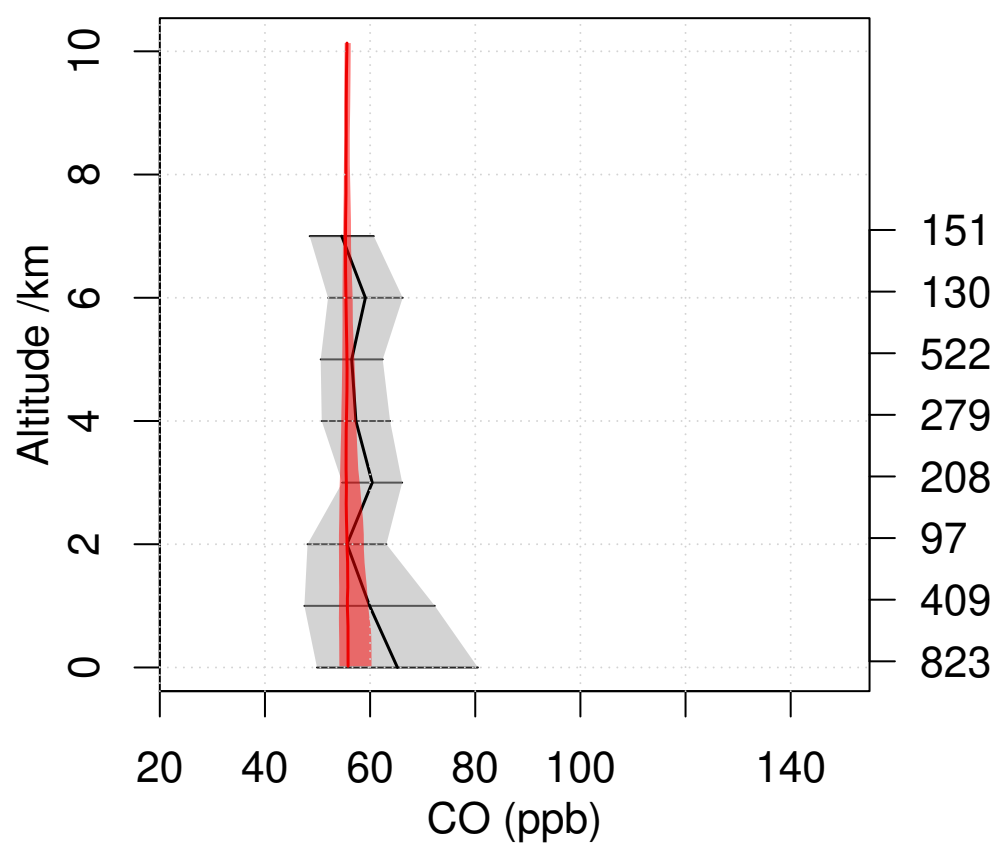
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



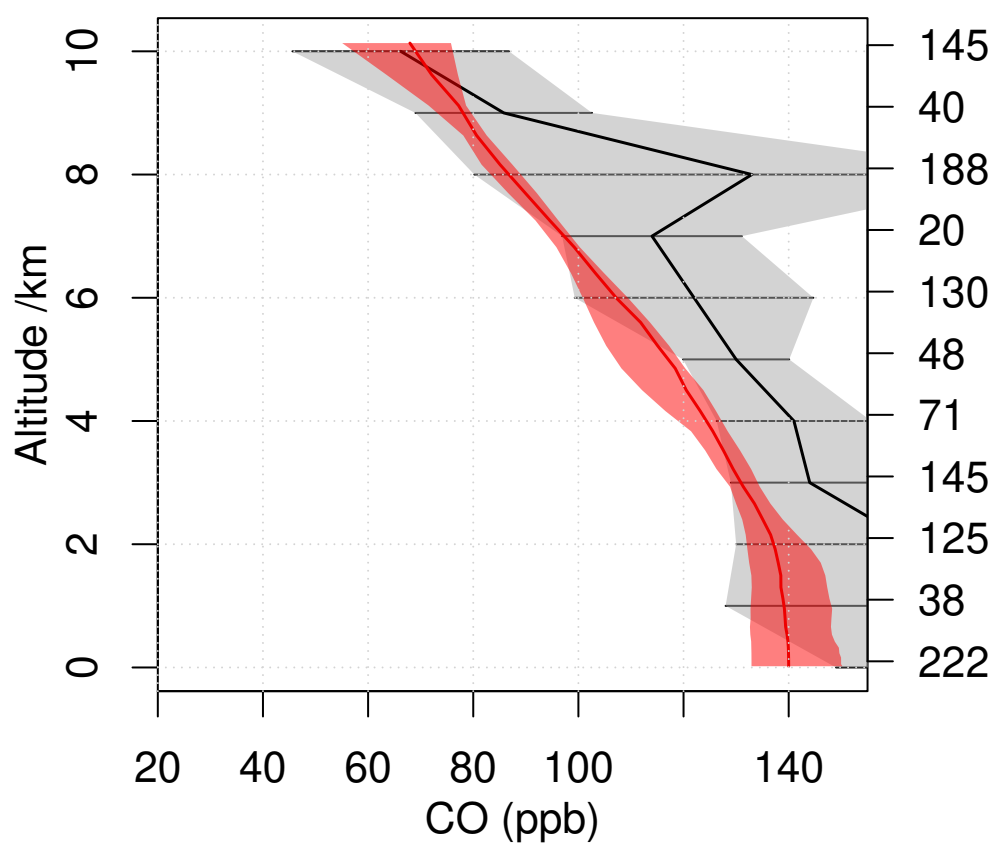
**PEM-Tropics-B Christmas-Island 1999 0**  
Lat 0 – 10 Lon 200 – 220



