IASI QUARTERLY PERFORMANCE REPORT

FROM 2011/09/01 TO 2011/11/30

BY IASI TEC (TECHNICAL EXPERTISE CENTER)

FOR IASI FM2 ON METOP A

ANALYSE DOCUMENTAIRE

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RESUME :

Quarterly report issued by the IASI TEC team to show trends and layout from the "long term synthesis" TEC function for flags and observables quality indicators

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Figures and tables

LIST OF ACRONYMS

[TBC]	To be confirmed
[TBD]	To be defined
APO	Other Parameters OPS
AR	Anomaly Report
BRD	BoaRD configuration
CGS	Core Ground Segment at EUMETSAT
CNES	Centre National d'Etudes Spatiales
DA	Applicable document
DPS	Data Processing Subsystem
EPS	EUMETSAT Polar System
EUMETSAT	European organisation for exploitation of METeorological SATellites
FM2 / FM3	Flight Model n°2 or 3
IASI	Infrared Atmospheric Sounding Interferometer
IIS	Integrated Imaging Subsystem
METOP	METeorological OPerational satellite
OPS	Operational Software
PDU	Power Distribution Unit
PL SOL	Payload switch off-line (It's a spacecraft anomaly external to IASI but still resulting in a switch off of the instrument.
PTSI	Parameter Table Status Identifier
RD	Reference document
SEU	Single Event Upset
TEC	IASI Technical Centre of Expertise (located in CNES, Toulouse)
VDS	Verification Data Selection

1 INTRODUCTION

The IASI TEC is based at CNES Toulouse and is responsible for the monitoring of the IASI system performances, covering both instrument and level 1 processing sub-systems.

This document describes the activities and results obtained at the IASI TEC for instrument FM2 on METOP-A during the following period:

- Start Time: 2011/09/01 Orbit: 25250
- End Time: 2011/11/30 Orbit: 26542
- Duration:3 months

Note that IASI ended the Calibration / Validation (commissioning) phase on July 2007.

2 RELATED DOCUMENTS

2.1 APPLICABLE DOCUMENTS

N°	Reference	Titre
DA.1	IA-SP-0000-3242-CNE	Spécification de suivi de la performance en vol de IASI sur METOP-A

2.2 REFERENCE DOCUMENTS

N°	Reference	Titre
RD.1	EUM/OPS/-EPS/TEN/08/206710	IASI annual in-flight review 1st February 2007 - 31st August 2008
RD.2	EUM/OPS-EPS/REP/09/0223	IASI annual in-flight performance report 2009
RD.3	EUM/OPS-EPS/REP/10/0020	IASI annual in-flight performance report 2010

3 SIGNIFICANT EVENTS

The following tables present a timeline of the various requests sent by TEC and the external IASI activities.

Those events are typically the configuration changes, programming requests, software update, but also any external operation or activity such as mission interruption, manoeuvre, dissemination problem, …)

3.1 EXTERNAL CALIBRATION

Table 1 shows the External Calibration within the time period reported here. Note that the VDS files that come with each request are not described here.

Execution	TEC ref.(1)	Description	Activities
18/09/2011 from 5h13 to 9h09 orb. 25494 to 25496	RM-51	Monthly_MPF(2) Targets: Earth 15, Blackbody, 2nd Deep Space, Mirror Backside	For routine monitoring (IIS and IASI NeDT, scan mirror reflectivity, ghost,…)
17/10/2011 from 5h13 to 9h09 orb. 25906 to 25908	RM-52	Monthly_MPF(2) Targets: Earth 15, Blackbody, 2nd Deep Space, Mirror Backside	For routine monitoring (IIS and IASI NeDT, scan mirror reflectivity, ghost,…)
15/11/2011 from 5h13 to 9h09 orb. 26318 to 26320	RM-53	Monthly_MPF(2) Targets: Earth 15, Blackbody, 2nd Deep Space, Mirror Backside	For routine monitoring (IIS and IASI NeDT, scan mirror reflectivity, ghost,…)

Table 1: External Calibration TEC Requests

(1) TEC convention: R for Routine, M for Monthly and L for moon avoidance, followed by a chronological number

(2) An external calibration could be the result of:

- a TEC request or
- a "MPF" uploaded directly by EUMETSAT in full accordance with TEC. The reference "Monthly_MPF" is based on the March 2008 TEC External Calibration request. The MPF for moon avoidance is based on the December 2008 TEC External Calibration request: "ICAL_OCF_xx_M02_20081216060000Z_20090616060000Z_20081209100934Z_IAST_EXTCALIBRA.dts"

3.2 ON BOARD CONFIGURATION

Table 2 presents the on-board processing configuration updates that had been made within the time period reported here:

PTSI	IASI on board parameter files	Delivery by TEC	activated on	TEC ref.	affected parameters of a DPS TOP configuration update

Table 2: DPS and MAS configuration TEC Requests

For information, Table 3 shows the delivery applicable at the beginning of the period:

PTSI	IASI on board parameter files	Delivery by TEC	activated on	TEC ref.	affected parameters of a DPS TOP configuration update
13 2.0	IDPS_OBP_xx_M02_20110413060000Z_20111013060000Z_20110412132838Z_IAST_DPSPARAMOD.tar	12/04/2011 13h30	20/04/2011 09h50 orbit 23352	R_45	Update of reduced spectra 58: IRscSrd 59: IRshSrd 64: PTSI (0x0200 000C)

Table 3: DPS and MAS previous configuration

The associated ground configuration table (BRD file), necessary to handle coherent configuration at system level, is presented in the next section. These associated configuration table are necessary for L1 processing.

3.3 GROUND CONFIGURATIONS UPDATES FOR LEVEL 1 PROCESSING

Table 4 presents the on-ground processing configuration updates that had been made within the time period reported here:

IDef	IASI L1 auxiliary files	Delivery by TEC	Upload on GS1	Content

Table 4: IASI L1 Auxiliary File Configuration on the Operational EPS Ground Segment

For information, Table 5 shows the delivery applicable at the beginning of the period:

IDef	IASI L1 auxiliary files	Delivery by TEC	Upload on GS1	Content
45	IASI_BRD_xx_M02_20101222080000Z _xxxxxxxxxxxxxxZ_20101222072008Z _IAST_0000000012	12/04/2011	BRD activated on 07/02/2011 11:30 UTC, orbit 23352	BRD associated to TOP
22 10	IASI_GRD_xx_M02_20101220110000Z _xxxxxxxxxxxxxxZ_20101220101609Z _IAST_0000000022 IASI_ODB_xx_M02_20101222080000Z _20110622080000Z_20101222072116Z _IAST_0000000010	22/12/2010	BRD activated on 07/02/2011 orbit	GRD: update of scan mirror (SMA) ODB: Algorithm correction

Table 5: IASI L1 auxiliary file previous configuration

3.4 DATA BASES UPDATE FOR THE USERS

The Noise Covariance Matrix (NCM) and Spectral data base (SDB) are specific data bases for the users. They are updated according to the main ground level 1 evolutions.

Table 6 presents the updates of the NCM and SDB that had been made within the time period reported here:

IDef	Users Data-Base	Delivery by TEC	TEC ref.	Comments

Table 6: IASI Data Bases for the users

For information, Table 7 shows the delivery applicable at the beginning of the period:

IDef	Users Data-Base	Delivery by TEC	TEC ref.	Comments
3	IASI_NCM_xx_M02_20091217060000Z _20091217060000Z_20091216123652Z_ IAST_SPECTRESPO	16/12/2009	R_COV_3	Noise Covariance Matrix after decontamination; Covariance matrix from L0 noise on BB (External Calibration of 2009/10/22)
10	IASI_SDB_xx_M02_20110114080000Z _20110114080000Z_20110114073158Z _IAST_IASISPECDB	14/01/2011	R_44	User database associated to ODB IDefSDB 10

Table 7: previous IASI Data Bases

3.5 ON GROUND HW/SW EVOLUTION

Table 8 presents the updates of PPF L1 software within the time period reported here:

IASI L1 PPF software version	Delivery by TEC	Date introduced on GS1	Comments
6.1	24/08/2011	29/09/2011 for sensing time 11:42^UTC Orbit 25653	CCS anomaly correction
6.0	10/06/2011	Not introduced on GS1	First version compatible with IBM and Linux

Table 8: IASI L1 PPF Configuration on the Operational EPS Ground Segment

For information, Table 9 shows the software version applicable at the beginning of the period:

IASI L1 PPF software version	Delivery by TEC	Date introduced on GS1	Comments
5.1	11/05/2011	01/12/2010 for sensing time 11:30^UTC Orbit 21364	Full version before porting to Linux

Table 9: Previous IASI L1 PPF

3.6 DECONTAMINATION

Table 10 presents decontaminations that have been made or requested within the time period reported here:

Last due date	Date of decontamination	Description
After end of 2014		

Table 10: Decontamination TEC Requests

For information, Table 11 shows the previous decontamination:

Last due date	Date of decontamination	Description
Before end 2010	31/08/2010	

Table 11: Decontamination TEC Requests

3.7 INSTRUMENT

3.7.1 External events

This category is for those activities/events that are external to IASI but still have an impact. It is broken down into classes of *PL-SOL* and *OOP* manoeuvre.

3.7.1.1 Manoeuvres

Date	Type(*)	Description	IP flag	OoP mission Outage
28/09/2011 7h23 to 29/09 6h17	OoP	IASI in Heater 2	N/A	1 day

Table 12: Overview of METOP manoeuvres in the reporting period

(*): IP for In-Plane manoeuvres (IASI stays in NOp) and OoP for Out of plane manoeuvres (IASI is put in Heater 2)

3.7.1.2 PL-SOL

Table 13 presents the PL-SOL events that have occurred within the time period reported here:

Dates	Orbits	Description
October 22th 21:50Z to October 25th 17:31Z	25987 to 26027	METOP PL-SOL (IASI in heater refuse) due to SEU in OBDH… October 24th MCMD conflict during Heater2 transit → IASI in Standby refuse. AUX and NOp at the end of the afternoon.

Table 13: PL-SOL

3.7.2 Operation leading to mission outage

This chapter present the intervention on IASI needing routine interruption that have occurred within the time period reported here.

Dates	Orbits	type	IASI mode	Description

Table 14: Scheduled interruptions

3.7.3 Anomaly leading to mission outage

Table 15 and Table 16 present the major and minor anomalies internal to IASI that have occurred within the time period reported here.

Note that, in this section minor anomalies are all identified and without any impact on the mission, and major anomalies only affect IASI instrument, and no other sub-systems of the spacecraft.

Dates	Orbits	Anomaly type (*)	IASI mode	Description
27/11/2011 10:38:31.625	26492	pixel 1B DPC cheksum FW Auto Recovery	NOp transition	Hole: 10:38:20.744 to 10:41:16.718.
27/11/2011 13:35:00	26493	SAT_CONT procedure to re-enable the Auto Recovery patch	Auxiliary	Hole: 13:34:47.738 to 13:37:19.773
28/11/2011 12:26:47.420	26507	pixel 2B DPC cheksum FW Auto Recovery	NOp transition	1st hole: 12:26:39.570 to 12:29:32.528. 2nd hole: 13:15:29.728 to 13:15:54.376
28/11/2011 13:30:00	26508	SAT_CONT procedure to re-enable the Auto Recovery patch	Auxiliary	13:29:51.542 LN 453 to 13:32:15.537 LN 1 in transition

Table 15: Major anomalies

(*): SEU (LAS, CCM or DPS) anomalies or SET anomalies

Day	Orbits	error n°	Severity	Anomaly type	LN	SN	CCD	Description
01/09/2011				CCM CSQ			0	ELT saturated
04/09/2011 05:57:40.097	25296	6	1	CCM CSQ	29494	27	1	ODNV_CSQ
04/09/2011 13:03:48.016	25300	6	1	CCM CSQ	32690	13	1	ELT saturated
24/09/2011 18:27:59.780	25587	494	1	DCM arithmetic	3458	5	1	
19/10/2011 14:57:54.650	25940	494	1	DCM arithmetic	24217	3	0	in TM, ELT saturated
11/11/2011 12:55:55.066	26266	13	1	CCM CSQ	50464	32		
14/11/2011 10:13:46.455	26307	494	1	CCM CSQ	16112	3	1	ODNV_CSQ

Table 16: Minor anomalies

4 PERFORMANCE MONITORING

4.1 PERFORMANCE MONITORING

In order to insure that the IASI system is permanently running in good conditions, the CNES (IASI TEC) and EUMETSAT (CGS) are monitoring each orbit, both at line, PDU and DUMP levels.

The on-board and ground processing performance algorithms issue more than one hundred quality indicators, called flags and simple parameters. Those are alarms for any bad functioning or local performance degradation.

According to the results, the TEC is also in charge of delivering new on-board or ground parameters to EUMETSAT when it is necessary. EUMETSAT is then in charge of uploading them on-board or as an input of the level 1 processing chain. During the whole instrument life, these parameter adjustments are necessary in order to take into account instrument evolution in the processing and finally to maintain a good data quality.

The Table 17 is the colour code used for the status report.

Status Colour	Meaning
GREEN	≥ 95
YELLOW	< 95
RED	Production interrupted
BLANK	No Status Reported

Table 17: Functional status legend

4.2 PERFORMANCE SYNOPSIS

Table 18 provides a synthetic view of all the indicators evaluated for L0/L1 data and their current status.

Section	Component	Description	Status	Comments
4.3	L0	**Level-0 Data Quality** • Overall quality • Main flag and quality indicator parameters - Spikes monitoring - ZPD monitoring - Overflows/Underflows monitoring - Reduced Spectra monitoring • Second level flag and quality indicators	GREEN	On-board processing
4.4	L1	**Level-1 Data Quality** • Overall • Main flag and quality indicator parameters • Second level flag and quality indicators	GREEN	On ground processing
4.5	L1	**Sounder radiometric performances** • Radiometric noise • Radiometric calibration • Optical transmission • Interferometric contrast • Detection chain	GREEN	
4.6	L1	**Sounder spectral performances** • Dimensional stability • Acquisition chain delay • Ghost evolution • Instrument parameters	GREEN	
4.7	L1	**Geometric performances** • Sounder/IIS co-registration • IIS/AVHRR co registration • PDD SCAN, SQ1 flag, SQ2 flag	GREEN	
4.8	L1	**IIS radiometric performances** • IIS radiometric noise monitoring • IIS radiometric calibration monitoring	GREEN	

Table 18: IASI product components functional status

4.3 LEVEL 0 DATA QUALITY (L0)

4.3.1 Overall quality

The IASI L0 data quality (orbit average) through IASI engineering products is shown in Figure 1.

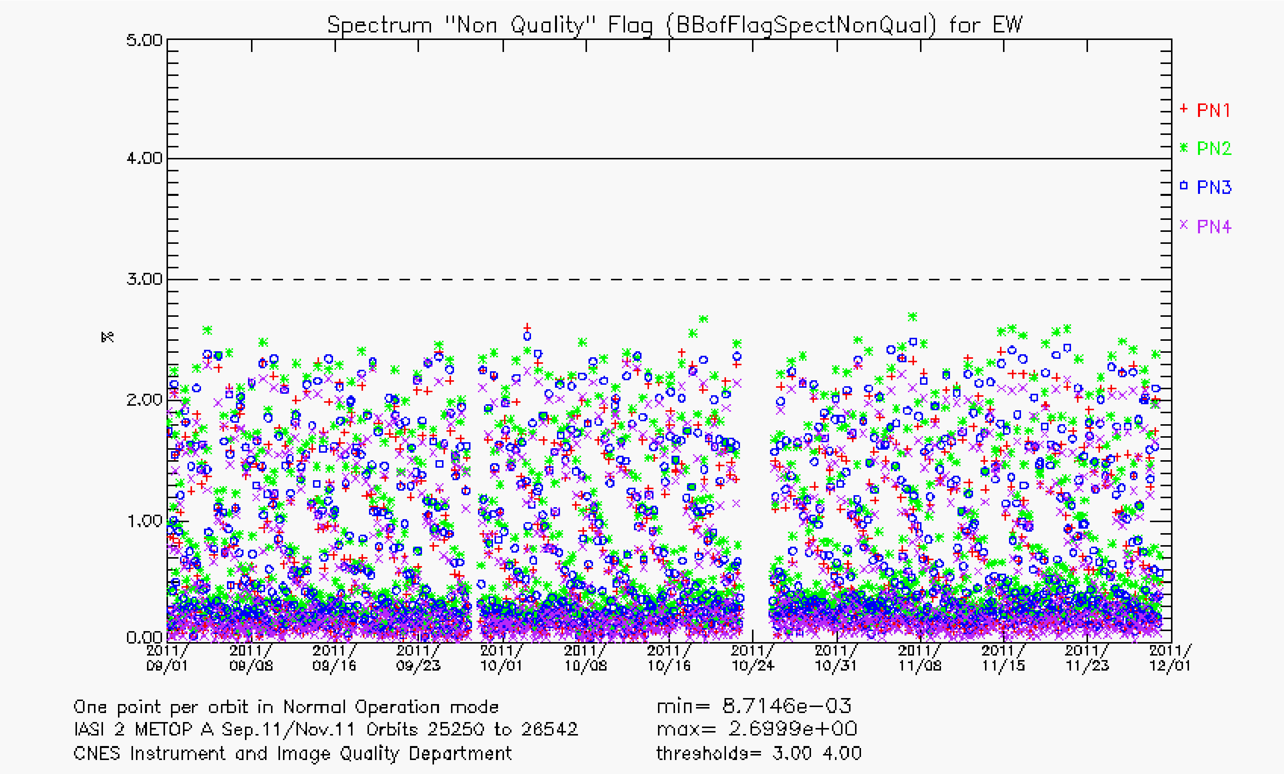


Figure 1 : IASI L0 data quality orbit average (per pixel and CCD)

The IASI L0 quality and on-board processing are nominal.

4.3.2 Main flag and quality indicator parameters

The main contributors to the rejected spectra by on-board processing are: the spikes (proton interaction on detectors), failure of NZPD algorithm determination and over/underflows (measured data exceeding on-board coding tables capacity). There are analysed in details hereafter.

4.3.2.1 Spikes monitoring

Spikes occur when a proton hit a detector. This very high energetic particle disrupts the measure of the interferogram and then corrupts the spectrum.

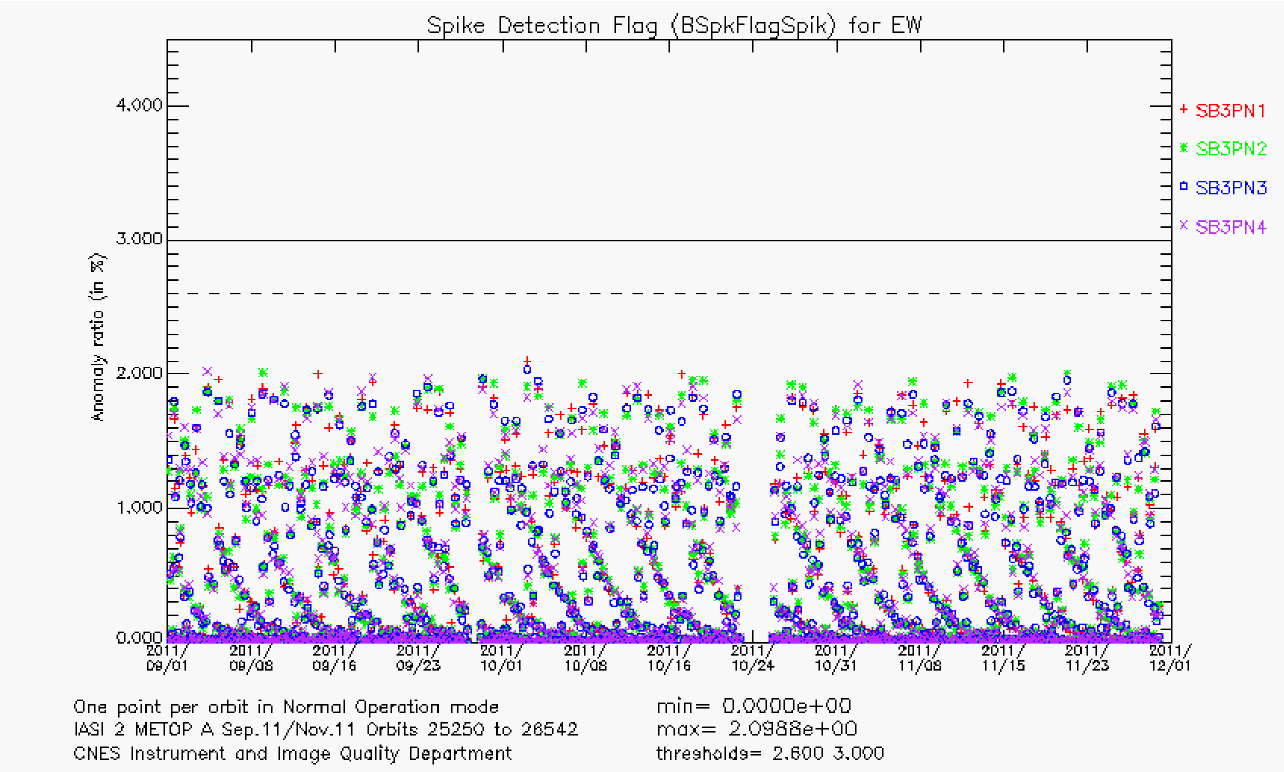


Figure 2 : Temporal evolution of spikes anomaly ratio in % for all pixels (orbit average)

Spike anomaly ratio is nominal for the reported period.

