Performance status of IASI on MetOp-A and MetOp-B

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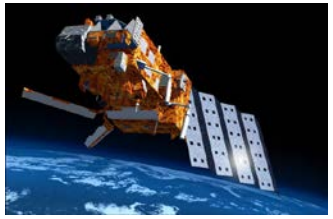
OUTLINE

- 1 – Introduction
- 2 – Overall quality
- 3 – Radiometric performances
- 4 – Spectral performances
- 5 – Conclusion

Introduction

- IASI (Infrared Atmospheric Sounding Interferometer) is a key element of the MetOp payloads.



MetOp

Very accurate Fourier Transform Spectrometer dedicated to atmospheric sounding that provides radiance spectra in the infrared spectral domain.

- Status of the performances of IASI on MetOp-A and MetOp-B after 7 years and 1 year in orbit respectively.

cnes

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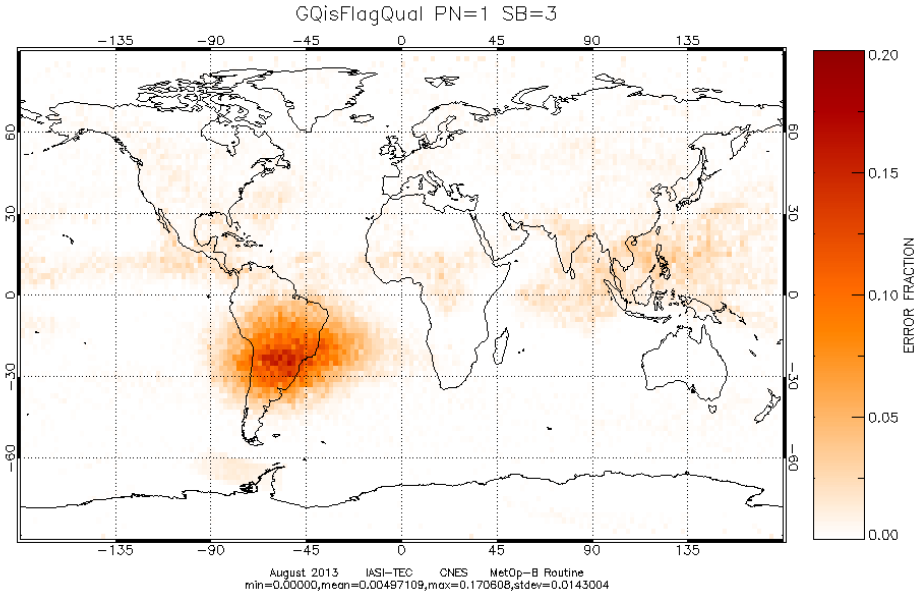
L0 & L1 data quality

- IASI-A and IASI-B L1C data quality on normal operation mode:
  99.4% (B3), **99.6%** (B1&B2)

- Spatial distribution of rejected spectra (< 0.6%) :

Spectral band 3



- Main contributors to rejections:
  - Spikes (energetic particles), mostly in B3 in SAA

  B1 and B2 are still available even if there is a spike in B3 (3 separated detectors)

  - NZpd computation failure

  - Over/underflow : due to sun reflection on clouds (cumulonimbus)

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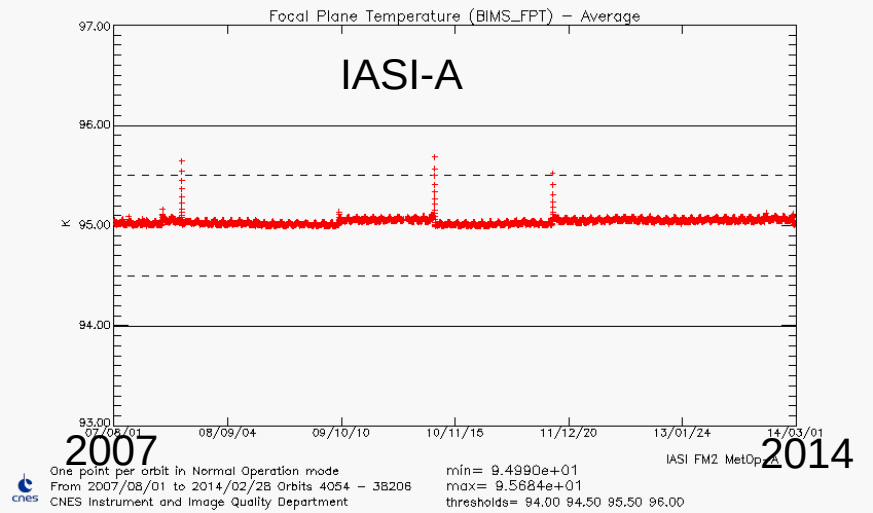
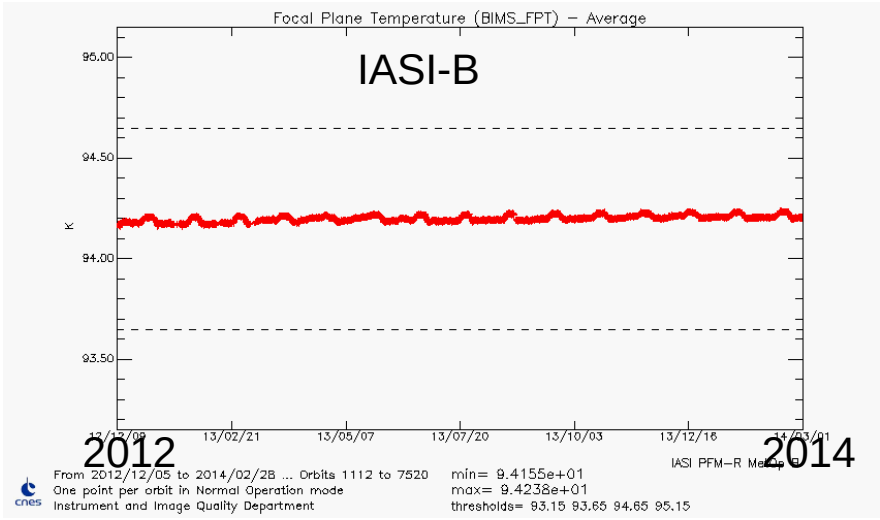
Sounder radiometric noise

