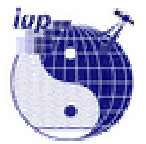




EVERGREEN

EnVisat for Environmental Regulation of GREENhouse gases (FP5 SCA 02/2003 – 01/2006)



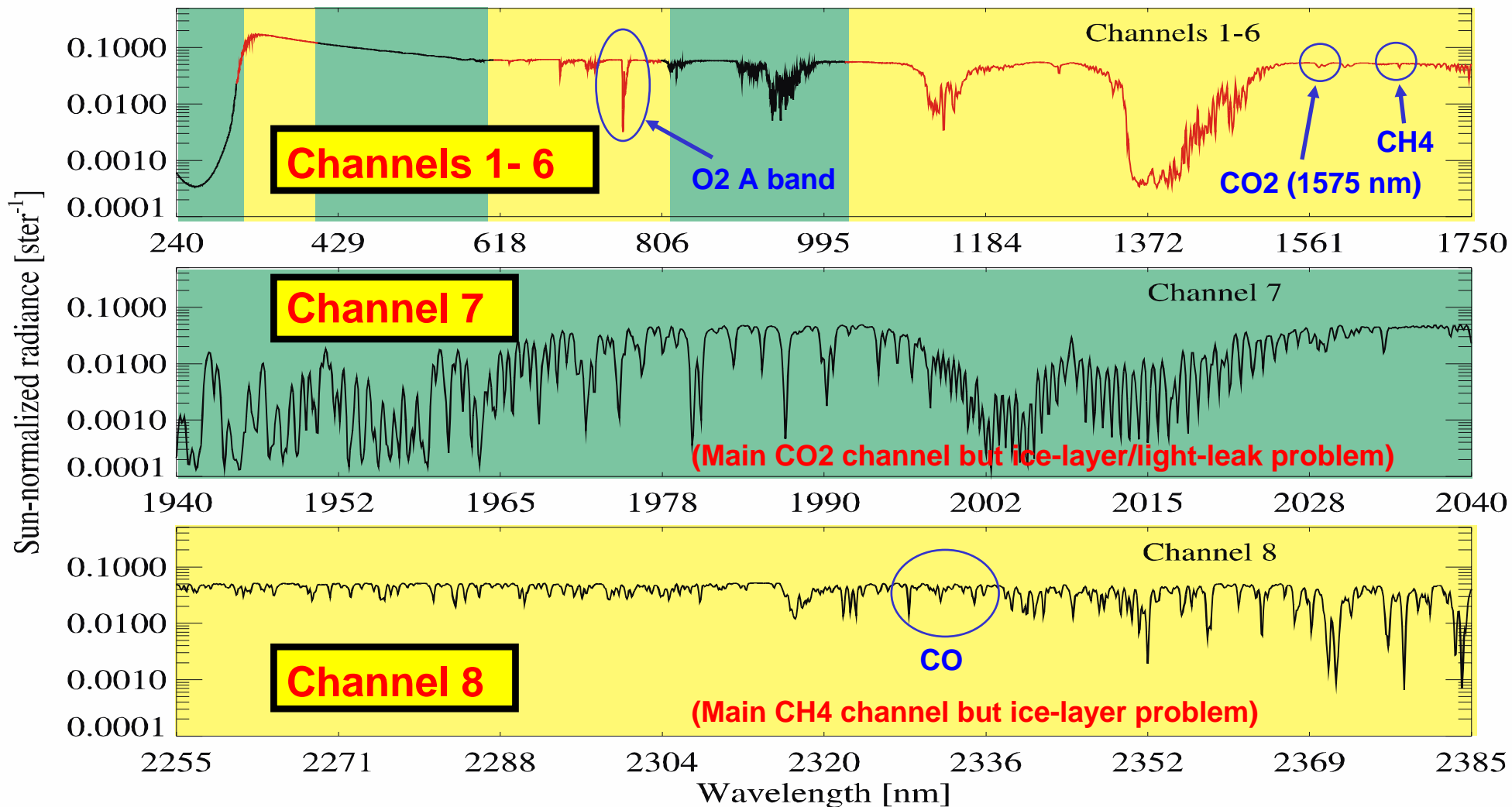
project overview:
<http://www.knmi.nl/evergreen/>

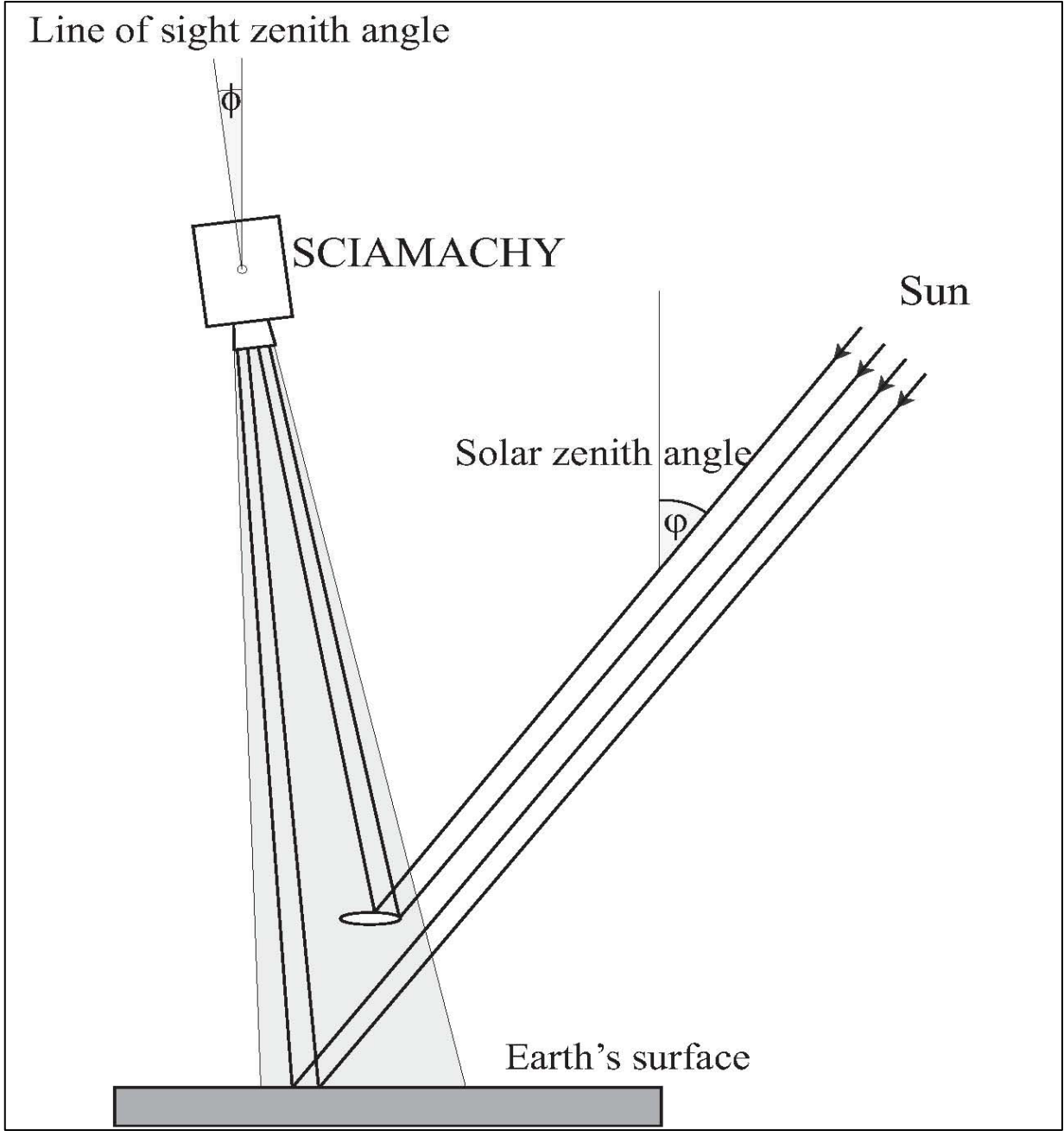
EVERGREEN international workshop, KNMI, de Bilt, NL, 19-20 January 2006

EVERGREEN Tasks/Leaders

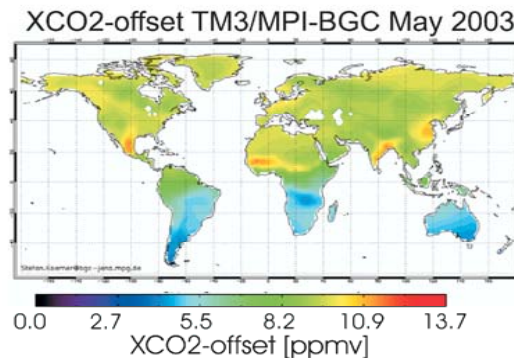
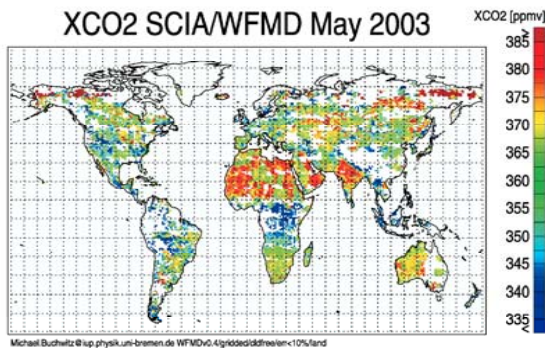


- *Retrieval and validation:* CH₄, CO, CO₂,
plus O₂ and clouds.
M Buchwitz, Uni Bremen
- *Radiation budget modelling:* use of measured CH₄
distributions in radiative budget and radiative forcing
calculations.
P Monks, Uni Leicester
- *(Inverse) modelling:* CH₄, CO, CO₂ emissions derived
from concentration measurements.
J-F Meirink, KNMI



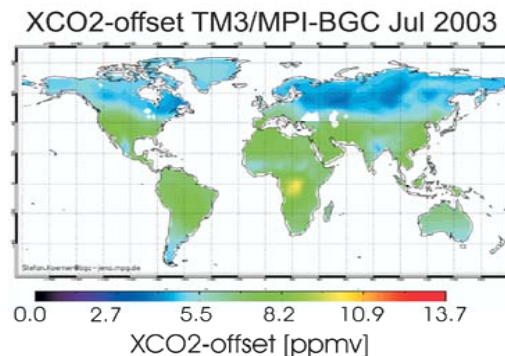
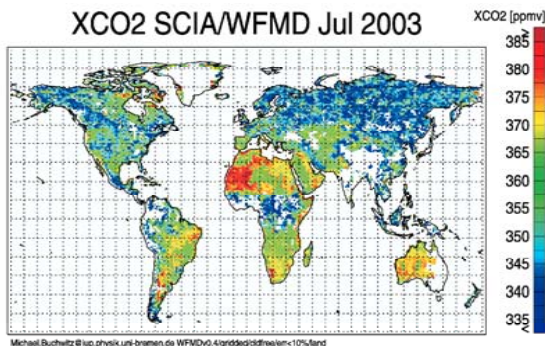


SCIA scale:
+/- 25 ppmv



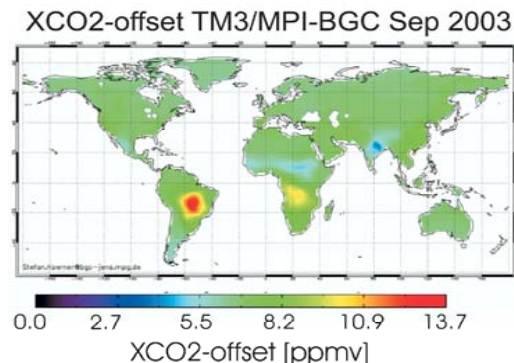
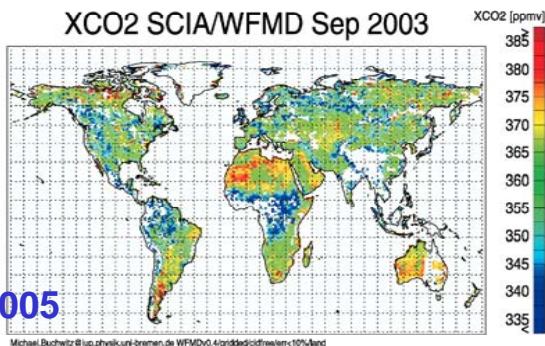
TM3 scale:
+/- 7 ppmv

