IASI on MetOp-B Radiometric Calibration

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2 Noveltis (Toulouse)
3 AKKA (Toulouse)

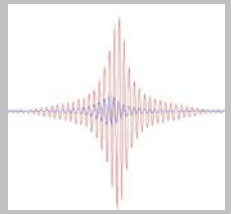
3rd IASI conference, 4-8 February 2013, Hyères, France

OUTLINE

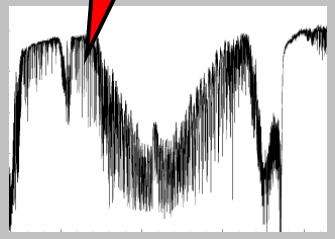
Space Segment – IASI instrument

Straylight

Detection chain
- Gain / Offset
- Delay
- Non linearity



Calibration
- NZpd
- FFT, BBT, CS
- Calibration coefficients
- Imaginary residuals



Coding
- table

Spikes

Ground Segment – L1 processing chain

IASI L0

Scan mirror
- Temperature
- Reflectivity

Black Body
- Temperature
- Filtering

IASI L1

OUTLINE

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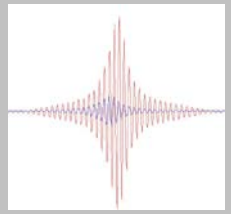

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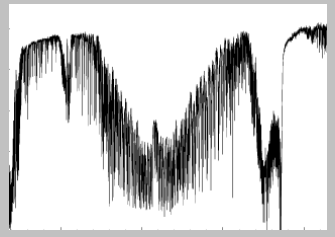

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Ground Segment – L1 processing chain

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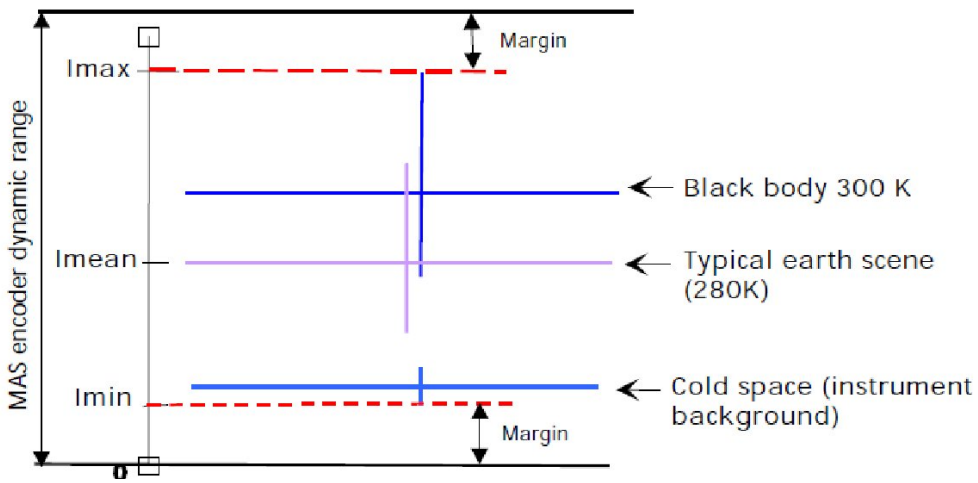
IASI L1

Detection chain

Detectors

Digital processing system

MAS GAIN & OFFSET



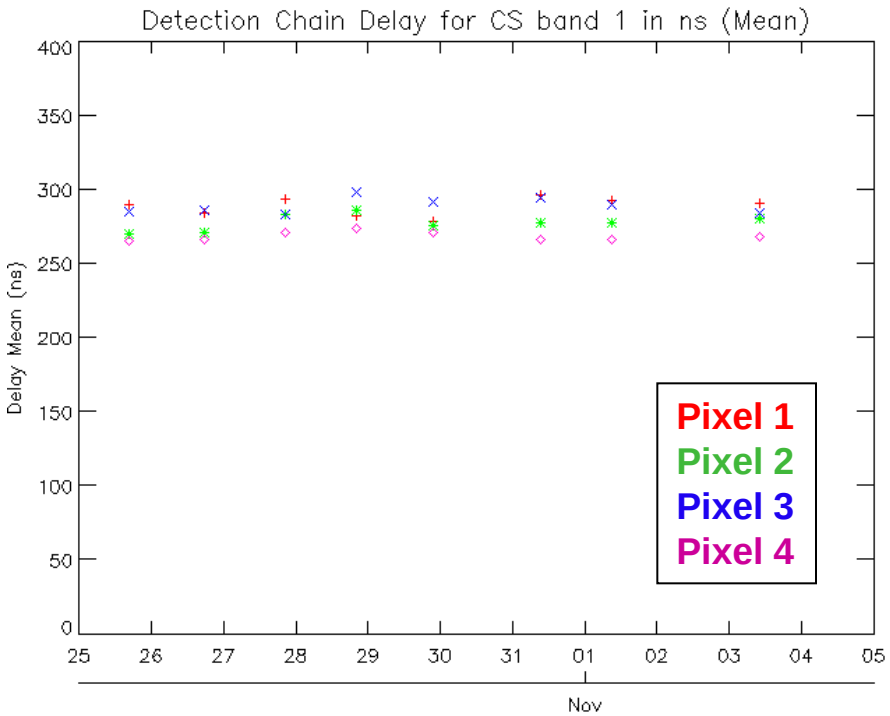
- **optimize detector signal amplification (Signal / Noise)**
- **for each pixel, each spectral band, 8 gains available**
- **Interferogram dynamic monitoring have shown that there's no need of gain & offset update**

Detection chain

Detectors

Digital processing system

DELAY



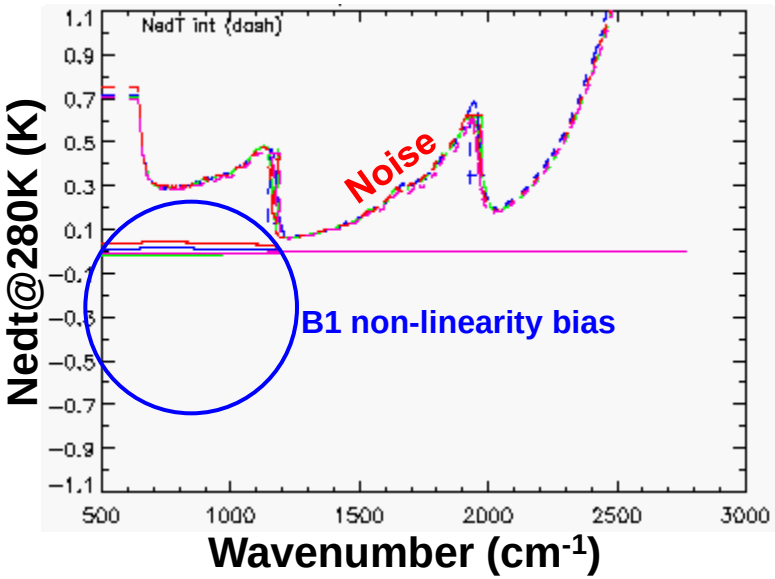
- **Monitored for calibration views (Black Body, Cold Space), Earth views**
- **Specification = max 400 ns**
- **On-board tuning**
- **Stable : no update needed**

