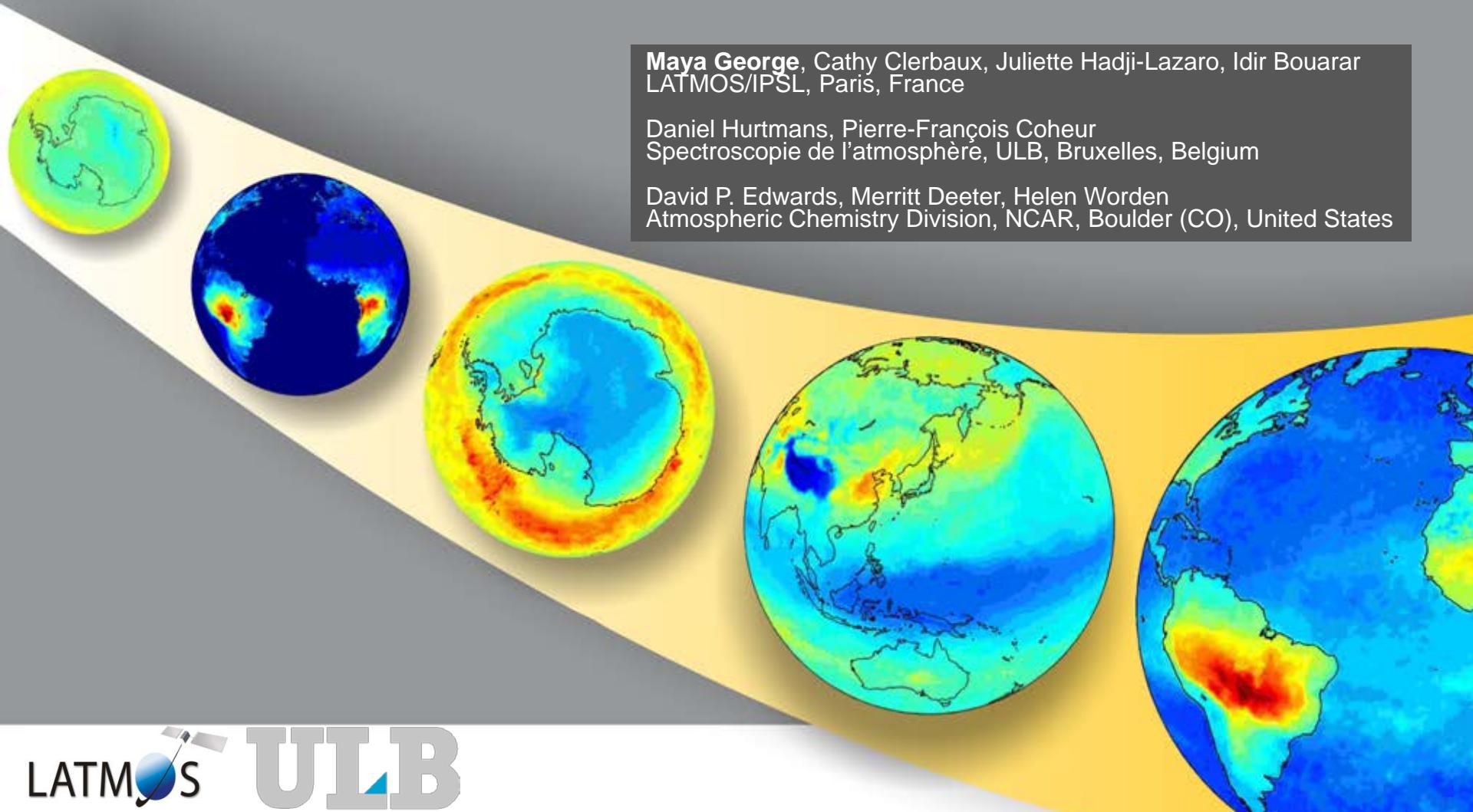


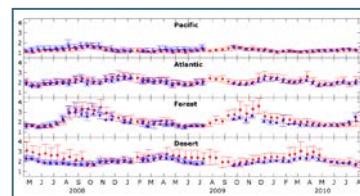
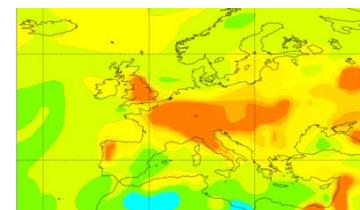
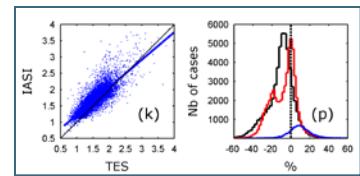
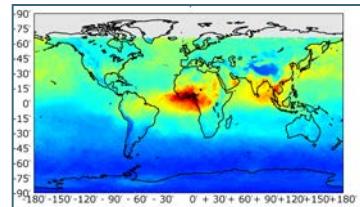
Monitoring of atmospheric composition with IASI and MOPIIT: CO distributions and variability

Maya George, Cathy Clerbaux, Juliette Hadji-Lazaro, Idir Bouarar
LATMOS/IPSL, Paris, France

Daniel Hurtmans, Pierre-François Coheur
Spectroscopie de l'atmosphère, ULB, Bruxelles, Belgium

David P. Edwards, Merritt Deeter, Helen Worden
Atmospheric Chemistry Division, NCAR, Boulder (CO), United States





Carbon monoxide (CO)

- FORLI-CO
 - Validated product
 - Operational application (MACC)
- IASI / MOPITT: five year comparison
 - Variability over different regions
 - The MOPITT algorithm with the FORLI *a priori*

CO total column / CO near the surface

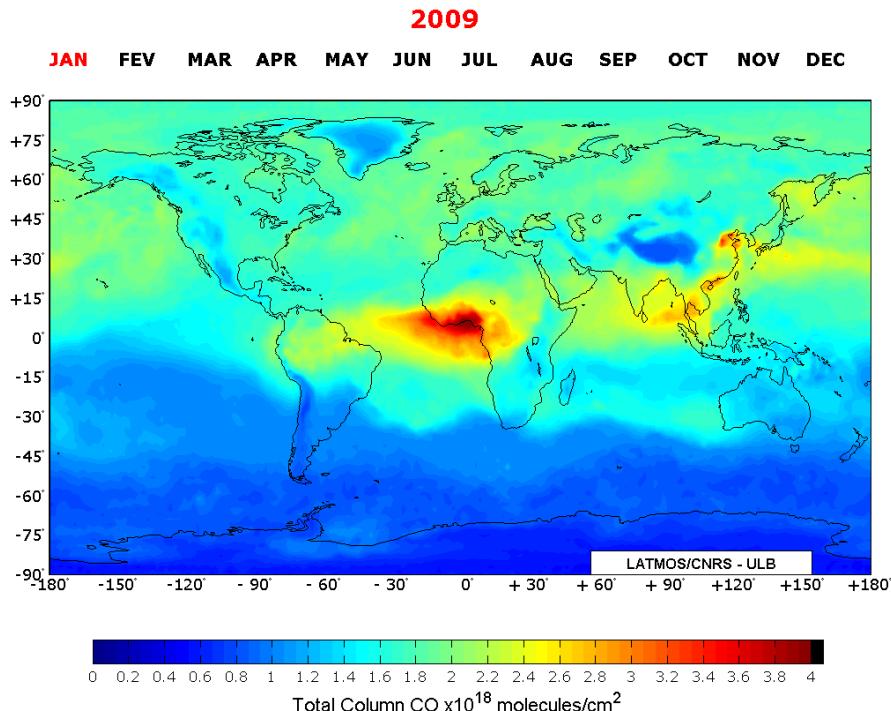
FORLI: Fast Operational Retrievals on Layers for IASI