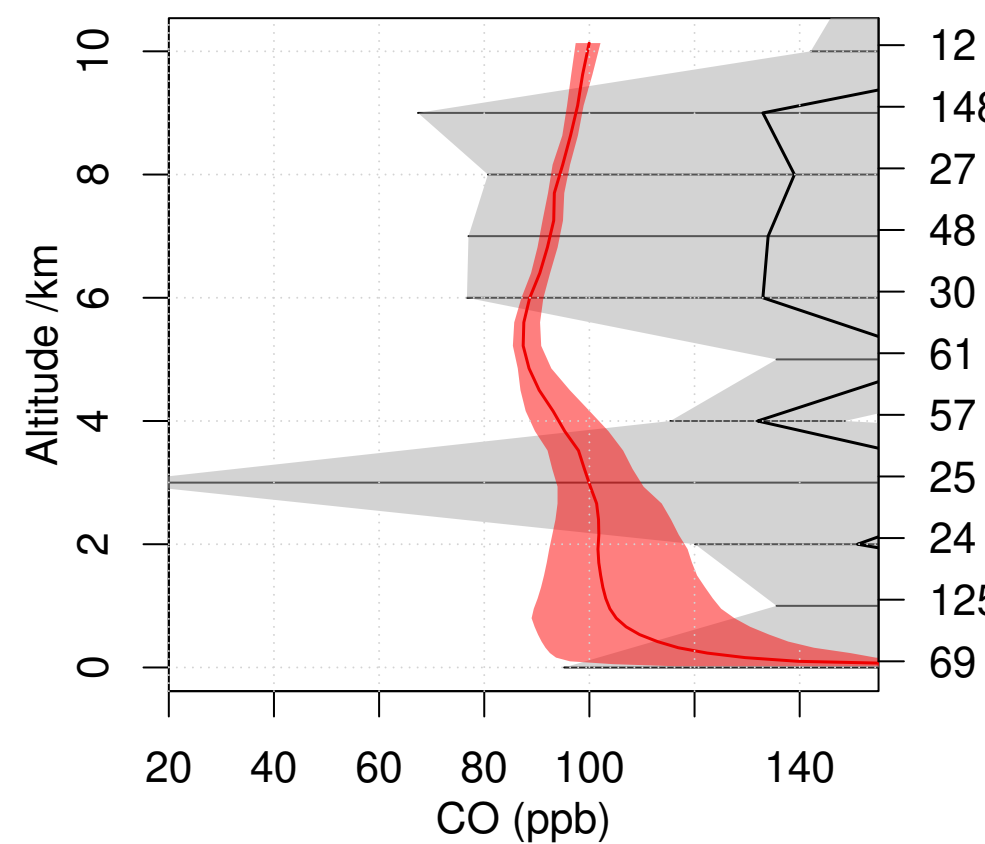
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



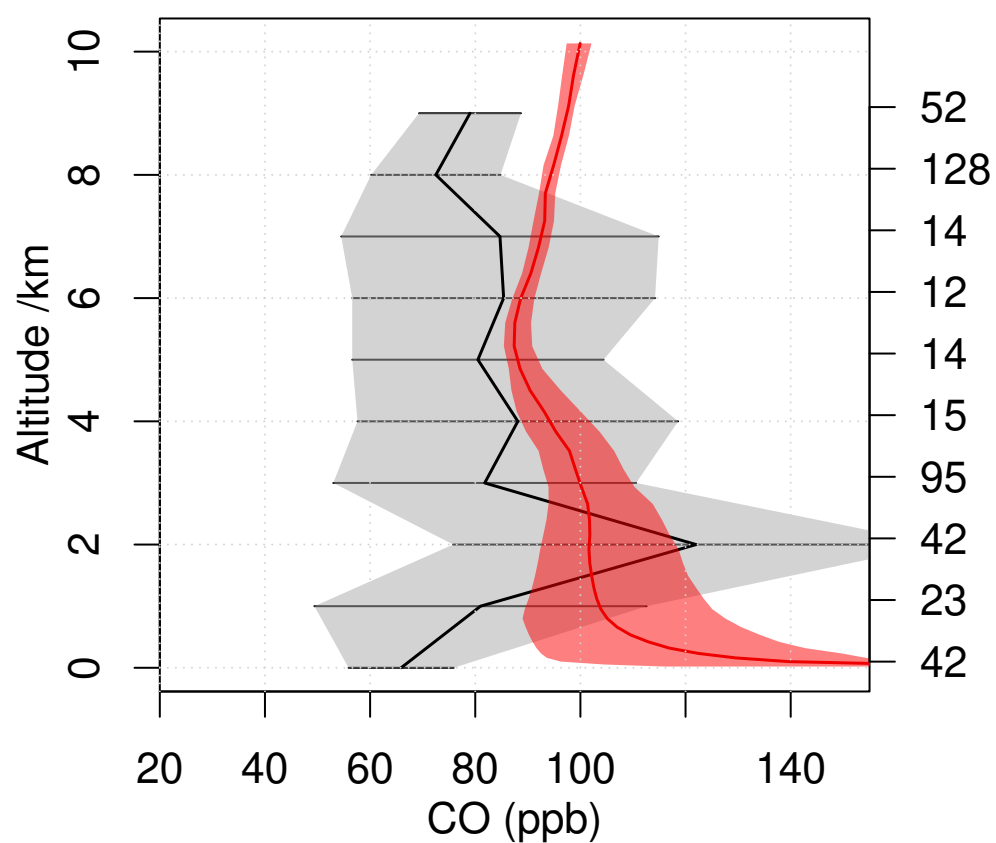
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



