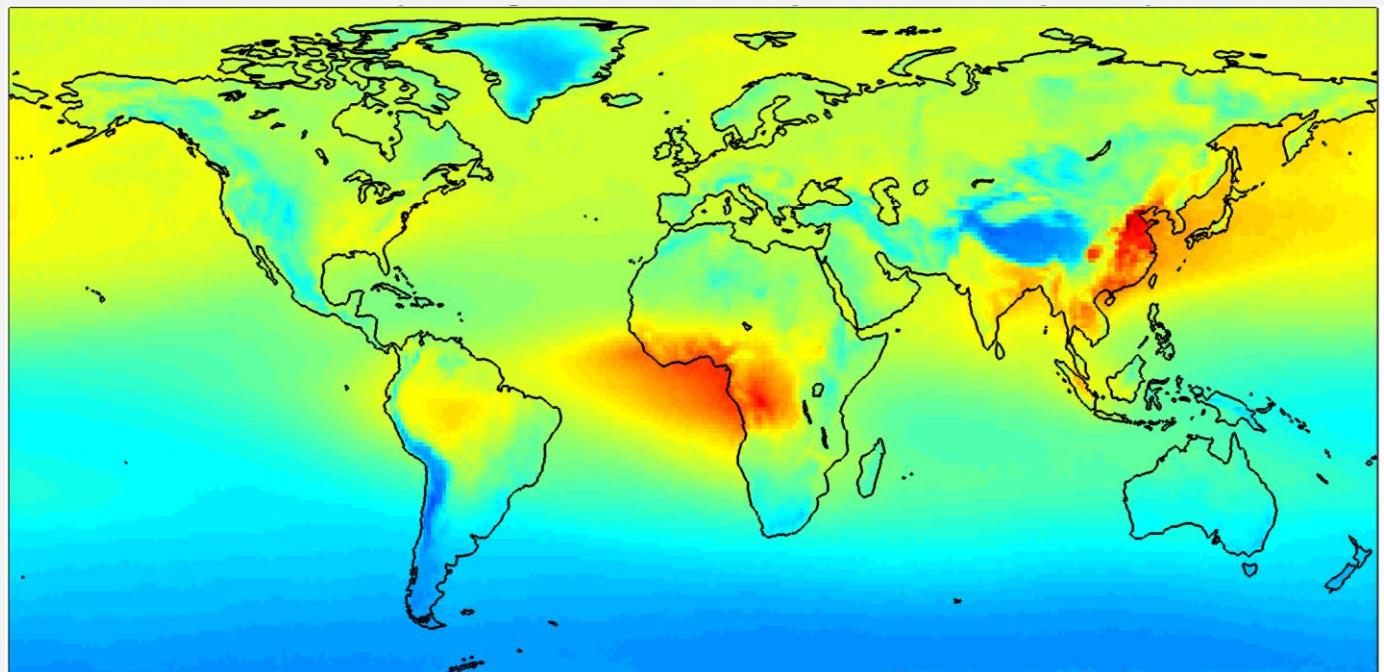


CO monitoring with IASI: global and local variability

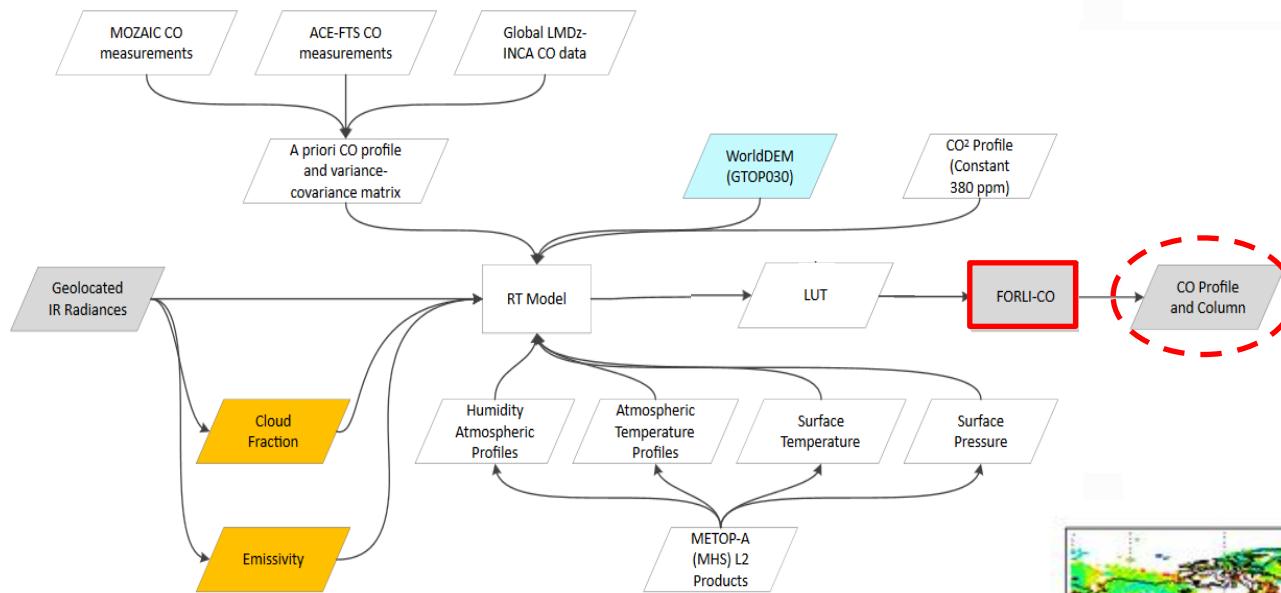


M. George¹

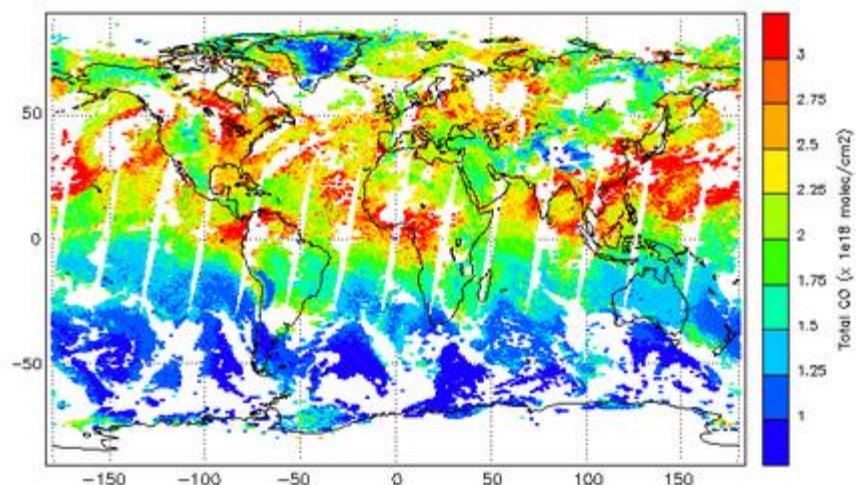
C. Clerbaux^{1,2}, J. Hadji-Lazaro¹, D. Hurtmans², S. Bauduin²,
S. Whitburn², I. Bouarar³, A. Inness⁴, and P.-F. Coheur²