4.3.2.2 ZPD monitoring

The ZPD ("Zero Path Difference") is the position of the central fringe of the interferogram. The NZPD is the number of the sample detected as the ZPD. On IASI, it is determined by a software. This is a special feature of IASI in comparison to other instruments for which NZPD determination is done by hardware.

NZPD variations are governed by two phenomenons:

1. ASE fluctuations which have the same effect on each pixel and can produce NZPD variation of 30-40 samples over month. This is the first order phenomena.
2. Mechanical deformation of the interferometer or evolution of detection chain delays. These phenomenons affect the 4 pixels in different way. However this phenomenon has a second order effect in comparison to the first one.

We monitor both NZPD determination quality flag and interpixel homogeneity. We expect a stability.

BZPDFlagNZPDNonQualEW: Temporal evolution of NZPD determination quality flag for earth view

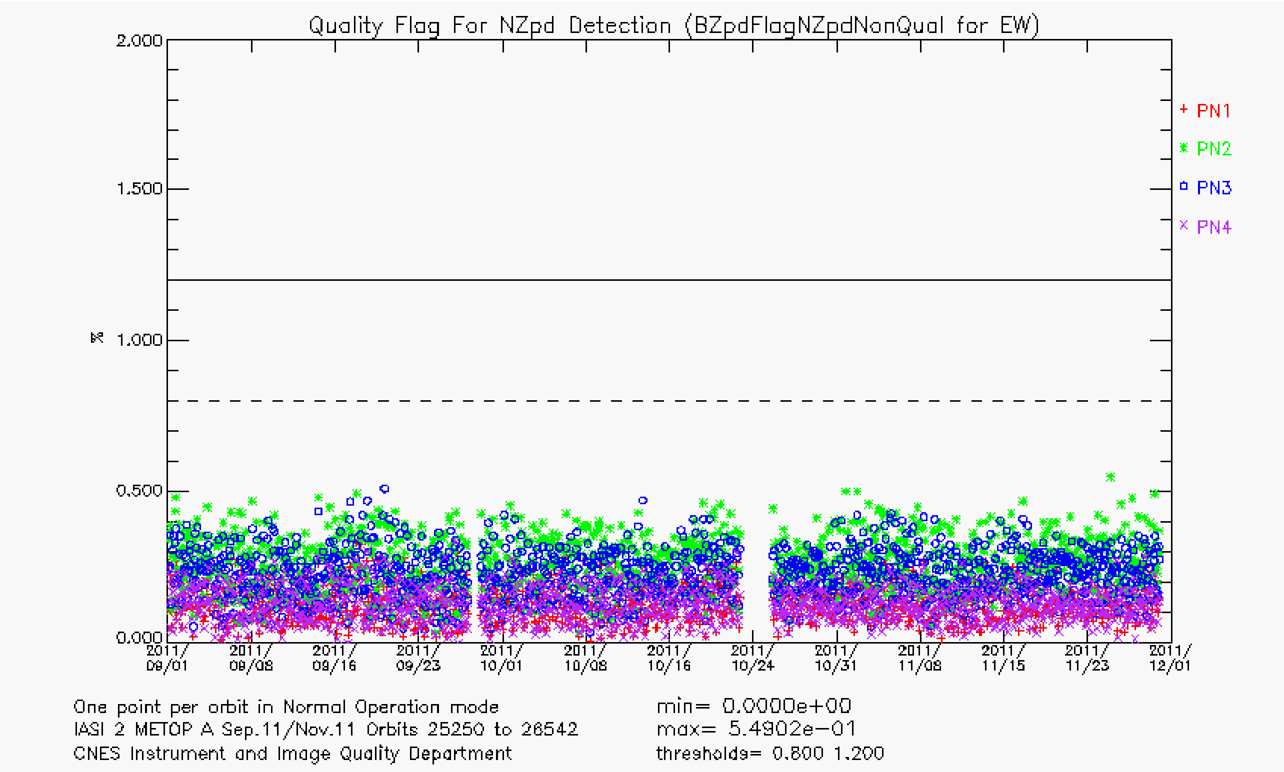


Figure 3 : Temporal evolution of NZPD determination anomaly ratio in % for all pixels (orbit average)

NZPD determination anomaly ratio is nominal for the reported period.

NZPD inter-pixel homogeneity monitoring

This monitoring is necessary in order to follow potential deformation of the interferometer or evolution of detection chain delay.

The NZPD inter-pixel homogeneity is nominal over the reported period.

Consequently, these parameters are perfectively stable and in-line with the specification.

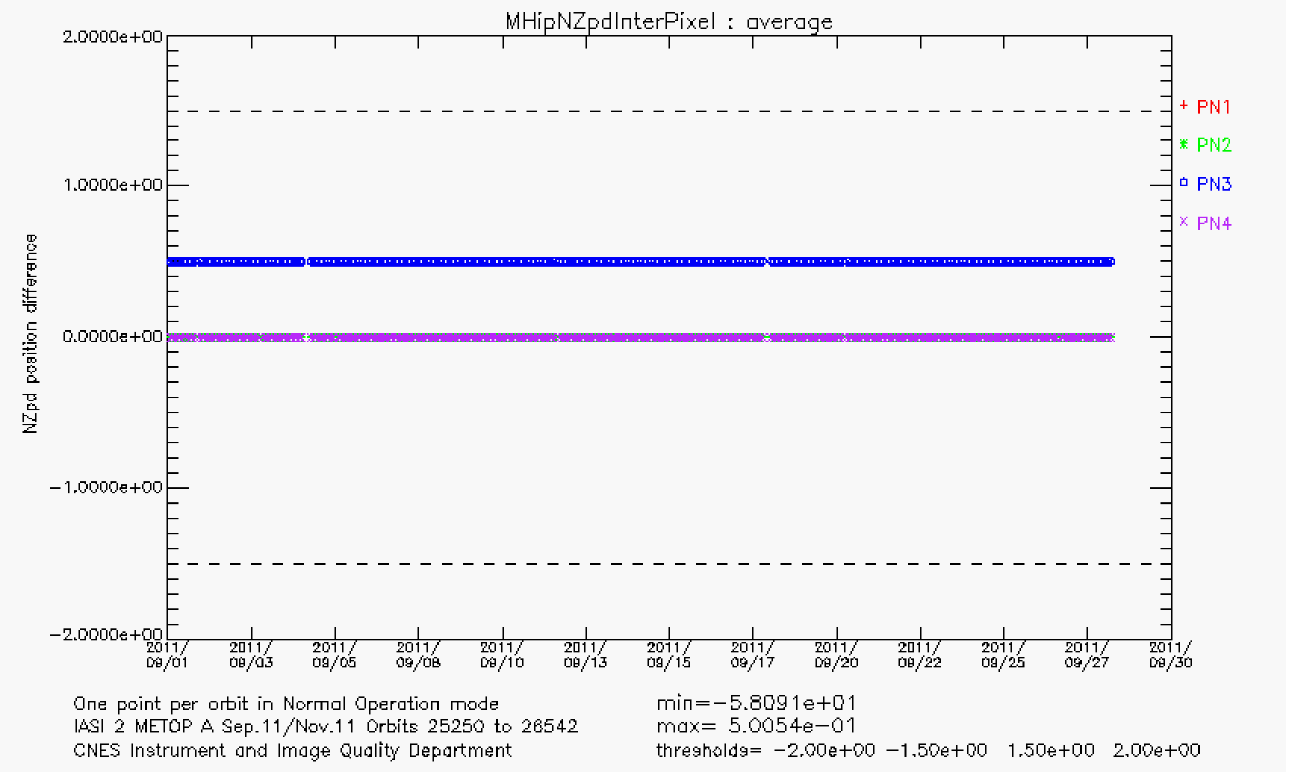


Figure 4 : NZPD inter-pixel for all pixels and CCD calculated with respect to pixel 1 (orbit average)

4.3.2.3 Overflows / Underflows monitoring

The total number of bits available for a spectrum to be transmitted to the ground is limited. For that reason, we have defined coding tables to encode each measured spectrum. These tables have been design by using "extreme spectrum" corresponding to known drastic atmospheric conditions. The coding step is also set to not introduce additional noise into the spectrum. However for very extreme atmospheric conditions (sunglint in B3, very high stratospheric temperature…) a measure can exceed on-board coding tables' capacity and causes an over/underflow.

Over/underflows occurrences are monitored and stability is expected. As long as they remain to low levels, the coding table is not changed. Note that changing the coding tables requires compromises. Indeed, increasing the encoding capacity can be achieved by two different ways. A first solution consists in an increase of the coding step without changing the number of bits. However, that leads to an increase of the digitalization noise. Then, a second solution consists in keeping the coding step constant while increasing the number of bits available for a particular band. But, the total amount of bits available for the entire spectrum is limited and constant. So, that requires to decrease the encoding capacity in another spectral band..

Time series of Overflows and Underflows (orbit average) are shown in following figure for all pixels.

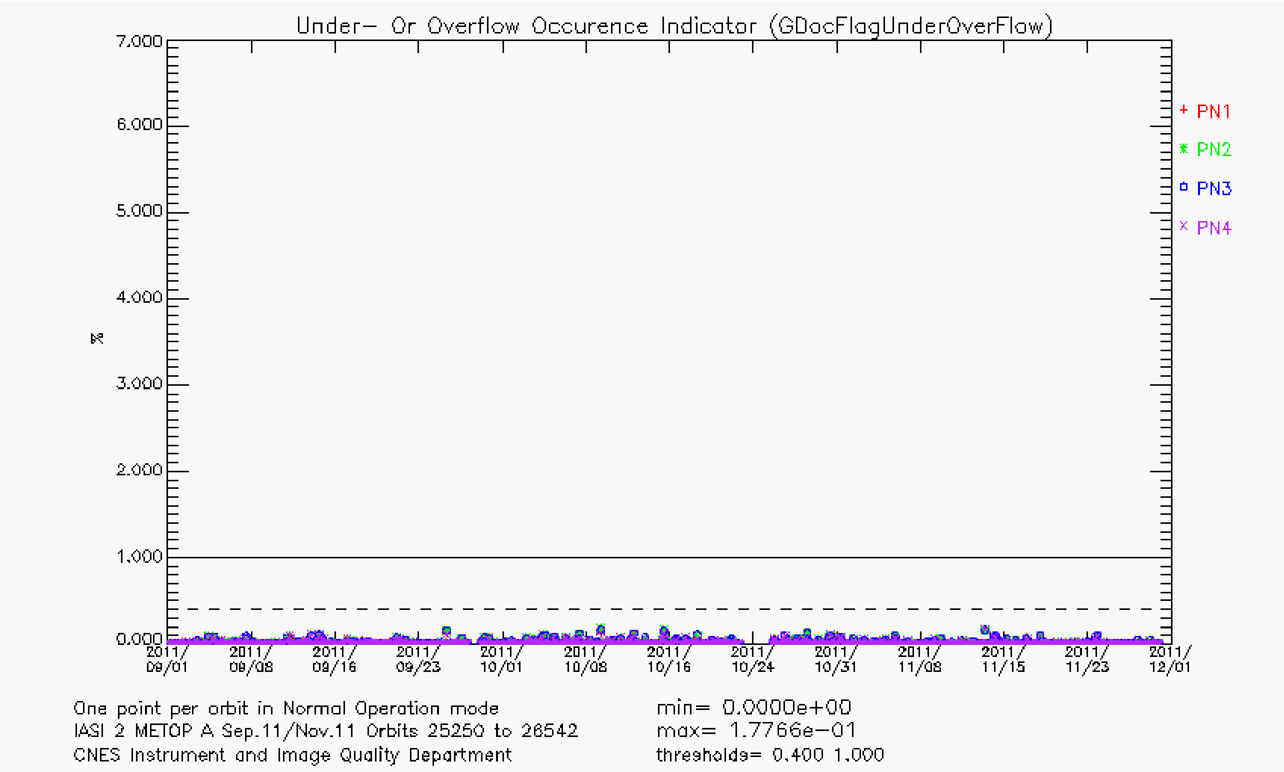


Figure 5 : IASI L0 over/under-flows orbit average of all pixels

Over/underflows ratio is nominal for the reported period.

4.3.2.4 Reduced Spectra monitoring

On-board Reduced Spectra is one of the most important monitoring. It ensures that on-board spectra still have a good radiometric calibration when on-board configuration reduced spectra are reloaded. This is the case, for instance, after an instrument mode change.

Reduced spectra are slightly evolving with respect to potential deformation of the interferometer (optical bench).

In order to prevent a large difference between current and on-board configuration reduced spectra, we monitor the evolution of ZPD determination quality index for calibration views (BZpdNzpdQualIndexBB and CS) obtained by DPS processing by simulating a perpetual mode change. Results of this monitoring are given hereafter.

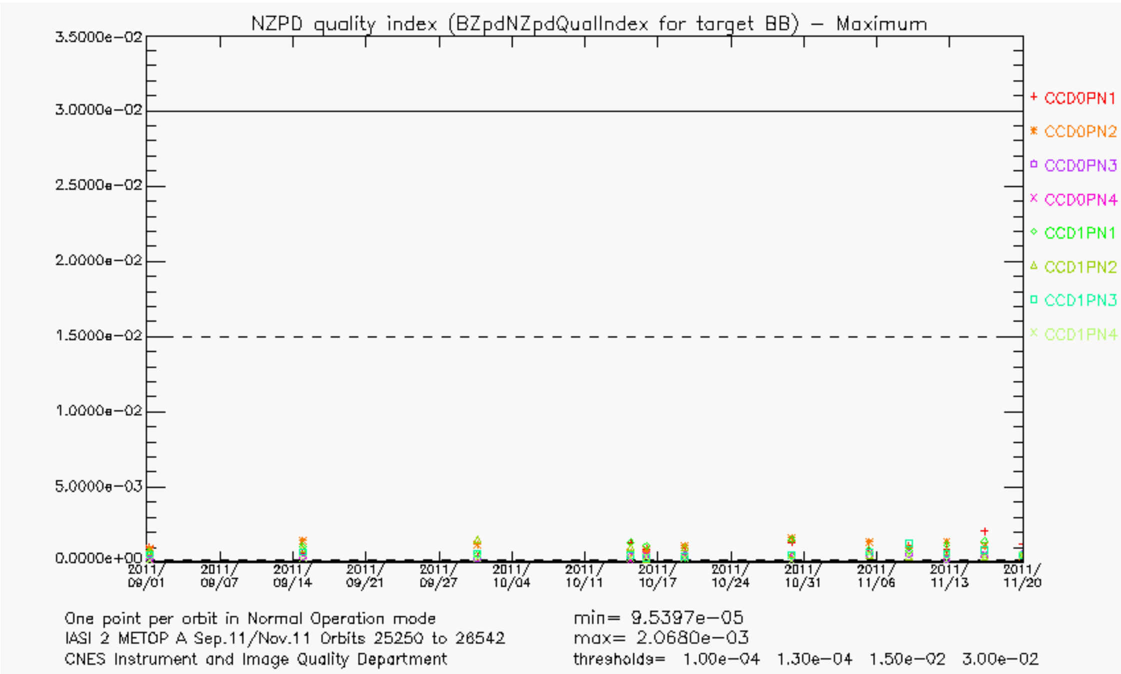


Figure 6 : Max of NZPD quality index for all pixels and CCD - BB

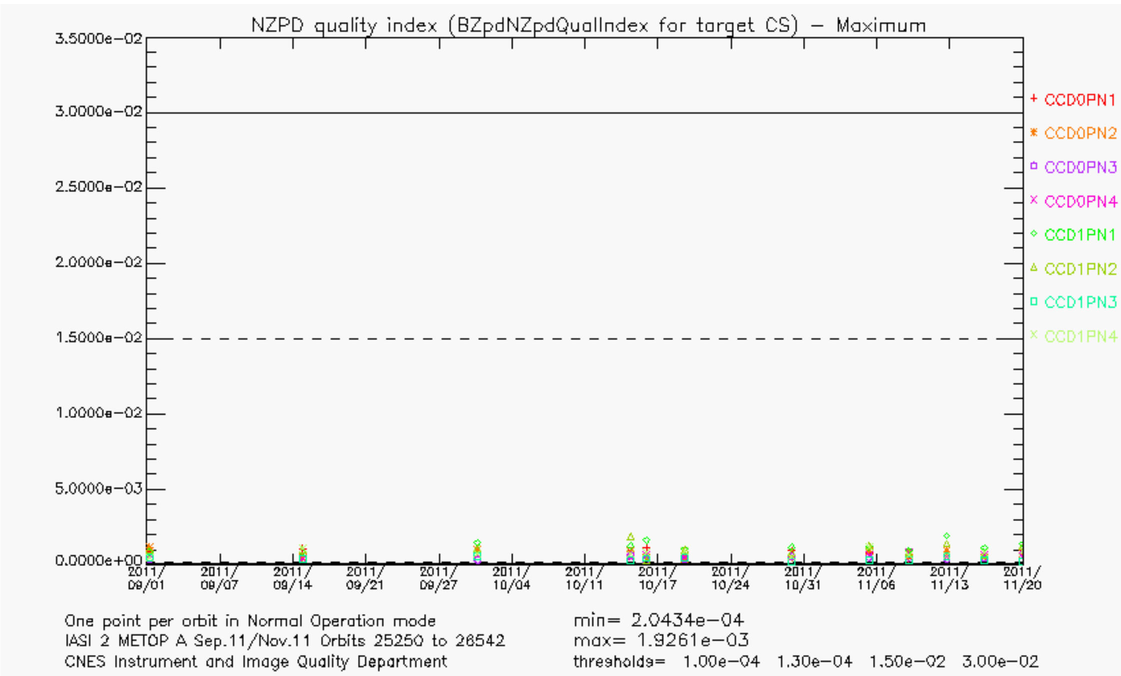


Figure 7 : Max of NZPD quality index for all pixels and CCD - CS

As soon as average BZPDNZPDQualIndexBB and CS remain below 0.03 on-board reduced spectra are robust to an instrument mode change.

On February 2009 and on April 2011, we updated the on board reduced spectra. As a consequence the NZPD quality indicator decreased which means that the reduced spectra quality of the on-board configuration increased.

4.3.3 Second level flags and quality indicators

All second level flags and indicators are stable and nominal.

4.3.4 Conclusion

L0 Flag and quality indicators are stable.

4.4 LEVEL 1 DATA QUALITY (L1)

4.4.1 Overall quality

The IASI overall quality is shown as the orbit averages of the quality indicator for the individual pixels in the next figure.

