IASI conference
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Improving the knowledge of the atmospheric state using the validation of the level1 radiances of IASI

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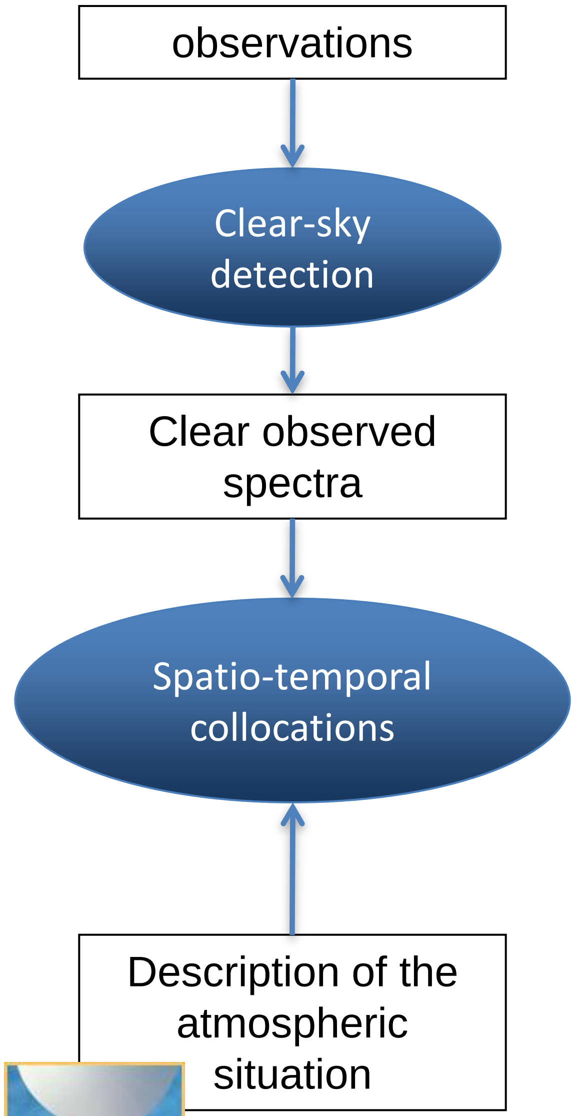
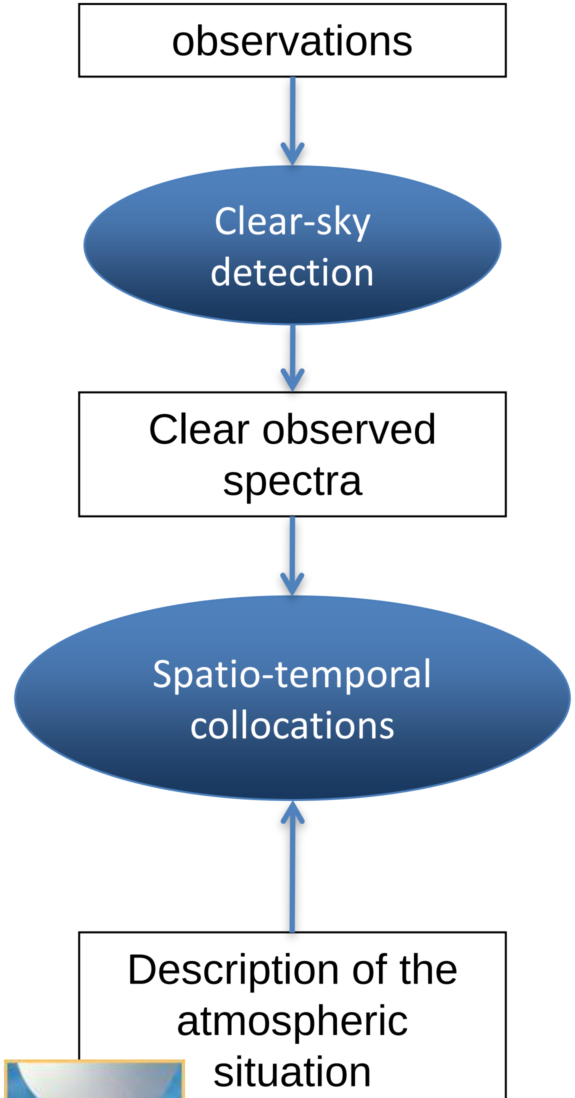
L1 Validation chain at LMD



Validation chain

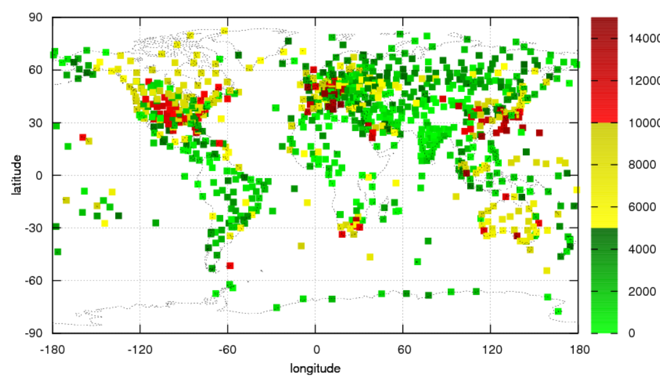


The Analysed RadioSounding Archive (ARSA)

- ❑Radiosounding from ECMWF selected after severe quality controls (fully automated)
- ❑Extrapolation of T and H_2O profiles when necessary (ERA_Interim up to 0.1 hPa, then with, ACE-FTS L2)
- ❑Add missing parameters such as ozone profile and surface temperature

⇒A 43-level description of the atmosphere between surface and 0.0026 hPa including P, T, H_2O, Ozone profiles, surface temperature, Geolocation + date/time

⇒***See Poster Scott et al. , S2-81***

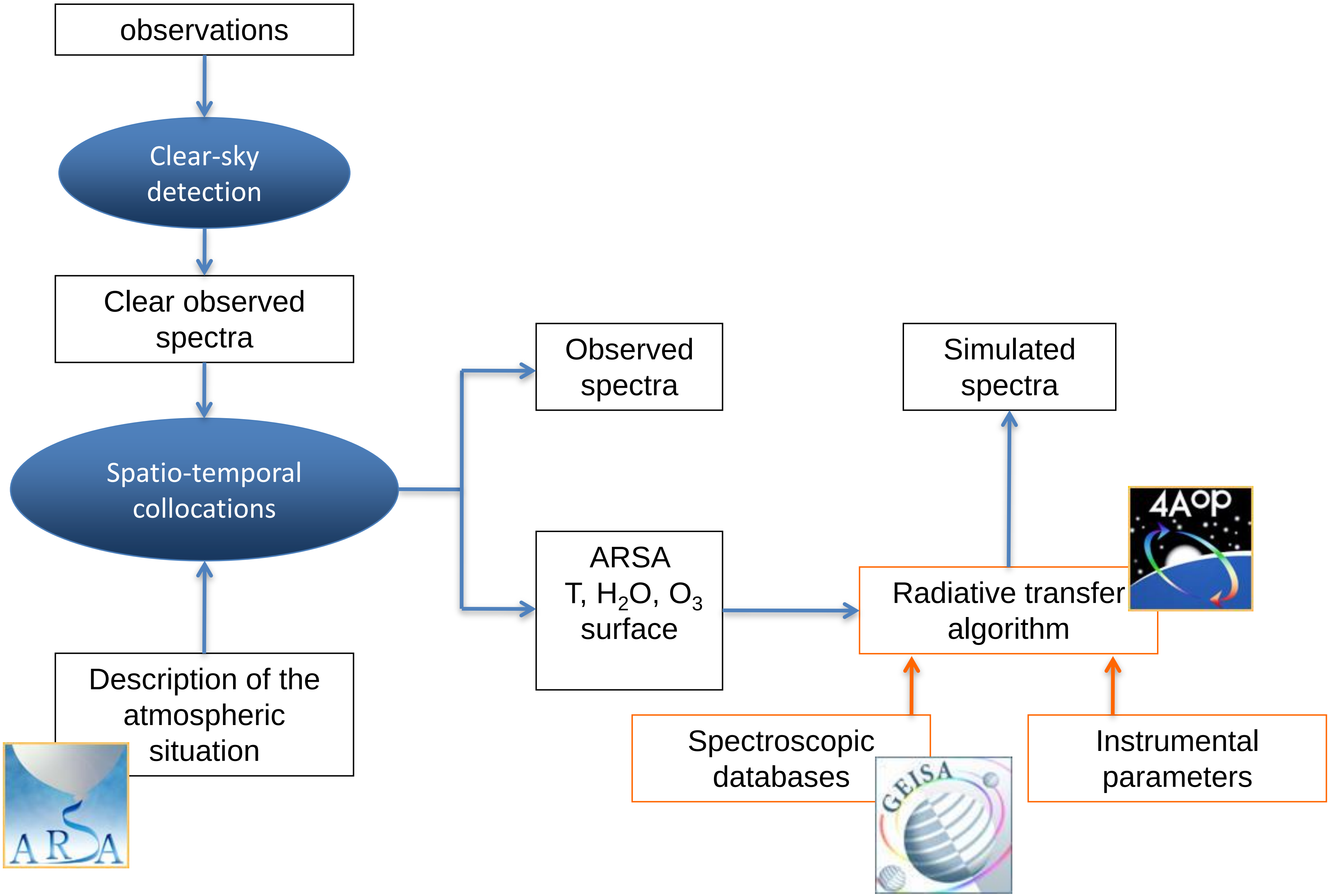


ARSA starts in January 1979 and is extended continuously

So far: A total of > 4.9 million profiles from a total of ~22 millions considered

