



Metop-B

Doc n°: IA-RP-2000-4479-CNE  
Issue: 1.0  
Date: 01/06/2019  
Sheet: 1 Of: 54



## **IASI QUARTERLY PERFORMANCE REPORT**

**FROM 2019/03/01 TO 2019/05/31**

-----

**BY IASI TEC (TECHNICAL EXPERTISE CENTER)**

**FOR IASI PFM-R ON METOP B**

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 2 Of: 54
--	--	--

<p align="center"><b>ANALYSE DOCUMENTAIRE</b></p> <p align="center"><b>Bordereau d'indexation</b></p>
---

<b>Classe (Confidentialité) : NC</b>		<b>Code Consultation :</b>	
<b>Mots clés d'auteur :</b> IASI TEC quarterly synthesis report			
<b>OBJET :</b>  <p align="center"><b>IASI TEC periodic report</b></p>			
<b>TITRE :</b>  <p align="center"><b>IASI quarterly performance report</b></p>			
<b>Auteur(s) :</b>  <p align="center">Bernard Delatte, Claire Maraldi et Laura Le Barbier (CNES) avec le support de Elodie Fernandez (THALES, marché AC-SIS 171475) et J.C. Calvel (AKKA Technologies, marché AC-SIS 171475)</p>			
<b>RESUME :</b>  <p>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</p>			
<b>Document(s) rattaché(s) :</b> Ce document vit seul		<b>Localisation physique du document :</b> Salle IASI TEC	
<b>Volume :</b>  <p align="center"><b>1</b></p>	<b>Nombre de pages total :</b>  <p align="center"><b>54</b></p> <p>dont - liminaires : 7 annexes : 0</p>	<b>Nombre d'annexes :</b>  <p align="center"><b>0</b></p>	<b>LANGUE :</b>  <p align="center"><b>English</b></p>
<b>Document géré en Configuration :</b>  Non		<b>A DATER DU :</b>	<b>RESPONSABLE :</b>
<b>Contrat :</b> Néant			
<b>SYSTEME HOTE : (logiciel + référence fichier) :</b>  <p align="center">LibreOffice 5.0</p>			



Doc n°:	IA-RP-2000-4479-CNE		
Issue:	1.0		
Date:	01/06/2019		
Sheet:	3	Of:	54

## DIFFUSION



On CNES web site : <https://iasi.cnes.fr>  
Instrument characteristics / In-orbit performances monitoring

## DOCUMENT MODEL CHANGE RECORD

Version	Date	Paragraphs	Description
1.0	05/03/2011		Creation of the model
2.0	01/01/2015	4.3.2.5 4.8	Cube corner Speed Quality (CSQ) monitoring IASI-B inter-calibration with IASI-A, CrIS and AIRS
2.1	01/03/2016	4.6.2  4.6.3  4.9	Spectral calibration will be synthesized only once per year (in REVEX report)  Monitoring of the Ghost evolution is stopped (there is no more ghost since CD stop)  IIS noise and IIS radiometric calibration will be computed in one monthly external calibration in three and monitored only once per year (in REVEX report)
2.2	01/12/2017		OpenOffice Writer → LibreOffice Writer 5



## DOCUMENT CHANGE RECORD

Version	Date	Paragraphs	Description
1.0	01/06/2019		Creation of the document

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 4 Of: 54
--	--	--

## Table of contents

<b>1 INTRODUCTION.....</b>	<b>9</b>
<b>2 RELATED DOCUMENTS.....</b>	<b>9</b>
2.1 APPLICABLE DOCUMENTS.....	9
2.2 REFERENCE DOCUMENTS.....	9
<b>3 SIGNIFICANT EVENTS.....</b>	<b>10</b>
3.1 EXTERNAL CALIBRATION.....	10
3.2 ON BOARD CONFIGURATION.....	10
3.3 GROUND CONFIGURATIONS UPDATES FOR LEVEL 1 PROCESSING.....	11
3.4 DATA BASES UPDATE FOR THE USERS.....	11
3.5 ON GROUND HW/SW EVOLUTION.....	12
3.6 DECONTAMINATION.....	12
3.7 INSTRUMENT.....	12
3.7.1 External events.....	12
3.7.2 Operation leading to mission outage.....	13
3.7.3 Anomaly leading to mission outage.....	13
<b>4 PERFORMANCE MONITORING.....</b>	<b>14</b>
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.....	18
4.3.3 Second level flags and quality indicators.....	27
4.3.4 Conclusion.....	27
4.4 LEVEL 1 DATA QUALITY (L1).....	27
4.4.1 Overall quality.....	27
4.4.2 Main flag and quality indicator parameters.....	28
4.4.3 Conclusion.....	31
4.5 SOUNDER RADIOMETRIC PERFORMANCES.....	32
4.5.1 Radiometric Noise.....	32
4.5.2 Radiometric Calibration.....	33
4.5.3 Delay of Detection Chains.....	37
4.5.4 Optical Transmission.....	38
4.5.5 Interferometric Contrast.....	40
4.5.6 Interferogram Baseline.....	41
4.5.7 Detection Chain.....	42
4.5.8 Conclusion.....	42
4.6 SOUNDER SPECTRAL PERFORMANCES.....	43
4.6.1 Monitoring of the ISRF inputs.....	43
4.6.2 Spectral calibration assessment.....	45
4.6.3 Conclusion.....	45
4.7 GEOMETRIC PERFORMANCES.....	46
4.7.1 Sounder / IIS co-registration monitoring.....	46
4.7.2 IIS / AVHRR co-registration.....	46
4.7.3 Conclusion.....	47

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 5 Of: 54
--	--	--

4.8 IASI-B INTER-CALIBRATION WITH IASI-A, CRIS AND AIRS.....	48
4.8.1 IASI-B inter-calibration with IASI-A.....	48
4.8.2 IASI-B inter-calibration with CrIS.....	51
4.8.3 IASI-B inter-calibration with AIRS.....	51
4.9 IIS RADIOMETRIC PERFORMANCES.....	53
4.9.1 IIS Radiometric Noise Monitoring.....	53
4.9.2 IIS Radiometric Calibration Monitoring.....	53
<b>5 IASI TEC SOFTWARE AND INTERFACES.....</b>	<b>53</b>
5.1 IASI TEC EVOLUTION.....	53
5.2 SIC EVOLUTION.....	53
5.3 EUMETCAST INTERFACE.....	53
5.4 FTP INTERFACE.....	53
<b>6 CONCLUSION AND OPERATIONS FORESEEN.....</b>	<b>54</b>
6.1 SUMMARY.....	54
6.2 SHORT-TERM EVENTS.....	54
6.3 OPERATIONS FORESEEN.....	54

## Figures and tables

Table 1: External Calibration TEC Requests.....	10
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.....	11
Table 5: IASI L1 auxiliary file previous configuration.....	11
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.....	12
Table 9: Previous IASI L1 PPF.....	12
Table 10: Decontamination TEC Requests.....	12
Table 11: Previous decontamination.....	12
Table 12: Overview of METOP manoeuvres in the reporting period.....	12
Table 13: PL-SOL.....	13
Table 14: Scheduled interruptions.....	13
Table 15: Major anomalies.....	13
Table 16: Minor anomalies.....	13
Table 17: Functional status legend.....	14
Table 18: IASI product components functional status.....	15
Figure 1 : IASI L0 data quality orbit average (per pixel and CCD).....	16
Figure 2 : IASI L0 data quality spatial distribution (per pixel).....	17
Figure 3 : Temporal evolution of spikes anomaly ratio in % for all pixels (orbit average).....	18
Figure 4 : Geographical distribution of spikes occurrences in % for band 3 and all pixels.....	19
Figure 5 : Temporal evolution of NZPD determination anomaly ratio in % for all pixels (orbit average).....	20
Figure 6 : IASI NZPD determination quality flag spatial distribution (per pixel).....	21
Figure 7 : NZPD inter-pixel for all pixels and CCD calculated with respect to pixel 1 (orbit average).....	22
Figure 8 : IASI L0 over/under-flows orbit average of all pixels.....	23
Figure 9 : IASI Overflows and Underflows spatial distribution (per pixel).....	24