Detection chain

Detectors

Digital processing system

ANALOGICAL NON LINEARITY



- **Can cause radiometric error / bias !!**
- **Spectral Band 1 is the most non-linear**
- **Non linearity = f (detector temperature)**
- **Detector target T has changed**

- **Non linearity bias 0.3-0.5 K => < 0.05 K**

OUTLINE

Space Segment – IASI instrument

Detection chain
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- Delay
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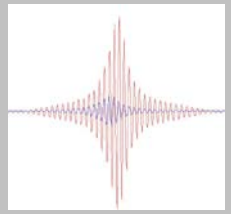

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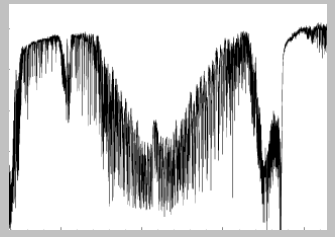

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Spikes

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Ground Segment – L1 processing chain

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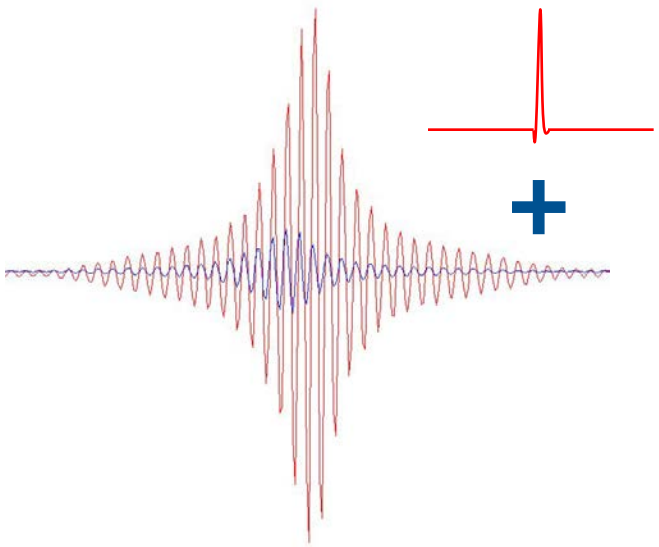
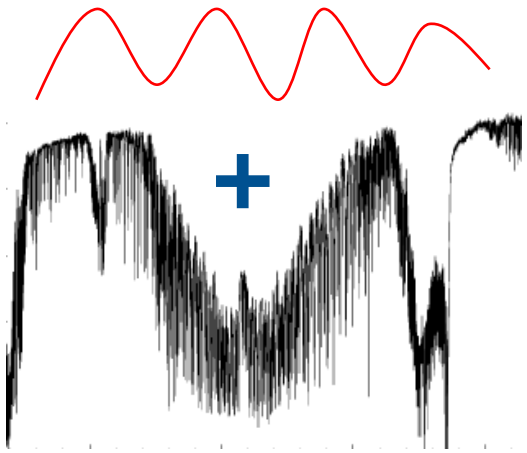
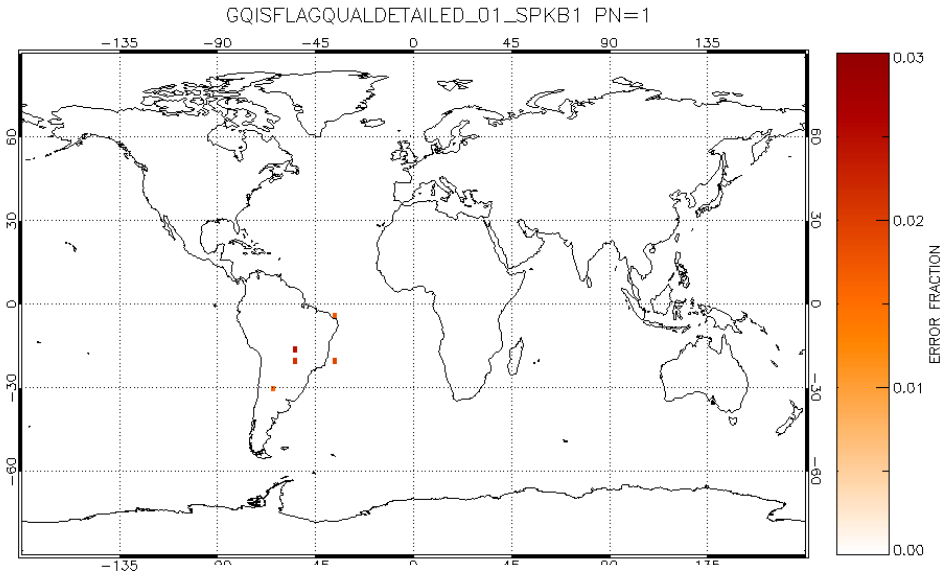
IASI L1

Spikes



Fourier Transform





<u>On-board spike filter :</u>

<u>Method :</u>

- Determine spike model
- Simulate spike effect in the output spectrum and determine the threshold above which the signal in the output spectrum becomes greater than ¼ instrument noise.
- Load the threshold into on-board configuration.

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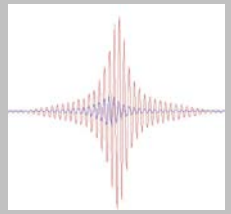

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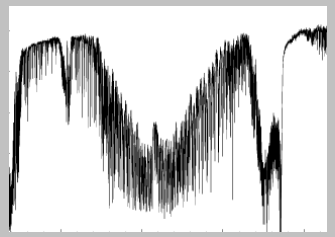

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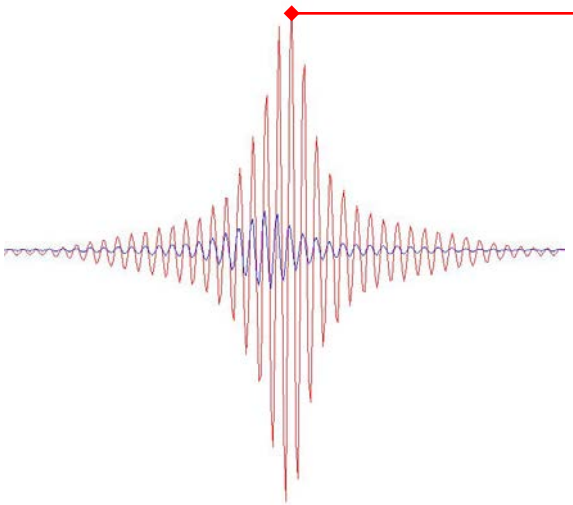
IASI L1

NZpd determination



Method : 3 steps determination (soft)

1- Interferogram maximum
2- Central fringe barycenter
3- Search for the optimal NZpd with respect to the calibration line

Effect of a wrong ZPD:

