First IASI Conference

Anglet, 13-16 November 2007

Midtropospheric CO_2 Concentration Retrieval in the Tropical Zone from MetOp IASI/AMSU Observations

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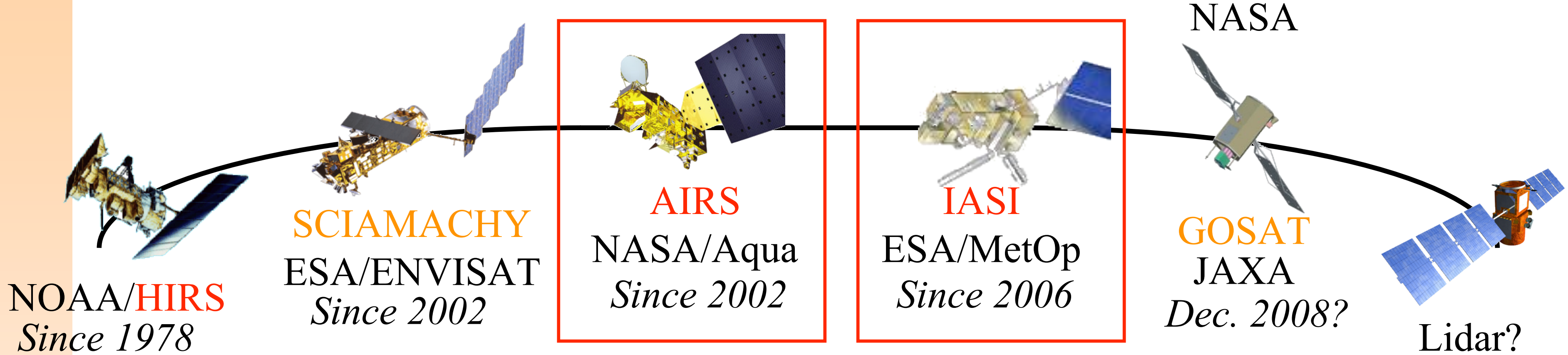
CO_2 from space observation

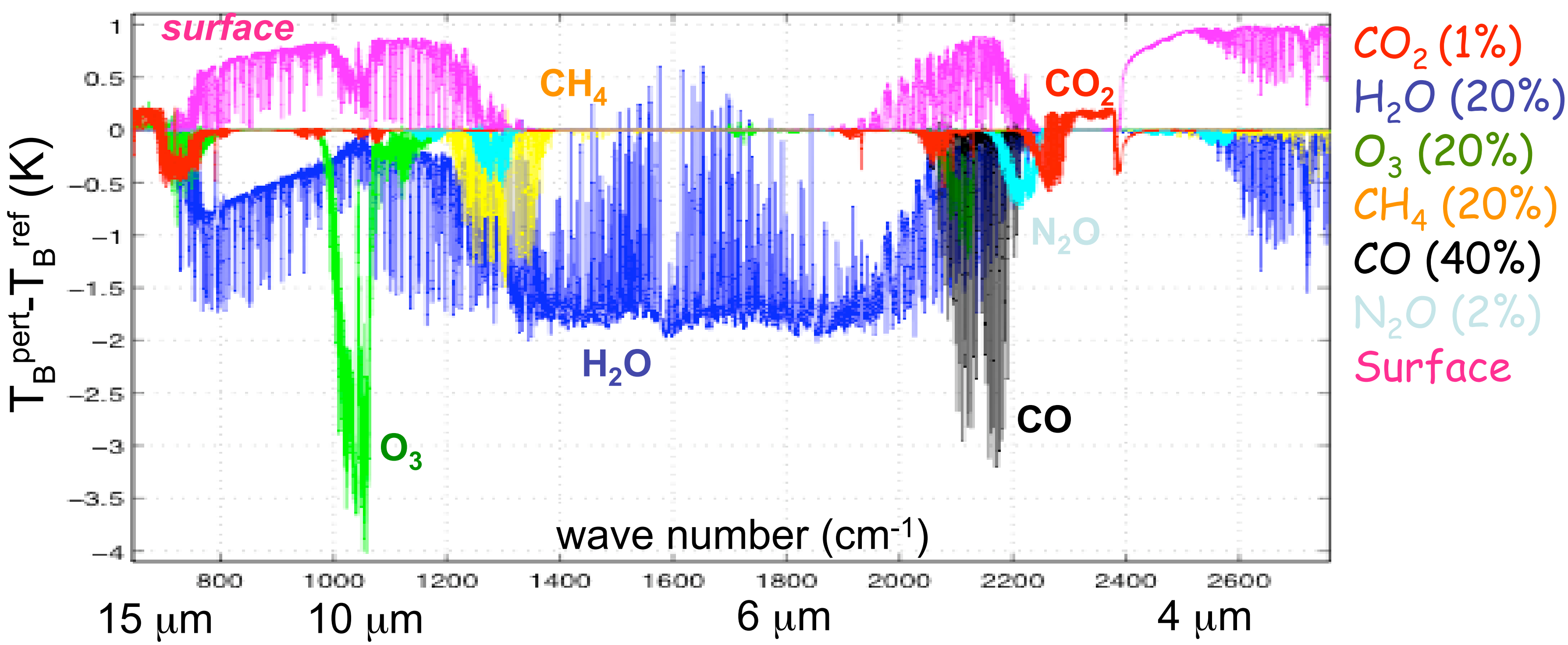


	Aqua/AIRS	MetOp/IASI
Date of launch	May 2002	Oct. 2006
Spectral coverage	3 IR bands	IR Continuous
Spectral resolution	0.5 - 2 cm^{-1}	0.5 cm^{-1} (apodized)
# IR channels	2378	8461
Local time	1.30	9.30

Also onboard Aqua and MetOp: AMSU-A with 15 MW channels

CO_2 channel selection - IASI

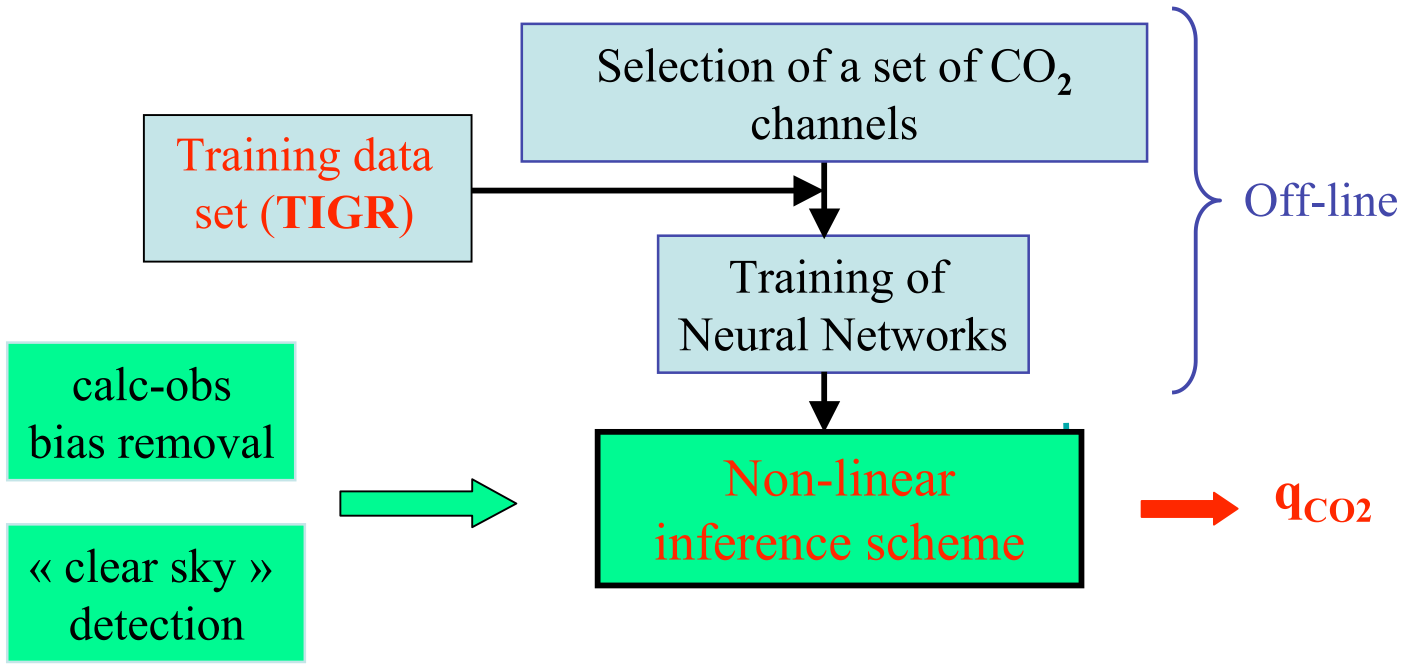
Sensitivity of IASI T_B to variations of atmospheric and surface variables (simulations with the 4A RT model)



- 0.1 % of CO_2 variation → 0.04% of T_B variation
- At LMD: 421 IASI channels have been selected.