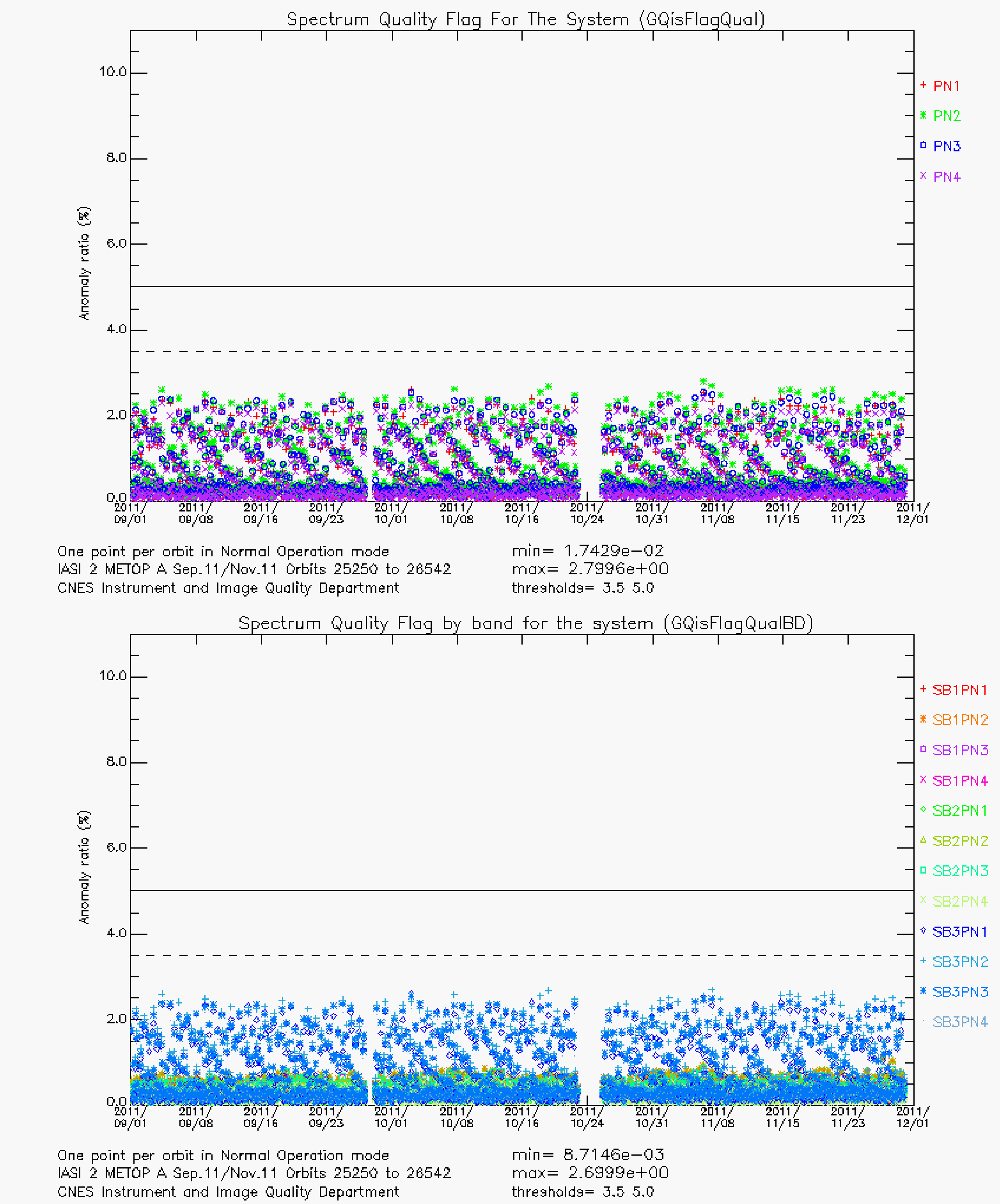


Figure 8 : IASI L1 data quality orbit average (% of bad by PN at upper plot and % of good by PN and SB at lower plot)

One should note that, over the period covered by the present document, the averaged data rejection ratio is less than 1%.

4.4.2 Main flag and quality indicator parameters

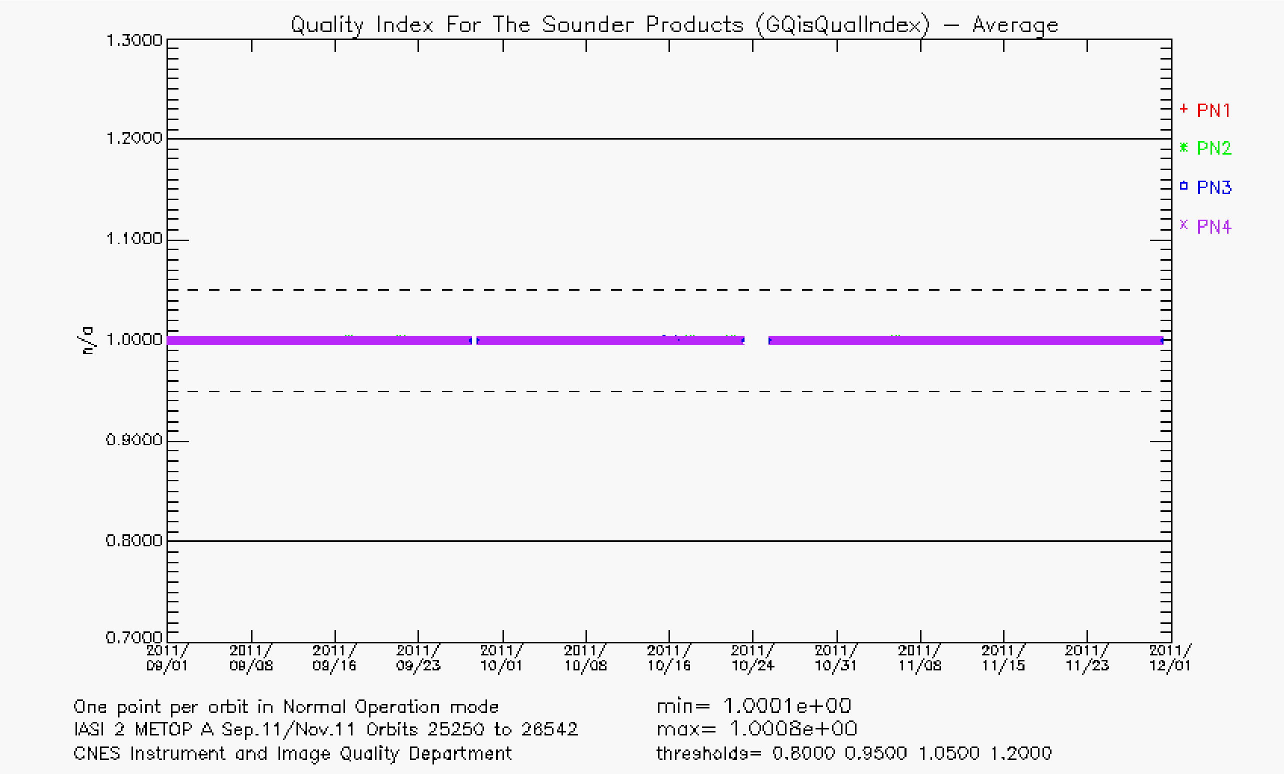


Figure 9 : GQisQualIndex average (L1 data quality index for IASI sounder)

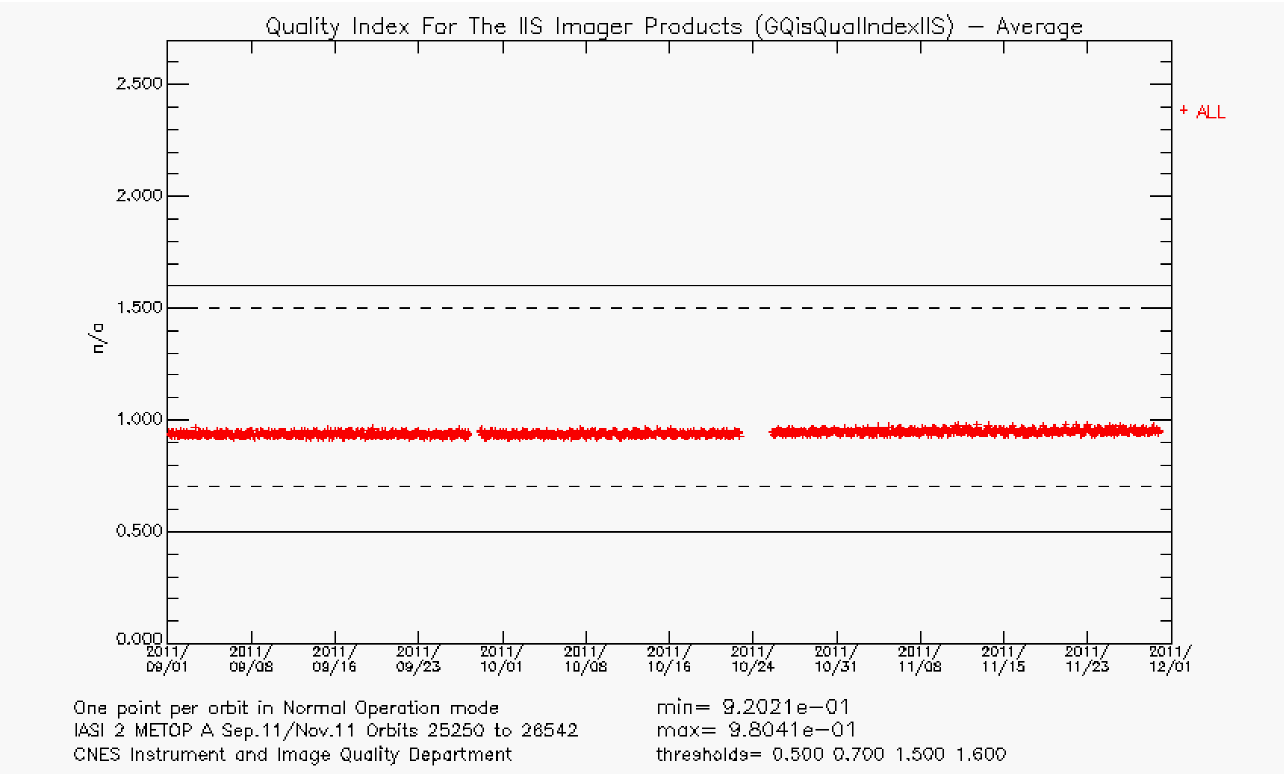


Figure 10 : GQisQualIndexIIS average (L1 data quality index for IASI Integrated Imager)

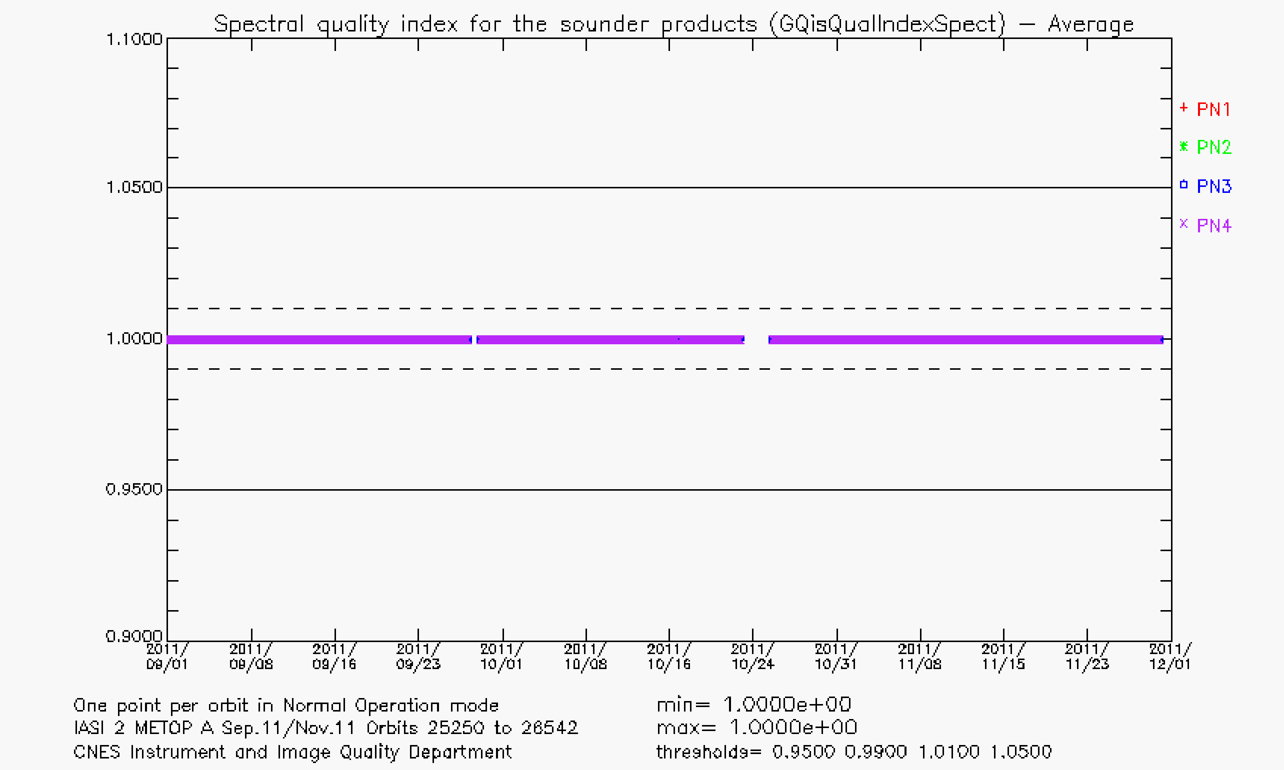


Figure 11 : GQisQualIndexSpect average (L1 data index for spectral calibration quality)

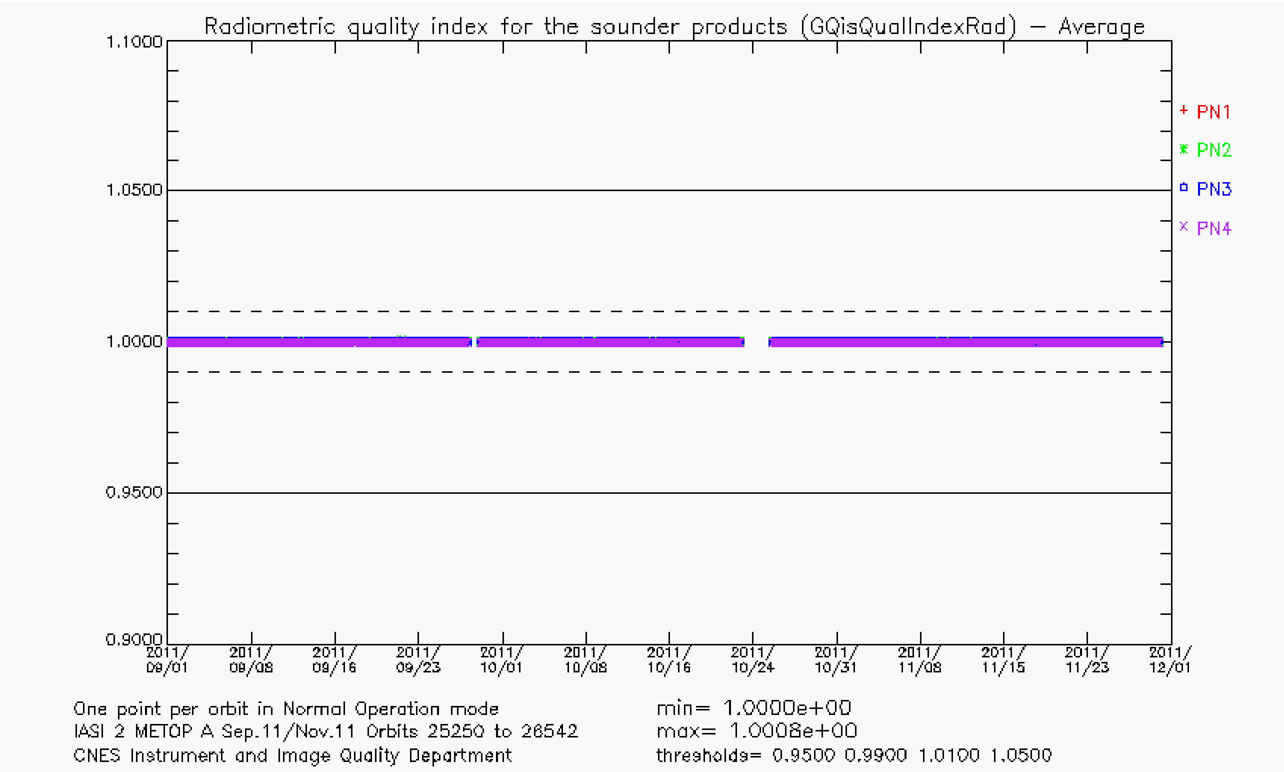


Figure 12 : GQisQualIndexRad average (L1 data index for radiometric calibration quality)

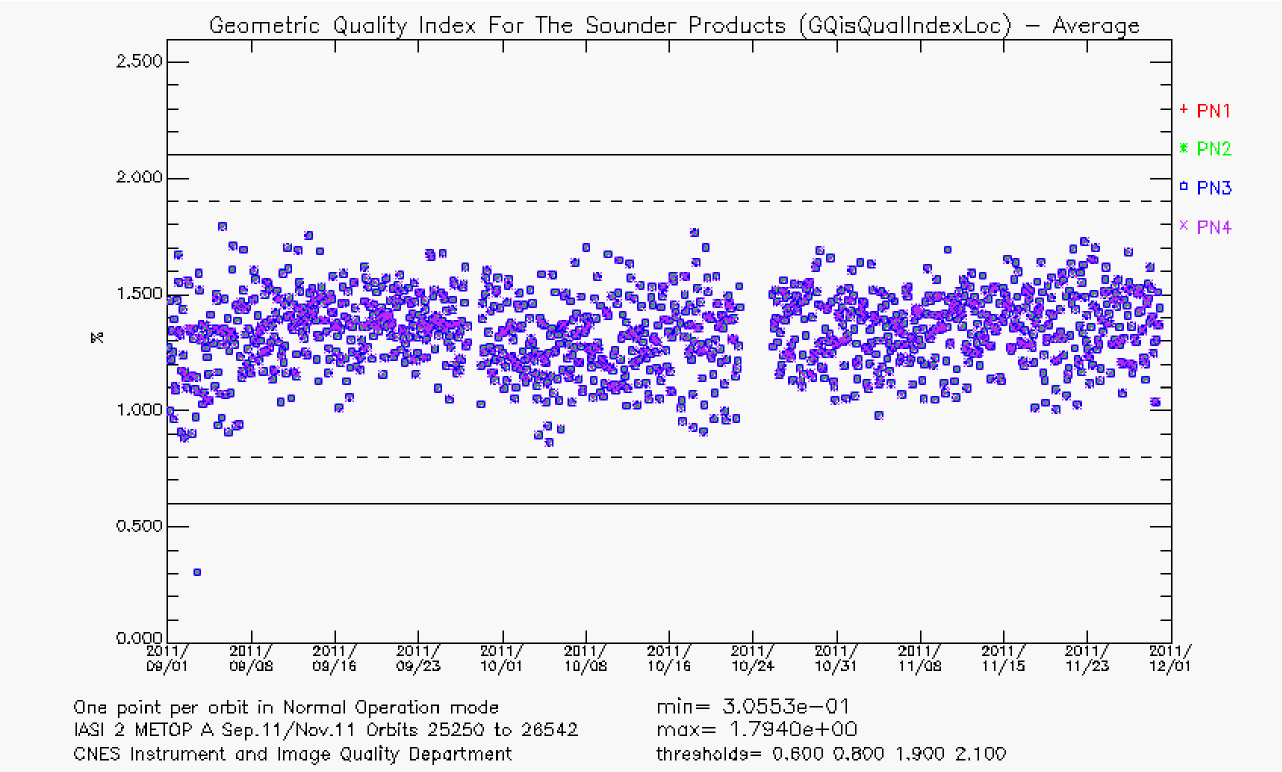


Figure 13 : GQisQualIndexLoc average (L1 data index for ground localisation quality)