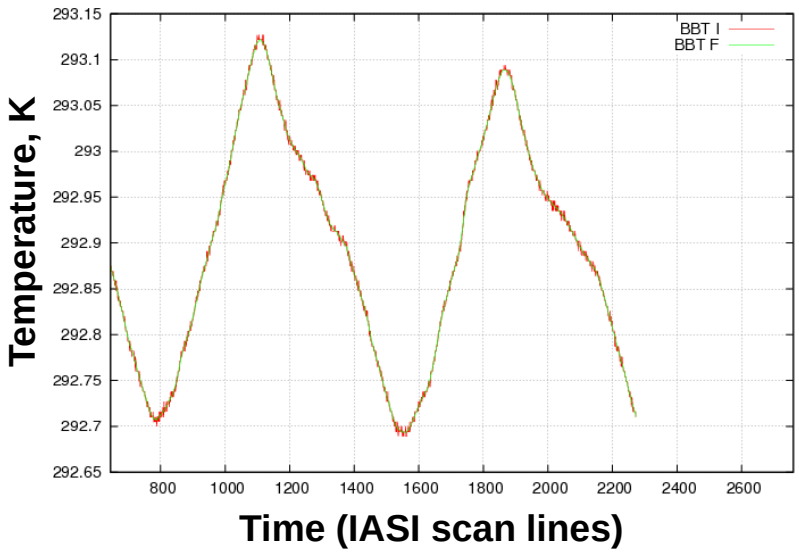
⇔ **Shift of interferogram**
⇔ **Rotation of output spectrum in complex space**
⇔ **Radiometric calibration error**

NZpdQualityIndex :

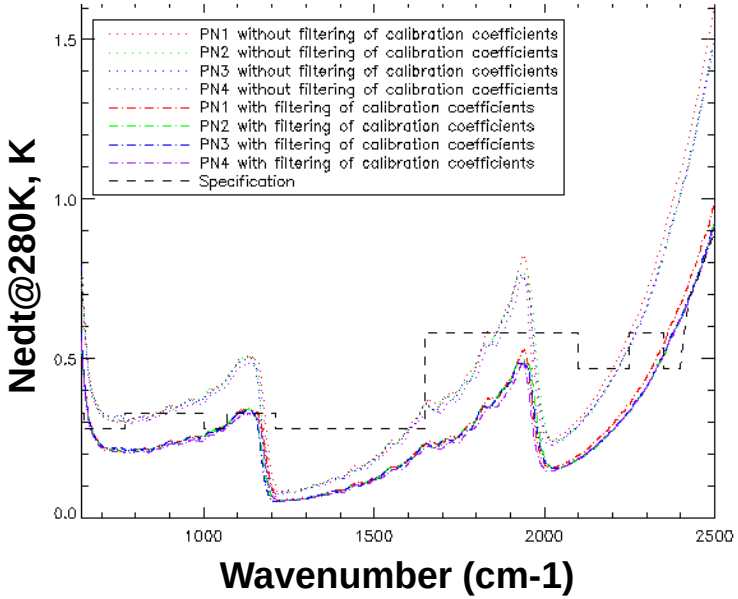
Quality indicator of NZpd determination

Complex calibration method & coefficients

Black body temperature over 2 orbits



Simulated instrument noise



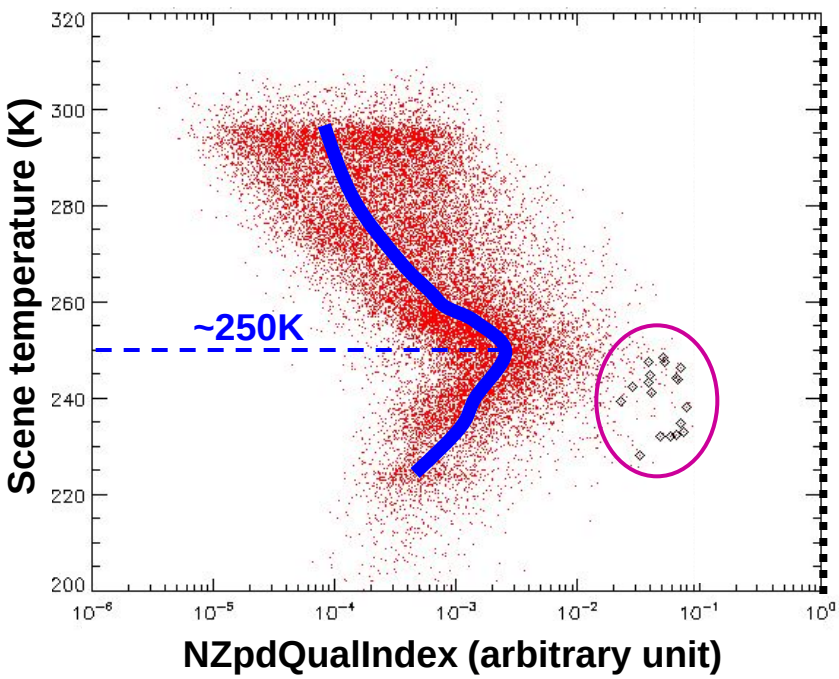
- Calibration coefficients are computed every scan line using BB and CS
- Tunable filter on-board
- Simulation with instrument numerical prediction model

- Optimum => 20 scan lines (160 s)

Calibration residuals : on-board data filtering

NZpdQualIndex

Quality Indicator of NZpd determination

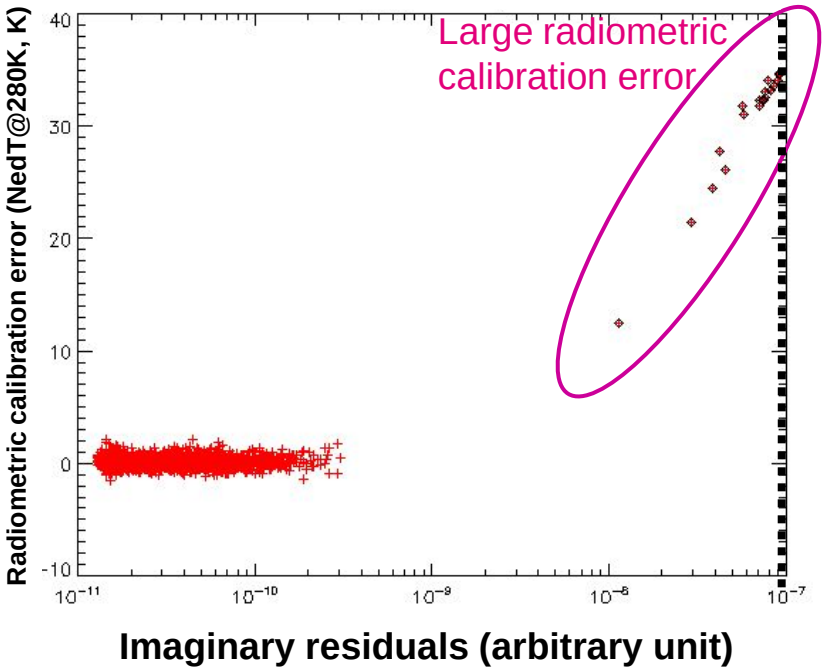


Quality decrease

- Bias around instrument background
- => relaxed on-board filtering

BArcImagMeanRms

Calibration imaginary residuals



- efficient on-board filtering
  - No bias
  - No false alarm

=> Imaginary residuals have a higher discrimination power

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Straylight

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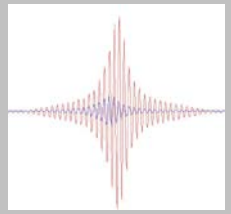

