

Quantitative analysis of SCIAMACHY CO variability and its implication for chemistry transport models

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Why CO?

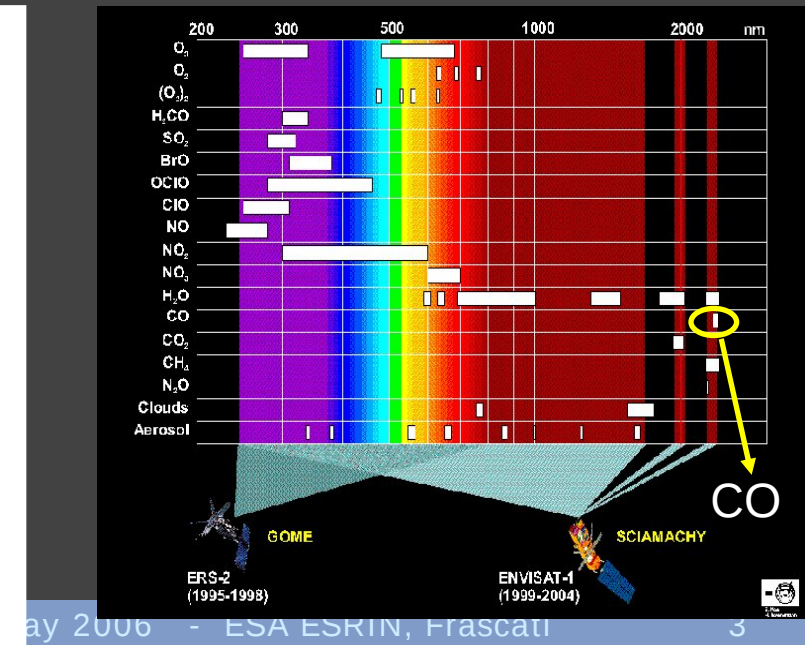
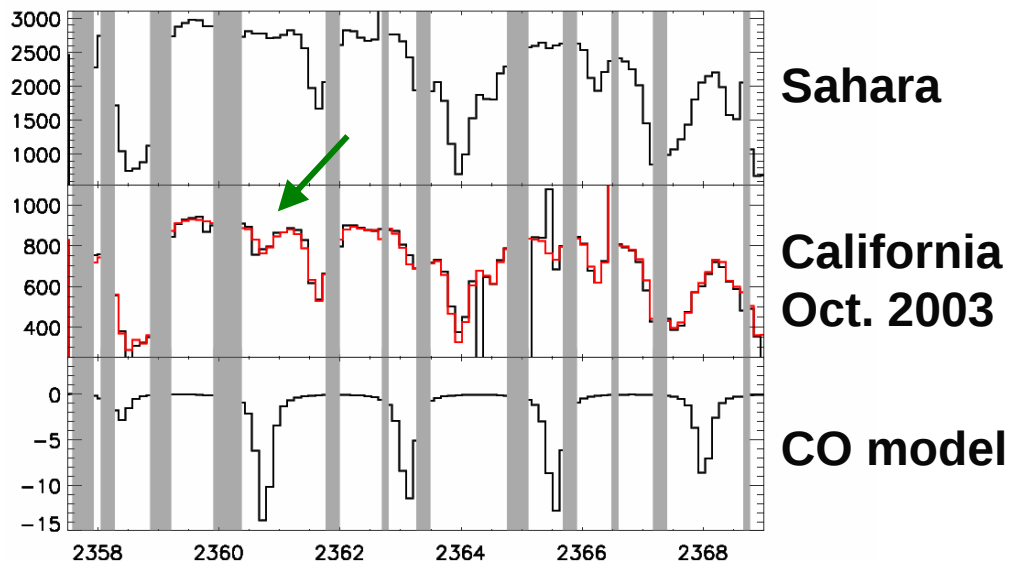
- Gas with strong temporal and spatial variations
- Lifetime: 1-2 months → Indicator of transport processes
- Important for atmospheric chemistry and air quality
- Mostly anthropogenic
- SCIAMACHY: improve estimates of anthropogenic emissions, biomass burning



