



Doc n°: IA-RP-2000-3524-CNE

Issue: 1.0

Date: 2011-01-20



Sheet: 1 Of: 43

IASI QUARTERLY PERFORMANCE REPORT

FROM 2010/06/01 TO 2010/08/31

BY IASI TEC (TECHNICAL EXPERTISE CENTER)



FOR IASI FM2 METOP A

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2011-01-20 Sheet: 2 Of: 43
--	---	--

ANALYSE DOCUMENTAIRE

Bordereau d'indexation

Classe (Confidentialité) : NC		Code Consultation :	
Mots clés d'auteur : IASI TEC quarterly synthesis report			
OBJET : <div style="text-align: center;">IASI TEC periodic report</div>			
TITRE : <div style="text-align: center;">IASI quarterly performance report</div>			
Auteur(s) : J.Chinaud, V.Lonjou, E.Péquignot avec le support de C.Baqué (AKKA technologies) pour DCT/ME/EI marché 60023/00			
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			
Document(s) rattaché(s) : Ce document vit seul		Localisation physique du document : Salle IASI TEC	
Volume : <div style="text-align: center;">1</div>	Nombre de pages total : <div style="text-align: center;">43</div> <div style="margin-top: 10px;"> dont - liminaires : 7 annexes : 0 </div>	Nombre d'annexes : <div style="text-align: center;">0</div>	LANGUE : <div style="text-align: center;">English</div>
Document géré en Configuration : <div style="text-align: center;">Non</div>		A DATER DU :	RESPONSABLE :
Contrat : Néant			
SYSTEME HOTE : (logiciel + référence fichier) : <div style="text-align: center;">OpenOffice Writer 3.2</div>			

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2011-01-20 Sheet: 3 Of: 43
--	---	--

DIFFUSION

On CNES web site : <http://smc.cnes.fr/IASI>
Instrument characteristics / In-orbit performances monitoring

DOCUMENT CHANGE RECORD

Version	Date	Paragraphs	Description
1.0	05/06/10		Creation of the document





		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2011-01-20 Sheet: 4 Of: 43
--	--	--

Table of contents

1 INTRODUCTION.....	9
2 RELATED DOCUMENTS.....	9
2.1 APPLICABLE DOCUMENTS.....	9
2.2 REFERENCE DOCUMENTS.....	9
3 SIGNIFICANT EVENTS.....	10
3.1 EXTERNAL CALIBRATION.....	10
3.2 ON BOARD CONFIGURATION.....	11
3.3 GROUND CONFIGURATIONS UPDATES FOR LEVEL 1 PROCESSING.....	11
3.4 DATA BASES UPDATE FOR THE USERS.....	12
3.5 ON GROUND HW/SW EVOLUTION.....	12
3.6 DECONTAMINATION.....	12
3.7 INSTRUMENT.....	13
3.7.1 External events.....	13
3.7.2 Operation leading to mission outage.....	13
3.7.3 Anomaly leading to mission outage.....	13
4 PERFORMANCE MONITORING.....	14
4.1 PERFORMANCE MONITORING.....	14
4.2 PERFORMANCE SYNOPSIS.....	15
4.3 LEVEL 0 DATA QUALITY (L0).....	16
4.3.1 Overall quality.....	16
4.3.2 Main flag and quality indicator parameters.....	17
4.3.3 Second level flags and quality indicators.....	21
4.3.4 Conclusion.....	21
4.4 LEVEL 1 DATA QUALITY (L1).....	22
4.4.1 Overall quality.....	22
4.4.2 Main flag and quality indicator parameters.....	23
4.4.3 Second level flag and quality indicators.....	25
4.4.4 Conclusion.....	26
4.5 SOUNDER RADIOMETRIC PERFORMANCES.....	27
4.5.1 Radiometric Noise.....	27
4.5.2 Radiometric Calibration.....	27
4.5.3 Optical Transmission.....	30
4.5.4 Interferometric Contrast.....	32
4.5.5 Detection Chain.....	33
4.5.6 Conclusion.....	33
4.6 SOUNDER SPECTRAL PERFORMANCES.....	34
4.6.1 Dimensional Stability Monitoring.....	35
4.6.2 Ghost evolution monitoring.....	35
4.6.3 Instrument parameters.....	37
4.6.4 Conclusion.....	37
4.7 GEOMETRIC PERFORMANCES.....	38
4.7.1 Sounder / IIS co-registration monitoring.....	38
4.7.2 IIS / AVHRR co-registration.....	39
4.7.3 Conclusion.....	39

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2011-01-20 Sheet: 5 Of: 43
--	---	--

4.8 IIS RADIOMETRIC PERFORMANCES.....	40
4.8.1 IIS Radiometric Noise Monitoring.....	40
4.8.2 IIS Radiometric Calibration Monitoring.....	41
4.8.3 Conclusion.....	42
5 IASI TEC AND EUMETCAST INTERFACE EVOLUTION.....	43
5.1 IASI TEC EVOLUTION.....	43
5.2 EUMETCAST INTERFACES.....	43
6 CONCLUSION AND OPERATIONS FORESEEN.....	44
6.1 SUMMARY.....	44
6.2 SHORT-TERM EVENTS.....	44
6.3 OPERATIONS FORESEEN.....	44

Figures and tables

Table 1: External Calibration TEC Requests.....	9
Table 2: DPS and MAS configuration TEC Requests.....	10
Table 3: DPS and MAS previous configuration.....	10
Table 4: IASI L1 Auxiliary File Configuration on the Operational EPS Ground Segment.....	10
Table 5: IASI L1 auxiliary file previous configuration.....	10
Table 6: IASI Data Bases for the users.....	11
Table 7: previous IASI Data Bases.....	11
Table 8: IASI L1 PPF Configuration on the Operational EPS Ground Segment.....	11
Table 9: Previous IASI L1 PPF.....	11
Table 10: Decontamination Operations.....	11
Table 11: Previous decontamination TEC Requests.....	11
Table 12: Overview of METOP manoeuvres in the reporting period.....	12
Table 13: PL-SOL.....	12
Table 14: Scheduled interruptions.....	12
Table 15: Major anomalies.....	12
Table 16: Minor anomalies.....	12
Table 17: Functional status legend	13
Table 18: IASI product components functional status	14
Figure 1 : IASI L0 data quality orbit average (per pixel and CCD).....	15
Figure 2 : Temporal evolution of spikes anomaly ratio in % for all pixels (orbit average).....	16
Figure 3 : Temporal evolution of NZPD determination anomaly ratio in % for all pixels (orbit average).....	17
Figure 4 : NZPD inter-pixel for all pixels and CCD calculated with respect to pixel 1.....	18
Figure 5 : IASI L0 over/under-flows orbit average of all pixels.....	19
Figure 6 : Max of NZPD quality index for all pixels and CCD - BB.....	20
Figure 7 : Max of NZPD quality index for all pixels and CCD - CS.....	20
Figure 8 : IASI L1 data quality orbit average.....	21
Figure 9 : GQisQualIndex average (L1 data quality index for IASI sounder).....	22
Figure 10 : GQisQualIndexIIS average (L1 data quality index for IASI Integrated Imager).....	22
Figure 11 : GQisQualIndexSpect average (L1 data index for spectral calibration quality).....	23
Figure 12 : GQisQualIndexRad average (L1 data index for radiometric calibration quality).....	23
Figure 13 : GQisQualIndexLoc average (L1 data index for ground localisation quality).....	24
Figure 14 : GFaxAxeY average (Y filtered coordinates of sounder interferometric axis).....	24







		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2011-01-20 Sheet: 6 Of: 43
--	--	--

Figure 15 : GFaxAxeZ average (Z filtered coordinates of sounder interferometric axis).....	25
Figure 16 : MDptPixQual average (L1 quality index for IASI integrated imager / fraction of not dead pixels).....	25
Figure 17 : Instrument noise evolution between start and end of the period.....	26
Figure 18 : Scan mirror reflectivity evolution.....	27
Figure 19 : Radiometric calibration error due to scan mirror reflectivity dependency with viewing angle Maximum effect on SN1 for different scene temperature.....	27
Figure 20 : Black Body Temperature.....	28
Figure 21 : Focal Plane Temperature.....	29
Figure 22 : Ratio of calibration coefficient slopes as a function of wave number and time after the second decontamination.....	30
Figure 23 : Temporal evolution of calibration ratio coefficient slopes since the last decontamination. A linear extrapolation had been added to determined a rough date for the next decontamination (relative gain evolution of 0.8). ..	30
Figure 24 : Monitoring of contrast for SB3.....	31
Figure 25 : Monitoring of detection chain margins.....	32
Figure 26 : Cube Corner offset variation.....	34
Figure 27 : Ghost amplitude as a function of wave number for different time (Top: pixel 2, bottom: pixel 4).....	35
Figure 28 : Optical bench Temperature.....	36
Figure 31 : Column offset (black) guess vs. column offset averaged over all lines (LN) as a function of the scan position (SP=SN), and orbit number.....	38
Figure 32 : 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.....	38
Figure 33 : Temporal evolution of the noise between start and end of the period.....	39
Figure 34 : Slope and offset coefficients matrix.....	40
Figure 35 : Evolution in % of average of slope (red curve) and offset (black curve) coefficients.....	41
Figure 36 : IIS Focal Plane Temperature.....	41
Table 19: IASI TEC at CNES Toulouse.....	42
Figure 37: status of TEC's EUMETCAST terminals.....	42

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2011-01-20 Sheet: 7 Of: 43
--	---	--

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

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 8 Of: 43
--	---	--

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: 2010/06/01 Orbit: 18758
- End Time: 2010/08/31 Orbit: 20040
- 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 1 st February 2007 - 31 st August 2008
RD.2	EUM/OPS-EPS/REP/09/0223	IASI annual in-flight performance report 2009

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 9 Of: 43
--	---	--

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 configurations change, 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
11/06/2010 from 5h14 to 9h10 orb. 18902 to 18904	RM-35	Monthly_MPF ⁽²⁾ Targets: Earth 15, Blackbody, 2 nd Deep Space, Mirror Backside	For routine monitoring (IIS and IASI NeDT, scan mirror reflectivity, ghost,...)
10/07/2010 from 5h13 to 9h12 orb. 19314 to 19316	RM-36	Monthly_MPF ⁽²⁾ Targets: Earth 15, Blackbody, 2 nd Deep Space, Mirror Backside	For routine monitoring (IIS and IASI NeDT, scan mirror reflectivity, ghost,...)
from 30/07/10 17h26 to 31/07/10 22h11 orb. 19605 to 19622	RL-08	Moon avoidance MPF ⁽²⁾ Targets: 1 st Deep Space	Monitoring of moon intrusion in CS1 FOV
08/08/2010 from 5h13 to 9h09 orb. 19726 to 19728	RM-37	Monthly_MPF ⁽²⁾ Targets: Earth 15, Blackbody, 2 nd Deep Space, Mirror Backside	For routine monitoring (IIS and IASI NeDT, scan mirror reflectivity, ghost,...)
from 29/08/10 12h26 to 29/08/10 14h32 orb. 20029 to 20030	RL-09	Moon avoidance MPF ⁽²⁾ Targets: 1 st Deep Space	Monitoring of moon intrusion in CS1 FOV

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_IASIT_EXTALIBRA.dts”

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 10 Of: 43
--	---	---

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
12 2.0	IDPS_OBP_xx_M02_20090216161739Z_20090816161739Z_20090216161854Z_IASDPSPARAMOD.tar	16/02/2009 16h	24/02/2009 13h53 orbit 12202	R_36	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
41 21 8	IASI_BRD_xx_M02_20100520091039Z_XXXXXXXZ_20100520122037Z_IASD_00000012 IASI_GRD_xx_M02_20100520091039Z_XXXXXXXZ_20100520122048Z_IASD_00000021 IASI_ODB_xx_M02_20100301171000Z_XXXXXXXXXXXXZ_20100301170923Z_IASD_0000000008	27/05/2010	BRD activated on 23/06/2010 12:00 ^{UTC} , orbit 19077	BRD associated to GRD GRD: update of IDefInterPixNZPD

Table 5: IASI L1 auxiliary file previous configuration

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 11 Of: 43
--	---	---

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_IASISPECTRESP0	16/12/2009	R_COV_3	Noise Covariance Matrix after decontamination; Covariance matrix from L0 noise on BB (External Calibration of 2009/10/22)
8	IASI_SDB_xx_M02_20100308060000Z_20100308060000Z_20100305120822Z_IASISPECD0	05/03/2010	R_40	User database associated to ODB IDefSDB 8

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

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
5.0.3	09/04/2010	23/06/2010 for sensing time 12:00 ^{UTC} Orbit 19077	

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
30 Sept. 2010	30/08/2010	

Table 10: Decontamination Operations

For information, Table 11 shows the previous decontamination:

Last due date	Date of decontamination	Description
July 2008	20/03/2008	

Table 11: Previous decontamination TEC Requests

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 12 Of: 43
--	---	---

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
10/06/2010	IP	IASI in Normal Operation	No for orbit 18893	

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

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
2010/08/30 08:00 to 2010/09/04 13:32	20040 to 20115		ATC lines recovery (ICU off)	IMS SW patch to V4.32

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

Table 15: Major anomalies

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

Day	Orbits	error n°	Severity	Anomaly type	LN	SN	Description
22/06/2010 01:32:51	19056	13	2B	Err_MASVLNFlag	49836		AR 7489
23/06/2010 09:41:34	19075	494	1	DMC arithmetic	64302	1	
2010/07/18 12:08:09	19432	13	1	CCM CSQ	22204	29	AR 6667

Table 16: Minor anomalies

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 13 Of: 43
--	---	---

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 <ul style="list-style-type: none"> Overall quality Main flag and quality indicator parameters <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Overall Main flag and quality indicator parameters Second level flag and quality indicators 	GREEN	On ground processing
4.5	L1	Sounder radiometric performances <ul style="list-style-type: none"> Radiometric noise Radiometric calibration Optical transmission Interferometric contrast Detection chain 	GREEN	
4.6	L1	Sounder spectral performances <ul style="list-style-type: none"> Dimensional stability Acquisition chain delay Ghost evolution Instrument parameters 	GREEN	
4.7	L1	Geometric performances <ul style="list-style-type: none"> Sounder/IIS co-registration IIS/AVHRR co registration PDD SCAN, SQ1 flag, SQ2 flag 	GREEN	
4.8	L1	IIS radiometric performances <ul style="list-style-type: none"> IIS radiometric noise monitoring IIS radiometric calibration monitoring 	GREEN	

Table 18: IASI product components functional status

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 15 Of: 43
--	---	---

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.

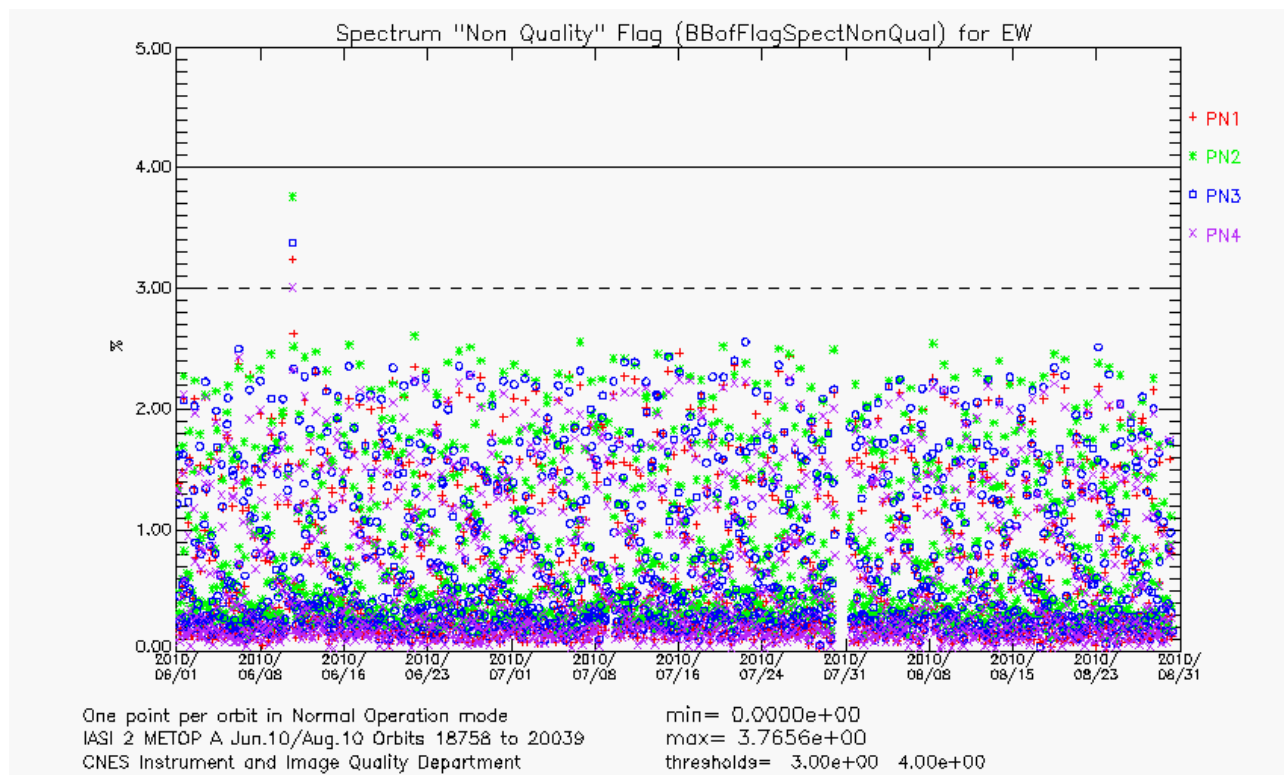




Figure 1 : IASI L0 data quality orbit average (per pixel and CCD)

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

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 16 Of: 43
---	---	---

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.