Hurtmans et al., 2012

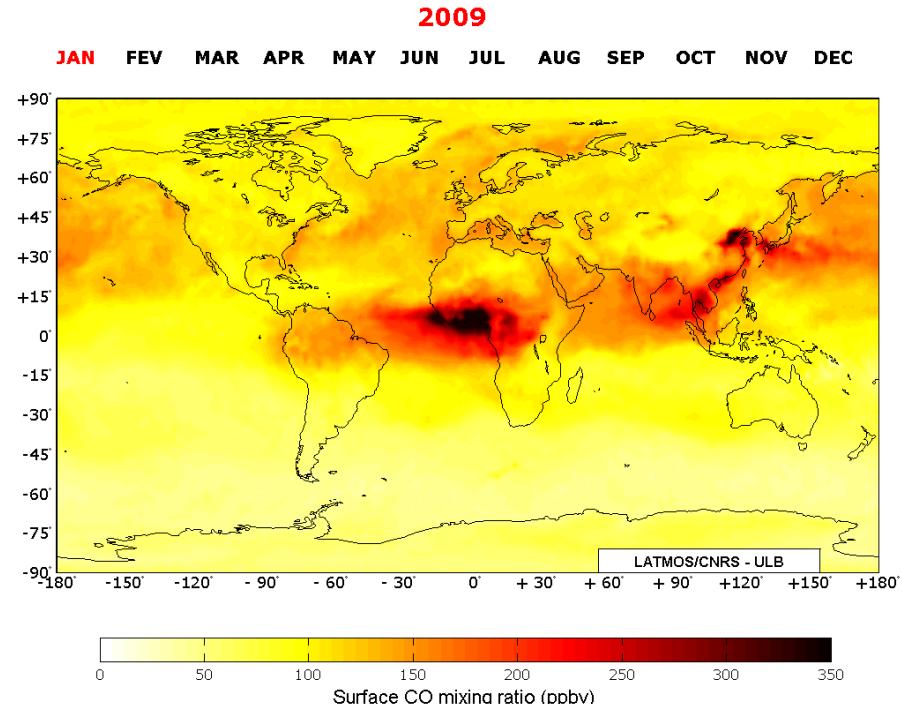
Optimal Estimation Method (OEM), Rodgers 2000.

CO profiles + AK

CO total column



CO 1st layer



Satellites	<p>George et al.: Carbon monoxide distributions from the IASI/METOP mission: evaluation with other space-borne remote sensors ACP 2009</p> <p>August et al.: IASI on Metop-A: Operational Level 2 retrievals after five years in orbit JQSRT 2012</p>	<p>IASI /MOPITT /AIRS /TES</p> <p>IASI /IASI</p>
Ground-based	<p>Kerzenmacher et al.: Validation of IASI FORLI carbon monoxide retrievals using FTIR data from NDACC AMT 2012</p>	
Aircraft	<p>De Wachter et al.: Retrieval of MetOp-A/IASI CO profiles and validation with MOZAIC data AMT 2012</p> <p>Pommier et al.: IASI carbon monoxide validation over the Arctic during POLARCAT spring and summer campaigns ACP 2010</p>	

Decadal record of satellite carbon monoxide observations
Worden et al., ACP, 2013

Assimilation of IASI satellite CO fields into a global chemistry transport model for validation against aircraft measurements
Klonecki et al., ACP, 2012

Carbon monoxide urban emission monitoring: A ground-based FTIR case study
Té et al., J. Atmos. Oceanic Technol., 2012.

The MACC reanalysis: an 8-yr data set of atmospheric composition
Inness et al., ACPD, 2012

How much CO was emitted by the 2010 fires around Moscow?
Krol et al., ACPD, 2012

Top-down estimation of carbon monoxide emissions from the Mexico Megacity based on FTIR measurements from ground and space
Stremme et al., ACPD, 2012

Satellite- and ground-based CO total column observations over 2010 Russian fires: accuracy of top-down estimates based on thermal IR satellite Data
Yurganov et al., ACP, 2011

Episodes of cross-polar transport in the Arctic troposphere during July 2008 as seen from models, satellite, and aircraft observations
Sodemann et al., ACP, 2011

See Juliette Hadji-Lazaro's poster (#87)

FORLI-CO data available from Ether data base

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

Ether Atmospheric Chemistry Data Centre

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Ether users Data/Services Ether organisation

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29 march 2013 : Ether users committee meeting
June 2013 : Summer School HighResMIR
June 2013 : ESA Symposium on European Rocket & Balloon Programmes
September 2013 : EUMETSAT meteorological satellite conference

Reprobus map for the TRO-pico campaign 380K [bam](#)

Atmospheric Data - Satellites - Balloons - NDACC - ECCAD - IASI - GOSAT - IAGOS

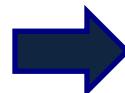
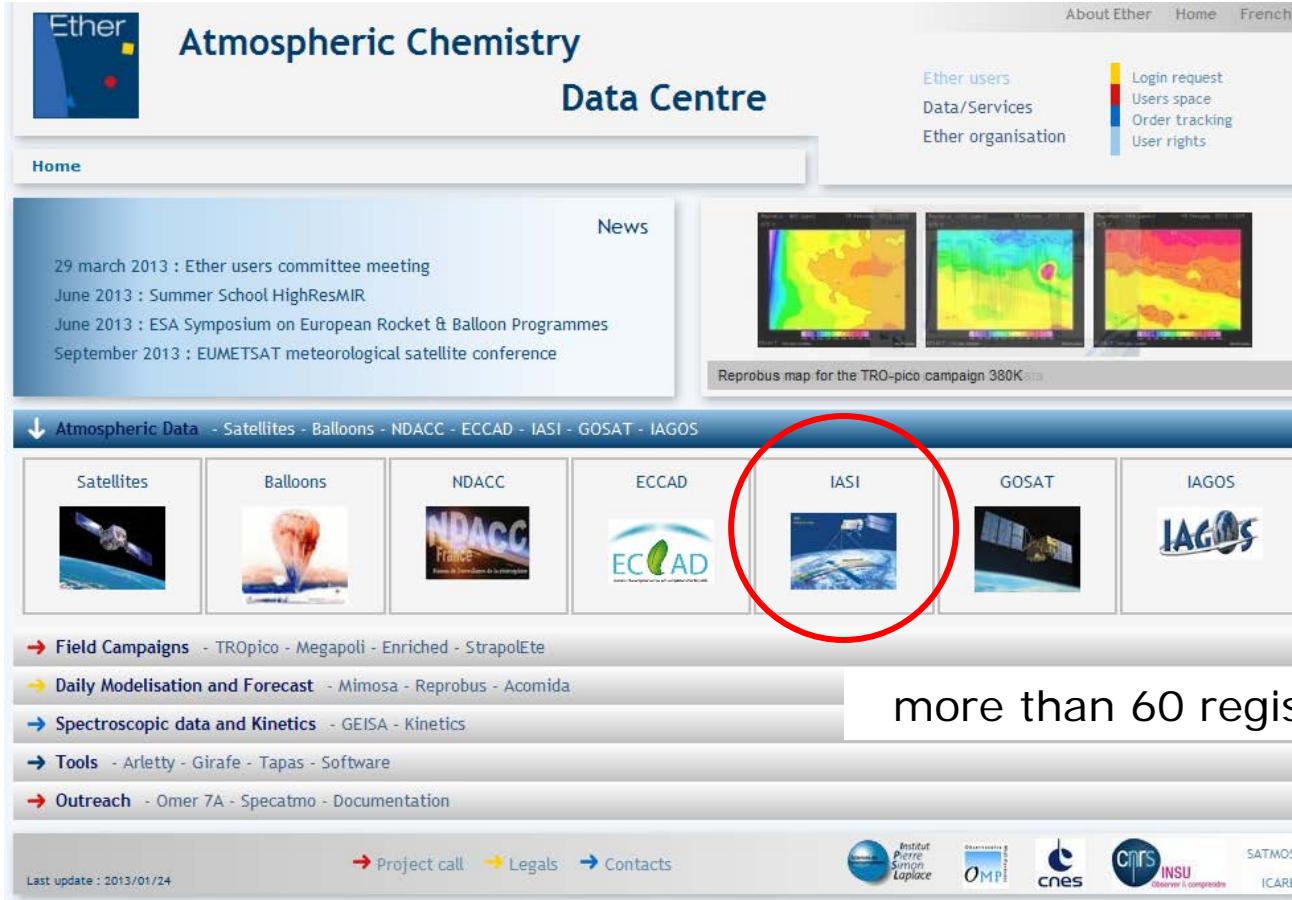
Satellites Balloons NDACC ECCAD IASI GOSAT IAGOS