	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 6 Of: 54
--	--	--

Figure 10 : Max of NZPD quality index for all pixels and CCD - BB.....	25
Figure 11 : Max of NZPD quality index for all pixels and CCD - CS.....	25
Figure 12 : Number of CSQ.....	26
Figure 13 : IASI L1 data quality orbit average (% of good by PN and SB).....	27
Figure 14 : IASI product overall quality spatial distribution (per pixel).....	28
Figure 15 : GQisQualIndex average (L1 data quality index for IASI sounder).....	29
Figure 16 : GQisQualIndexIIS average (L1 data quality index for IASI Integrated Imager).....	29
Figure 17 : GQisQualIndexSpect average (L1 data index for spectral calibration quality).....	30
Figure 18 : GQisQualIndexRad average (L1 data index for radiometric calibration quality).....	30
Figure 19 : GQisQualIndexLoc average (L1 data index for ground localisation quality).....	31
Figure 20 : MDptPixQual average (L1 quality index for IASI integrated imager, fraction of not dead pixels).....	31
Figure 21 : Instrument noise evolution between start and end of the period.....	32
Figure 22 : Scan mirror reflectivity evolution.....	33
Figure 23 : Radiometric calibration error due to scan mirror reflectivity dependency with viewing angle Maximum effect on SN1 for different scene temperature. Done with the period November 17 / May 19.....	34
Figure 24 : Black Body Temperature.....	35
Figure 25 : Focal Plane Temperature.....	36
Figure 26 : Monitoring of detection chain maximum delays for all bands.....	37
Figure 27 : Ratio of calibration coefficient slopes as a function of wave number and time after the last decontamination.....	38
Figure 28 : Temporal evolution of calibration ratio coefficient slopes since the last decontamination. The curve was fitted with a decreasing exponential function to determine a rough date for the next decontamination (relative gain evolution of 0.8).....	39
Figure 29 : Contrast Monitoring.....	40
Figure 30 : Monitoring of interferogram baseline.....	41
Figure 31 : Monitoring of detection chain margins.....	42
Figure 32 : GFaxAxeY average (Y filtered coordinates of sounder interferometric axis).....	43
Figure 33 : GFaxAxeZ average (Z filtered coordinates of sounder interferometric axis).....	44
Figure 34 : Cube Corner offset variation.....	44
Figure 35 : Optical bench Temperature.....	45
Figure 36 : Column offset (black) guess vs. column offset averaged over all lines (LN) as a function of the scan position (SP=SN), and orbit number (across track IIS/AVHRR offset).....	46
Figure 37 : 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 (along track IIS/AVHRR offset).....	47
Figure 38 : Mean (black curve) and standard deviation (yellow) of the difference in brightness temperature IASI-B – IASI-A.....	48
Figure 39 : Temporal evolution of differences IASI-B – IASI-A in brightness temperature spectrally integrated over the approximate three IASI bands.....	49
Figure 40 : Mean (black curve) and standard deviation (yellow curve) of the difference spectral calibration $\Delta v/v$ between IASI-B and A.....	50
Figure 41 : Temporal evolution of the difference spectral calibration $\Delta v/v$ between IASI-B and A in the spectral window centered around 2200cm-1.....	50
Figure 42 : Mean (black curve) and standard deviation (yellow) of the difference in brightness temperature IASI-B – AIRS.....	51
Figure 43 : Temporal evolution of the differences IASI-B – AIRS in brightness temperature over the approximate three IASI bands, with monthly mean.....	52

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 7 Of: 54
--	--	--



**LIST OF ACRONYMS**

4A/OP	Automatized Atmospheric Absorptions Atlas/ Operational
APO	Other Parameters OPS
AR	Anomaly Report
ASE	Acquisition Start End
AVHRR	Advanced Very High Resolution Radiometer
BB	Black Body
BRD	BoaRD configuration
CCFD	Cube Corner Functional Device
CCD	Cube Corner Direction
CCM	Cube Corner Mechanism
CD	Cube corner Compensation Device
CHART	Component Health Assessment and Reporting Tool
CGS	Core Ground Segment at EUMETSAT
CNES	Centre National d'Etudes Spatiales
CS	Cold Space
DA	Applicable document
DPS	Data Processing Subsystem
ECMWF	European Centre for Medium Range Weather Forecasts
EM	Engineering Model
EPS	EUMETSAT Polar System
EUMETSAT	European organisation for exploitation of METeorological SATellites
FM2 / FM3	Flight Model n°2 or 3
FOV	Field Of View
GRD	GRound configuration
IASI	Infrared Atmospheric Sounding Interferometer
IIS	Integrated Imaging Subsystem
IPSF	Instrument Point Spread Function
ISRF	Instrument Spectral Response Function
LFD	Locking Filtering Device
LN	Line Number
LSB	Least Significant Bit
METOP	METeorological OPERational satellite
MPF	Mission Planning Facility
NedT	Noise equivalent difference Temperature
NDVI	Normalized Difference Vegetation Index
NZPD	Number of Zero Path Difference
ODB	Operational Data Base
OPS	Operational Software
PC	Principal Component
PDD	Position Data Diagnostic

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 8 Of: 54
---	--	--

PDU	Product Dissemination Unit
PL SOL	PayLoad Switch Off-Line
PN	Pixel Number
PTSI	Parameter Table Status Identifier
RMS	Root Mean Square
RD	Reference Document
SAA	South Atlantic Anomaly
SEU	Single Event Upset
TEC	IASI Technical Centre of Expertise (located in CNES, Toulouse)
TIGR	Thermodynamic Initial Guess Retrieval data set
VDS	Verification Data Selection
ZPD	Zero Path Difference



	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 9 Of: 54
--	--	--

## 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-system.

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

- Start Time: 2019/03/01 Orbit: 33462
- End Time: 2019/05/31 Orbit: 34768
- Duration: 3 months

Note that IASI ended the Calibration / Validation (commissioning) phase on April 2013.



## 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
DA.2	IA-DF-0000-4195-CNES	Spécification de l'outil d'inter-étalonnage SIC
DA.3	IA-SP-1000-3650-CNE	Spécification de suivi par la TEC des paramètres fonctionnels de IASI en vol

### 2.2 REFERENCE DOCUMENTS

N°	Reference	Titre
RD.1	EUM/OPS-EPS/REP/14/748544	Metop-B IASI annual in-flight performance report 2013
RD.2	EUM/OPS-EPS/REP/15/796329	Metop-B IASI annual in-flight performance report 2014
RD.3	EUM/OPS-EPS/REP/16/847537	Metop-B IASI annual in-flight performance report 2015
RD.4	EUM/OPS-EPS/REP/17/917879	Metop-B IASI annual in-flight performance report 2016
RD.5	EUM/OPS-EPS/REP/18/993063	Metop-B IASI annual in-flight performance report 2017

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 10 Of: 54
--	--	---

### 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. <sup>(1)</sup>	Description	Activities
23/03/2019 from 5h13 to 9h09 orb. 33777 to 32970	RM-75	Monthly_MPF <sup>(2)</sup> Targets: Earth 15, Blackbody, 2 <sup>nd</sup> Deep Space, Mirror Backside	For routine monitoring (IIS and IASI NeDT, scan mirror reflectivity, ghost,...)
21/04/2019 from 5h14 to 9h10 orb. 34189 to 34191	RM-76		
20/05/2019 from 5h14 to 9h10 orb. 34601 to 34603	RM-77		

**Table 1: External Calibration TEC Requests**

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

<sup>(2)</sup> 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\_IAS\_EXTALIBRA.dts”

#### 3.2 ON BOARD CONFIGURATION

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**

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
<b>14</b> 1.0	IDPS_OBP_xx_M01_20170907000000 Z_20180307000000Z_20170906135920 Z_IAS_DPSPARAMOD.tar	06/09/17	21/09/2017, orbit 25997	R_44	Update of Reduced Spectra

**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.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 11 Of: 54
--	--	---

### 3.3 GROUND CONFIGURATIONS UPDATES FOR LEVEL 1 PROCESSING

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**

Delivery applicable at the beginning of the period:

IDef	IASI L1 auxiliary files	Delivery by TEC	Upload on GS1	Content
45	IASI_BRD_xx_M01_20171004000000Z_XXX XXXXXXXXXXZ_20171003081207Z_IAS1_00 00000014	03/10/17	BRD and GRD activated on 02/11/2017 10:38, orbit 26592	Update of Scan Mirror Reflectivity Coefficients
22	IASI_GRD_xx_M01_20171004000000Z_XXX XXXXXXXXXXZ_20171003081218Z_IAS1_00 00000022			
12	IASI_ODB_xx_M01_20130417100000Z_XXX XXXXXXXXXXZ_20130417082506Z_IAS1_00 00000012	17/04/13	ODB activated on 14/05/13 12:05 orbit 3393	

**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.

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**

Delivery applicable at the beginning of the period:

IDef	Users Data-Base	Delivery by TEC	TEC ref.	Comments
2	IASI_NCM_xx_M01_20130522081244Z_ 20130522081244Z_20130522081245Z_IA ST_SPECTRESPO	22/05/13	CVA_COV_2	Update of NCM
12	IASI_SDB_xx_M01_20130923150000Z_ 20130923150000Z_20130923132439Z_IA ST_IASISPECDB	25/09/13	R_33	User database associated to ODB IDefSDB 12

**Table 7: previous IASI Data Bases**

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 12 Of: 54
--	--	---

### 3.5 ON GROUND HW/SW EVOLUTION

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**

Software version applicable at the beginning of the period:

IASI L1 PPF software version	Delivery by TEC	Date introduced on GS1	Comments
8.0	07/07/2017	13/09/2017 for sensing time 13:52 Orbit 25883	AIX 7.1 and Linux 6.5 upgrade, LMA_SIMU and PGE_SIMU update, processing of big orbits in 32 bits

**Table 9: Previous IASI L1 PPF**

### 3.6 DECONTAMINATION

Decontaminations that have been made or requested within the time period reported here:

Last due date	Date of decontamination	Description

**Table 10: Decontamination TEC Requests**

Previous decontamination:

Last due date	Date of decontamination	Description
End June 2018	27 June to 2 July 2018	Decontamination 200K

**Table 11: Previous decontamination**

### 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 <sup>(*)</sup>	Description	IP flag	OoP mission Outage
08/05/2019	IP	IP manoeuvre #34 (orbit 34435)	Yes	

**Table 12: Overview of METOP manoeuvres in the reporting period**

<sup>(\*)</sup>: IP for In-Plane manoeuvres (IASI stays in NOP) and OoP for Out of plane manoeuvres (IASI is put in Heater 2)

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 13 Of: 54
--	--	---

### 3.7.1.2 PL-SOL

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 presents 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

Tables 15 and 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 <sup>(*)</sup>	IASI mode	Description
08/04/2019 23:53	34015-34017	DPS		DPS Pixel mode Acquisition anomaly → auto-recovery on 09/04 at 01:48

**Table 15: Major anomalies**

<sup>(\*)</sup>: SEU (LAS, CCM or DPS) anomalies or SET anomalies

Day	Orbits	error n°	Severity	Anomaly type	LN	SN	Description
02/04/2019 09:44	33922			CSQ	42724	19	CCD=1 (forward)

**Table 16: Minor anomalies**

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 14 Of: 54
--	--	---

## 4 PERFORMANCE MONITORING

### 4.1 *PERFORMANCE MONITORING*

In order to ensure that the IASI system is permanently running in good conditions, the CNES (IASI TEC) and EUMETSAT (CGS) are monitoring products at various temporal levels : at line, PDUs and DUMP (full orbit).

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.

Colour code used for the status report.

Status Colour	Meaning
GREEN	$\geq 95\%$ of good spectra
YELLOW	$< 95\%$ of good spectra
RED	Production interrupted
BLANK	No Status Reported



***Table 17: Functional status legend***

## 4.2 PERFORMANCE SYNOPSIS

Synthetic view of all the indicators evaluated for L0/L1 data and their current status.

Section	Component	Description	Status	Comments
<a href="#">4.3</a>	L0	<b>Level-0 Data Quality</b> <ul style="list-style-type: none"> <li>Overall quality</li> <li>Main flag and quality indicator parameters</li> <li>Spikes monitoring</li> <li>ZPD monitoring</li> <li>Overflows/Underflows monitoring</li> <li>Reduced Spectra monitoring</li> <li>Second level flag and quality indicators</li> </ul>	GREEN	On-board processing
<a href="#">4.4</a>	L1	<b>Level-1 Data Quality</b> <ul style="list-style-type: none"> <li>Overall quality</li> <li>Main flag and quality indicator parameters</li> </ul>	GREEN	On ground processing
<a href="#">4.5</a>	L1	<b>Sounder radiometric performances</b> <ul style="list-style-type: none"> <li>Radiometric noise</li> <li>Radiometric calibration</li> <li>Acquisition chain delay</li> <li>Optical transmission               <ul style="list-style-type: none"> <li>Ice</li> <li>Prediction of decontamination date</li> </ul> </li> <li>Interferometric contrast</li> <li>Interferogram Baseline</li> <li>Detection chain</li> </ul>	GREEN	
<a href="#">4.6</a>	L1	<b>Sounder spectral performances</b> <ul style="list-style-type: none"> <li>Dimensional stability               <ul style="list-style-type: none"> <li>Position of axis</li> <li>Cube Corner constant offset</li> <li>Cube Corner velocity</li> <li>Optical bench temperature</li> </ul> </li> <li>Spectral calibration</li> </ul>	GREEN	
<a href="#">4.7</a>	L1	<b>Geometric performances</b> <ul style="list-style-type: none"> <li>Sounder/IIS co-registration</li> <li>IIS/AVHRR co registration</li> </ul>	GREEN	
<a href="#">4.8</a>	L1	<b>IASI-B inter-calibration</b> <ul style="list-style-type: none"> <li>IASI-B inter-calibration with IASI-A</li> <li>IASI-B inter-calibration with CrIS</li> <li>IASI-B inter-calibration with AIRS</li> </ul>	GREEN	
<a href="#">4.9</a>	L1	<b>IIS radiometric performances</b>	GREEN	

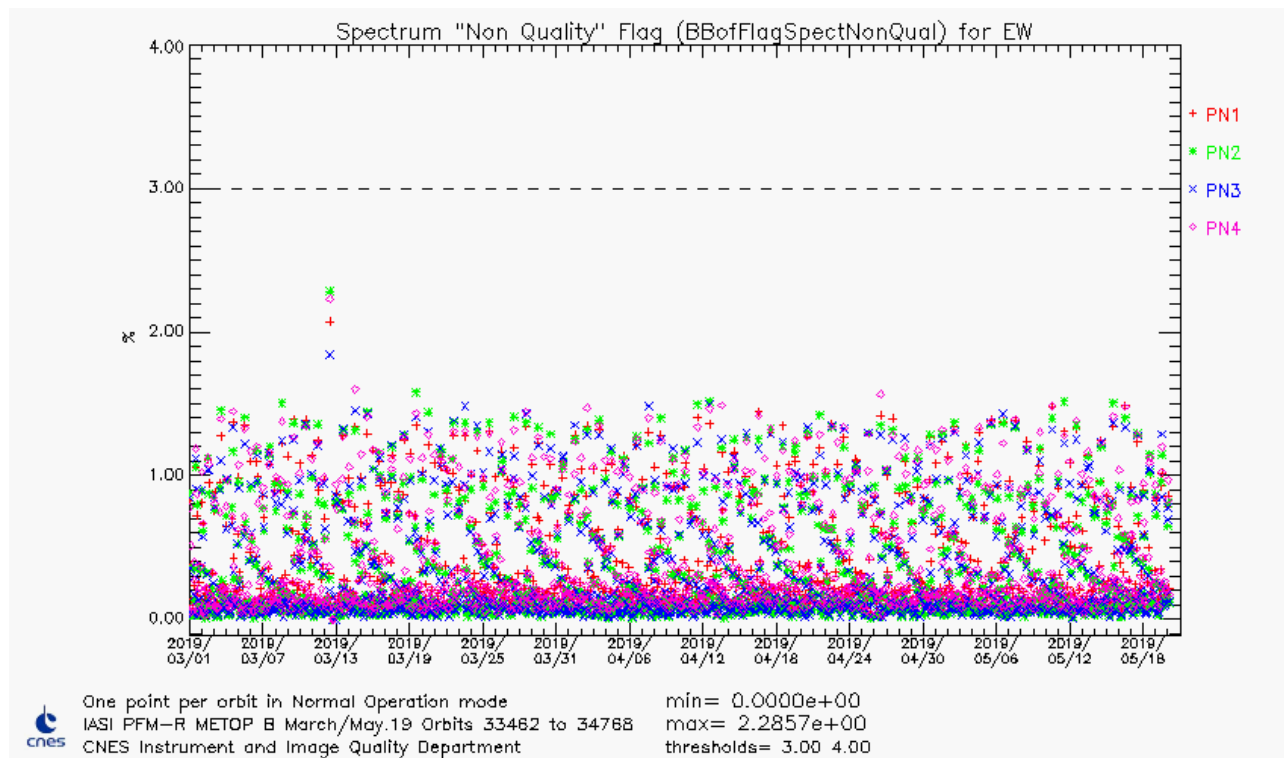
Table 18: IASI product components functional status

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 16 Of: 54
--	--	---

### 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 geographical distribution of the overall L0 (board) quality flag for the 4 pixels is shown in Figure 2.