**Low CO₂ as
observed by
SCIA**



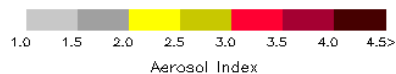
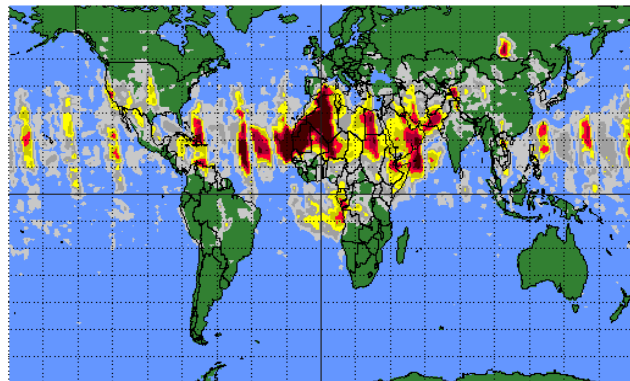
**Low CO₂ due
to uptake of
NH land
biosphere**

Buchwitz et al., ACP, 2005



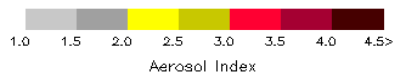
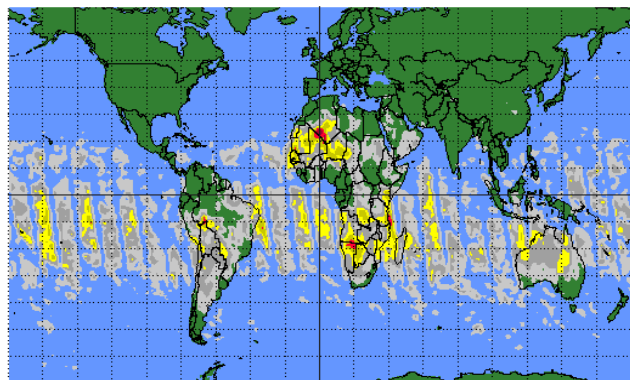
**TM3 data: S. Körner,
M. Heimann, MPI-BGC,
Jena**

Earth Probe TOMS Version 8 Aerosol Index
on July 15, 2003



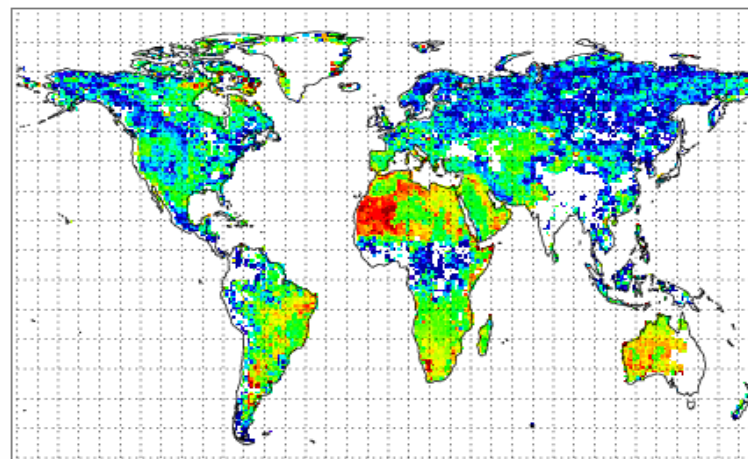
Goddard Space Flight Center

Earth Probe TOMS Version 8 Aerosol Index
on October 15, 2003

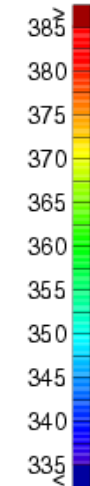


Goddard Space Flight Center

XCO2 SCIA/WFMD Jul 2003

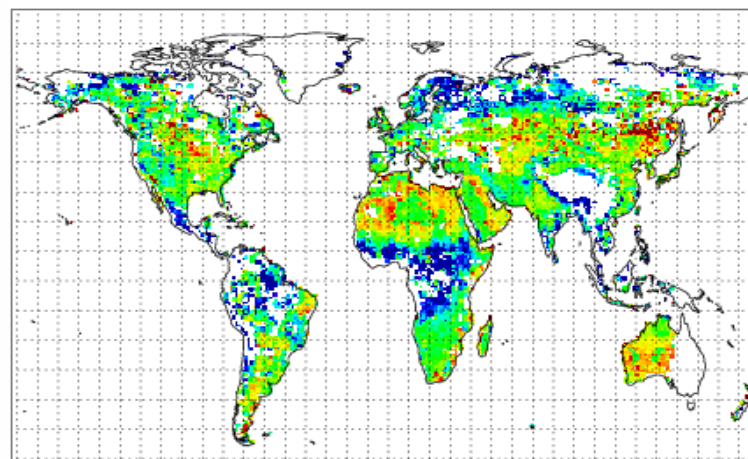


XCO2 [ppmv]



Michael.Buchwitz@up.physik.uni-bremen.de WFMDv0.4gridded/dt/res=10%land

XCO2 SCIA/WFMD Oct 2003

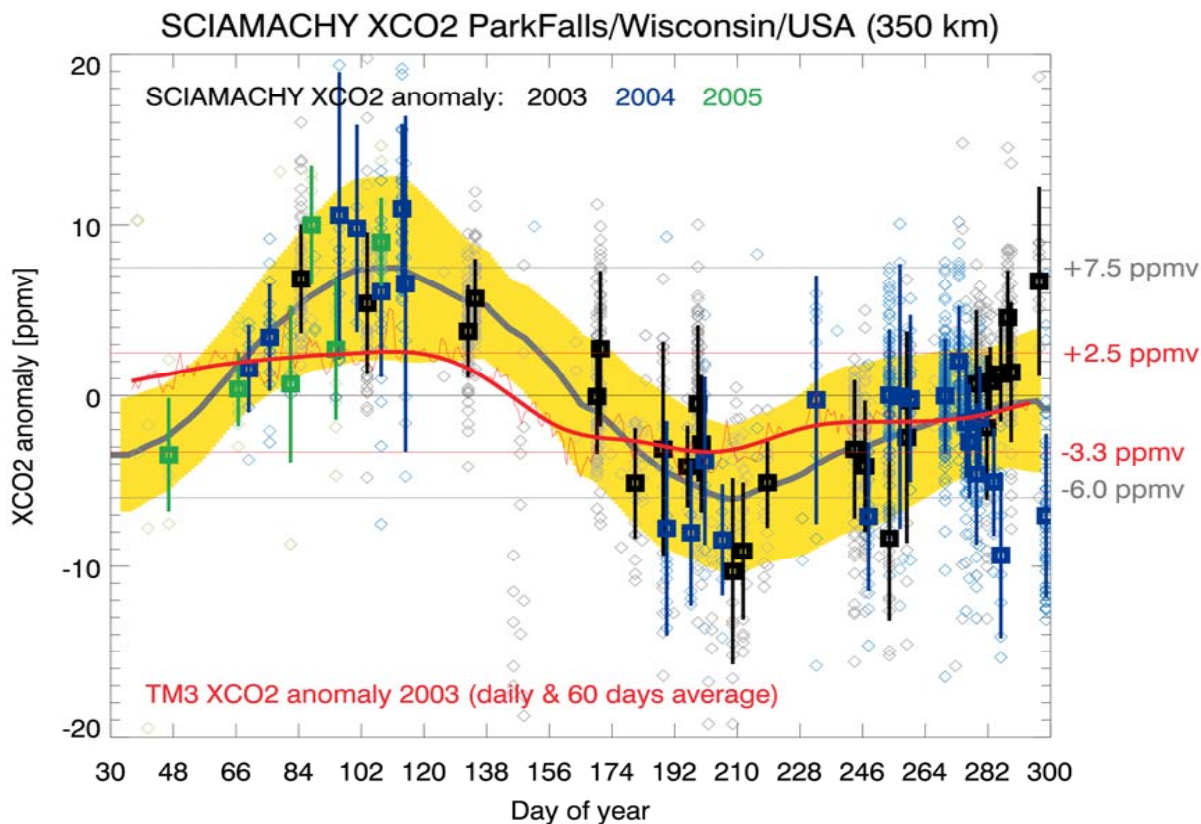


XCO2 [ppmv]



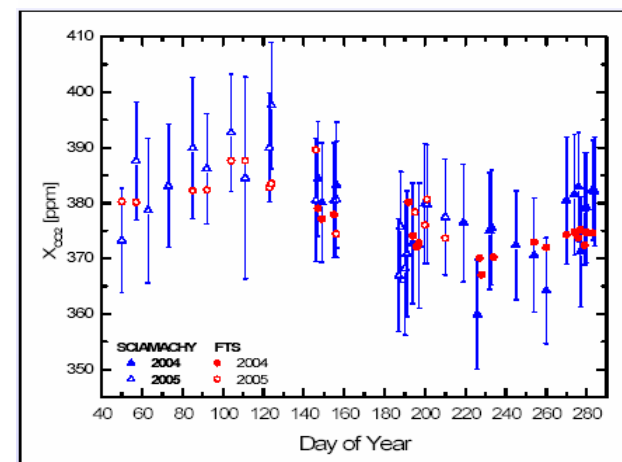
Michael.Buchwitz@up.physik.uni-bremen.de WFMDv0.4gridded/dt/res=10%land

WFM-DOAS applied to SCIAMACHY:



de Beek et al., ACPD, 2006

OCO algorithm applied to SCIAMACHY & comparison with preliminary FTS:

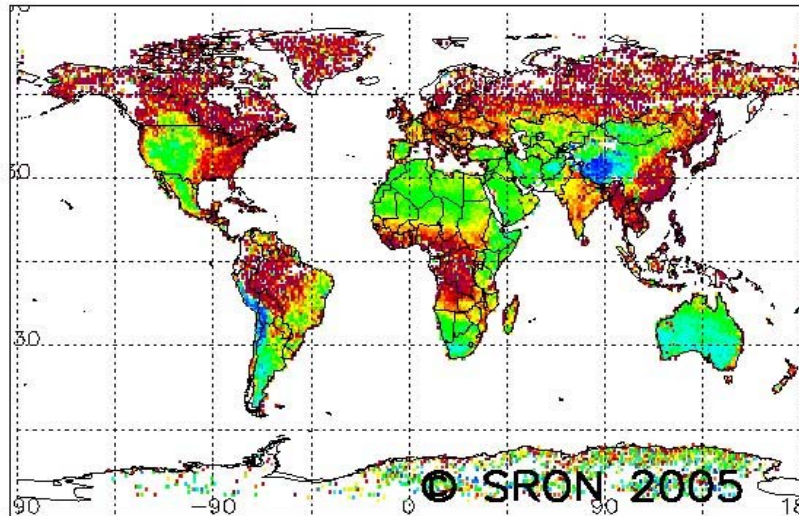
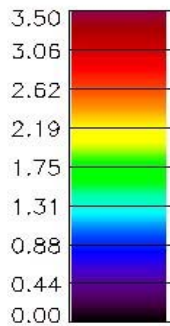