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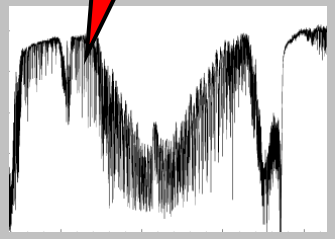

Coding
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IASI L0

Ground Segment – L1 processing chain

Scan mirror
- Temperature
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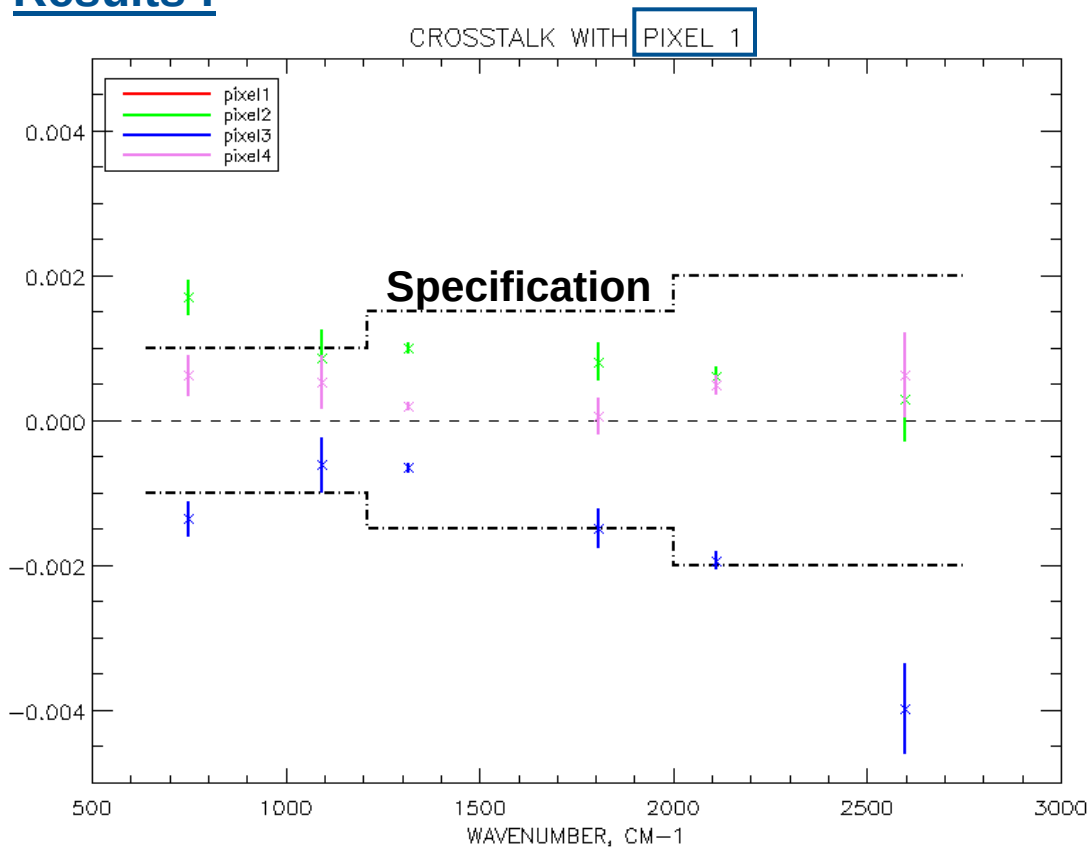
IASI L1

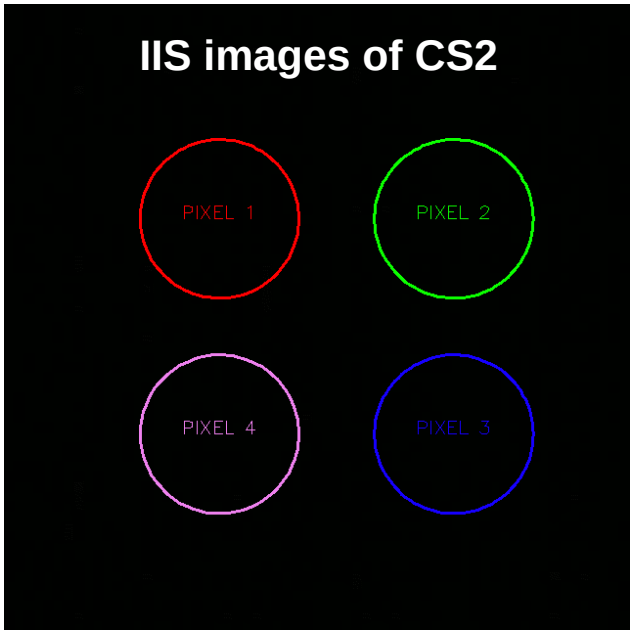
Straylight

Method : To use Moon transit in Cold Space 2 target with the instrument in external calibration.

Crosstalk PNx => PNy = F_PNy / F_PNx

Results :





- **No significant crosstalk for Pixel 2 and Pixel 4**
- **Pixel 1 and Pixel 3 seems to be weakly anti-correlated (~1/1000)**

OUTLINE

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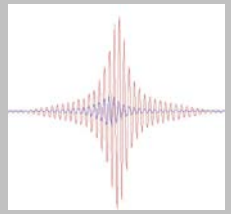

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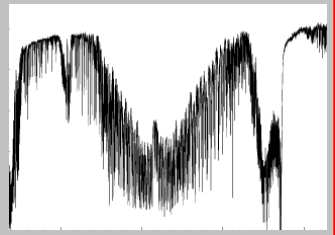