- Stability of the detector temperature





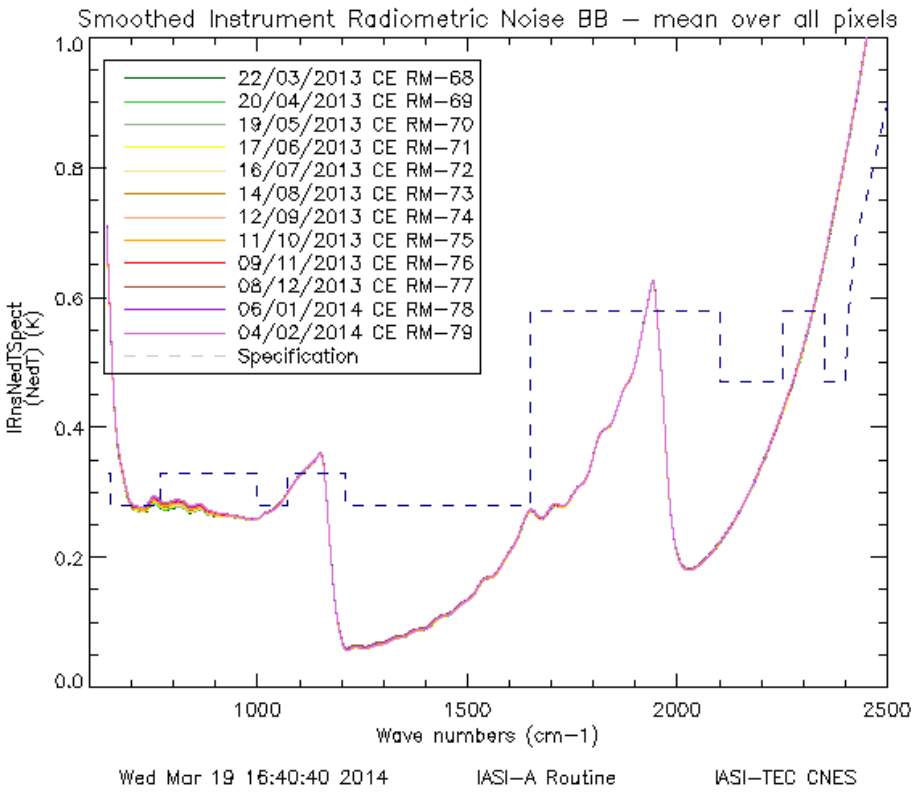
Focal plane temperature (K)

- Nominal behaviour
  - IASI-A : 95 K
  - IASI-B : 94.2 K
- Stability of FPT → stability of instrument noise and non linearity correction