Bösch et al., AGU (poster), 2005

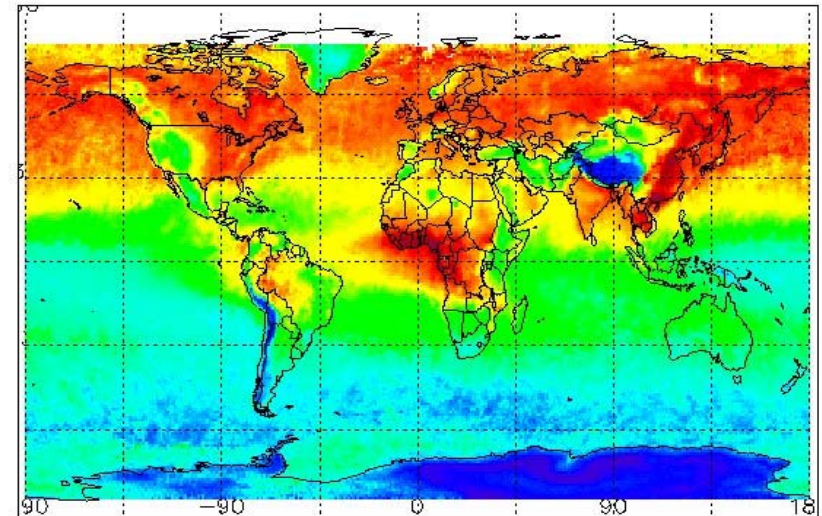
Preliminary FTS XCO₂ seasonal cycle peak-to-peak ~13 ppmv in good agreement with SCIAMACHY

SCIAMACHY CO: IMLM / MOPITT (2003)

CO total column
(10^{18} molec/cm²)



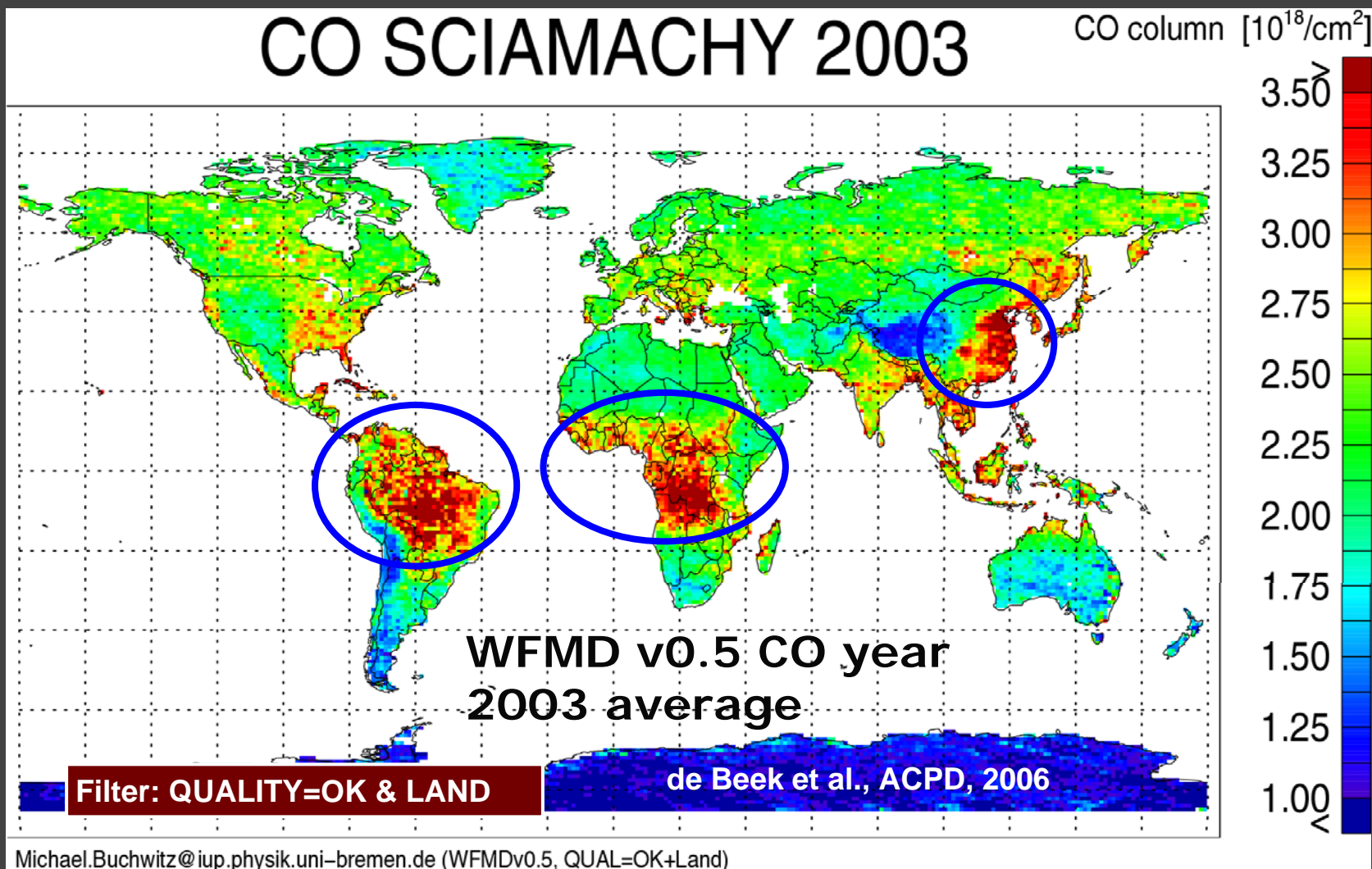
IMLM v6.3



MOPITT

2003 yearly averages

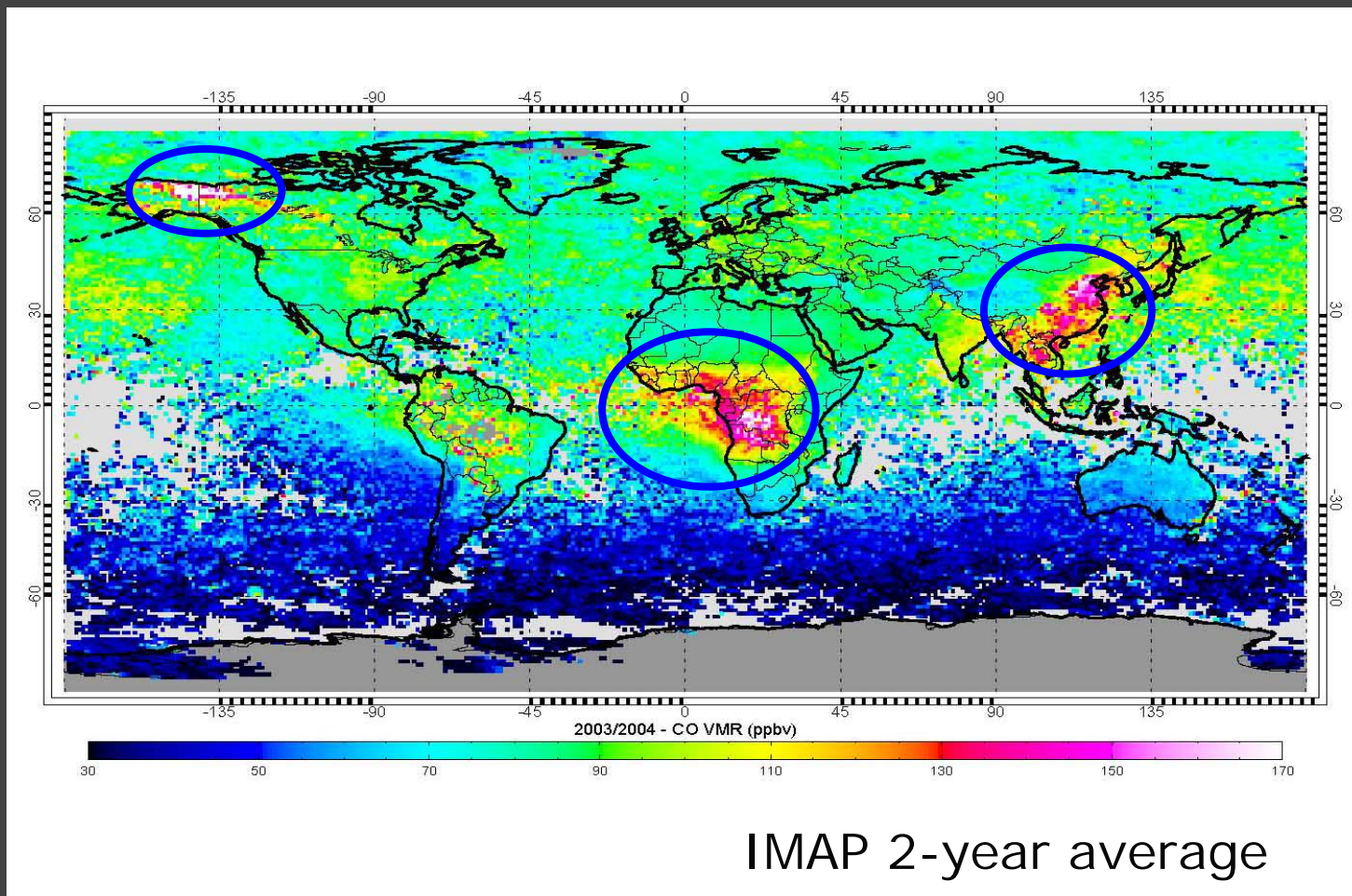
SCIAMACHY CO WFMD (2003)



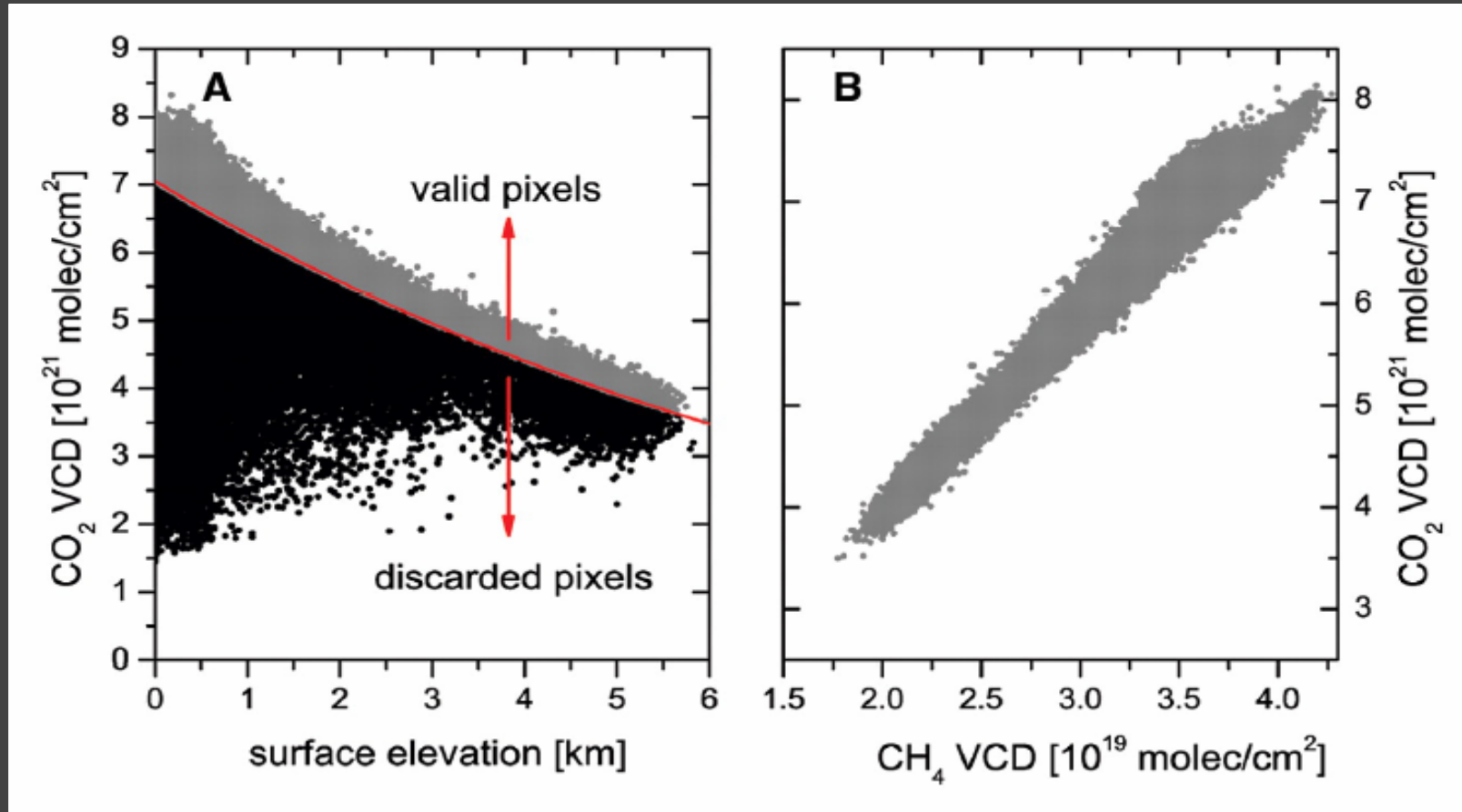
SCIAMACHY CO IMAP (2003-2004)