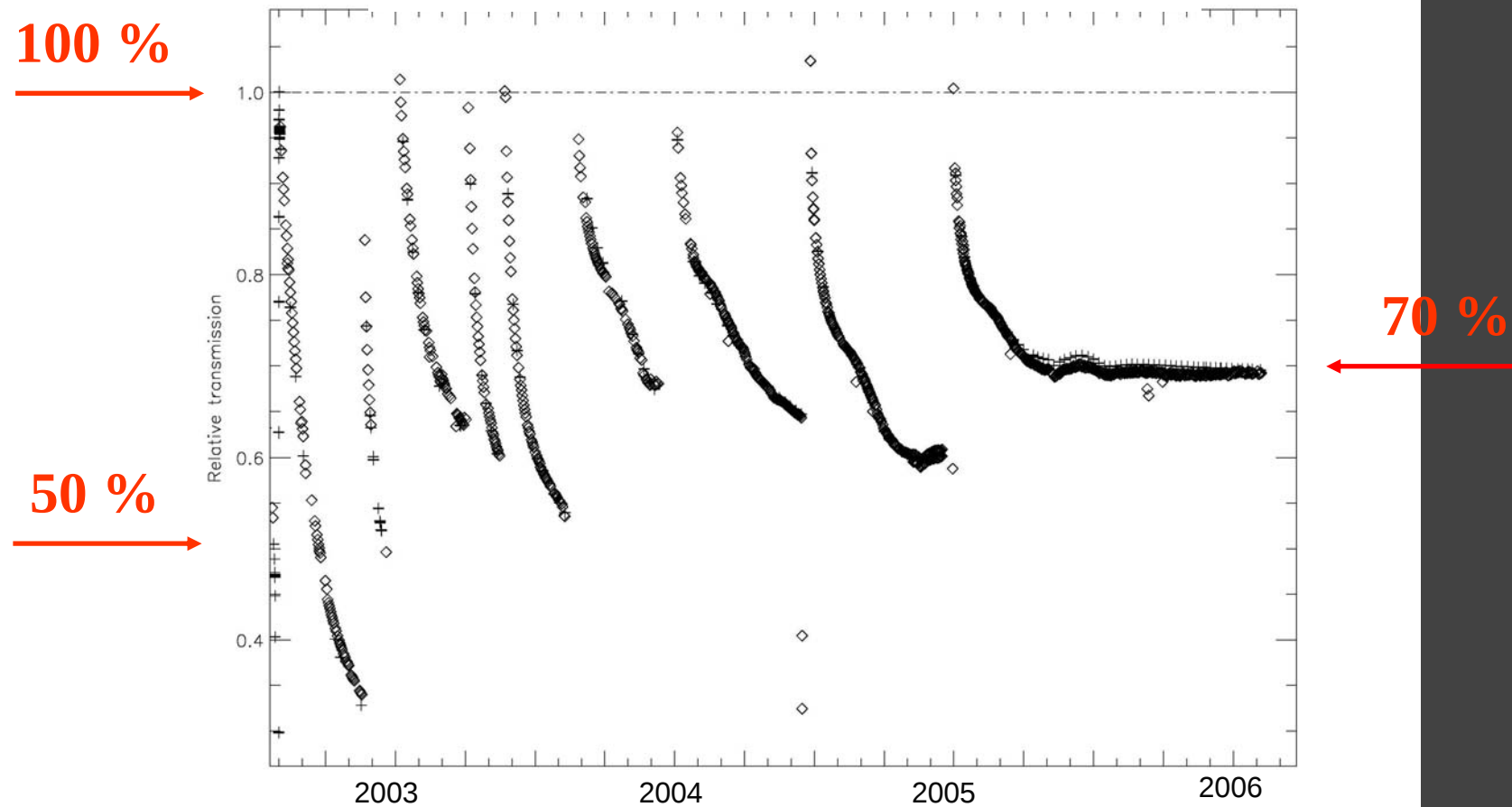
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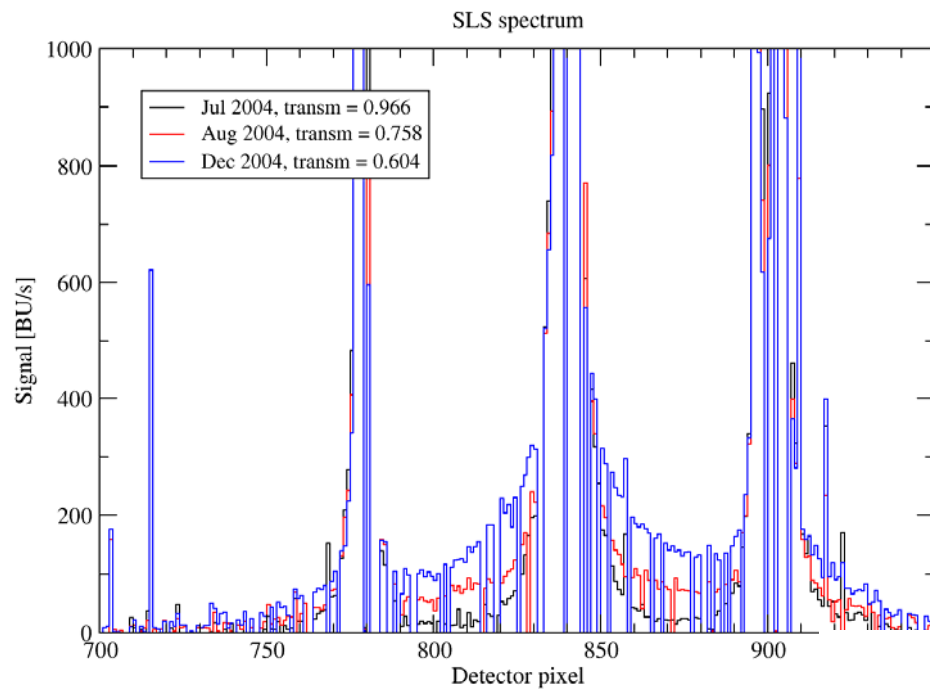
SCIAMACHY CO retrievals: a real challenge!

- Near-infrared CO lines between ~2310-2380 nm
- CO lines are weak and often overlap with strong H₂O and CH₄ lines
- Weak atmospheric signal
- Important instrument calibration issues further complicate the CO retrievals, in particular:
 - Presence of ice layer on the detector (up to ~400 μm thick!)
 - Increasing number of dead/bad detector pixels