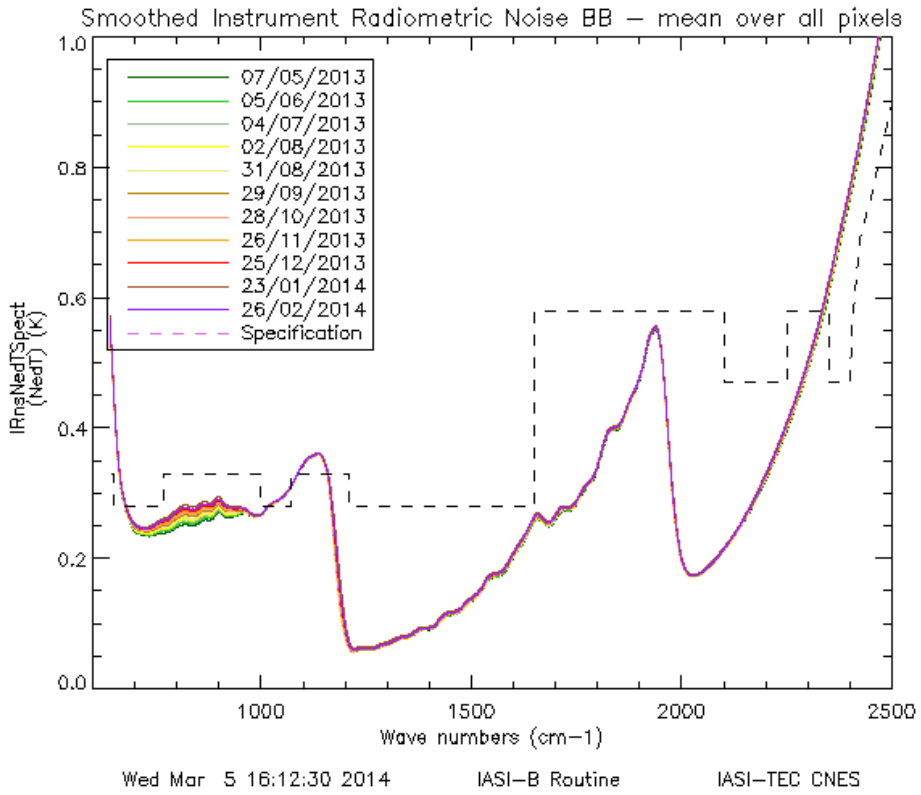
Sounder radiometric noise

IASI in-flight measured L0 NedT on internal Black Body target

IASI-A



IASI-B

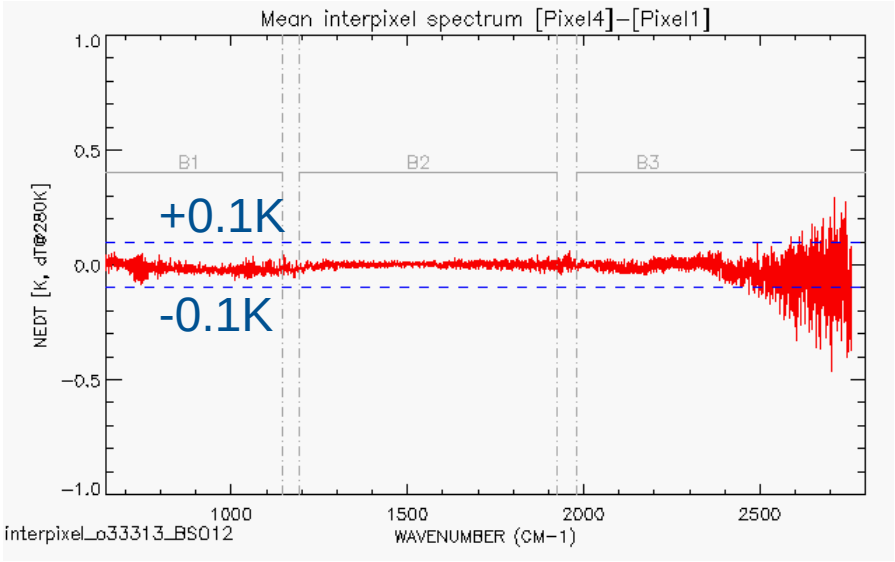


- IASI-A and IASI-B radiometric noises are very close.
- Very stable, apart from ice effect between 700 and 1000 cm^{-1}.