Coding
- table

IASI L0

Ground Segment – L1 processing chain

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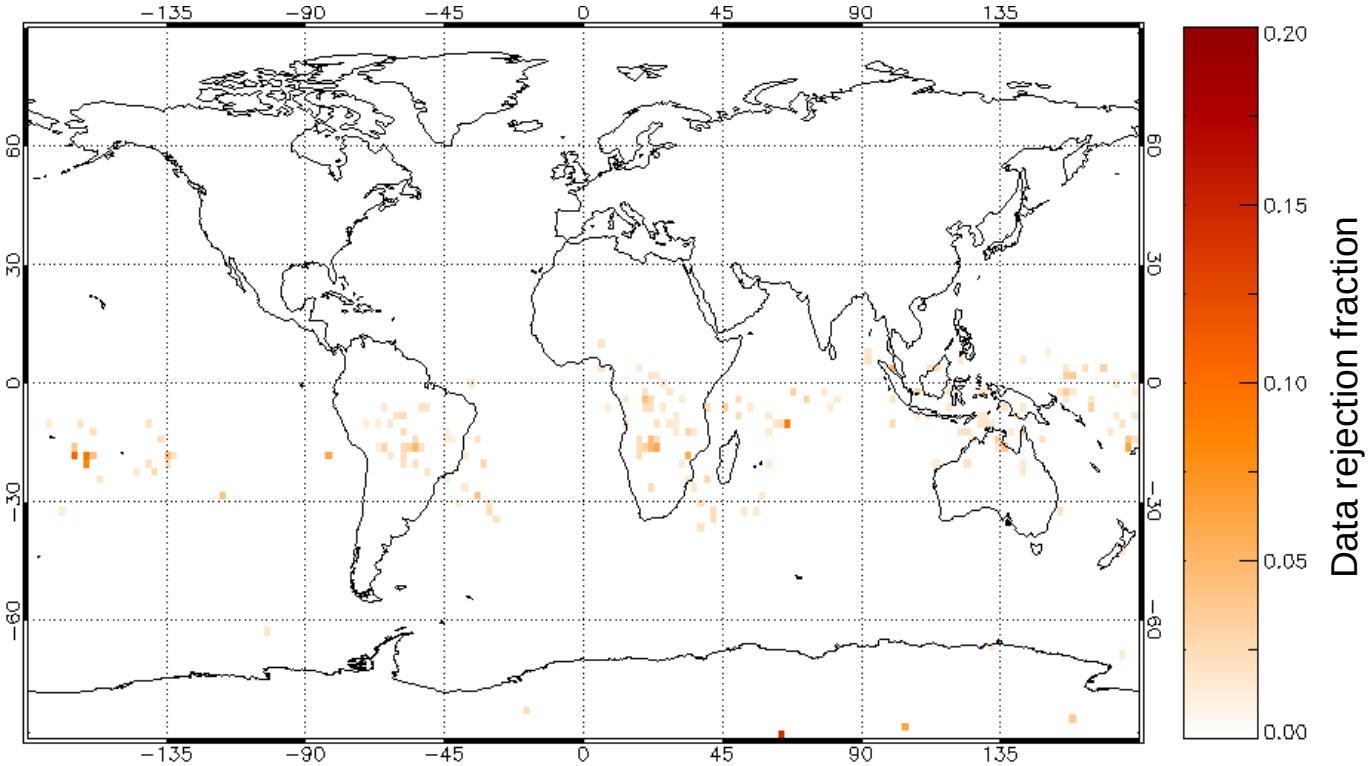
IASI L1

Coding table

Goal : optimize digitalization noise = f (wavenumber), avoid saturation
Constraints : available bandwidth

Overflow/Underflow spatial distribution



Sun reflection in high thick clouds in tropical region
Overall data rejection < 0.02%

OUTLINE

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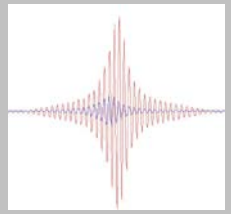

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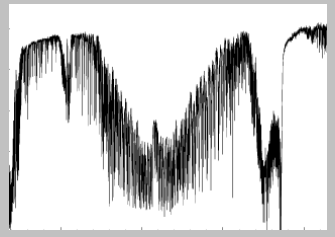

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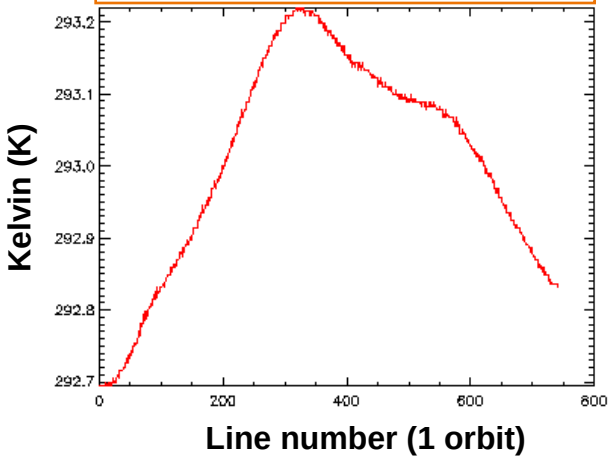
IASI L1

Black Body

sensors

On-board instantaneous temperature



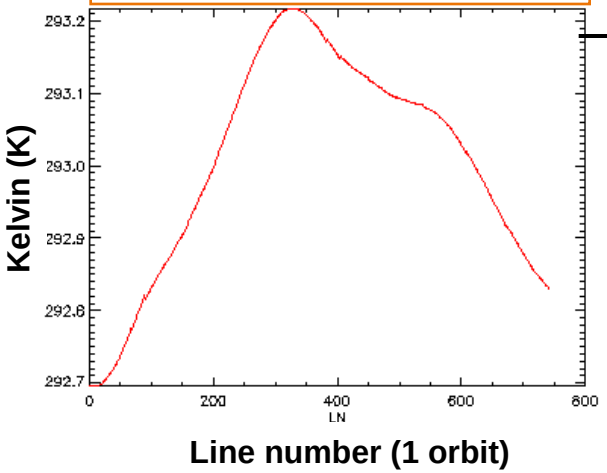
Orbital variation ~ 0.5 K

IASI instrument

L1 processing chain

Filtering

On-ground filtered temperature



Radiometric post-calibration

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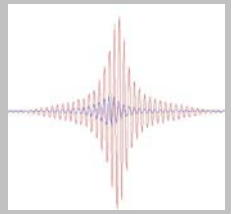

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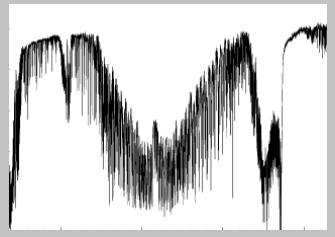