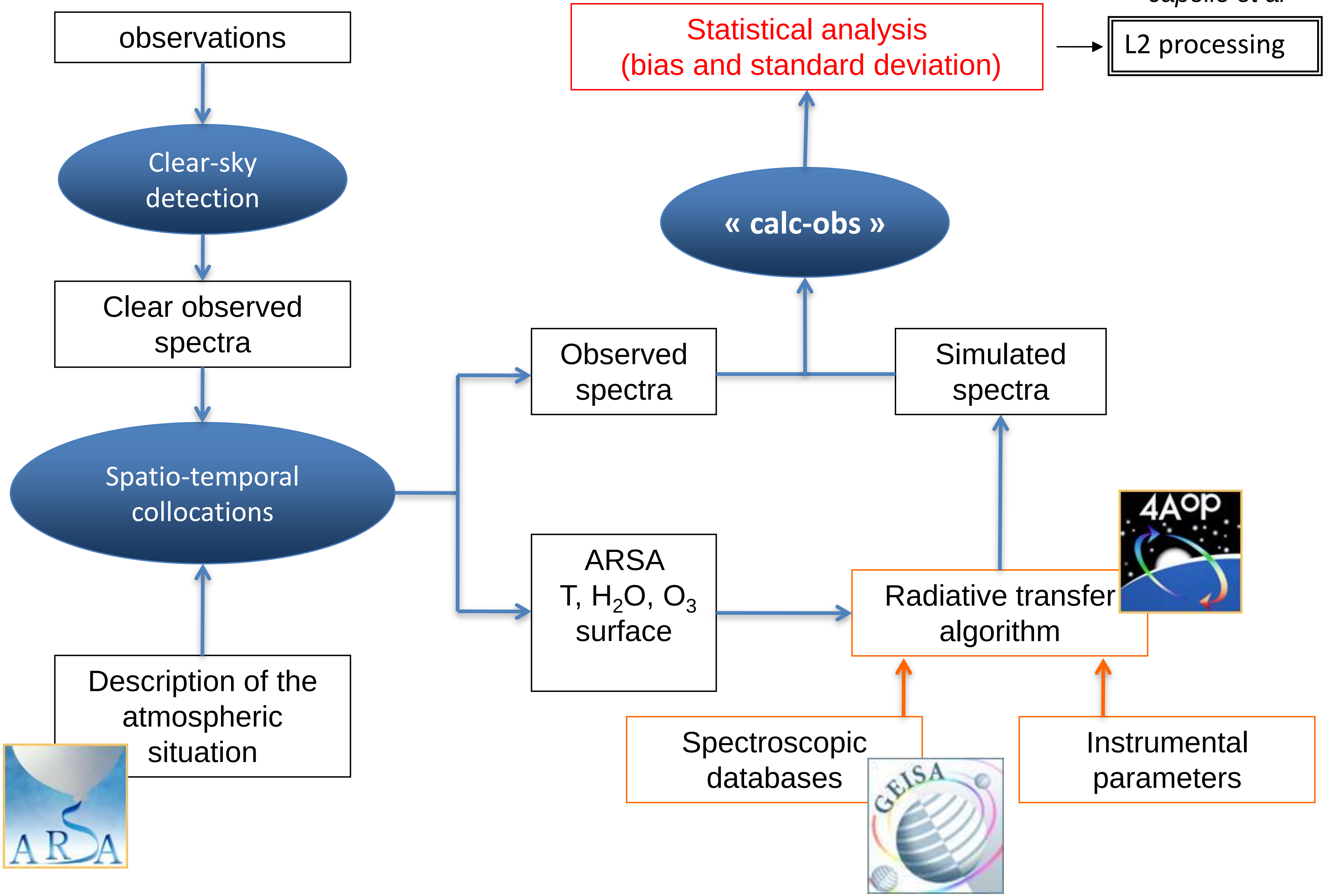
ARSA available at http://ara.abct.lmd.polytechnique.fr/index.php?page=arsa.

Validation chain

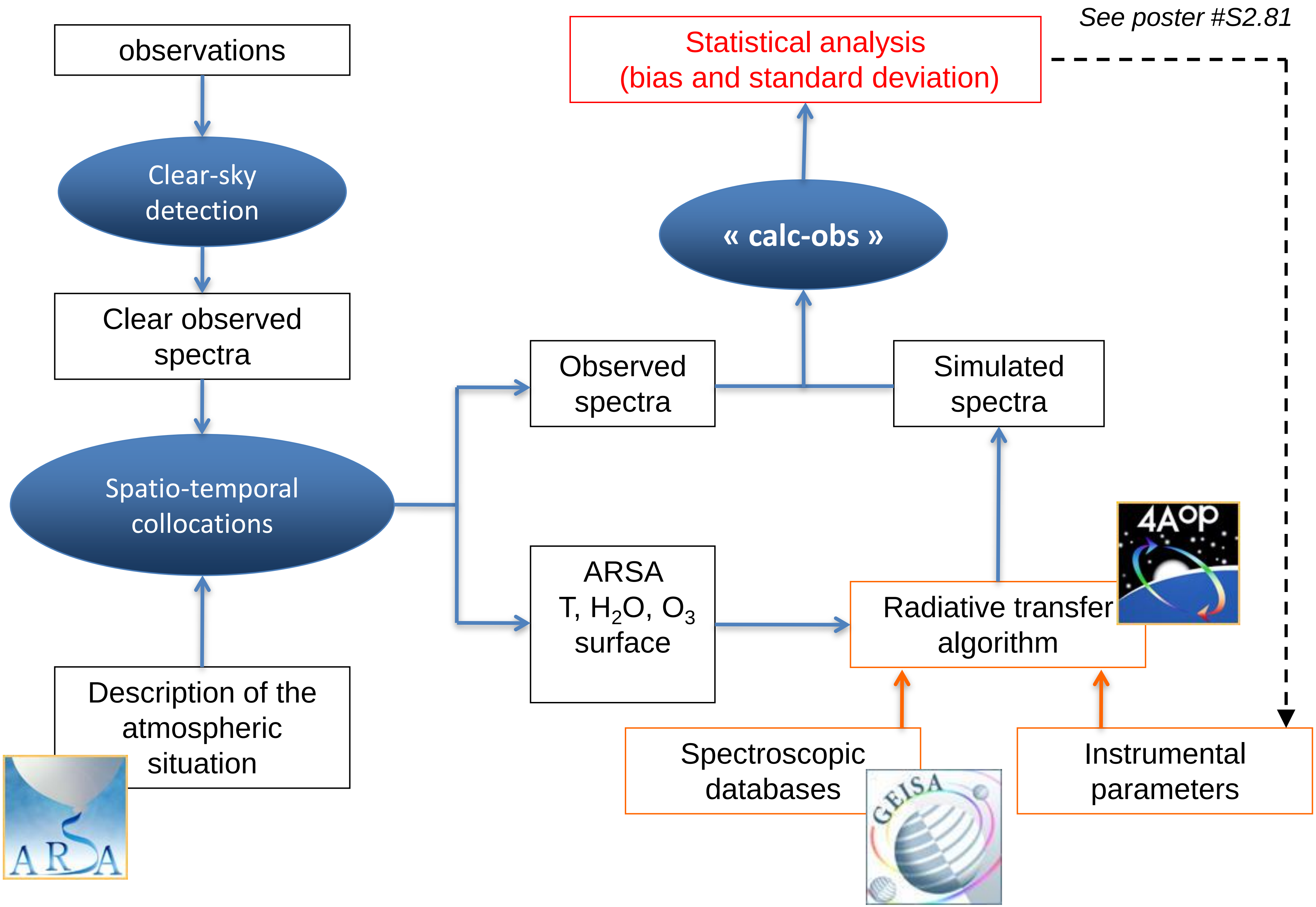


Validation chain

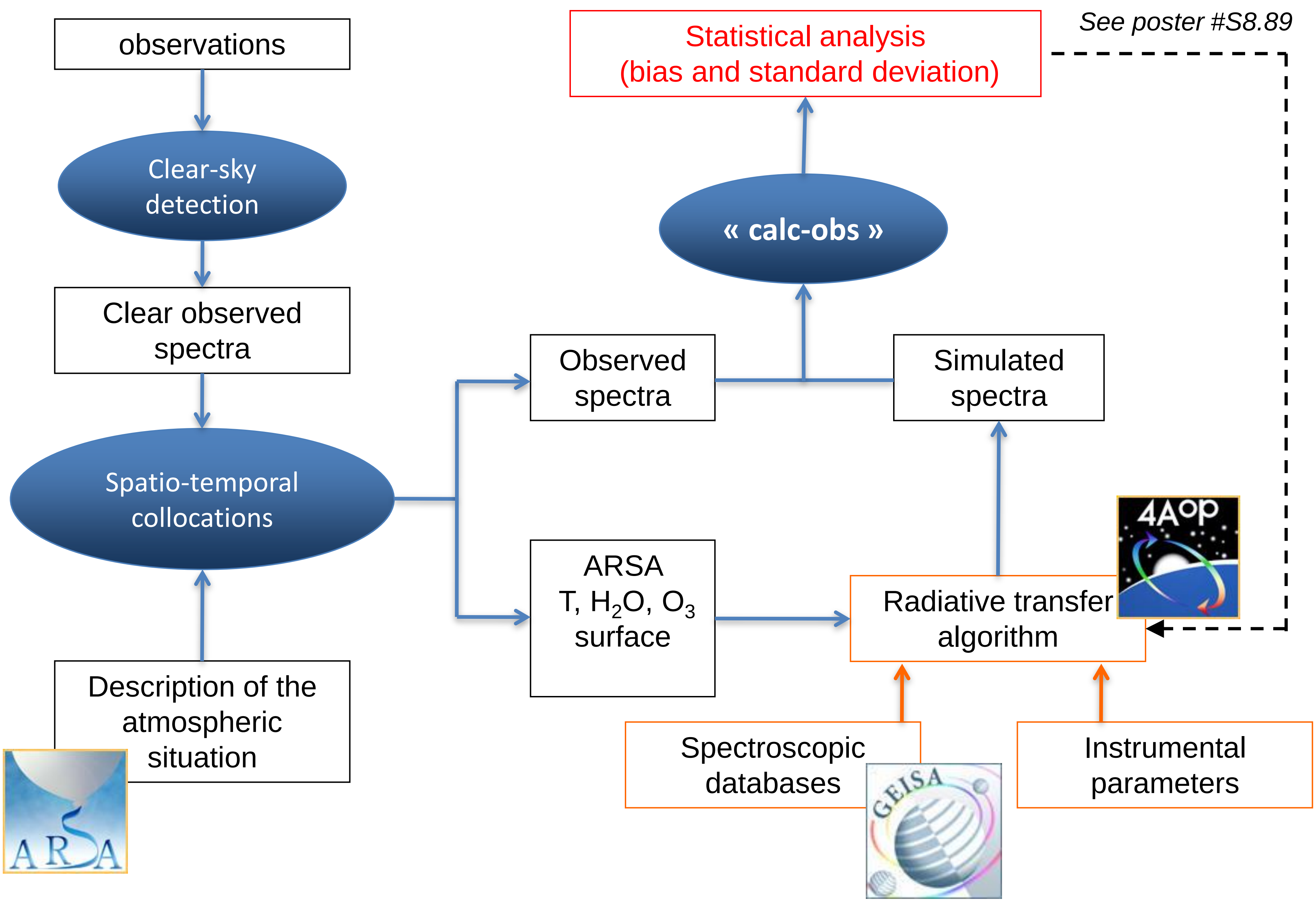
See posters #S2.82, S5.105, S7.14, oral capelle et al