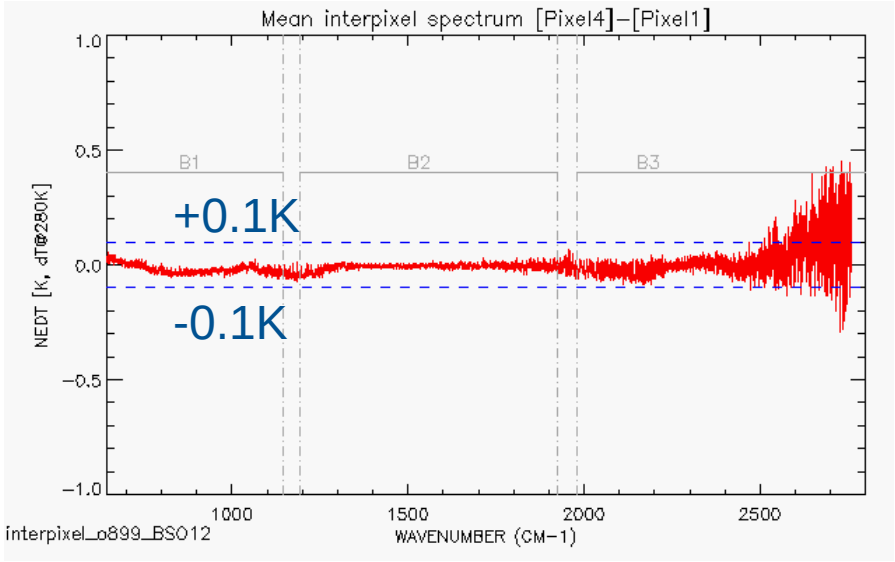
Interpixel radiometry at L1C on EW

- Interpixel radiometry at L1C on EW, orbital time scale, no scene selection

IASI-A



IASI-B

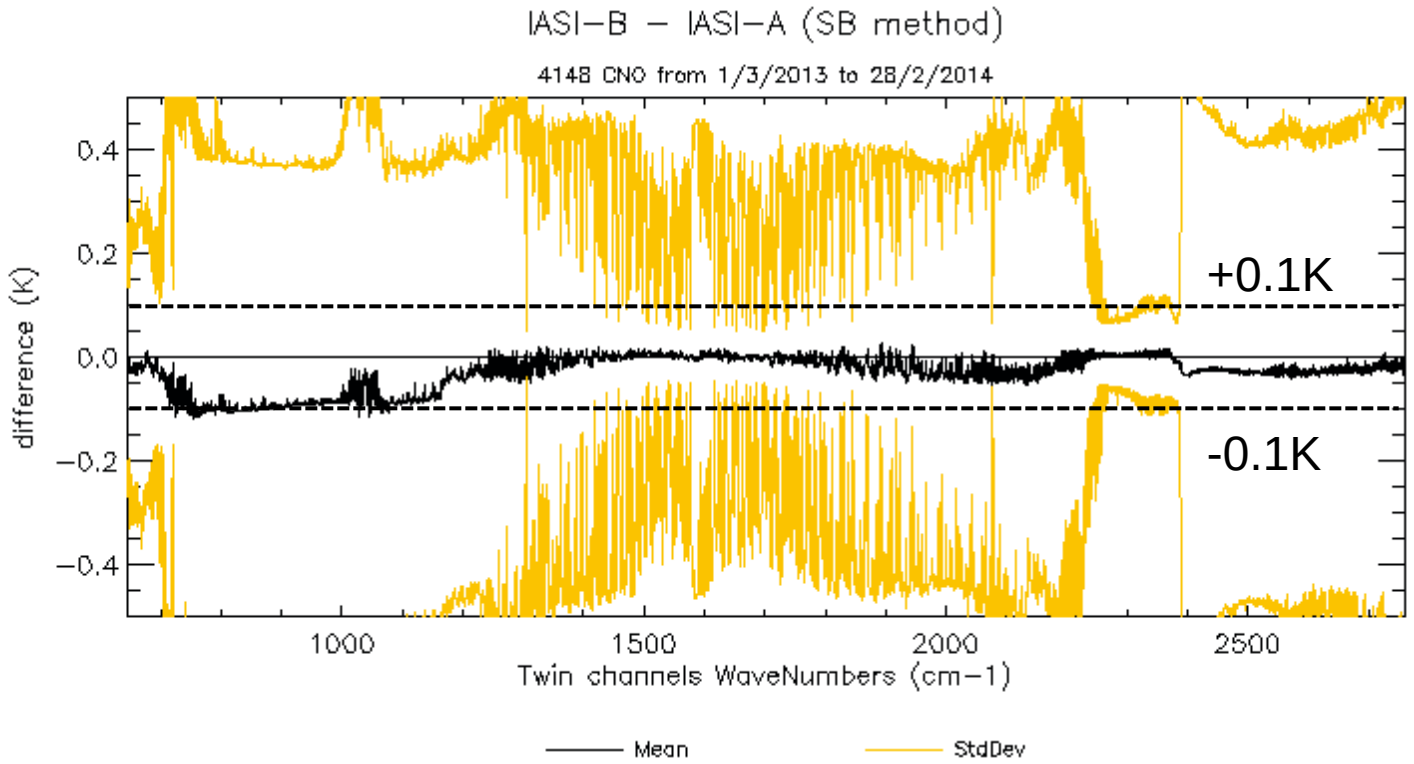


- Radiometric interpixel at L1C is better than 0.1K on an orbital time scale: at L1C all pixels are radiometrically independent

- Still some effects in the interbands due to sharp gradients of band spectral filter.

Intercomparison between IASI-A and IASI-B : radiometry

- Biases and standard deviation over the selected dataset
  (homogeneous and stable scenes, night, as many “A before B” as “A after B”)



- Very good cross calibration: Biases < ~0.1K
- Statistics mostly on cold scenes
- Highest bias in B1 => shape still under investigation. Possible residual non linearity
- Note: absolute radiometric specification of each IASI is 0.5K @280K

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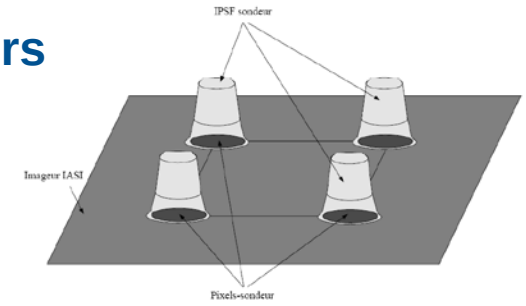
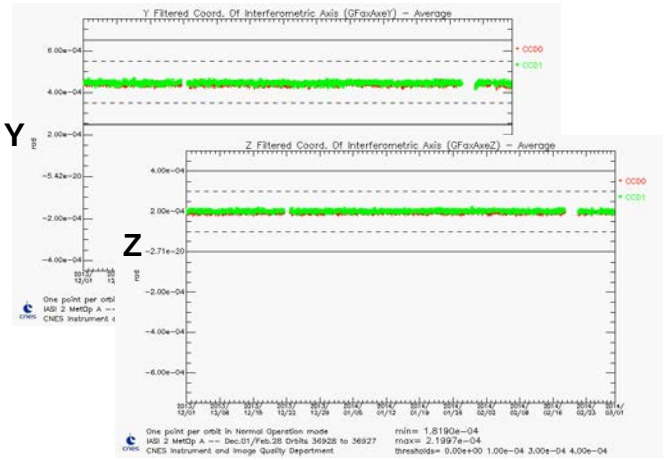
Inputs of ISRF model