A stand-alone approach

General features of the CO_2 retrieval scheme : non-linear regressions



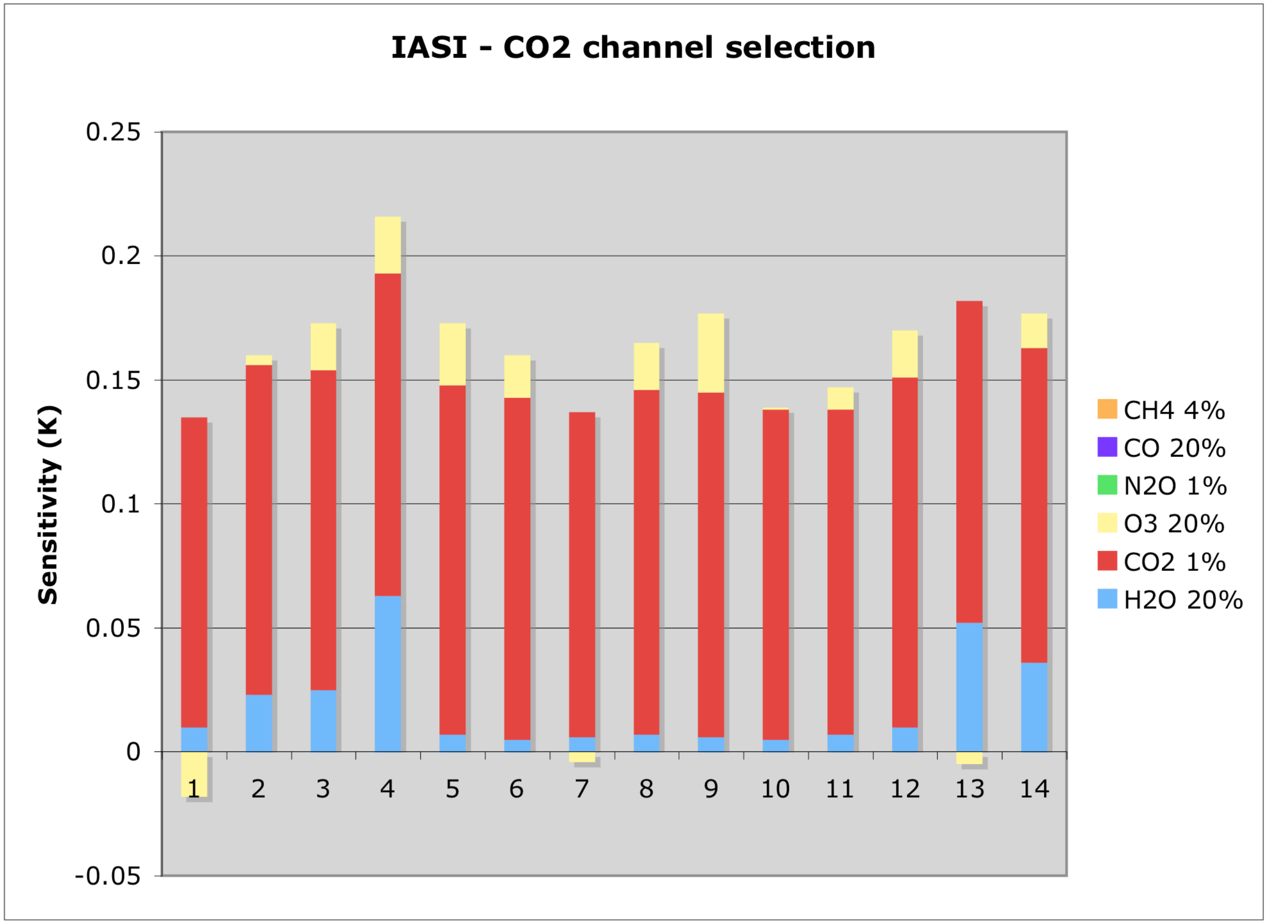
- Simultaneous use of IR and MW channels to decorrelate T/CO_2.

IASI AMSU

- Retrieval limited to the tropical region.

[Chédin et al., JGR, 2003; Crevoisier et al., GRL, 2004]

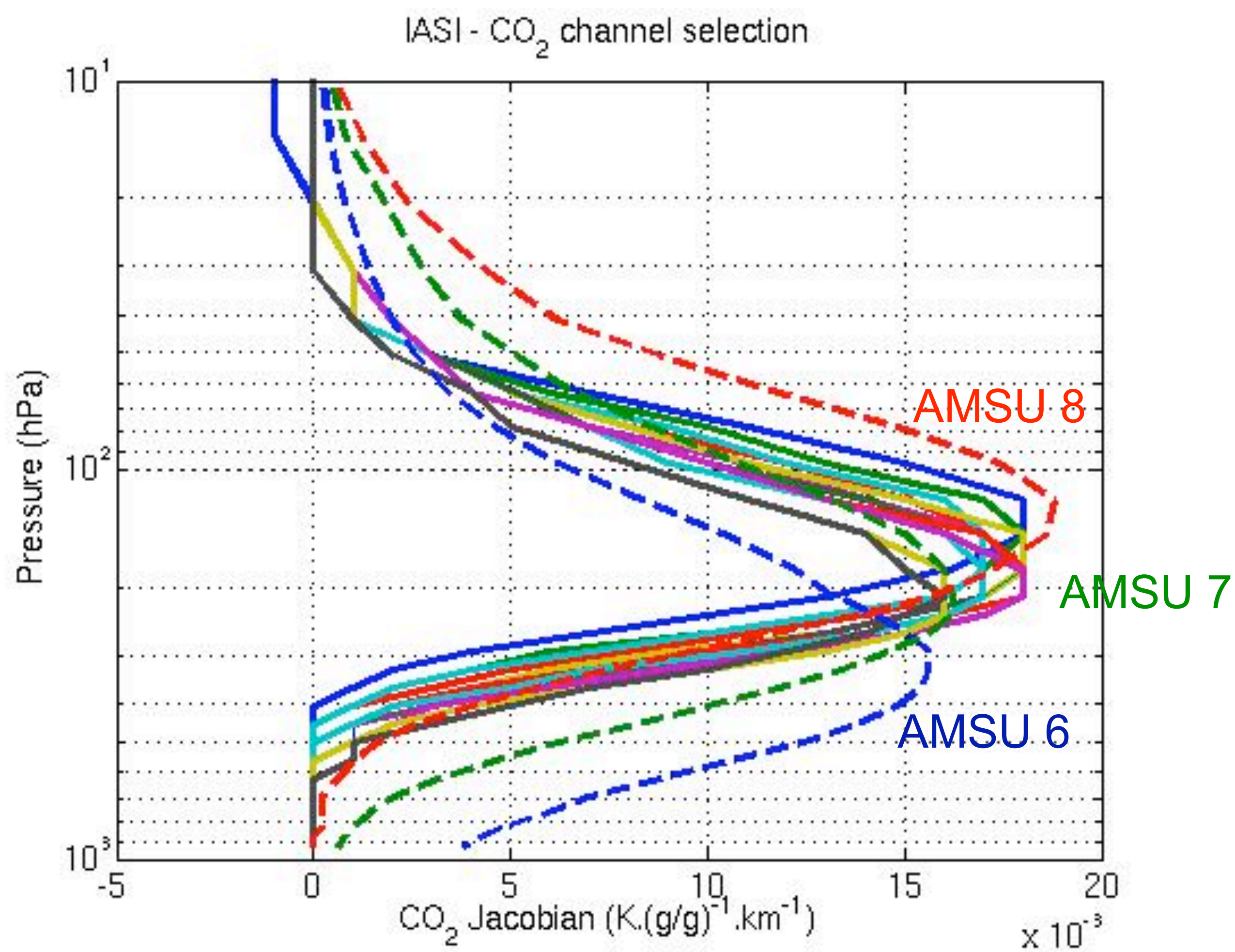
CO_2 channel selection - IASI



- 14 channels have been selected for CO_2.
- All are located in the LW band (high noise in the SW band).