Validation chain : L1



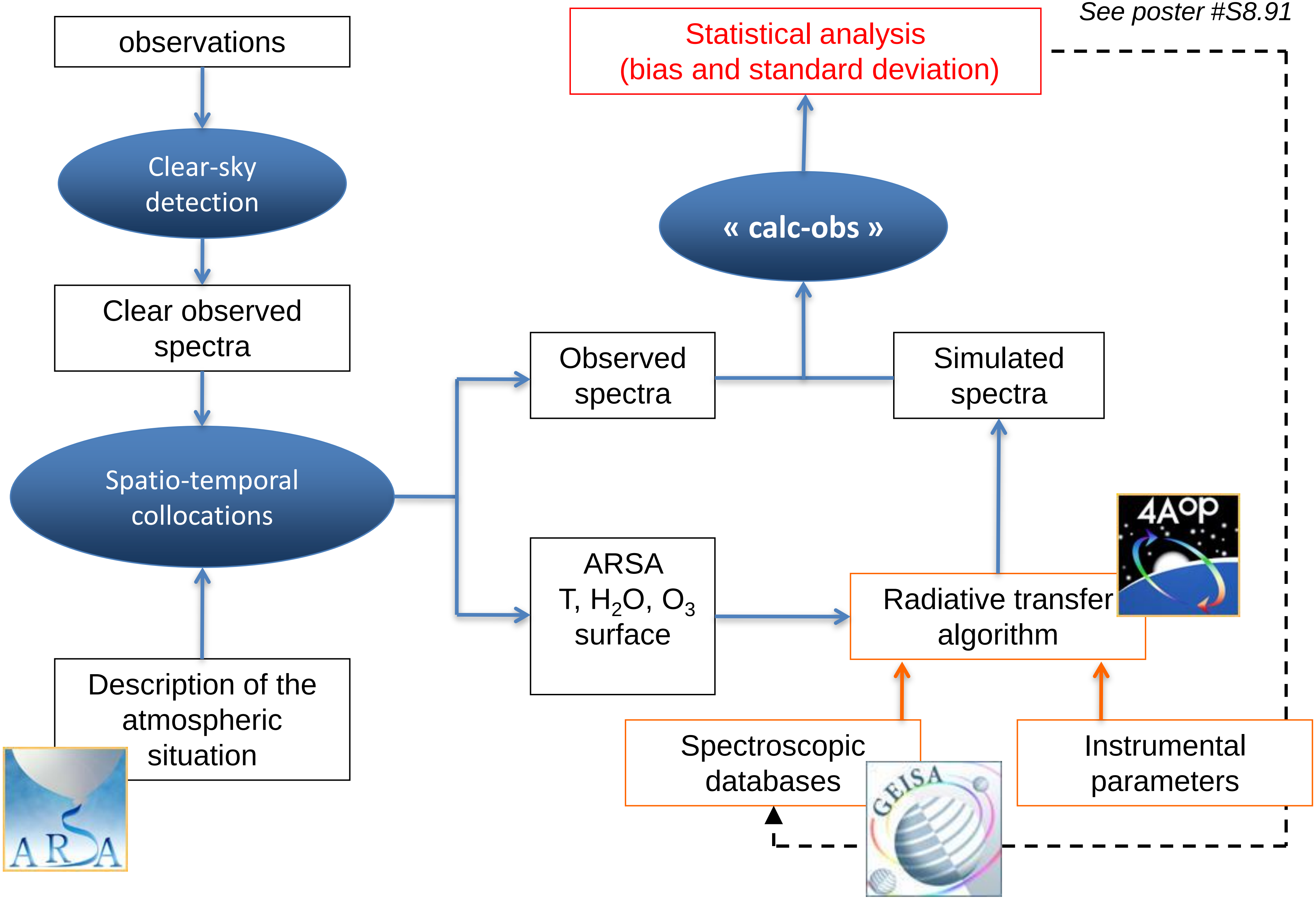
Validation chain: Radiative transfer



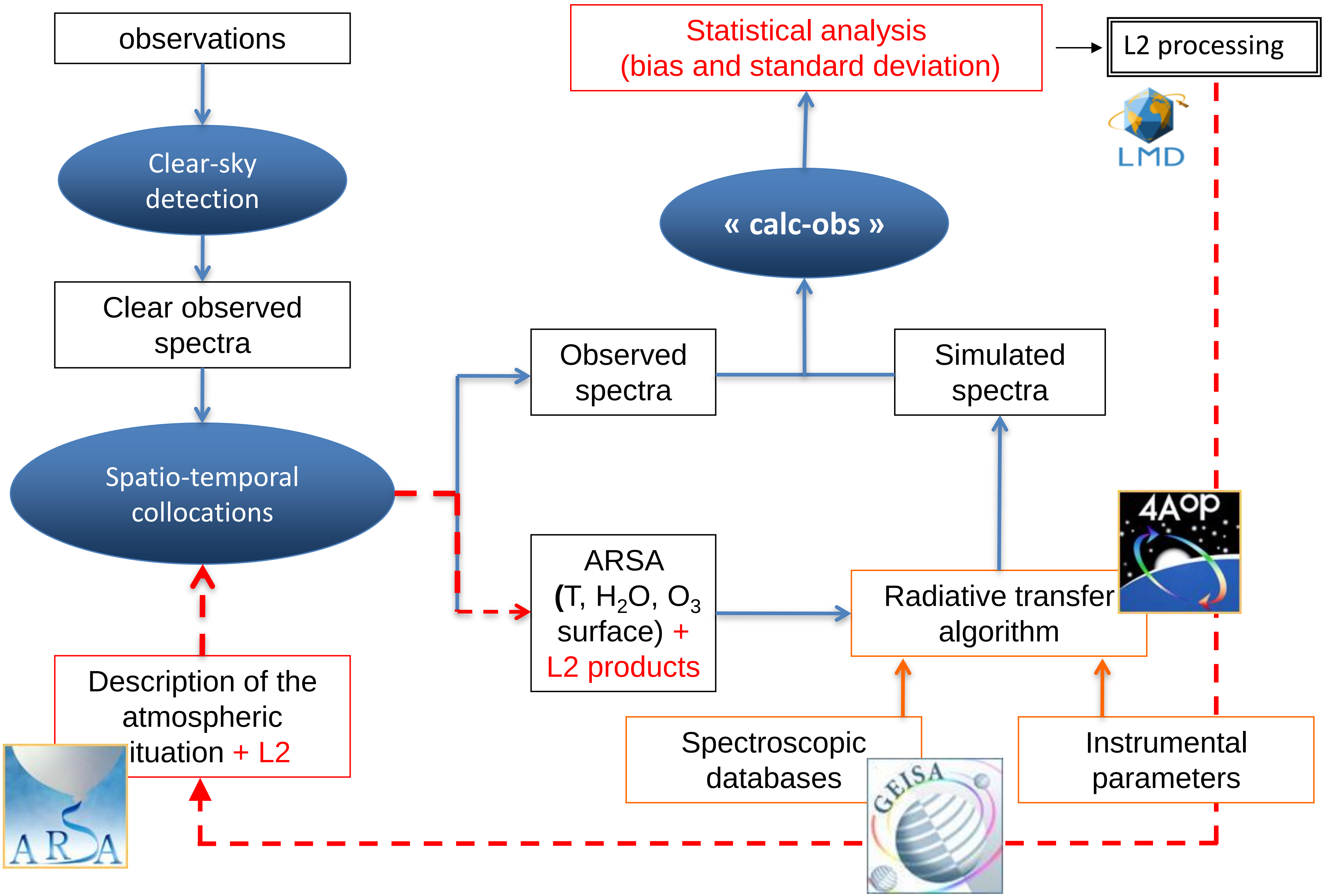
Validation chain: Spectroscopic parameters

(Armante et al, JMS, 2016 accepted)

See poster #S8.91



This talk: Validation chain for L2 products



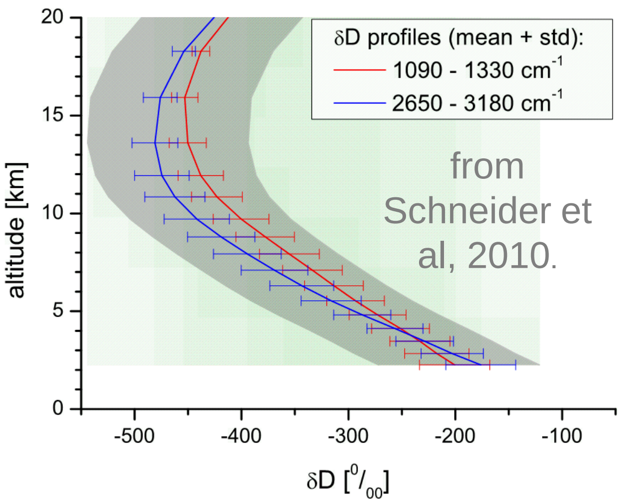
L2 Validation: HDO/H_2O

(Armante et al, JMS, 2016 accepted)

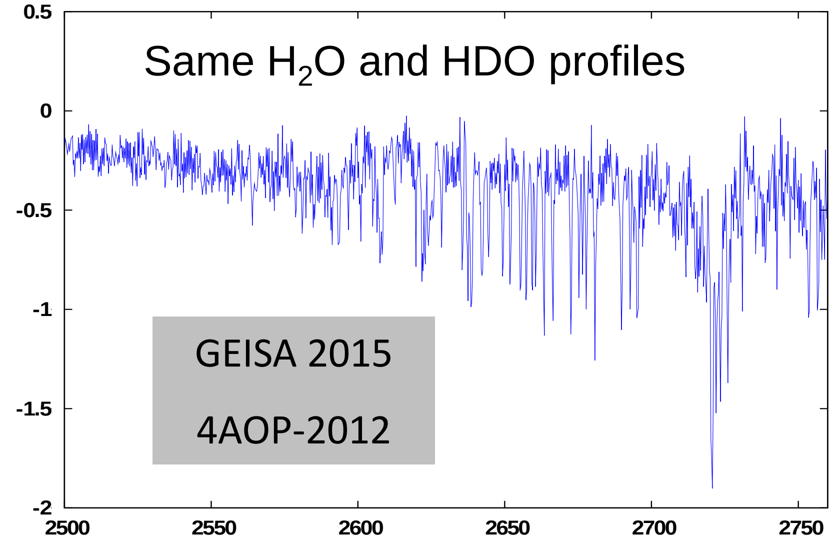
Results : In the 2500-2760 cm^{-1} spectral region