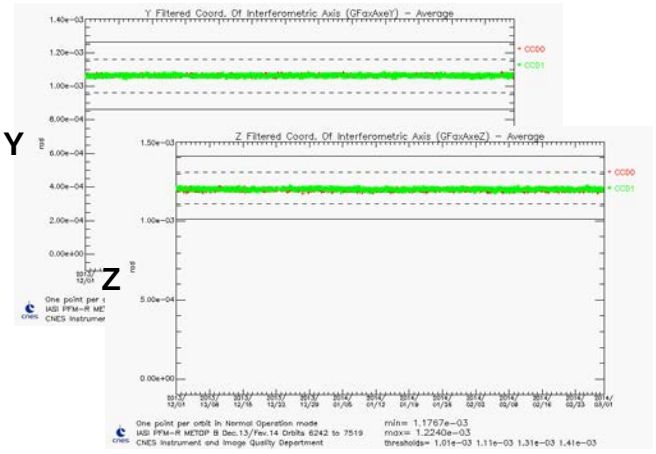
- **Instrument Spectral Response Function (ISRF) parameters** are characterized and monitored
  - ✦Laser alignment (sampling laser wavelength)
  - ✦Instrument Point Spread Functions IPSF (Y and Z field angles and weights for each pixel)
  - ✦Beam splitter and compensator plate (width, angles)
  - ✦Cube corner trajectory :
    - » Moving corner cube displacement law (linear) + Fixed cube corner offset
    - » Interferometric axis



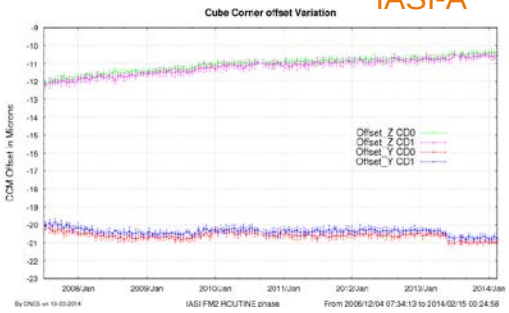
IASI-A



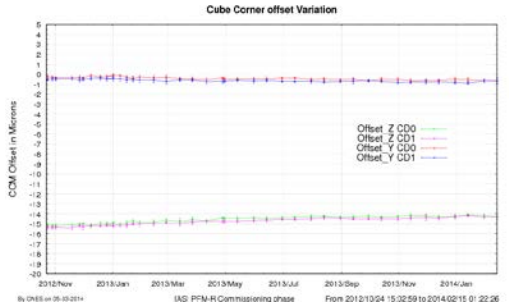
IASI-B



IASI-A



IASI-B

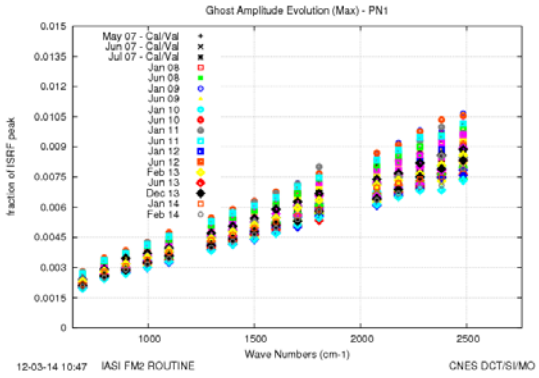


ISRF parameters are stable

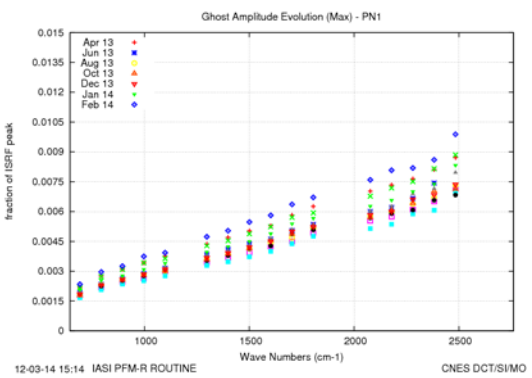
Ghost effect

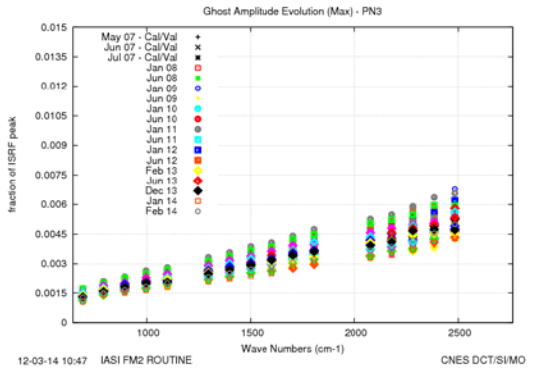
- Origin: sampling jitter (harmonic) induced by the cube corner compensation device
- Analysis done on BB spectra, maximum values of ISRFmax (@2760 cm^{-1})