Well-known features clearly visible:

- Biomass burning Africa
- Pollution Asia
- Forest fires Alaska

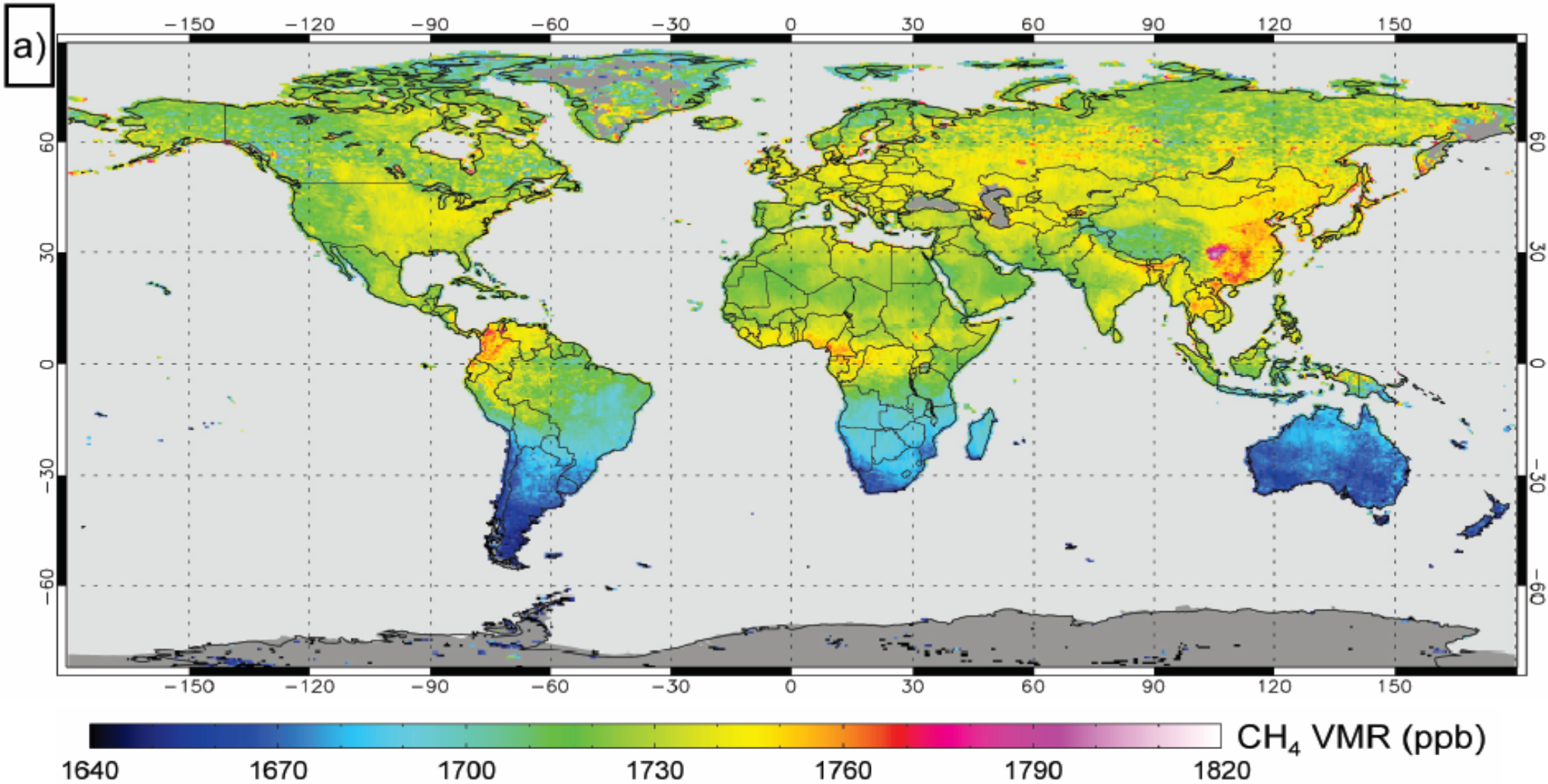


CO₂ VCD: Cloud filter and proxy

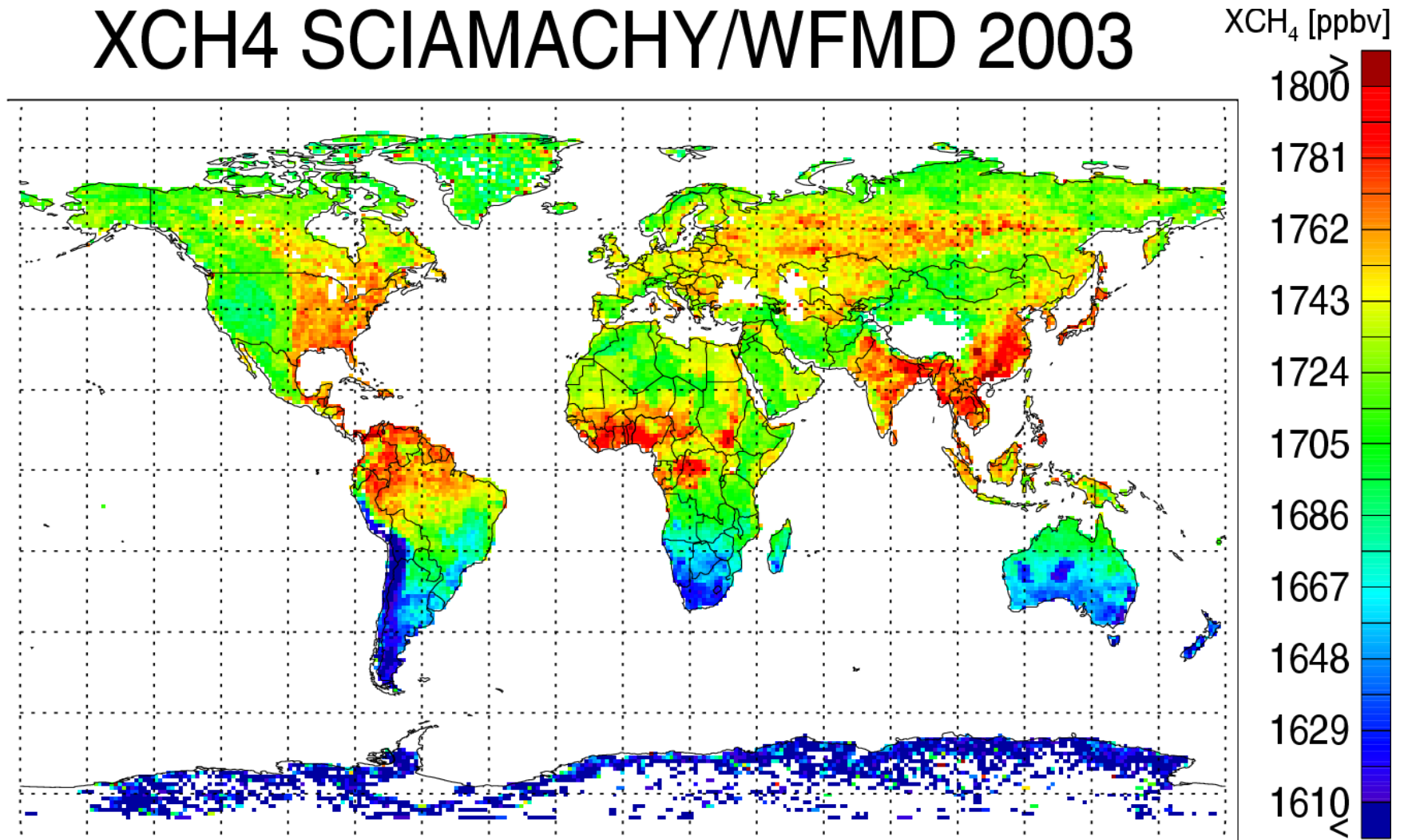


Frankenberg et al., Science, 2005

SCIAMACHY CH₄ IMAP (2003-2004)



XCH₄ SCIAMACHY/WFMD 2003



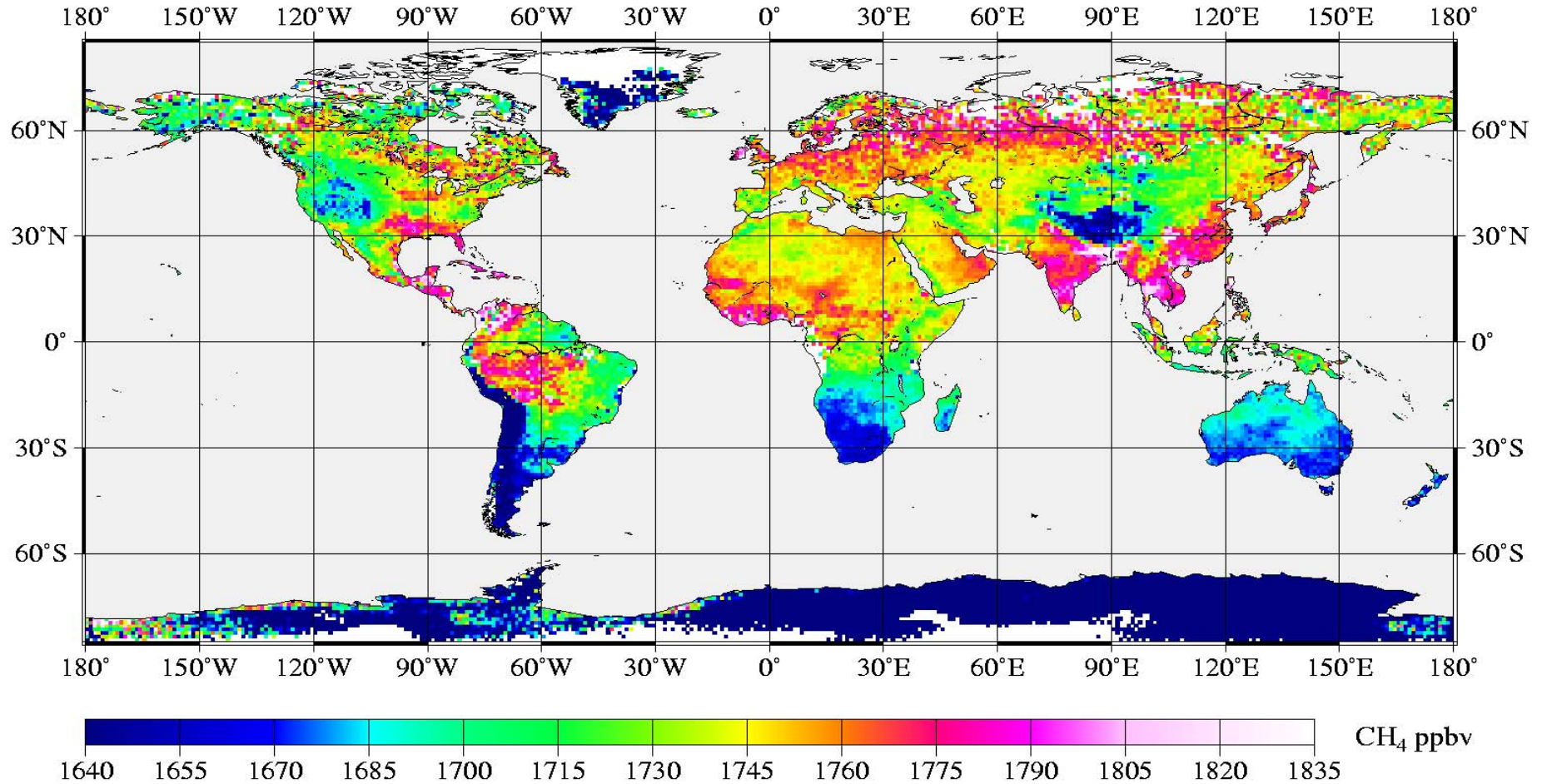
Michael.Buchwitz@iup.physik.uni-bremen.de (WFMDv0.5, QUAL=OK+Land+NH>1670/SH>1560)