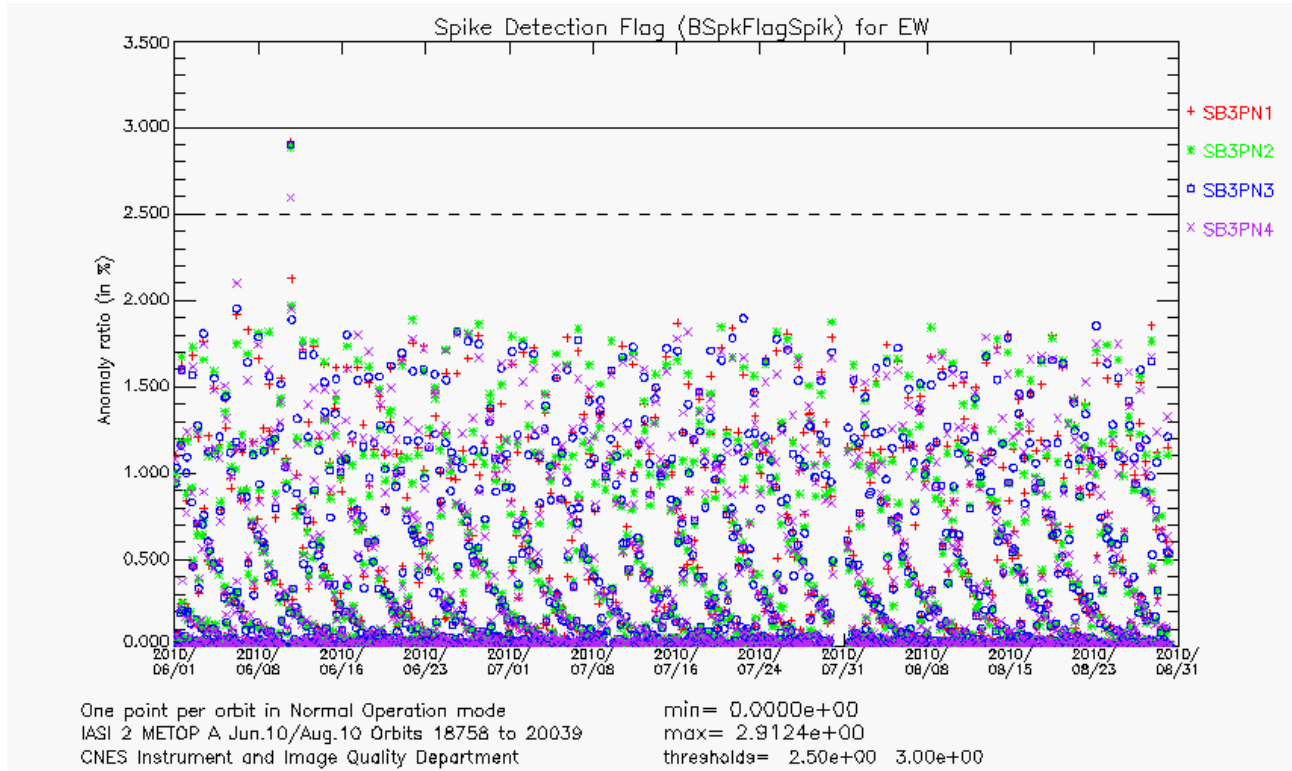


Figure 2 : Temporal evolution of spikes anomaly ratio in % for all pixels (orbit average)

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.

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 17 Of: 43
--	--	---

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

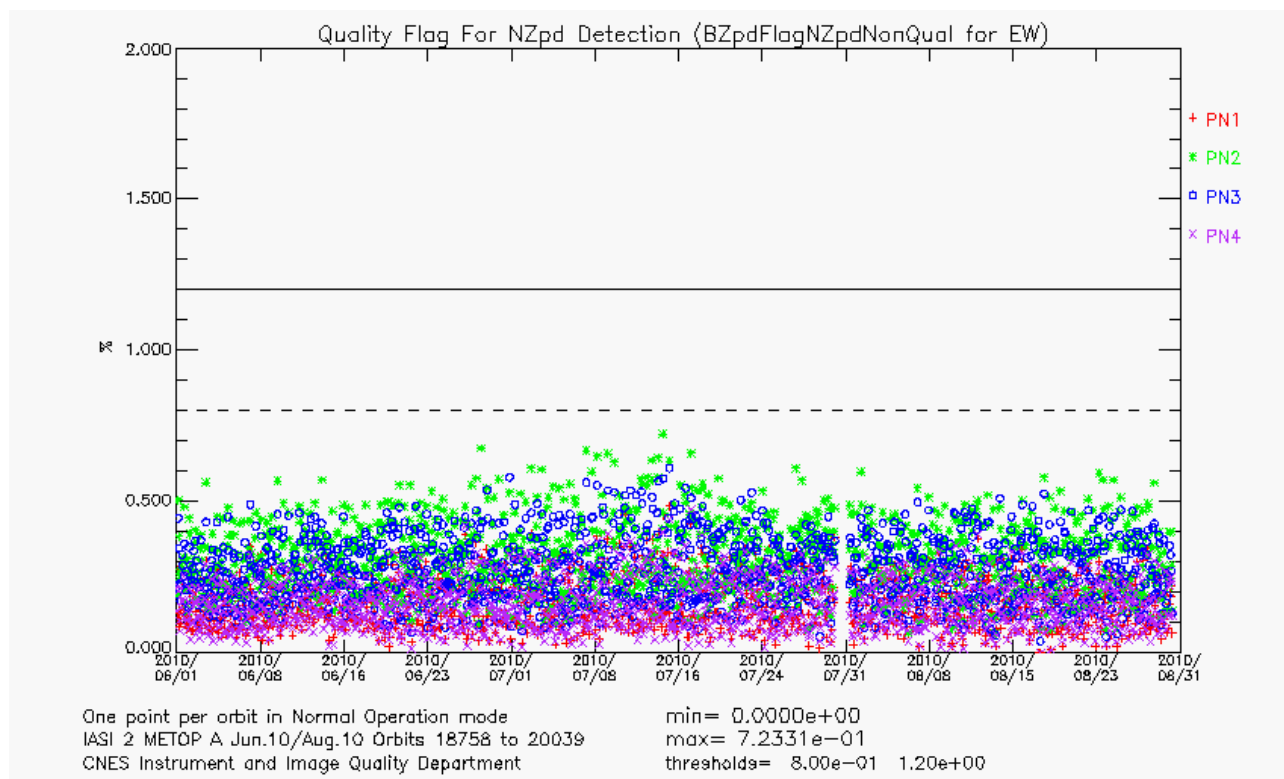




Figure 3 : Temporal evolution of NZPD determination anomaly ratio in % for all pixels (orbit average)

NZPD determination anomaly ratio is nominal for the reported period.

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 18 Of: 43
--	--	---

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. The colour change (in June) points out a modification of the level 1 configuration (IdefNZpdInterPix).

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

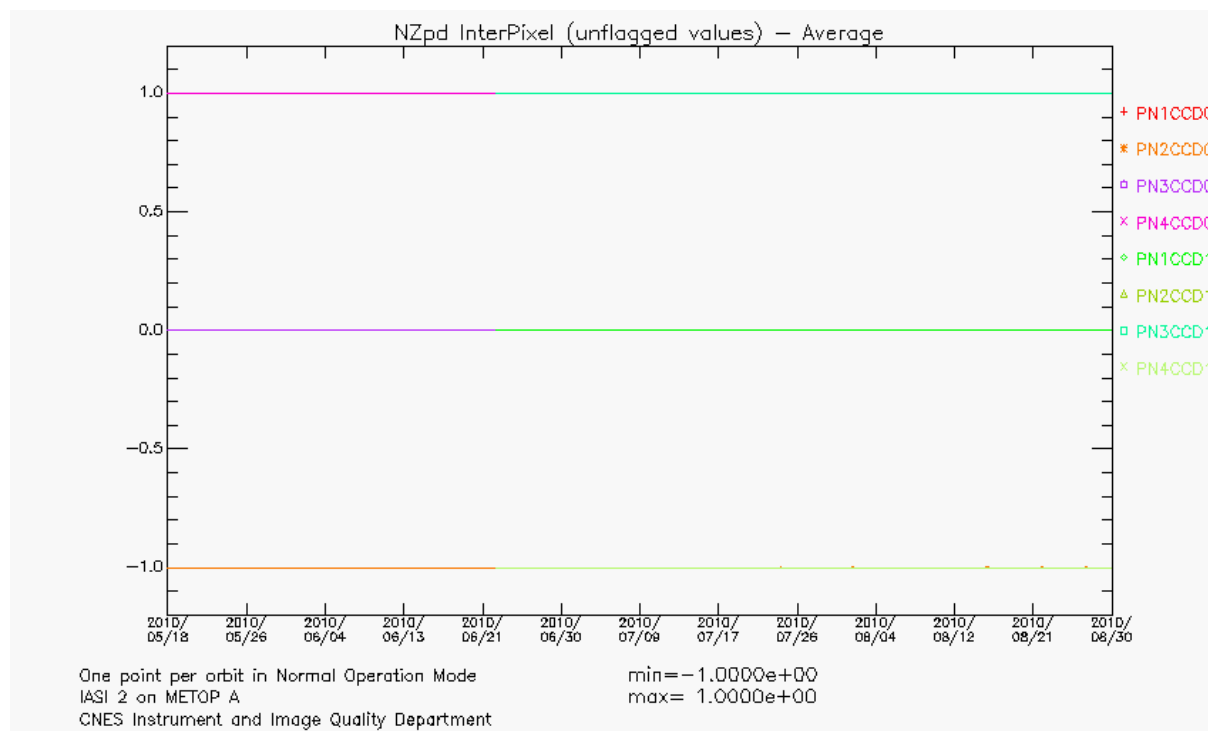




Figure 4 : NZPD inter-pixel for all pixels and CCD calculated with respect to pixel 1

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 19 Of: 43
---	---	---

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.

We monitor over/underflows and we expect a stability. As long as they remain to low levels we do not change the coding table. Note that changing the coding tables is tricky: when you want to increase the encoding capacity of a given spectral band, you have two solutions. First you can increase the coding step without changing the number of bits. This leads to an increase of the noise level in the spectrum. The second solution consists in keeping the coding step constant and increasing the number of bits available for a particular band. Of course the total amount of bits available for the entire spectrum is limited and constant. So you will have taken them away from other spectral bands and consequently decrease encoding capacity of these corresponding bands.

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

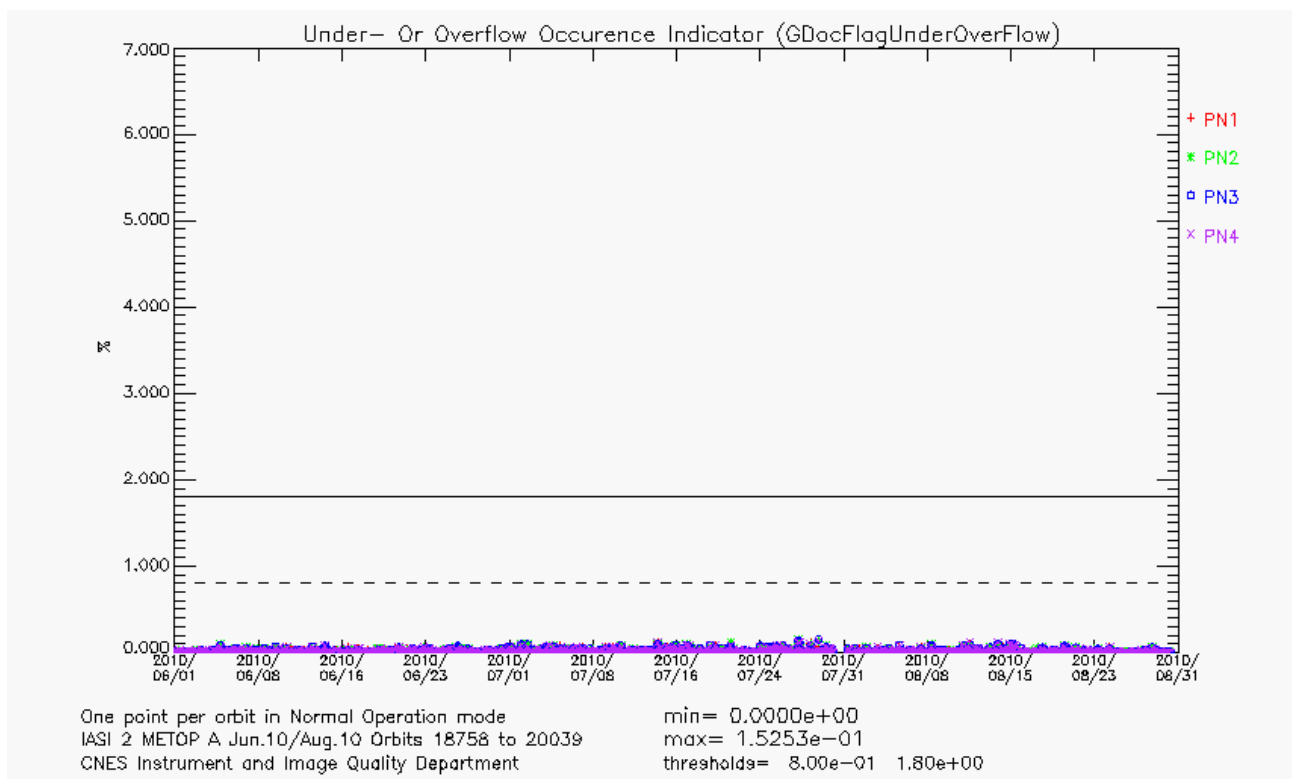


Figure 5 : IASI L0 over/under-flows orbit average of all pixels

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.