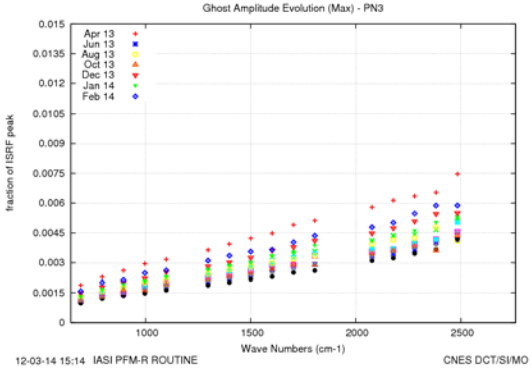
IASI-A



IASI-B







- IASI-A and IASI-B:
  - Same behavior for :
  - PN1 and PN2 : 1% (max)

FOVs projected onto the top part of the beam-splitter, vibrates the most, maximum effect

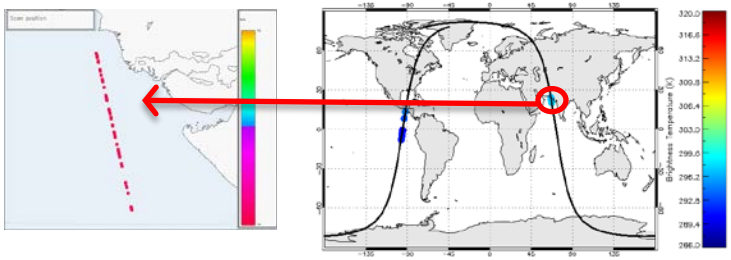
  - PN3 and PN4 : 0.6% (max)

FOVs projected onto the bottom part of the beam-splitter which is attached to the optical bench, weaker effect

- No significant evolution over time.
- IASI-B has the same behavior as IASI-A

Spectral calibration assessment

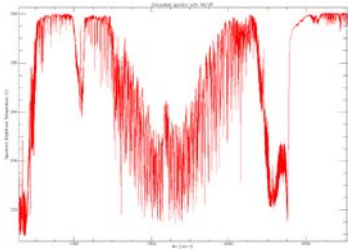
Spectral calibration: verification method



- Selection on homogeneous scenes, warm and clear in external calibration mode nadir viewing

- Comparison between IASI spectra with simulated spectra on homogeneous scenes in external calibration mode nadir viewing + inter-pixel comparison

- Simulate spectra with:
  - Radiative transfer model 4A/OP
  - and ECMWF analysis fields: temperature + H_2O profiles



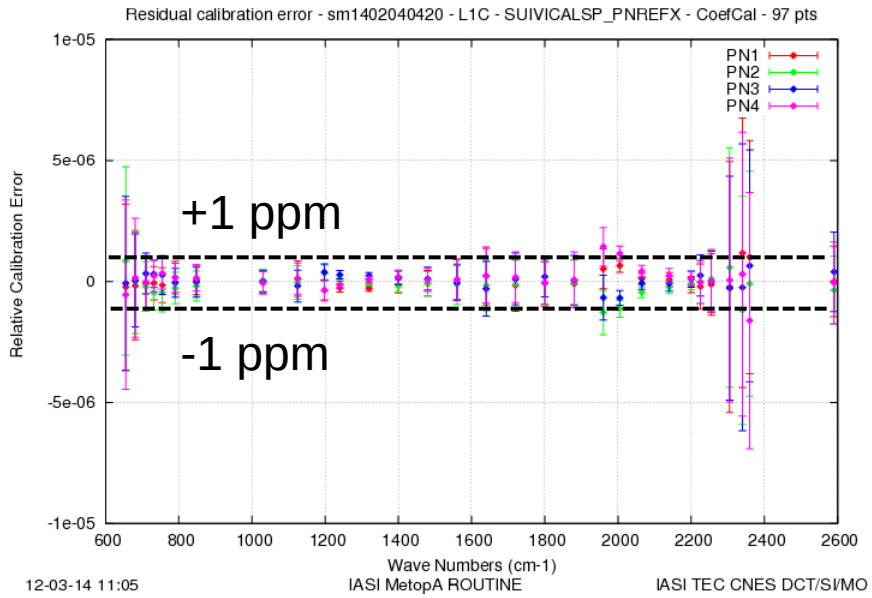
- Comparison using the correlation method in spectral windows.