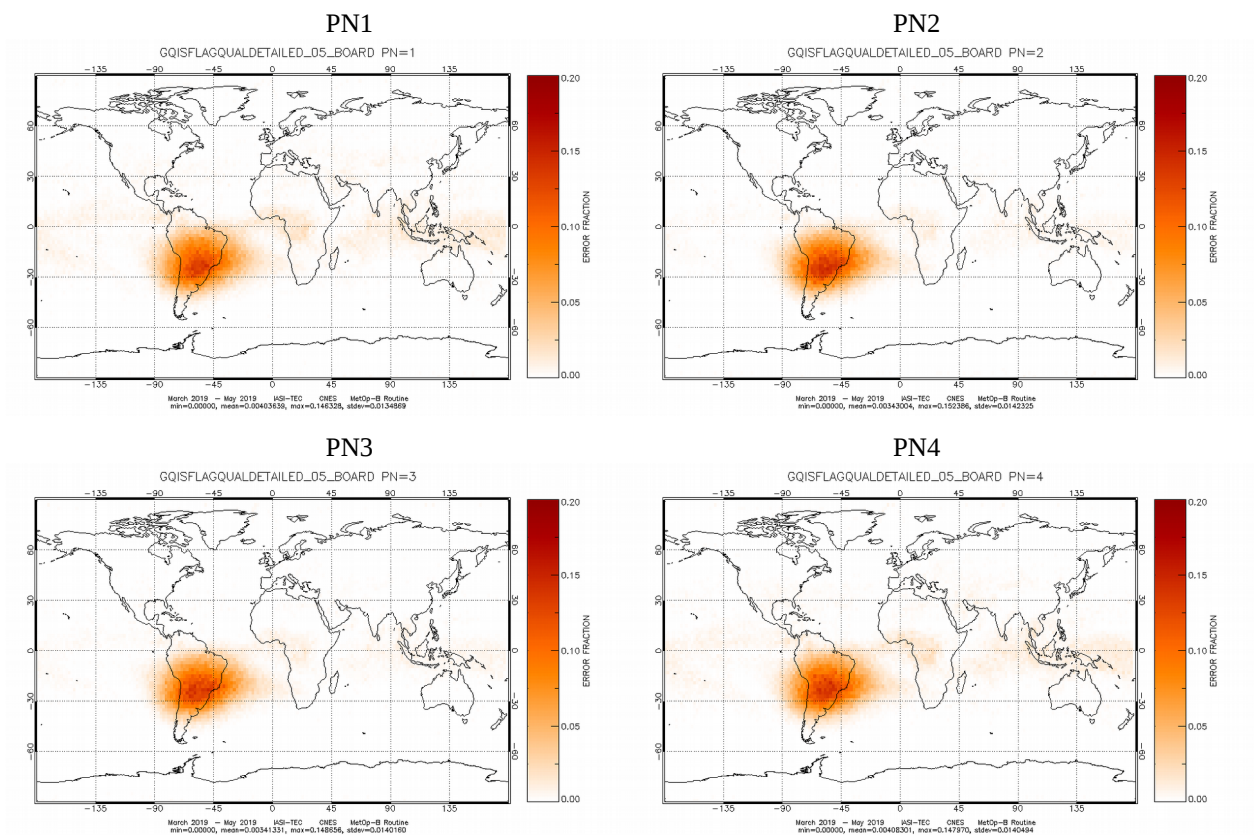
MetOp-B

Doc n°: IA-RP-2000-4479-CNE

Issue: 1.0



Date: 01/06/2019

Sheet: 17 Of: 54



**Figure 2 : IASI L0 data quality spatial distribution (per pixel)**

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

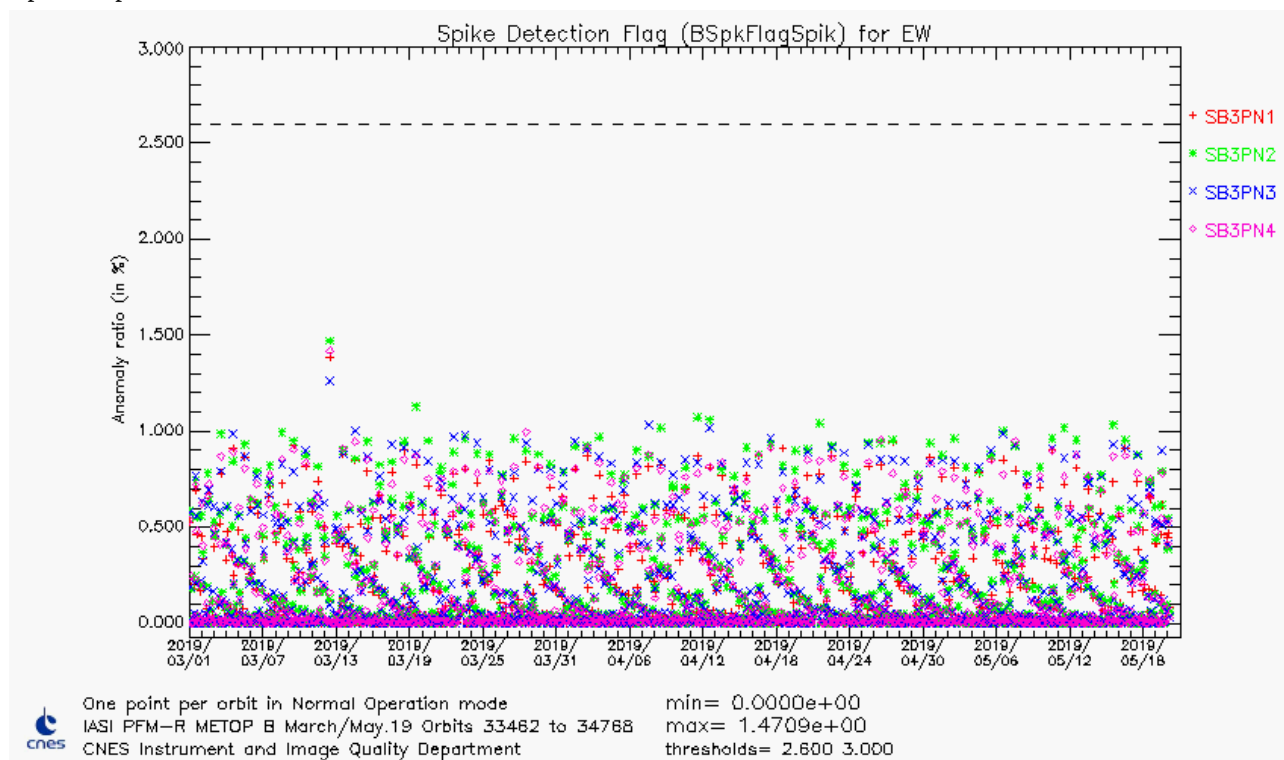
	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 18 Of: 54
--	--	---