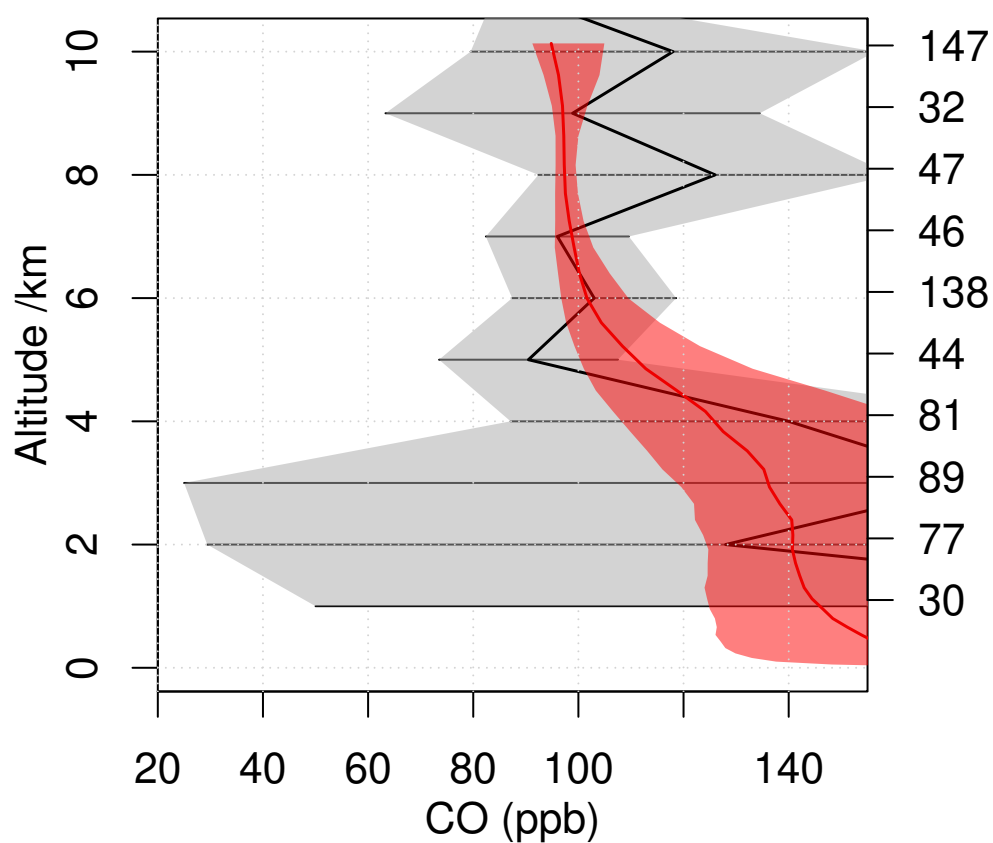
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



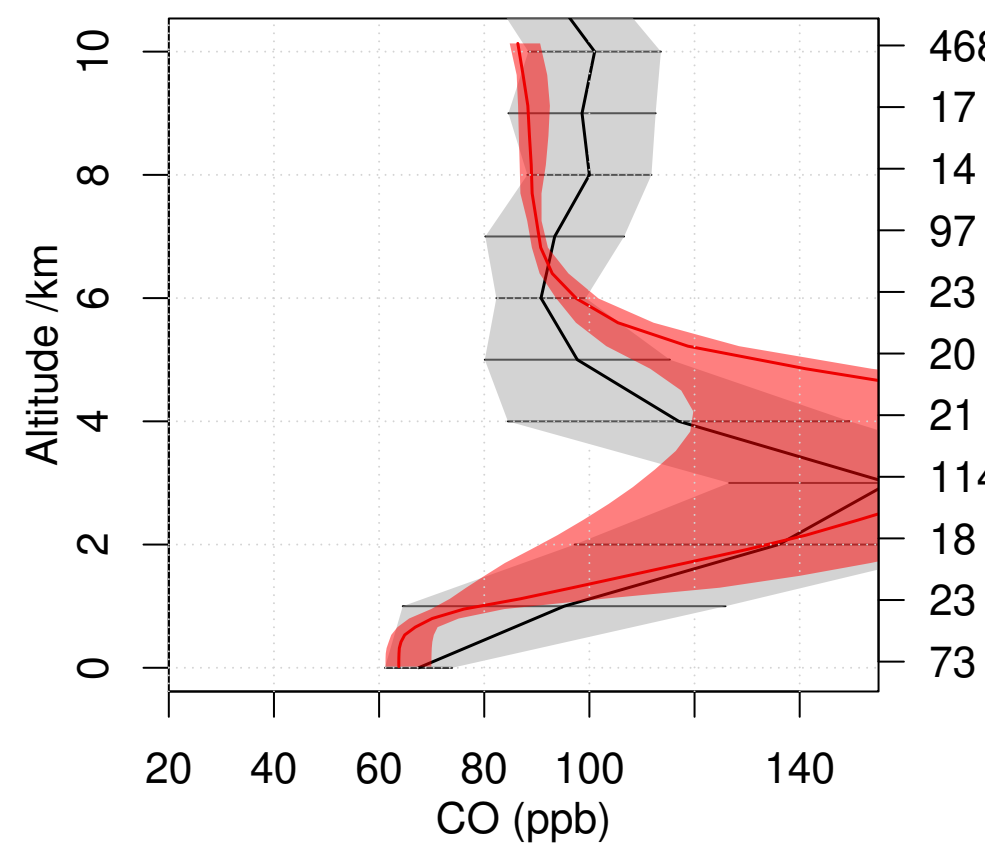
**TRACE-A E-Brazil Coast 1992 09**  
Lat -35 – -25 Lon 310 – 320