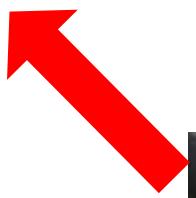
¹ LATMOS, ² ULB, ³ Max Planck Institute for Meteorology, ⁴ ECMWF



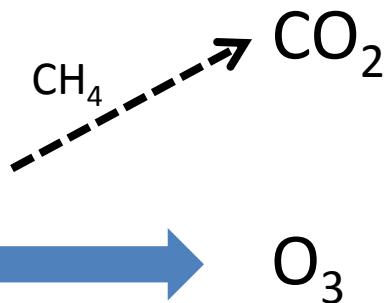


Daniel Hurtmans (ULB)
Fast Operational Retrievals on Layers for IASI
(Hurtmans et al., JQSRT 2012)



Sources:

+ Vegetation
+ Ocean

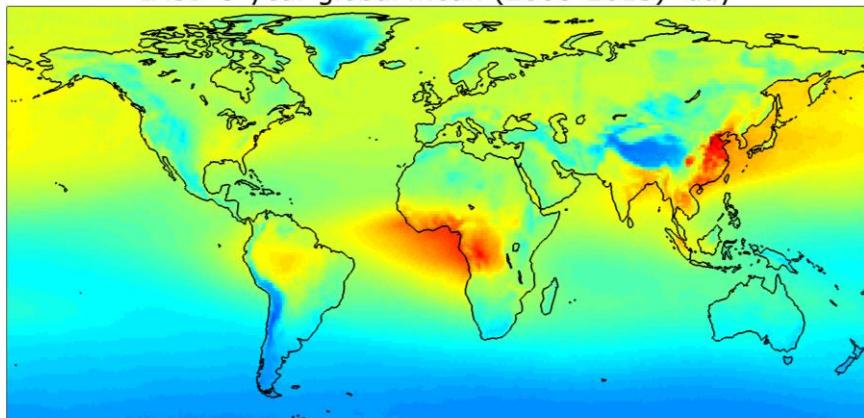
**Sinks:**

+ Deposition
+ Stratosphere loss

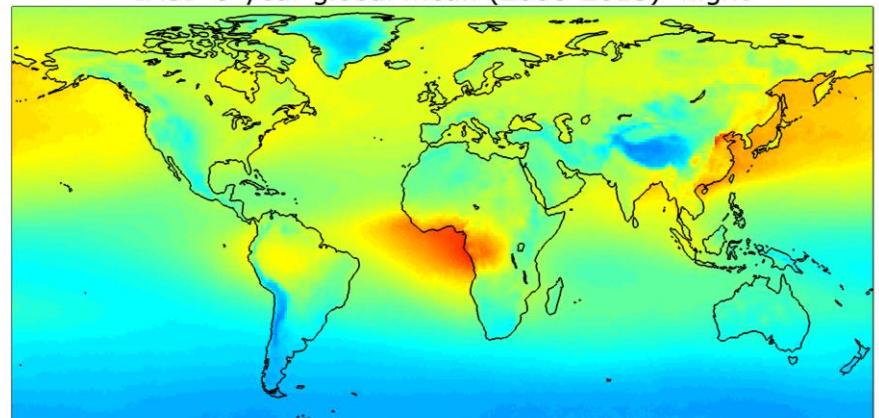


Lifetime: few weeks

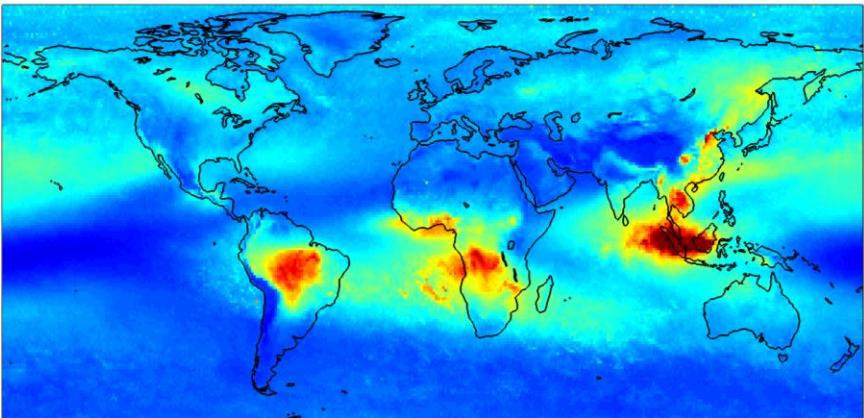
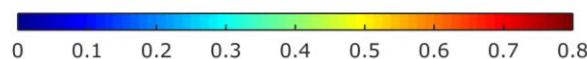
IASI 8-year global mean (2008-2015) day

CO total column $\times 10^{18}$ molecules/cm²

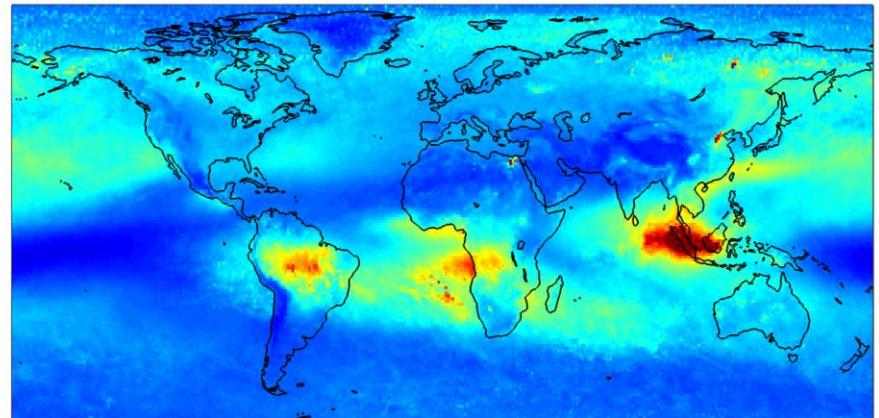
IASI 8-year global mean (2008-2015) night