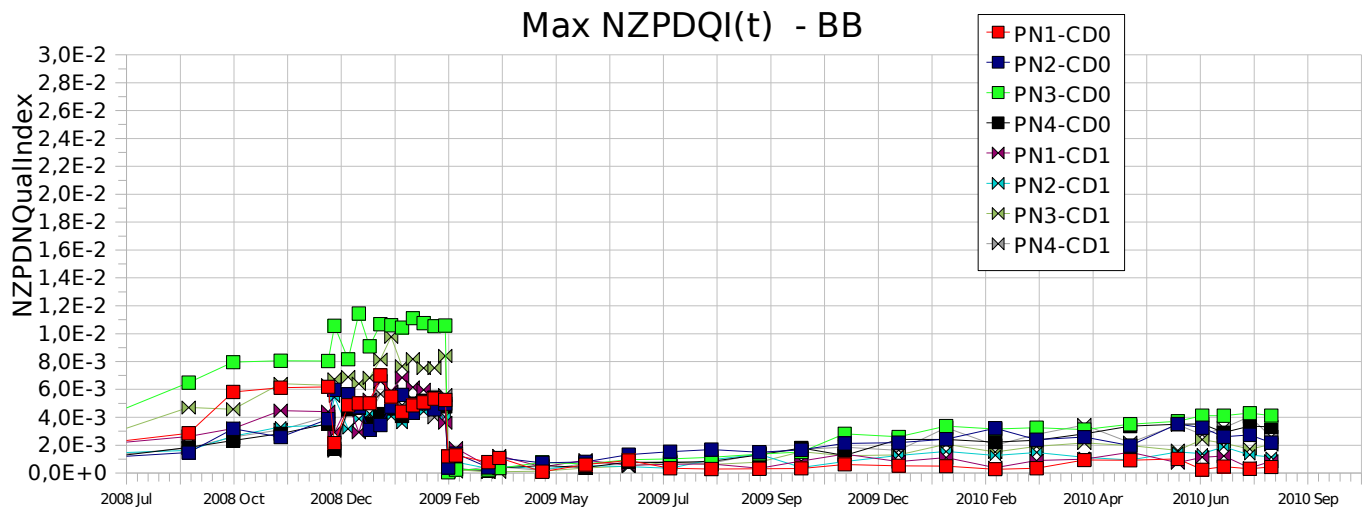


Figure 6 : Max of NZPD quality index for all pixels and CCD - BB

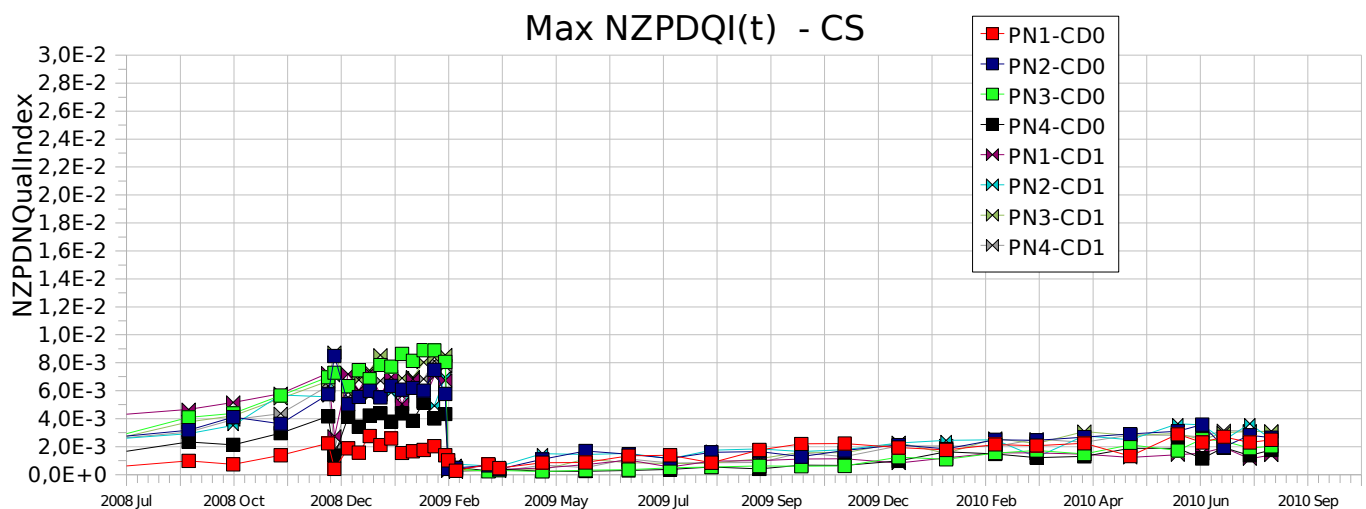


Figure 7 : Max of NZPD quality index for all pixels and CCD - CS

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

On February 2009 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.

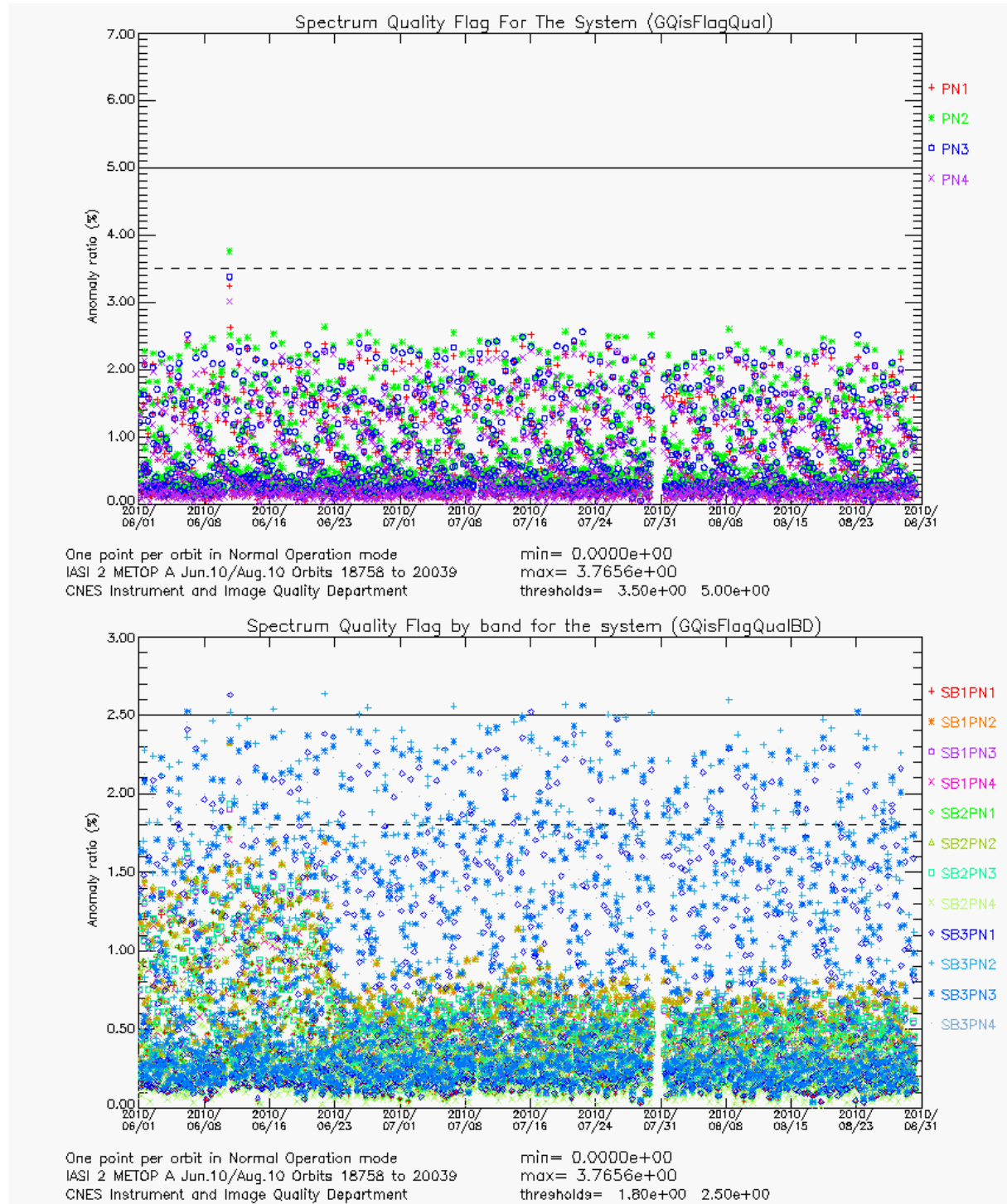


Figure 8 : IASI L1 data quality orbit average

One should note that, over the period covered by the present document, the averaged data rejection ratio is less than 1%. We clearly see the improvement of data quality on bands B1 and B2 in comparison to band B3 (which is the most affected by spikes).

The step observed for bands B1 and B2 on June 23rd corresponds to the upload of an optimized GRD configuration (IDefInterPixNZPD parameter).

4.4.2 Main flag and quality indicator parameters

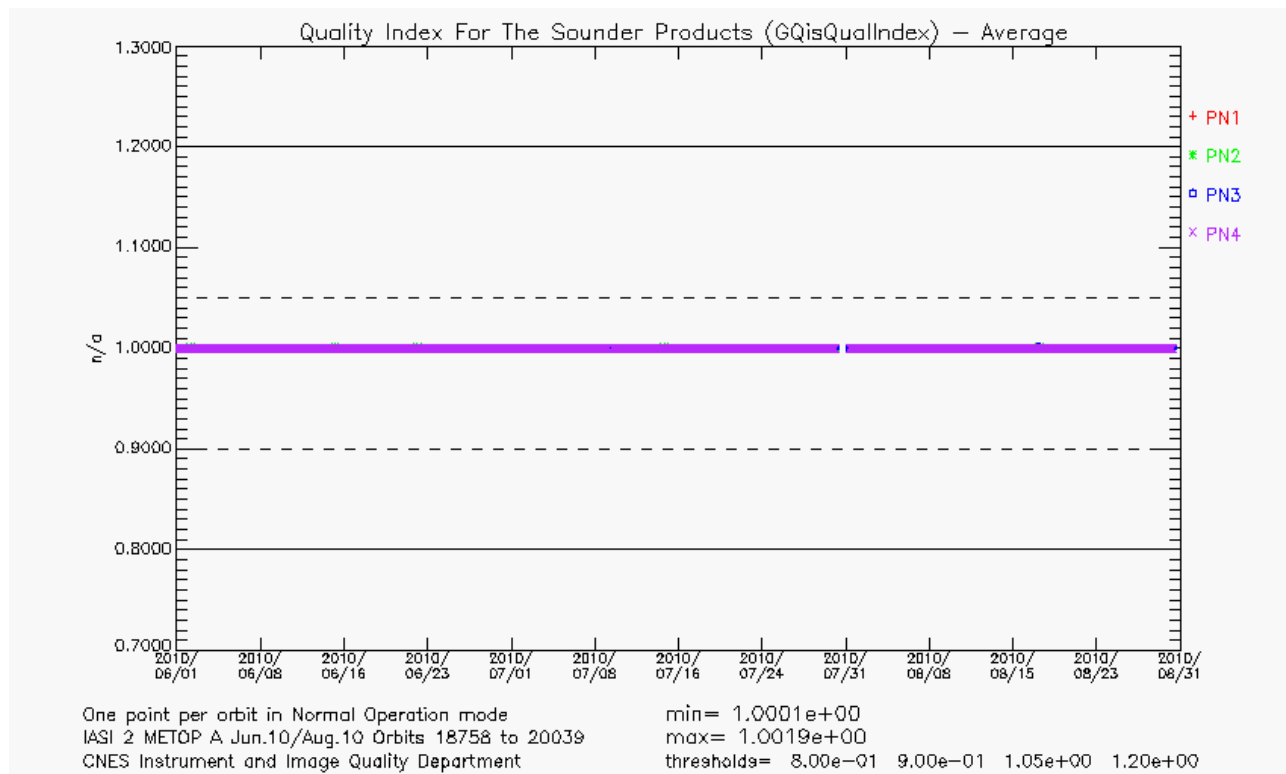


Figure 9 : GQisQualIndex average (L1 data quality index for IASI sounder)

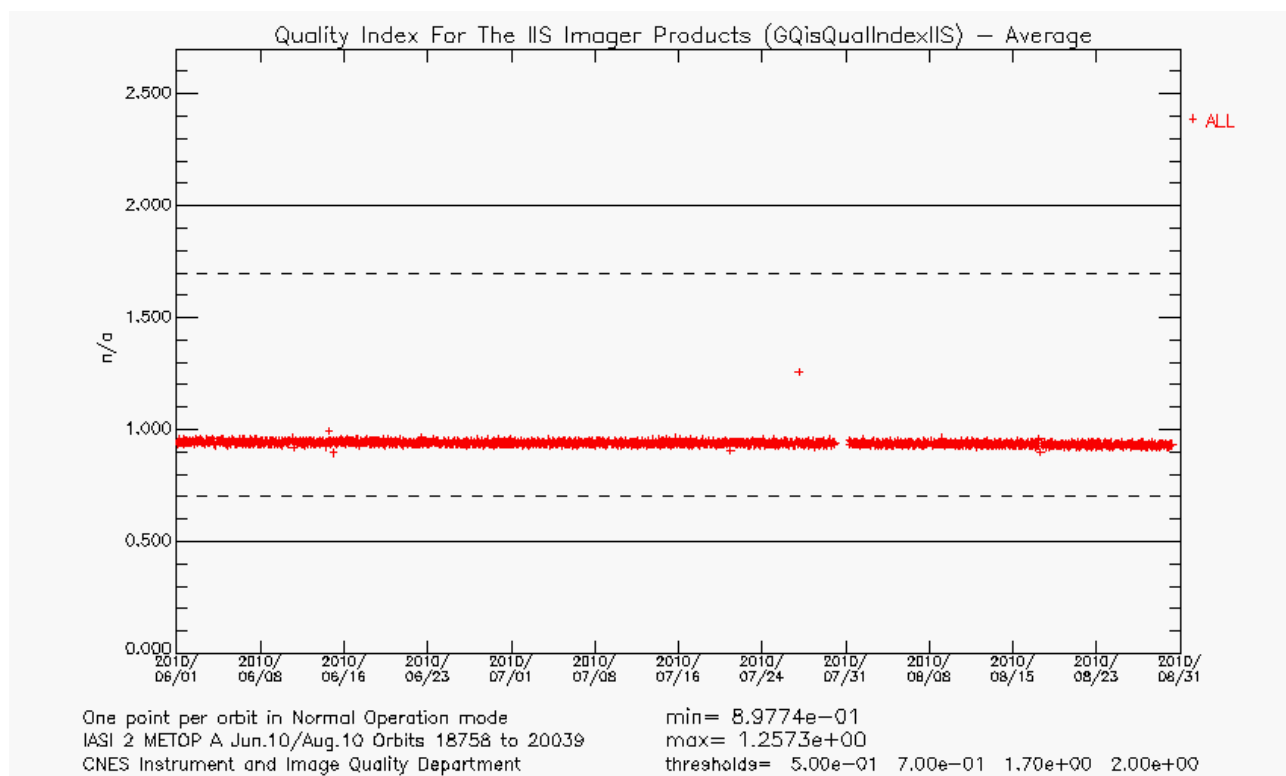


Figure 10 : GQisQualIndexIIS average (L1 data quality index for IASI Integrated Imager)

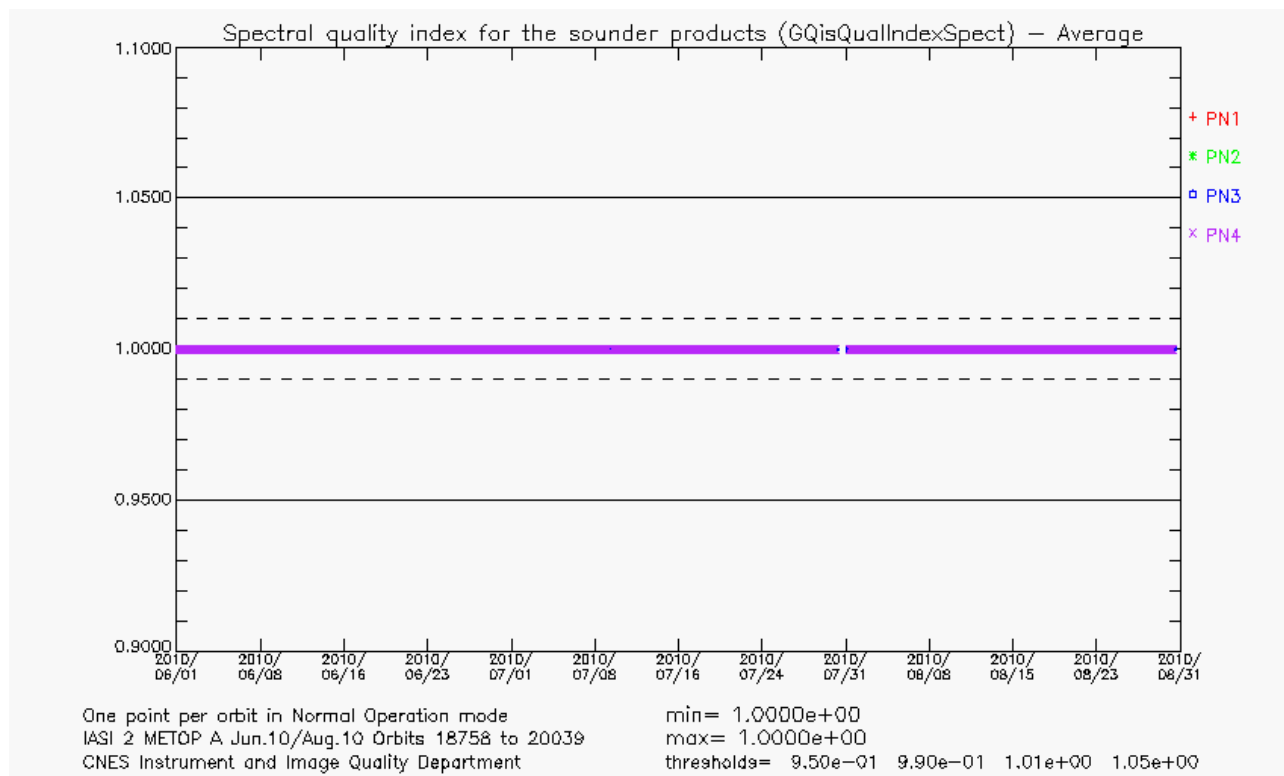


Figure 11 : GQisQualIndexSpect average (L1 data index for spectral calibration quality)

