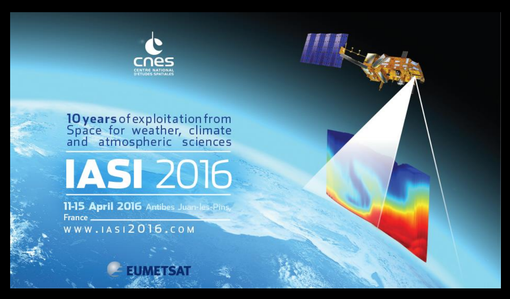

Performance status of IASI on-board Metop-A and Metop-B

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In-flight performance monitoring of the IASI level 0 (L0) and level 1(L1) processing is essential to guarantee the users that the data keep the required quality along the mission life time. Monitoring is also needed to detect and anticipate any evolution, and prepare corrections when possible. This is one of the main responsibilities of the IASI Center of Expertise (ICE) set-up and operated in CNES Toulouse. Here we focus on the IASI performances in terms of instrument and processing monitoring. This includes L0 and L1 data overall quality and the main spectral, radiometric and geometric performances. We explain why and how this monitoring is performed.

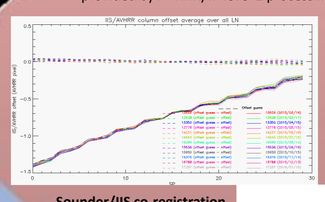
Radiometry of IIS

IIS is a monocanal IR imager (spectral band covered : 10.3-12.5µm). Its main task is to insure a good relative positioning of IASI sounder pixels with respect to AVHRR.

Radiometric calibration, radiometric noise and dead pixels of IIS are monitored.

IIS/AVHRR and Sounder/IIS co-registration

Geo-location of IASI pixels (12km) is ensured by both IIS and AVHRR imagers (reliable geo-location provided by AVHRR) in level 1 processing.

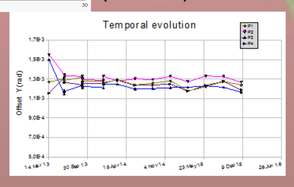


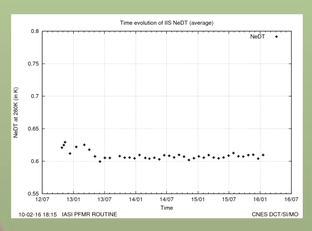
Residual between measured and IIS/AVHRR offset guess in the ground configuration is below 0.1 AVHRR pixel for all viewing angles (about 100m).

Sounder/IIS co-registration error < 0.1mrad (100m) for both IASI (mechanically linked)

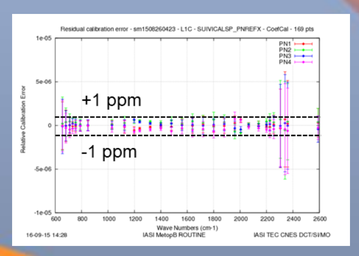
Absolute and inter-pixel calibration

The absolute spectral calibration assessment (not shown) is fully satisfactory. The specification of 2.10^{-6} is reached



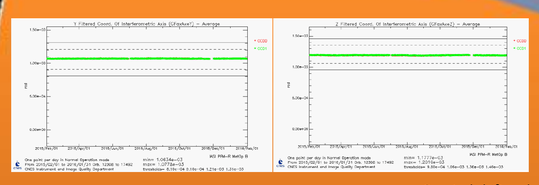


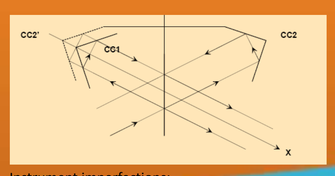
Radiometric noise of the IIS is very stable.



The interpixel spectral calibration is better than 0.2ppm; all pixels are independent.

Interferometric axis



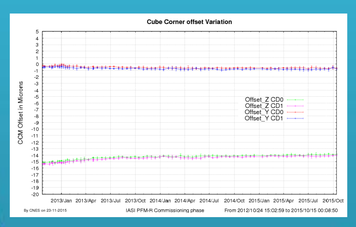


Spectral shift and dimensional stability of the instrument.
Stable parameters.