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



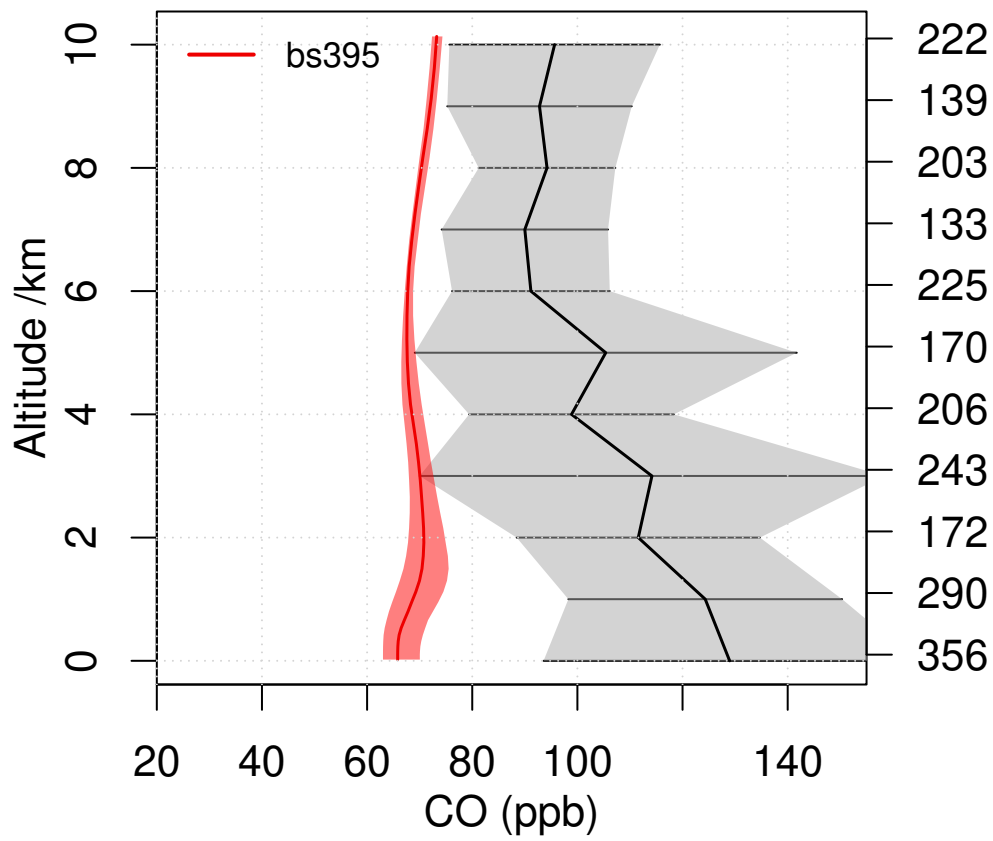
**TRACE-A W-Africa Coast 1992 09**  
Lat -25 – -5 Lon 0 – 10