CO total column $\times 10^{18}$ molecules/cm²

Associated standard deviation

 $\times 10^{18}$ molecules/cm²

Associated standard deviation

 $\times 10^{18}$ molecules/cm²

In Giens in 2013:

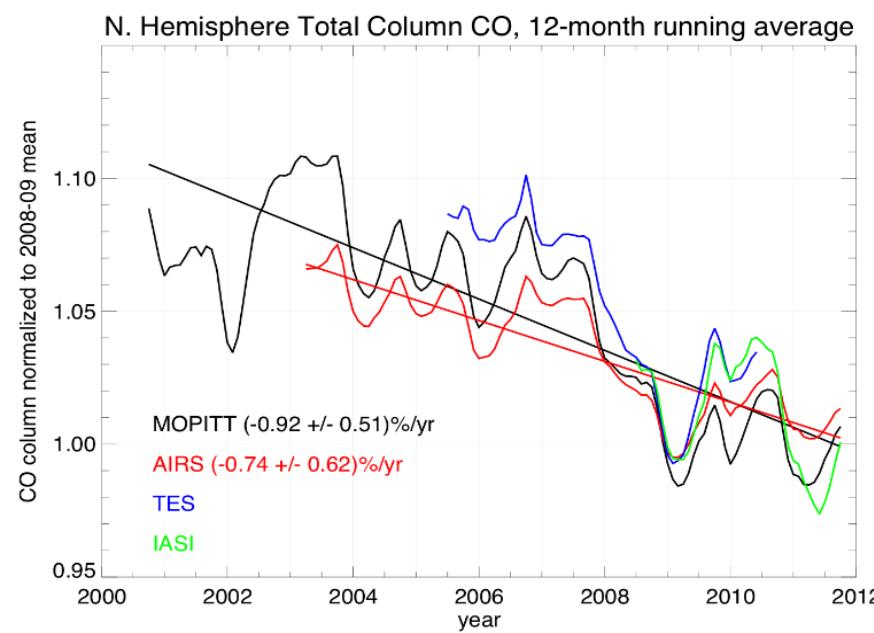
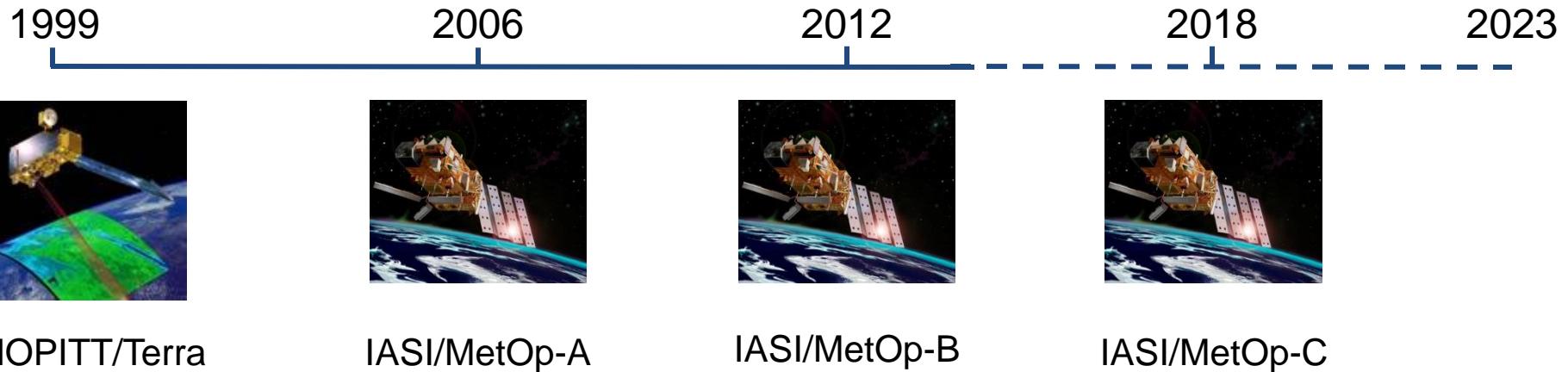
FORLI-CO data available from Ether data base

<http://www.pole-ether.fr> <http://www.aeris-data.fr>

more than ~~60~~ **120** registered users

Distributed by EUMETSAT in ~~2013~~ (profiles + AK) **O3M SAF**
Since September 2015

See Juliette Hadji-Lazaro's poster S4-50



Worden et al., ACP 2013

- IASI - MOPITT v5T comparisons:

- * a priori assumptions
- * IASI L2 v5 > v6

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www.atmos-meas-tech.net/8/4313/2015/
doi:10.5194/amt-8-4313-2015
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Atmospheric Measurement Techniques
Open Access

An examination of the long-term CO records from MOPITT and IASI: comparison of retrieval methodology

M. George¹, C. Clerbaux^{1,2}, I. Bouarar³, P.-F. Coheur², M. N. Deeter⁴, D. P. Edwards⁴, G. Francis⁴, J. C. Gille⁴, J. Hadji-Lazaro¹, D. Hurtman², A. Inness⁵, D. Mao⁴, and H. M. Worden⁴

¹Sorbonne Universités, UPMC Univ. Paris 06, Université Versailles St-Quentin, CNRS/INSU, LATMOS-IPSL, Paris, France

²Spectroscopie de l'Atmosphère, Chimie Quantique et Photophysique,

Université Libre de Bruxelles (U.L.B.), Brussels, Belgium

³Max Planck Institute for Meteorology, Hamburg, Germany

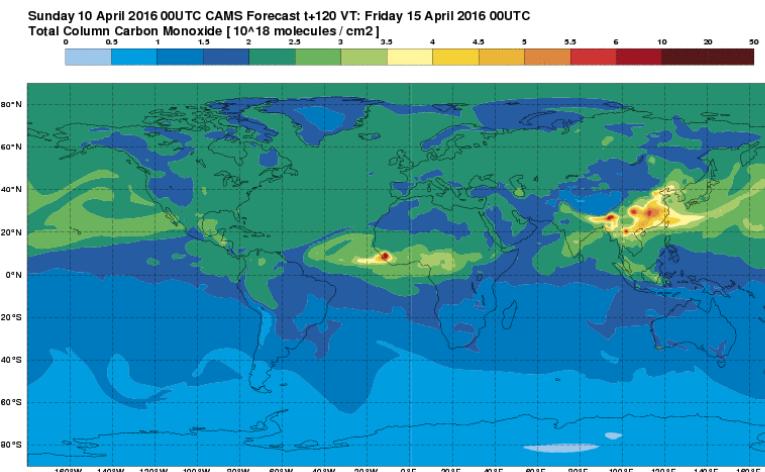
⁴Atmospheric Chemistry Observations and Modeling, National Center for Atmospheric Research, Boulder, CO, USA