### 4.3.2 Main flag and quality indicator parameters

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

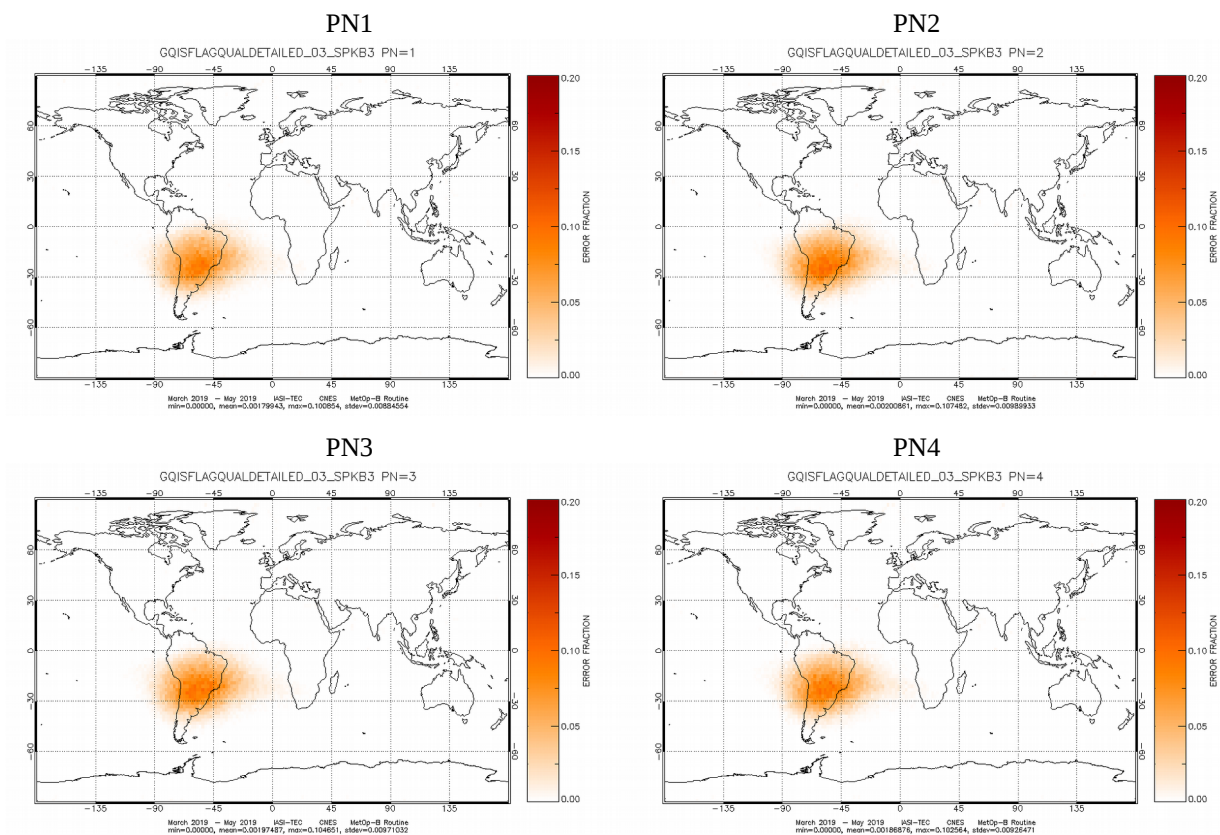
#### 4.3.2.1 Spikes monitoring

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



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



An example of the geographical distribution of spikes occurrences on band 3 for the 4 pixels is shown in Figure 4.



**Figure 4 : Geographical distribution of spikes occurrences in % for band 3 and all pixels**

Spikes are mainly located in the regions of Earth where the magnetic field doesn't protect the satellite from the energetic particles: the poles and the SAA (South Atlantic anomaly).

Spike anomaly ratio is nominal for the reported period.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 20 Of: 54
--	--	---

#### 4.3.2.2 ZPD monitoring

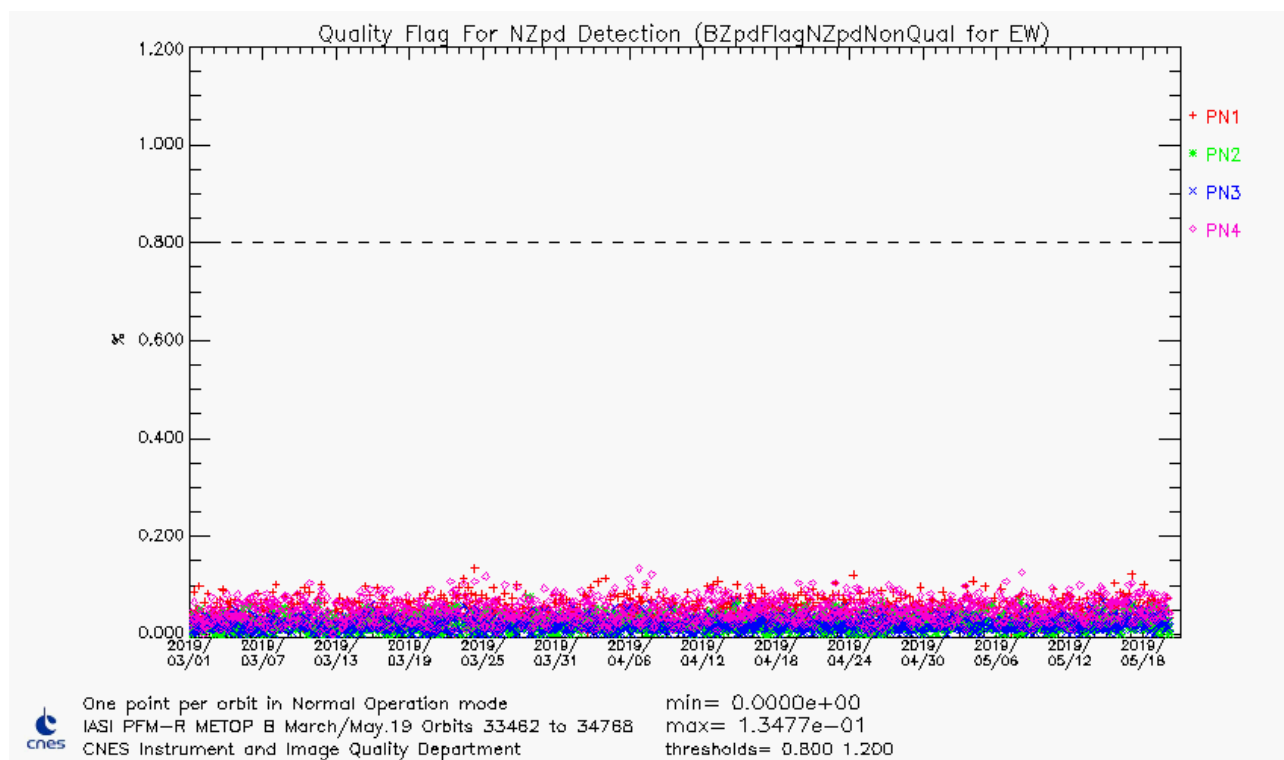
The ZPD (“Zero Path Difference”) is the position of the central fringe of the interferogram. The NZPD is the number of the sample detected as the ZPD. On IASI, it is determined by a software. This is a special feature of IASI in comparison to other instruments for which NZPD determination is done by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

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



**Figure 5 : Temporal evolution of NZPD determination anomaly ratio in % for all pixels (orbit average)**

NZPD determination anomaly ratio is nominal for the reported period.

The geographical distribution of the NZPD determination quality flag for the 4 pixels is shown in Figure 6.