4.4.3 Second level flag and quality indicators

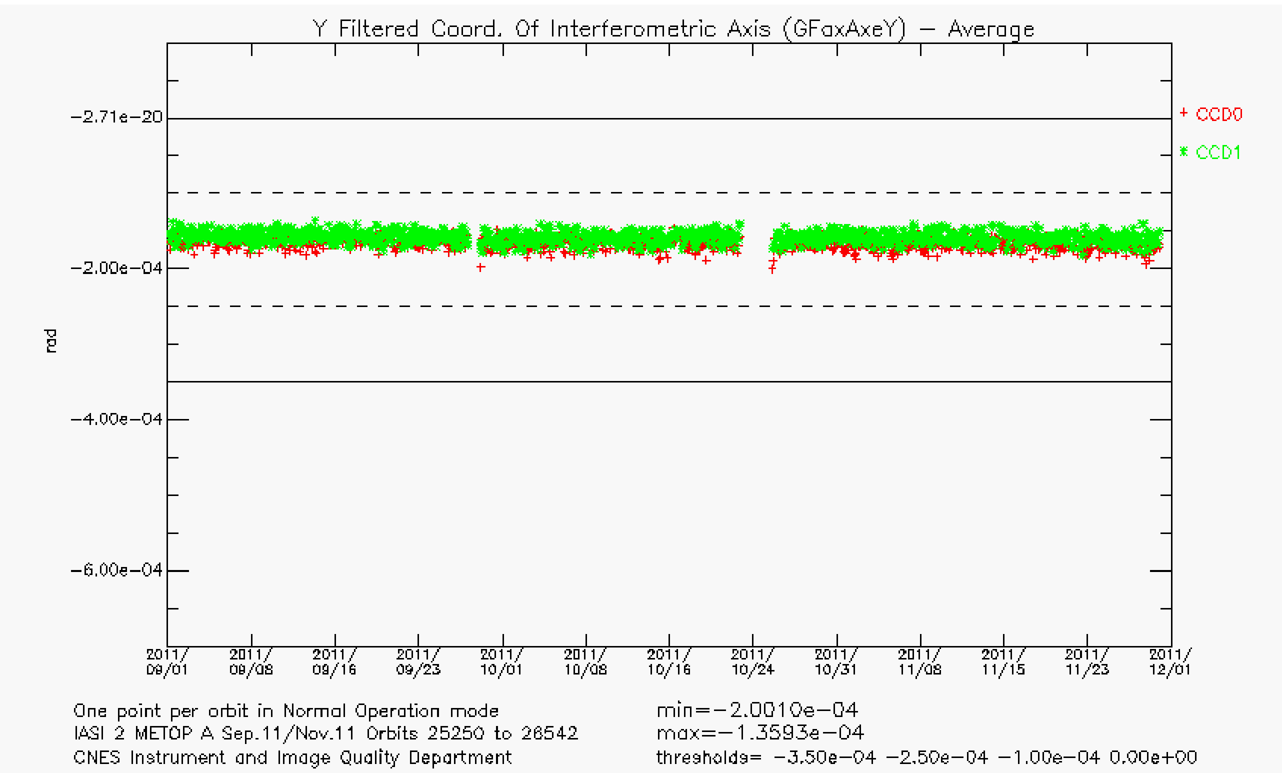


Figure 14 : GFaxAxeY average (Y filtered coordinates of sounder interferometric axis)

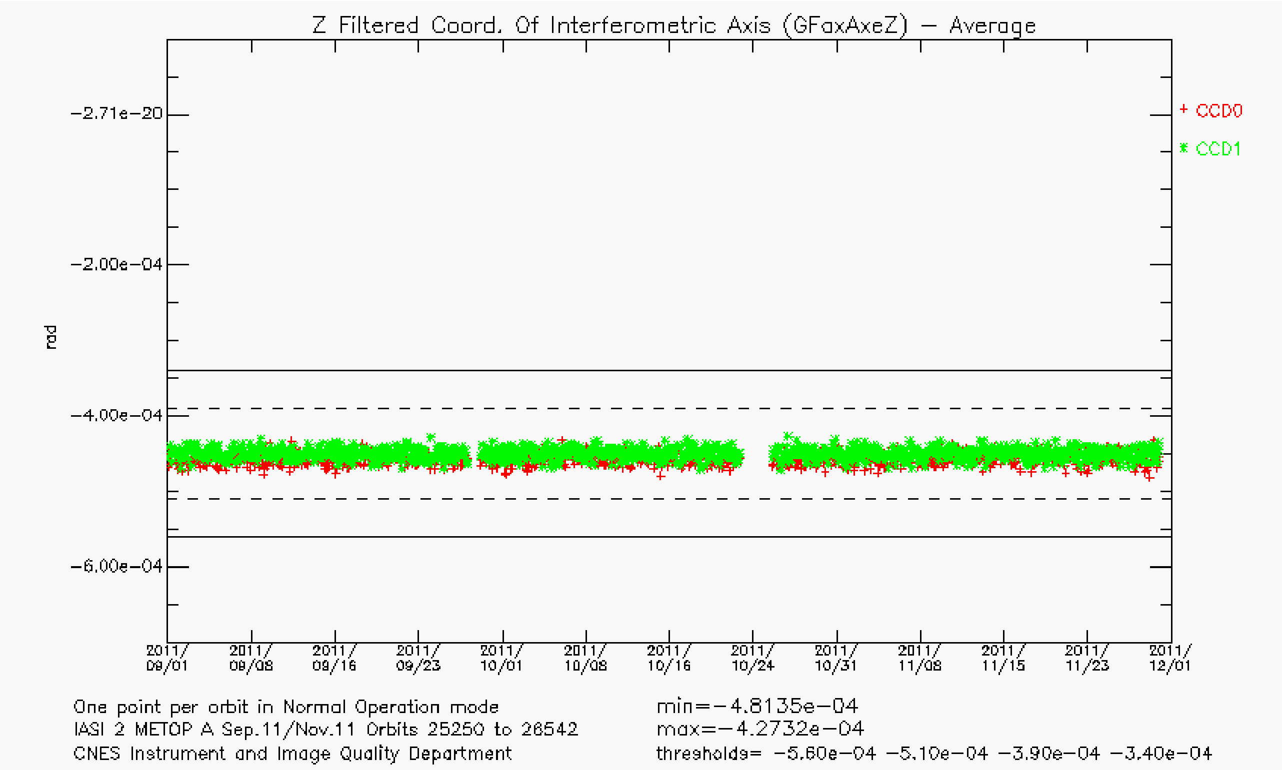


Figure 15 : GFaxAxeZ average (Z filtered coordinates of sounder interferometric axis)

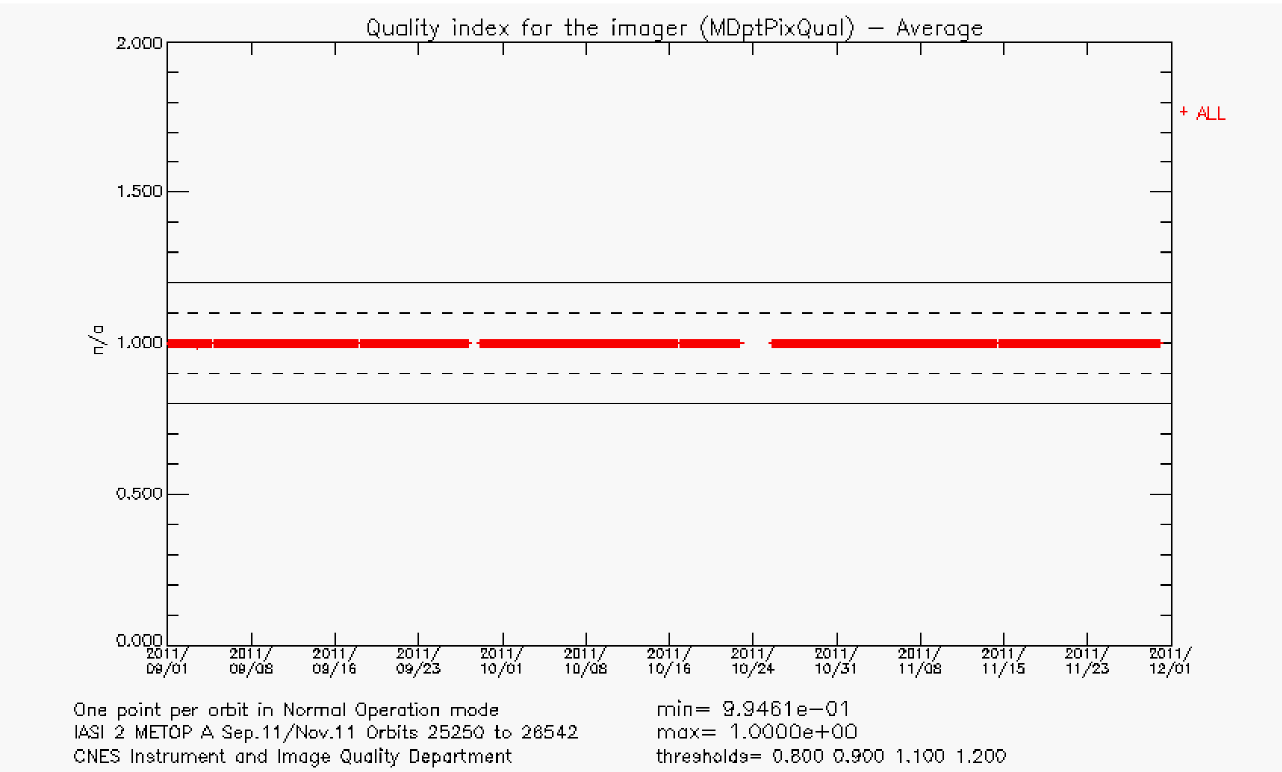


Figure 16 : MDptPixQual average (L1 quality index for IASI integrated imager / fraction of not dead pixels)

4.4.4 Conclusion

L1 Flag and quality indicators are stable and meet the specifications.

4.5 SOUNDER RADIOMETRIC PERFORMANCES

4.5.1 Radiometric Noise

Monitoring the radiometric noise allows to monitor the long term degradation of the instrument as well as to look for punctual anomaly of IASI or other component of METOP.

Monthly noise estimation (CE)

This monthly estimation is performed during routine External Calibration on BB views.

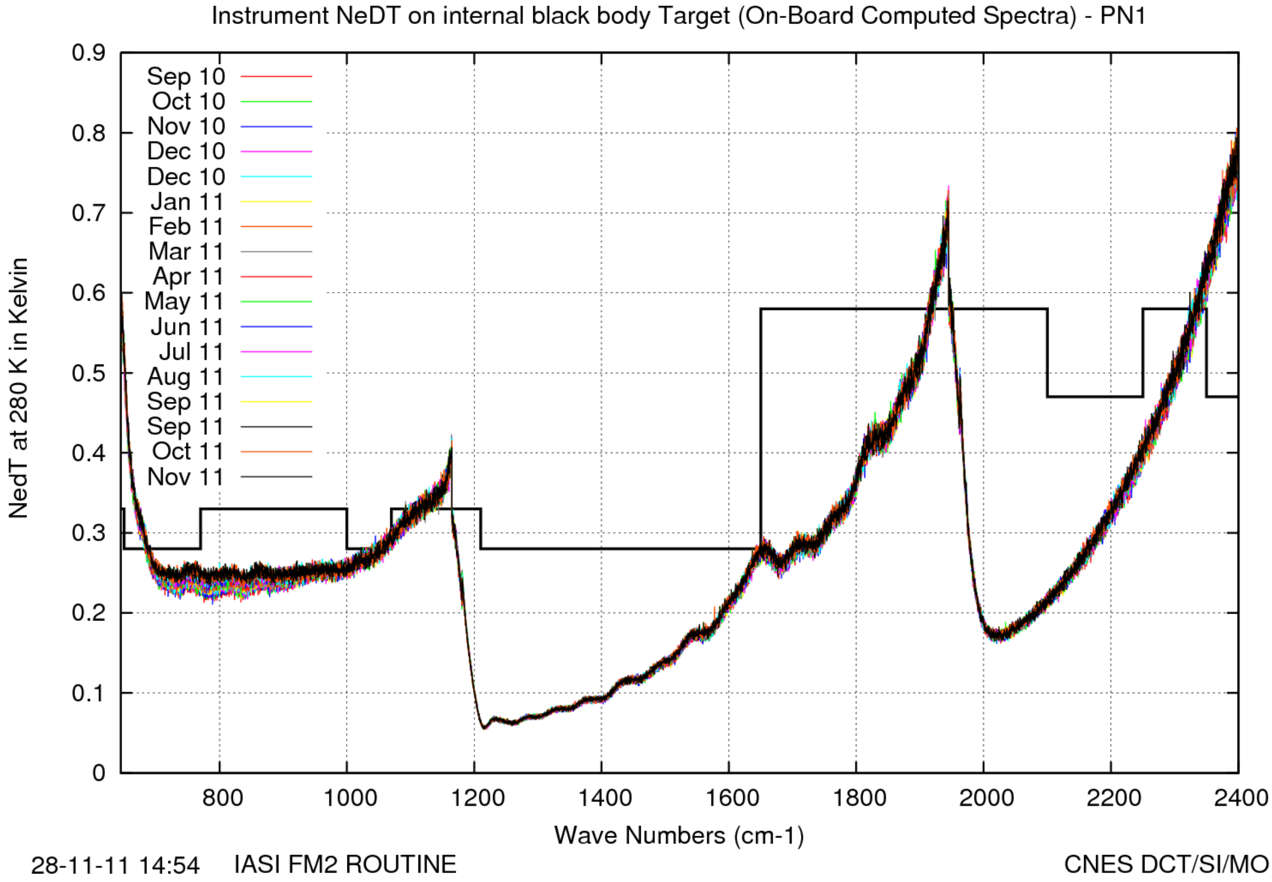


Figure 17 : Instrument noise evolution between start and end of the period

The instrument noise is very stable apart from ice effect between 700 and 1000 cm^{-1}. This point will be developed in section 4.5.4.1.

4.5.2 Radiometric Calibration

The radiometric calibration allows one to convert an instrumental measurement into a physical value. As far as IASI is concerned, the radiometric calibration is used to convert an interferogram into an absolute energy flux by taking into account instrument discrepancies. Even if the calibration has been studied on ground, it has to be continuously monitored in-flight in order to follow any potential degradation of the instrument (optics, detectors …).

Approach: Radiometric fine characterization has been done during ground testing and Cal/Val. All parameters likely to cause a failure in radiometric calibration process have been identified and are continuously monitored. As long as they remain stable, there is no problem with radiometric calibration.

Evolution of scanning mirror reflectivity

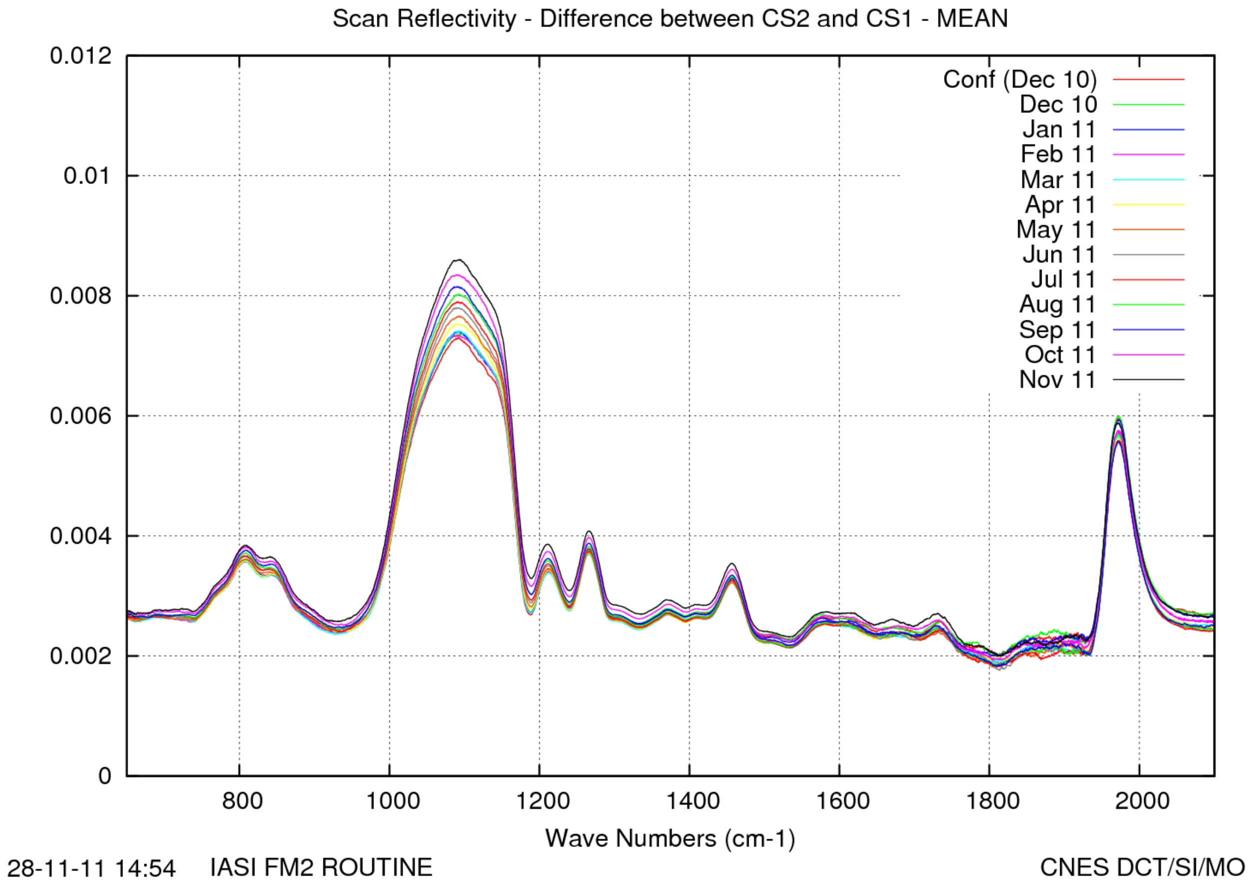


Figure 18 : Scan mirror reflectivity evolution

The reference reflexivity (in red) is the same since the launch. We see a slight evolution within [1000-1100 cm^{-1}] band. Values for wavenumbers greater than 2400 cm^{-1} are not significant because of instrument noise.

The next figure shows the translation of scan mirror reflectivity in terms of maximum radiometric calibration error for different scene temperatures.