de Beek et al., ACPD, 2006

SCIAMACHY CH₄ IMLM

SRON
© 2005

SCIAMACHY Sep - Nov 2003 channel 6



SRON

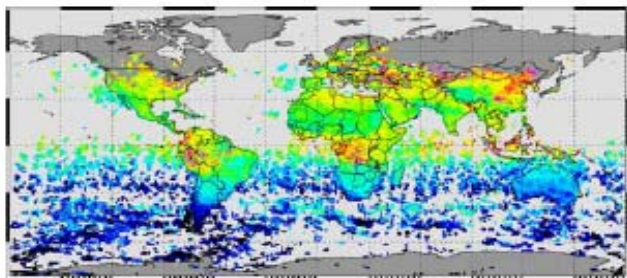
Netherlands Institute for Space Research

Satellite Group - SCIAMACHY

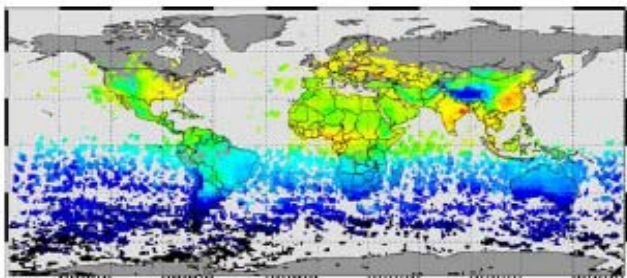


Institute
Universi

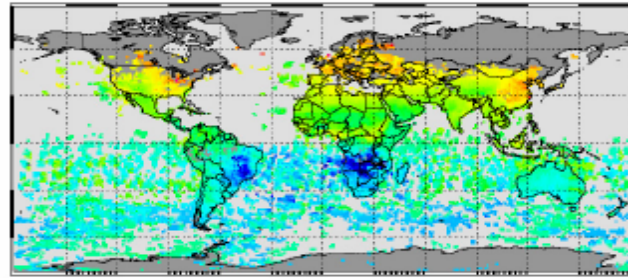
[Frankenberg, 2006]