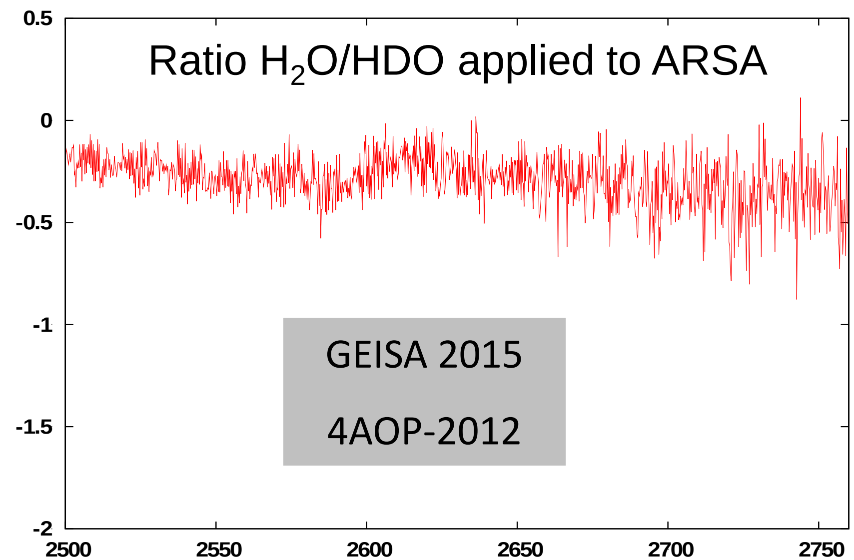
Bias between simulated and observed brightness temperatures may be as high as **1.5 K** especially in the 2720. – 2730 cm^{-1} spectral region. Sign is negative, indicating too high an absorption in this region.
From GEISA ➔ Main absorber is ***HDO***

Several works indicate a vertical variation of the δD value
$\delta D = 1000 \times ([HD^{(16)}O]/[H_2^{(16)}O] / SMOW - 1)$, with Standard Mean Ocean Water SMOW = 3.1152×10^{-4}



Vertical variation of the δD value :
Impact on Simulated vs Observed differences (mean H/D profile applied to each ARSA H_2O profiles)

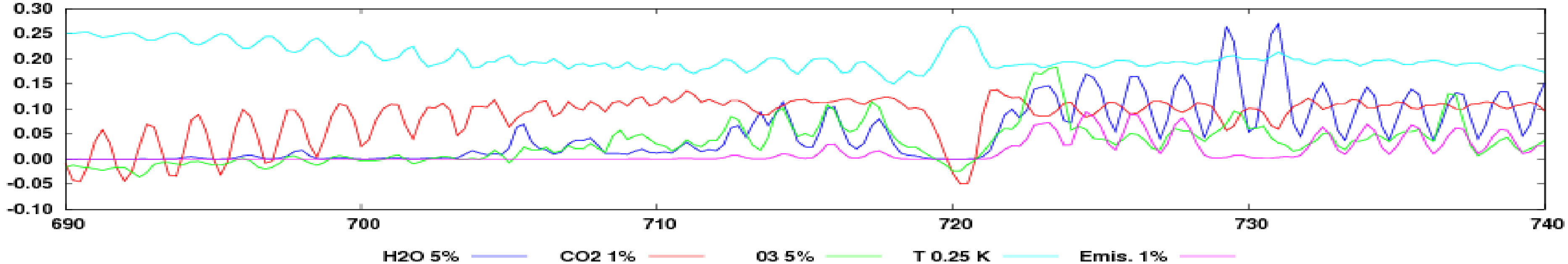


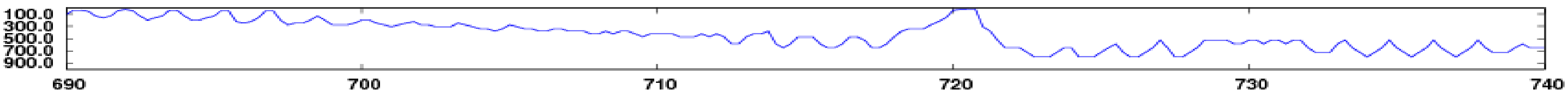


L2 Validation: GHG (CO_2 at 15 μm)

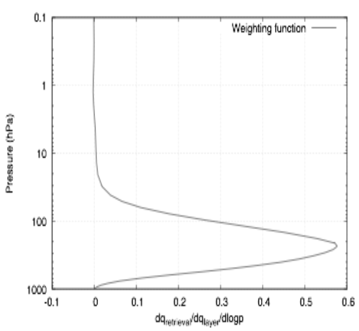
talk Membrive et al later

Sensitivity of IASI channels to various atmospheric variables



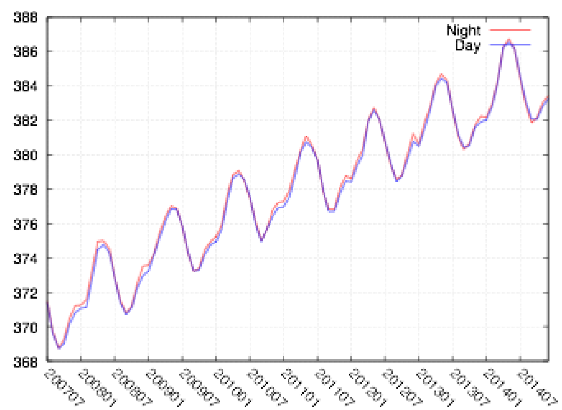


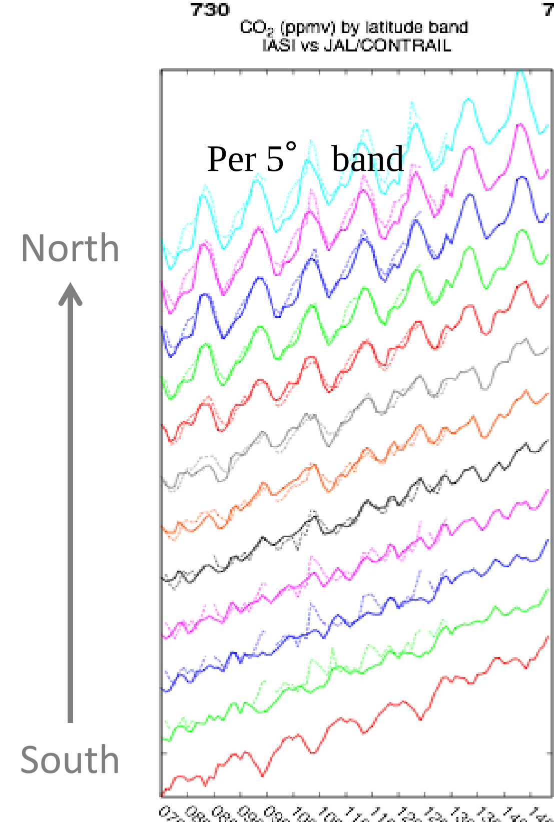
- **Evaluation of CO_2 retrieved at LMD from IASI/AMSU:**



•Mid-tropospheric column
•Clear-sky, land/sea, day/night
•NLIS method with 84 channels
•Tropics only: 30S-30N

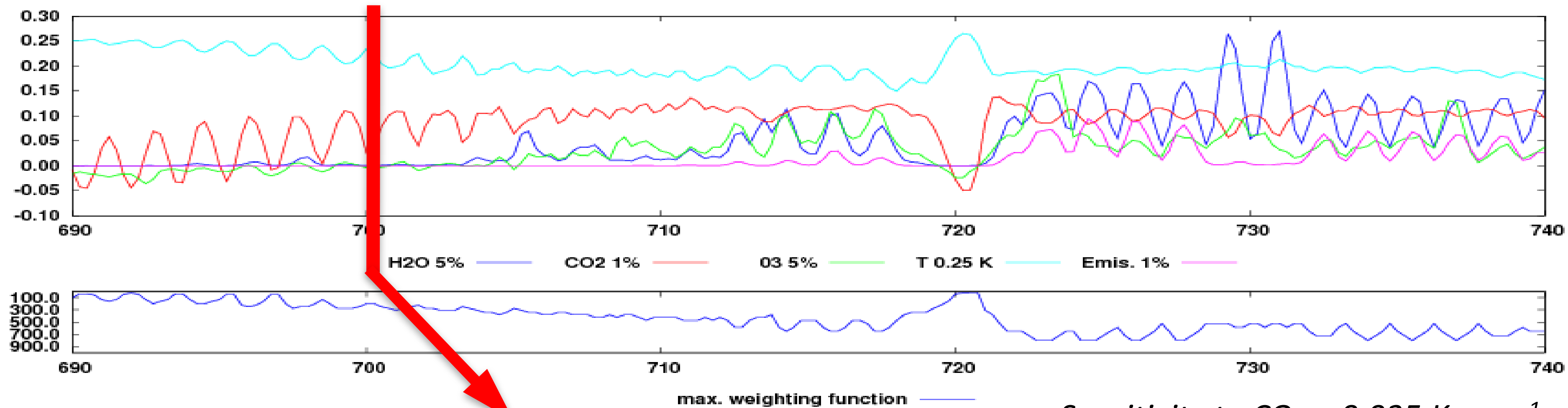
Averaged seasonal cycle



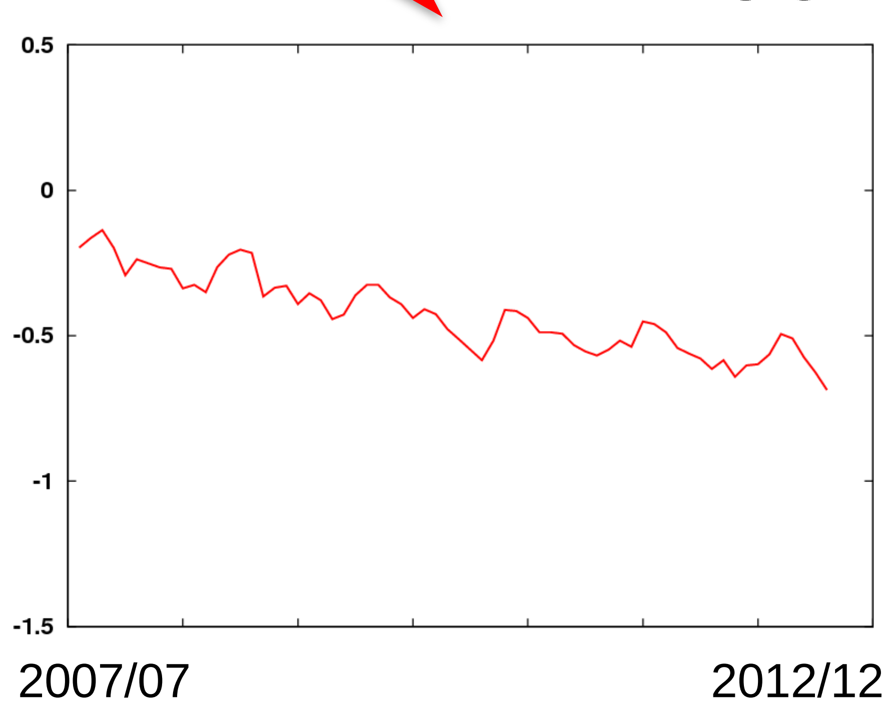


L2 Validation: GHG (CO_2 at 15 µm)

Ch 218: used in the retrieval.