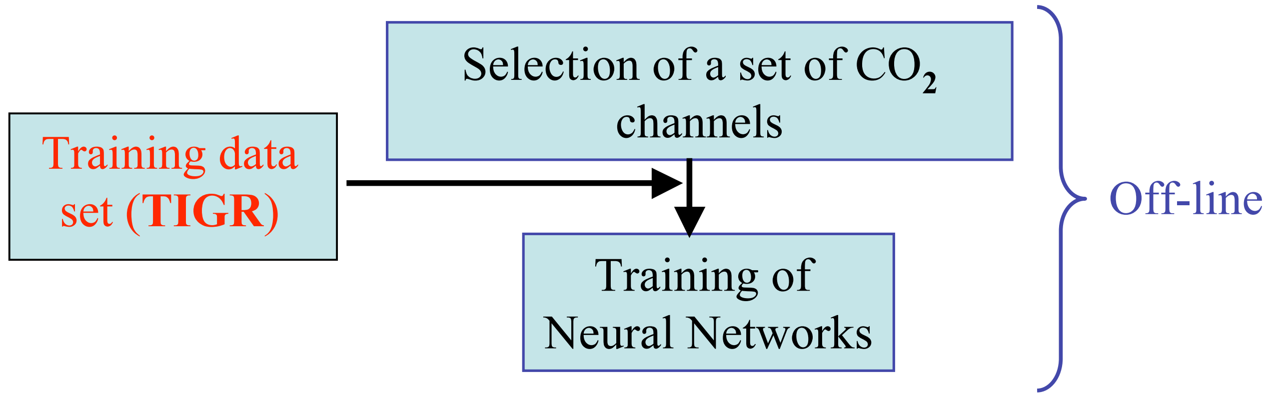
CO_2 channel selection - IASI

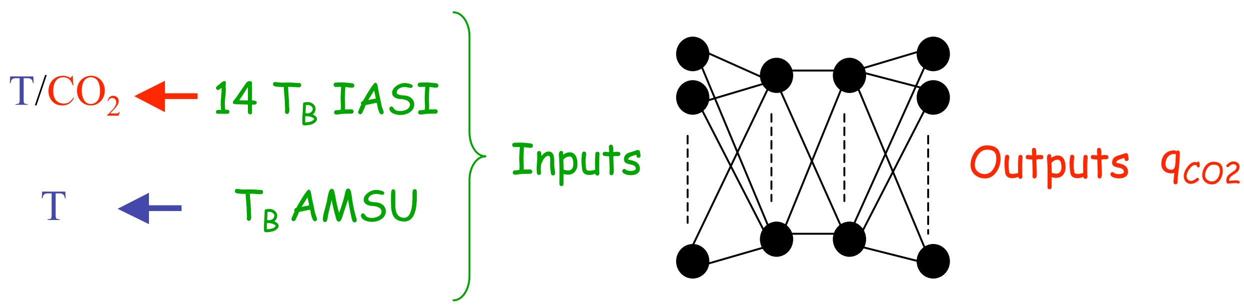
CO_2 Jacobians of the selected IASI channels and AMSU weighting functions



Training of the networks

Neural networks are trained using the set of selected channels.



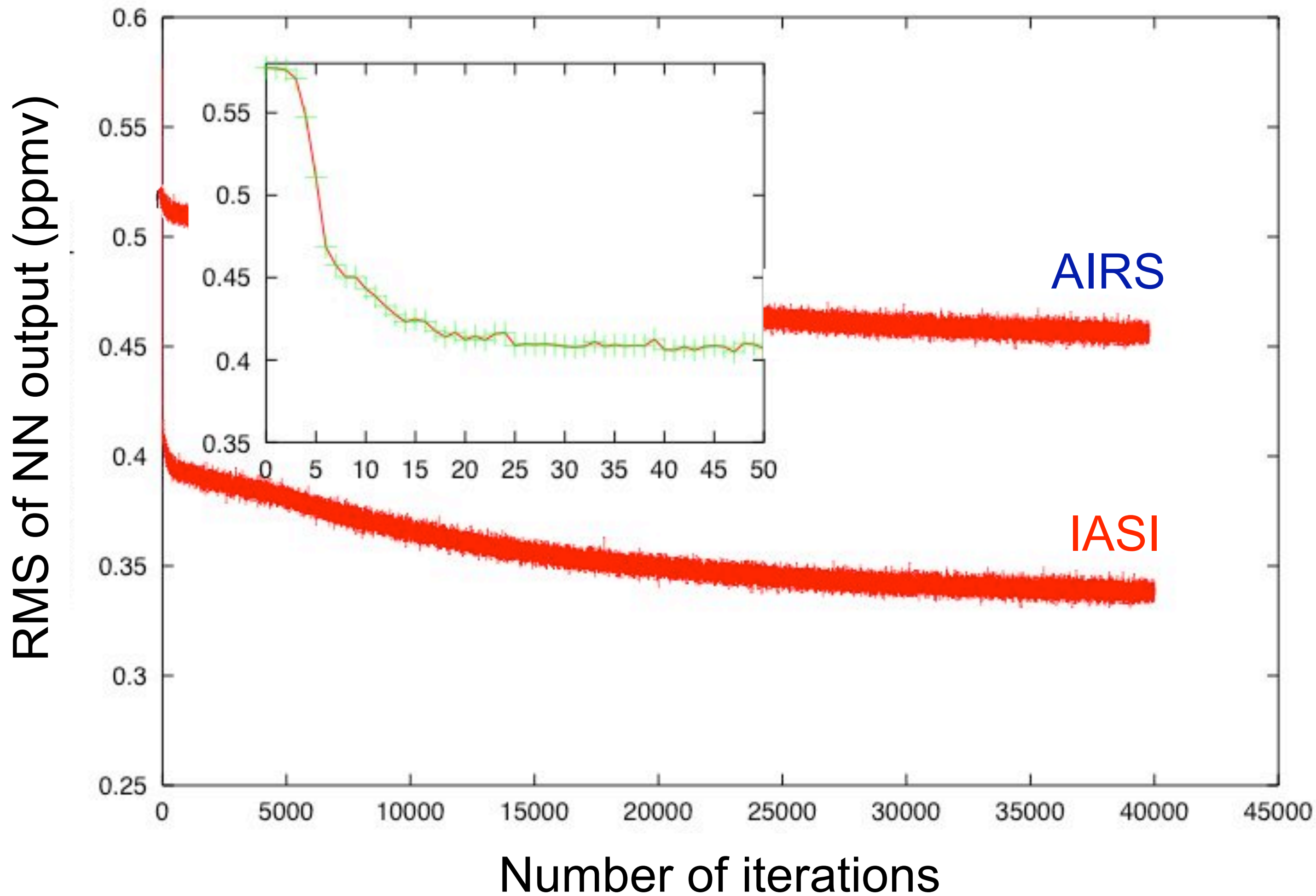


- *Learning data set*: tropical atmospheric situations from the TIGR dataset (821 atmospheres out of 6000); BT simulated by the 4A RT model.
- *Training* for 10 AMSU angles of view.

Training of the networks

Neural networks are trained using the set of selected channels.

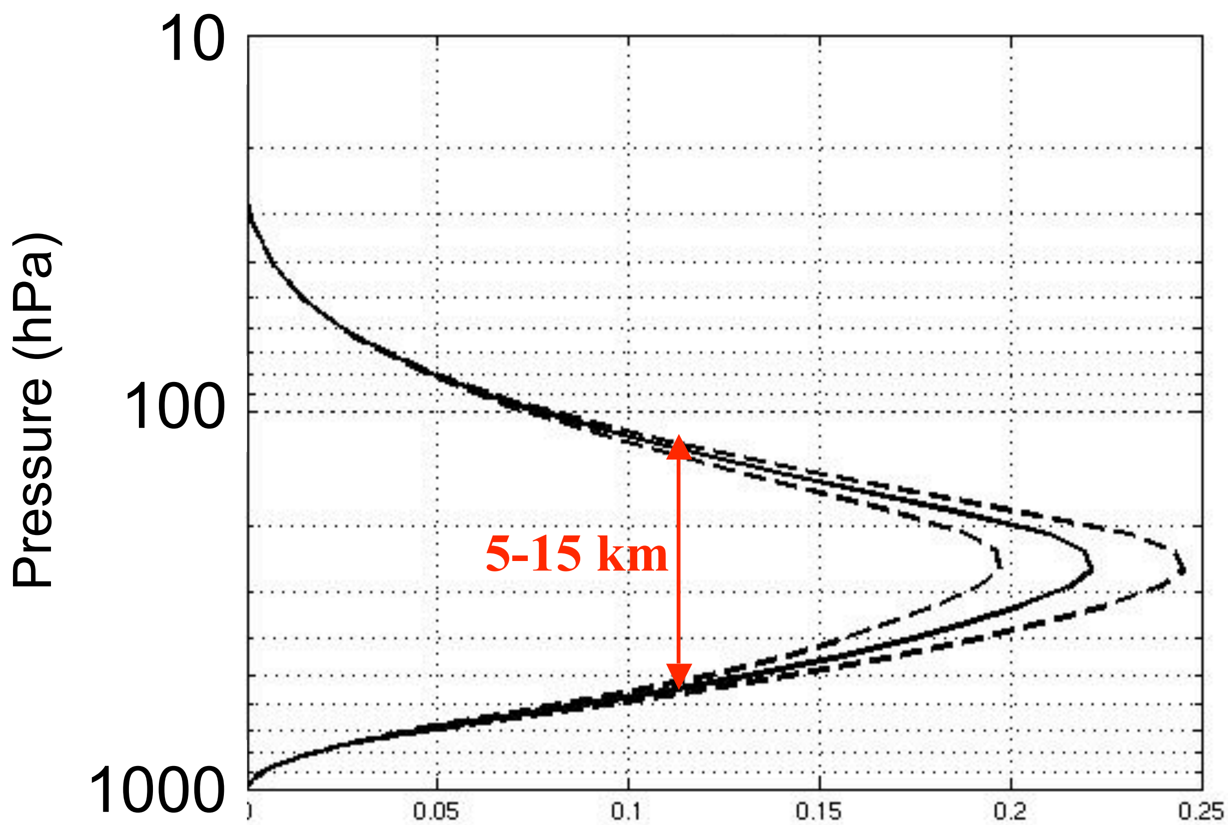
⟹ Evolution of the rms of the CO_2 output during training



Evaluation of the inference scheme characteristics

We retrieve a mid-to-upper tropospheric integrated content of CO_2.