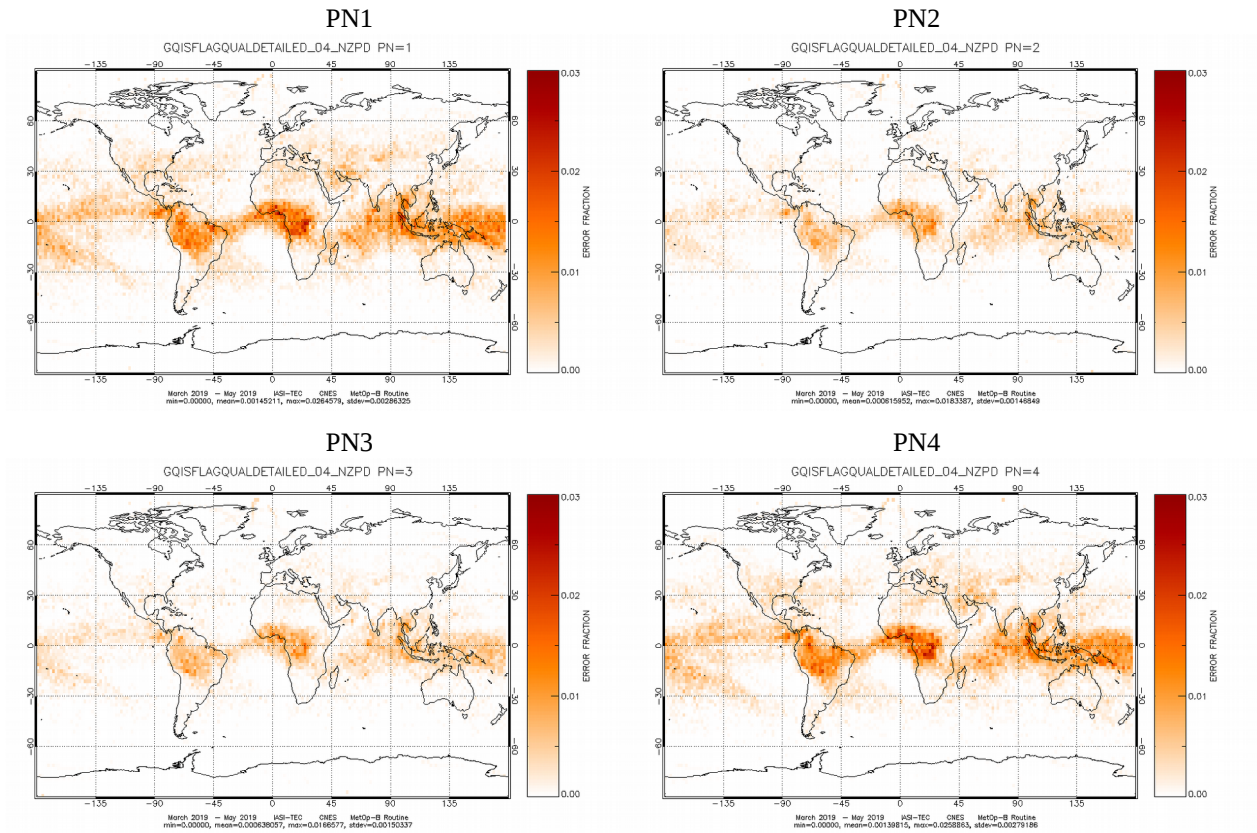
MetOp-B

Doc n°: IA-RP-2000-4479-CNE

Issue: 1.0



Date: 01/06/2019

Sheet: 21 Of: 54



**Figure 6 : IASI NZPD determination quality flag spatial distribution (per pixel)**

The NZPD determination fails over some clouds that have a temperature that induces no energy in the central fringe of the interferogram.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 22 Of: 54
--	--	---

### 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 perfectly stable and in-line with the specification.

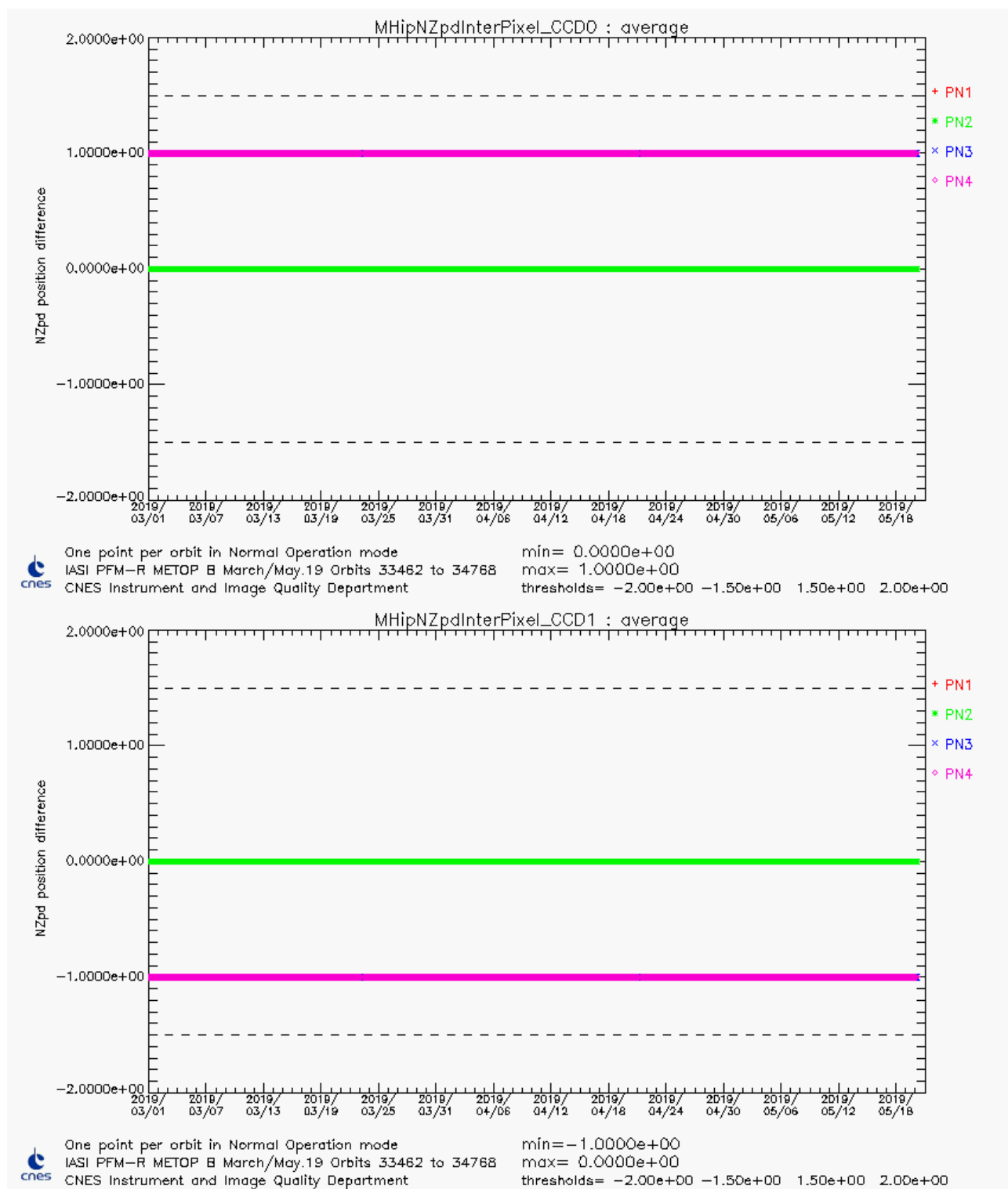




Figure 7 : NZPD inter-pixel for all pixels and CCD calculated with respect to pixel 1 (orbit average)



	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 23 Of: 54
--	--	---

#### 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 designed 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 measurement 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.