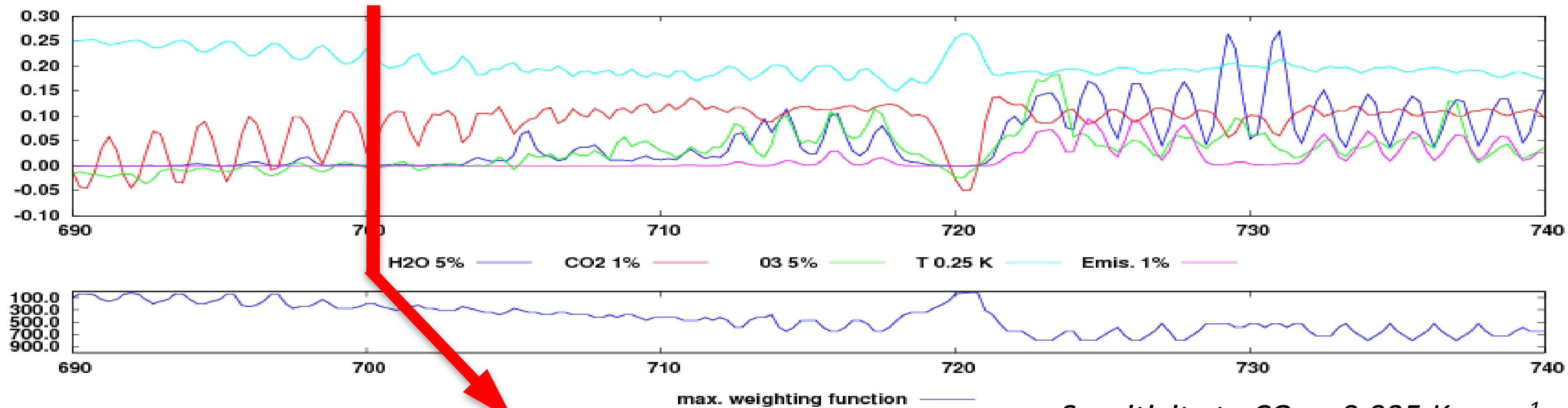
Sensitivity to CO_2: ~0.035 K ppm^{-1}



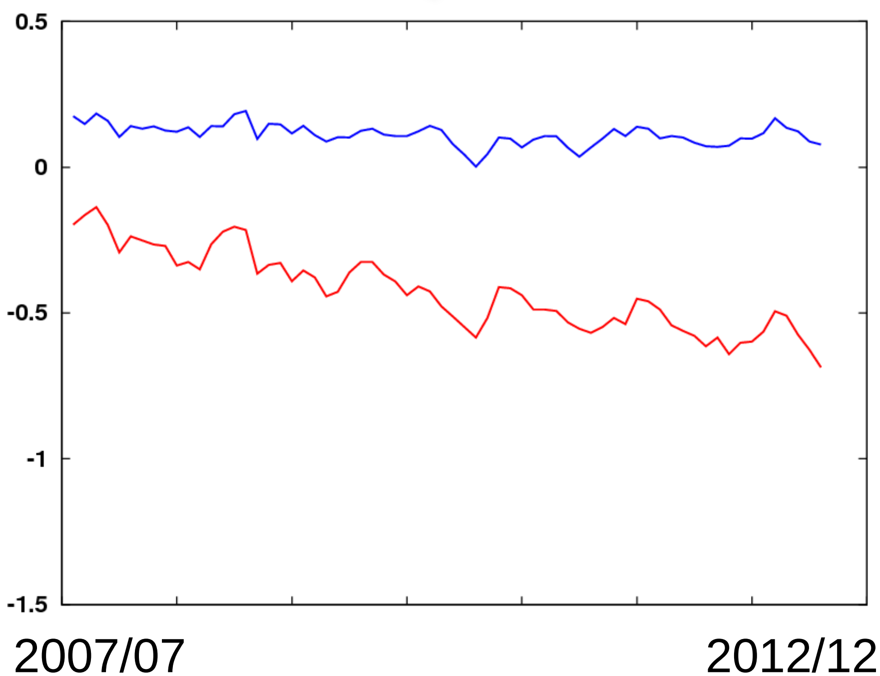
« calc – obs » when assuming a fixed CO_2 at 372 ppm

→ trend and seasonality due to CO_2 (1st order: 2.1 ppm yr^{-1})

L2 Validation: GHG (CO_2 at 15 µm)



Sensitivity to CO_2: ~0.035 K ppm^{-1}



« calc – obs » when using ARSA and the retrieved CO_2 column

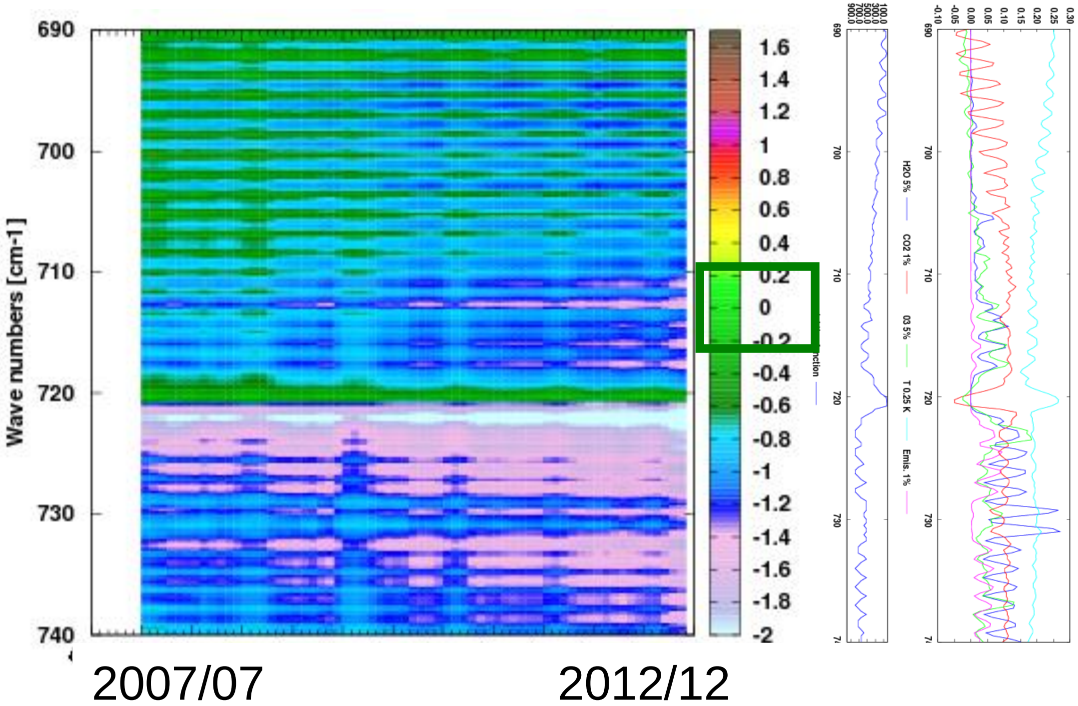
« calc – obs » when assuming a fixed CO_2 at 372 ppm

→ trend and seasonality due to CO_2 (1st order: 2.1 ppm yr^{-1})

Ch 218: used in the retrieval.

L2 Validation: GHG (CO_2 at 15 µm)

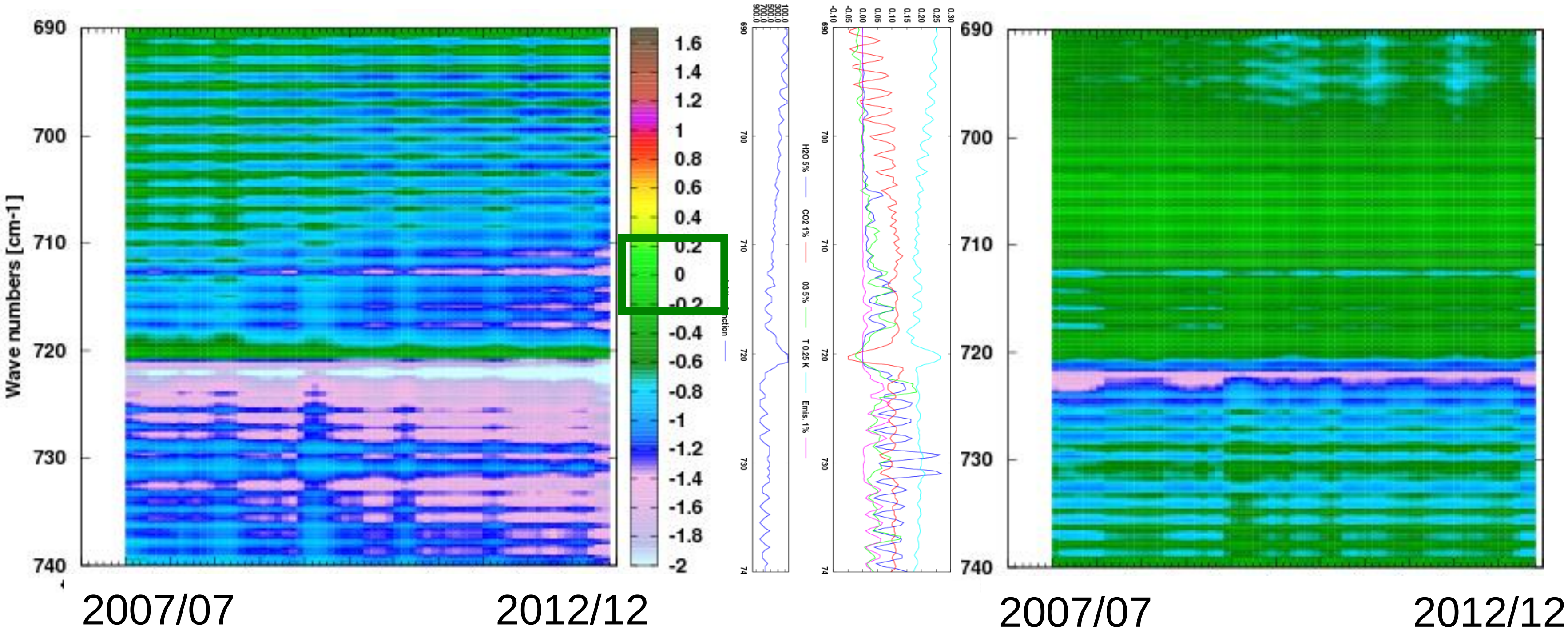
« Calc. – Obs. » 4A/OP, ARSA, Tropical, Sea, Day