⁵European Centre for Medium-Range Weather Forecasts, Reading, UK

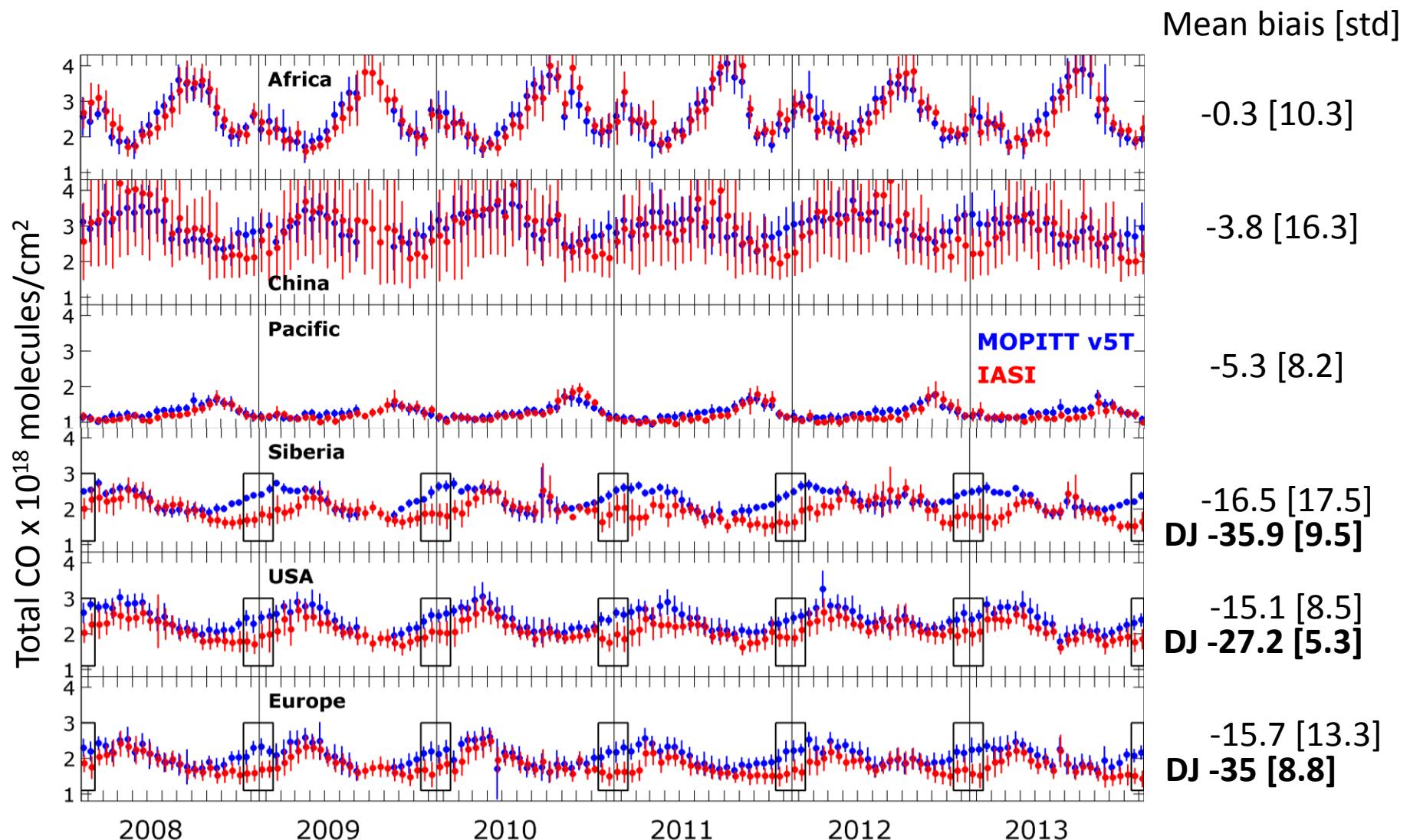
- Perspective:

Preliminary work: Fires in Indonesia (2015)

Assimilation in the CAMS project



http://www.gmes-atmosphere.eu/d/services/gac/nrt/nrt_fields/



**MOPITT:**

Gaz correlation radiometer

2 spectral channels for CO (4.8 and 2.3 μm)

10h30 (Equator crossing time)

IASI:

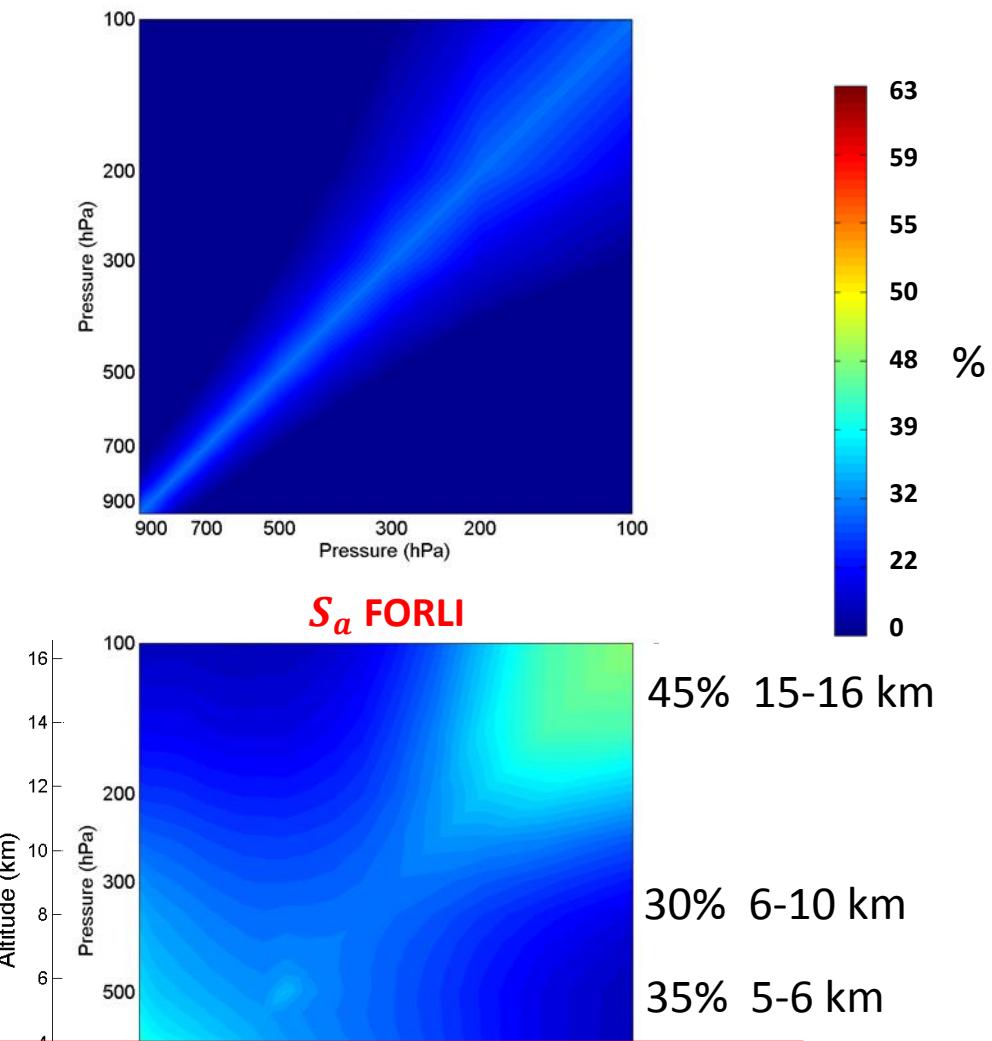
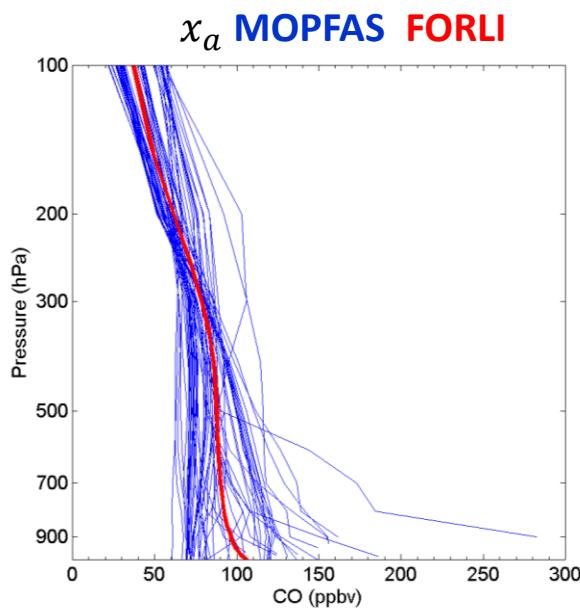
Fourier transform spectrometer

154 spectral channels for CO

9h30 (Equator crossing time)

The two retrieval algorithms (MOPFAS et FORLI) are based on the optimal estimation method (Rodgers, 2000).

	MOPFAS	FORLI
<i>A priori</i> profile and variance-covariance matrix	variables	single
Temperature and H ₂ O profiles	NCEP	IASI L2
Cloud filters	MOPITT/MODIS	IASI L2
Emissivity	NCEP	Zhou et al. (2011)

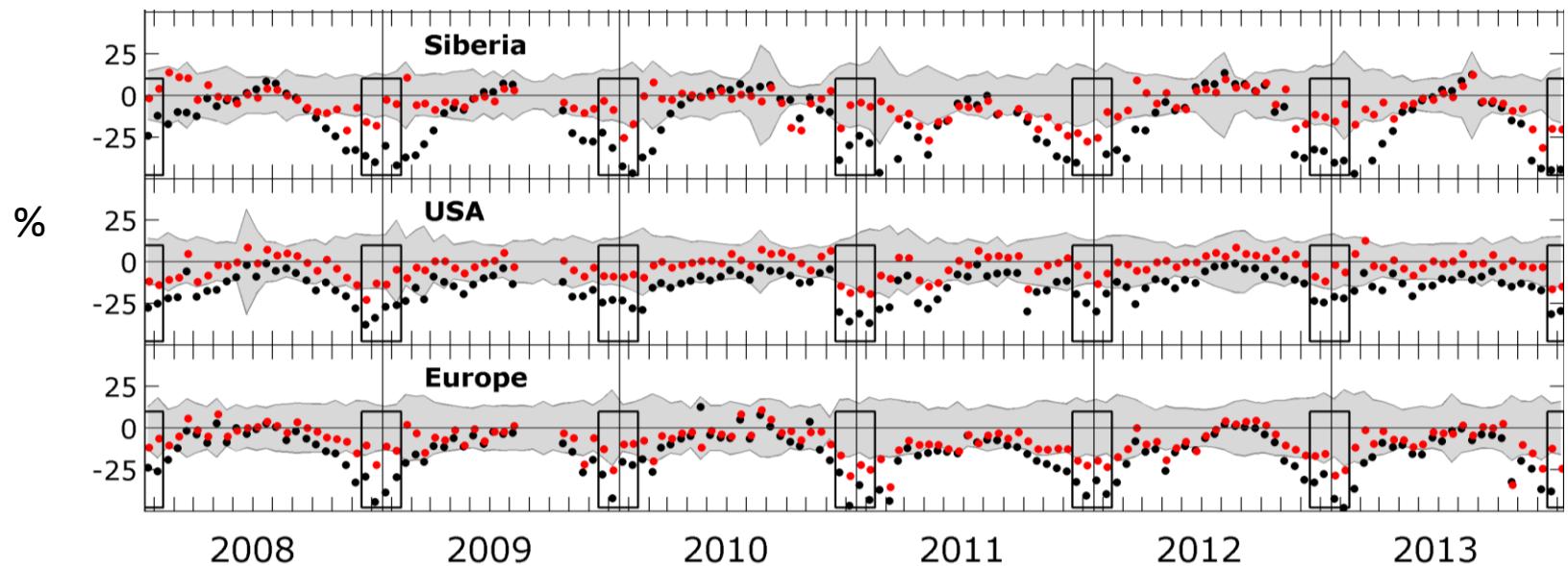


Collaboration with NCAR (National Center for Atmospheric Research)
MOPITT vX1: MOPITT with *a priori* assumptions from IASI

100*(IASI-MOPITT_v5T)/IASI
100*(IASI-MOPITT_vX1)/IASI



Variability of IASI total
column means



January-December:

Siberia: -35.9% [9.5] **-12.6% [8.7]**

USA: -27.2% [5.3] **-11.4% [5.3]**

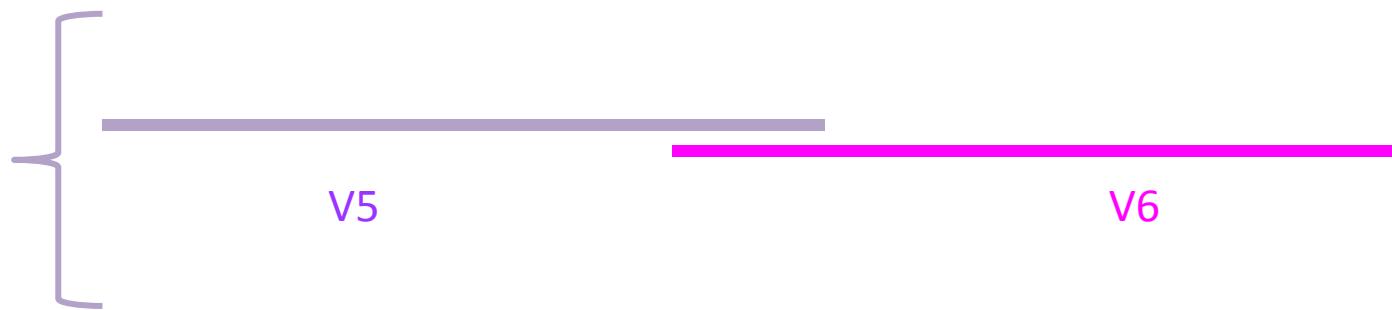
Europe: -35% [8.8] **-18.1% [6.7]**

September 2014

FORLI CO v20100815

FORLI CO v20140922

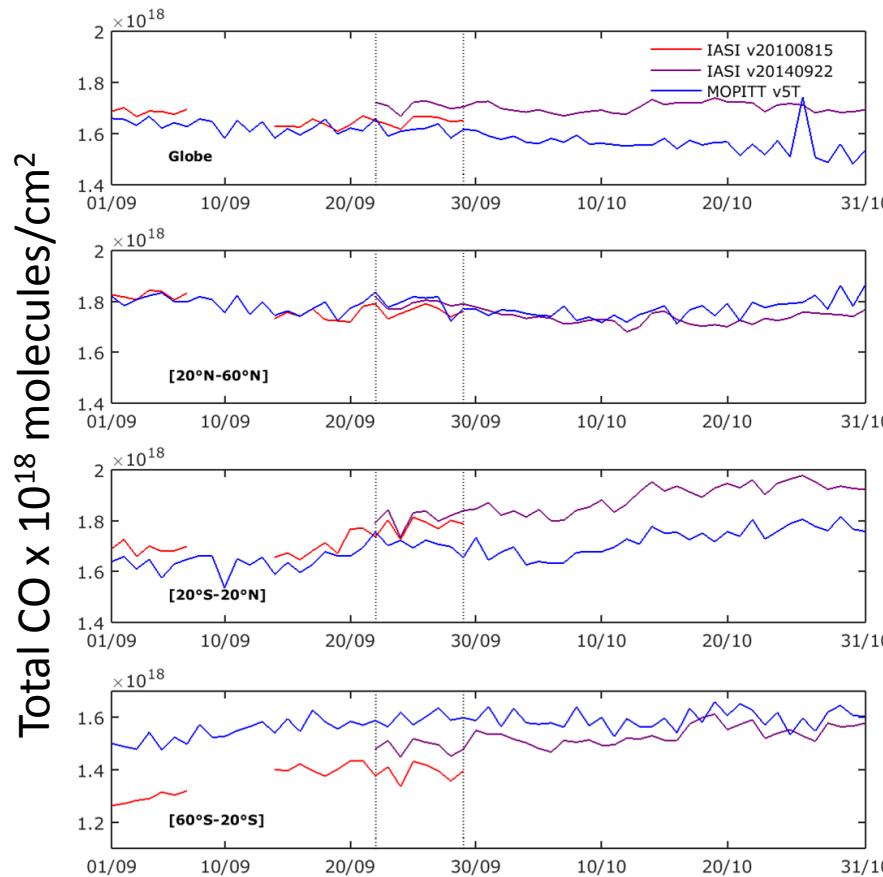
Changes in
EUMETSAT
Temperature,
Humidity,
Clouds
(IASI L2)



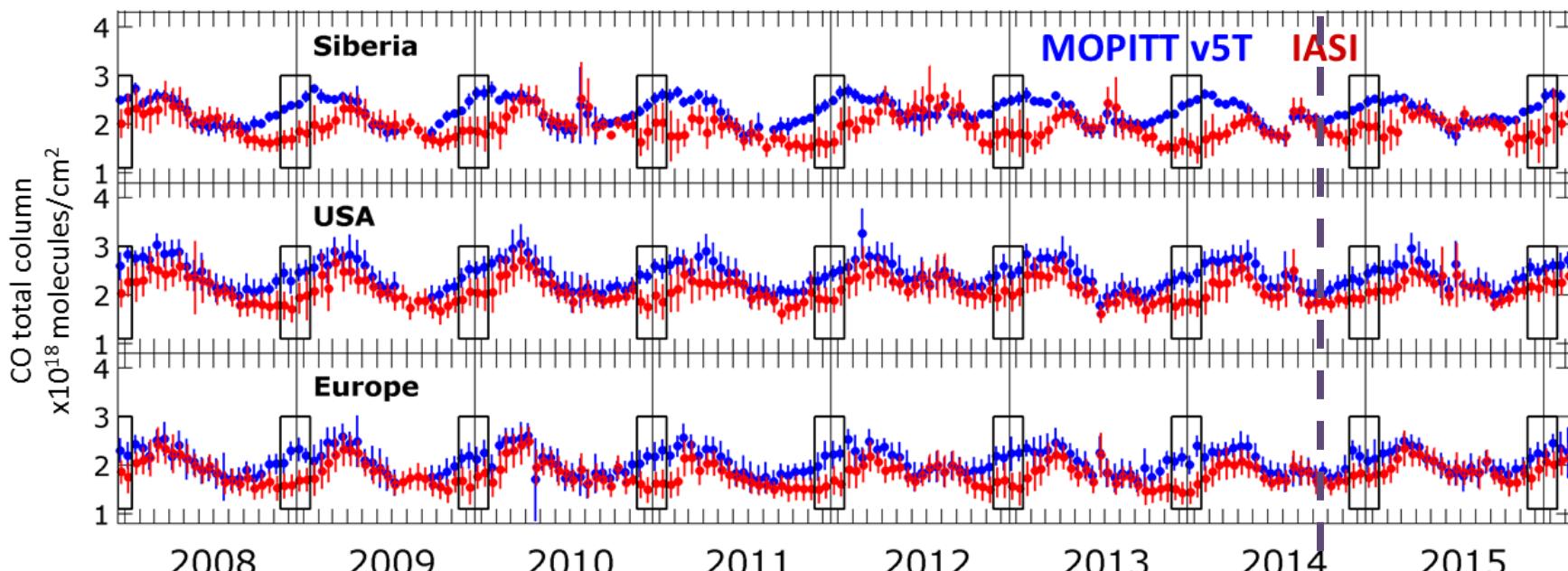
v5

v6

Differences between FORLI v20100815 (L2V5) and FORLI v20140922 (L2V6)



On average, for 8 days in September 2014, IASI v20100815 (IASI L2 V5) total columns are smaller than IASI v20140922 (IASI L2 V6). The relative differences are the smallest in the Northern Hemisphere ($20^{\circ}\text{N}-60^{\circ}\text{N}$) with **1.4%** and the largest in the Southern Hemisphere ($20^{\circ}\text{S}-60^{\circ}\text{S}$) with **4.2%**. On a globe scale, the relative difference is **2.9%** (V6>V5).