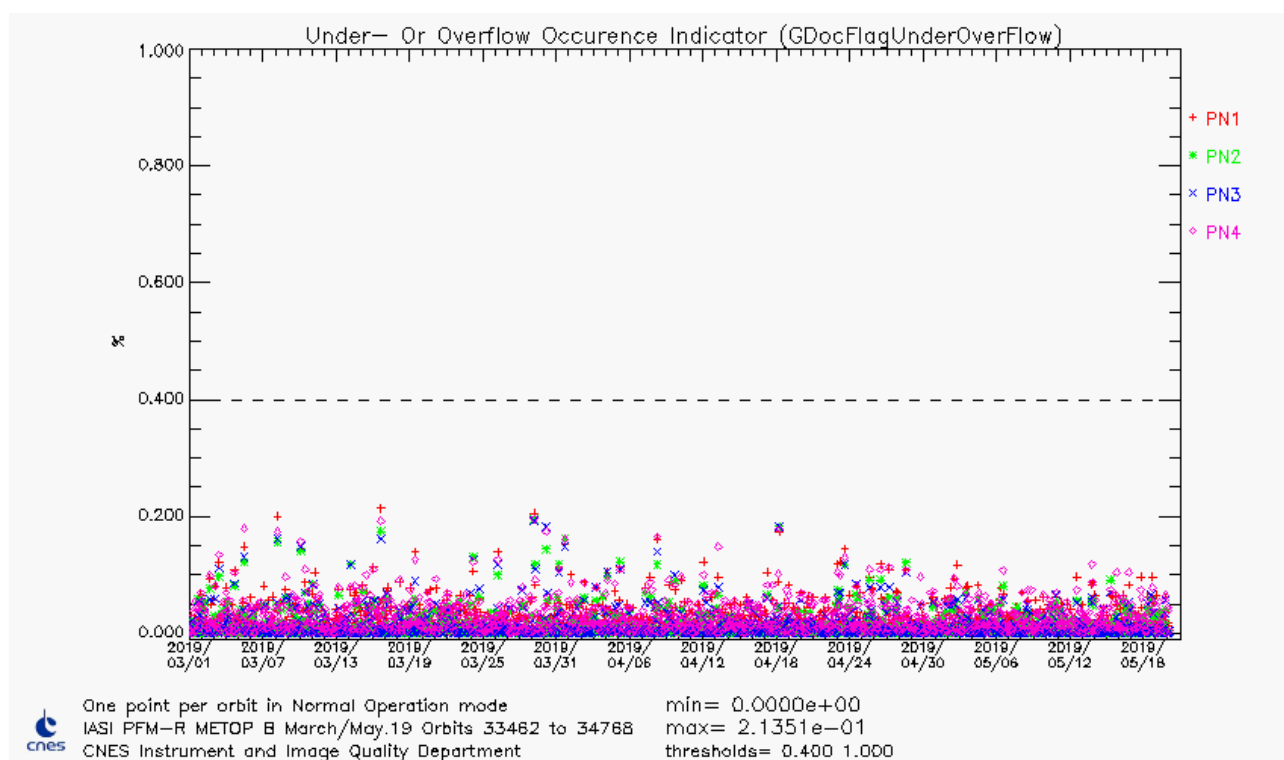




Figure 8 : IASI L0 over/under-flows orbit average of all pixels

Over/underflows ratio is nominal for the reported period.

The geographical distribution of the Overflows and Underflows for the 4 pixels is shown in Figure 9.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 24 Of: 54
--	--	---

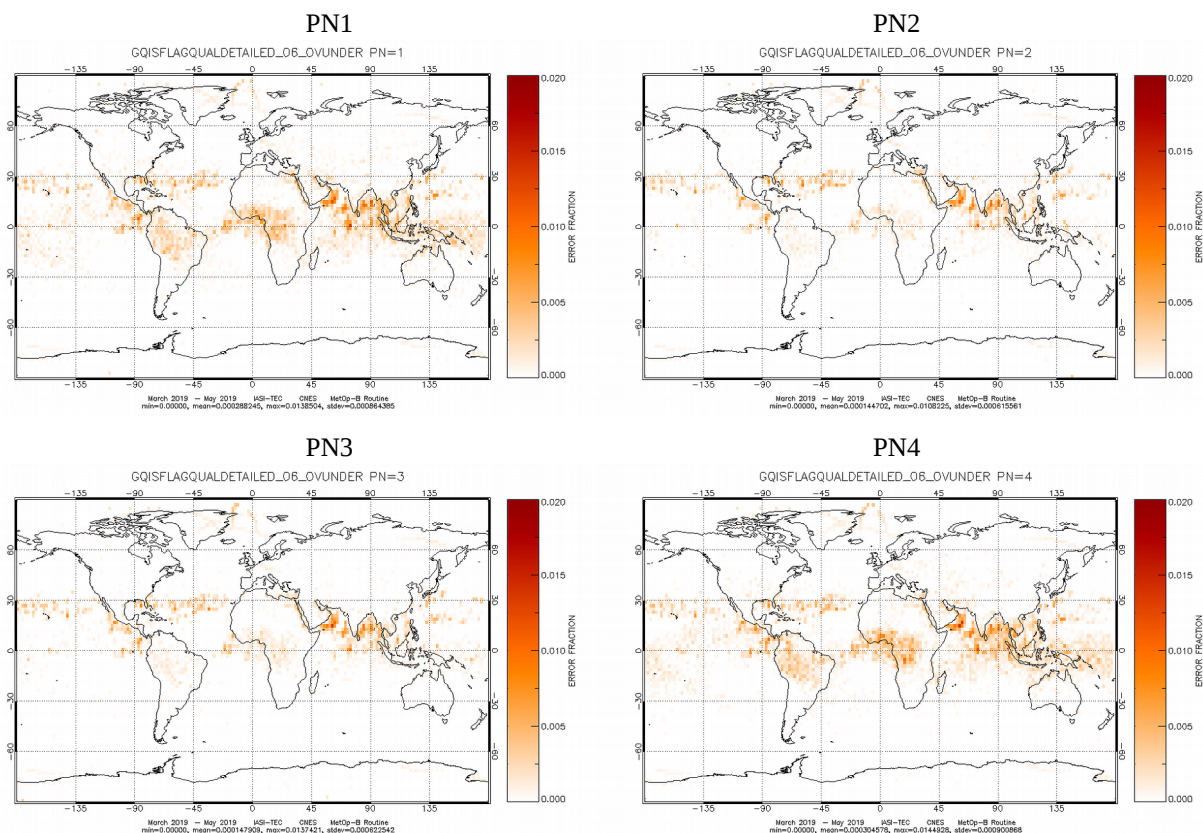


Figure 9 : IASI Overflows and Underflows spatial distribution (per pixel)

#### 4.3.2.4 Reduced Spectra monitoring

On-board Reduced Spectra is one of the most important parameter to monitor. 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 from a large difference between current and on-board configuration reduced spectra, we apply the DPS processing on the verification interferograms using the reduced spectra from the on-board configuration (TOP) instead of the filtered reduced spectra computed on-board with the current calibration views. These reduced spectra from the on-board configuration are used as initialisation each time there is mode change. If they are too far from the reality, no spectra can be computed on-board after a mode change. We monitor the evolution of ZPD determination quality index for calibration views (BZpdNzpdQualIndexBB and CS) obtained by this DPS processing at TEC, results of this monitoring are given hereafter.