Δc-o [372ppm] (K)

L2 Validation: GHG (CO_2 at 15 µm)

« Calc. – Obs. » 4A/OP, ARSA, Tropical, Sea, Day



Δc-o [372ppm] (K)

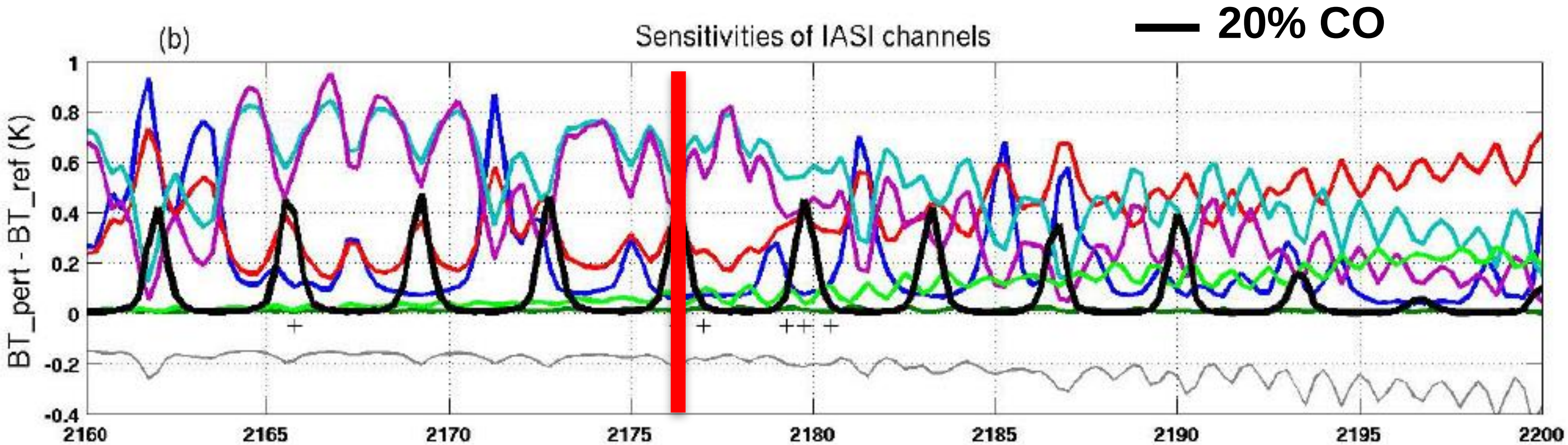
Δc-o [ARSA+L2 CO_2] (K)

- Taking L2 CO_2 yields radiative residuals Δc-o closer to 0 for channels mostly sensitive to CO_2 (wave numbers < Q-Branch at 720 cm-1).

  → Good consistency between CO_2 retrieved from IASI and… IASI radiances.

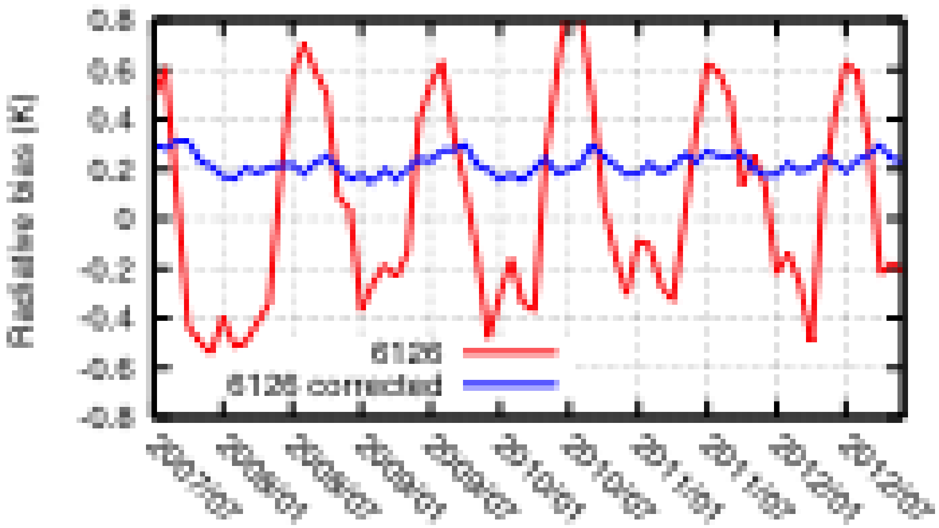
- For ω > 720 cm-1, seasonality and trend mostly removed but any spectroscopy issues could remained as well as high sensitivity to H_2O and O_3 has to be studied.

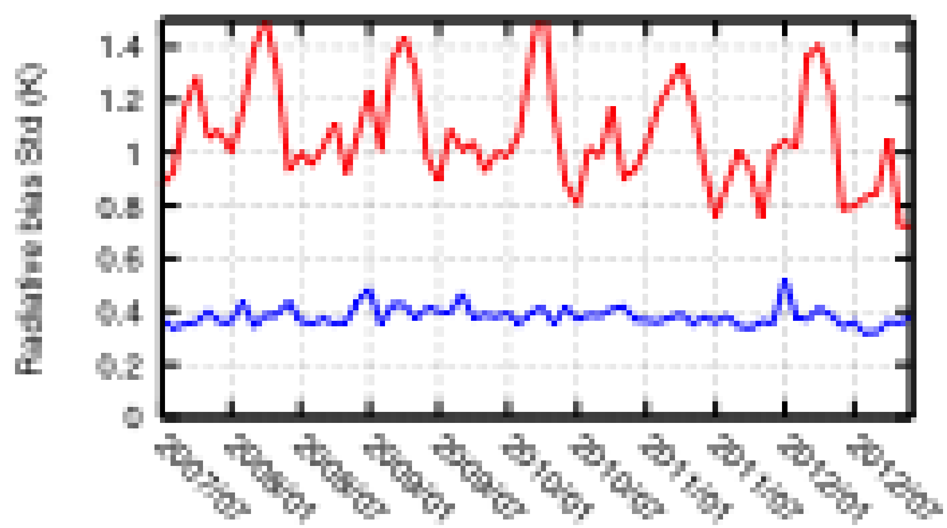
L2 Validation: GHG (CO at 4.6 µm)



ARSA (T, H2O, O3, Temp. Surface) + CO (LMD)

Ch. 6126





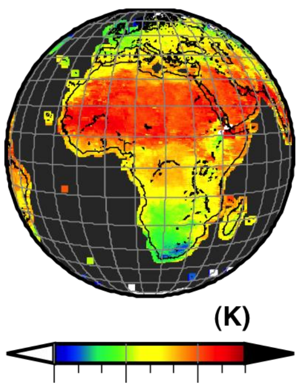
L2 validation: The surface properties (temperature and emissivity)

•**Method**: Physical inversion of the RTE using a fast RT model (Péquignot et al., 2006, Capelle et al., 2012)

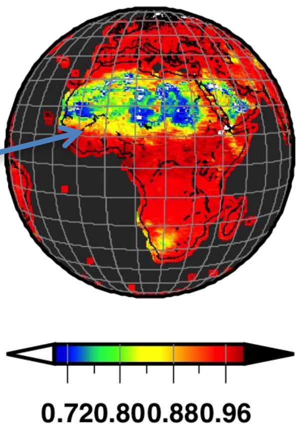
•**outputs**:

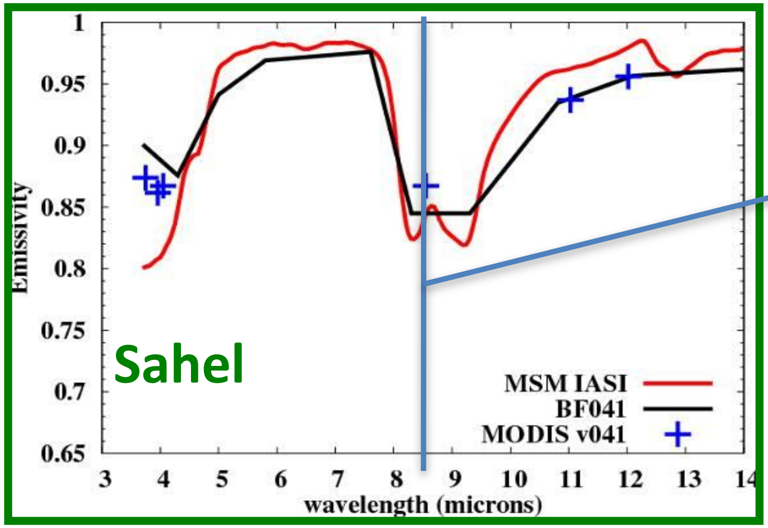
✓Sea: Surface Temperature
✓**Land: Surface temperature and emissivity continuous spectrum at 0.05 µm resolution between 3.7 and 14.0 µm for monthly grid (0.5° X 0.5°)**
✓ **ST and aerosols AOD for each IASI spot**