- The relative spectral shift errors (Δv/v) between measured and calculated calibrated spectra must be inside the specification: +/- 2.10^{-6} = 2 ppm

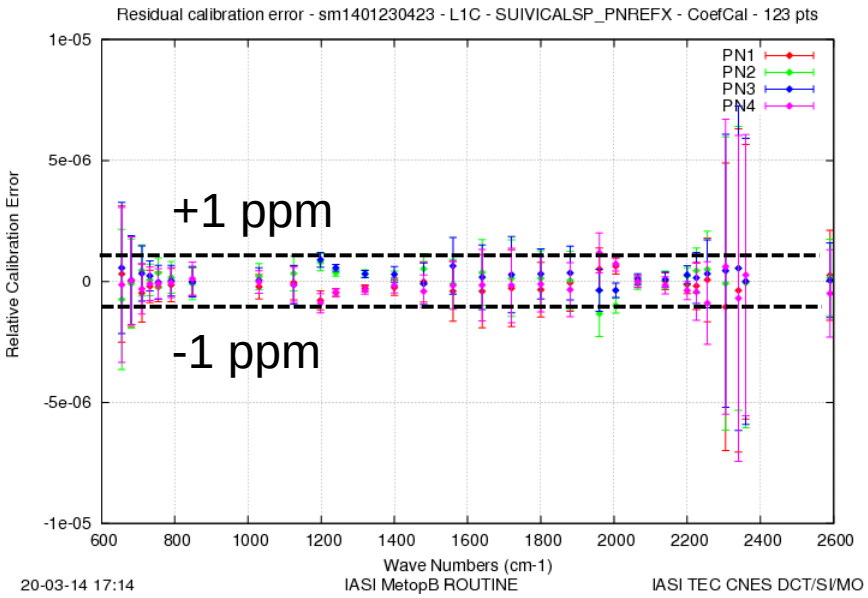
Spectral calibration assessment : interpixel

Interpixel spectral shift on L1C products

IASI-A



IASI-B



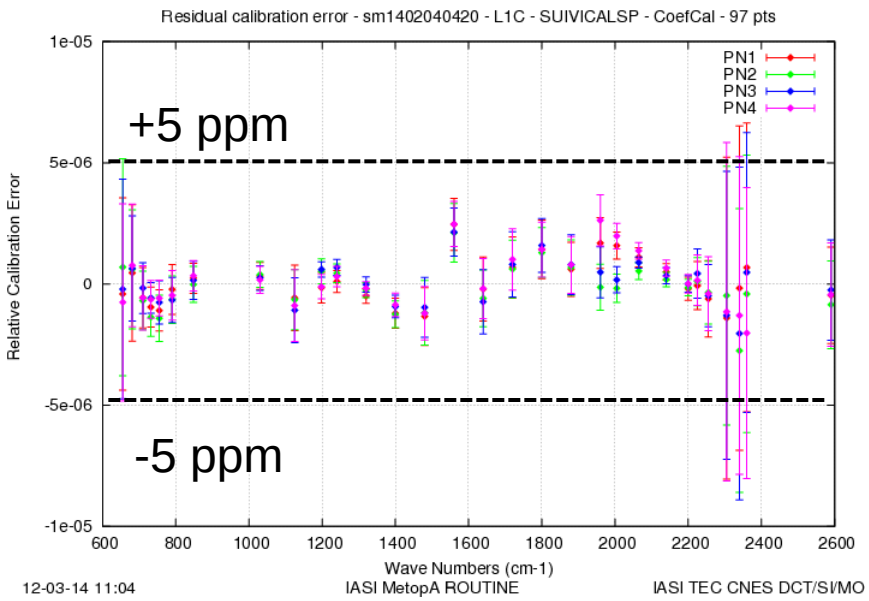
- Inter-pixel spectral shifts at L1C for both IASI-A and IASI-B are < 0.2 ppm, all pixels are independent
- Inter-bands : sharp gradient of the spectral filter at the edge of spectral bands
- L1B (spectral shift correction) & L1C (SRF removal) processing work well