IASI L2 V5 > IASI L2 V6

															v20140922					
2008-2009		2009-2010		2010-2011		2011-2012		2012-2013		2013-2014		2014-2015		2015-2016						
J-D		J-D		J-D		J-D		J-D		J-D		J-D		J-D						
bias	std	bias	std	bias	std	bias	std	bias	std	bias	std	bias	std	bias	std					
Siberia	-37,2	5,1	-35,8	11	-30,4	6	-44,6	8,3	-36,4	4	-53,3	11,8	-24,3	4,4	-32,4	9,3				
USA	-31	5,5	-24,5	2,3	-33,5	3,4	-23,2	5,1	-22,6	1,6	-30,2	4,2	-20,4	1,7	-15,9	2,9				
Europe	-35,5	7,4	-28,2	9,9	-37,7	9	-36	4,9	-37,8	9,3	-44,7	6,8	-21,7	5,2	-17,7	7,1				

=> Thomas

=> David

Conclusions:

IASI - MOPITT v5T comparisons

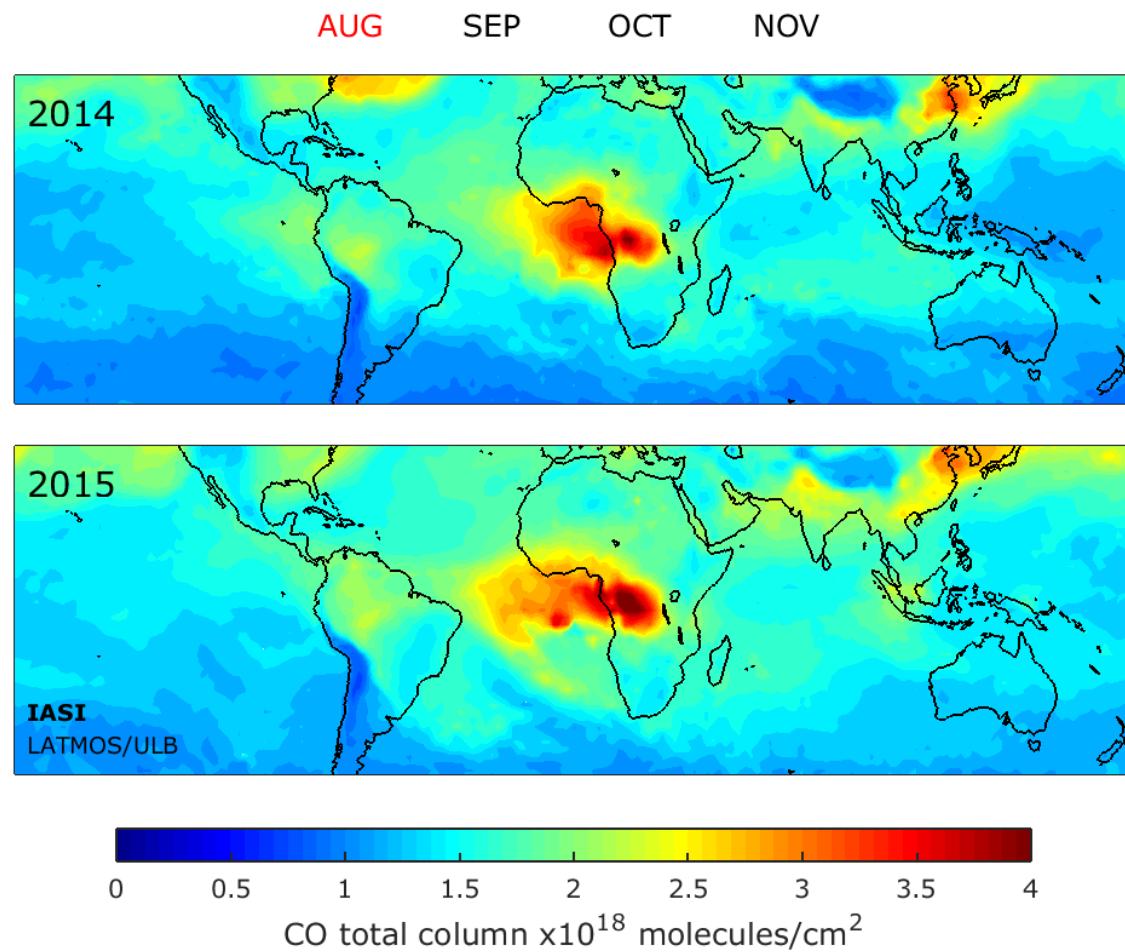
For Europe, Siberia and USA

=> Biases can be reduced when using the same *a priori*

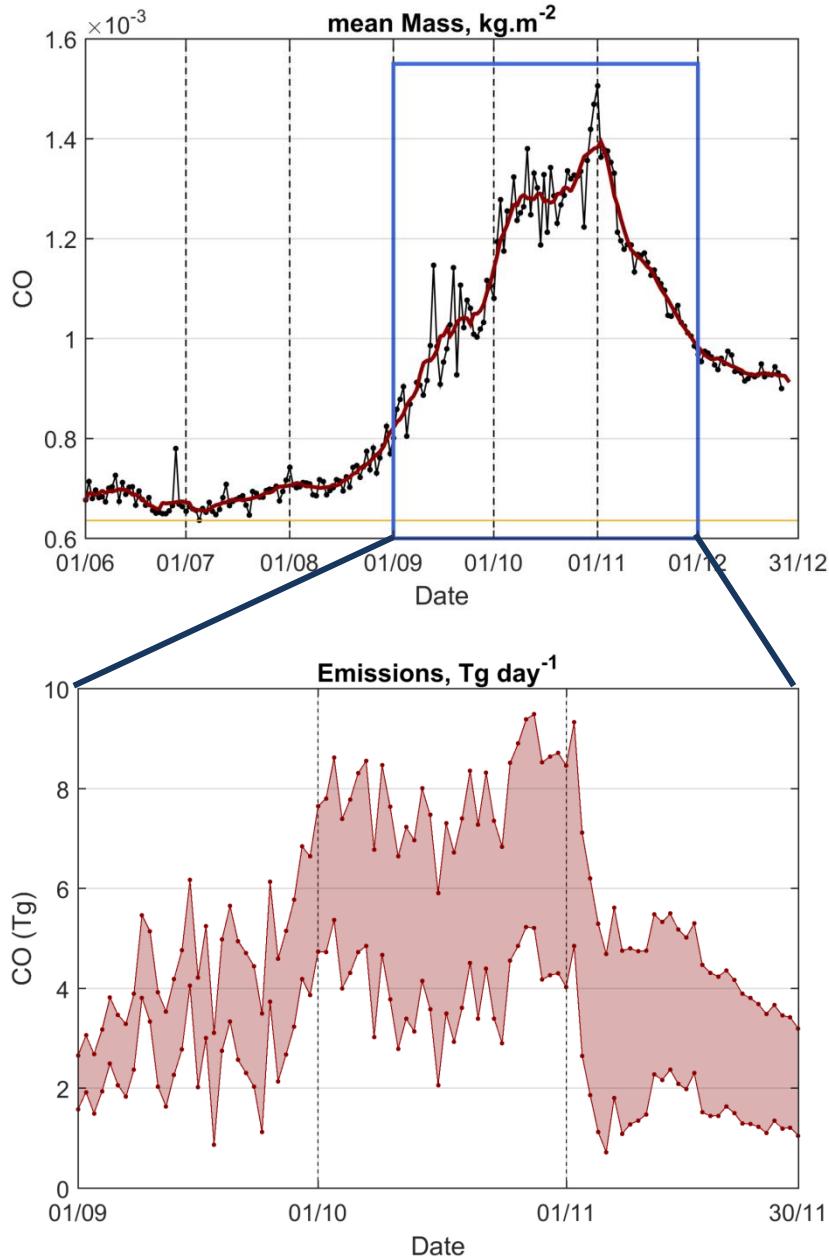
=> Biases can be reduced when improving IASI L2

Perspectives:





Courtesy Simon Whitburn (ULB) (See
Simon's poster S3-44)



1) Daily observed total CO masses

$$TM_X = \frac{M_X C_X S}{N_a},$$

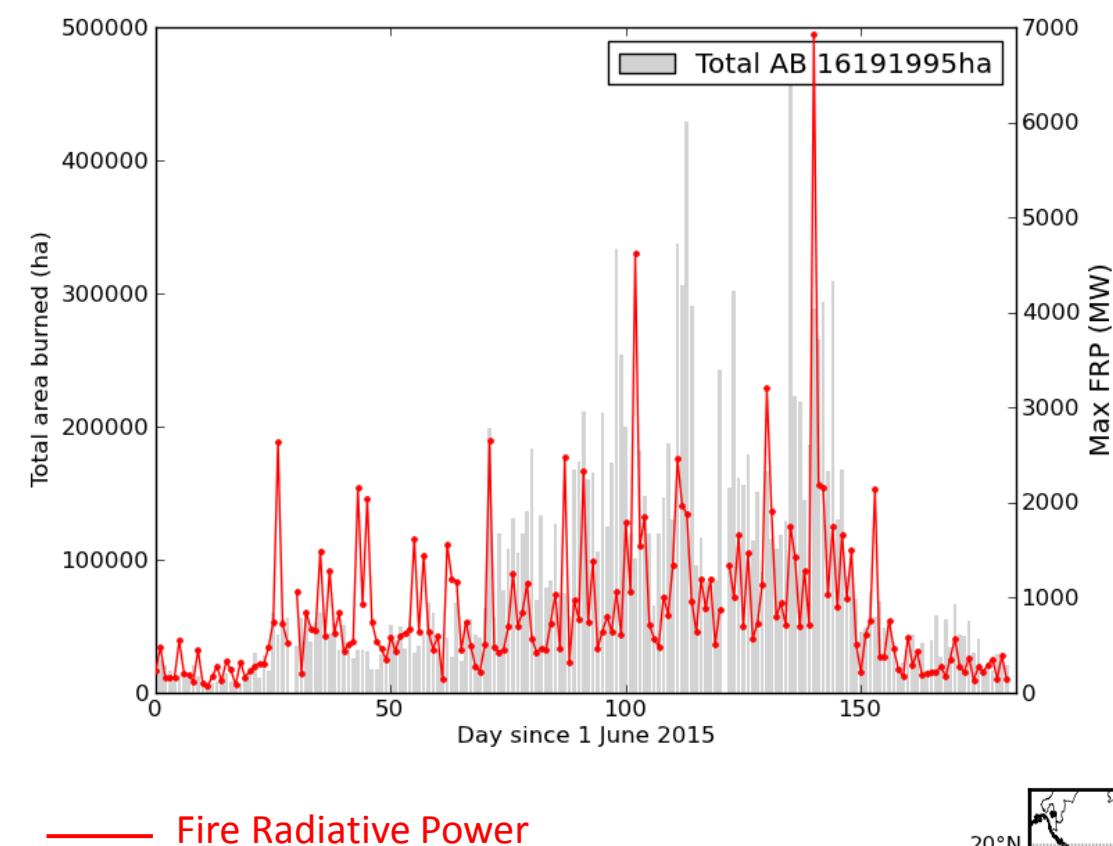
where M_X is the molar mass of X (in g mol⁻¹), C_X is the mean column retrieved from IASI daytime observations (in molec cm⁻²), N_a is the Avogadro number and S represents a defined surface area.

2) Mean Burden= smoothed total mass - background (Yurganov 2011)

3) Emission fluxes assuming a simple box model and first order loss terms (Jacob 1999) using two values of τ_{eff} —namely, 7 and 15 days.

$$E_{i+1}(X) = \frac{B_{i+1} - B_i e^{-t/\tau_{\text{eff}}}}{\tau_{\text{eff}}(1 - e^{-t/\tau_{\text{eff}}})}. \quad (3)$$

Here, E_i and B_i are respectively the flux and the burden on day i , t is time between two observations (here one day) and τ_{eff} is the effective lifetime of the species X. This lifetime term includes chemical losses, but also losses due to transport outside the considered area.



Courtesy Solène Turquety (LMD)

based on the area burned
calculated using MODIS data.

The area burned is therefore
multiplied by fuel loads and
emission factors characteristic
of the vegetation type burned
(MODIS classifications)

Work in progress...
M. Krol (University of Utrecht)