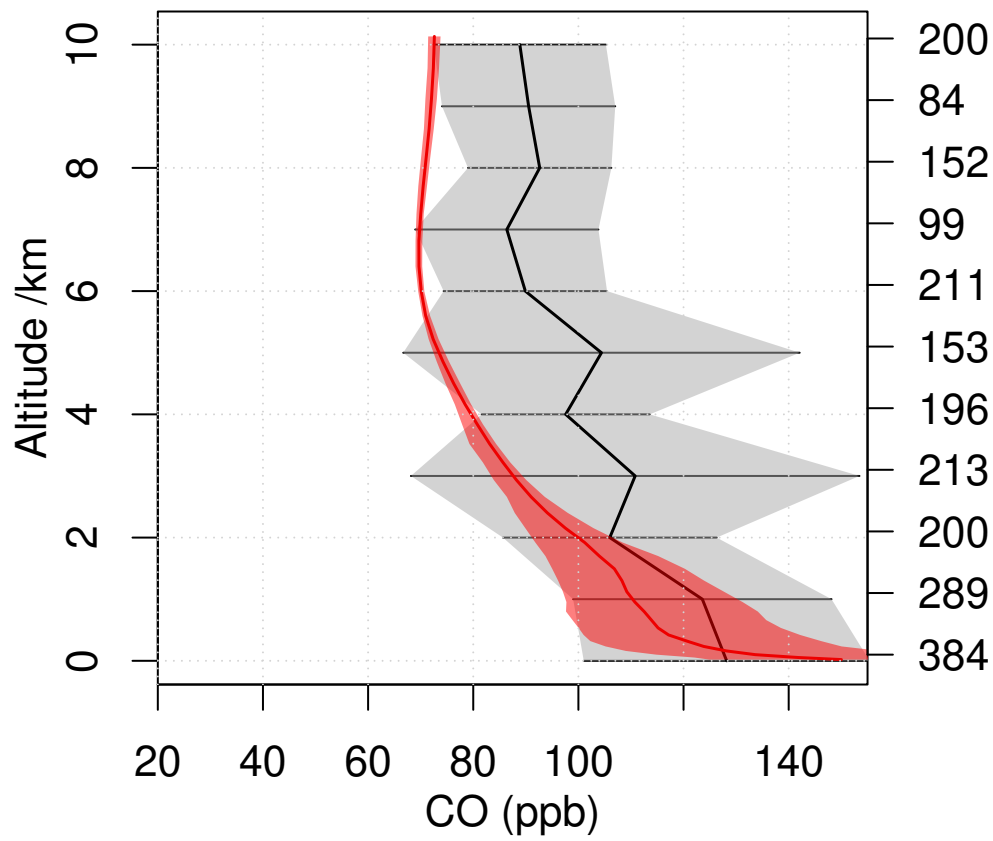


**Emmons CO comparison**

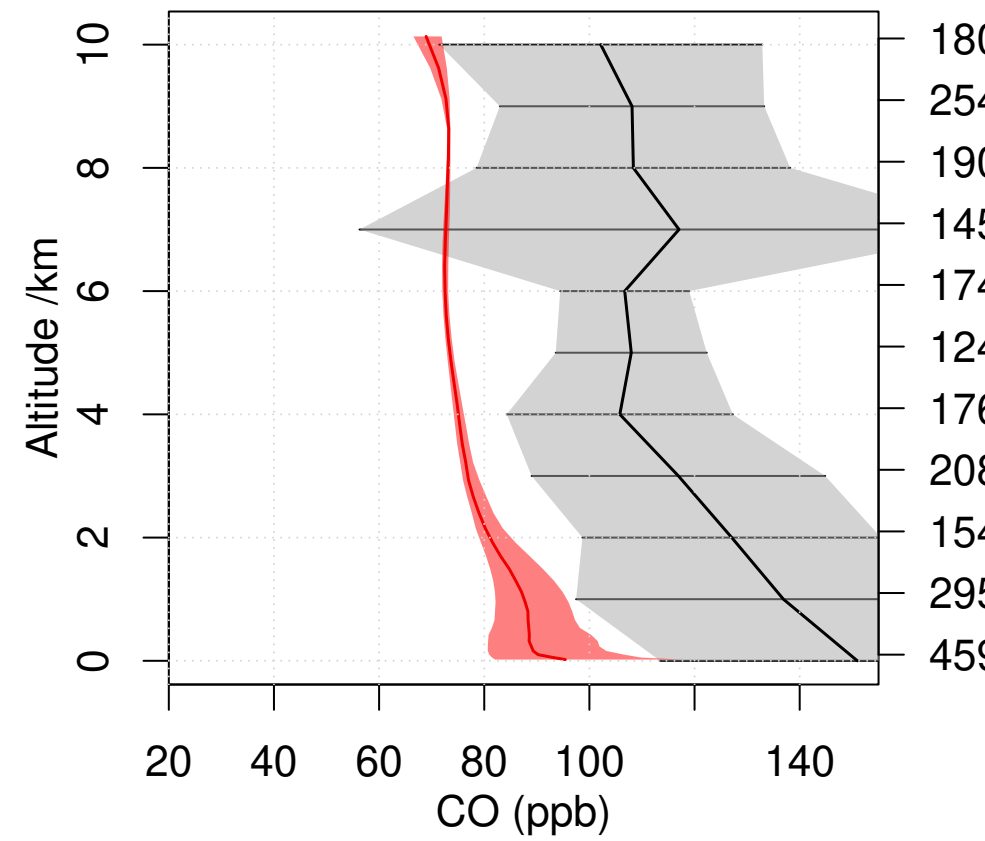
**INTEX-NA East Coast 2004 07**  
Lat 32.5 – 40 Lon 296.5 – 307



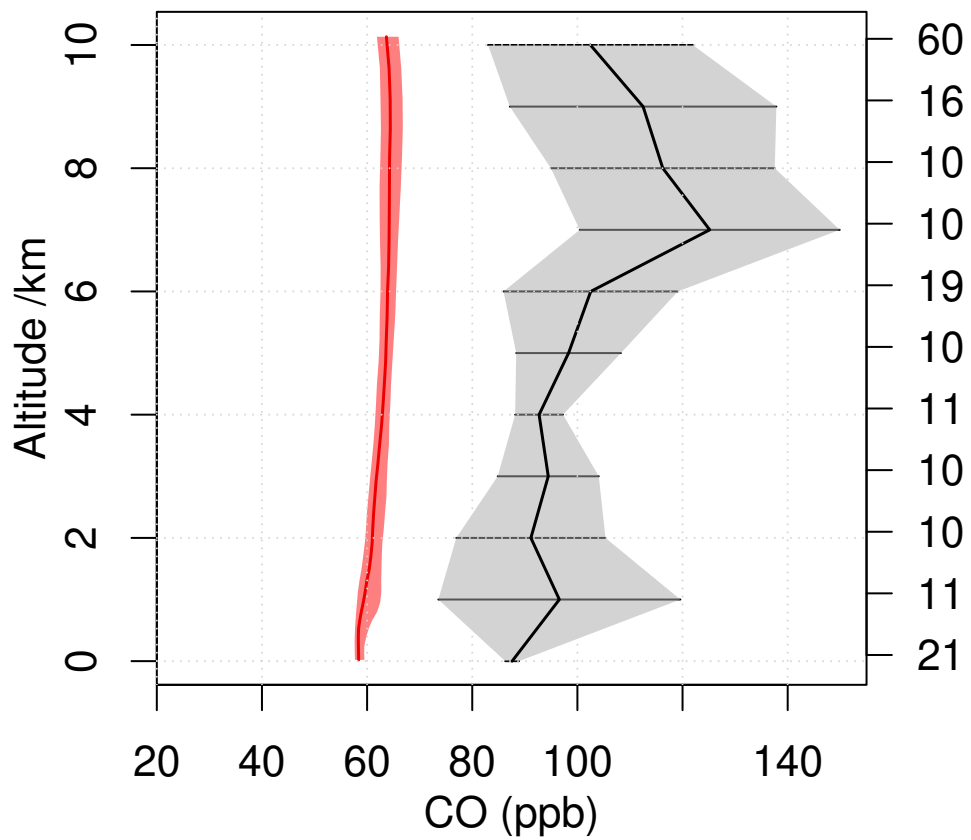
**INTEX-NA Central 2004 07**  
Lat 30 – 40 Lon 259.5 – 285



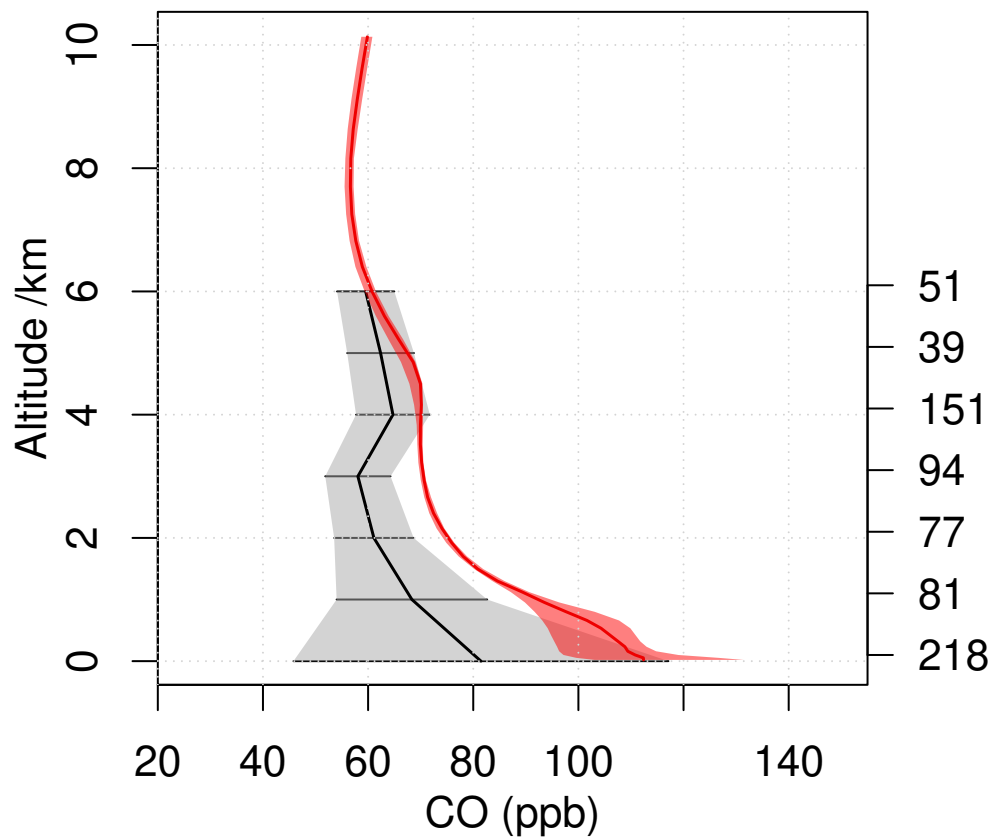
**INTEX-NA North East 2004 07**  
Lat 42.5 – 52.5 Lon 285 – 310