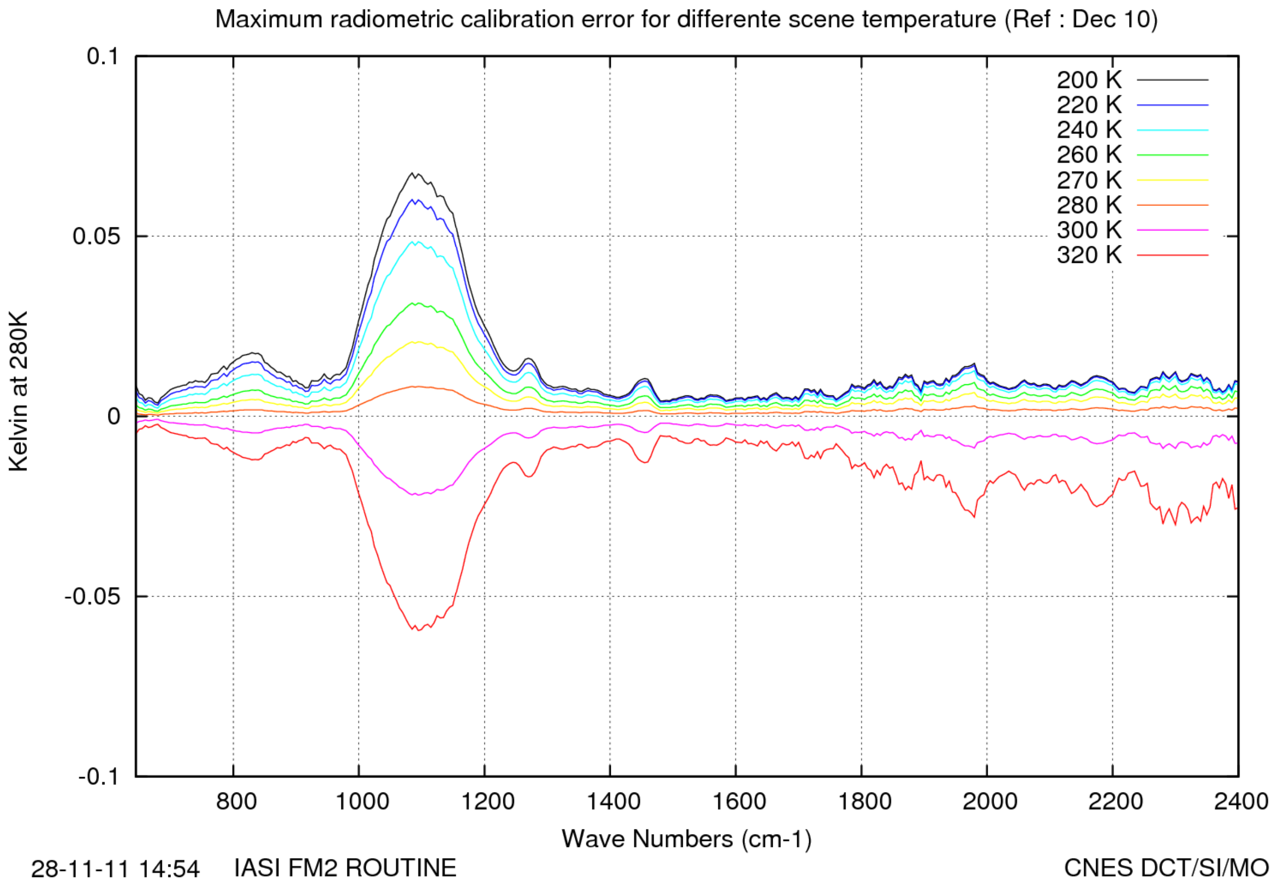
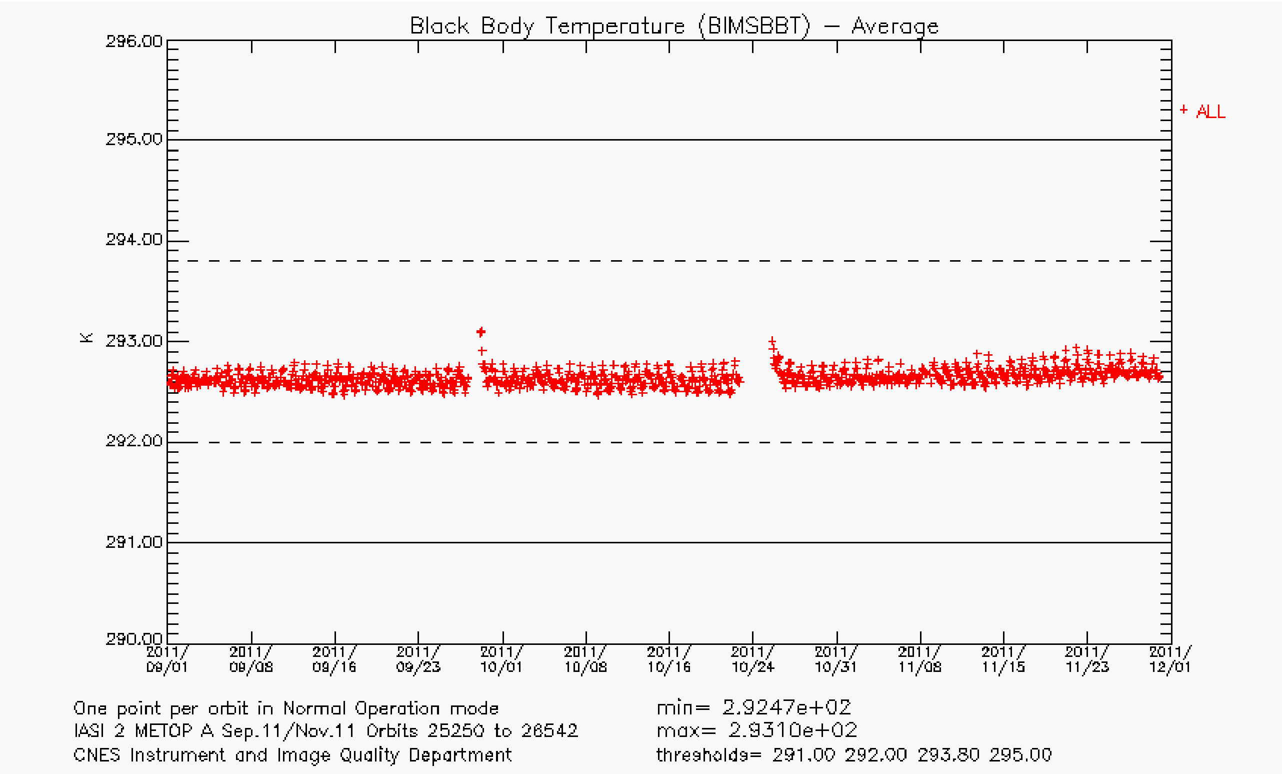


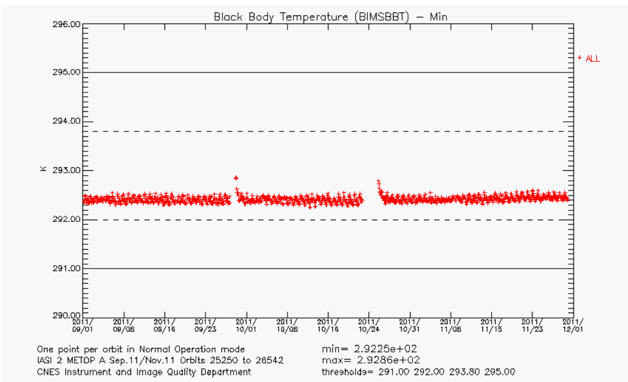
Figure 19 : Radiometric calibration error due to scan mirror reflectivity dependency with viewing angle Maximum effect on SN1 for different scene temperature

In any cases radiometric calibration maximum error is lower than 0.05K. This value is twice lower than the specification (0.1K).

Internal black body



Min



Max

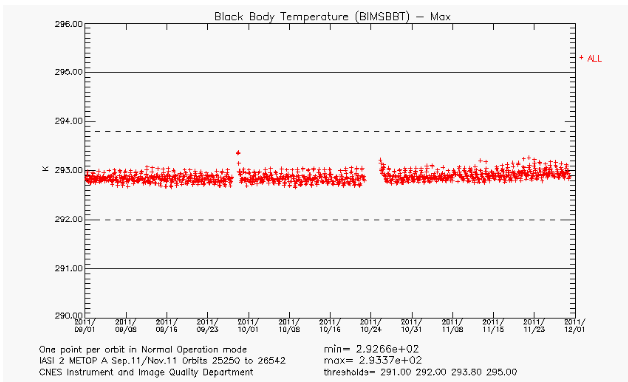


Figure 20 : Black Body Temperature

Minor variation of the black body temperature are observed after the OoP manoeuver on September 29th and after METOP PL-SOL on October 25th.

Non linearity of the detection chains

Non-linearity tables of the detection chains still nominal as long as sounder focal plane temperature variation amplitude is lower than 1K.

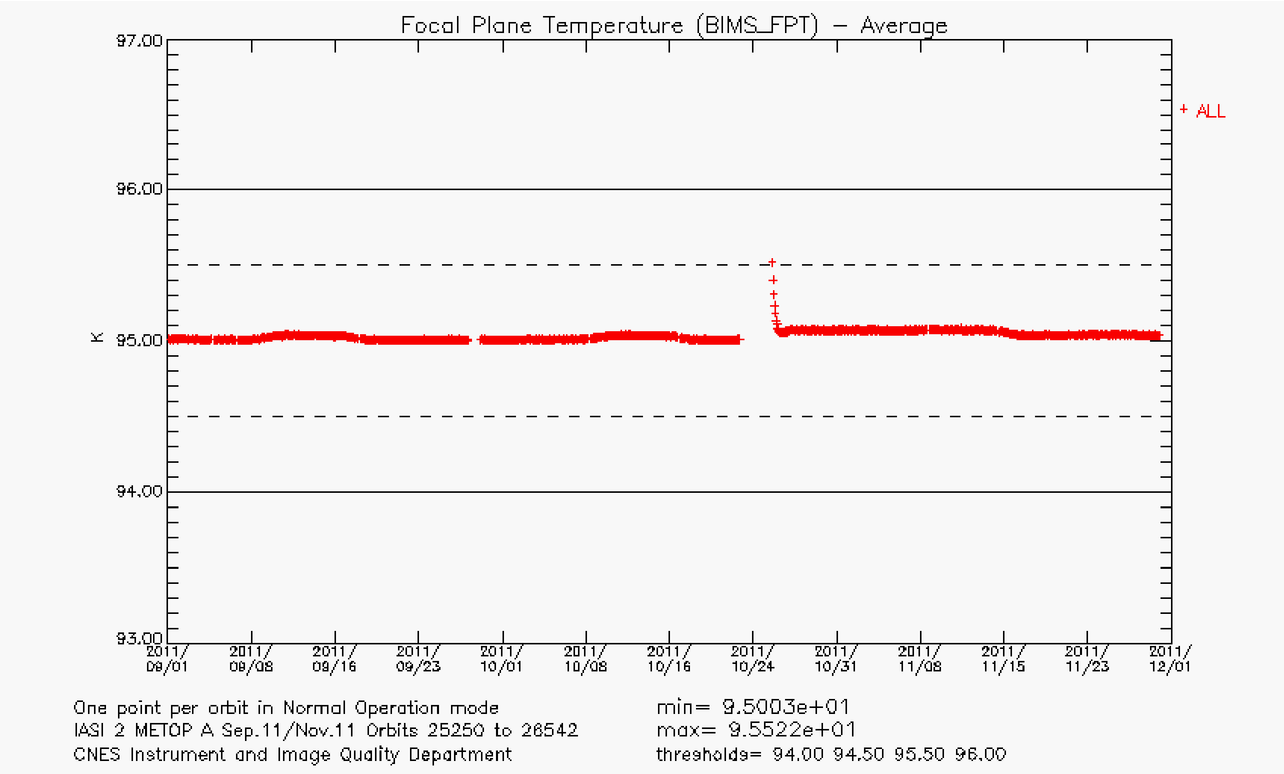
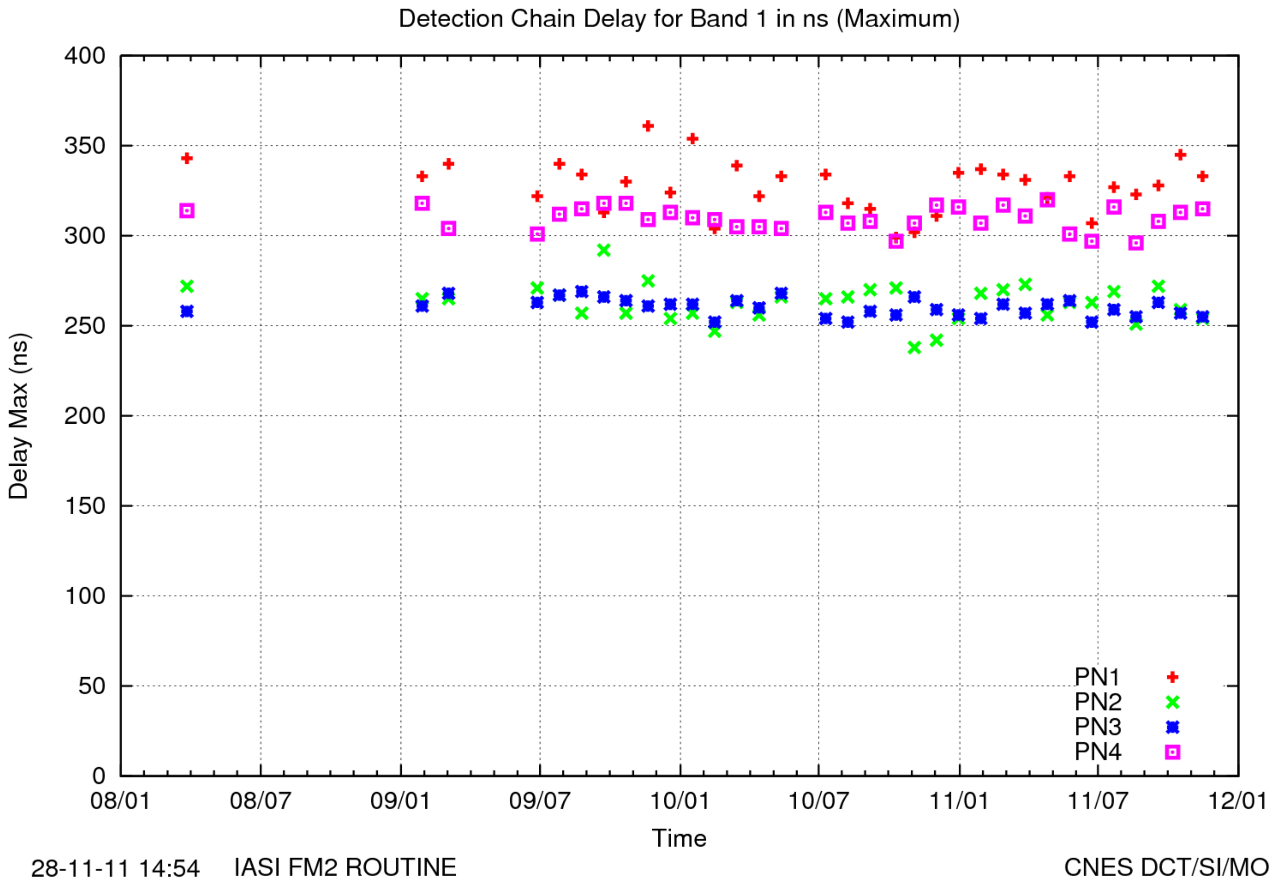


Figure 21 : Focal Plane Temperature

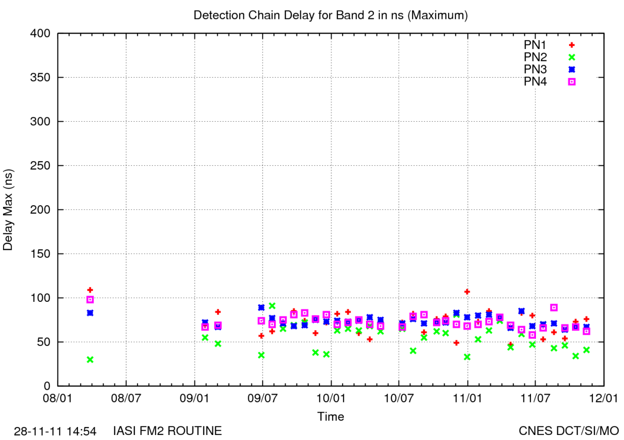
Minor variation of the black body temperature are observed after the METOP PL-SOL on October 25th.

4.5.3 Delay of detection chains

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



SB2



SB3

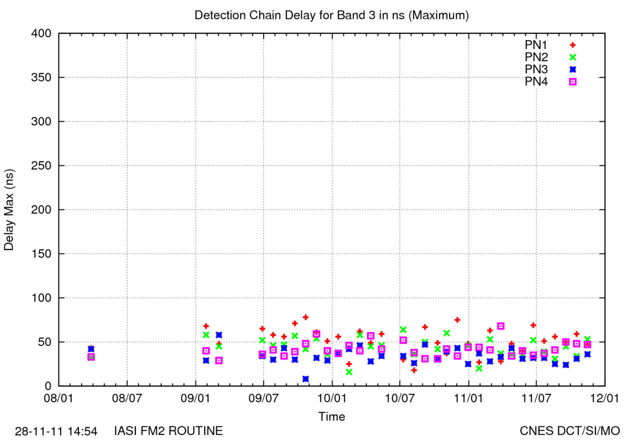
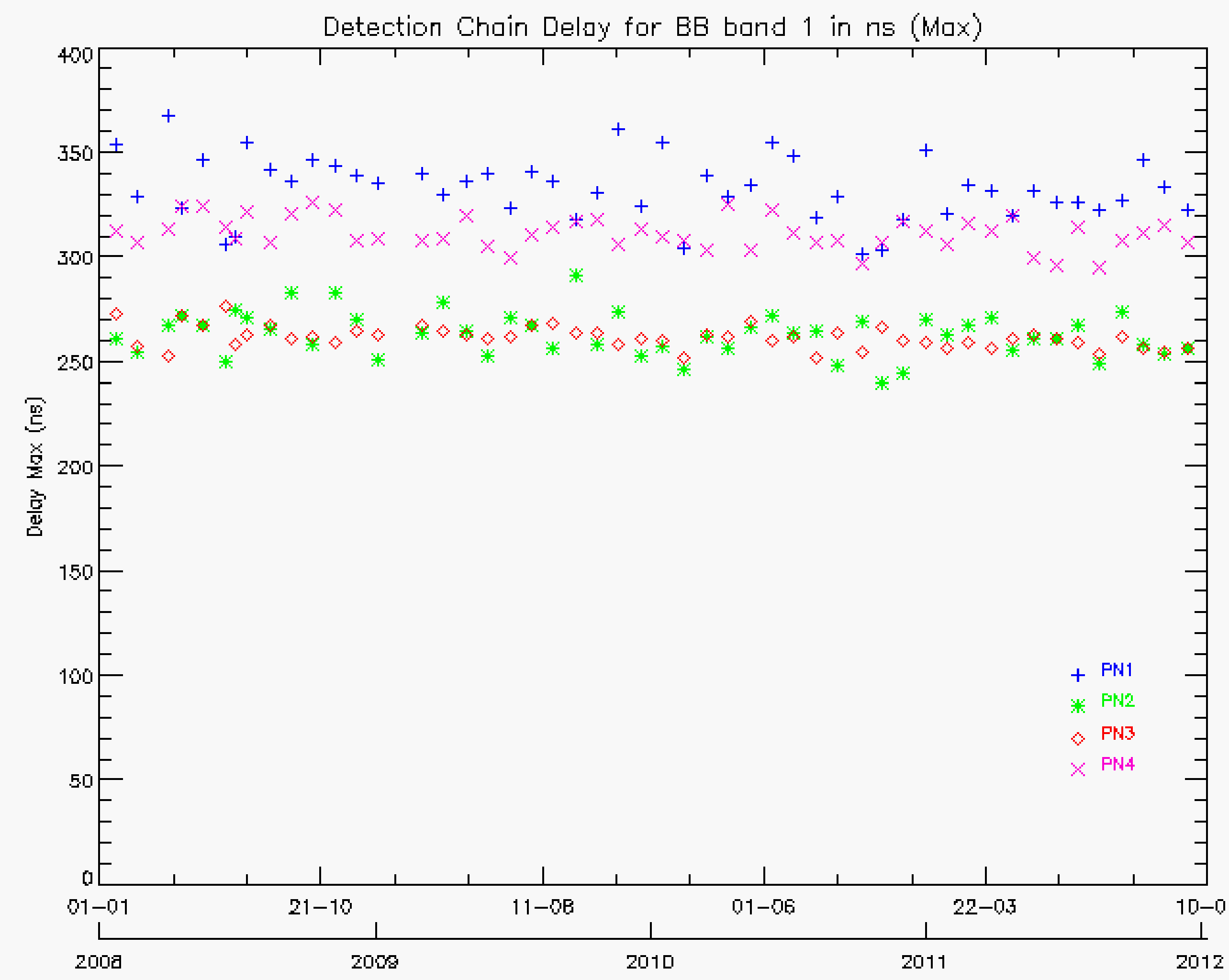
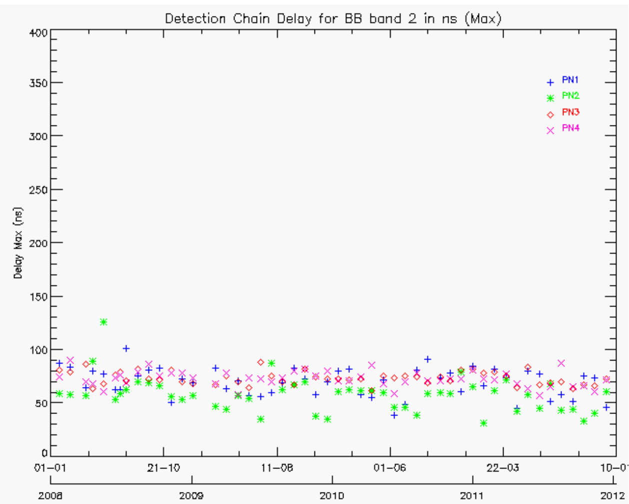