Field Campaigns - TROpico - Megapoli - Enriched - StrapolEte
Daily Modelisation and Forecast - Mimosa - Reprobus - Acomida
Spectroscopic data and Kinetics - GEISA - Kinetics
Tools - Arletty - Girafe - Tapas - Software
Outreach - Omer 7A - Specatmo - Documentation

more than 60 registered users

Last update : 2013/01/24 Project call Legals Contacts

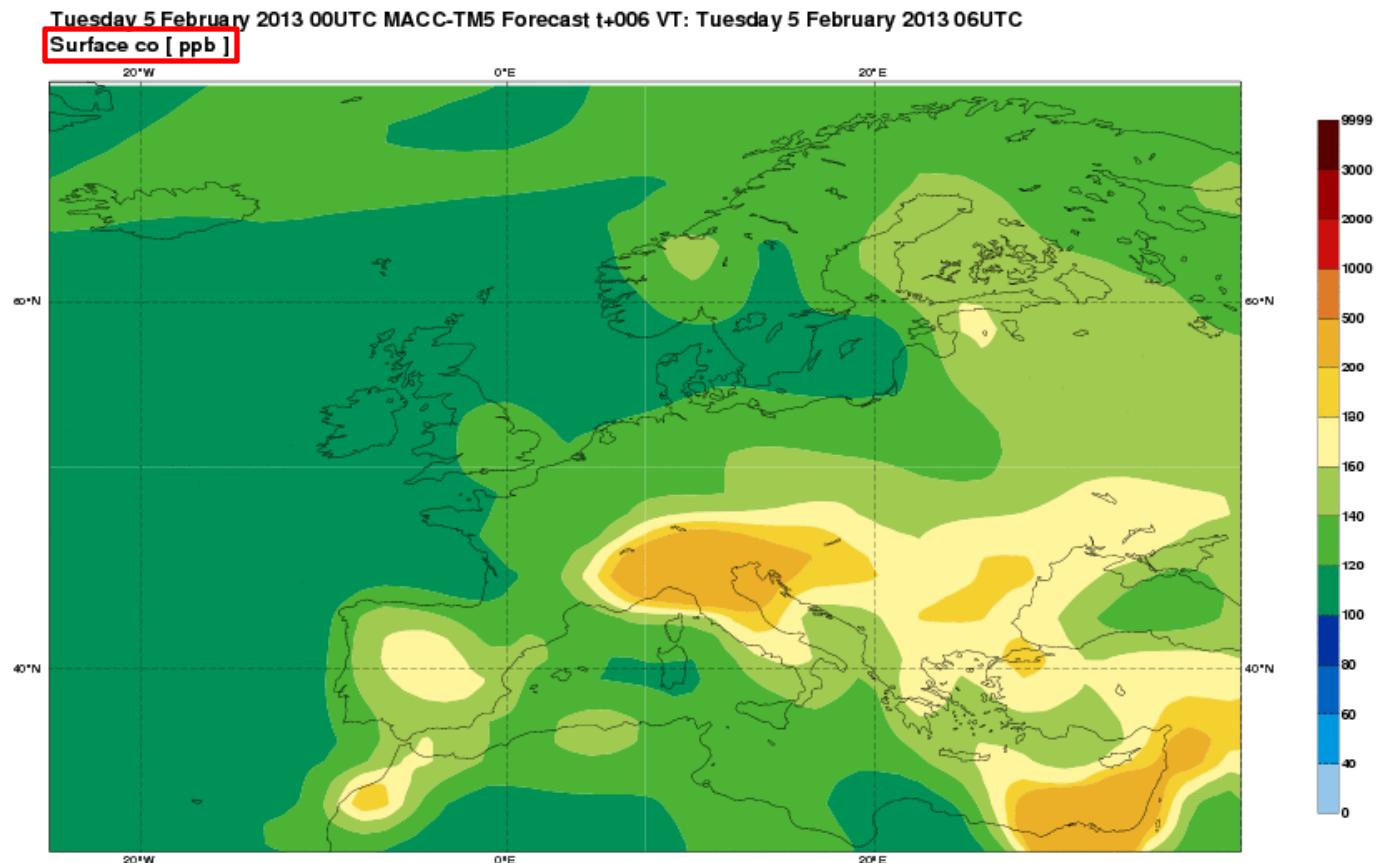
Institut Pierre Simon Laplace Observatoire de Paris OMP cnes CNRS INSU SATMOS ICARE



Distributed by EUMETSAT in 2013 (profiles + AK)



IASI CO total column data used in the **GMES/MACC** project
to provide CO forecast



macc
Monitoring atmospheric
composition & climate

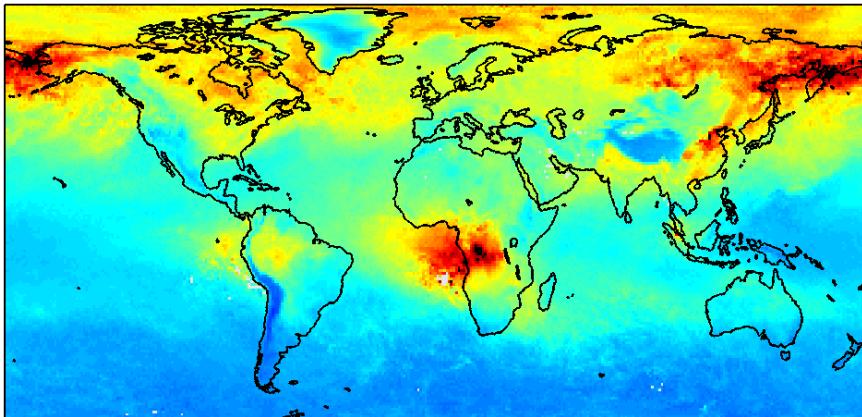
gmes
Observing our planet for a safer world

ecmwf

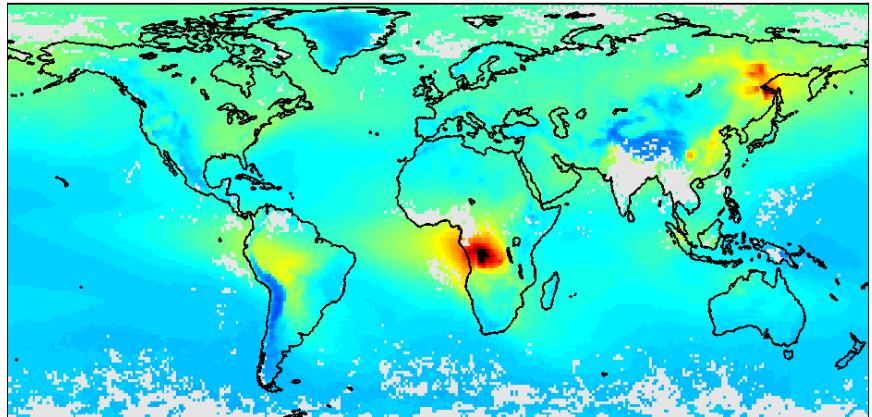
http://www.gmes-atmosphere.eu/d/services/gac/nrt/nrt_fields_tm5