Transmission channel 8 : affected by ice-layer

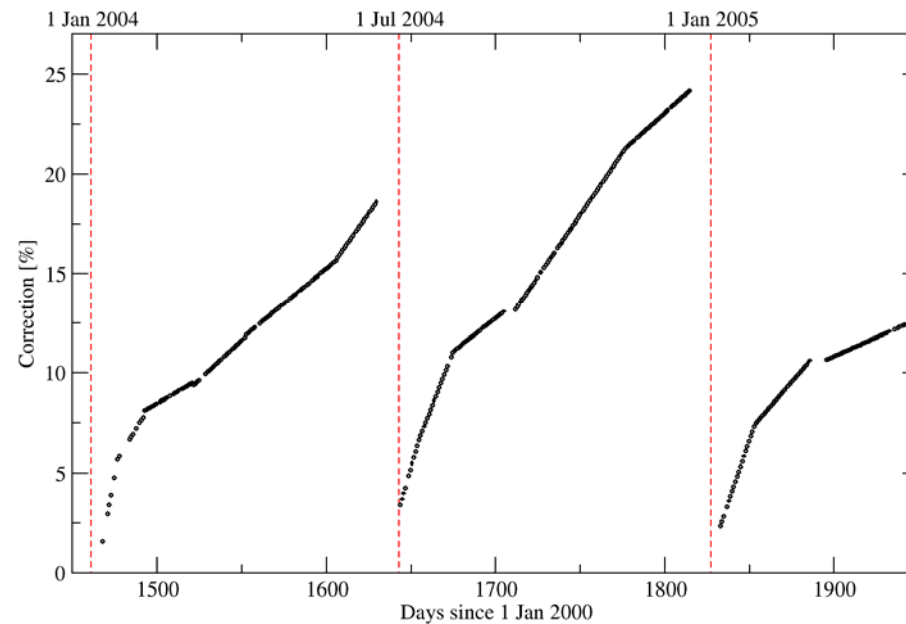




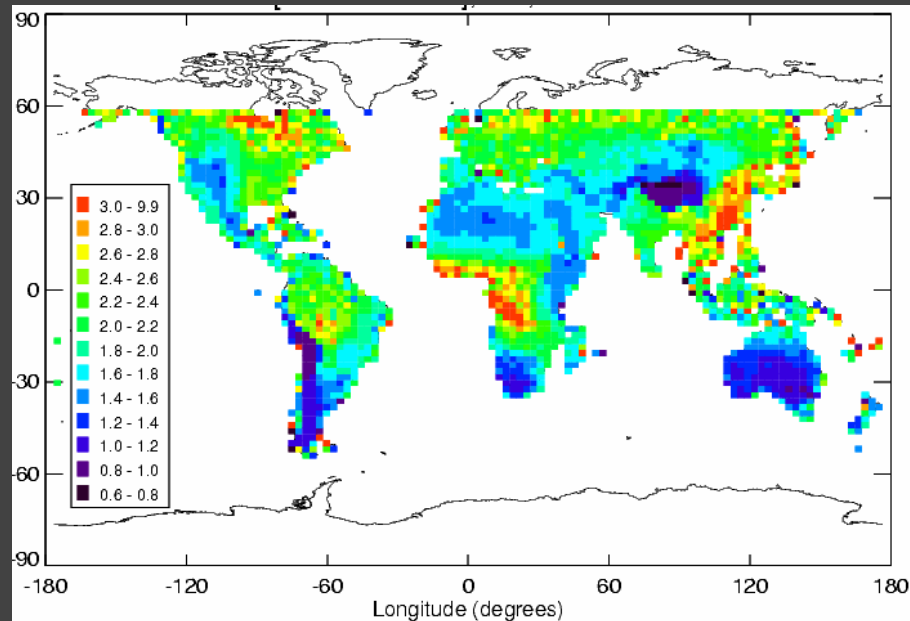
Scattering in ice layer affects spectral resolution

Scattering in ice-layer affects amount useful signal

Correct for effect through CH_4 reference calibration



SCIAMACHY CO total columns

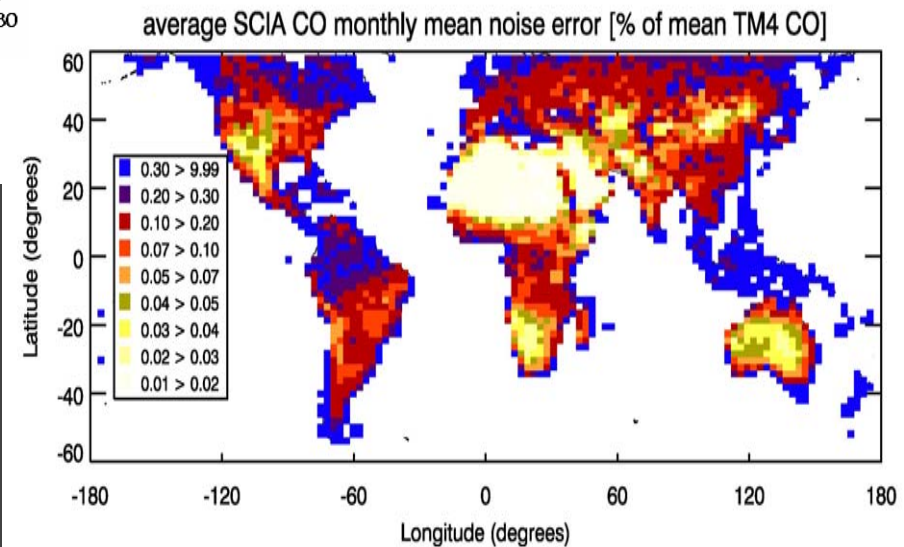


Annual mean SCIAMACHY CO (10^{18} molec/cm²)