Absolute spectral calibration assessment

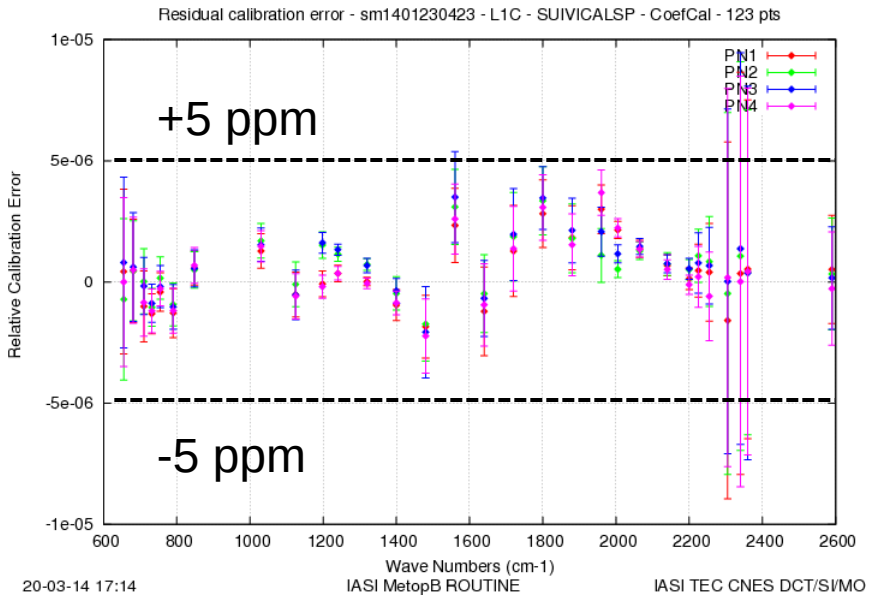
Absolute spectral calibration on L1C

dv/v

IASI-A



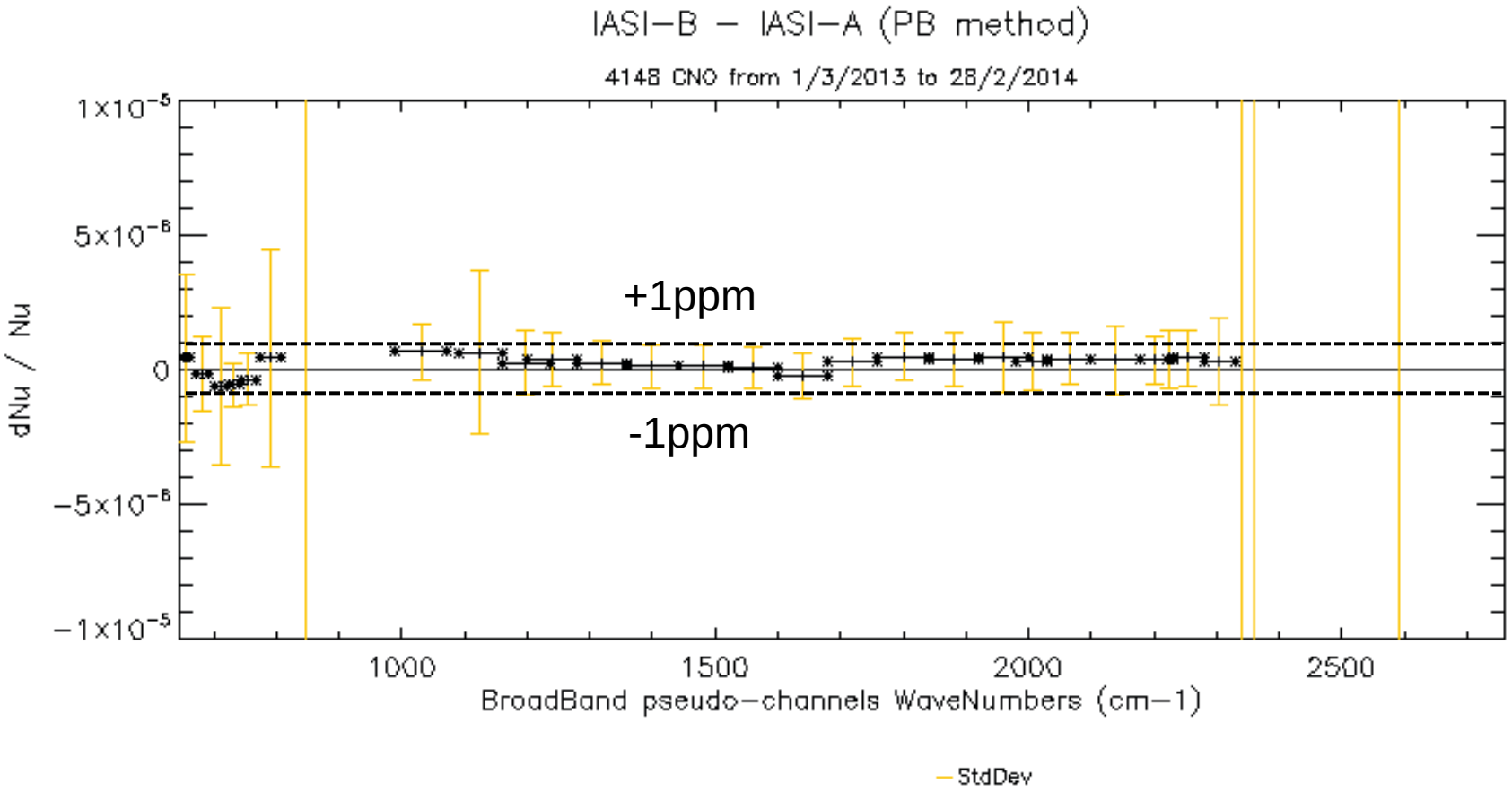
IASI-B



- Results are very dependent of our capacity to modelize the spectrum:
  - Radiative transfer: spectroscopy, line-mixing, pressure shift, non LTE,…
  - Atmospheric profile, particularly for water vapor in B2, and in a lesser extent in B1
- Absolute calibration assessment is thus **limited by the model**

Intercomparison between IASI-A and IASI-B : spectral

- Comparison on the same dataset than for radiometry, with the same correlation method in spectral windows than for other spectral verifications



- IASI-A and IASI-B are very well inter calibrated: < 0.5 ppm

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Conclusion

- IASI on MetOp-A and MetOp-B performances are all within the requirements and even more :
  - Data quality in normal operation > 99.4%
  - Stable NedT and stable ISRF parameters
  - Interpixel: radiometric < 0.1K, spectral shift < 0.2 ppm
  - Geolocation: IASI pixel centre localisation accuracy in AVHRR raster < 200 m. Stable and well within specification (5 km)
  - IIS radiometric characteristics are very good : NedT ~0.6K, stable

- IASI-A and IASI-B have similar performances and are very well inter-calibrated: < 0.5 ppm spectral, < 0.1 K radiometry

- Both instruments are very stable and in good health, no sign of ageing for IASI-A