CO forecasts

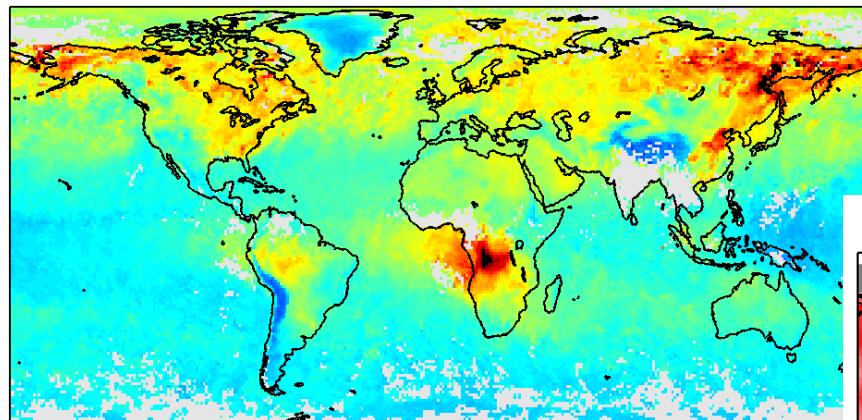
IASI 201208



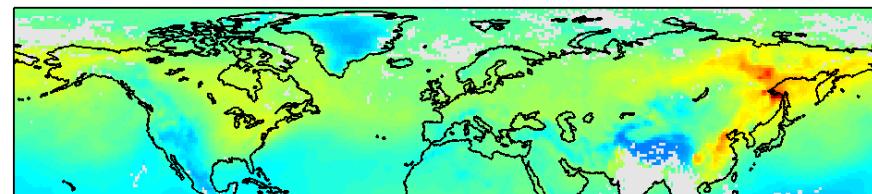
MACC no assim 201208



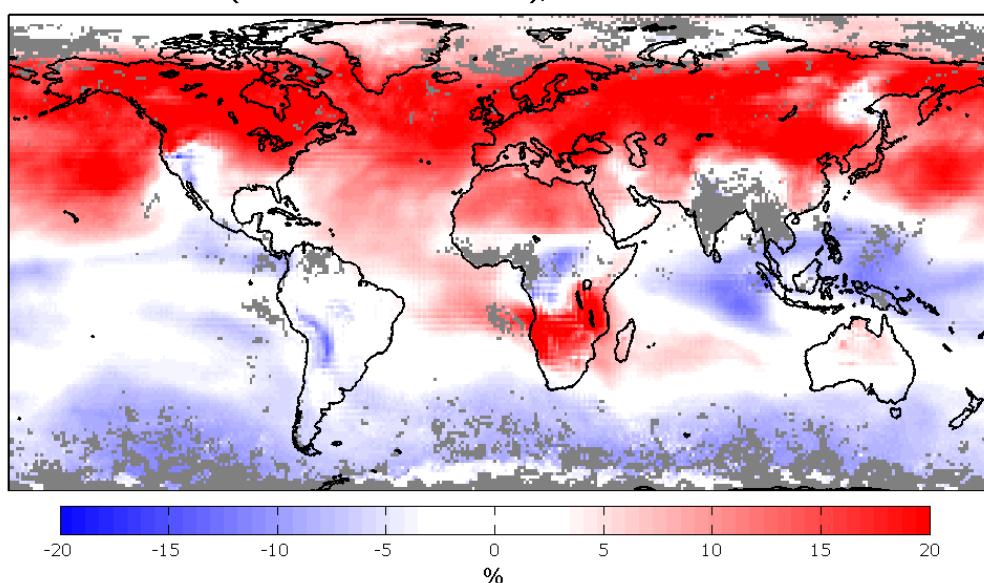
MOPITT V4 201208

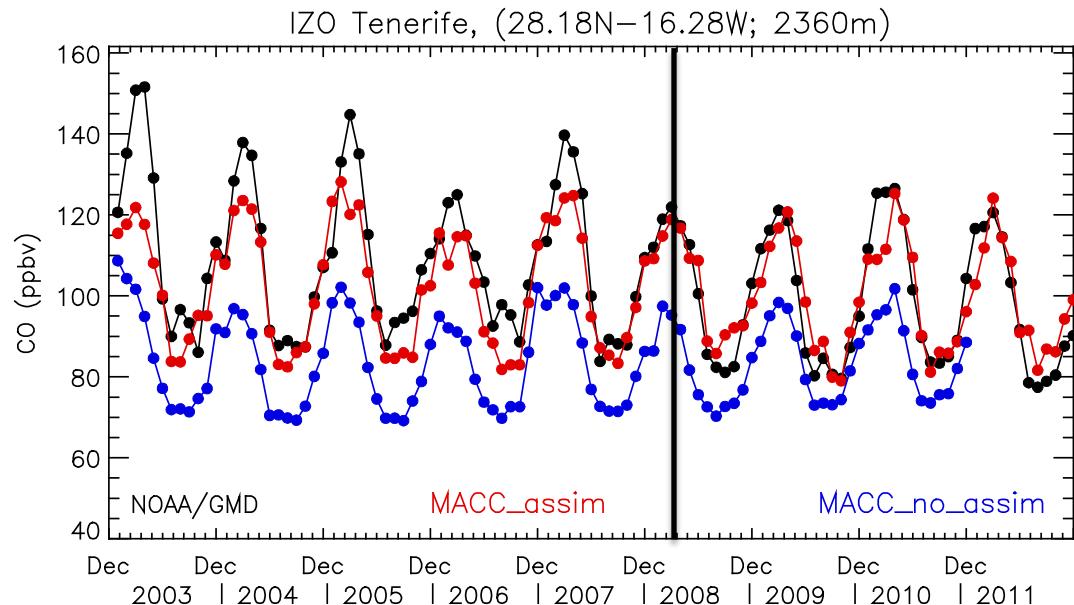


MACC assim 201208

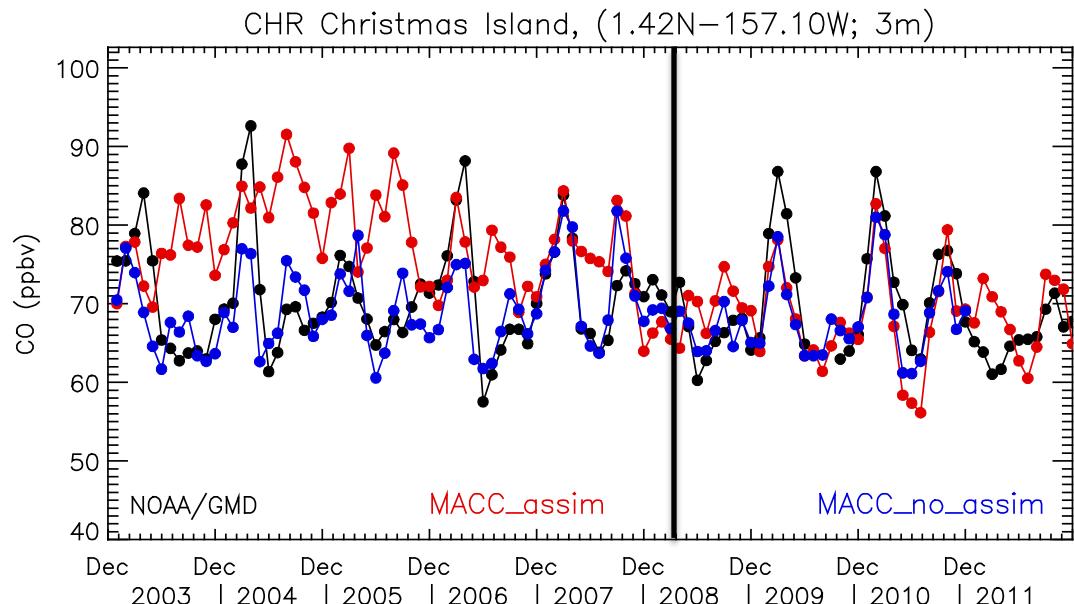


$100 \times (\text{ASSIM} - \text{NO ASSIM}) / \text{NO ASSIM}$ 201208