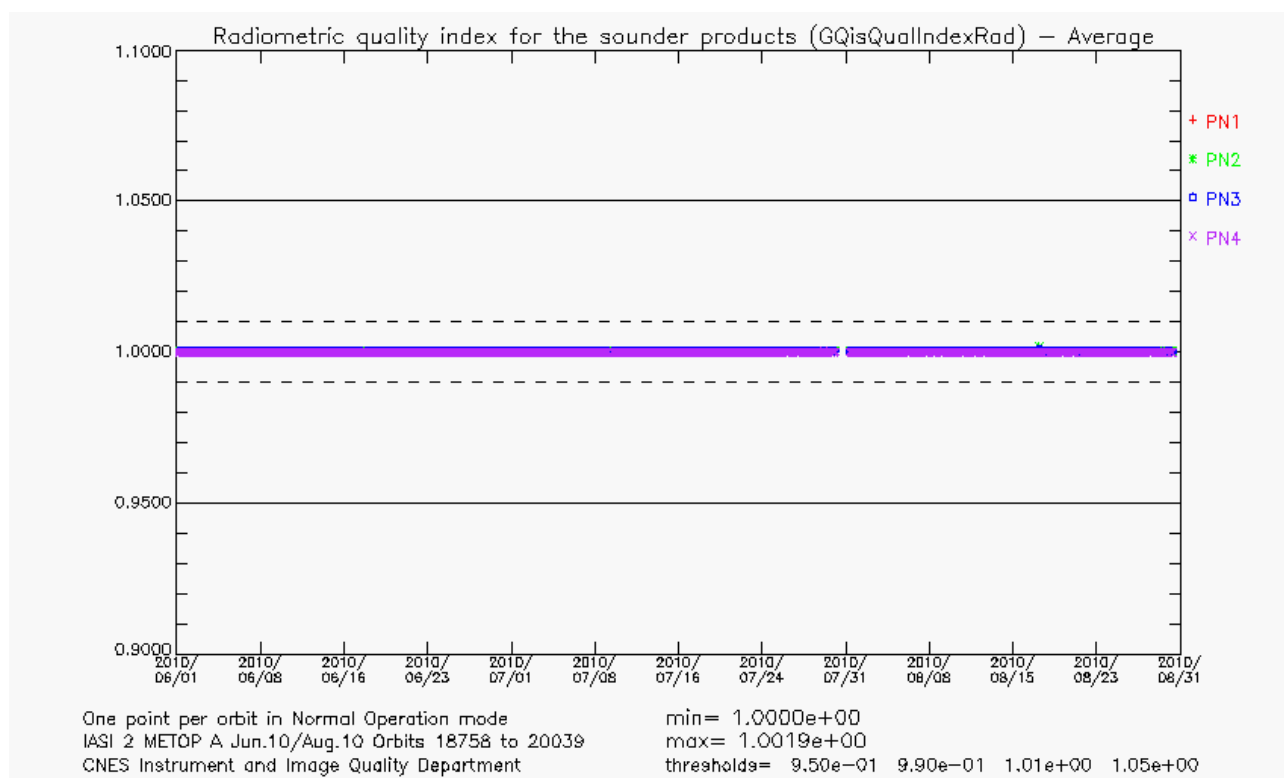


Figure 12 : GQisQualIndexRad average (L1 data index for radiometric calibration quality)

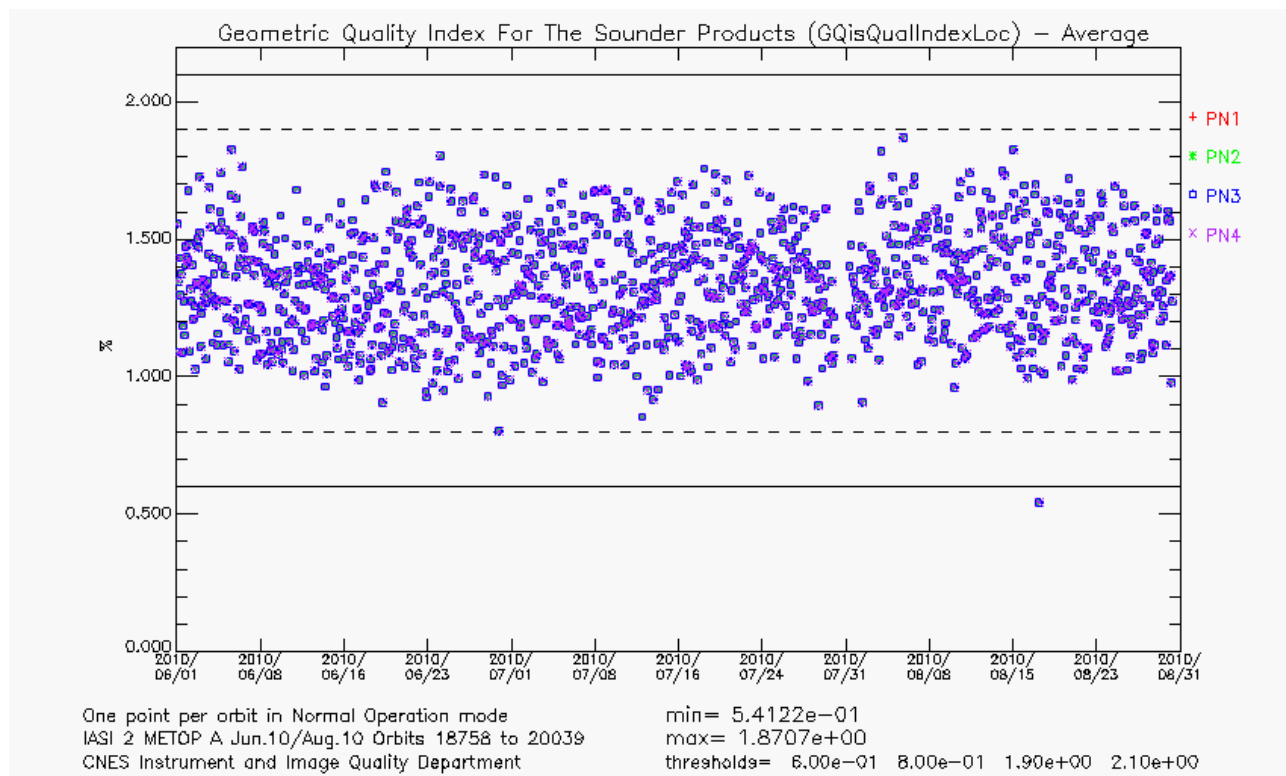


Figure 13 : GQisQualIndexLoc average (LI data index for ground localisation quality)

4.4.3 Second level flag and quality indicators

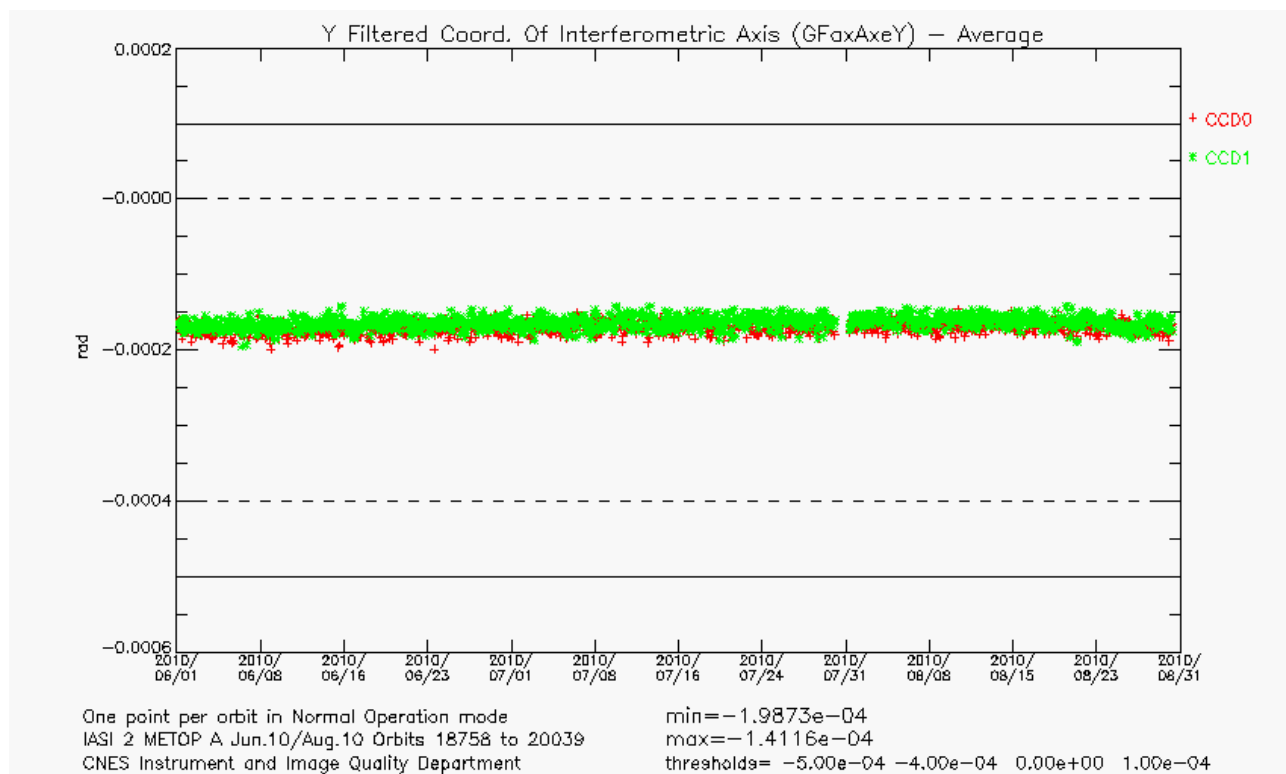


Figure 14 : GFaxAxeY average (Y filtered coordinates of sounder interferometric axis)

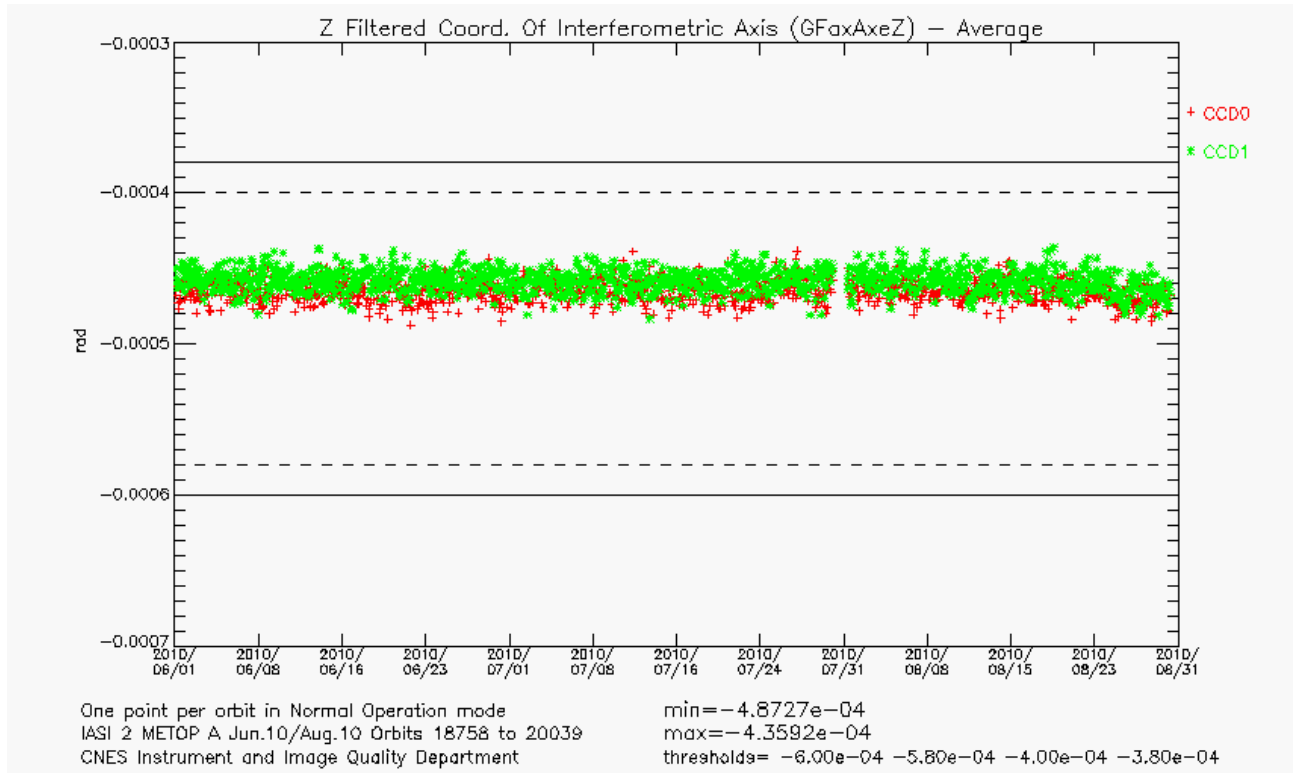


Figure 15 : GFaxAxeZ average (Z filtered coordinates of sounder interferometric axis)

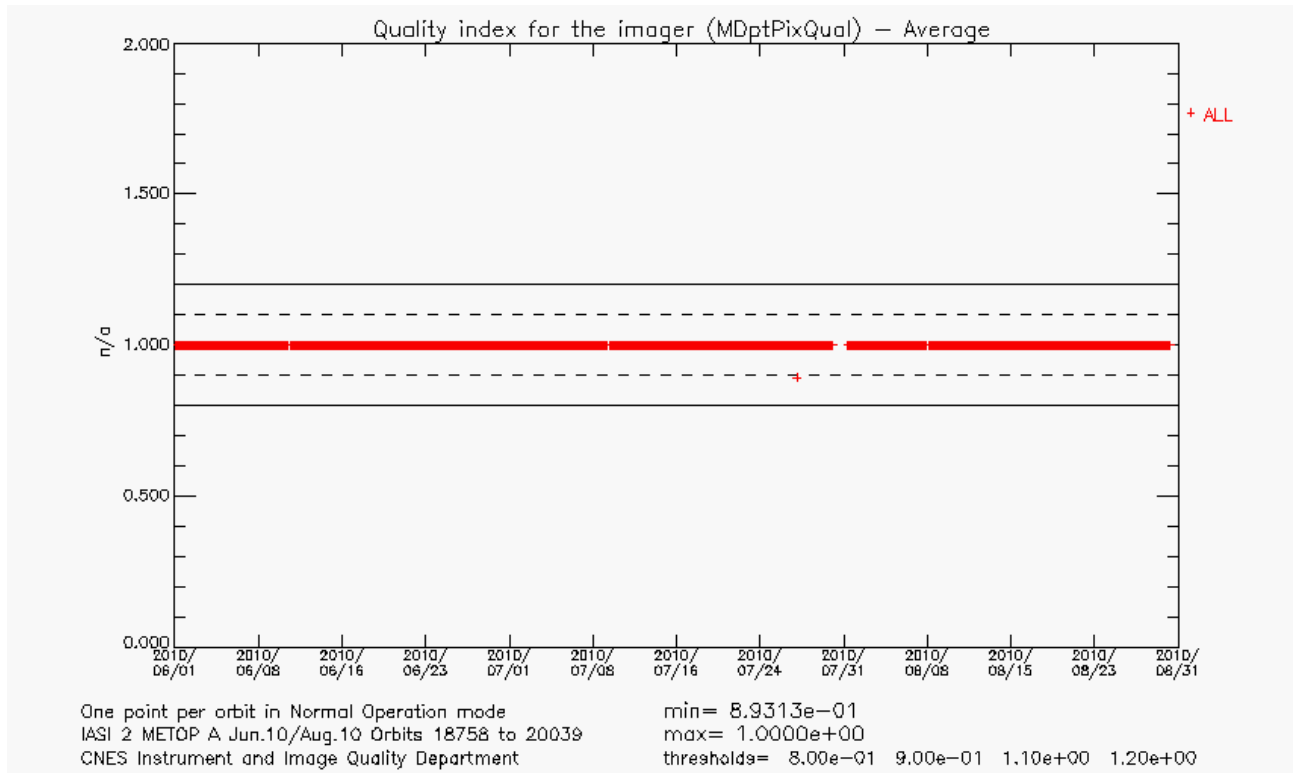


Figure 16 : MDptPixQual average (L1 quality index for IASI integrated imager / fraction of not dead pixels)

4.4.4 Conclusion

L1 Flag and quality indicators are stable.