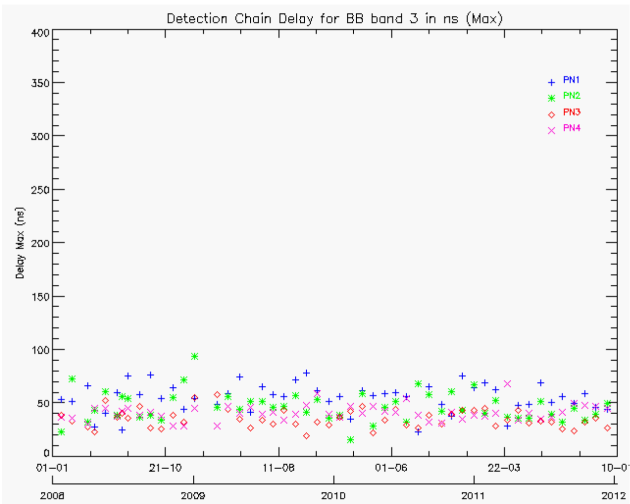
Figure 22 : Monitoring of detection chain maximum delays for all bands

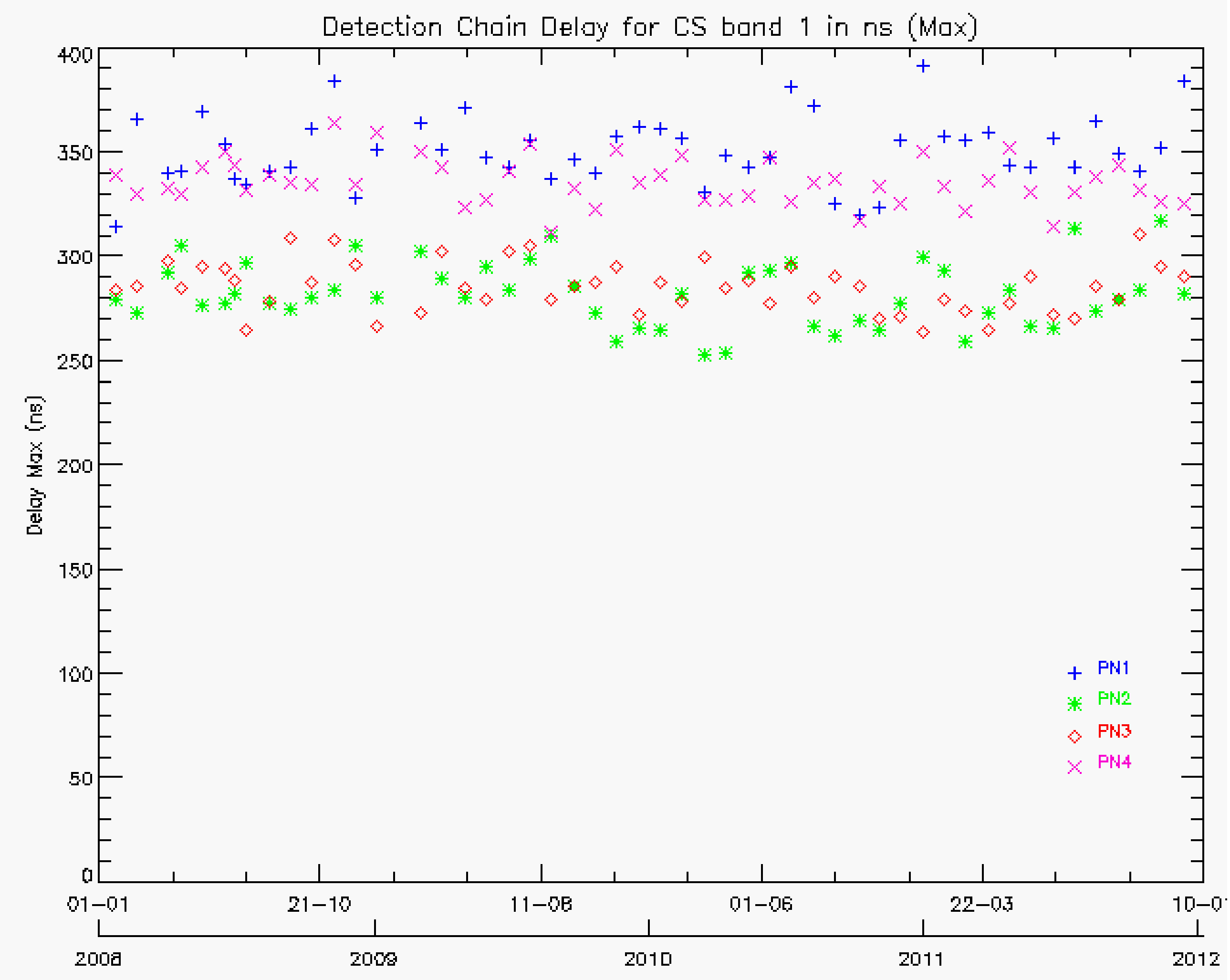

Detection Chain Delay for BB band 1 in ns (Max)
Delay Max (ns)
400
350
300
250
200
150
100
50
0
01–01
21–10
11–08
01–06
22–03
2008
2009
2010
2011
2012
PN1
PN2
PN3
PN4

SB2


Detection Chain Delay for BB band 2 in ns (Max)
Delay Max (ns)
PN1
PN2
PN3
PN4

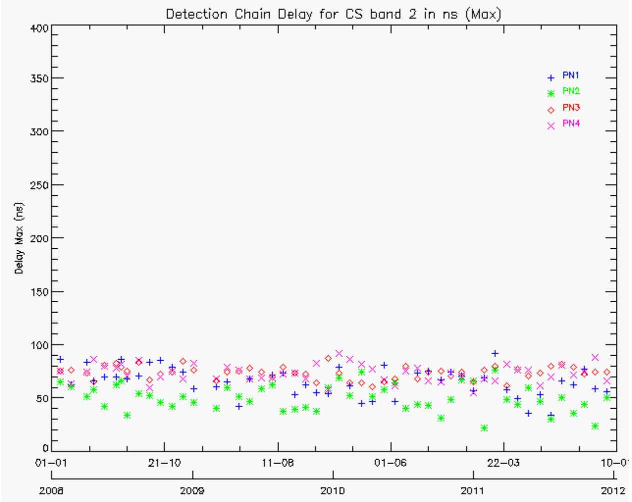
SB3


Detection Chain Delay for BB band 3 in ns (Max)
Delay Max (ns)
PN1
PN2
PN3
PN4

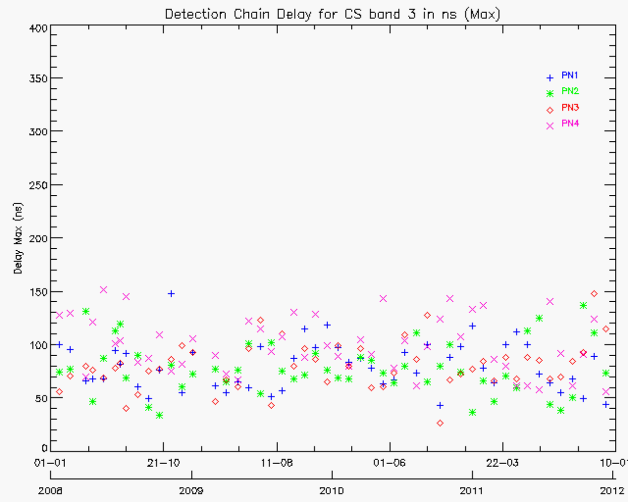


<<external_plots/101_Delay_SB01_Max.eps>>

SB2



SB3



4.5.4 Optical Transmission

4.5.4.1 Ice

The IASI interferometer and optical bench are regulated at 20°C temperature, while the cold box containing cold optics and detection subsystem is at about -180°C. Water desorption from the instrument causes ice formation on the field lens at the entrance of IASI cold box. This desorption phenomenon is particularly important at the beginning of the instrument in-orbit life. That's why one of the very first activities of IASI in-orbit commissioning was an outgassing phase consisting in heating the cold box up to 300 K during 20 days. This operation allows removing most of the initial contaminants coming from IASI and other MetOp instruments. A routine outgassing is then needed from time to time to remove ice contamination, but less and less frequently as the desorption process becomes slower. A first run of this routine outgassing procedure (shorter duration and at 200 K), was done for validation purpose during commissioning phase in December 2006. The second one, which was actually the first in routine phase, was done in March 2008. The third one was done in August 2010.

The maximum acceptable degradation of transmission is about 20% loss at 850 cm^{-1} (which corresponds to an ice deposit thickness of about 0.5 µm).

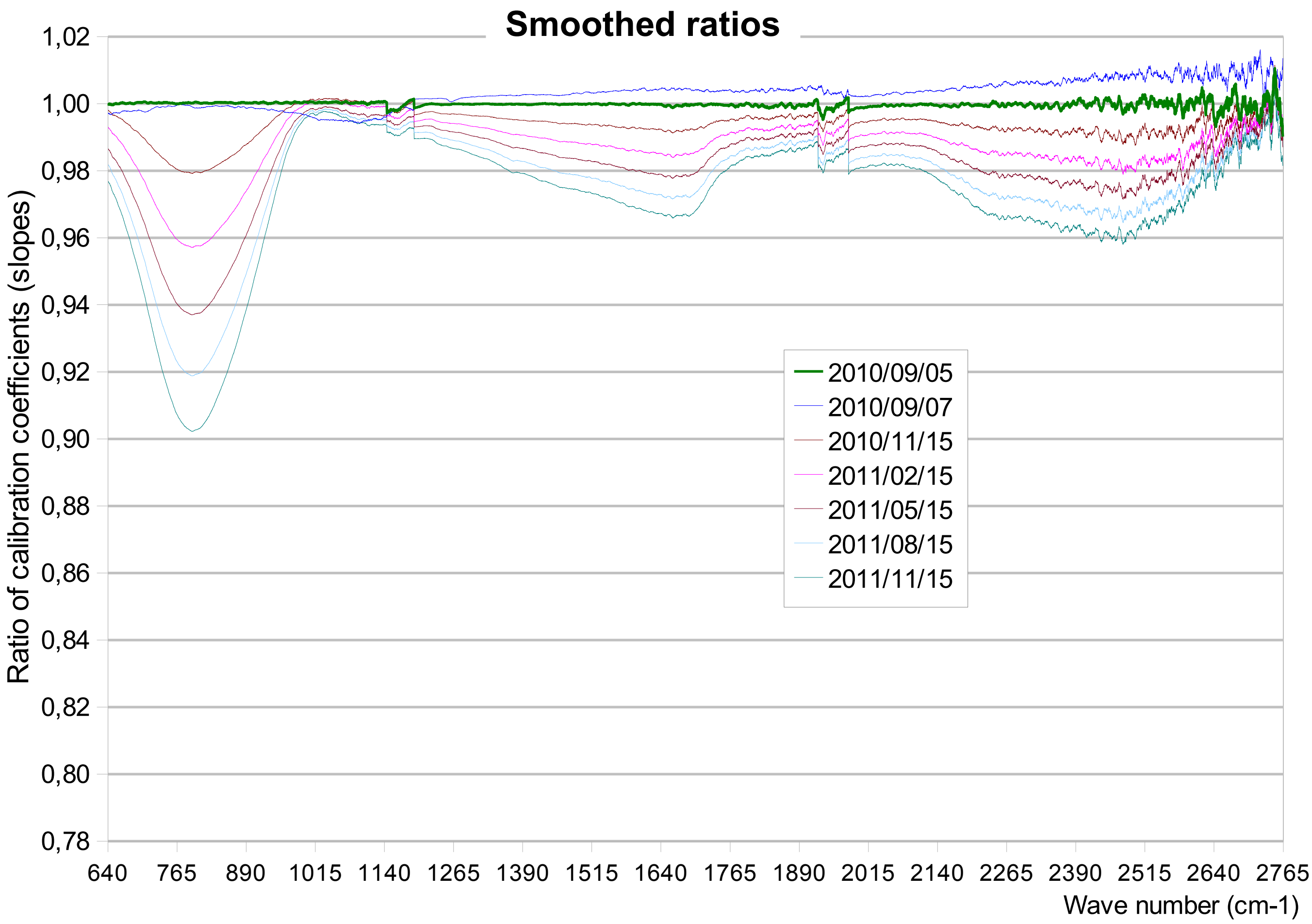


Figure 23 : Ratio of calibration coefficient slopes as a function of wave number and time after the second decontamination

4.5.4.2 Prediction of decontamination date

The transmission degradation rate is regularly monitored by CNES TEC through gain measurements given by calibration coefficients ratios.

The loss of instrument gain due to ice contamination is, as expected, decreasing over time.

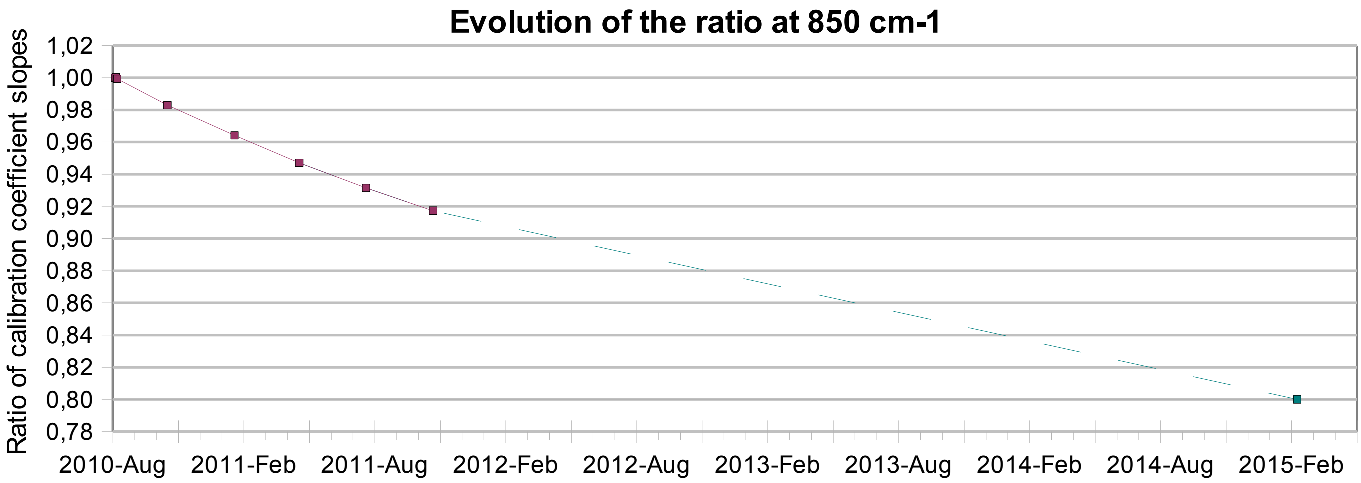


Figure 24 : Temporal evolution of calibration ratio coefficient slopes since the last decontamination.
A linear extrapolation has been added to determined a rough date for the next decontamination (relative gain evolution of 0.8)

4.5.5 Interferometric Contrast

The interferometric contrast is defined as the interferogram fringe discrimination power. Figure 25 shows temporal evolution of instrument contrast since the beginning of IASI life in orbit for all pixels and all CCD.

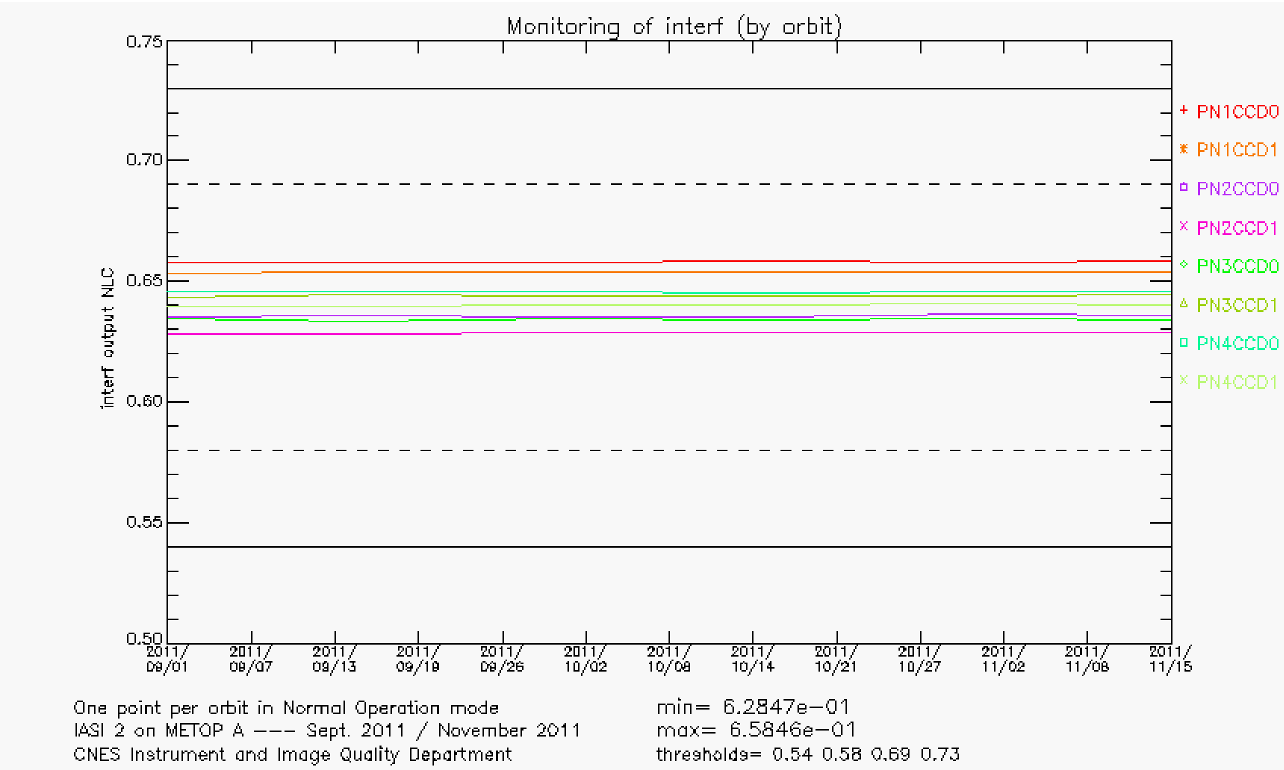


Figure 25 : Monitoring of contrast for SB3

4.5.6 Detection Chain

Detection chains are tune in gain and offset via telecommand. The goal is to avoid saturation while conserving the maximum dynamic to limit digitalization noise.

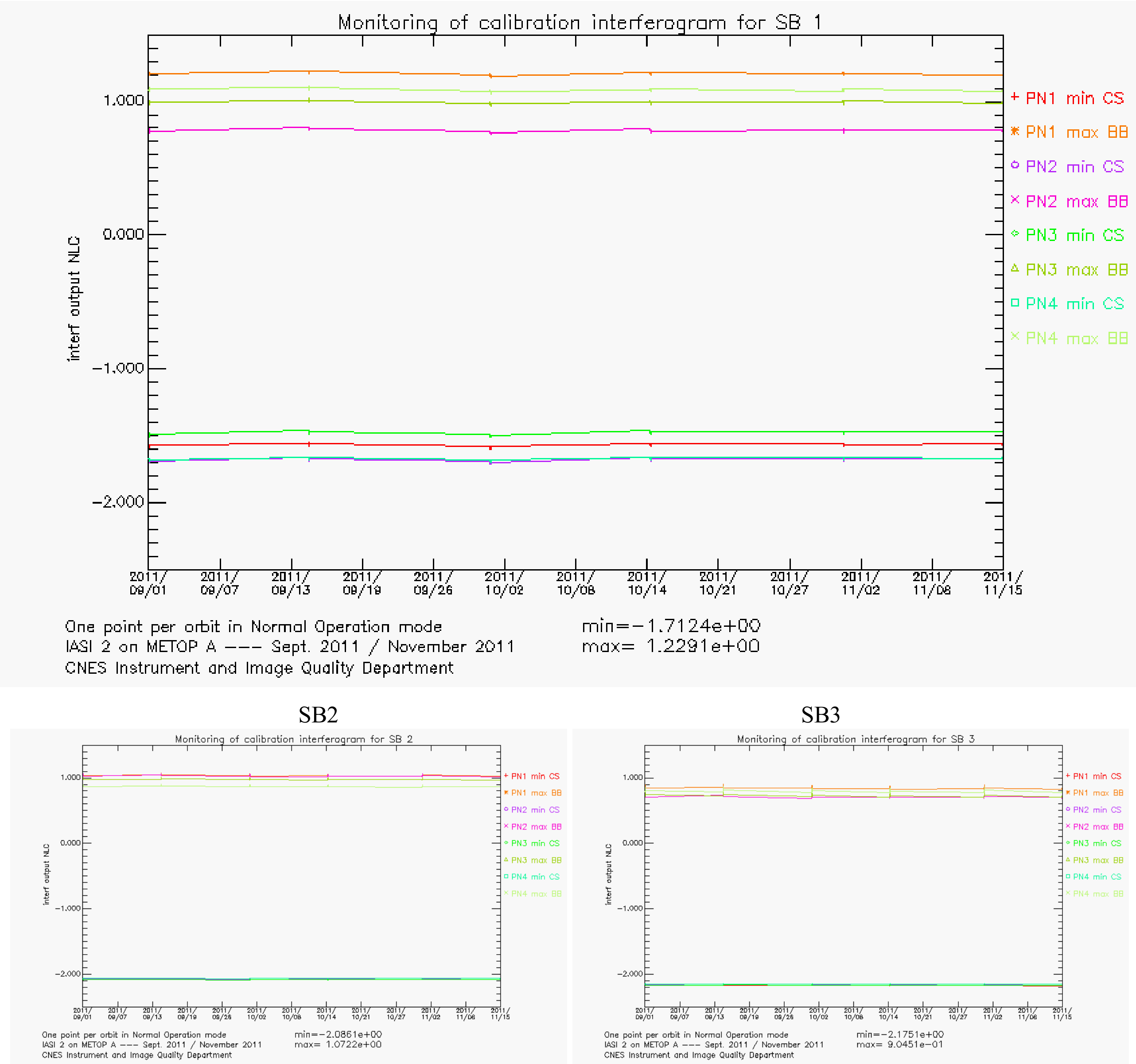


Figure 26 : Monitoring of detection chain margins

Margins are sufficient for the moment.