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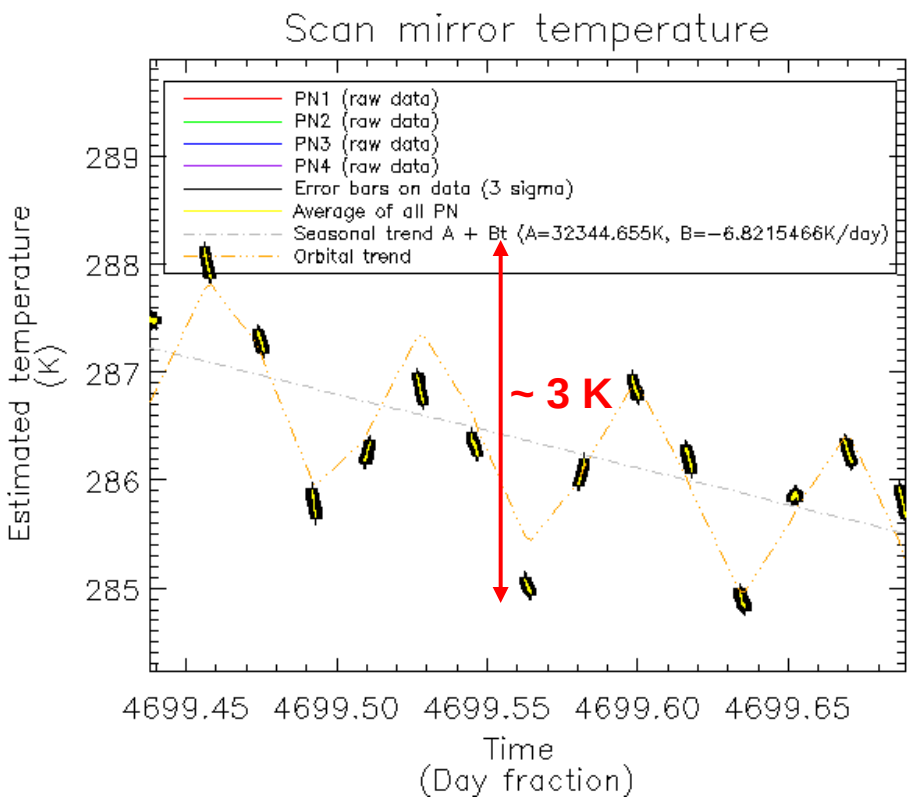
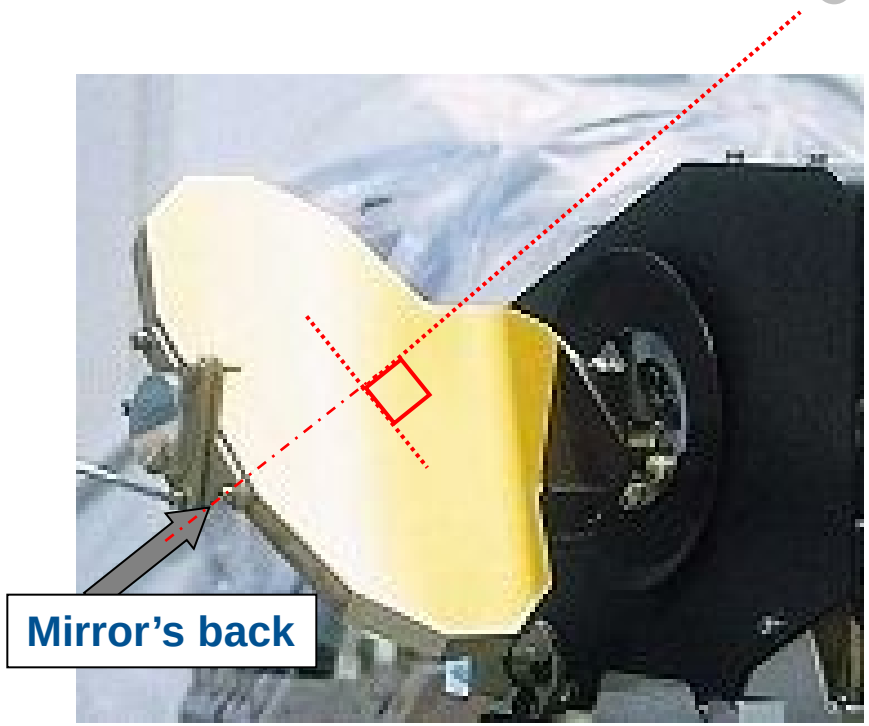
IASI L1

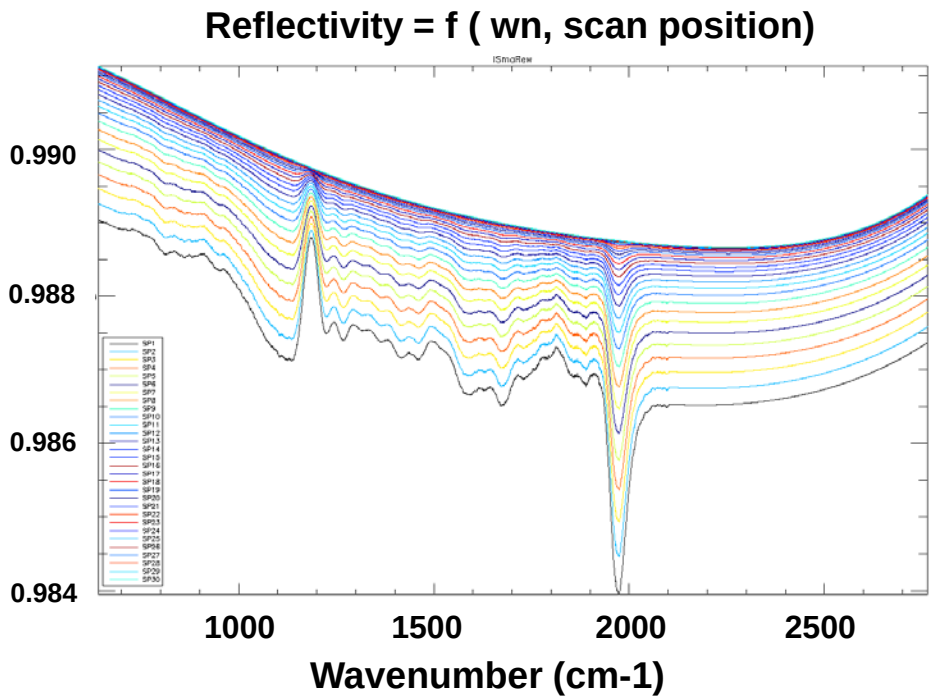
Scan Mirror : Temperature

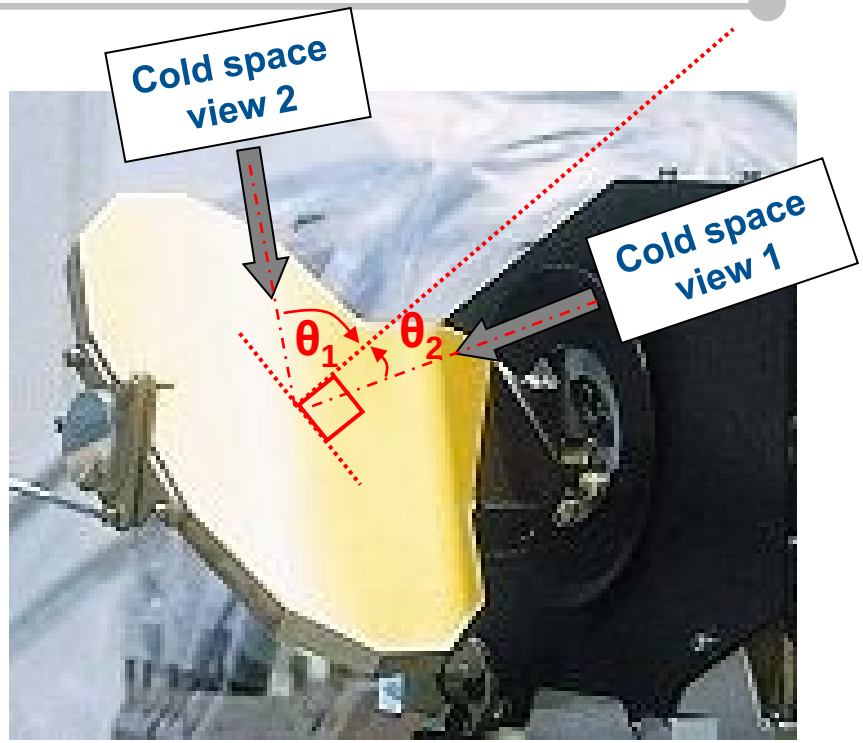




- Simulation demonstrates that Tscan variations of 3 K implies **< 0.01 K** on the radiometric calibration
- => No need of orbital model, use mean temperature, **Tscan=286.5 K**, for post radiometric calibration