Mean $\pm$ standard deviation of CO_2 weighting function over TIGR atmospheric dataset for nadir observation



Cloud mask

- Thin cirrus, low clouds and aerosols may contaminate observations.

  ⇒ Need to detect clear column.

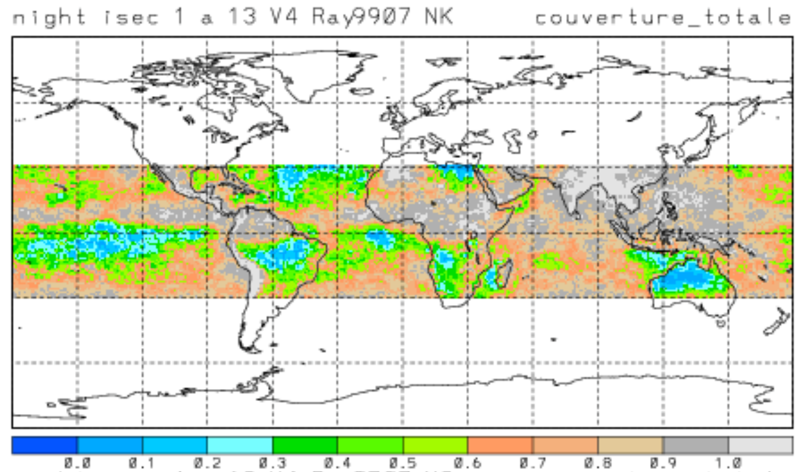
- Use of HIRS4-AMSU observations.
  - -Differences HIRS/AMSU-A
  - -Differences HIRS/HIRS (low clouds)

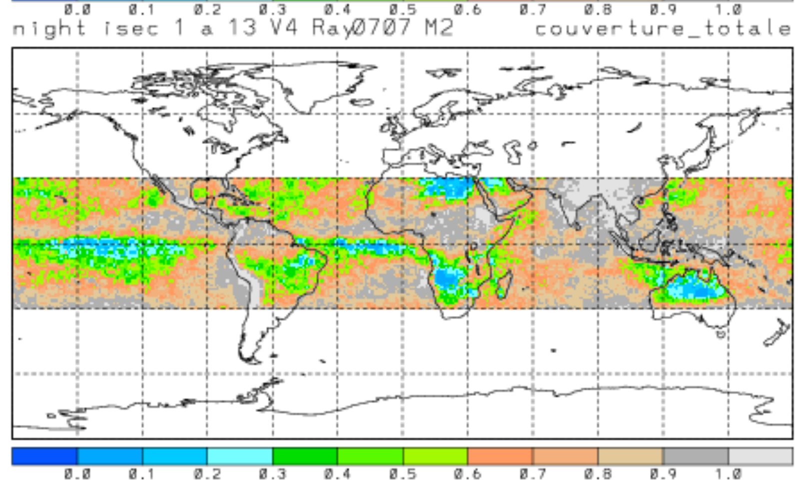
  -Spatial resolution = HIRS (mapping of AMSU-A in HIRS FOVS using AAPP)

➔Use of IASI/AMSU-A: in progress

➔Comparison of various detections in progress: HIRS4/AMSU-A, IASI/AMSU-A, AVHRR, AIRS/AMSU.

July 1999 NOAA-15





July 2007 Metop

Radiative Bias

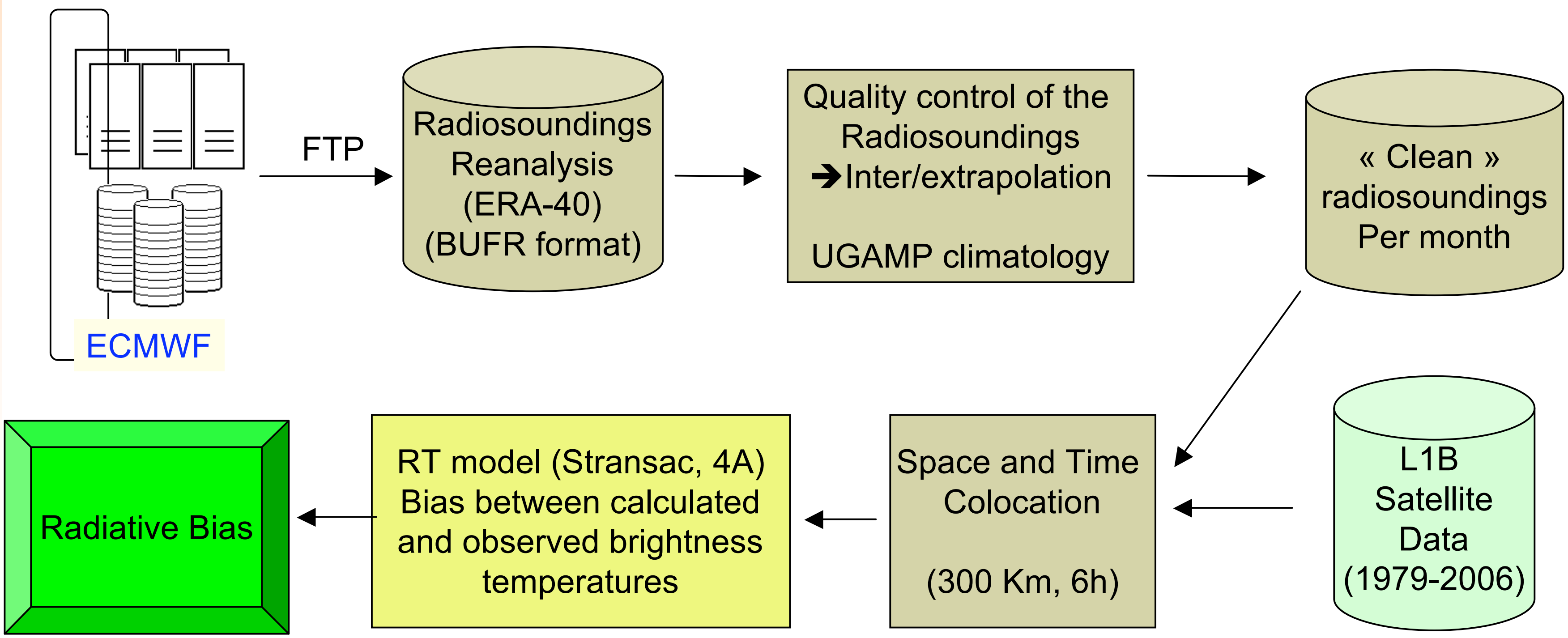
The level1b validation suite at LMD : colocation of IASI observations with radiosoundings or re-analyses ERA40

- Radiosoundings «ERA40 »
(23 Go from 1979 to 2007)
-Re-analyses ERA-40
(79 Mo / *day,* 2 days /month)

Example IASI/AMSU (MetOp) : July 2007

Satellite data :14 orbits / day

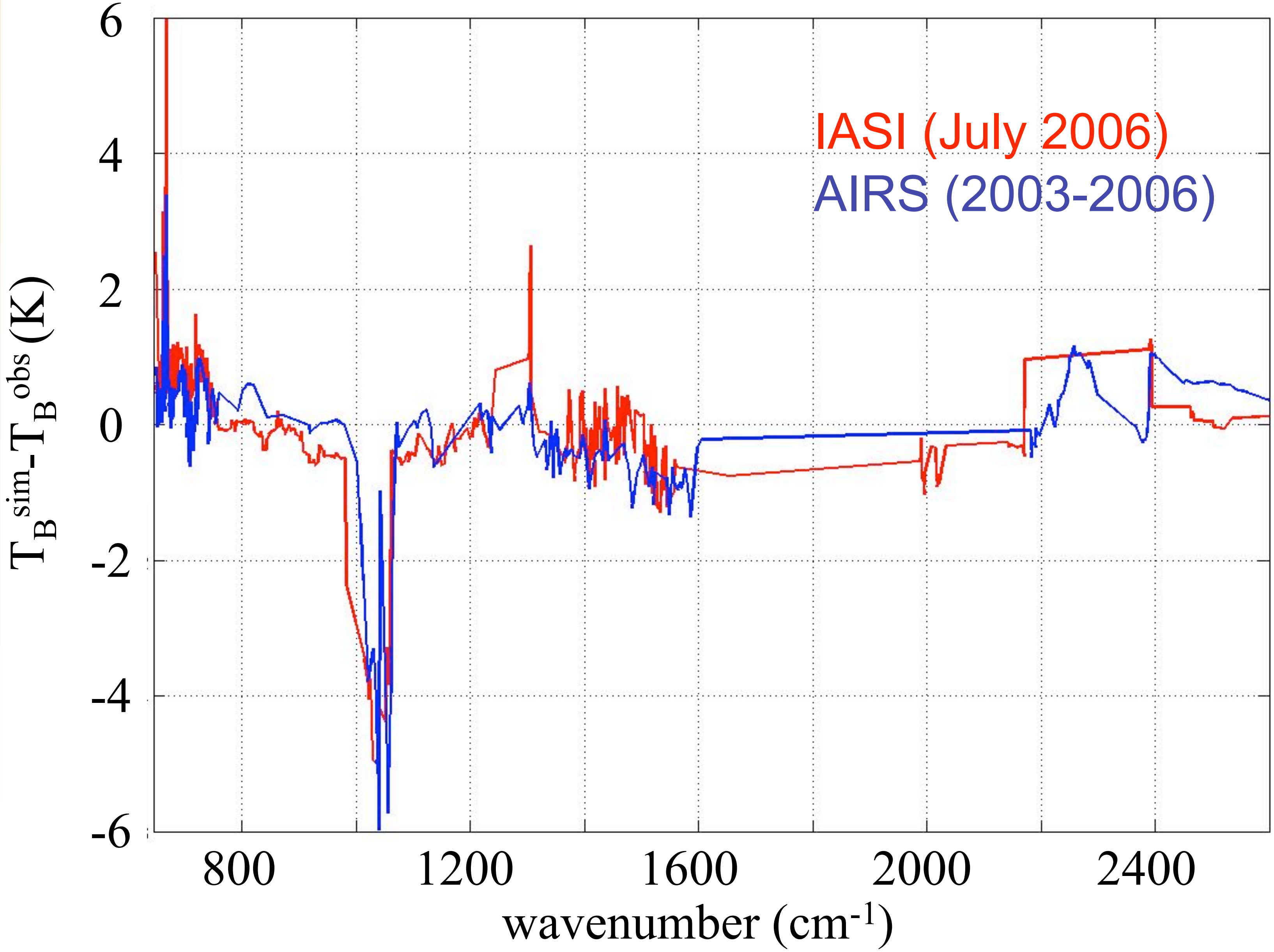
900 Mo / day; 421 channels IR, 15 channels MWV