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.

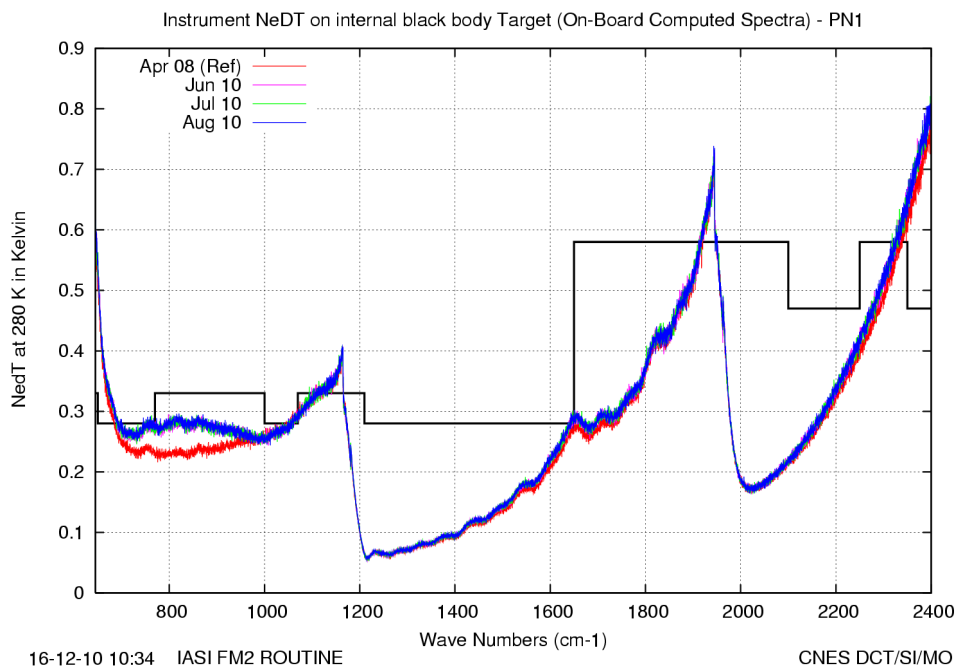


Figure 17 : Instrument noise evolution between start and end of the period

The instrument noise is very stable apart from ice effect between 800 and 1000 cm^{-1} . This point will be developed in section 4.5.3.1.

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

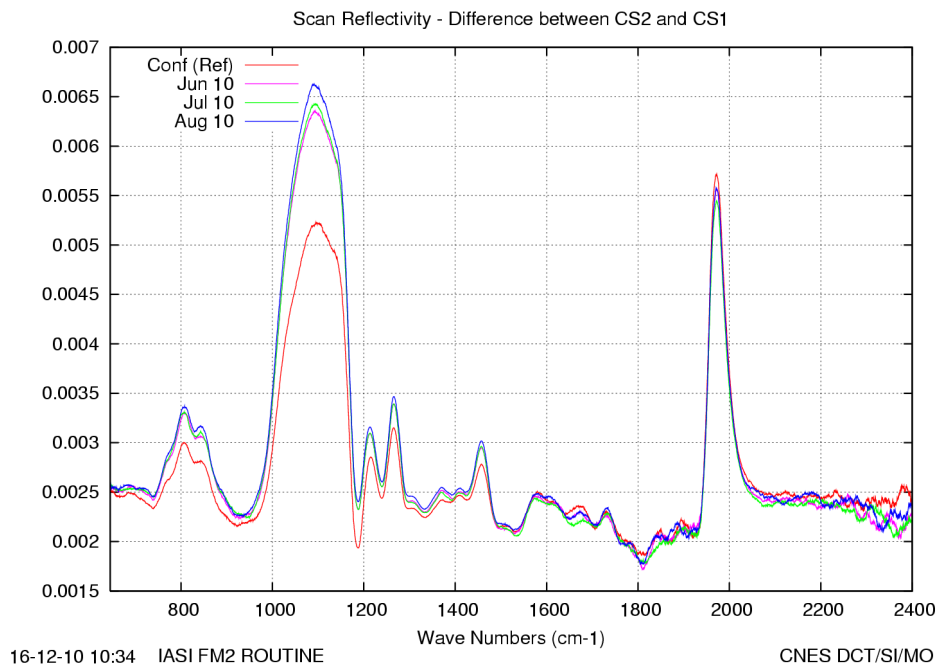


Figure 18 : Scan mirror reflectivity evolution

The reference reflectivity (in red) has been changed according to May 2009 configuration update. We still see a slight evolution within $[1000-1100 \text{ cm}^{-1}]$ band. Values for wave numbers 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.

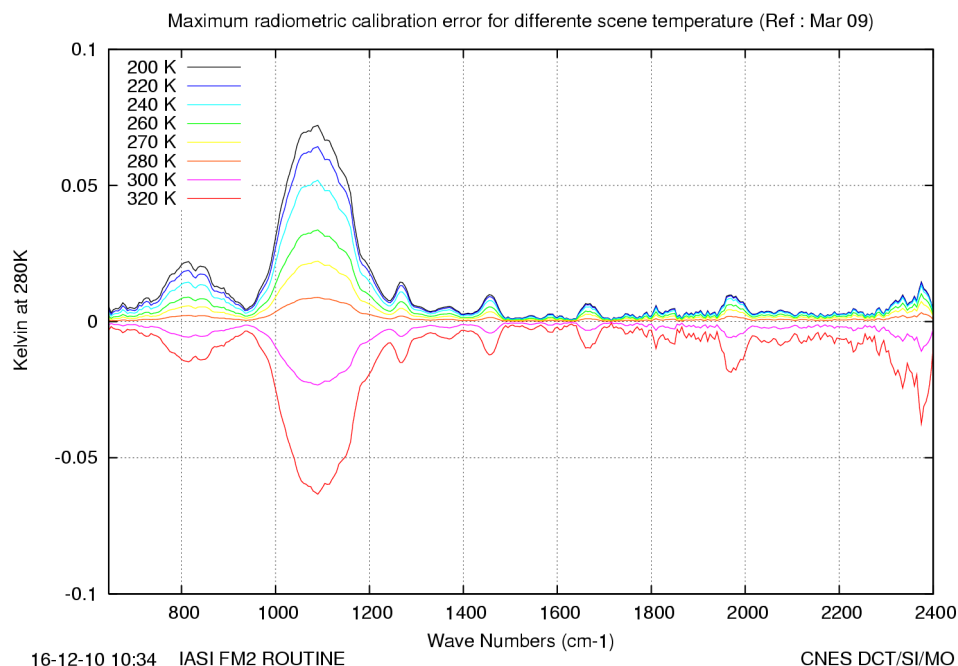


Figure 19 : Radiometric calibration error due to scan mirror reflectivity dependency with viewing angle Maximum effect on SN1 for different scene temperature

In any cases radiometric calibration maximum error is lower than 0.05K. This value is lower than the specification (0.1K). We expect an update of the scan mirror reflectivity in GRD file by the end of 2010 or the beginning of 2011.

Internal black body

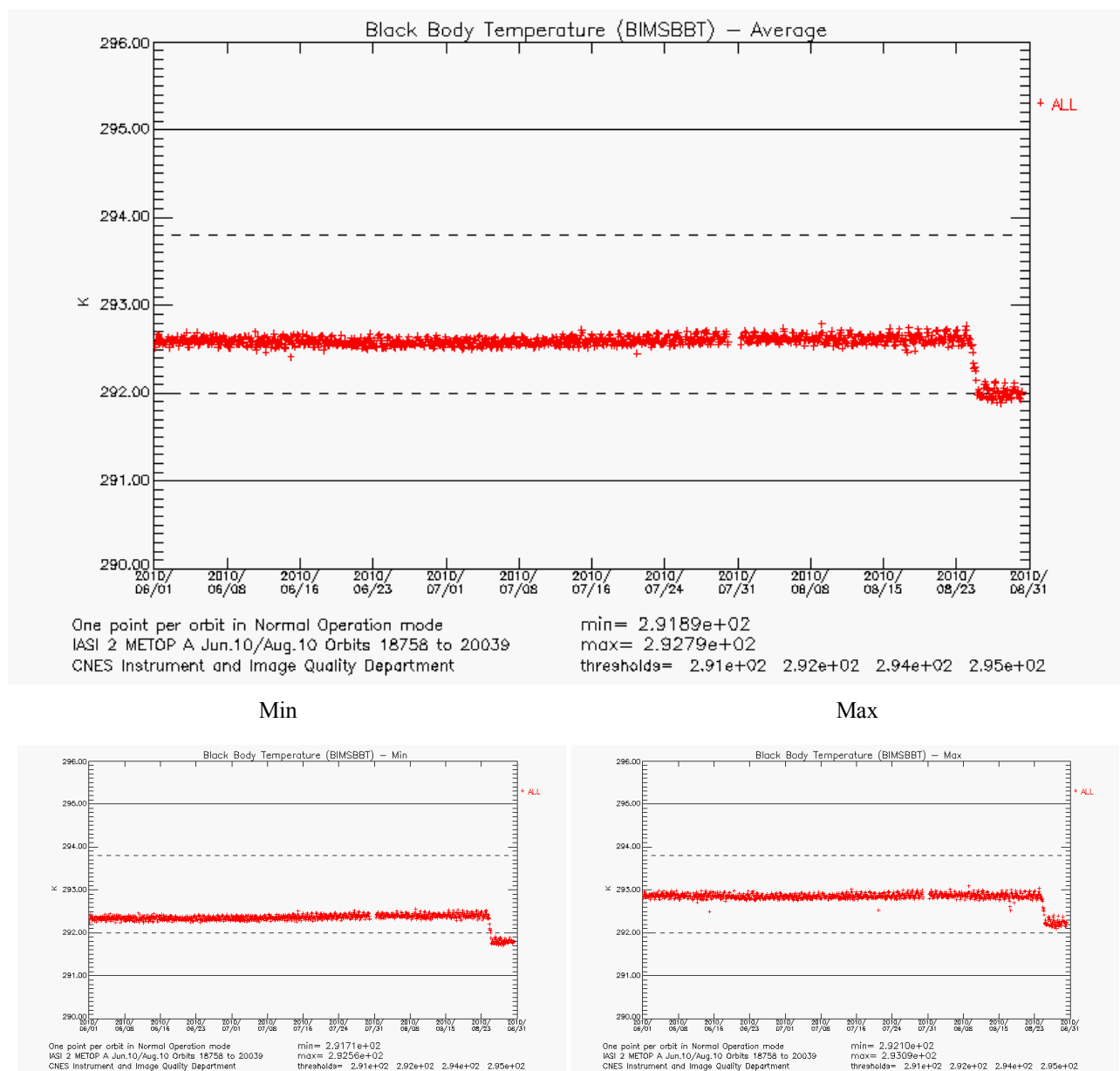




Figure 20 : Black Body Temperature

NCR 3924 reports a BBT temperature instability of a few degrees after a mode change. This is not visible on the upper plots where external calibration periods are removed. The correction of NCR 3924 has been implemented in IASI L1/PPF V5-0-3 patch.

Just before the decontamination (end of August 2010), ATC line number 10 was blocked to high or maximum power injection. This has lead to an increase of the MAS temperature and consequently to a new state of equilibrium of the instrument. This is in particular observable here on the BBT. This effect has been fully taken into account by on-board radiometric calibration and therefore there were no impact on spectra. This thermal anomaly has been cured by resetting the IMS, confirming that it was only a transient anomaly.

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 29 Of: 43
--	--	---

Non linearity of the detection chains

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

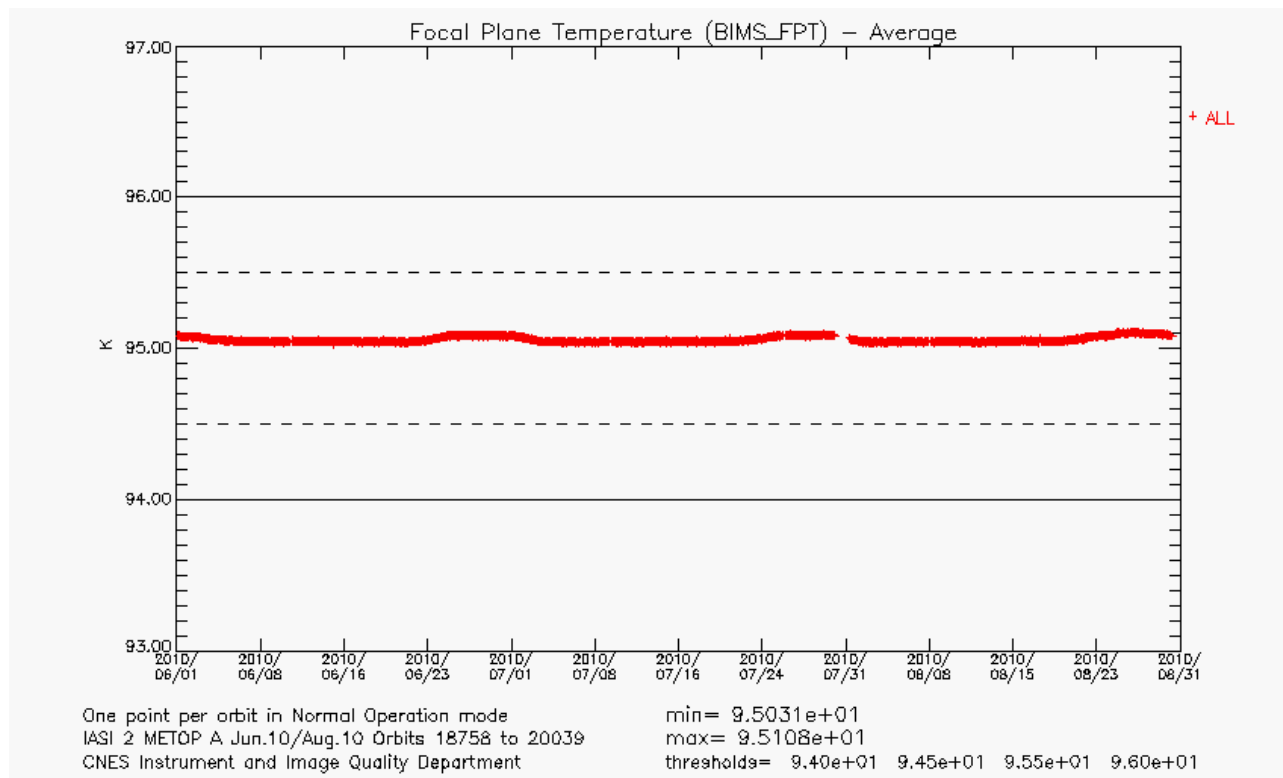


Figure 21 : Focal Plane Temperature

4.5.3 Optical Transmission

4.5.3.1 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 $0.5\text{ }\mu\text{m}$).