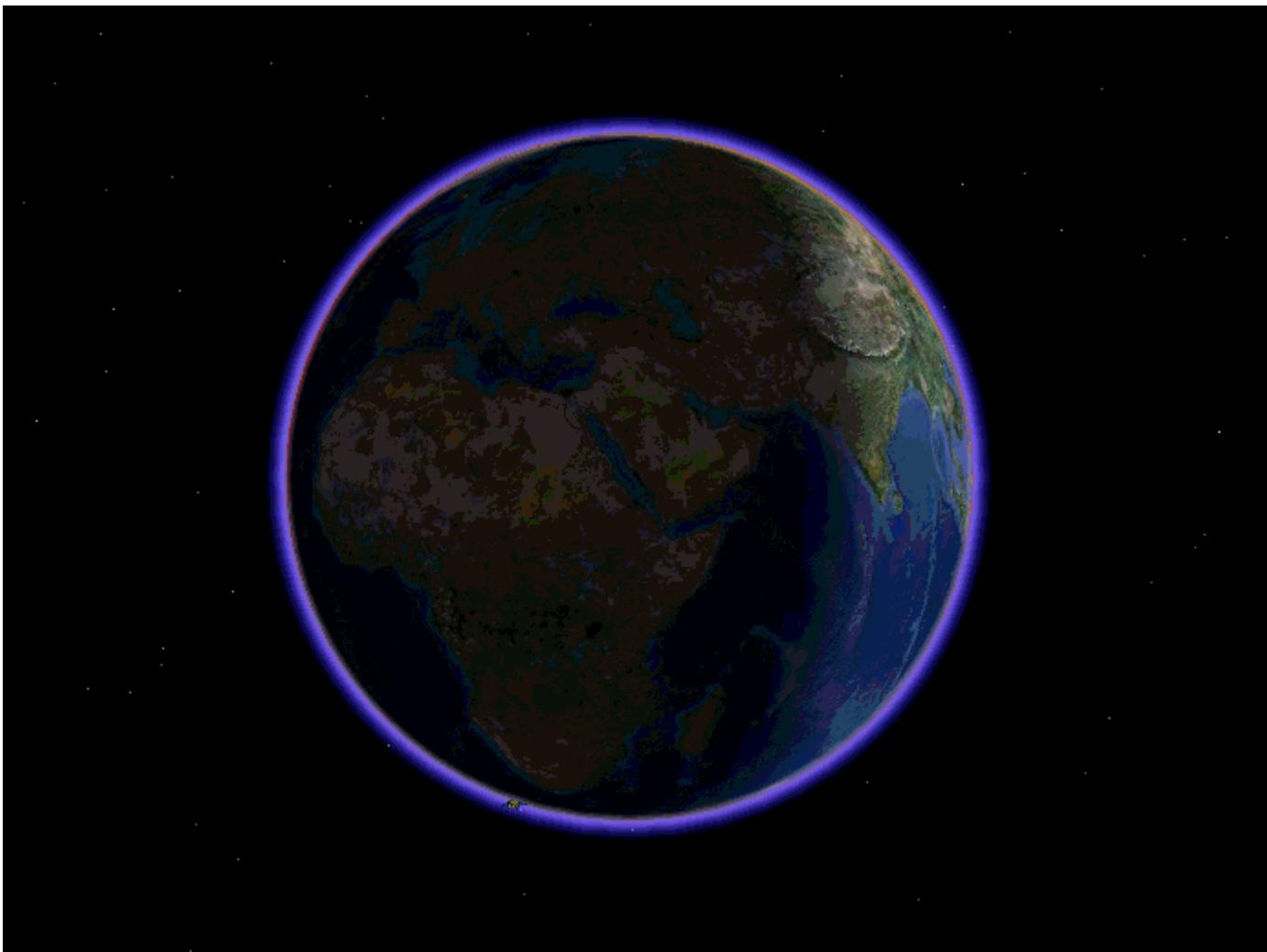




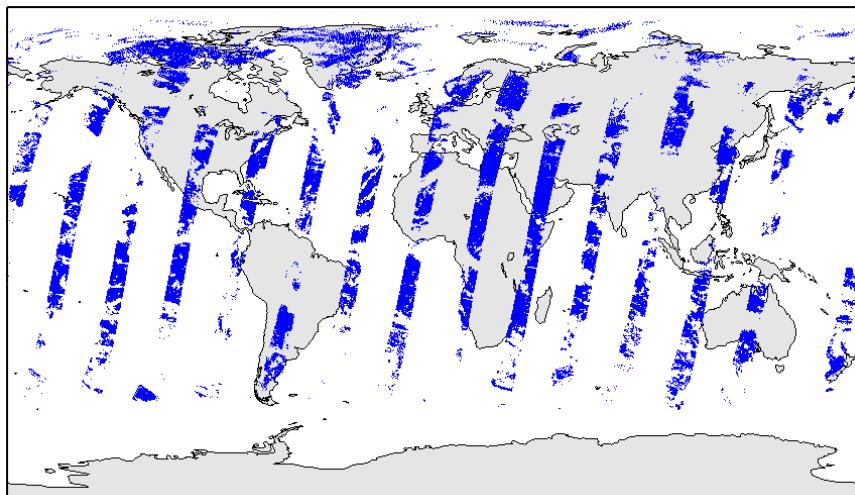
NOAA-GMD station
 MACC reanalysis
 assimilation of MOPITT and IASI
 (since April 2008) CO total columns
 MOZART stand alone run



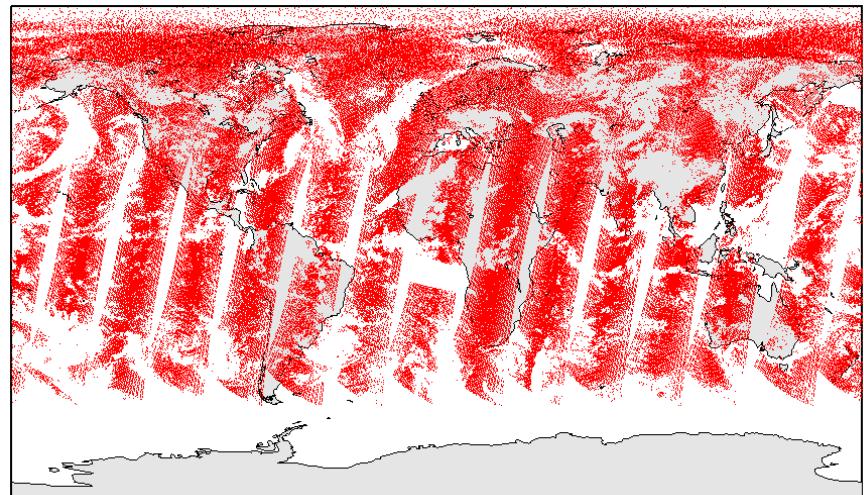
Courtesy I. Bouarar



MOPITT



IASI



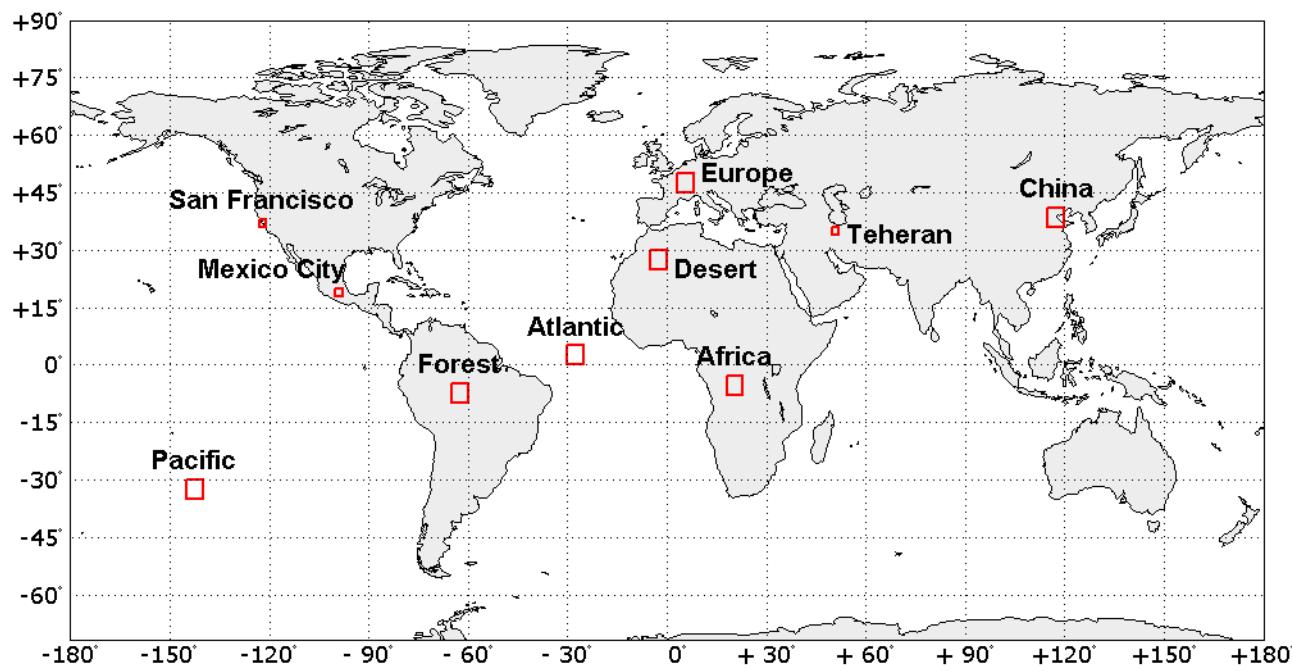
**Retrieval algorithms:
Optimal Estimation Method
(OEM)**