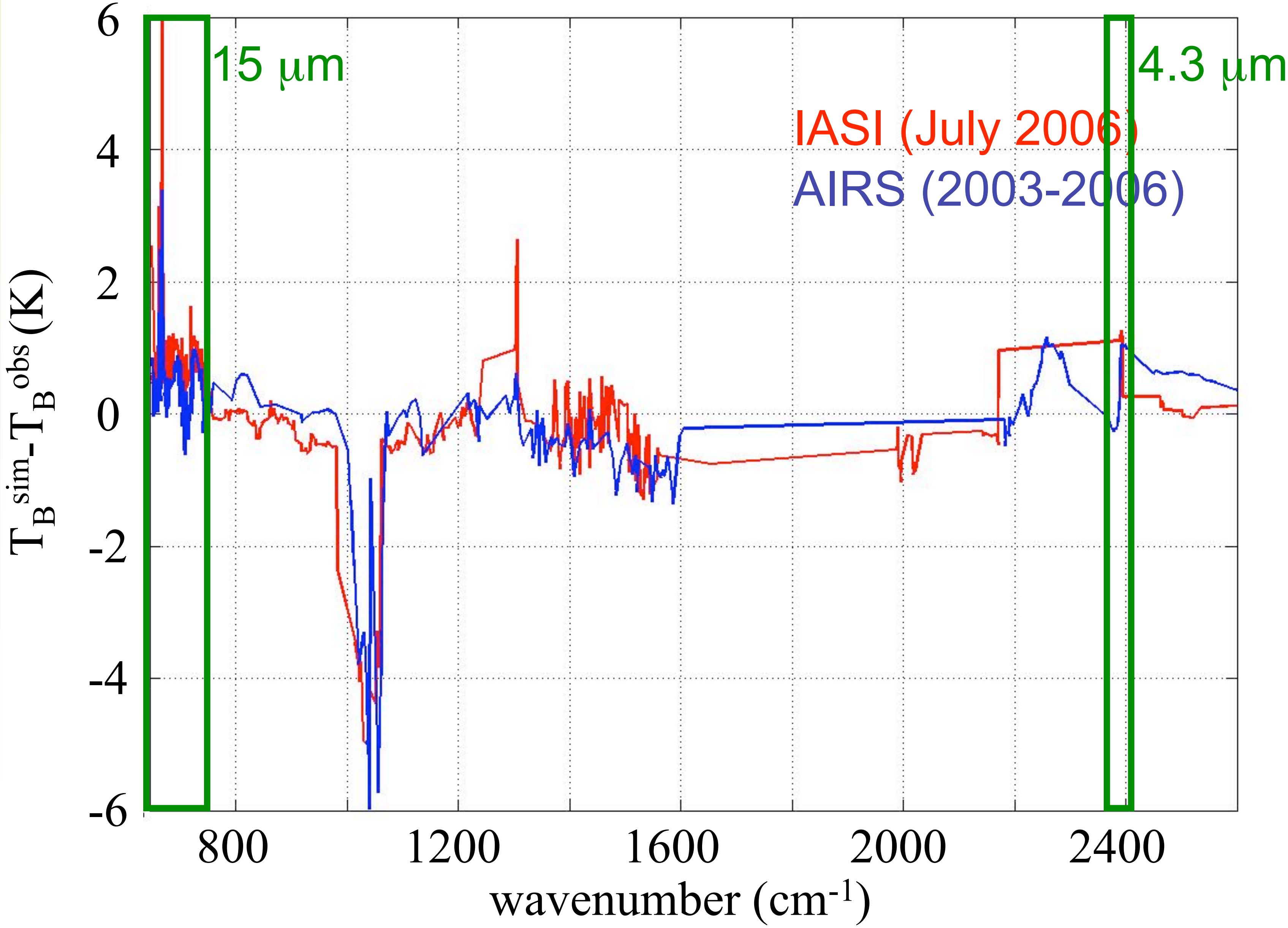
Fixed CO_2=372 ppmv

See Poster of Armante et al.