IMLM v6.3 09-2003 to 2004-08

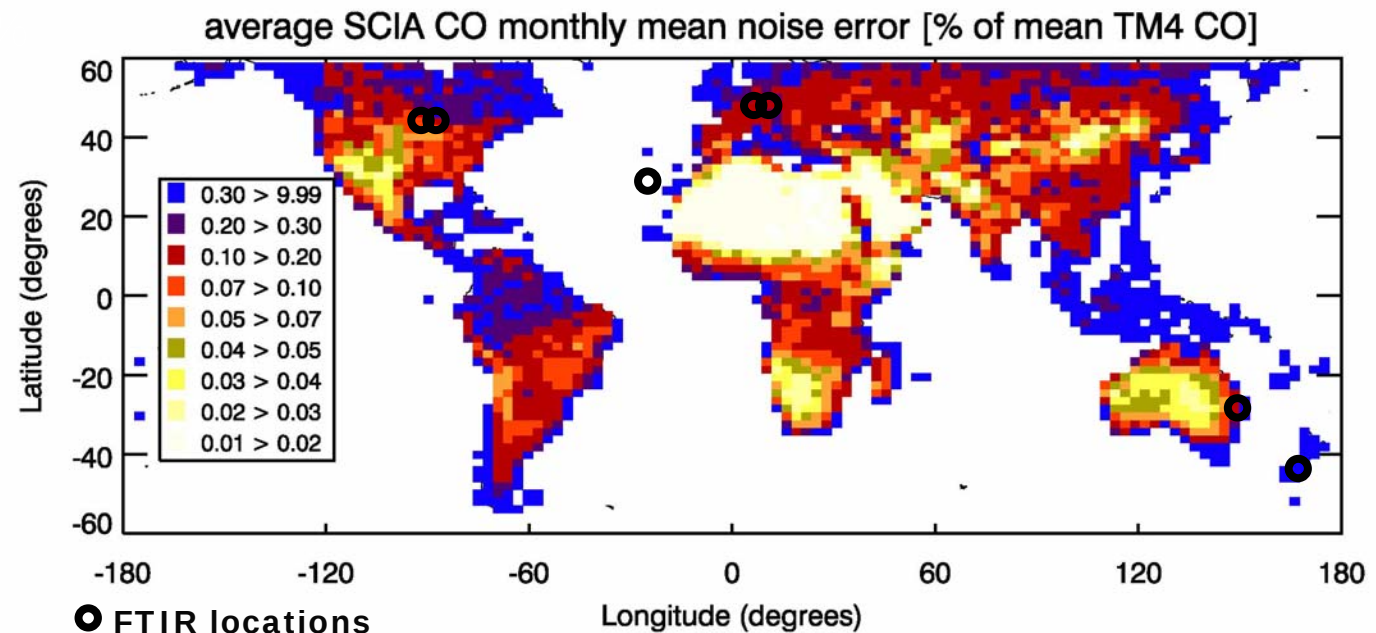
CO precision depends on:

- number of collocations: temporal and spatial averaging
- signal level: surface albedo and solar zenith angle

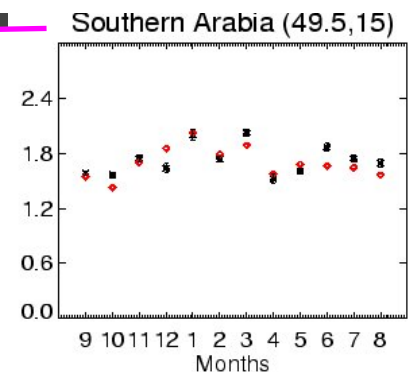
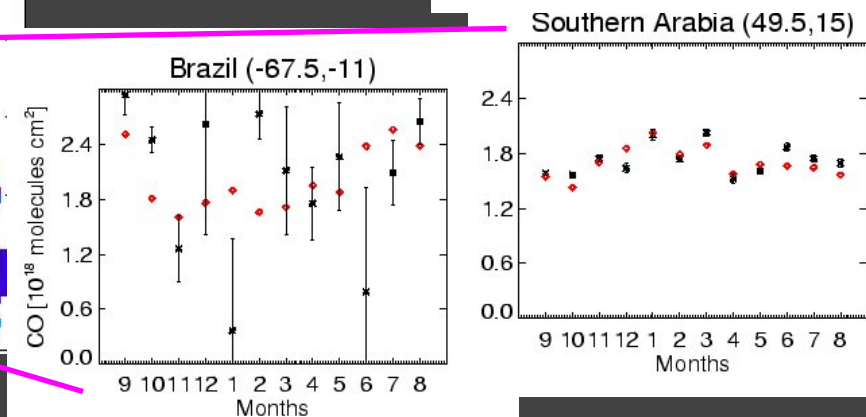
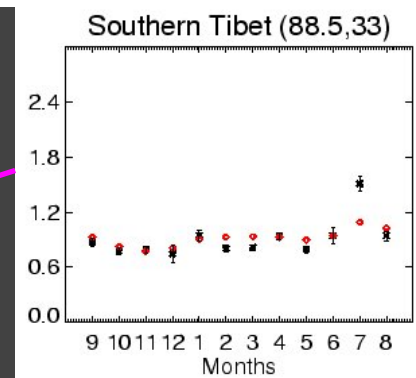
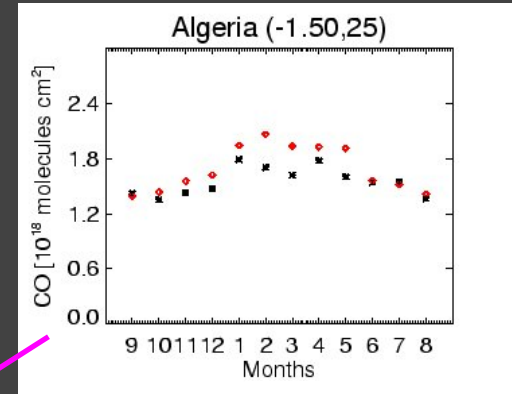
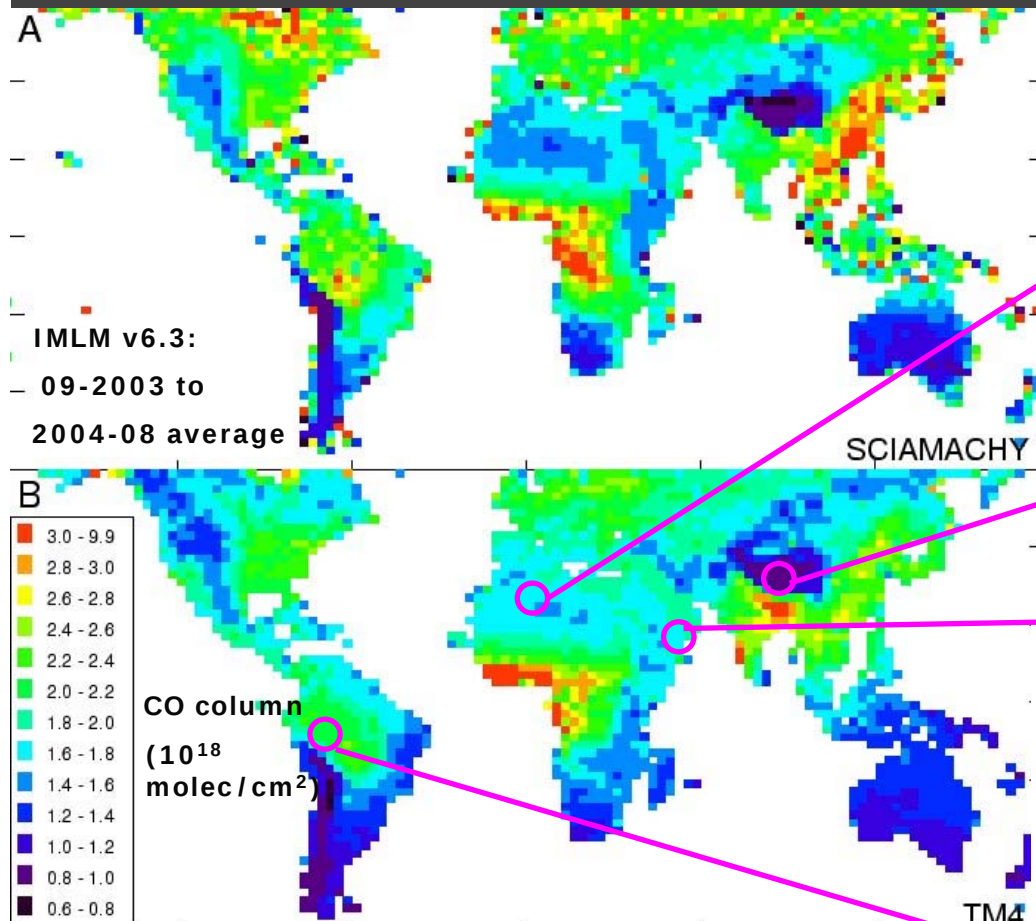