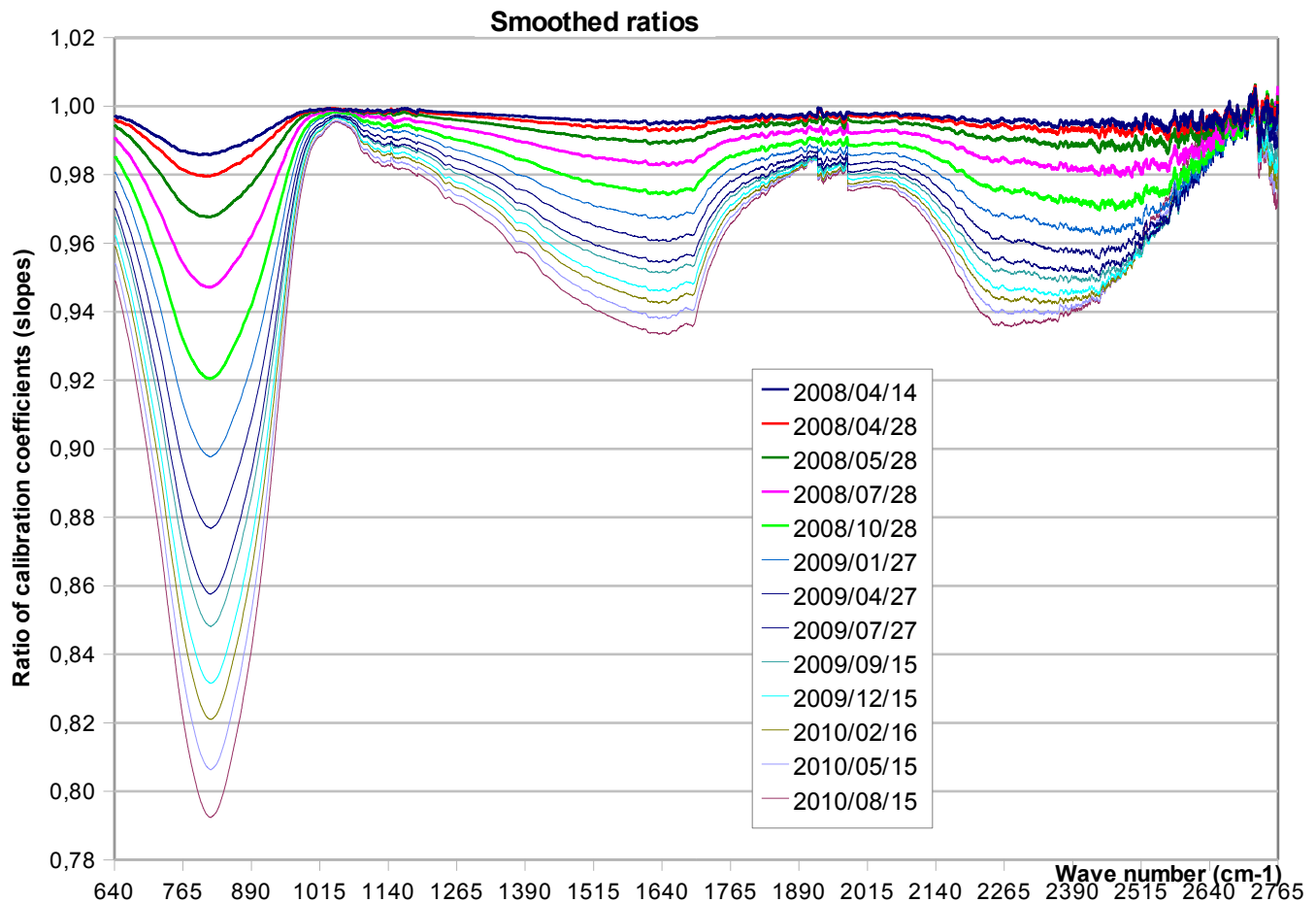


Figure 22 : Ratio of calibration coefficient slopes as a function of wave number and time after the second decontamination

4.5.3.2 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.

Evolution of the ratio at 850 cm^{-1}

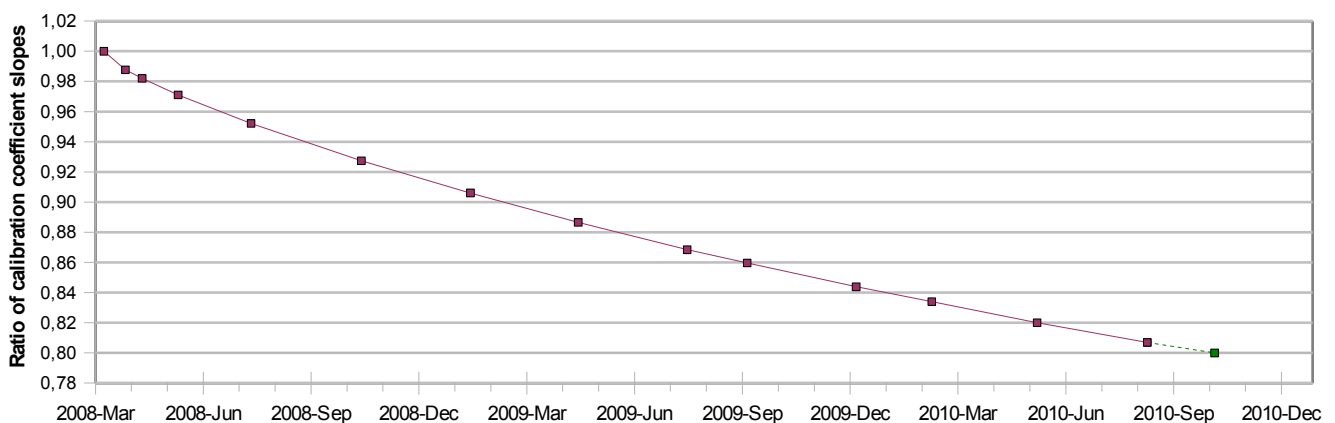


Figure 23 : Temporal evolution of calibration ratio coefficient slopes since the last decontamination. A linear extrapolation had been added to determined a rough date for the next decontamination (relative gain evolution of 0.8)

4.5.4 Interferometric Contrast

The interferometric contrast is defined as the interferogram fringe discrimination power. Figure 24 shows temporal evolution of instrument contrast since the beginning of IASI life in orbit for all pixels and all CCD.

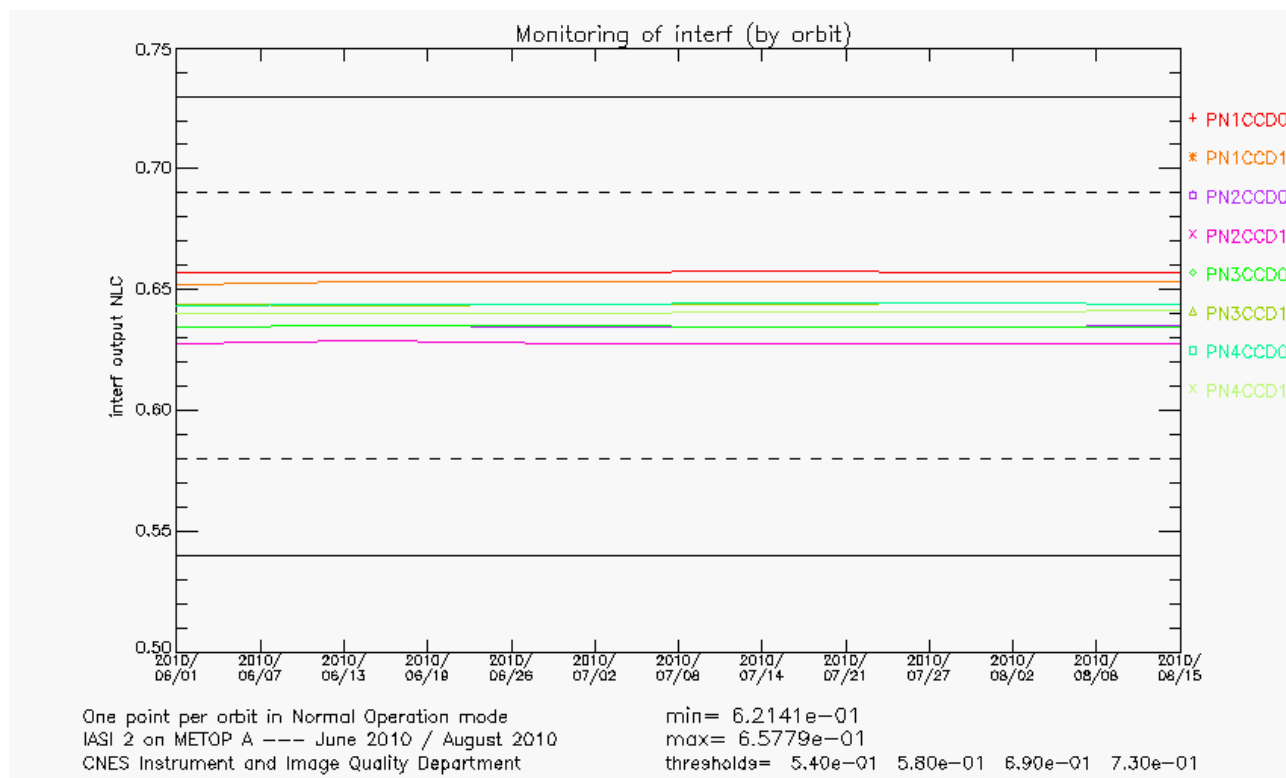
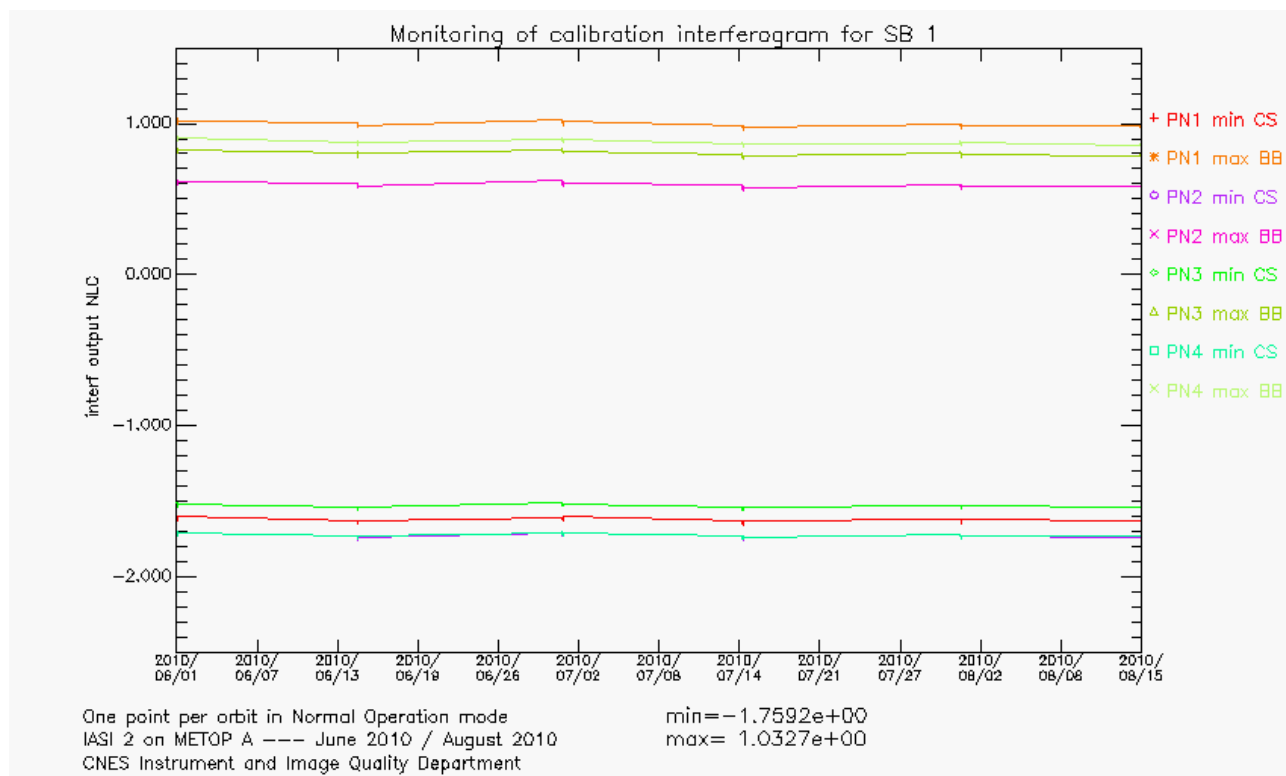


Figure 24 : Monitoring of contrast for SB3

4.5.5 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.



SB2

SB3

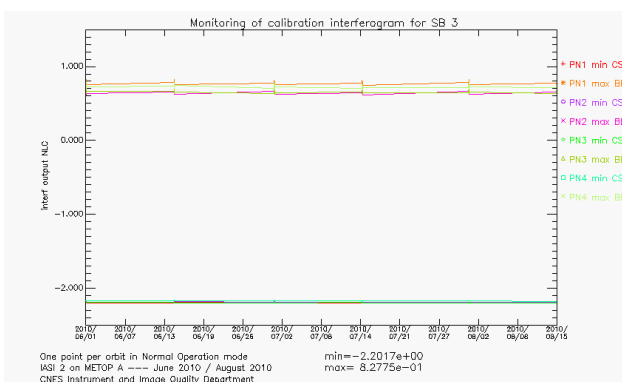
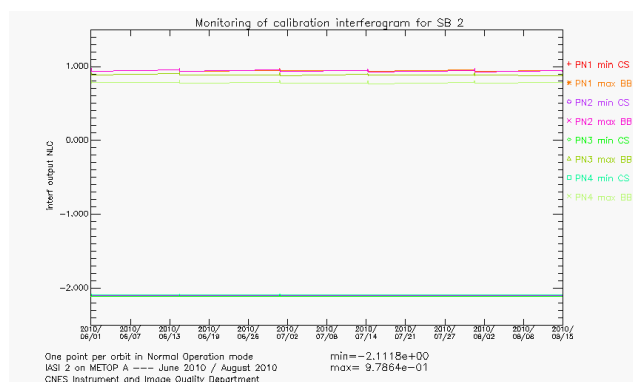




Figure 25 : Monitoring of detection chain margins

Margins are sufficient for the moment.

4.5.6 Conclusion

The radiometric performances of IASI are nominal and stable. A linear extrapolation of the actual contamination ratio leads to an earliest date for the next decontamination of September 2010. Scan mirror reflectivity will be updated in end 2010.

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 33 Of: 43
--	---	---

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.

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 34 Of: 43
---	---	---

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 $-200\ \mu\text{rad}$ and $-400\ \mu\text{rad}$, respectively for Y and Z axis. Since the drift of the interferometer axis is lower than $300\ \mu\text{rad}$, there is no need to update the “spectral database”, see chapter 4.4.3.

4.6.1.2 Cube Corner constant offset

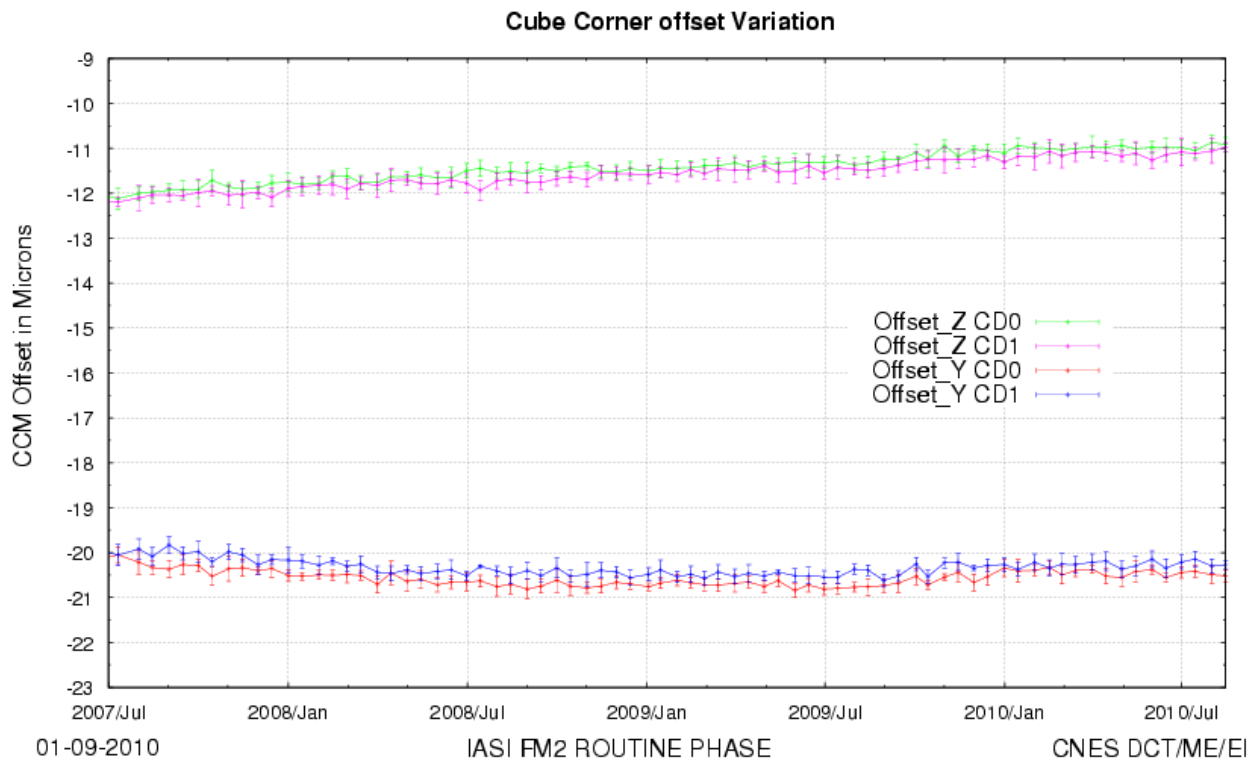


Figure 26 : Cube Corner offset variation

Reference cube corner offsets, used in the “spectral database” generation, are $-20.16\ \mu\text{m}$, $-19.84\ \mu\text{m}$, $-12.16\ \mu\text{m}$ and $-12.22\ \mu\text{m}$, respectively for Y CD0, Y CD1, Z CD0 and Z CD1. Since the drift of cube corner offset is lower than $4\ \mu\text{m}$, 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 this is attached to the optical bench.