Instrument imperfections:

- Beam splitter (thickness of the beam splitter, non parallel faces, surface imperfections)
- Cube corner and its motion (non rectilinear trajectory, non constant motion, constant offset)

Fixed cube corner offset

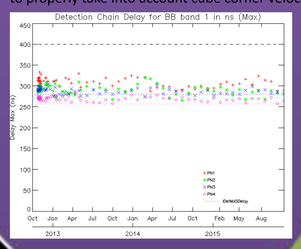


Dimensional stability of the instrument
Small drift.

Detection chain delay

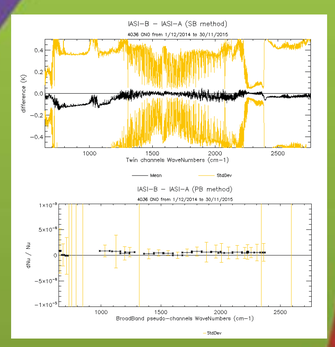
Variation of cube corner velocity onto spectral performances has to be minimized. It implies a minimization of the delay between the measurement chain and reference laser chain.

Long term stability and values lower than 400 ns are required in order to properly take into account cube corner velocity fluctuations.

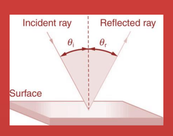


Sounder Inter-calibration

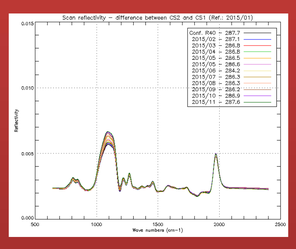
Monitoring of radiometric and spectral differences between IASI-A, IASI-B, CrIS, AIRS.



Scan mirror reflectivity

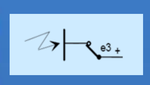


Variation of scan mirror reflectivity with incidence. Difference between extreme incidence angles is increasing with time due to scan mirror aging (material desorption, molecular contamination, polymerization due to UV reflected by Earth).



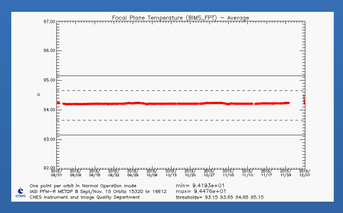
Monitoring of scan mirror reflectivity is based on estimation between CS1 (10°) and CS2 (60°) views.
Effects are compensated at L1 (radiometric post-calibration) with regular coefficients' updates (once a year).

Non linearity of the detection chain



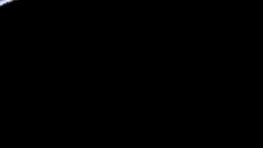
Detector for the photon flux to electron conversion

Analog non-linearity of the detection chain function is due to detector imperfection (mainly in B1 because of the technology used for photoconductive IR detector).
It is dependent on detector temperature.
→ Monitoring via the focal plane temperature.

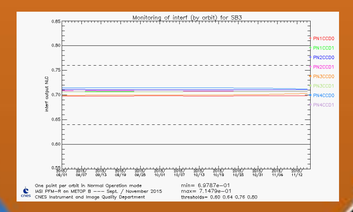


Stable parameter.

Interferometric contrast



Interferogram fringe discrimination power.
Decrease of interferometric contrast induces decrease of instrument gain.



Stable parameter.

Coding tables

Coding tables aim in encoding measured spectrum.

Specificities for coding tables computation:
- Limited number of bits for the spectrum coding (on-board compression)
- designed by using "extreme spectrum" (i.e. drastic atmospheric condition)
- Additional noise due to digitalization
- Compromise between maximum dynamic and noise

Possible coding table exceeded in case of very extreme atmospheric conditions (e.g.: polar vortex collapse).
Over/underflows ratio is nominal (low occurrence).