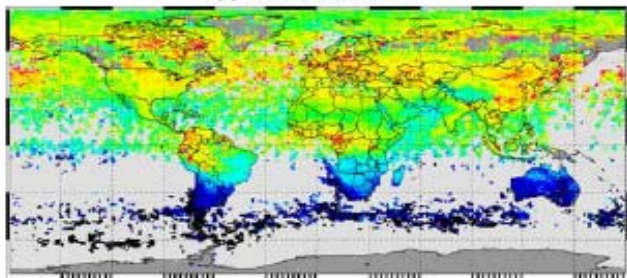
(a) DJF SCLAMACHY



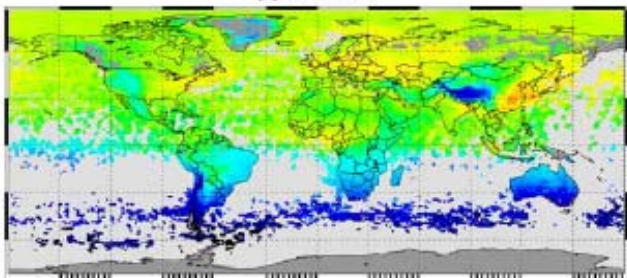
(b) DJF TM4



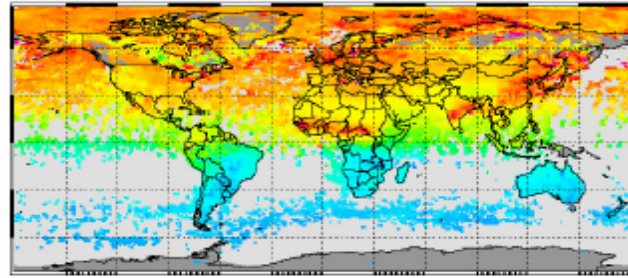
(a) DJF TM3 CO₂



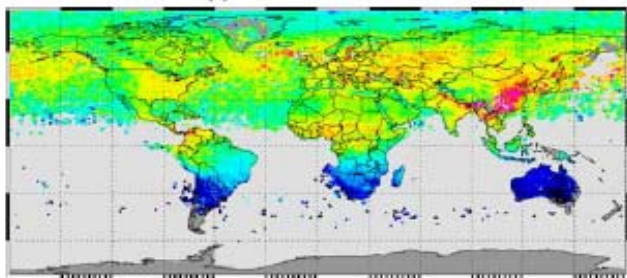
(c) MAM SCLAMACHY



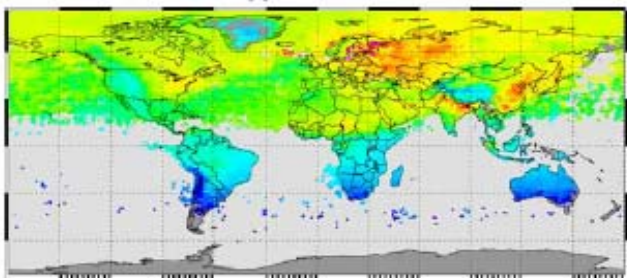
(d) MAM TM4



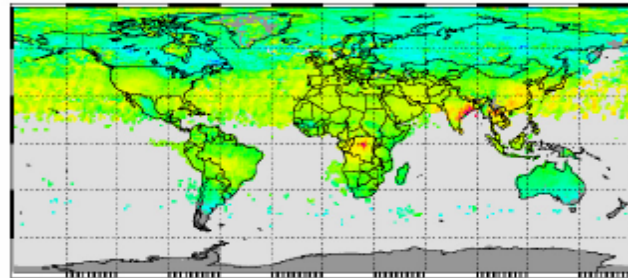
(b) MAM TM3 CO₂



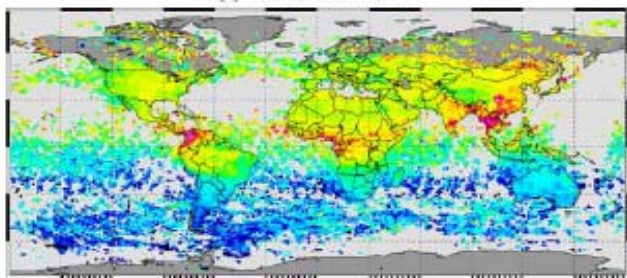
(e) JJA SCLAMACHY



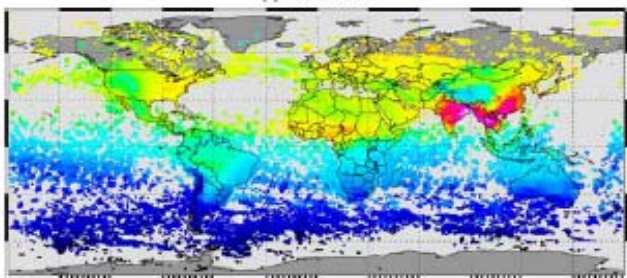
(f) JJA TM4



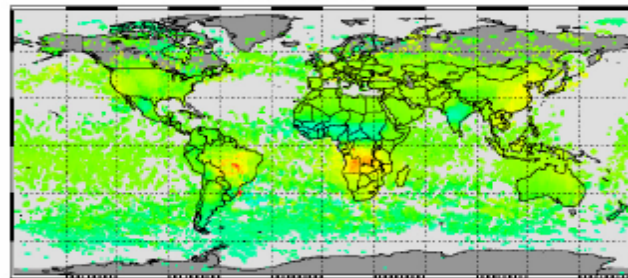
(c) JJA TM3 CO₂



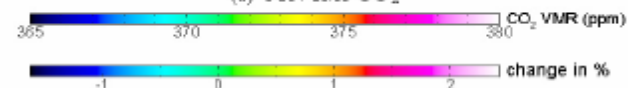
(g) SON SCLAMACHY



(h) SON TM4



(d) SON TM3 CO₂



SRON

Netherlands Institute for Space Research

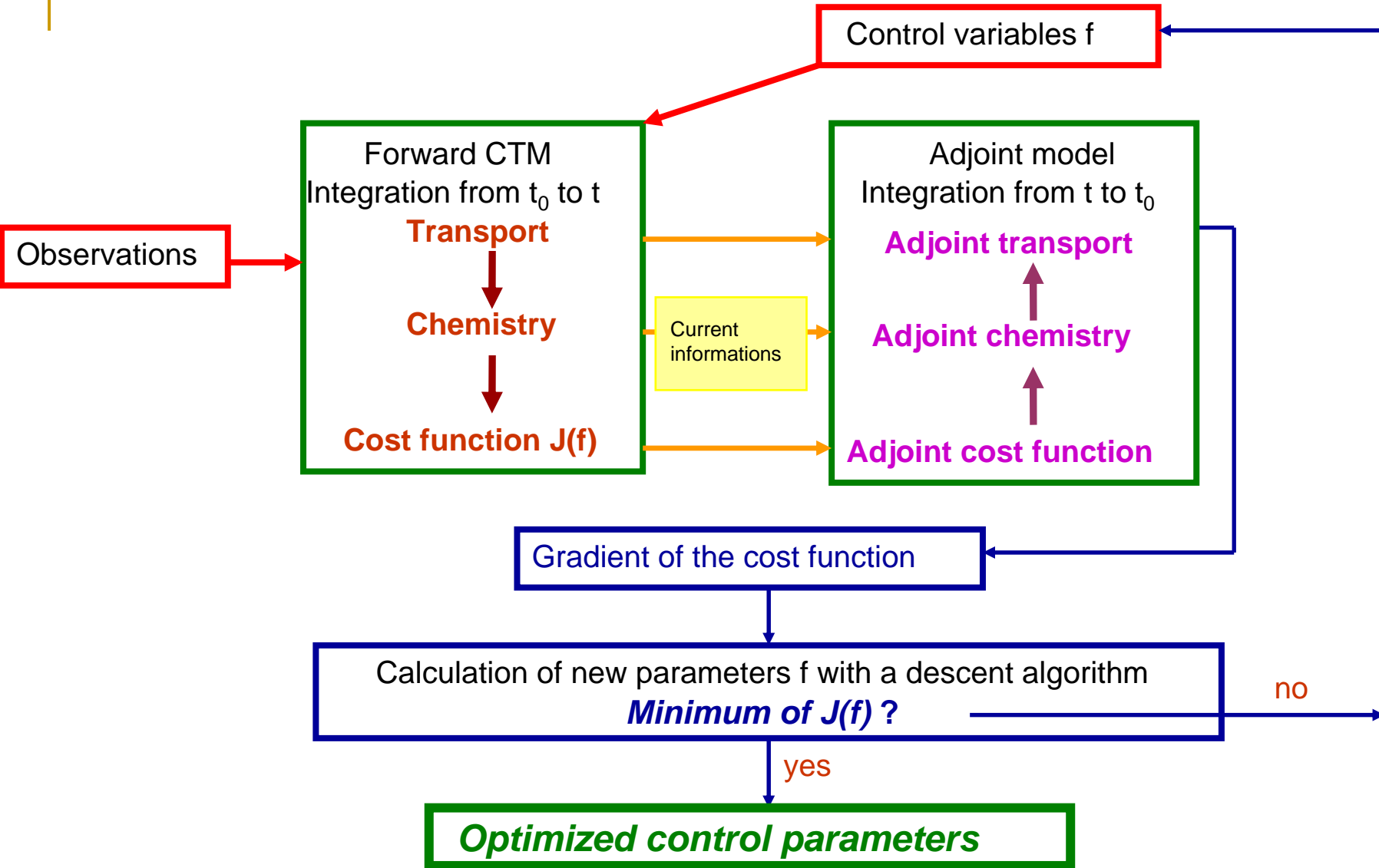
Satellite Group - SCLAMACHY



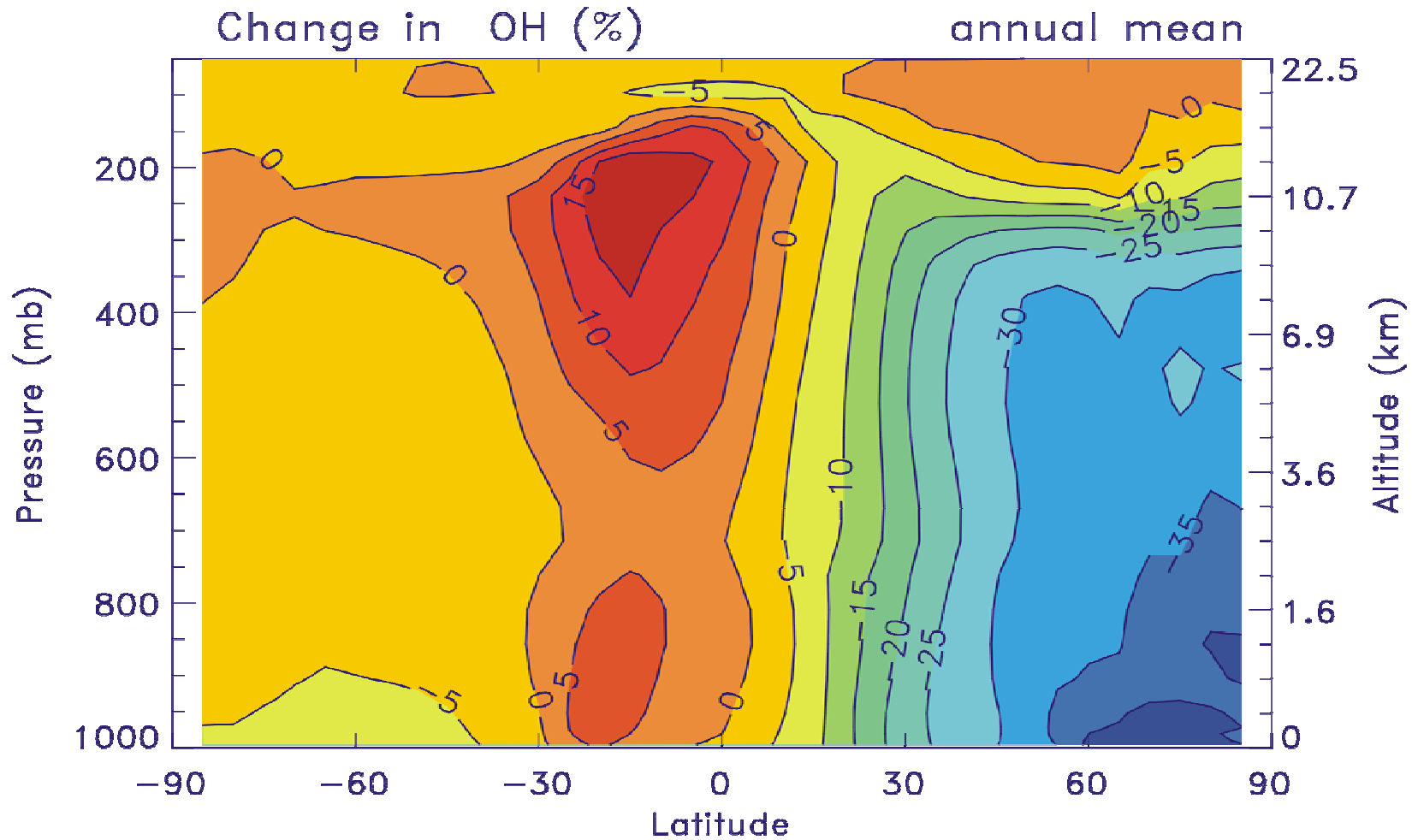
Institute
Universi

[Frankenberg, 2006]

CO inverse modelling / adjoint model



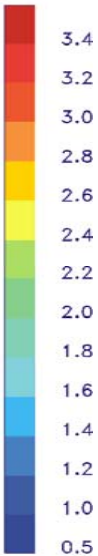
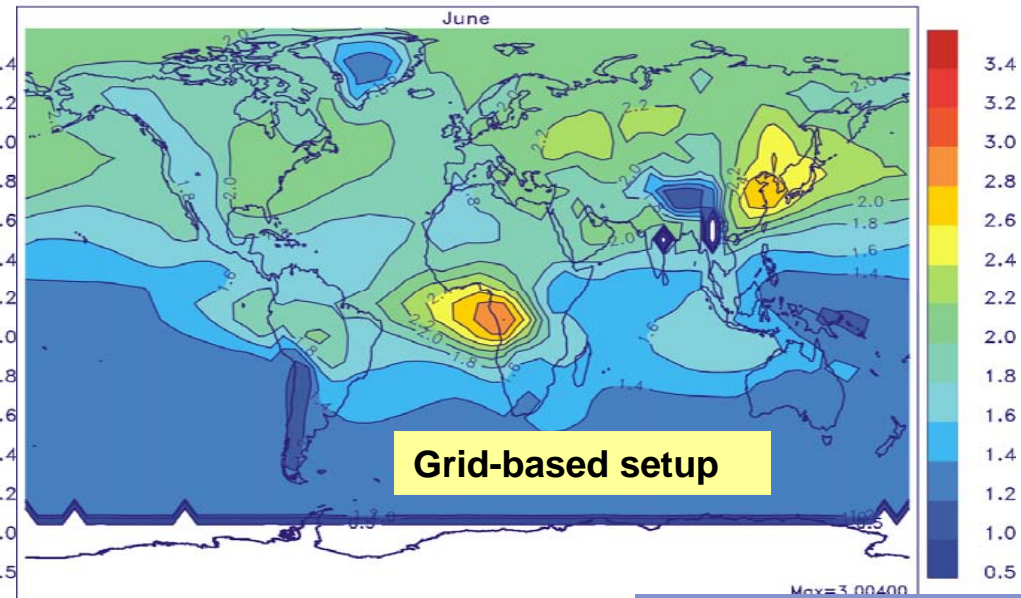
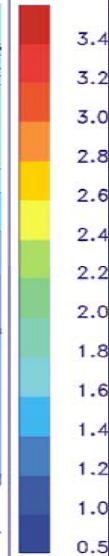
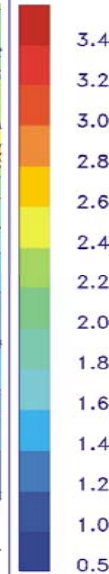
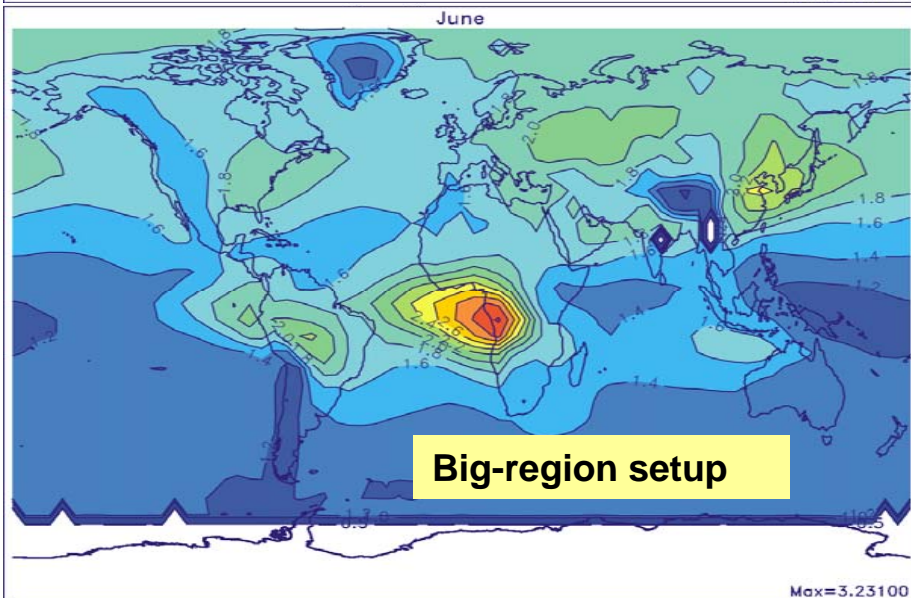
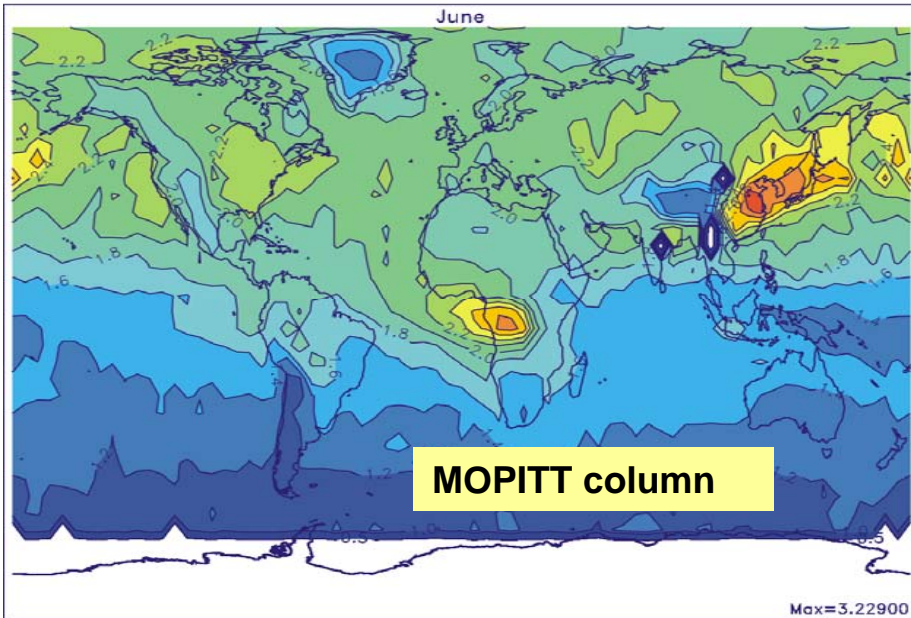
Impact of emission changes on OH



CO inverse modelling: big-region vs. grid-based setup

Optimization results

- Both solutions succeed in reducing the model/MOPITT bias over most regions
- Larger cost reduction in the grid-based case (4.6) as compared to the big-region setup (2.2)