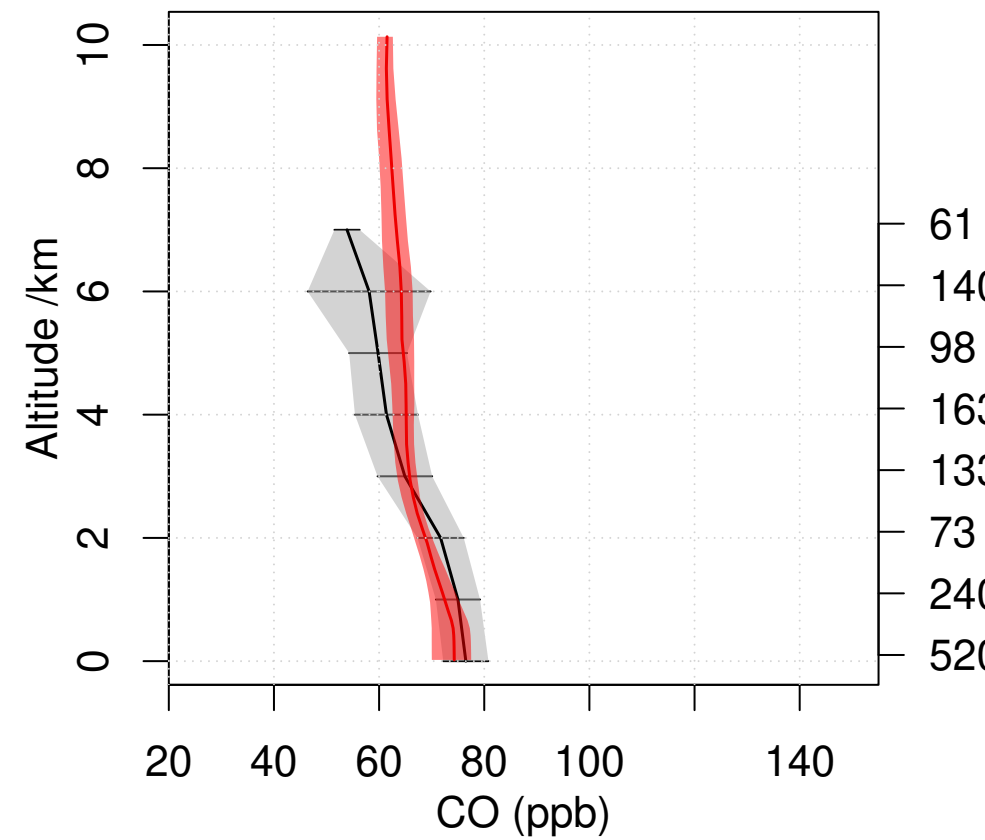
**INTEX-NA West Coast 2004 07**  
Lat 32.5 – 45 Lon 217 – 240



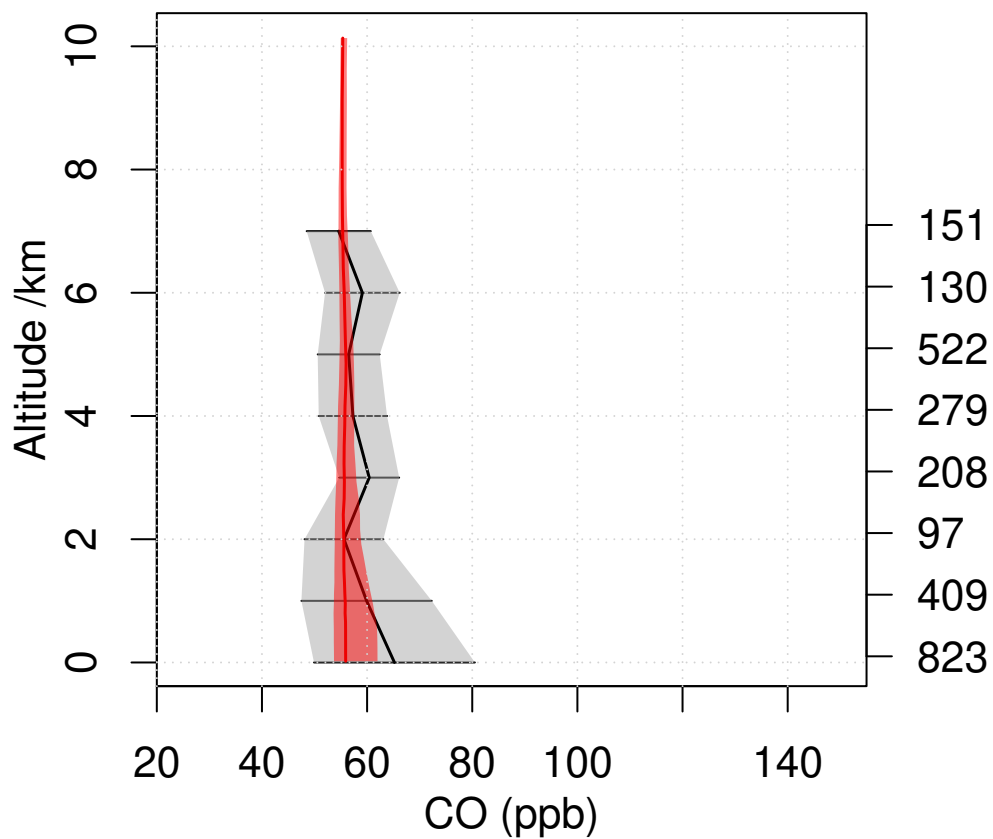
**OP3 2008 07**  
Lat 2.5 – 7.5 Lon 112.5 – 120