Surface temperature



Surface emissivity at 8.65µm





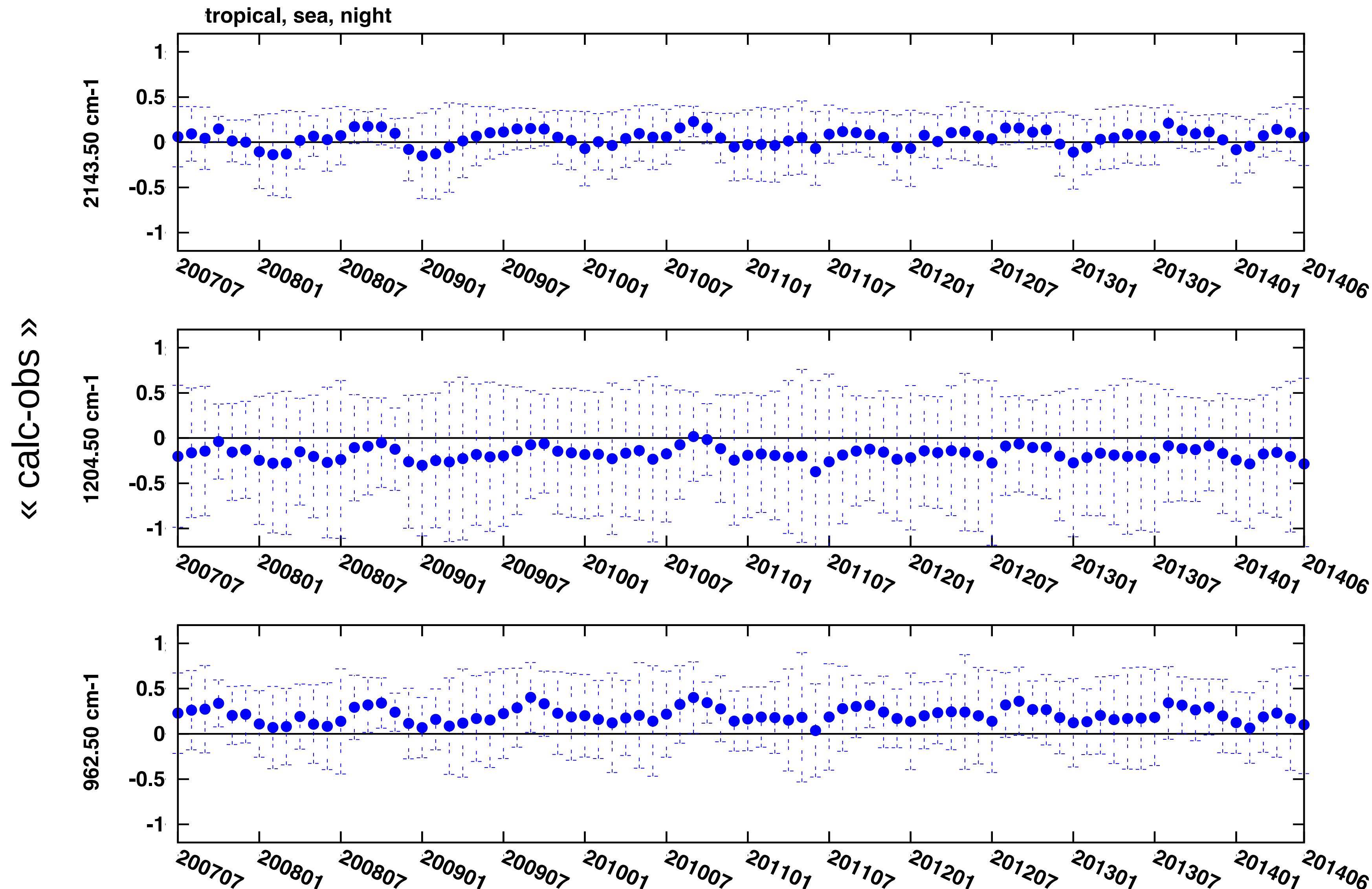
See poster #S8.91

L2 validation: Impact of two different SST on the L1 “calc-obs” (1/2)

•**NB**: an alternative/first method developed at LMD was a regression using channels around 2143 cm^{-1}

➢ **tropical, sea, night, 2007/07 → 2012/12 (snyder emissivity used)**

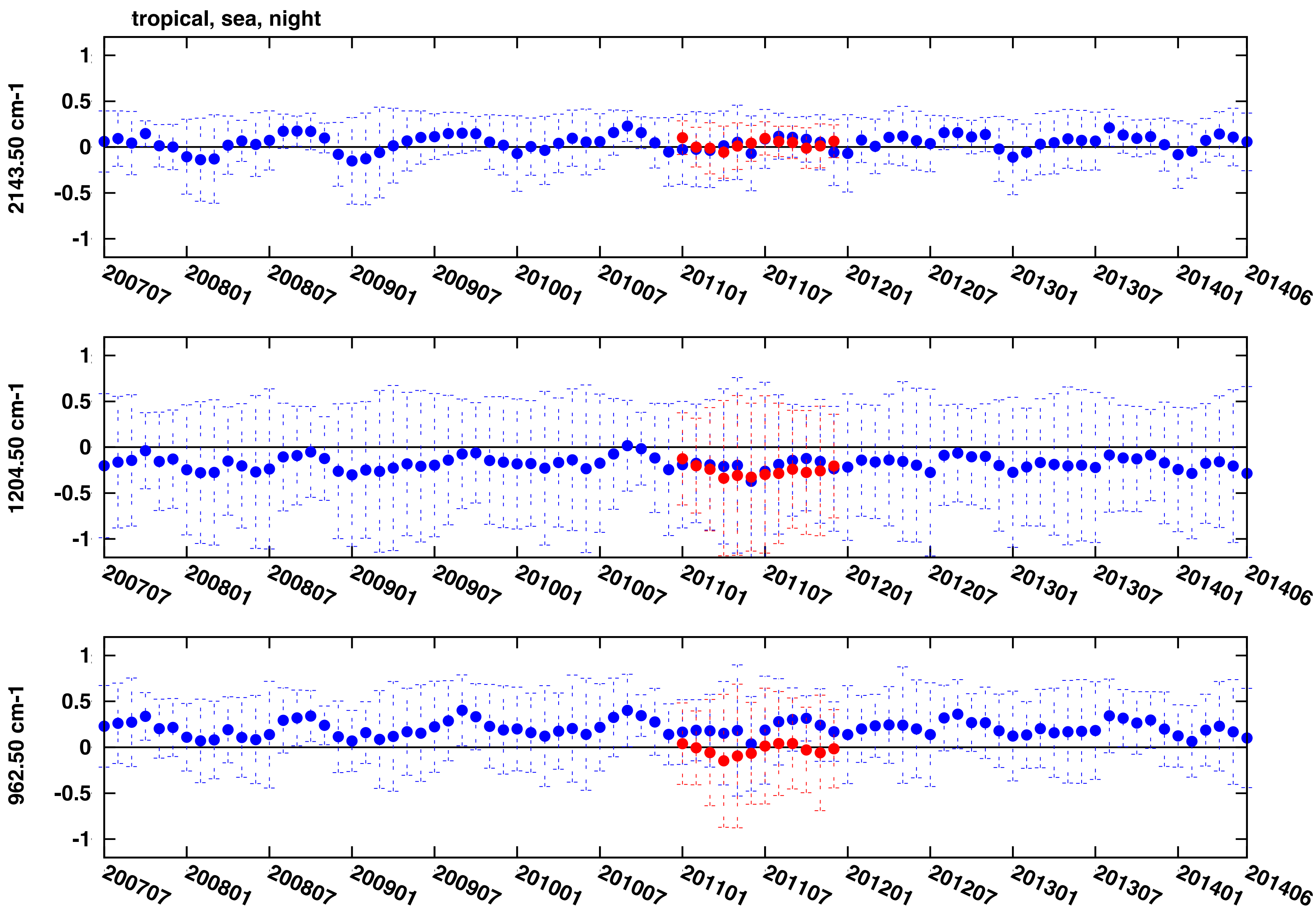
60000 atms



L2 validation: The SST

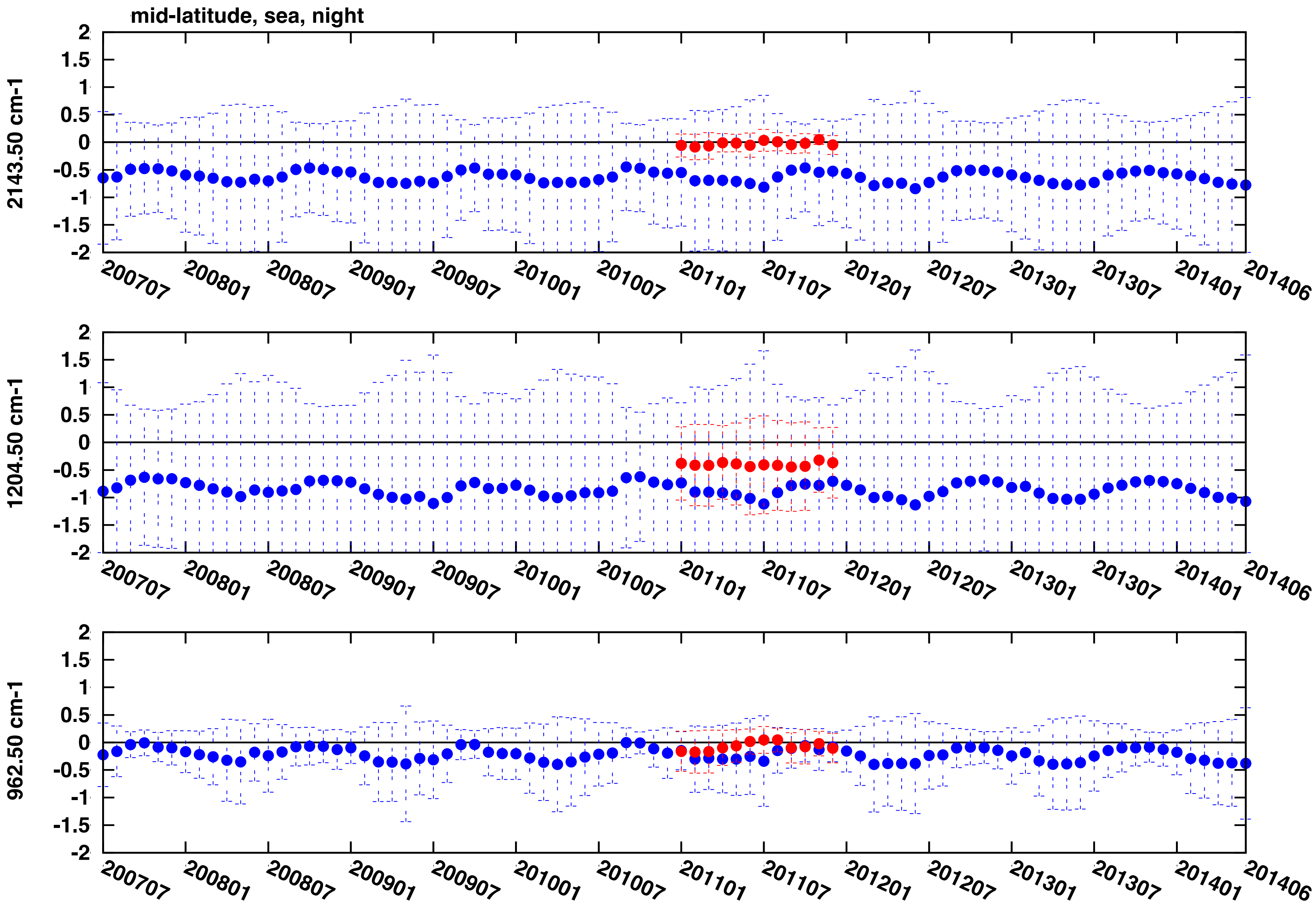
- regression using the 2143.50 cm-1 IASI channel (blue)
- Physical method (red) (use of the emissivity of snyder)