Inversion real SCIA data

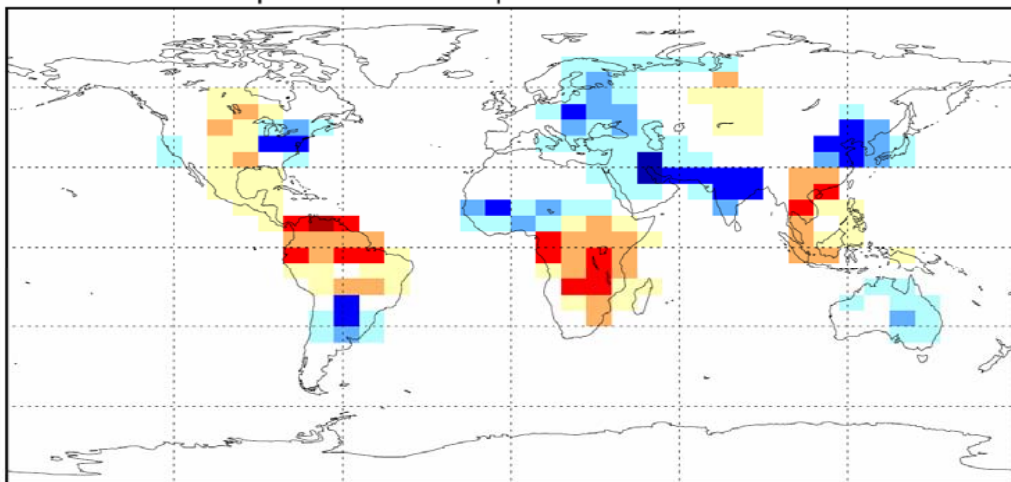


- Model: TM4 at 9x6 degrees x 25 levels
- Dataset:
 - CH₄/CO₂ from Univ. Heidelberg
 - Year: 2004
 - So far: **no** model CO₂ correction, and averaging kernels **neglected**
- Error assumptions
 - Prior emissions: 50% uniformly; spatial correlations L=1500 km
 - Prior initial concentrations: ~1-2%; same spatial correlations
 - Observations: uncorrelated, typical precision single obs. 1-2%

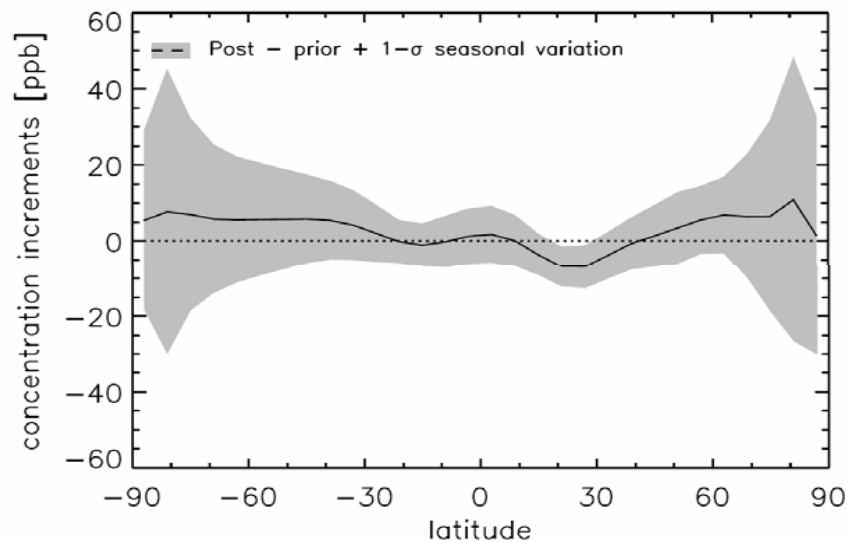
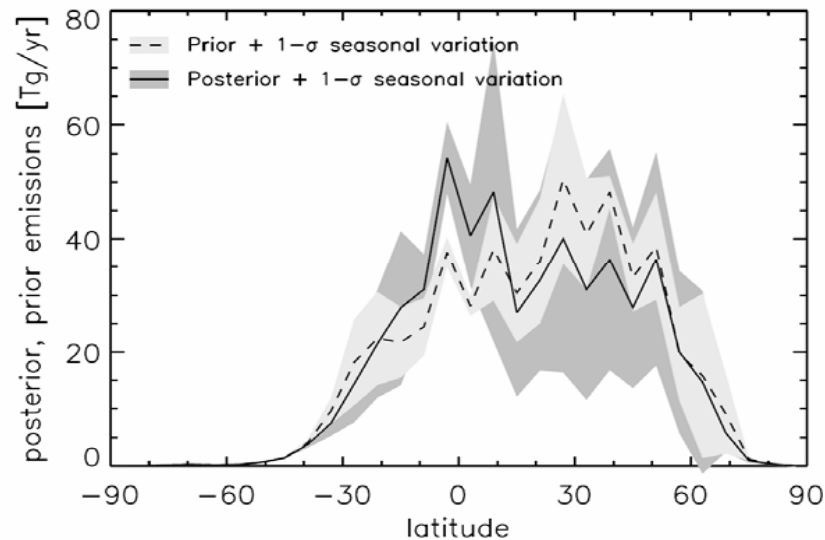
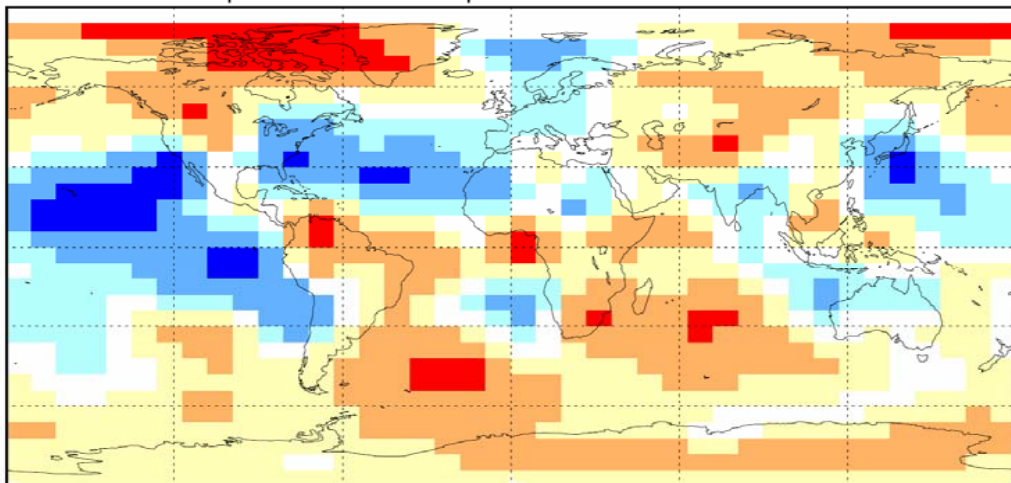
Analysis increments



A posteriori minus a priori emissions 2004

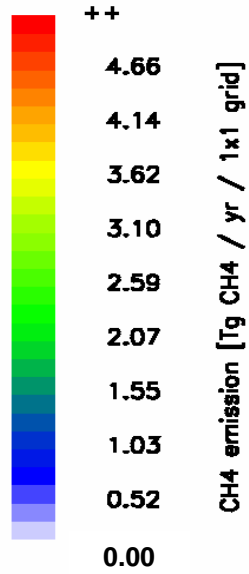
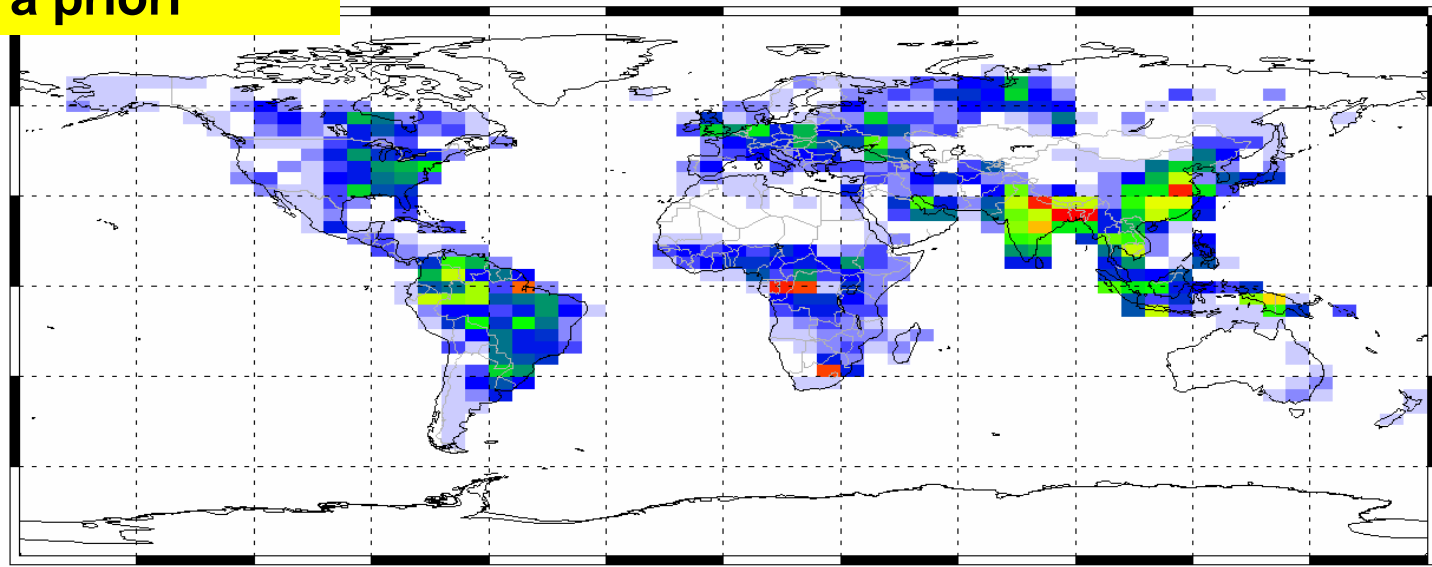


A posteriori minus a priori concentrations 2004

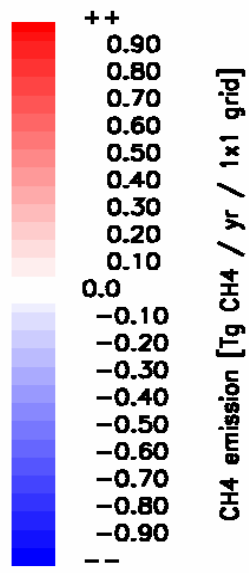
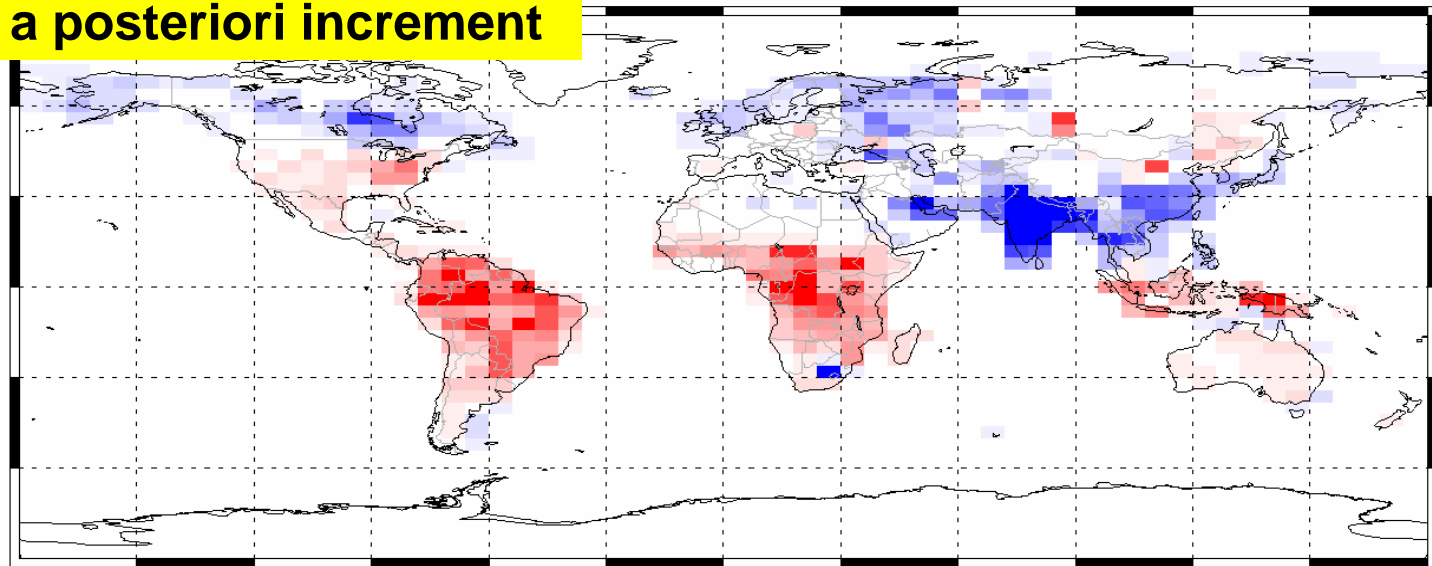