Scan Mirror : Reflectivity





- External calibration targetting CS1 and CS2 allows to model the scan mirror reflectivity = f (wn, SP), part of L1 processing chain parameters
- reflectivity slowly evolves with time, monitored every month.
- updated ~ 1 time per year when impact on radiometric calibration is too high (> 0.1 K)

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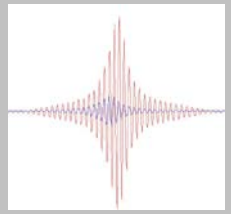

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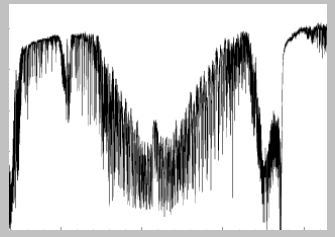

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IASI L0

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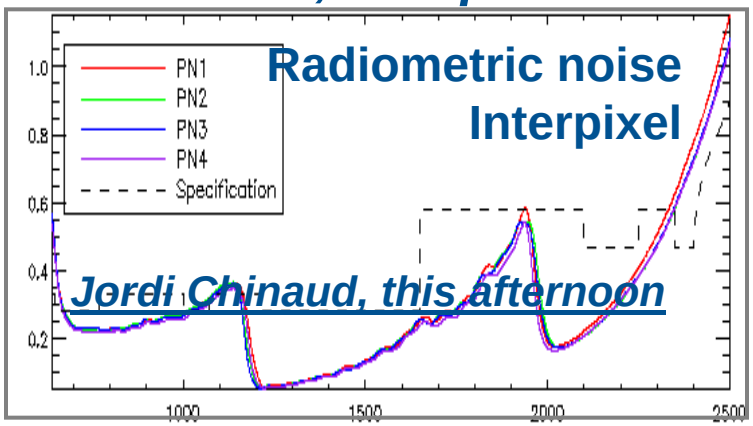
IASI L1