4.5.7 Conclusion

The radiometric performances of IASI are nominal and stable. A linear extrapolation of the current contamination ratio leads to an earliest date for the next decontamination at the end of 2014. Scan mirror reflectivity will be updated in 2012. The date has to be phased with METOP-B Cal/Val activities.

4.6 SOUNDER SPECTRAL PERFORMANCES

This part is specific to hyperspectral sounders. The goal of the spectral calibration is to provide the best estimates of spectral position of the 8461 IASI channels.

The large sensitivity of infrared spectrum to spectral calibration errors has lead to stringent specifications:

• A priori knowledge of spectral position better than of 2.10^{-4} (design)

• A posterior maximum spectral calibration relative error of 2.10^{-6} (after calibration by OPS)

In order to reach the specification of 2.10^{-6}, we need an accurate Instrument Spectral Response Function (ISRF) model. This model have been done and validated in the early time of IASI development.

For sake of operational time constrain, complete ISRF calculation is not done in real-time by OPS software but pre-calculated and stored in a database called “spectral database”. OPS processing determine on-line the most relevant instrument function to be used by OPS with respect to current values of a set of parameters (interferometric axis, cube corner offset…).

The approach to monitor IASI spectral performances is very similar to the one used for radiometric calibration. Spectral calibration fine characterization has been done during ground testing and Cal/Val. All parameters likely to cause a failure in spectral calibration process have been identified and are continuously monitored. As long as they remain stable, there is no problem with IASI spectral calibration.

4.6.1 Dimensional Stability Monitoring

4.6.1.1 Monitor the position of the interferometric axis

Interferometric axis reference positions, used in the "spectral database" generation, are -200 µrad and -400 µrad, respectively for Y and Z axis. Since the drift of the interferometer axis is lower than 300 µrad, there is no need to update the "spectral database", see chapter 4.4.3.

4.6.1.2 Cube Corner constant offset

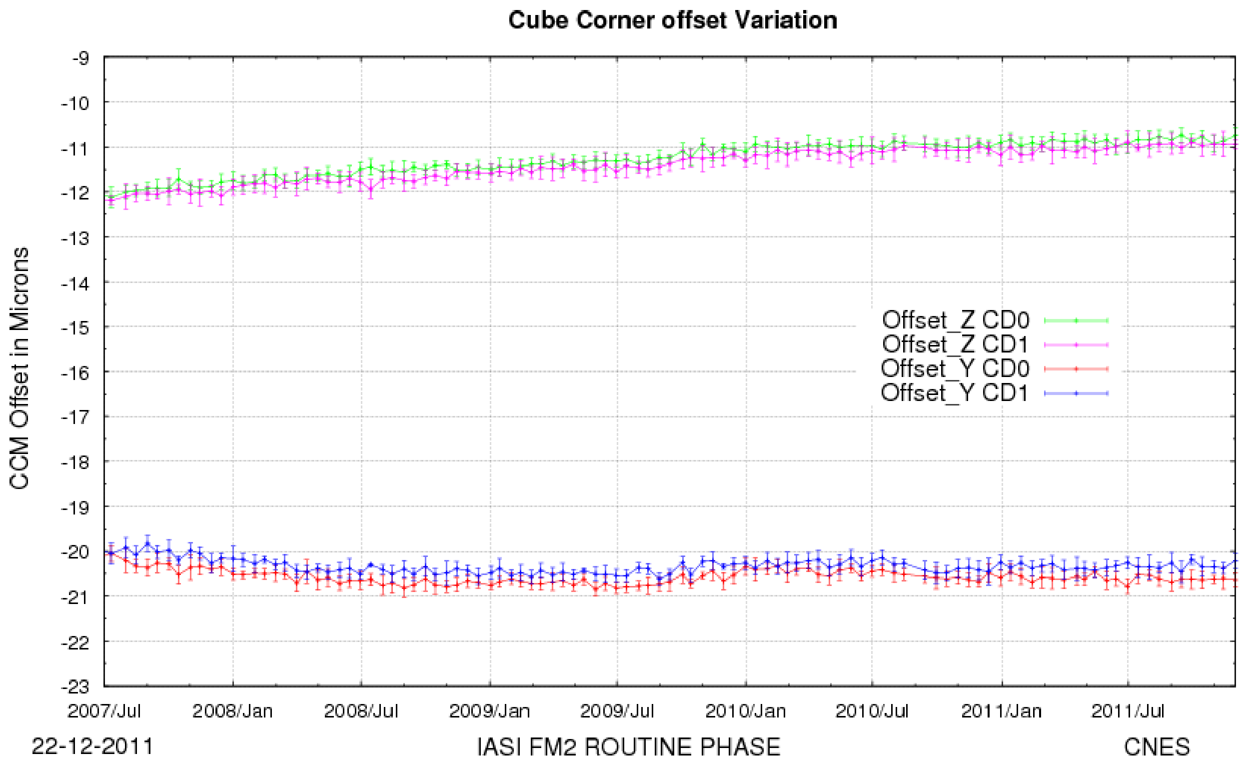


Figure 27 : Cube Corner offset variation

Reference cube corner offsets, used in the "spectral database" generation, are -20.16 µm, -19.84 µm, -12.16 µm and -12.22 µm, respectively for Y CD0, Y CD1, Z CD0 and Z CD1. Since the drift of cube corner offset is lower than 4 µm, there is no need to update the "spectral database".

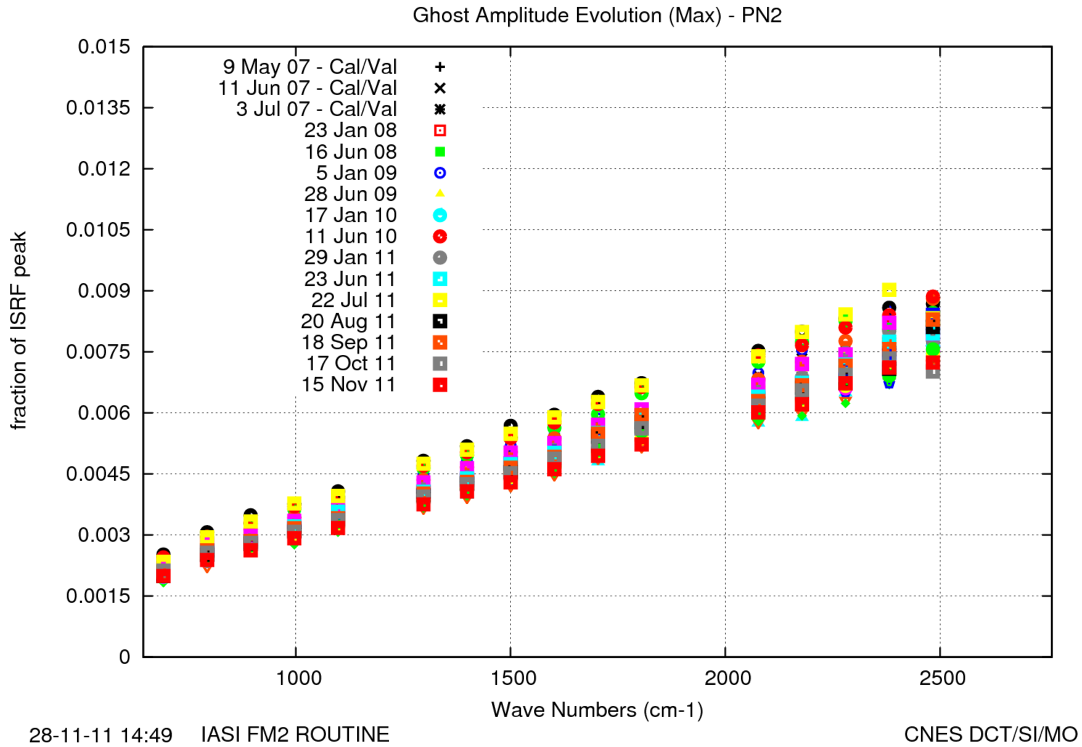
4.6.2 Ghost evolution monitoring

On-ground test of the instrument has shown a perturbation in the ISRF mainly caused by micro-vibrations of the interferometer separator blade. The amplitude of these micro-vibrations was characterized on ground and is measured on board.

Ghost origin is understood to be due to micro-vibrations of the beam-splitter. It is therefore stronger for the FOVs which project onto the top part of the beam-splitter (which vibrates more), and weaker for the FOVs which project onto the bottom part of the beam-splitter as it is attached to the optical bench.

The ghost affects the ISRF basically by replicating it at about ±14cm^{-1}. Of course, the amplitude of these replications is very low with respect to ISRF maximum value. The amplitude and the central wave number of ISRF replications are function of: cube corner velocity, frequency and mechanical amplitude of the beam-splitter vibration and wave number.

We are continuously monitoring the impact of the ghost on ISRF by monitoring, for each wave numbers, the maximum amplitude of the replicated ISRF with respect to $ISRF_{max}$ value using monthly external calibration (BB views). The evolution over time of ghost amplitude with respect to $ISRF_{max}$ amplitude is shown below for pixel 2 and 4.



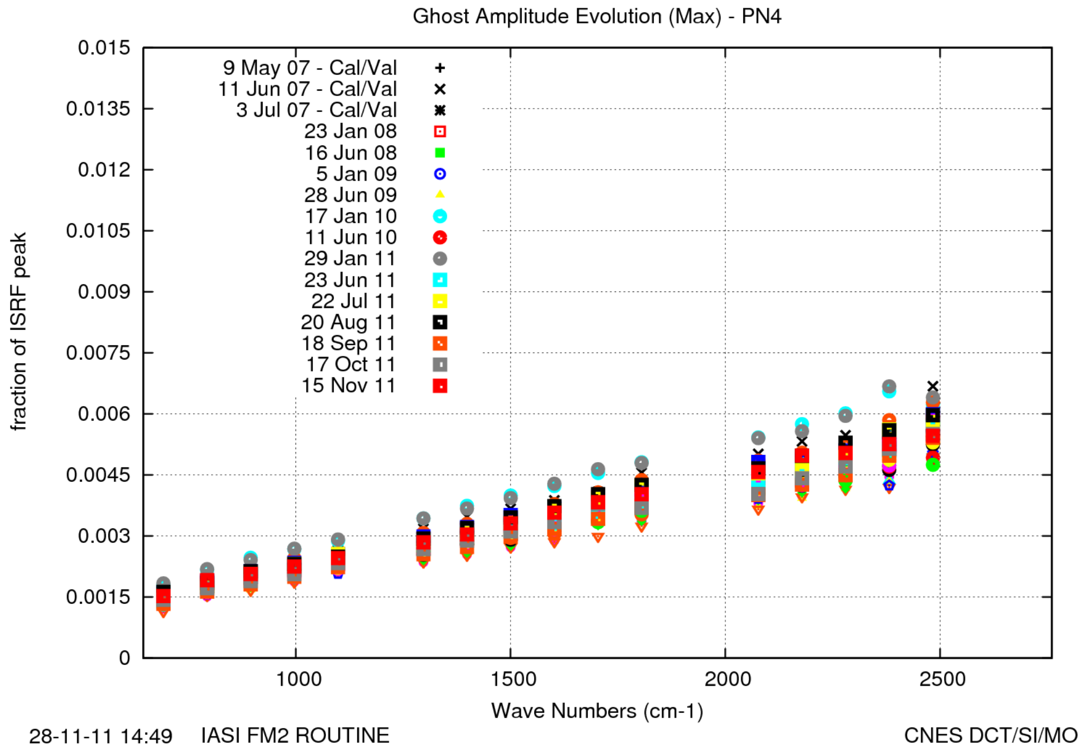


Figure 28 : Ghost amplitude as a function of wave number for different time (Top: pixel 2, bottom: pixel 4)

Maximum values of $ISRF_{max}$ (@2760 cm^{-1}) are respectively 0.9% for pixel 1-2 and 0.6% for pixel 3-4. We don't see any significant evolution over time.

Pseudo-noise induced by the ghost is lower than the 0.066K allocated specification and under control as soon as all cube corner velocity, frequency and mechanical amplitude of the beam-splitter vibration remain stable.

4.6.3 Instrument parameters

4.6.3.1 Cube corner offset

see section 4.6.1.1.

4.6.3.2 Cube corner velocity

Refer to REVEX, paragraph 5.5.

4.6.3.3 Interferometer optical bench temperature

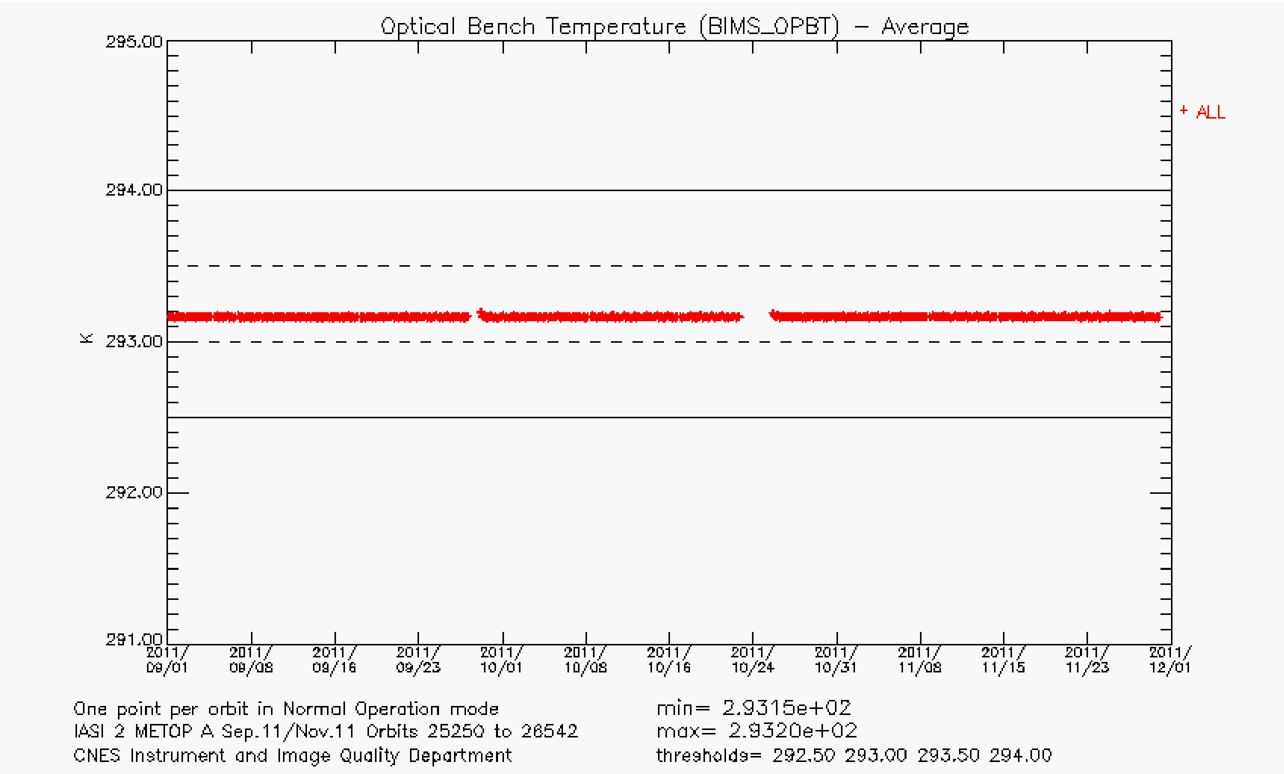


Figure 29 : Optical bench Temperature

4.6.4 Conclusion

All parameters impacting IASI spectral calibration are stable and within specifications.

4.7 GEOMETRIC PERFORMANCES

The geometric calibration is performed on ground (level 1 processing). Most of the analyses of geometric performances require being in external calibration mode.

Specifications are the following: the IIS/AVHRR co-registration has to be better than 0.3 AVHRR pixel while the IIS/sounder co-registration has to be better than 0.8 mrad.

4.7.1 Sounder / IIS co-registration monitoring

This monitoring is performed one time a year, generally around September for REVEX and march for mid-REVEX.

4.7.2 IIS / AVHRR co-registration

The following figures show a comparison of IIS-AVHRR offsets (GIacOffsetIISAvhrr) mean profiles.