The ghost affects the ISRF basically by replicating it at about $\pm 14\text{cm}^{-1}$. 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.

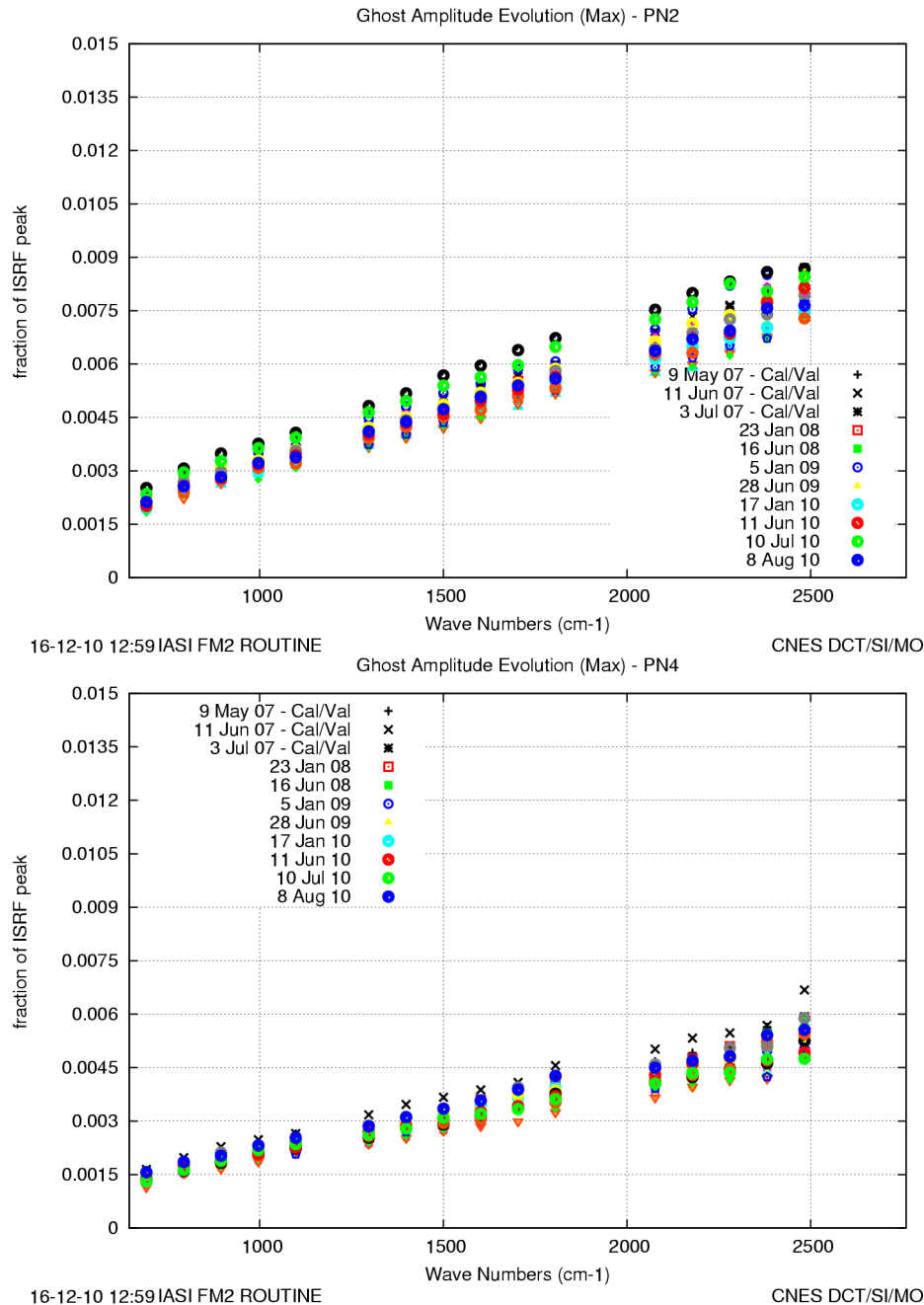




Figure 27 : Ghost amplitude as a function of wave number for different time (Top: pixel 2, bottom: pixel 4)

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.

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 36 Of: 43
--	--	---

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

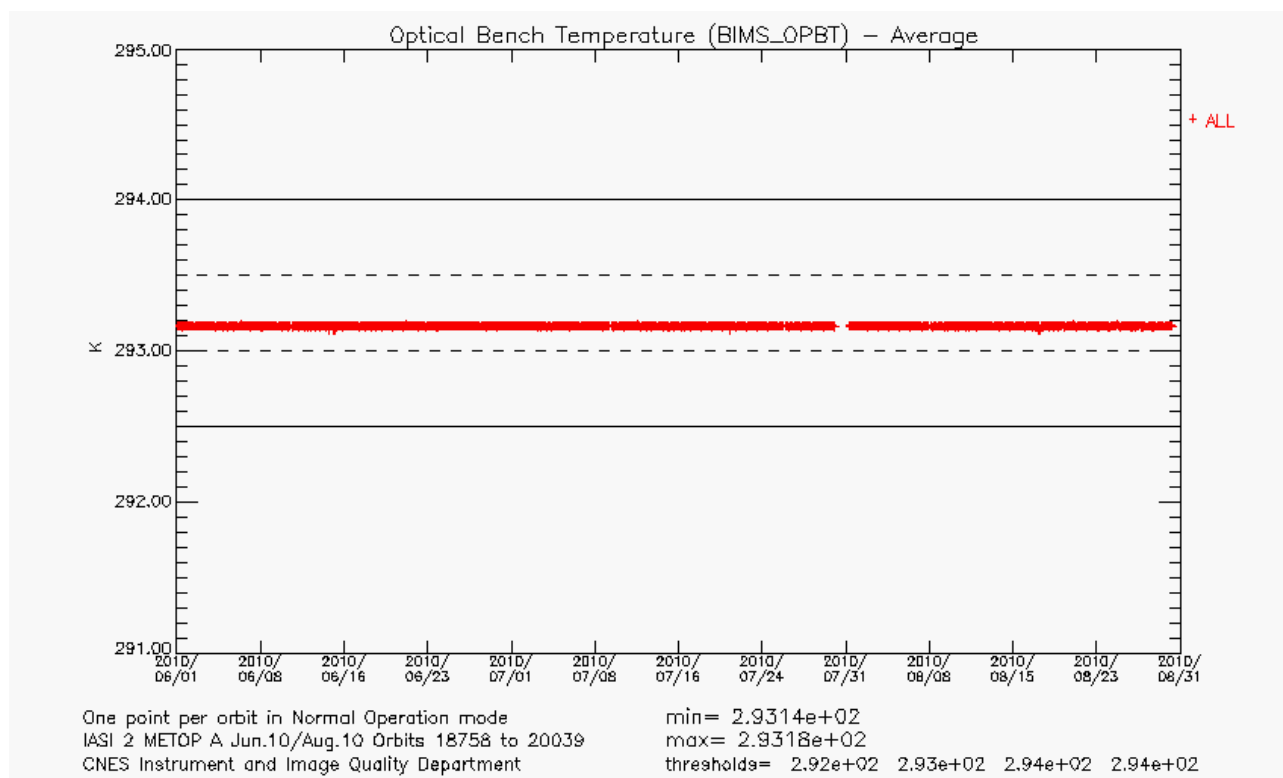


Figure 28 : Optical bench Temperature

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

The following figures show the evolution of the IIS/sounder co-registration. The sounder and IIS are mechanically linked onto the same instrument, so the co-registration of the latter is particularly stable and, consequently, is monitored only twice a year, generally around September for REVEX and February.

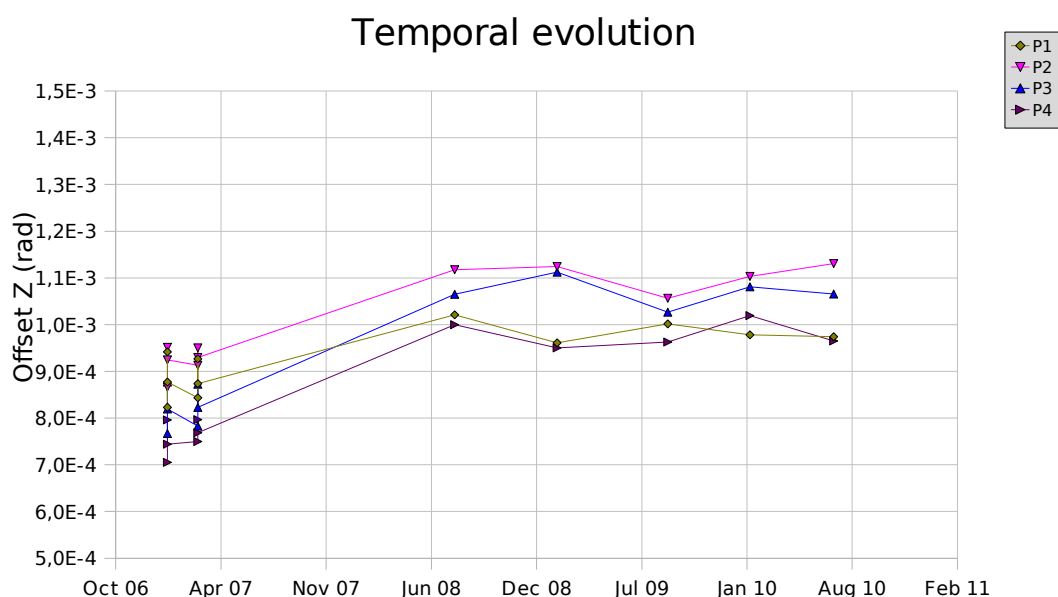


Figure 29 : Temporal evolution of the IIS/sounder co-registration for each sounder pixel.
The offsets are reported in radian, Y and Z define an orthogonal referential linked to IIS

Since the positions of IASI pixels are considered as stable during data processing, one can convert the evolution of sounder pixel position distortion in IIS raster into an error on the spectral calibration. The impact of IIS / sounder co-registration error on spectral calibration is shown in fig.30. The maximum relative error on the spectral calibration should be lower than $2 \cdot 10^{-6}$.

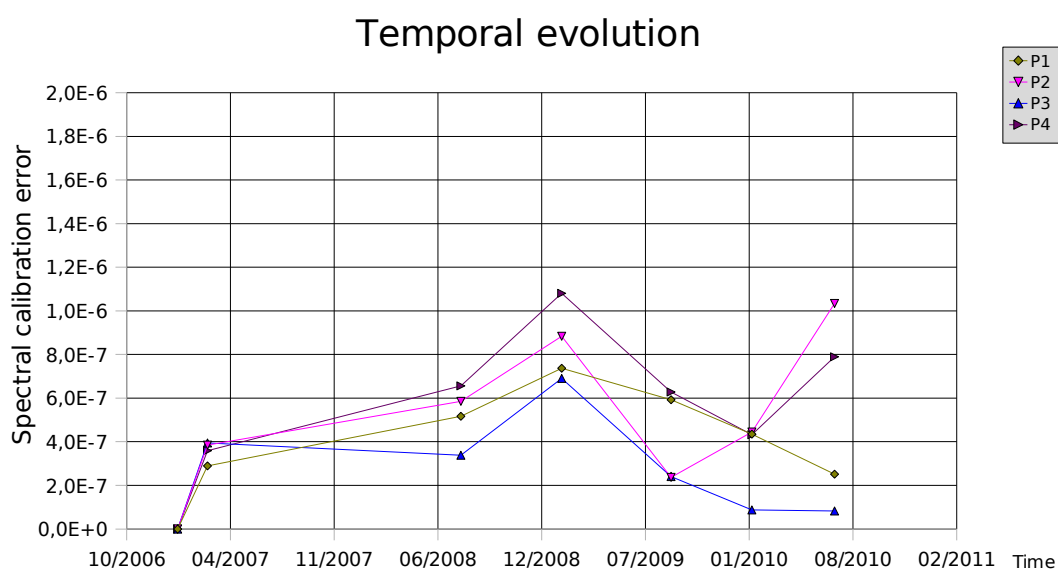


Figure 30 : Maximum impact of the IIS/sounder co-registration evolution on the spectral calibration

4.7.2 IIS / AVHRR co-registration

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

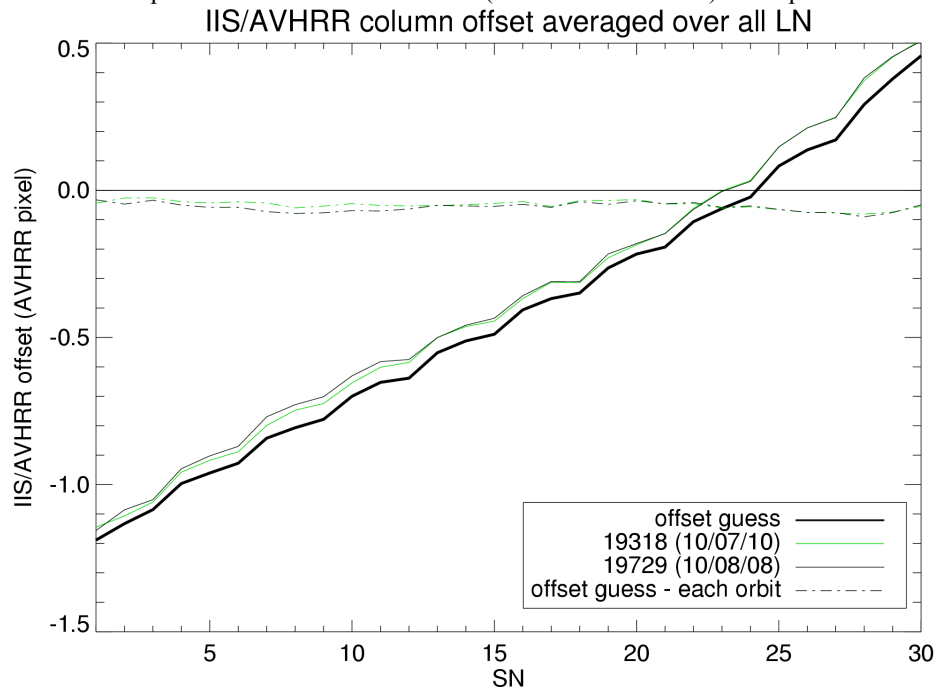


Figure 31 : Column offset (black) guess vs. column offset averaged over all lines (LN) as a function of the scan position ($SP=SN$), and orbit number

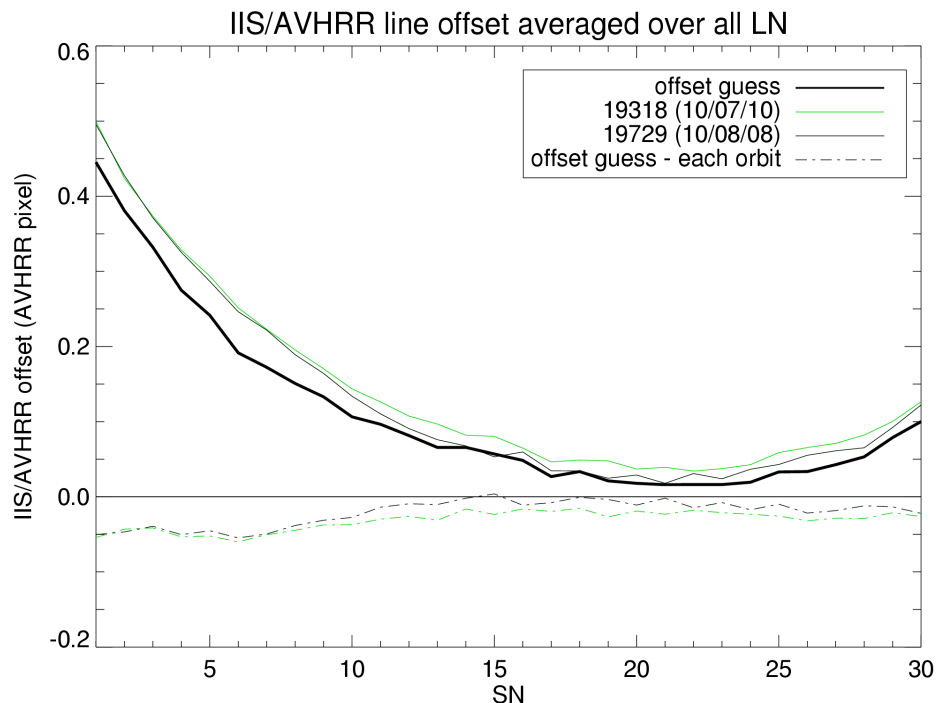


Figure 32 : Line offset guess (black) vs. line offset averaged over all lines (LN) as a function of the scan position ($SP=SN$), and the orbit number