Radiative Bias

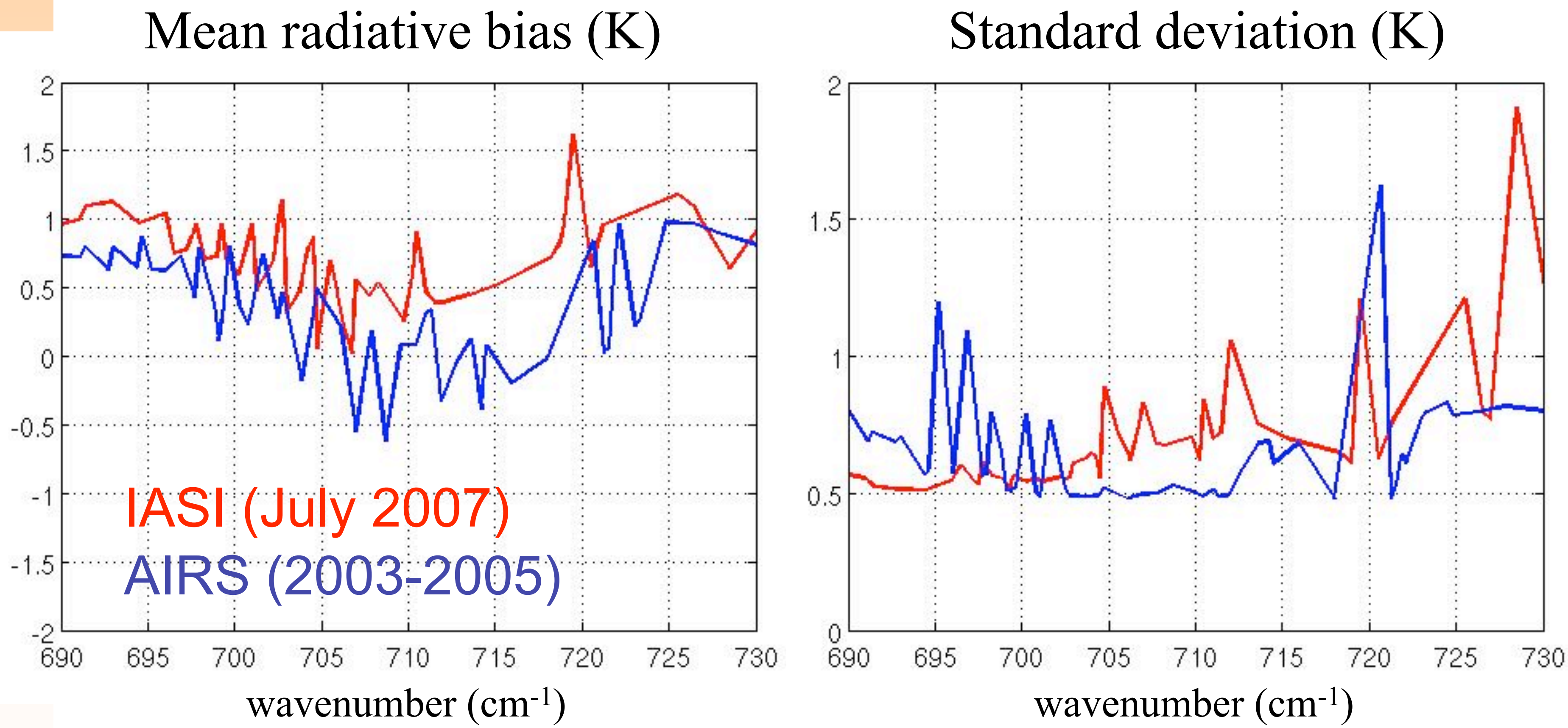


Radiative Bias



Radiative Bias

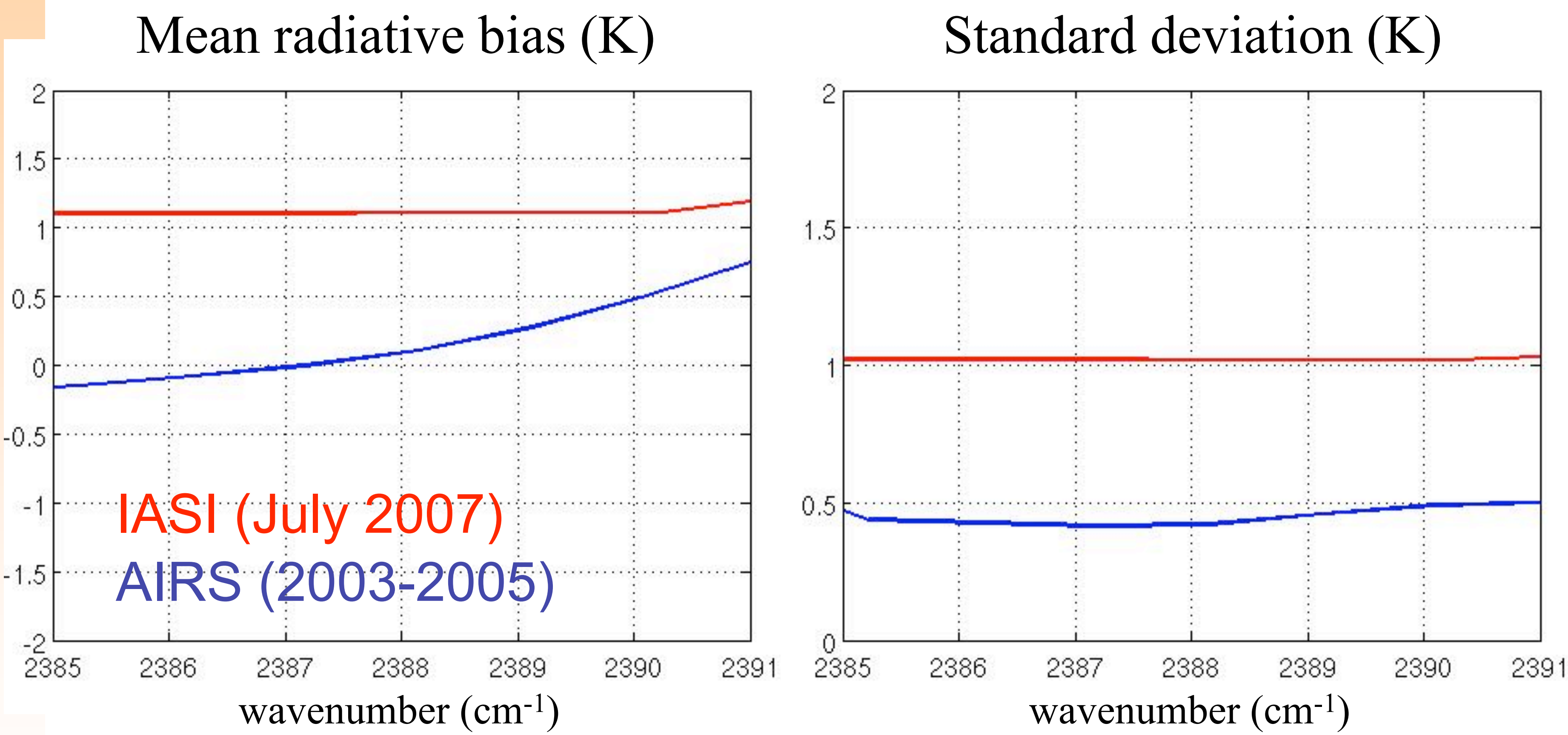
15 μm band



- Higher bias for IASI: ΔCO_2 = +6ppmv ⟹ ΔT_B = +0.5 K
- Lower IASI noise for the selected channels