Evaluation SCIAMACHY CO quality

1. Ground-based stations:
 - No global coverage
 - Some on top of mountains: large SCIAMACHY foot print also includes CO at lower altitudes
 - Others at low surface albedo locations: low SCIAMACHY CO precision
2. Other satellite measurements:
 - Global coverage, but thermal infrared: less sensitive to boundary layer
3. Well-validated models useful for first evaluation of seasonality of SCIAMACHY CO on monthly to yearly time scales



Comparison with models: TM4



De Laat et al. 2006
(GRL, Vol 33, No. 7,
L07807)

Model sampled at SCIA overpasses, 2°x3° boxes

SRON

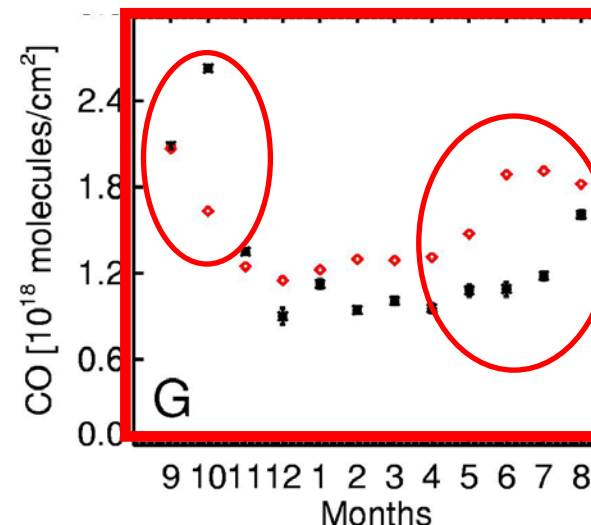
No ocean data considered yet, and only cloud-free (<20%) observations

SCIAMACHY versus model CO

model shortcomings in
Biomass Burning Emissions

Confirmed by MODIS fire counts

Southern Africa (Angola)



SCIAMACHY
TM4 model

De Laat et al. 2006 (GRL, Vol 33, No. 7, L07807)

Solution: replace climatological biomass burning emissions (Hao et al.) with satellite-based monthly updated BB emissions (GFEDv2, van der Werf et al., 2006)

New GFEDv2 biomass-burning emission data

- Quantification BB emissions using remote sensing: burned area, vegetation characteristics
- Use satellite-based observations of fire counts:

MODIS, (A)ATSR & TRMM VIRS

MODIS

1997

1998

1999

2000

2001

2002

2003

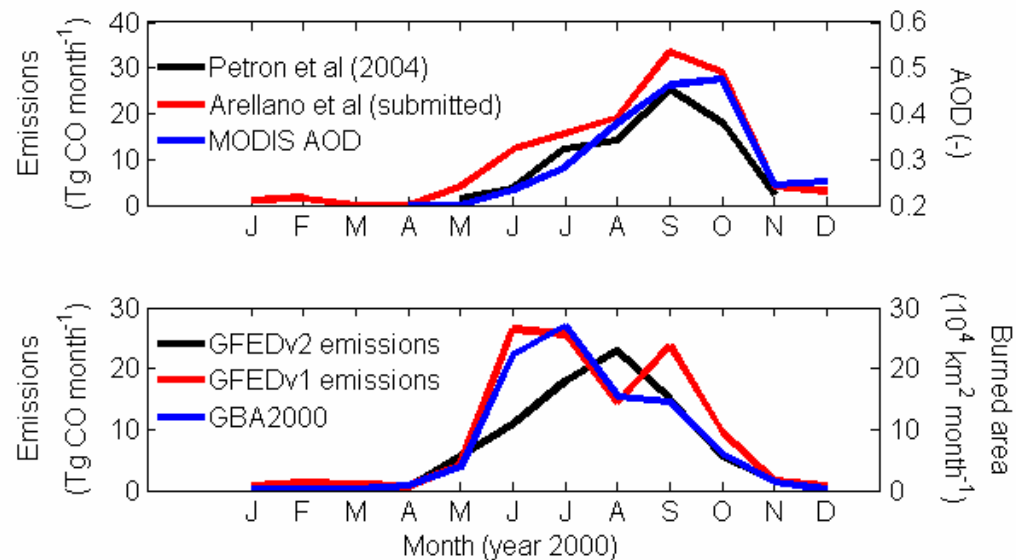
2004

TRMM VIRS

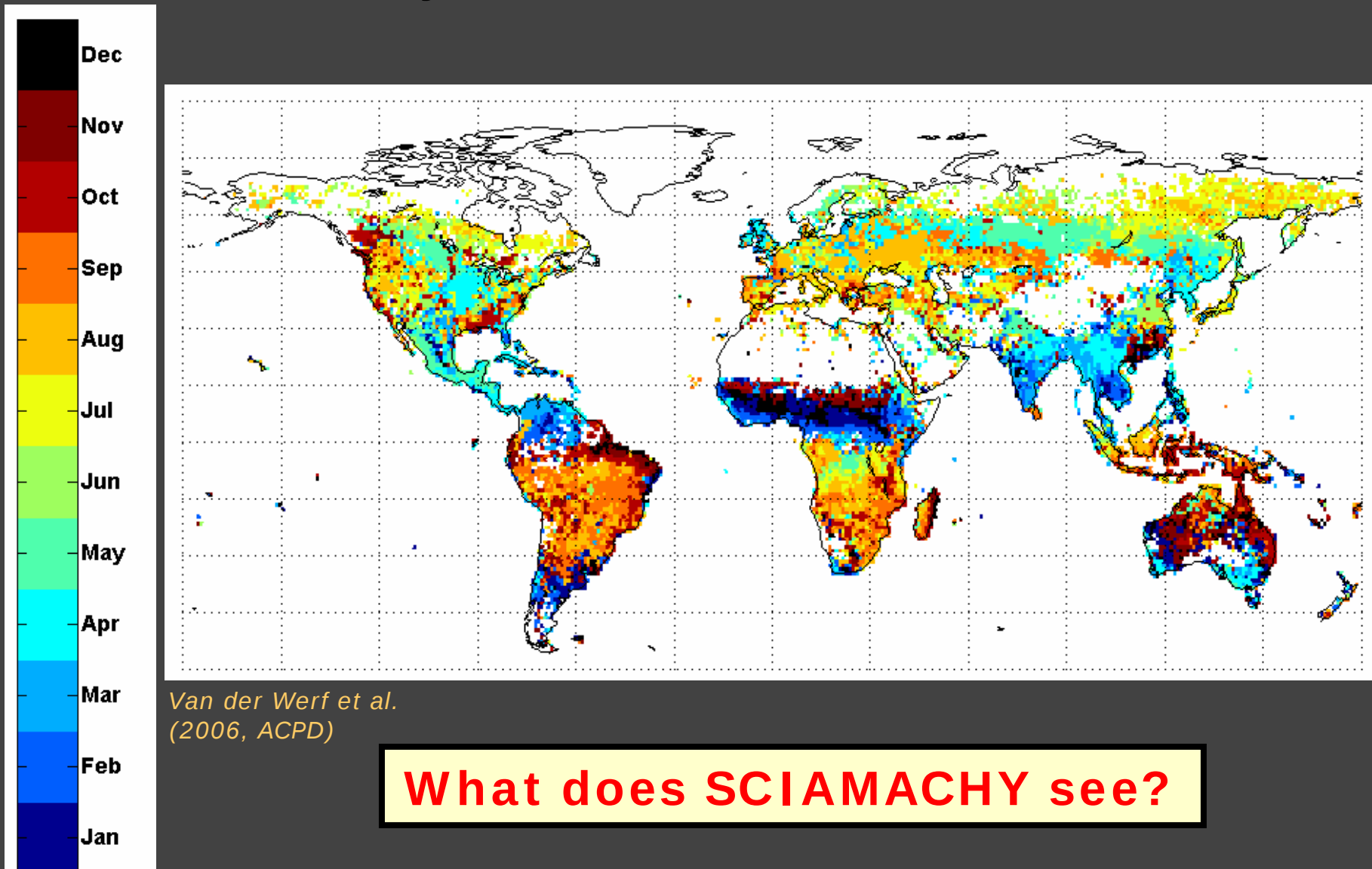
(A)ATSR

- Seasonality GFEDv2 in agreement with other BB estimates
- Absolute values may be too low

Van der Werf et al.
(2006, ACPD)



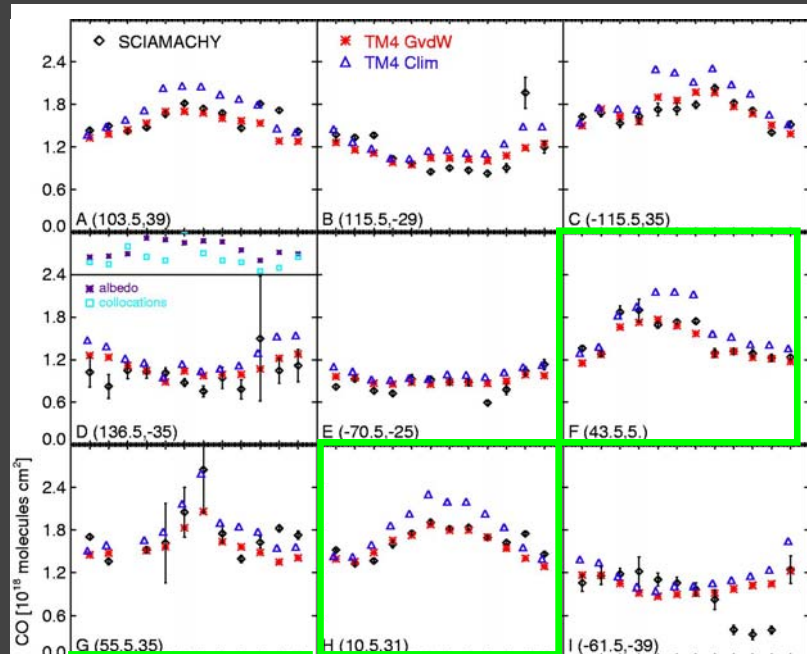
BB Seasonality of GFEDv2 emissions



What does SCIAMACHY see?