4.7.3 Conclusion

The positions of IASI pixels 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

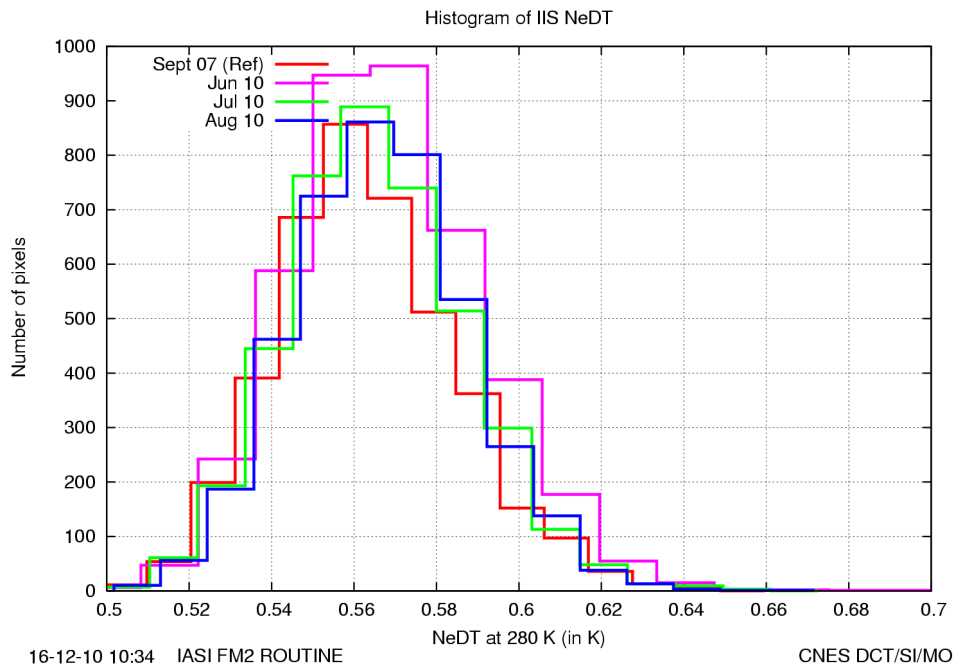




Figure 33 : Temporal evolution of the noise between start and end of the period

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

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 40 Of: 43
---	---	---

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 34 shows a comparison of slope and offset coefficients matrix between start and end of the period.

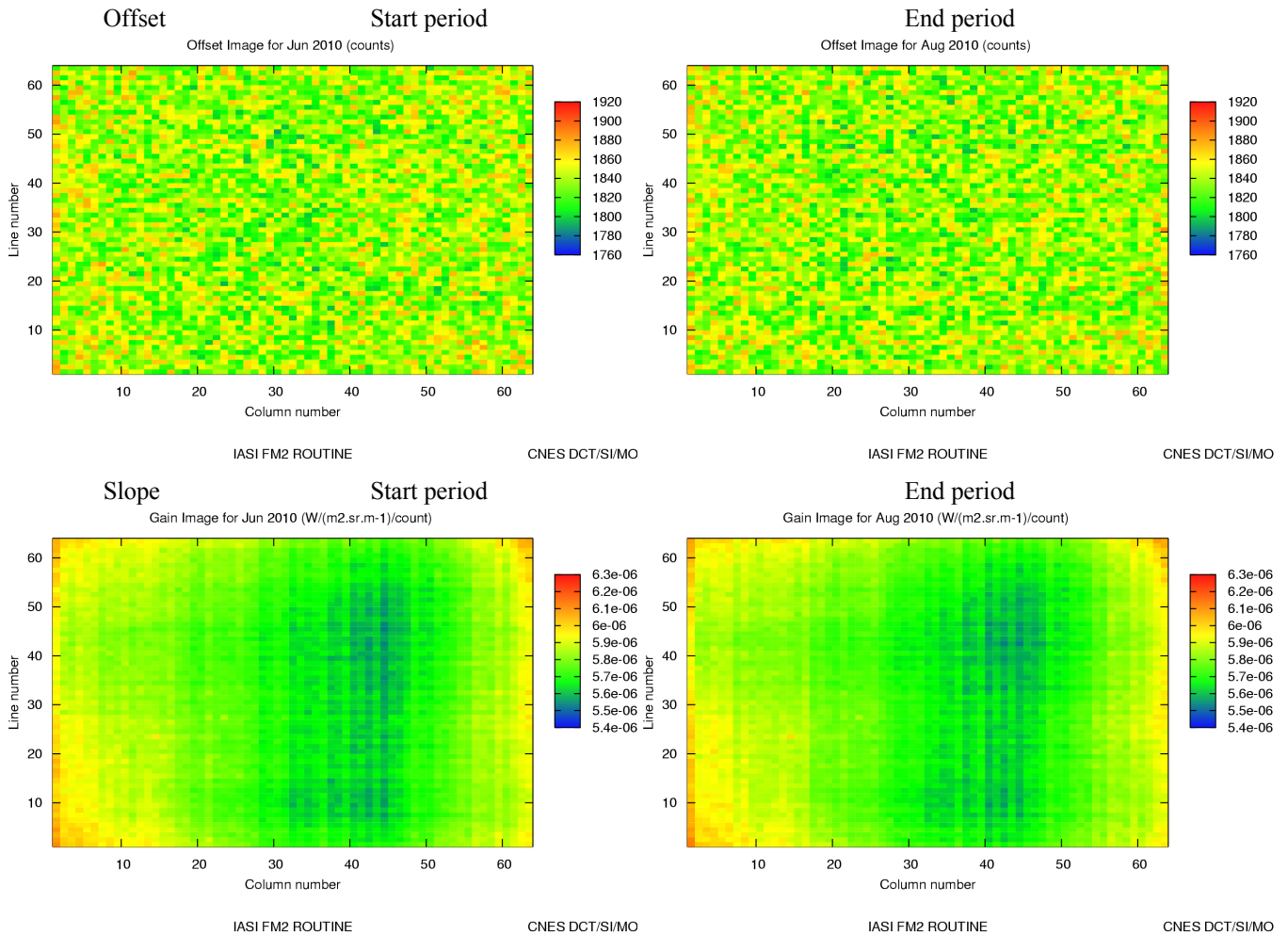


Figure 34 : Slope and offset coefficients matrix

The complete time series of average slope and offset coefficients is given in Figure 35.

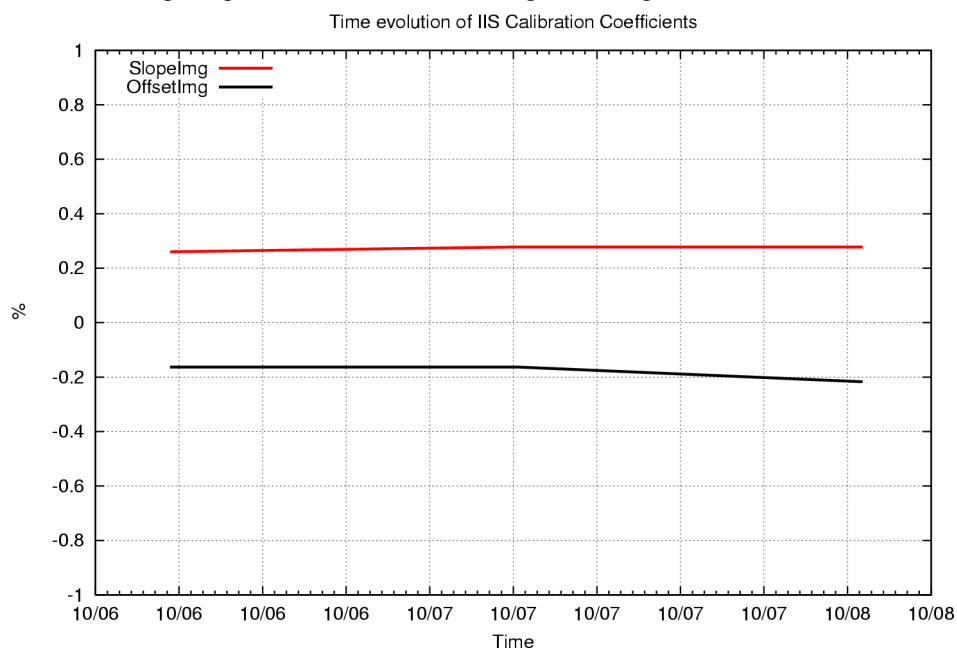


Figure 35 : Evolution in % of average of slope (red curve) and offset (black curve) coefficients

The slope and offset coefficients are stables.

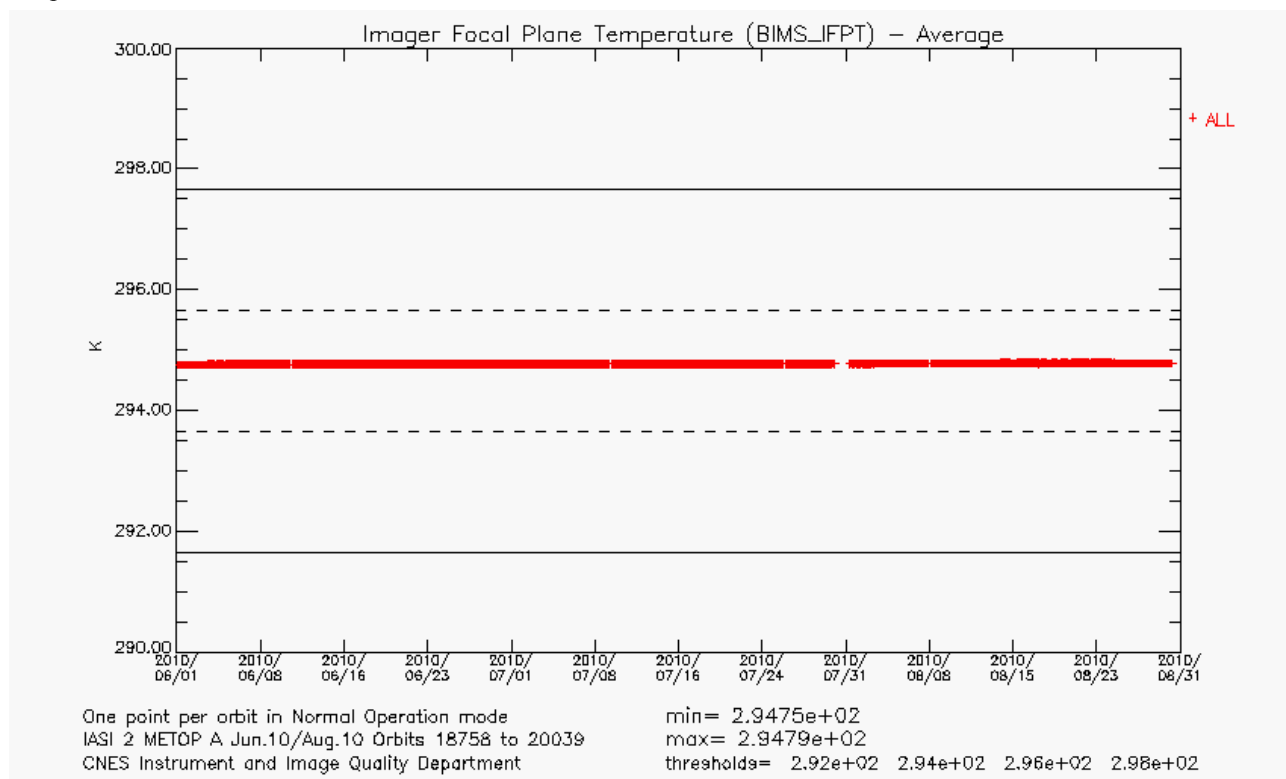




Figure 36 : IIS Focal Plane Temperature

4.8.3 Conclusion

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

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 42 Of: 43
--	--	---

5 IASI TEC AND EUMETCAST INTERFACE EVOLUTION

For more information about the IASI news please see <http://smmc.cnes.fr/IASI/index.html>

5.1 IASI TEC EVOLUTION

Table 19 lists the evolutions within the period.

IASI TEC software version	implementation	Comments
7.1	17 December 2009	Day2 format (analyses tools)

Table 19: IASI TEC at CNES Toulouse

5.2 EUMETCAST INTERFACES

EUMETCast dissemination is used for Near Real Time data reception at the IASI TEC at CNES, Toulouse. Each orbit, L1 ENG, L1 VER, L0, 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 inside the machine for a longer period than on the nominal terminal: this allows CNES to loose not too much time and to retrieve manually the stored products if necessary.

The EUMETCAST maintenance team regularly receives logs from the nominal terminal and anomaly reports in case of crash.

The nominal EUMETCast hung up:

- On Monday 14/06/2010 20:38 (restarted on Tuesday 6h --> 10h30 of missing products)
- On Tuesday 15/06/2010 08:34 (restarted at 9h18 --> 30mn of missing products)
- On Wednesday 16/06/2010 17:50 (restarted on Thursday 6h--> 6h of missing products)
- On Tuesday 20/07/2010 22:14 (restarted on Wednesday --> 10h of missing products)
- On Wednesday 18/08/2010 06:13 (restarted at 8h50 --> 1h35 of missing products)

Hereunder is a figure showing the frequency of terminals failures.

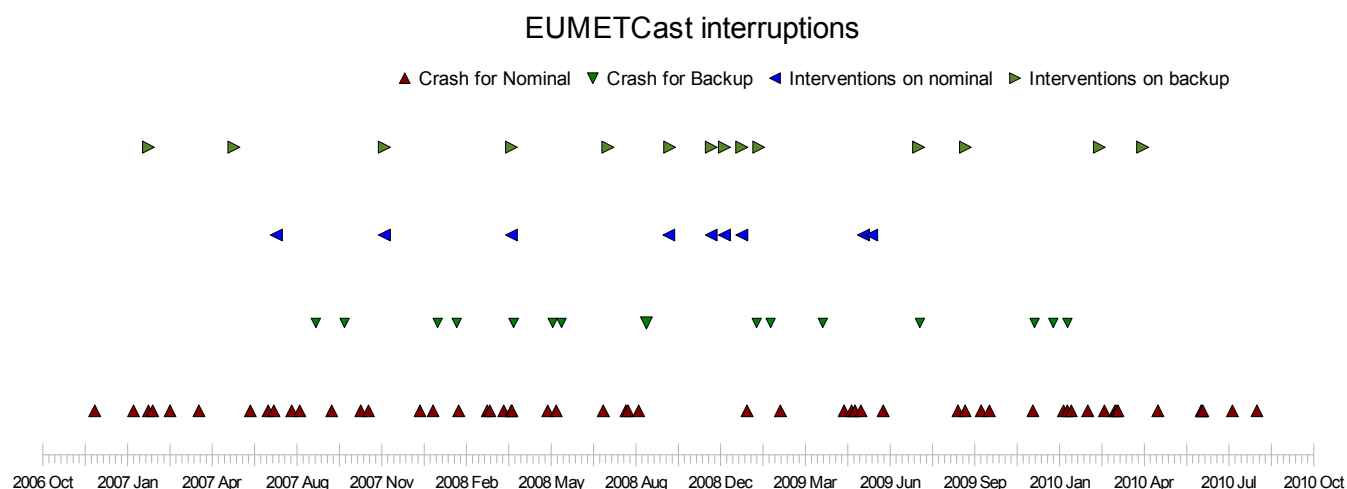




Figure 37: status of TEC's EUMETCAST terminals

		Doc n°: IA-RP-2000-3524-CNE Issue: 1.0 Date: 2017-09-28 Sheet: 43 Of: 43
--	--	---

6 CONCLUSION AND OPERATIONS FORESEEN

6.1 SUMMARY

The IASI FM2 instrument is fully operational.

The instrument configuration is the nominal one.

Next decontamination happened at the end of August 2010

6.2 SHORT-TERM EVENTS

6.3 OPERATIONS FORESEEN

- Update of OPS configuration in order to take into account scan mirror reflectivity evolution (end of 2010).
- Moon on 24-25 December 2010

End of document