SCIA CH₄ inverse modelling with 4

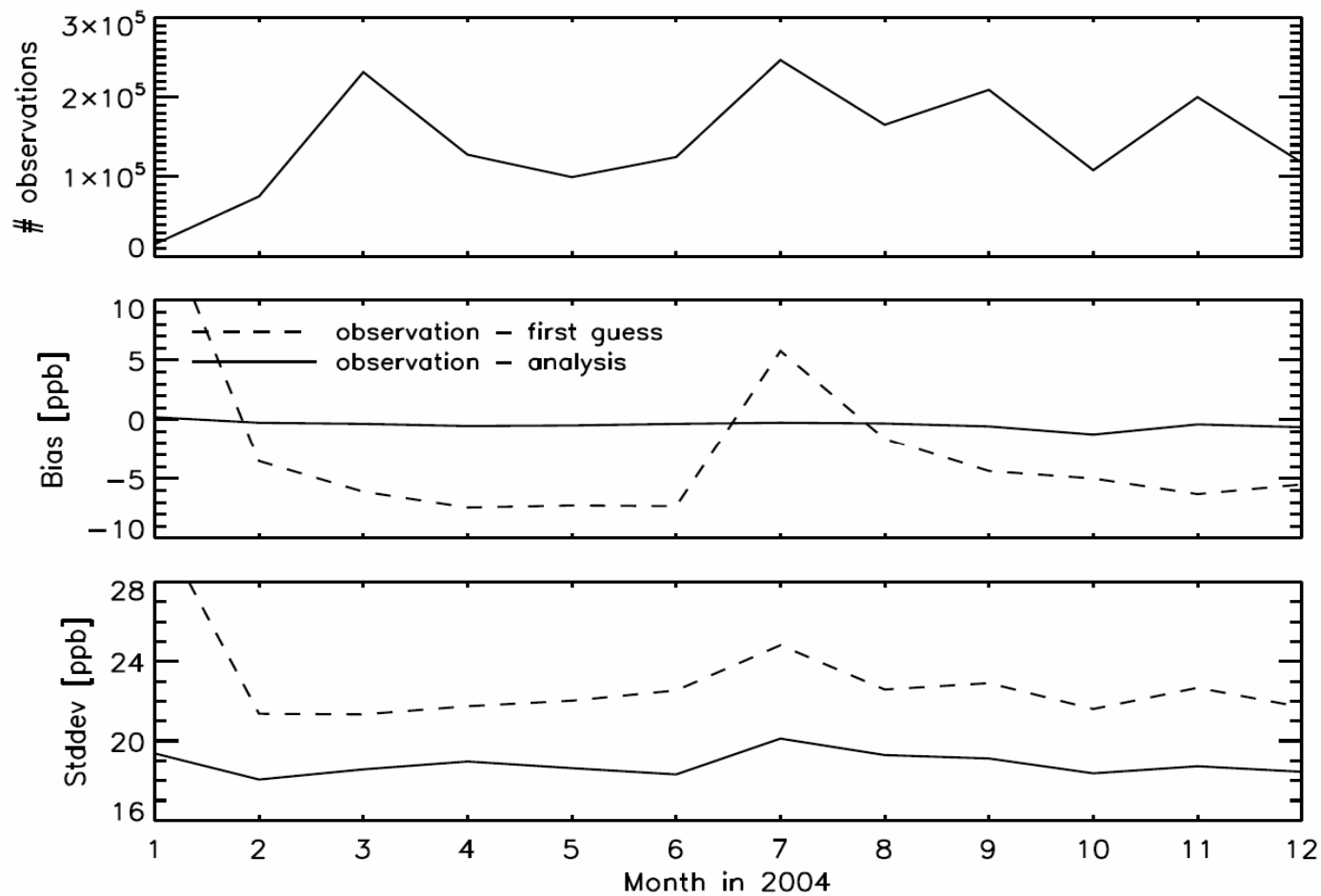
a priori



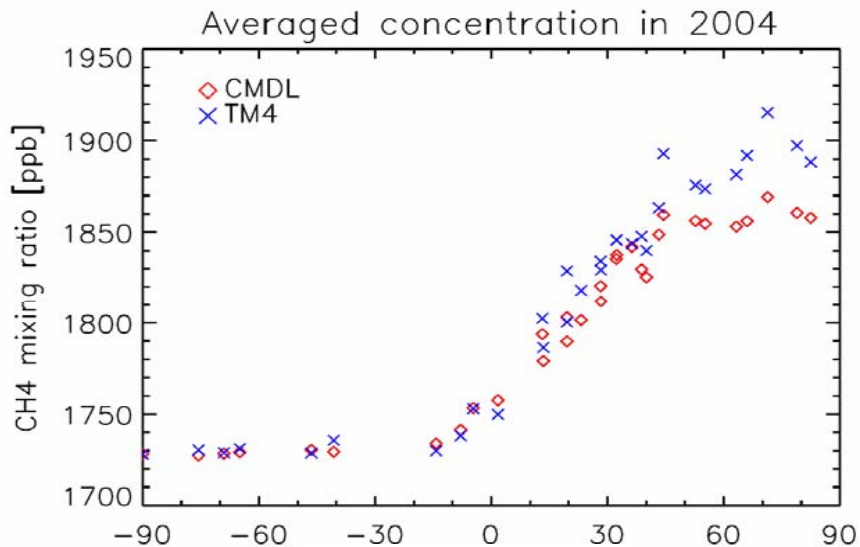
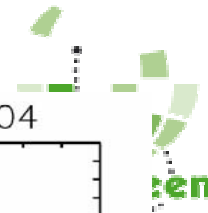
a posteriori increment



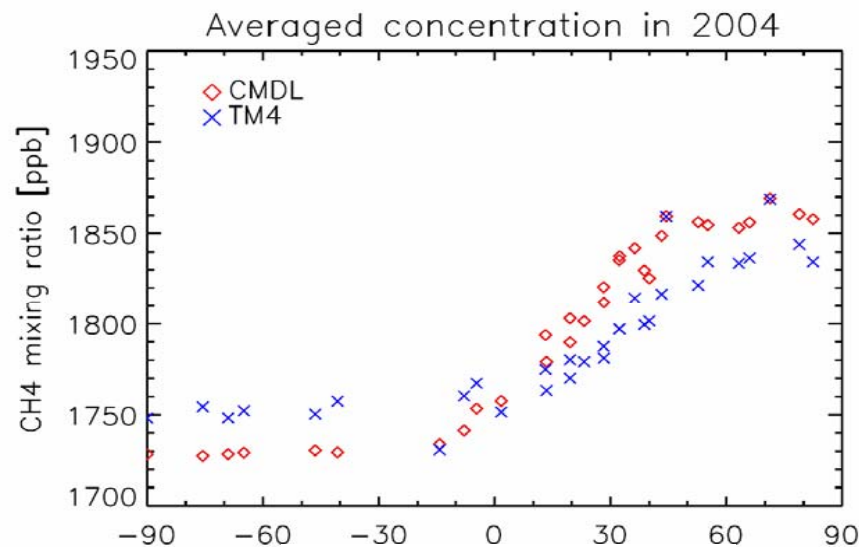
Global assimilation statistics



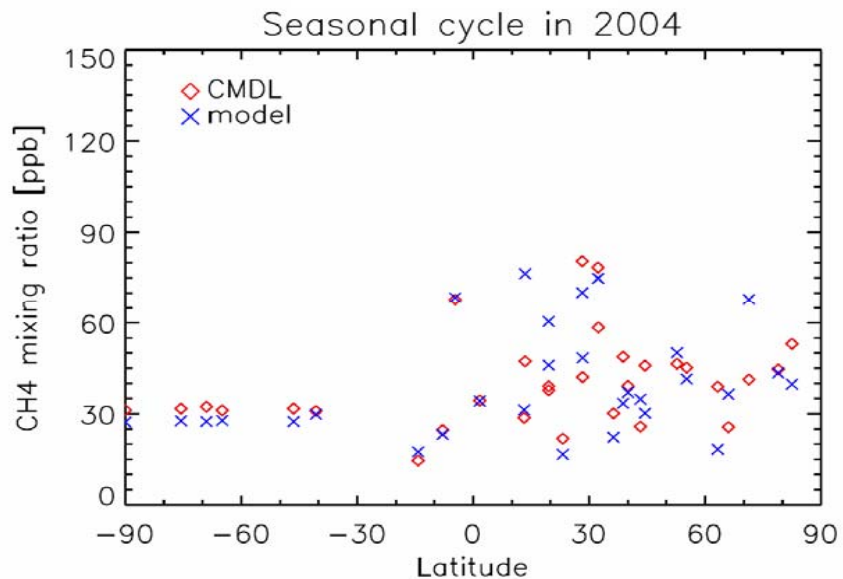
Comparison with flasks



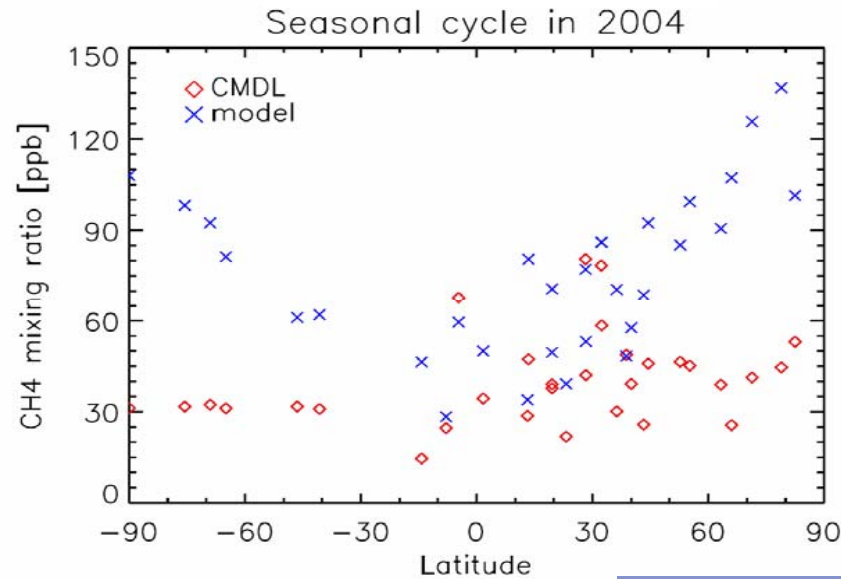
Free run



Assimilation



ng'



006