Conclusions

- **All parts of the radiometric calibration chain behave nominally**

- **Data availibilty improvement / IASI-Metop-A**

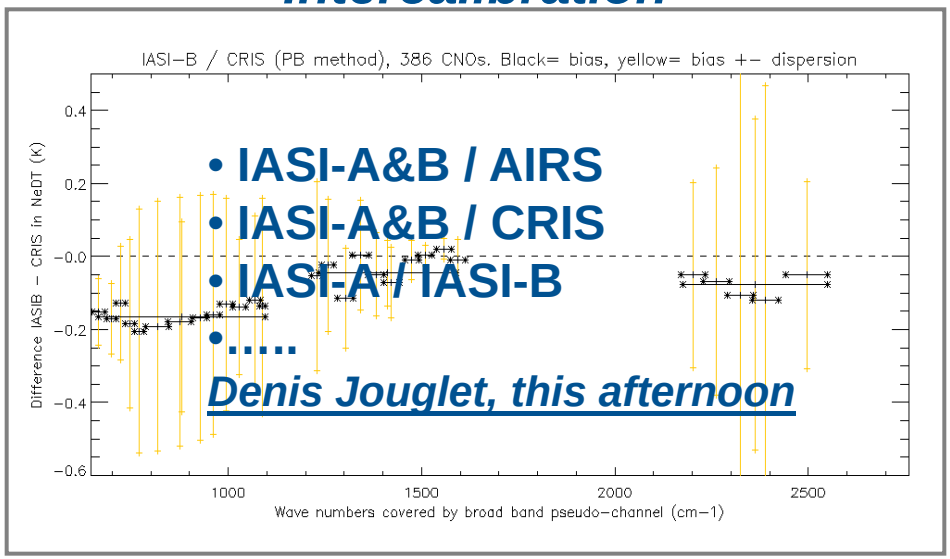
Noise, interpixel



Radiometric noise
Interpixel

Jordi Chinaud, this afternoon

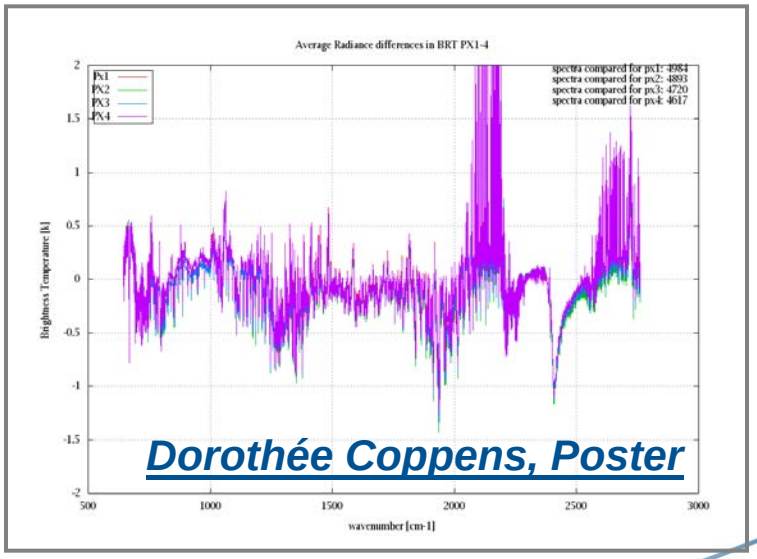
Intercalibration



- **IASI-A&B / AIRS**
- **IASI-A&B / CRIS**
- **IASI-A / IASI-B**
- **.....**

Denis Jouglet, this afternoon

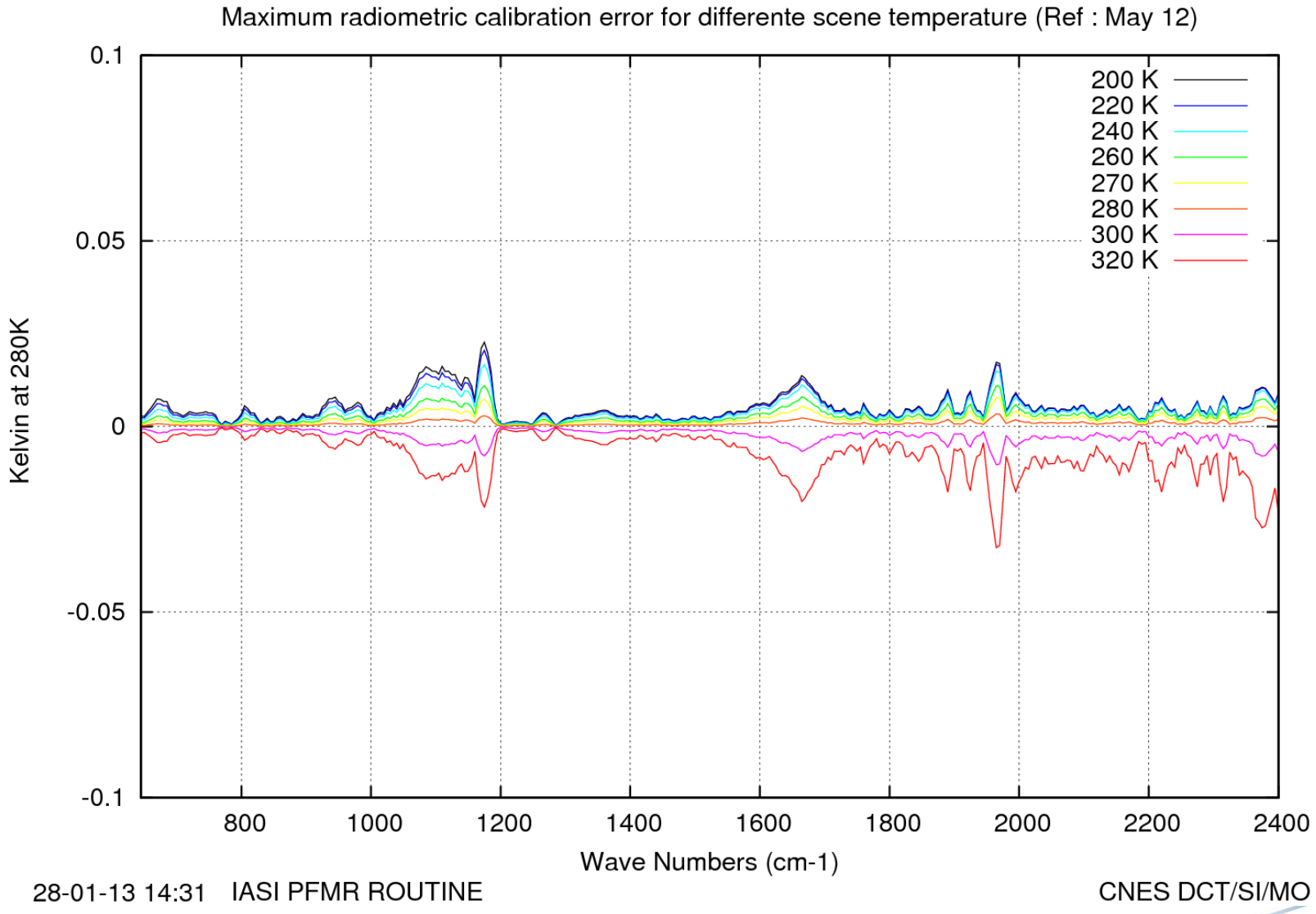
Obs - Calc.



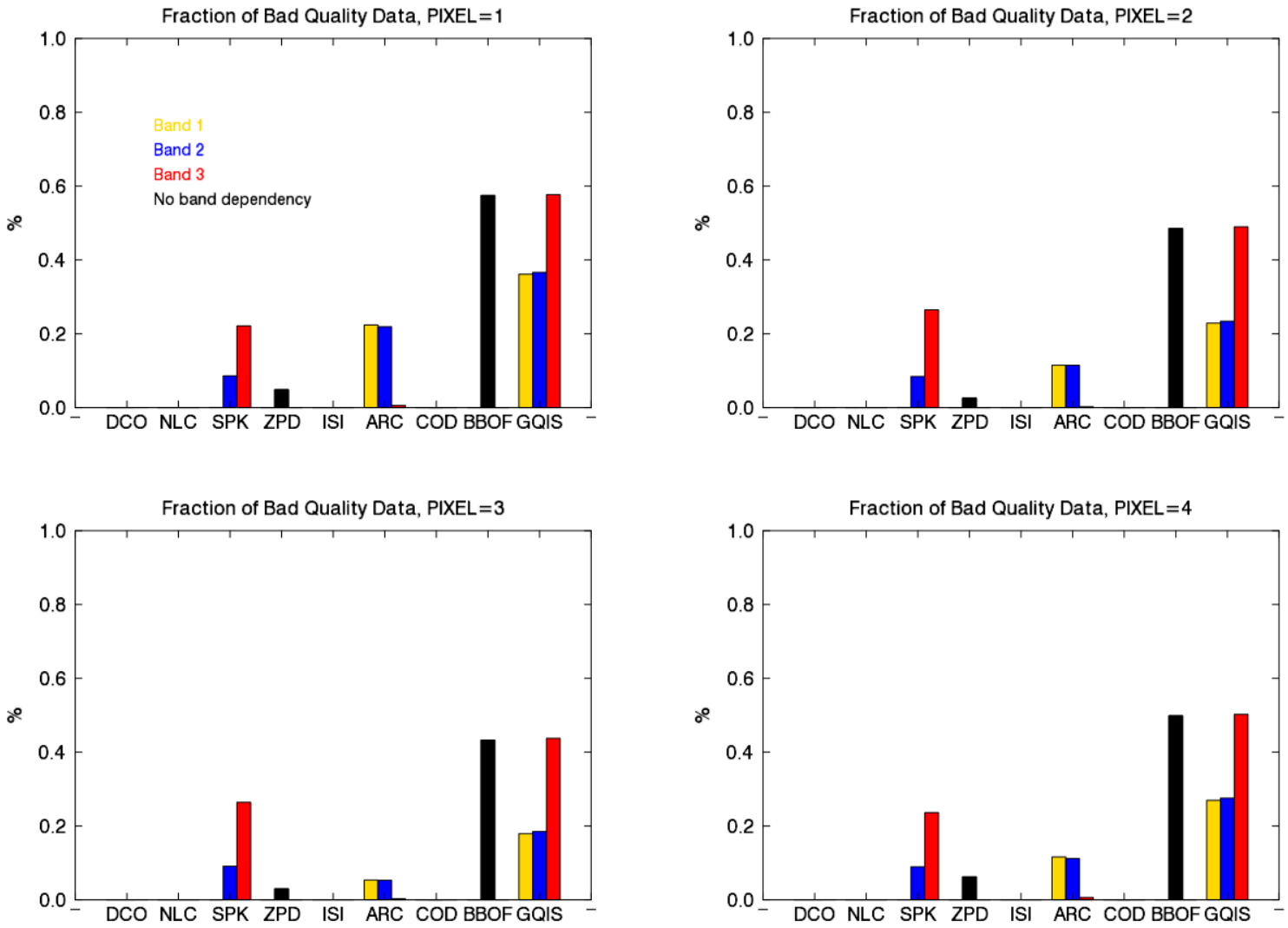
Dorothée Coppens, Poster

BACKUP SLIDES

Scan Mirror


Maximum radiometric calibration error for differente scene temperature (Ref : May 12)
0.1
0.05
0
-0.05
-0.1
Kelvin at 280K
800
1000
1200
1400
1600
1800
2000
2200
2400
Wave Numbers (cm-1)
200 K
220 K
240 K
260 K
270 K
280 K
300 K
320 K
28-01-13 14:31 IASI PFMR ROUTINE
CNES DCT/SI/MO

On-board processing quality monitoring



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