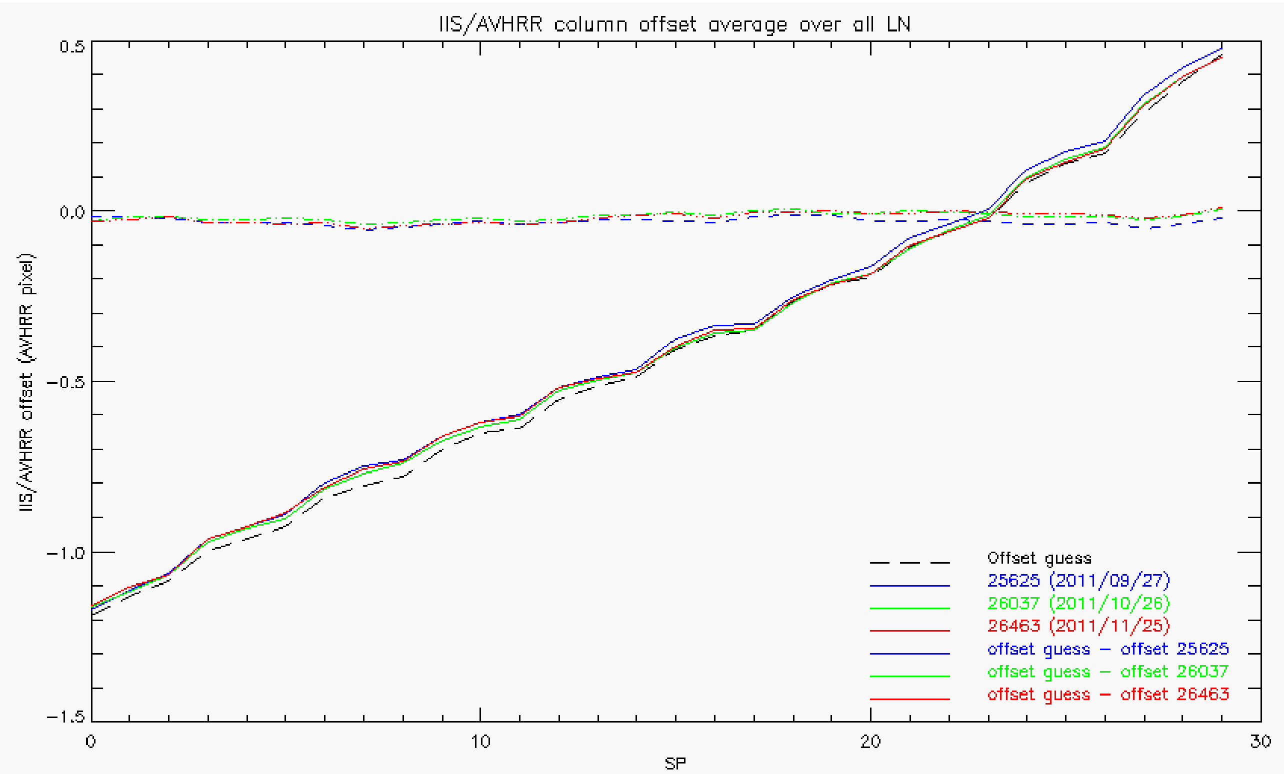


Figure 30 : Column offset (black) guess vs. column offset averaged over all lines (LN) as a function of the scan position (SP=SN), and orbit number

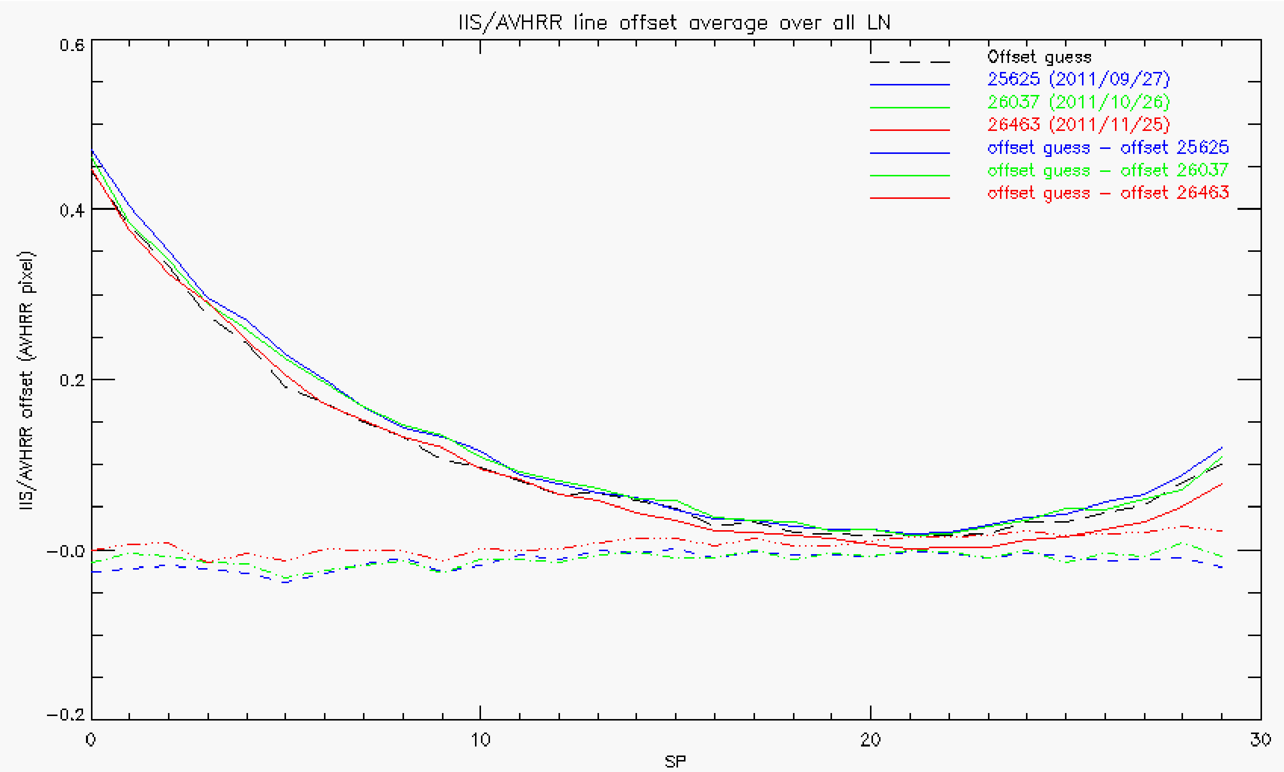


Figure 31 : Line offset guess (black) vs. line offset averaged over all lines (LN) as a function of the scan position (SP=SN), and the orbit number

4.7.3 Conclusion

The positions of IASI pixel are considered stable and well within specification.

IIS-sounder co-registration is stable at about 1.1 mrad which is equivalent to 1 km on ground.

IIS-AVHRR offset is lower than two pixels and stable over time (less than 0.3 AVHRR pixels over two months), the co-registration is within the specification.

The geolocation of IASI pixels are considered stable and well within specification (5 km).

4.8 IIS RADIOMETRIC PERFORMANCES

The main task of IIS is to insure a good relative positioning of IASI sounder pixels with respect to AVHRR. Its performances are studied each month using routine External Calibration data.

4.8.1 IIS Radiometric Noise Monitoring

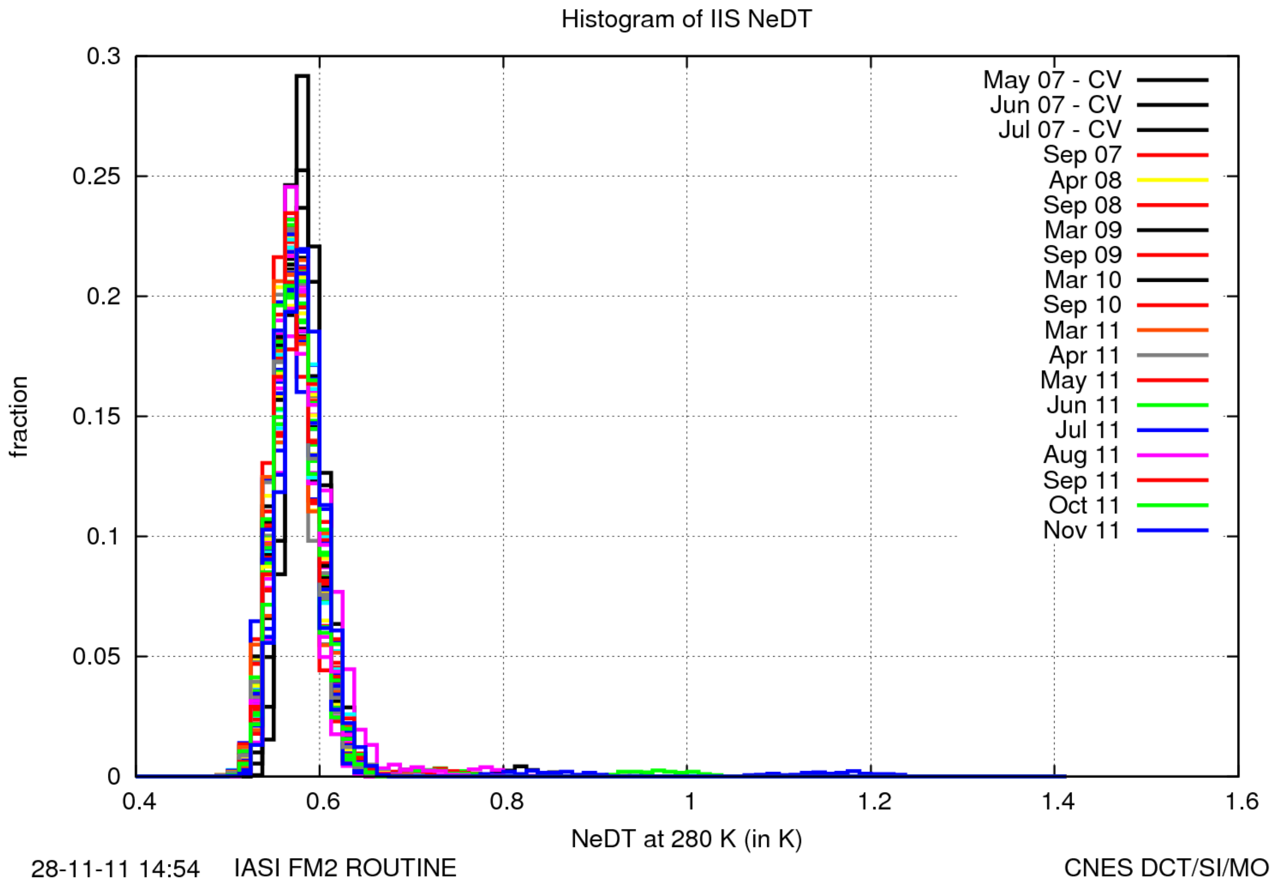


Figure 32 : Temporal evolution of the noise between start and end of the period

Radiometric noise of the IIS is very stable and lower than the specification of 0.8K.

4.8.2 IIS Radiometric Calibration Monitoring

In order to assess the stability of IIS radiometric calibration, we follow the time evolution of slope and offset coefficients. Figure 33 shows a comparison of slope and offset coefficients matrix between start and end of the period.

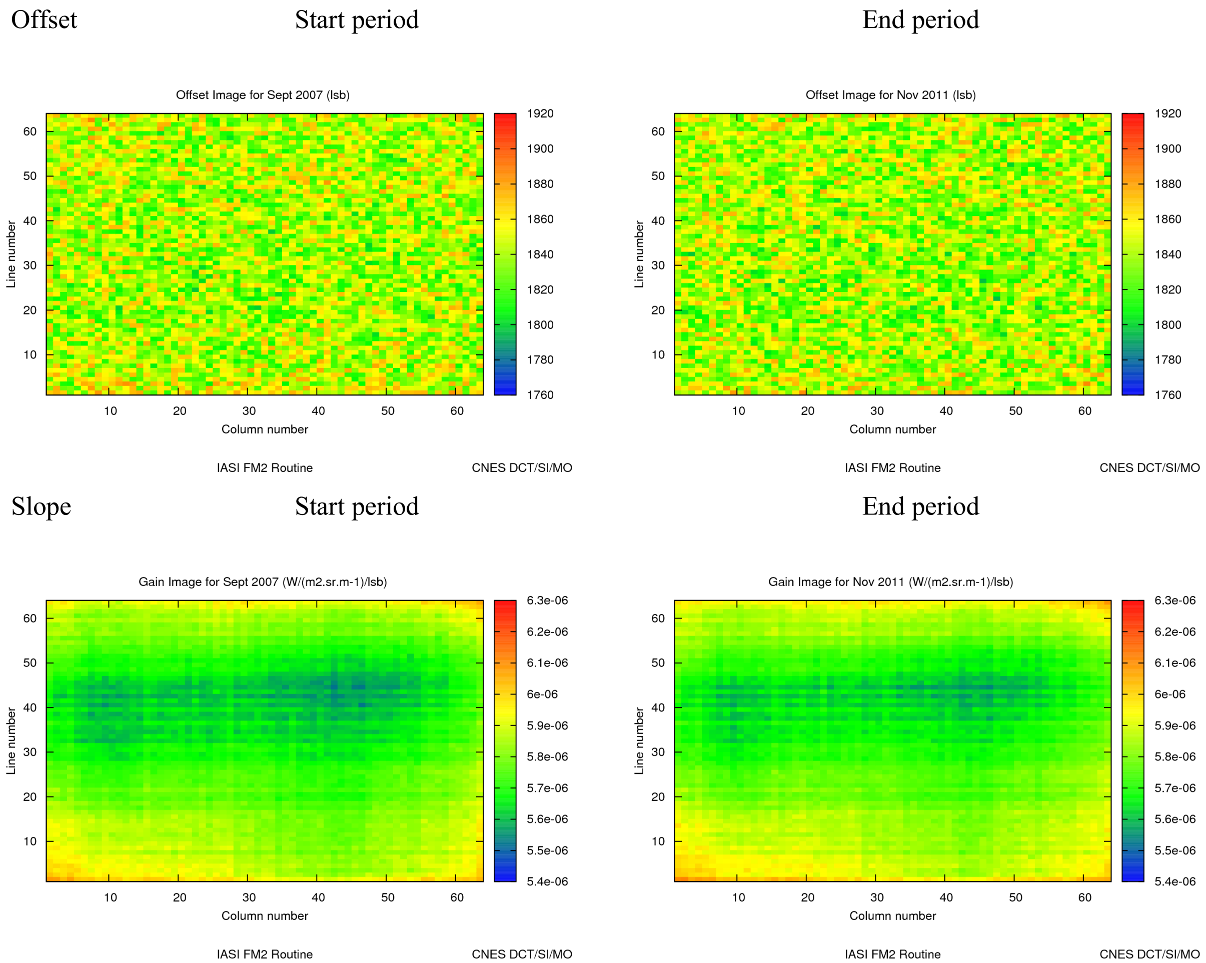


Figure 33 : Slope and offset coefficients matrix

The complete time series of average slope and offset coefficients is given in Figure 34.

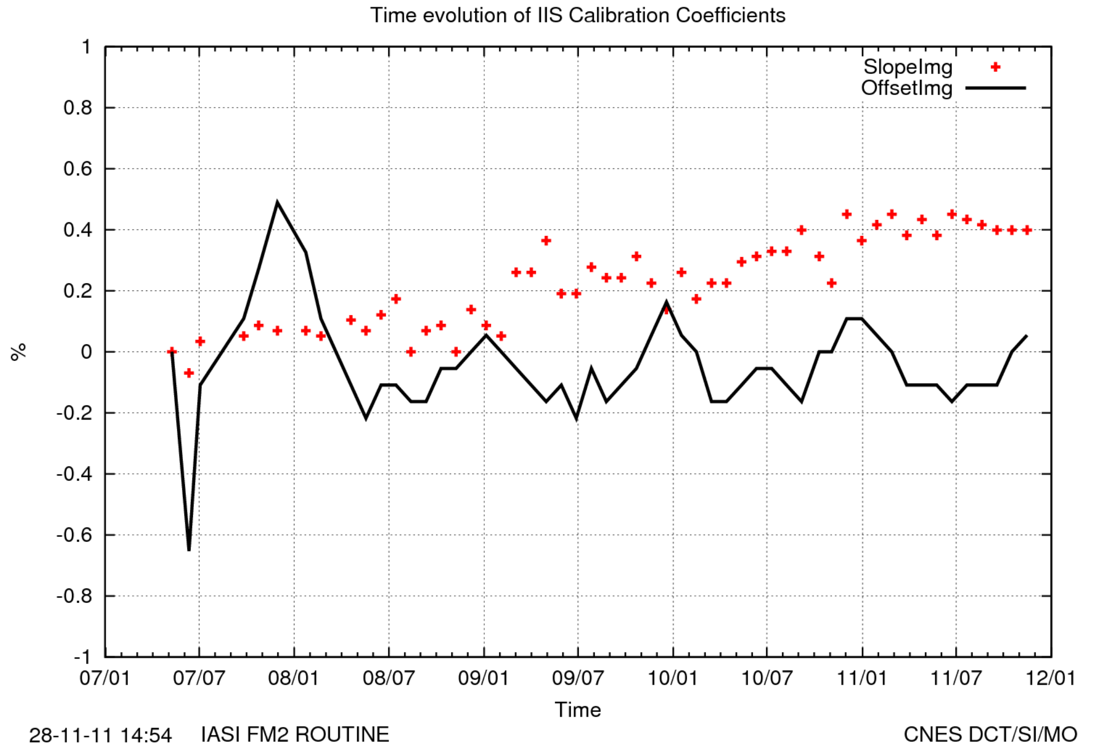


Figure 34 : Relative evolution in % of average of slope (red curve) and offset (black curve) coefficients

The slope coefficient is stable. The offset coefficient is slightly evolving (0.4%). This evolution is likely to be linked with the slight evolution of IIS focal plan temperature.

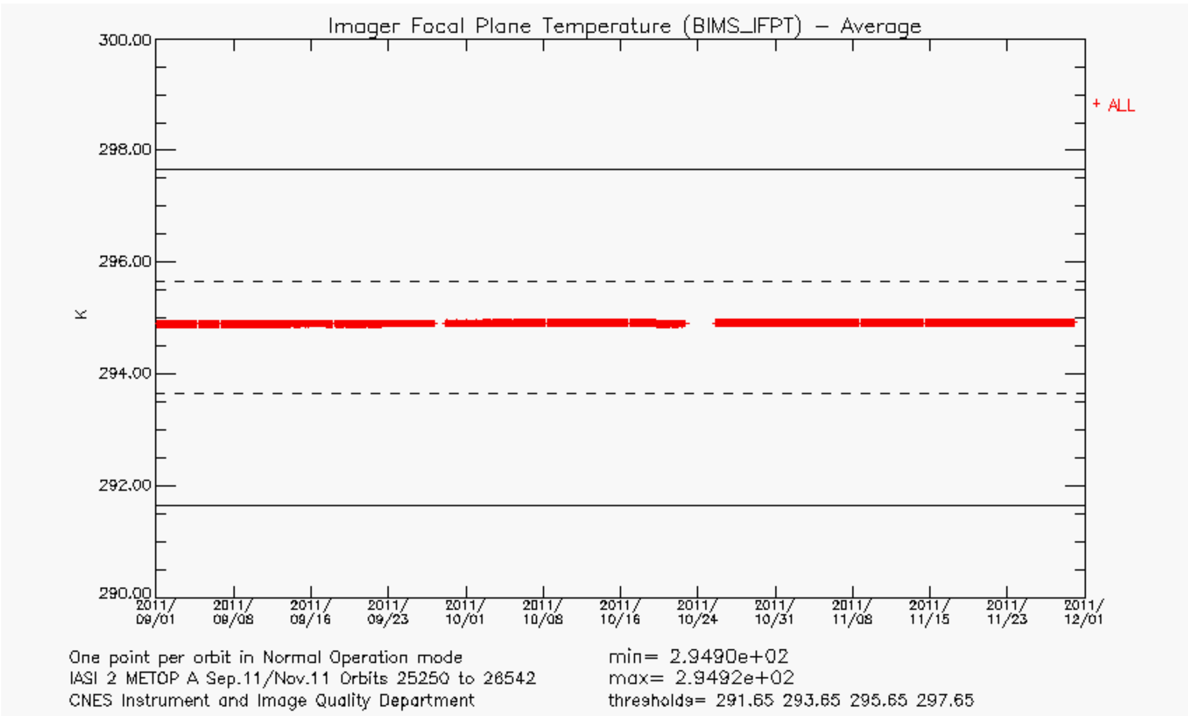


Figure 35 : IIS Focal Plane Temperature

4.8.3 <u>Conclusion</u>

The radiometric performance of IIS is very stable and within specification.

5 IASI TEC SOFTWARE AND INTERFACES

5.1 *IASI TEC EVOLUTION*

A new version "8.1" of the software "TEC" had been installed.

Table 19 lists previous software evolutions.

IASI TEC software version	implementation	Comments
8.0	14 January 2011	Hardware renewal - porting software to Red Hat Entreprise Linux 5.3 (OS) and Oracle 11g R2 (database)
8.1	06 October 2011	Automatic downloads of L0 products from EUMETSAT FTP

Table 19: IASI TEC at CNES Toulouse

5.2 *INTERFACE*

5.2.1 *EUMETCAST*

EUMETCast dissemination is used for Near Real Time data reception at the IASI TEC at CNES, Toulouse. Each orbit, L1 ENG, L1 VER, and AVHRR 1B products, are received under continuous series of 3 minutes granules, which are reconstructed directly by the terminal. The EUMETCast terminal is directly connected to the TEC.

As this terminal regularly fails, a back up station was implemented by EUMETSAT to support the problem by keeping products on the machine for a longer period than on the nominal terminal: this allows CNES to save time and to manually retrieve the stored products if necessary.

The reception of IASI L0 via EUMETCast stopped on March 29th.

The backup terminal was upgraded on August 3rd and the nominal terminal was upgraded on December 4th. It consists in both hardware and software modification. Up to now, its behaviour is nominal.

No hang up occurred since June 2011.

5.2.2 *FTP*

Since March 29th, IASI L0 products are available in Near Real Time on a EUMETSAT FTP server.

A new IASI TEC feature was developed to automatically download products from the EUMETSAT FTP server. This feature is operational Since October 6th.

6 CONCLUSION AND OPERATIONS FORESEEN

Please visit http://smsc.cnes.fr/IASI/ to get IASI news.

6.1 SUMMARY

The IASI FM2 instrument is fully operational.

The instrument configuration is the nominal one.

The main events are the Out of Plane METOP manoeuvre on 28-29 September 2011 and METOP PL-SOL on October 22-25th.

A new IASI TEC software had been installed, it implements L0 products download through FTP.

6.2 SHORT-TERM EVENTS

Moon on 14-15 December 2011

6.3 OPERATIONS FORESEEN

None

End of document