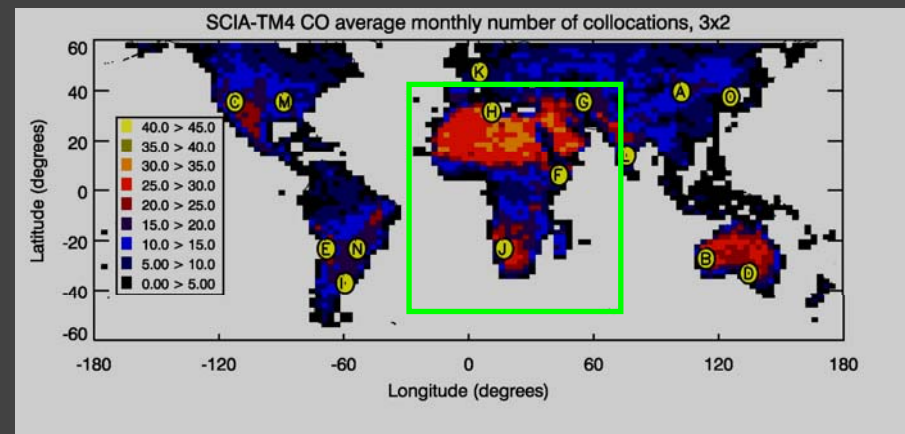
Replacing climatological biomass burning emissions (Hao et al.) with GFEDv2 data base (van der Werf et al., 2006)

Comparison improves significantly
~30% (preliminary results)