Radiative Bias

4.3 μm band

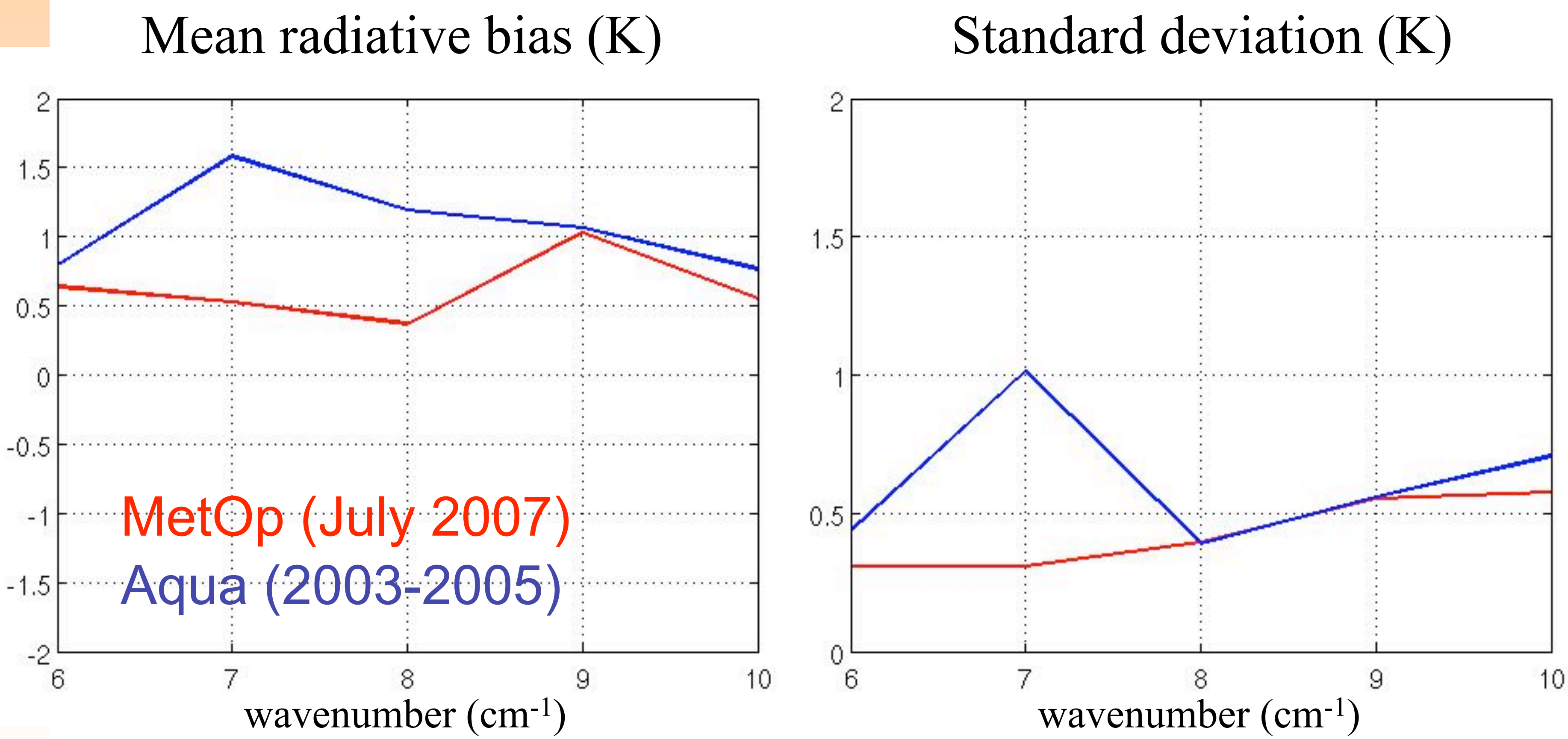


- Higher noise for IASI as compared to AIRS and IASI 15μm

⟹ IASI channels at 4.3μm are not used in the retrieval scheme

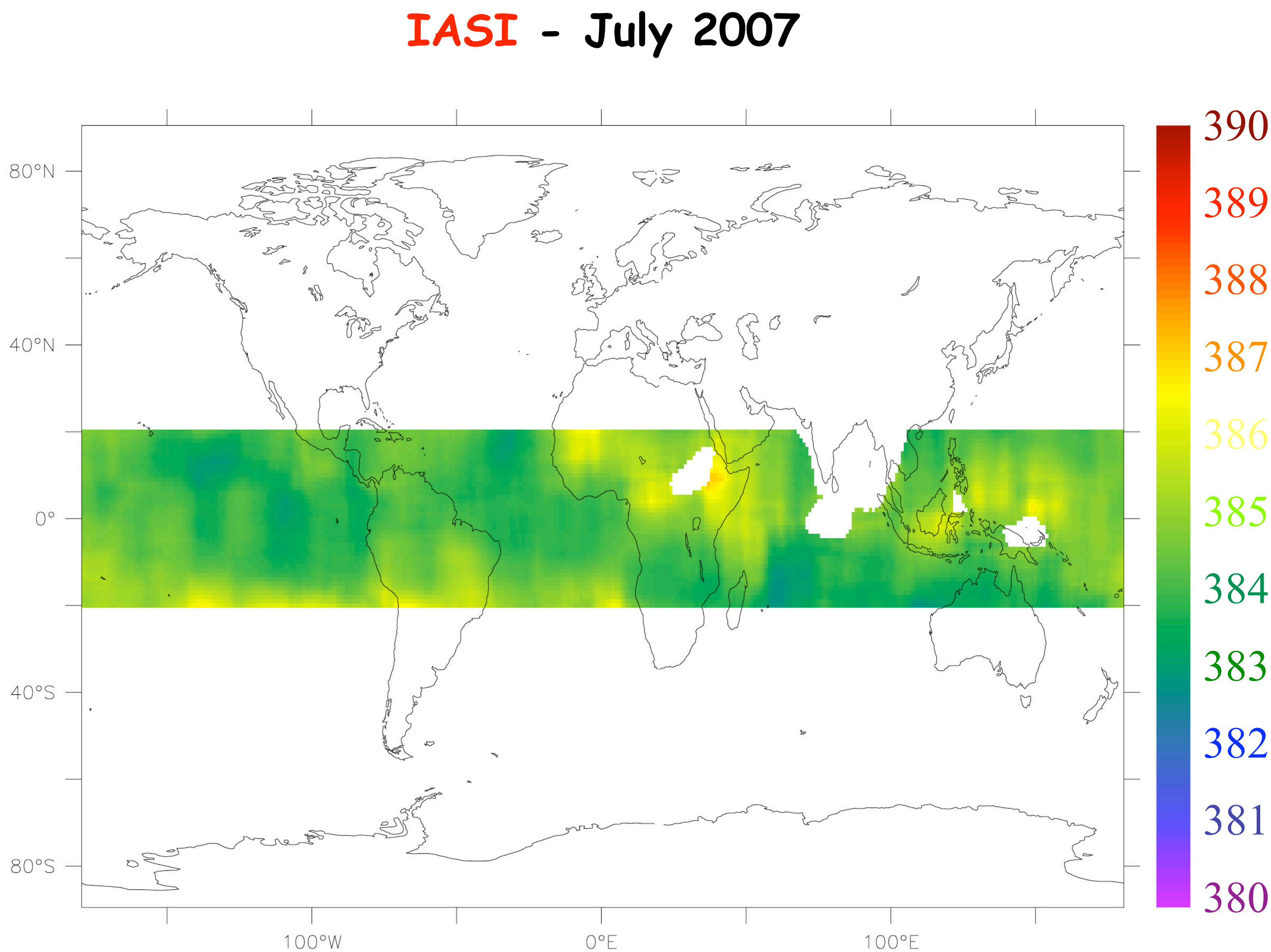
Radiative Bias

AMSU channels 6-10



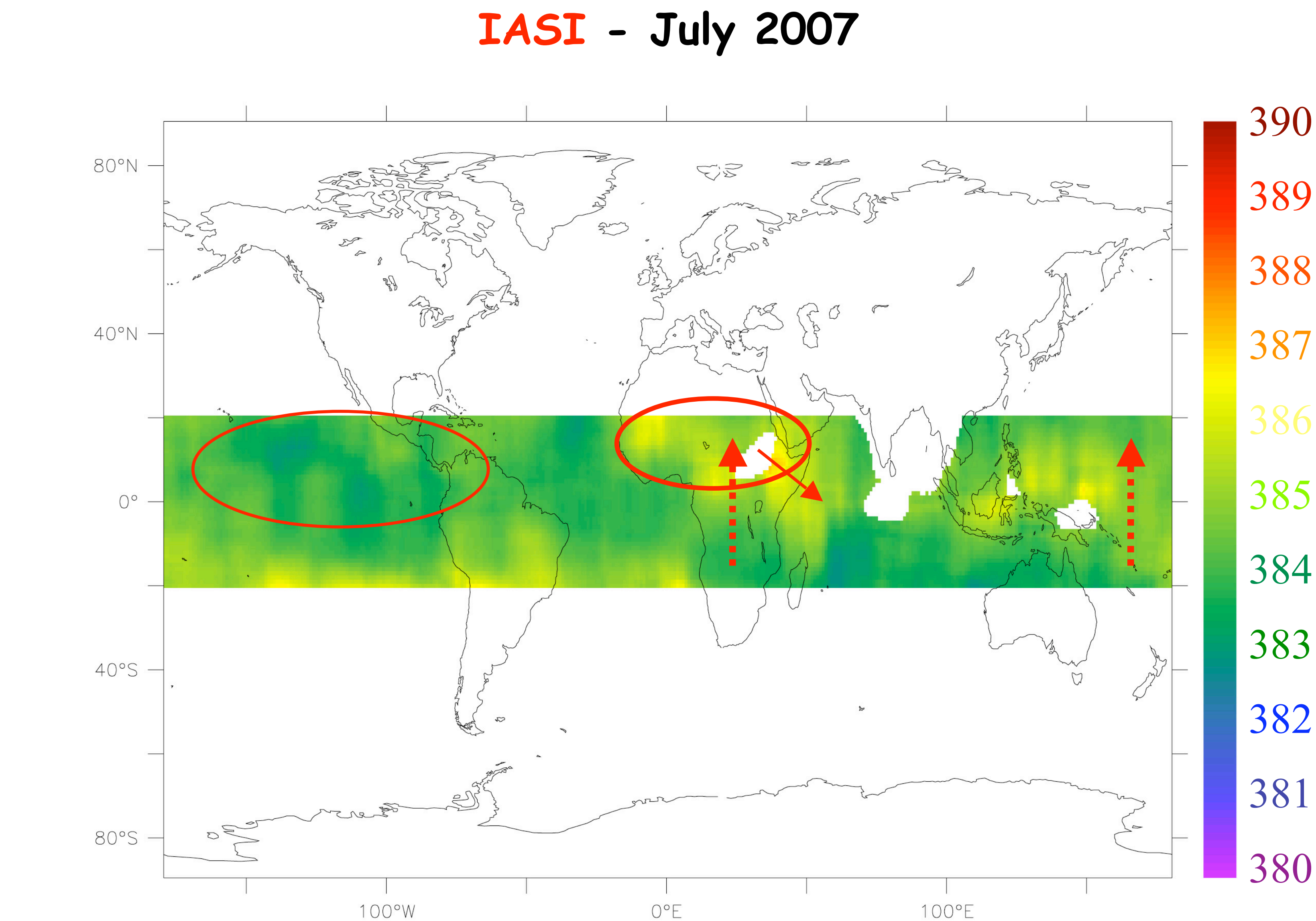
AMSU 7 is working on MetOp!!!