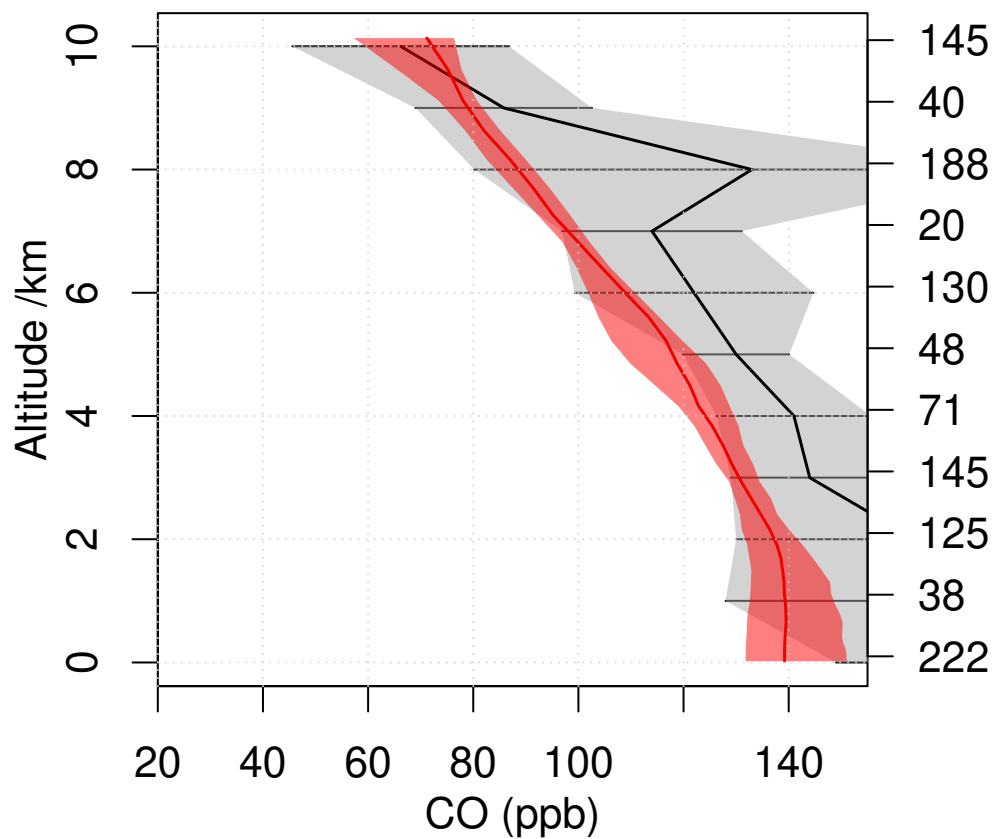
**PEM-Tropics-B Christmas-Island 1999 0**  
Lat 0 – 10 Lon 200 – 220



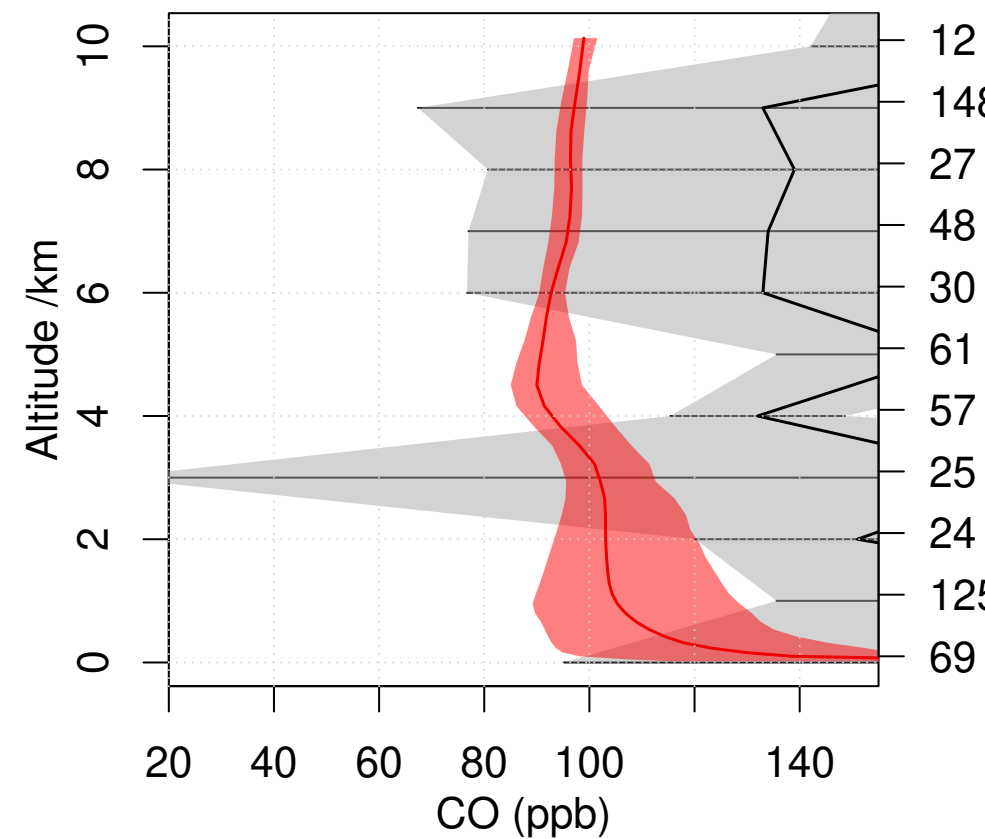
**PEM-Tropics-B Tahiti 1999 03**  
Lat -20 – 0 Lon 200 – 230