Single *a priori*

Variable *a priori*

IASI/MetOp	817 km	645 to 2760
EUMETSAT/CNES	09:30, d	12 km diam \times 4 pixels, swath 2200 km
October 2006	FTS, 8461 channels, OPD 2 cm	0.5 cm^{-1} (apodized)
May 2007		0.25 K
MOPITT/TERRA	705 km	2140–2192, 4265–4305
NASA (EOS)	10:30, d	22 \times 22 km, swath 640 km
December 1999	Gas correlation radiometer, 3 bands,	0.04 cm^{-1} (effective)
March 2000	8 channels	0.05 K

Variability over different regions



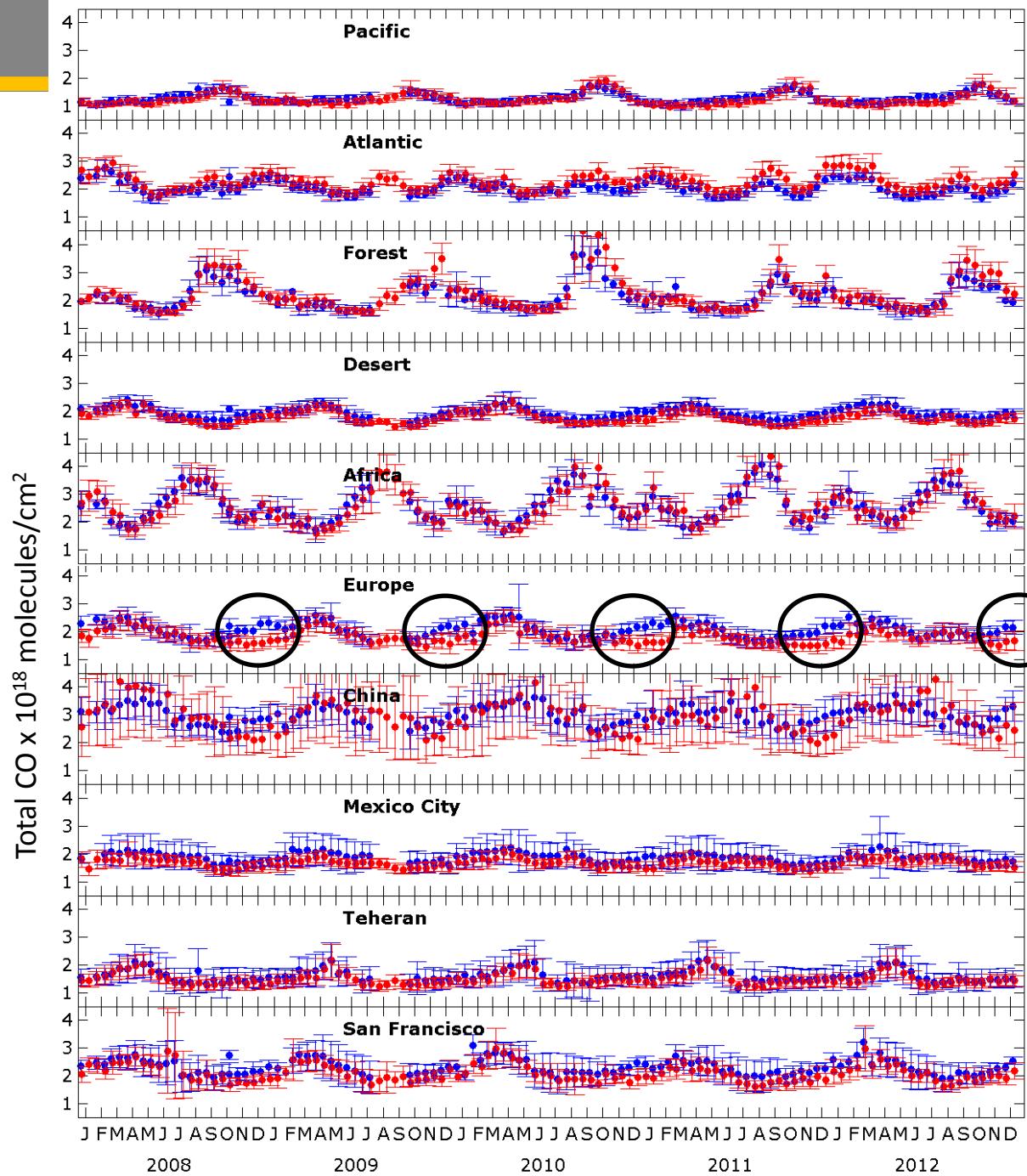
5°x5°:

- Forest
- Non polluted sea (Pacific)
- Polluted sea (Atlantic)
- Desert (Sahara)
- Fires (Africa)
- Pollution (China)
- Europe

2°x2°:

- Teheran
- Mexico city
- San Francisco

Variability over 5 years

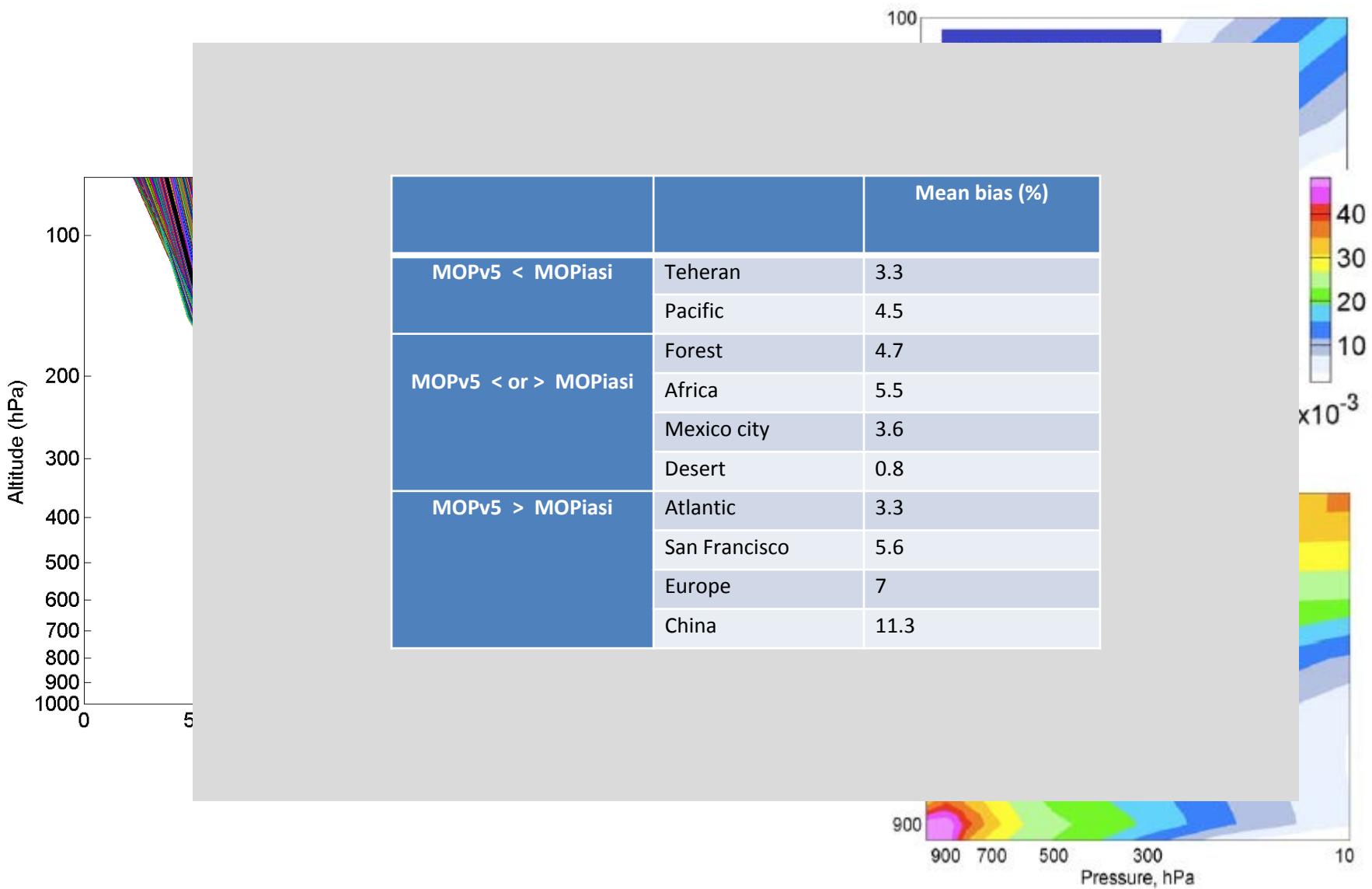


- IASI (Red circle)
- MOPITT V5 TIR (Blue circle)

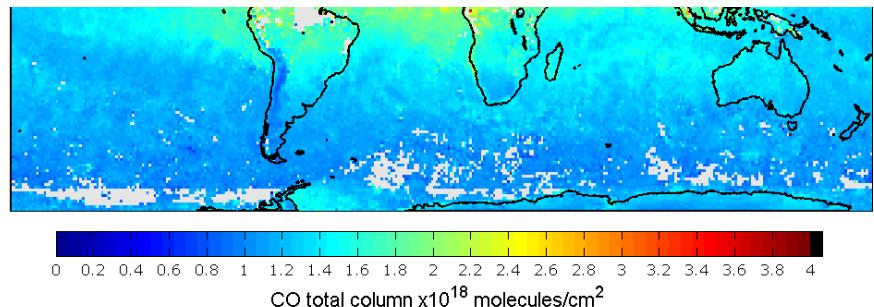
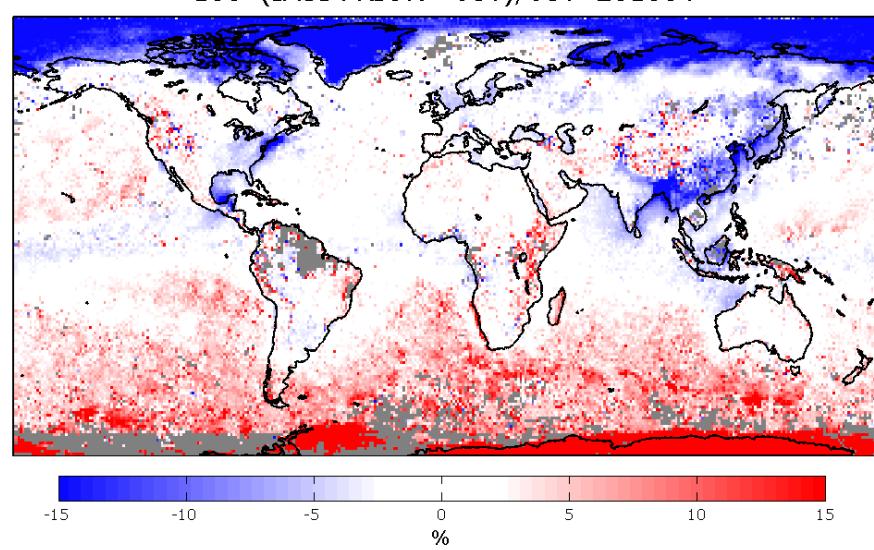
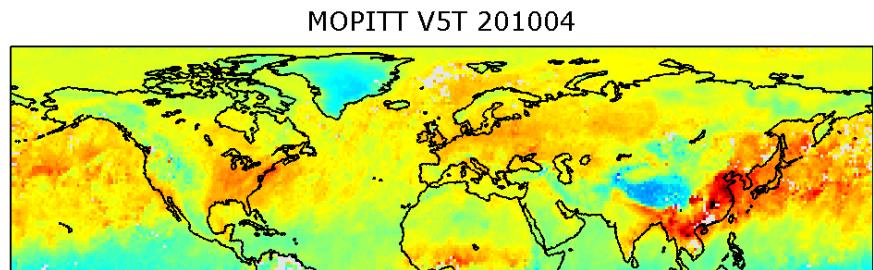
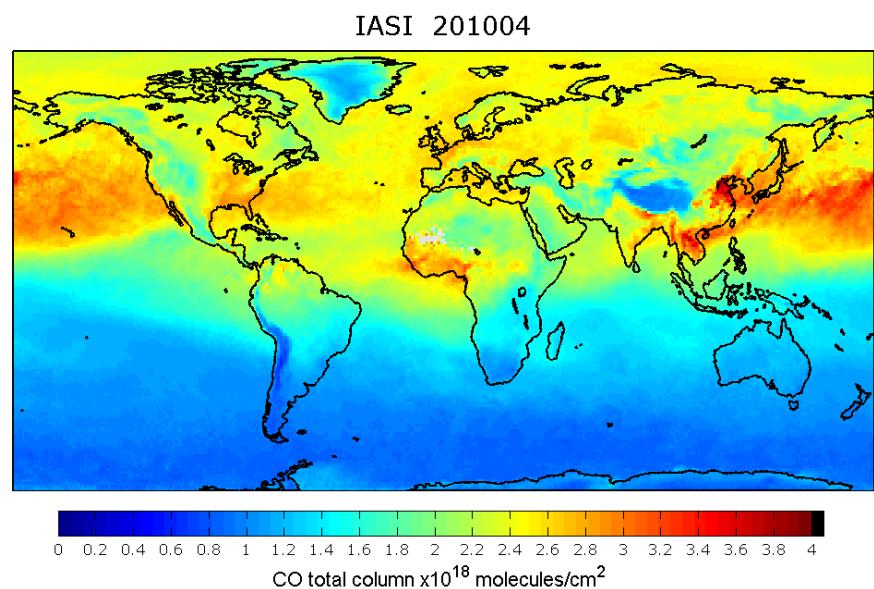
		Mean bias (%)
IASI < MOPITT	Europe	14.1
	Teheran	12.1
	San Francisco	11.2
	Desert	9.4
	Mexico city	8.5
IASI ~ MOPITT	China	12
	Africa	8.5
	Forest	8.2
	Pacific	7.4
IASI > MOPITT	Atlantic	11.1