CO_2 field - July 2007



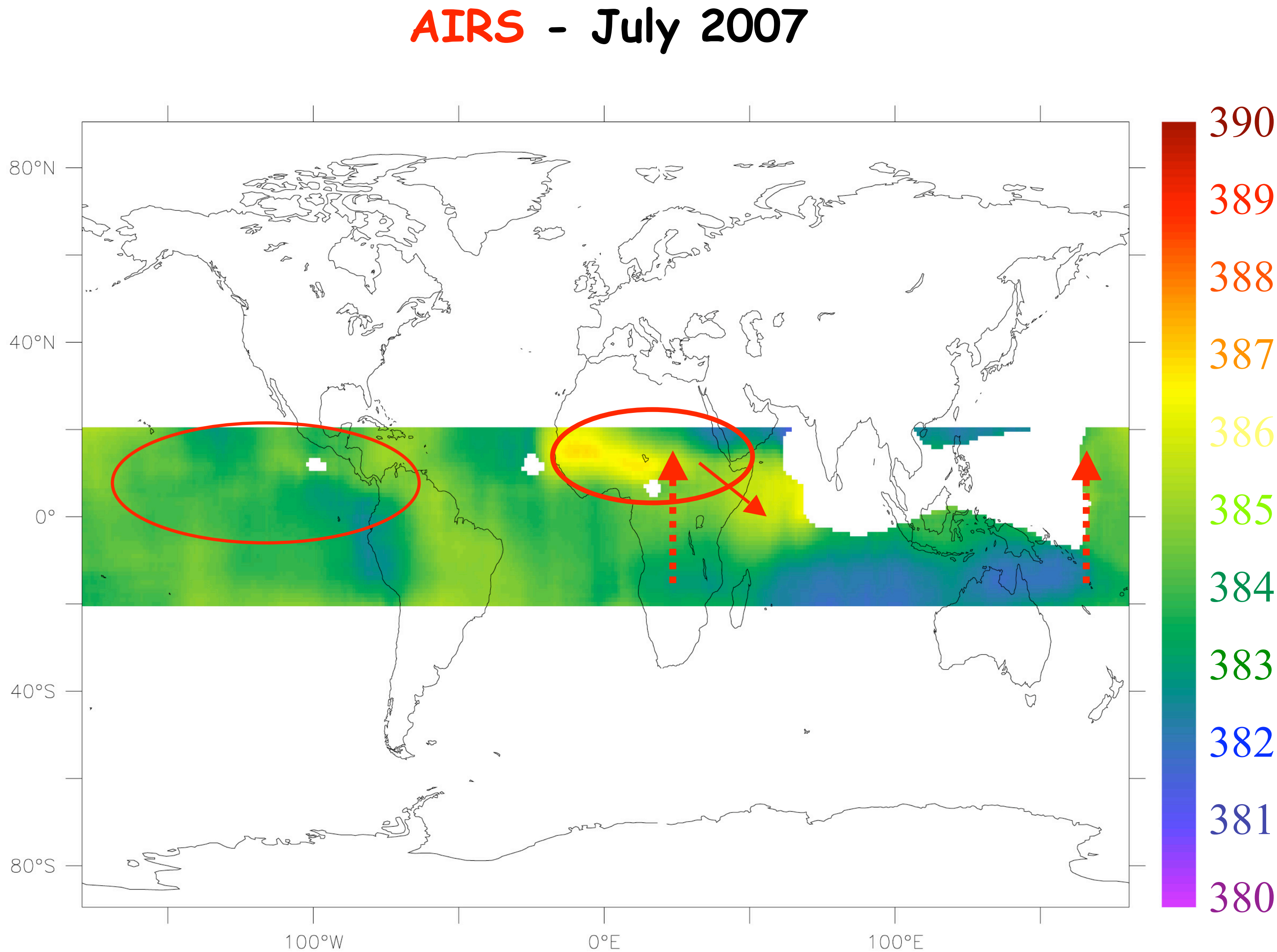
Blanck area = high cloudiness

CO_2 field - July 2007



Blanck area = high cloudiness

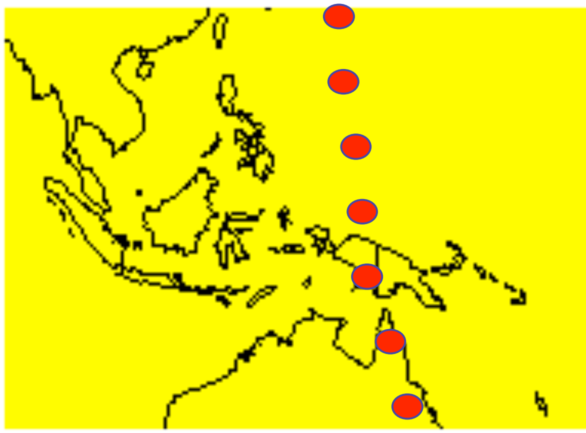
CO_2 field - July 2007



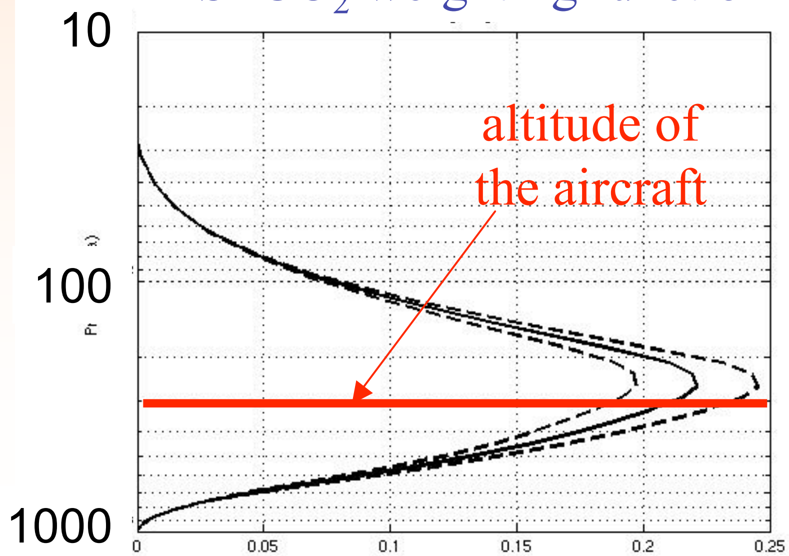
Higher variability with AIRS than with IASI but similar patterns

Evaluation of IASI CO_2

JAL commercial airliners
between Australia and Japan



IASI CO_2 weighting function



•Aircraft [Matsueda et al.]

-8-10 km

-1-2 points/month

-until March. 2007

•IASI CO_2

-integrated content 5-15 km

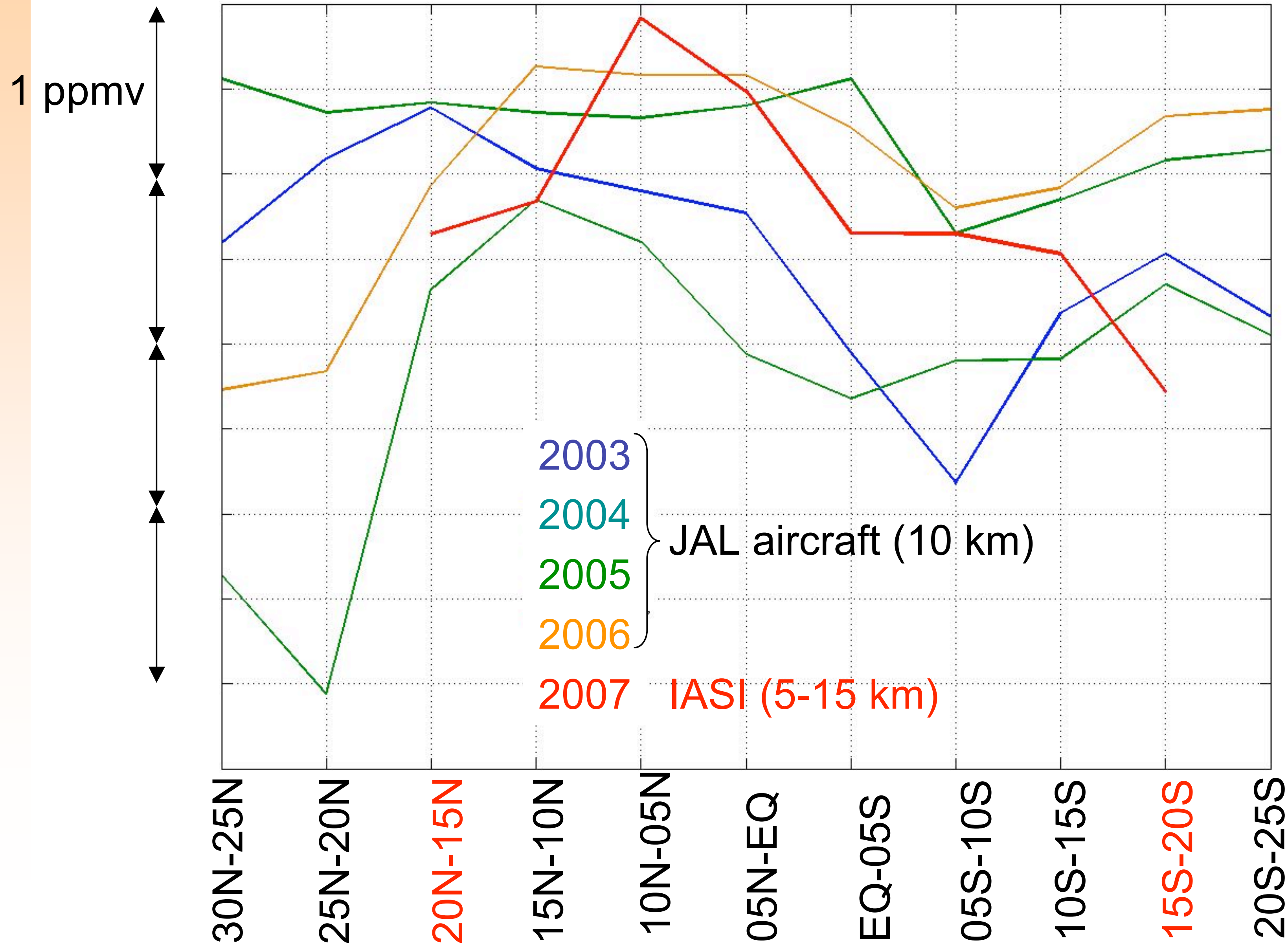
-monthly mean

-period: July 2007

Study of the North-to-South gradient

Study of the North-South gradients

CO_2 latitudinal variation in July



Conclusions

1. One month has been interpreted in terms of mid-to-upper tropospheric concentration of CO_2 in the tropics. This has required:
   - -downloading of the data
   - -cloud detection (HIRS4)
   - -radiative biases

2. Good agreement of CO_2 distribution between IASI and AIRS but lower variability with IASI.

3. General good agreement with in-situ observation in terms of latitudinal gradients.

4. Next steps:

-Extend the retrievals to the whole period…

-Extend the retrievals to temperate regions.

-Study of other gases: CH_4, CO, etc.

-Study of related signals such as fire emission.