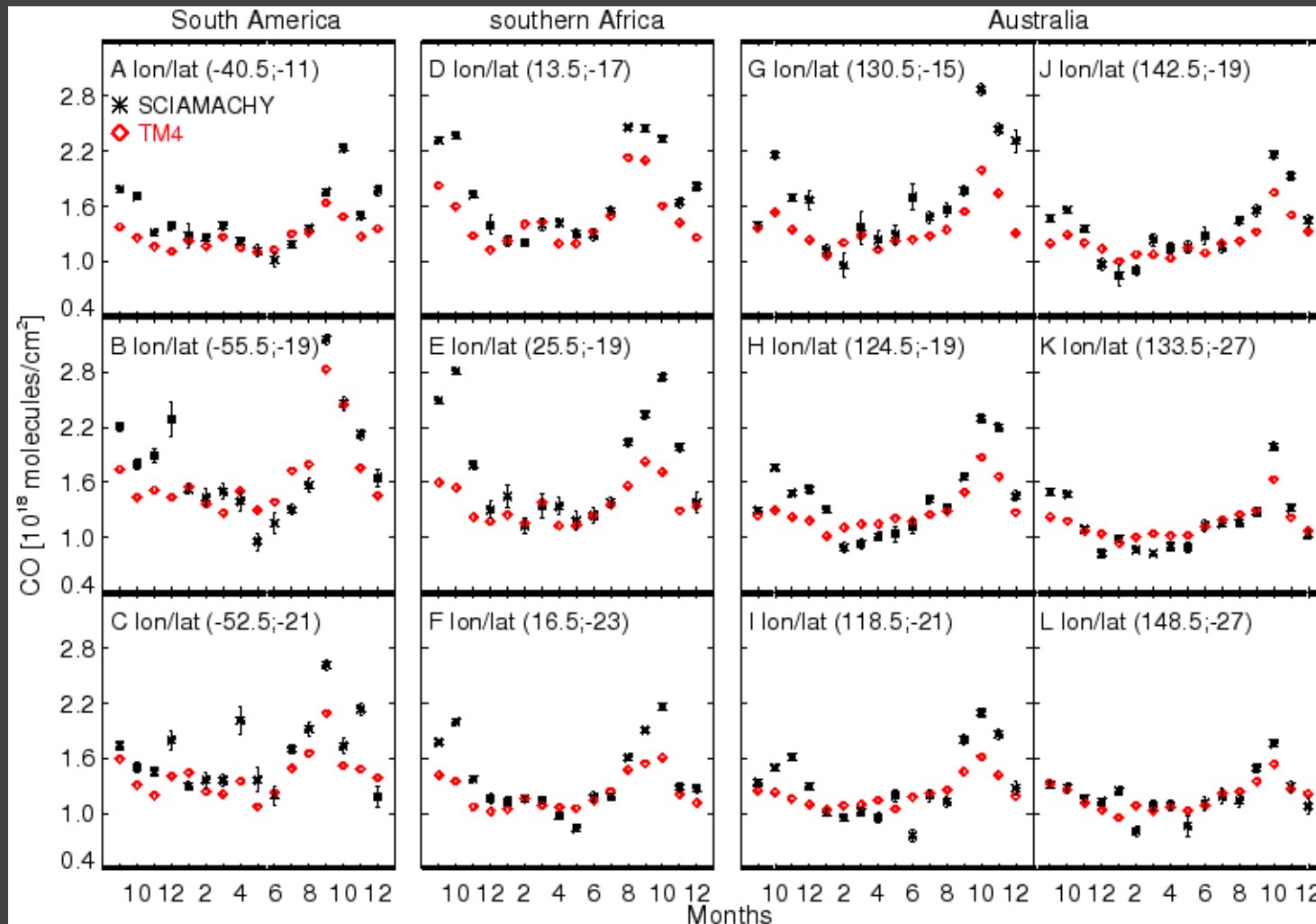


Months: Sept 2003 – Aug 2004

TM4 Climatology
TM4 GFEDv2 BB emissions



SCIAMACHY CO over biomass-burning regions



SCIA & model agree well outside BB season: average difference <5%

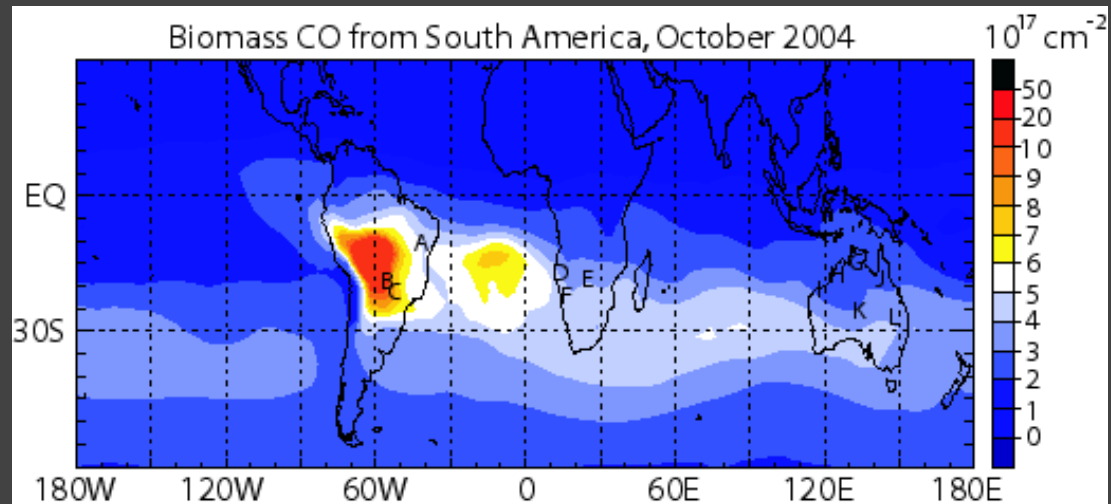
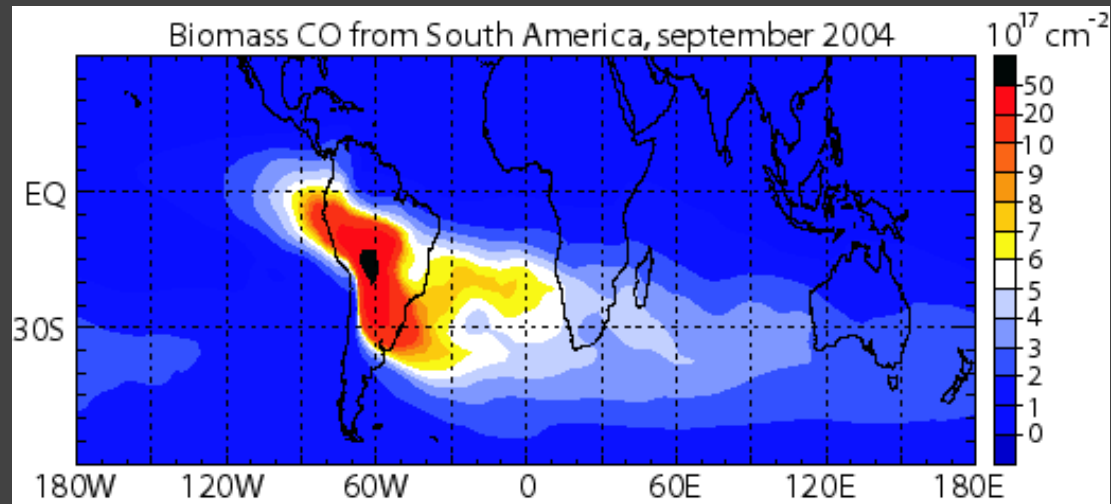
During BB season SCIA generally higher than model

GFEDv2 emissions probably still too low

SCIAMACHY
TM4 GFEDv2 BB emissions

Gludemans et al. (2006, submitted)

Transport of biomass-burning CO



Main conclusions

- Resolved ice-layer (& radiation damage) calibration issues
- Instrument noise error good first indication of overall error
- Monthly mean SCIAMACHY CO provides useful data for science
- New GFEDv2 BB emission data base major improvement over climatological BB emissions
- SCIAMACHY CO agrees well with model simulations including GFEDv2 emissions
- Indication that GFEDv2 BB emissions may still be too low
- Data available for use : 2003 - 2004



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SCIAMACHY products

all SCIA products *)

O3	NO2
BrO	SO2
HCHO	OCIO
H2O	CO
CH4	N2O
CO2	T/p
cloud/PSC	
aerosol	
UV	
spectra	

all CO products

product	made by **)	period	maturity i			validation i
CO vertical column	SRON Utrecht	Jan 2003 to Dec 2004	AD	PSD	Avail	
	IUP Heidelberg	Jan 2003 to Dec 2004	AD	PSD	Avail	
	IFE/IUP Bremen	Jan 2003 to Dec 2003	AD	PSD	Avail	

2003-2004 data available

contact : a.gloudemans@sron.nl

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available data	Ja o c
point of contact	Annemieke Gloudemans
algorithm description	The algorithm is described in the Algorithm Document .
product details	All details can be found in the Product Specification Document .
validation results	Validation of this product is described by Dils et al., Atmos. Chem. Phys. Discussions, 2005 , Straume et al., Adv. in Space Research, 2005 , and Gloudemans et al., Proc. of the ACVE-2 workshop, 2004 .

*) Click on a product to get a list of all available data sets.

***) Click on an institute to get product details.

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Done