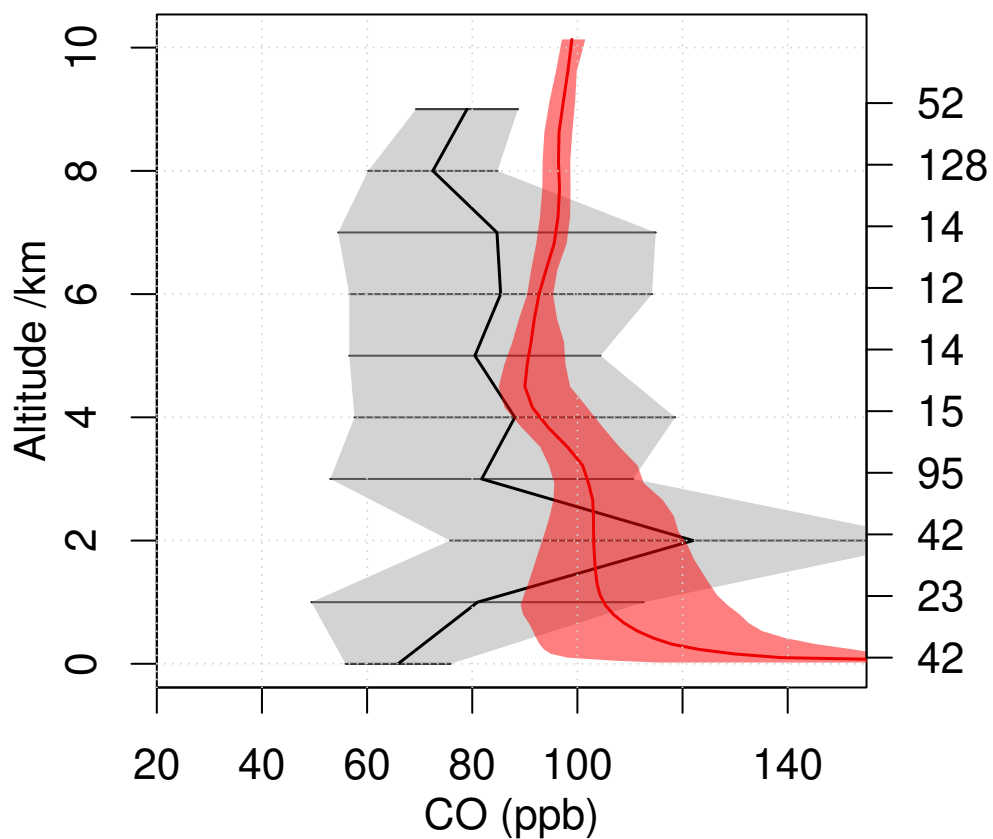
**PEM-West-B Japan 1994 02**  
Lat 25 – 40 Lon 135 – 150



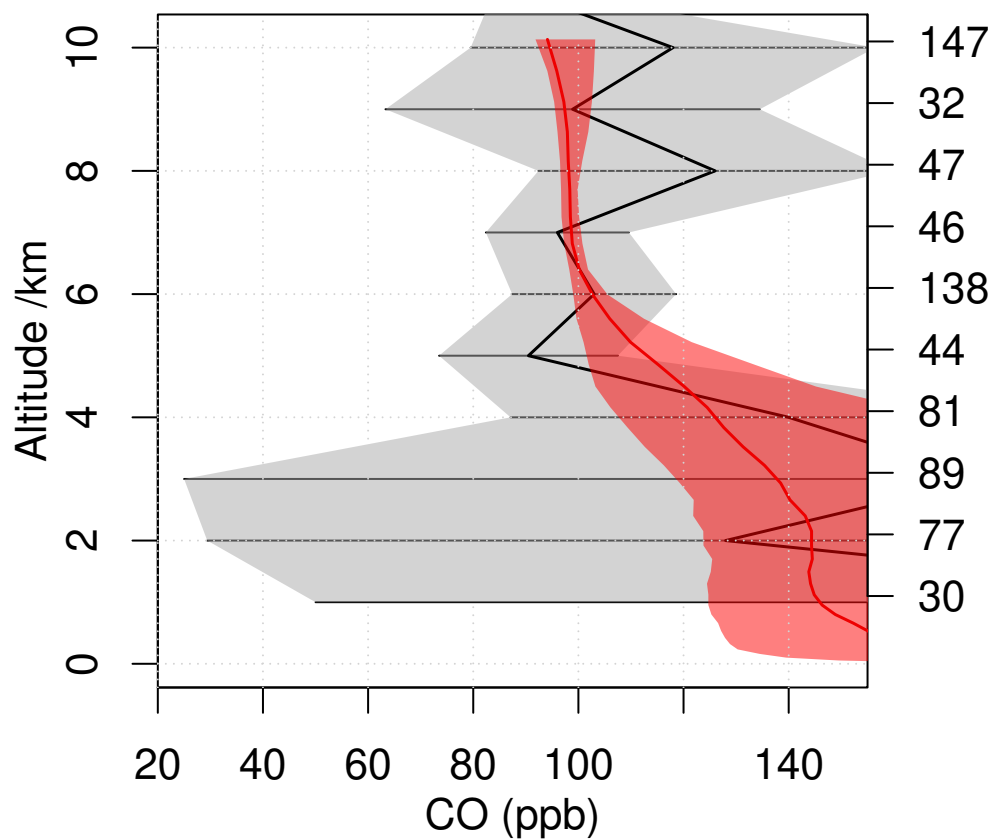
**TRACE-A E-Brazil 1992 09**  
Lat -15 – -5 Lon 310 – 320



**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