2011 : 13000 atms



L2 validation: The SST

- ➢regression using the 2143.50 cm-1 IASI channel (blue)
- ➢Physical method (red) ➔ emissivity of snyder

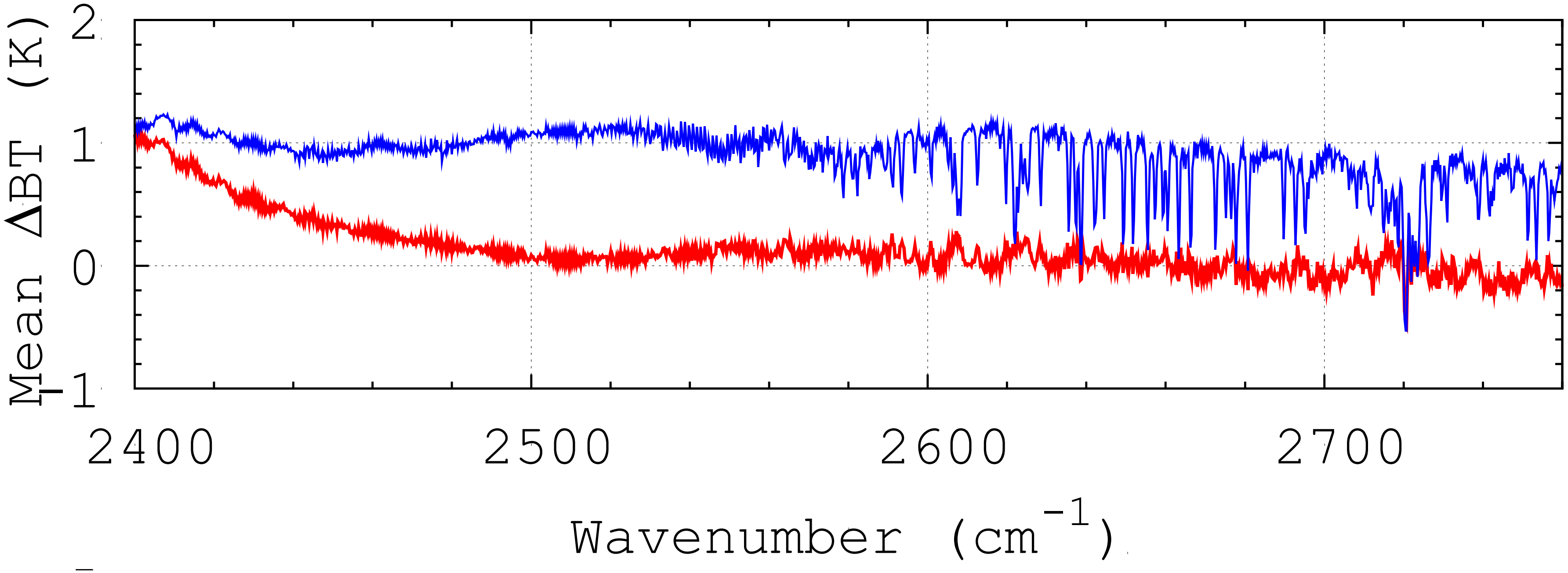


L2 validation: The LST and emissivity

- ➢regression using the 2143.50 cm-1 IASI channel (blue)
- ➢Physical method (red) ➔ temperature and emissivitiy

2011 : 30000 atms

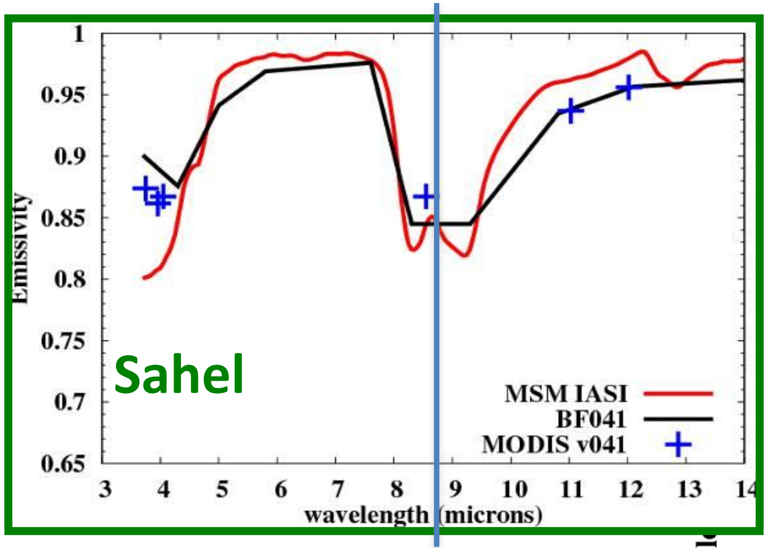
Saharan collocations (100 km)



L2 validation: The LST and emissivity

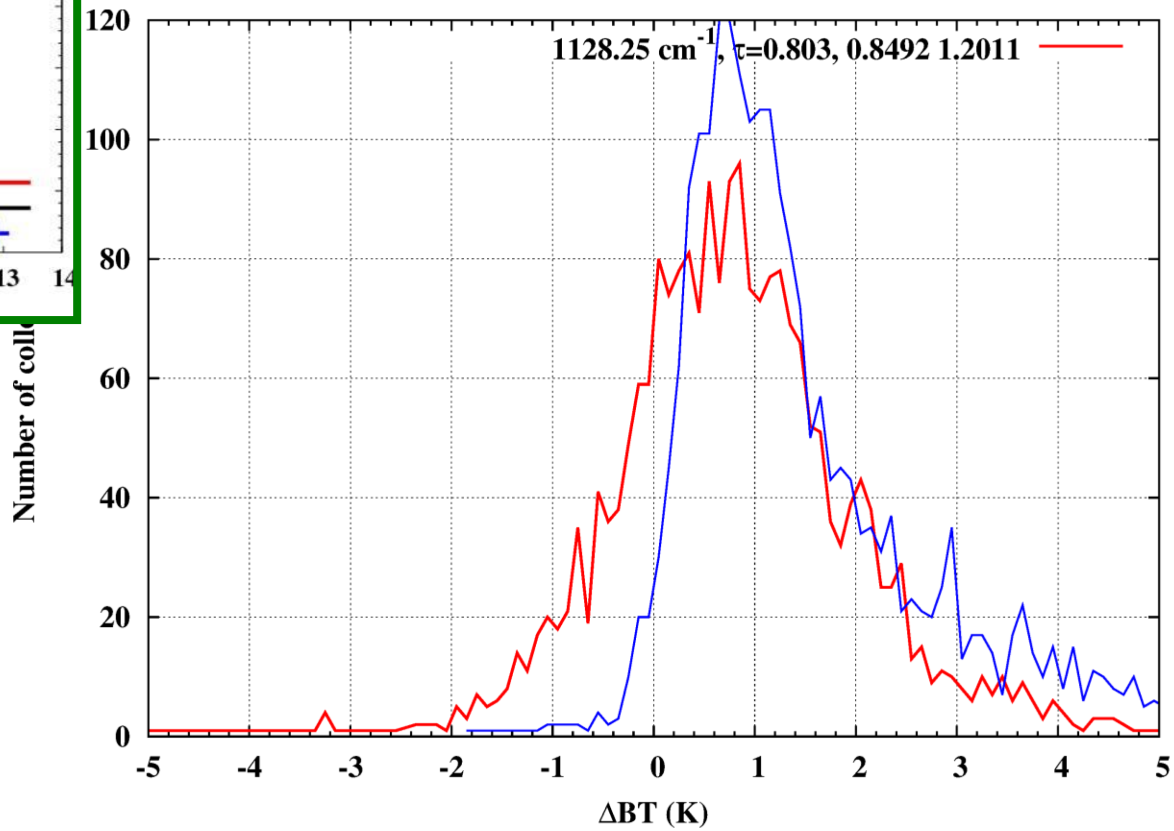
2011 : 20000 atms

- regression using the 2143.50 cm-1 IASI channel (blue), emiss.=0.98
- Physical method (red) ➔ temperature and emissivity



Saharan collocations (100 km)

Bias=0.85 K, Stdv=1.2 K



Poster #S5.105

L2 validation: Conclusions and perspectives

Conclusions:

✓Study of radiative biases give a way of evaluating the consistency of the retrievals
✓Knowledge of channel characteristics vs. L2 is needed (e.g. tropo. vs strato, interferences between species, etc.) to refine the analysis
✓good constitency of the time series for one parameter at a time (HDO, GHG, Surface properties)
✓Goal: 0 K radiative bias… if spectroscopy, RT code (e.g. line-mixing), instrument, etc. all properly taken into account!

Perspectives:

✓Over sea, estimate also the emissivity and test it in the validation chain
✓Look at the residuals as a function of the viewing angle to detect possible angular effect in the inversion (AMSU asymmetry, …)
✓ take into account various variables simultaneously.
✓validation with the use in the chain of other datasets: ECMWF, Eumetsat L2, …

LMD

L2 validation: Thank you !