15 day average;
Vertical bars = Standard deviation
inside the box

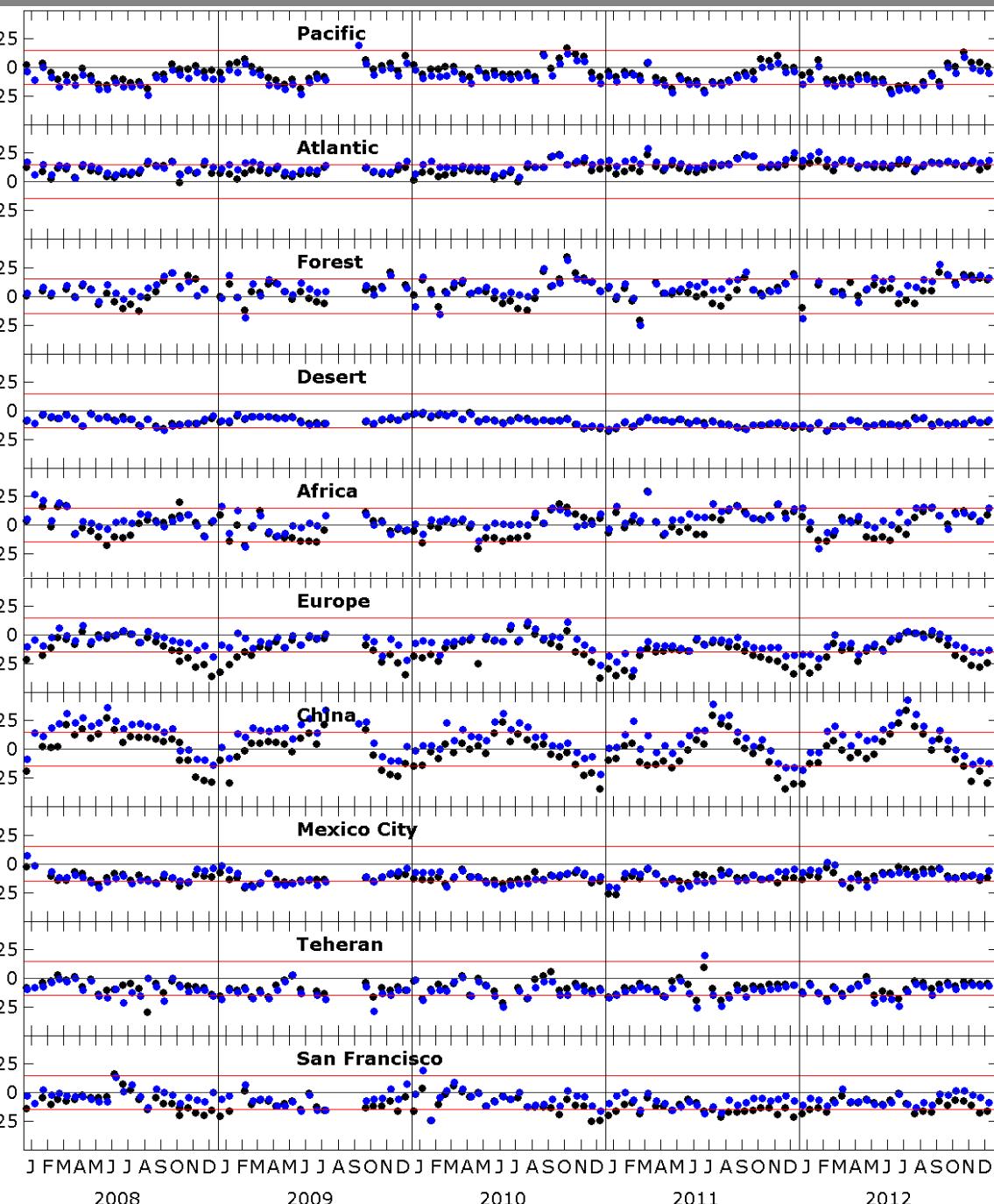
MOPI TT retrieval algorithm with IASI *a priori* assumptions



At global scale, for one month

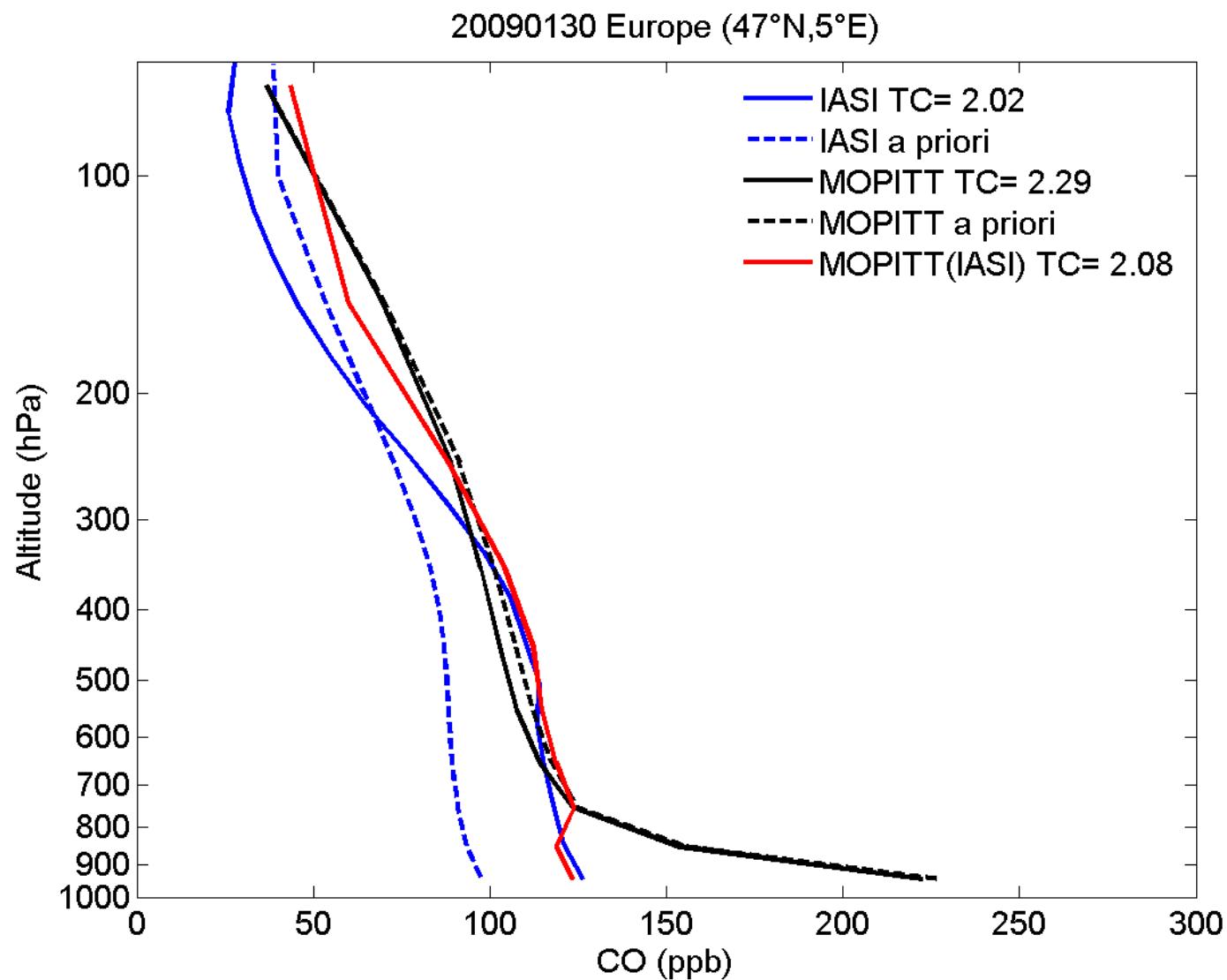


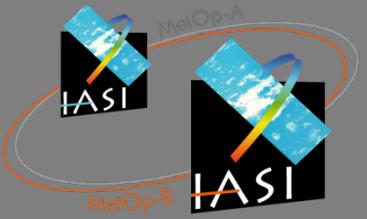
Biases



- IASI – MOPITT V5
- IASI – MOPITT_iasi

		Mean bias (%)	IASI <i>a priori</i> Mean bias (%)
IASI < MOPITT	Europe	14.1	8.6
	Teheran	12.1	11.8
	San Francisco	11.2	7.2
	Desert	9.4	9.5
	Mexico city	8.5	11.2
IASI < or > MOPITT	China	12	13.9
	Africa	8.5	7.1
	Forest	8.2	9
	Pacific	7.4	10
IASI > MOPITT	Atlantic	11.1	14.2
		10.25	8.6





- IASI FORLI-CO : validated product
- Data available from Ether data base
<http://www.pole-ether.fr/>
In 2013: available from Eumetsat (O3M SAF)
- Used in near real time for forecast (MACC)
- In very good agreement with MOPITT
Study of the impact of the *a priori* assumptions on the retrievals is ongoing (LATMOS / NCAR)