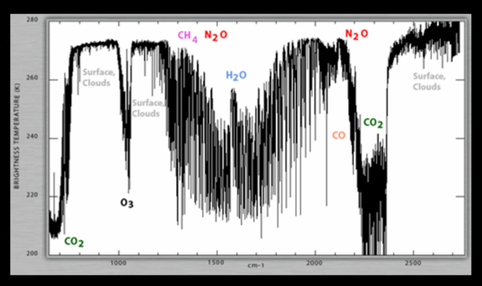
Geometry and IIS

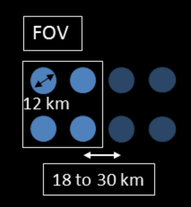
L0

Spectral

Radiometry

Radiometric performances



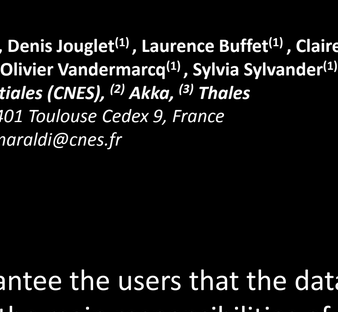


Spectral performances

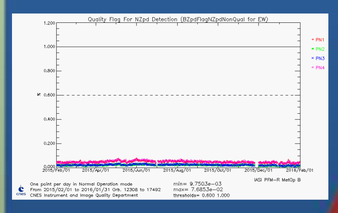
Geometric performances

Reduced spectra monitoring

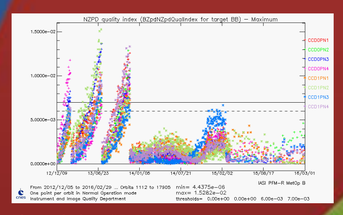
Evolution of reduced spectra is due to the deformation of the interferometer. It evolves rapidly at the beginning of instrument life and more slowly after.
On-board configuration reduced spectra are the default values for the reload of this parameter (e.g. after instrument mode change). They ensure a good radiometric calibration when on-board configuration reduced spectra are reloaded.
We monitor the difference between current reduced spectra and on-board configuration reduced spectra for calibration views.



ZPD quality is proportional to the residual distance of the spectrum to the calibration line defined by the calibration reduced spectra.



Stable quality flag of NZPD determination.

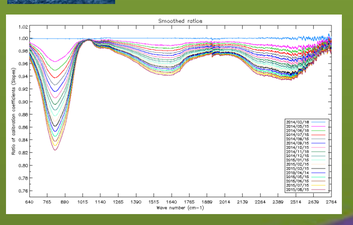


The evolution of ZPD determination quality index is well beneath on-board threshold (on-board cutoff equal to 0.02).

Critical monitoring

Optical transmission

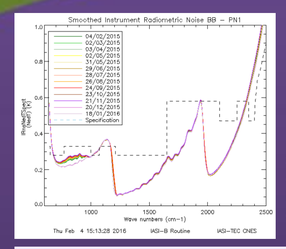
→ Condensation of water on the field lens at 100K
→ Formation of Ice
→ **Loss of instrument transmission**



Monitoring via the ratio of calibration coefficient slopes (proportional to transmission loss at 850cm-1).

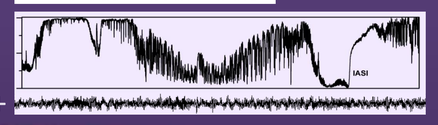
→ Schedule of decontamination before the transmission loss reaches 20%.

Radiometric noise



Monitoring of IASI instrument aging and ice contamination.

Stable apart from ice effects, especially between 700 and 1000 cm-1.



BB: Black Body
CS: Cold Space
ICE: IASI Center of Expertise
ZPD: Zero Path Difference

The performances of the two IASI instruments on-board Metop-A and Metop-B after respectively 9 years and 3 years are fully compliant with specifications. IASI performances are very satisfactory and very stable thanks to regular updates of on-board and L1 ground configuration files and thanks to specific operations. This allows to take into account and to compensate for the instrument evolution and aging, and to maintain the high level of performances.