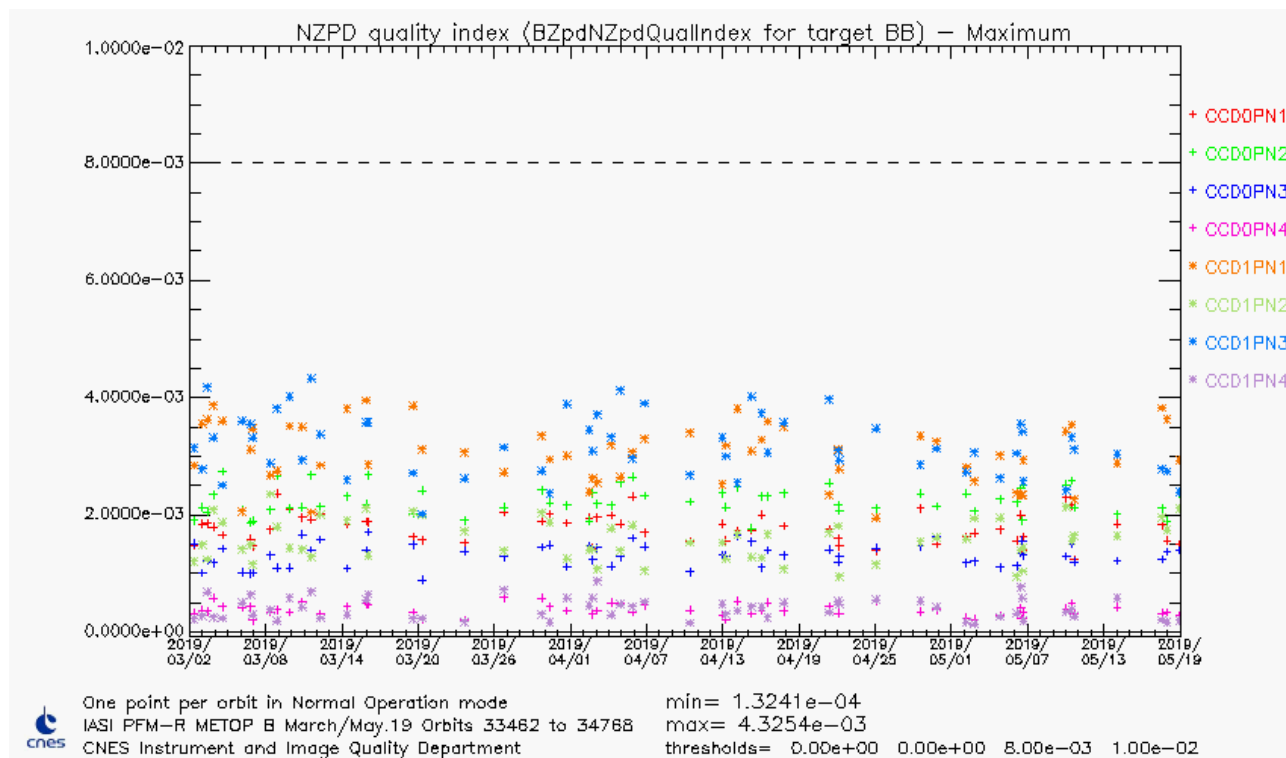


Figure 10 : Max of NZPD quality index for all pixels and CCD - BB

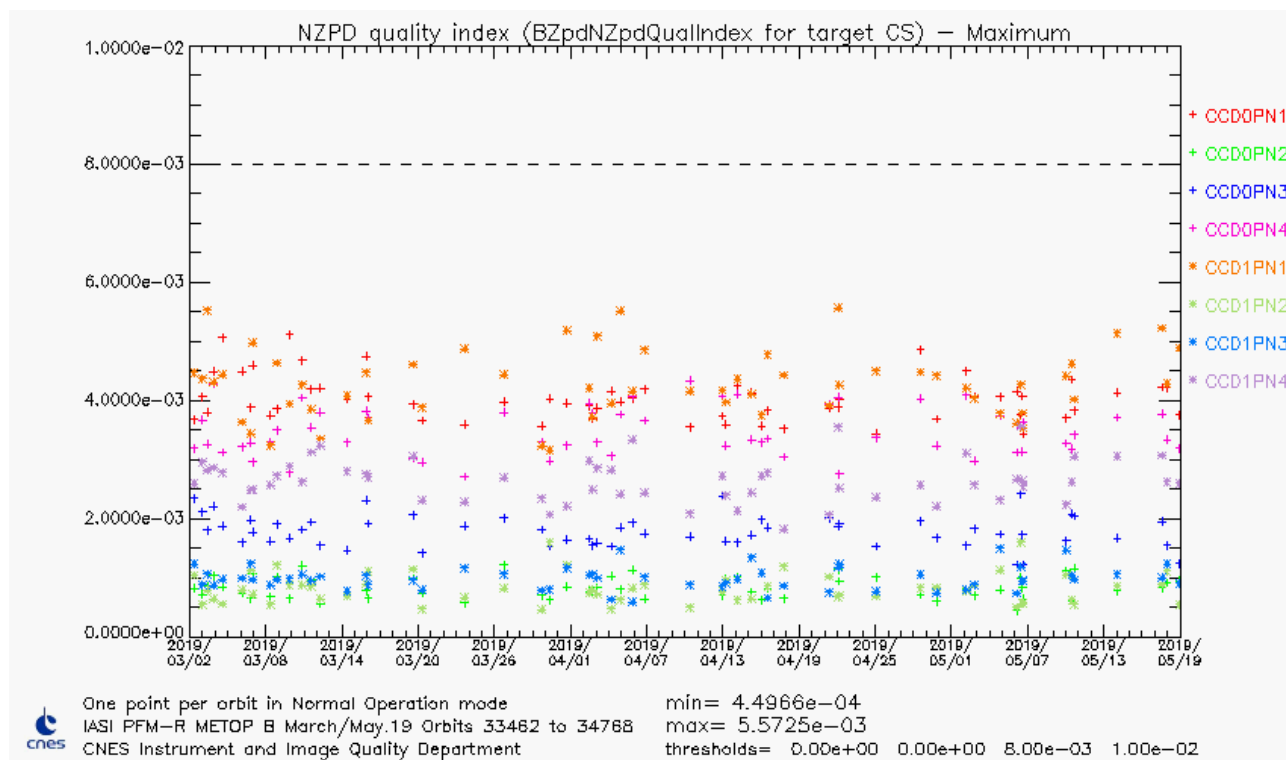




Figure 11 : Max of NZPD quality index for all pixels and CCD - CS

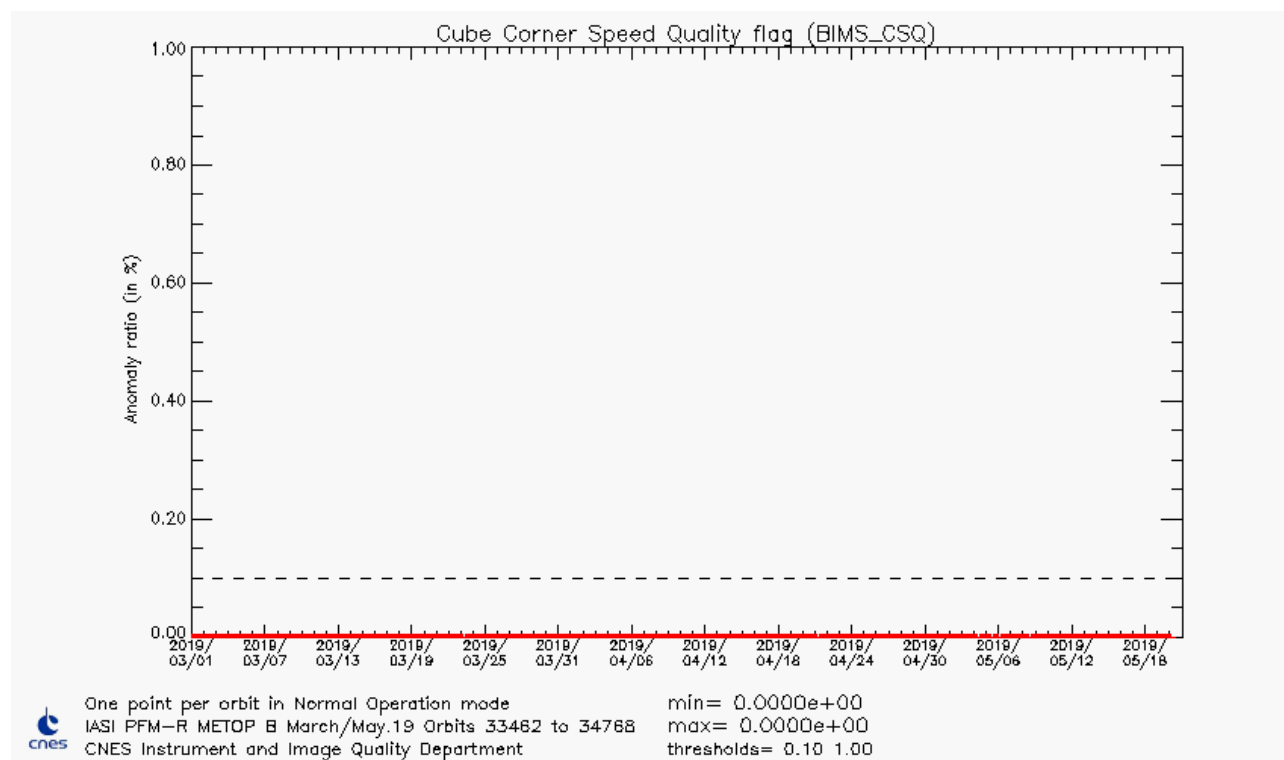
As soon as BZPDNZPDQualIndexBB and CS remain below 0.02 on-board reduced spectra are robust to an instrument mode change.

The reduced spectra quality is well within specification since the last update of the on-board reduced spectra performed in September 2017.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 26 Of: 54
--	--	---

#### 4.3.2.5 Cube corner Speed Quality (CSQ) monitoring

From verification products (BB & CS):



From engineering products (EW):

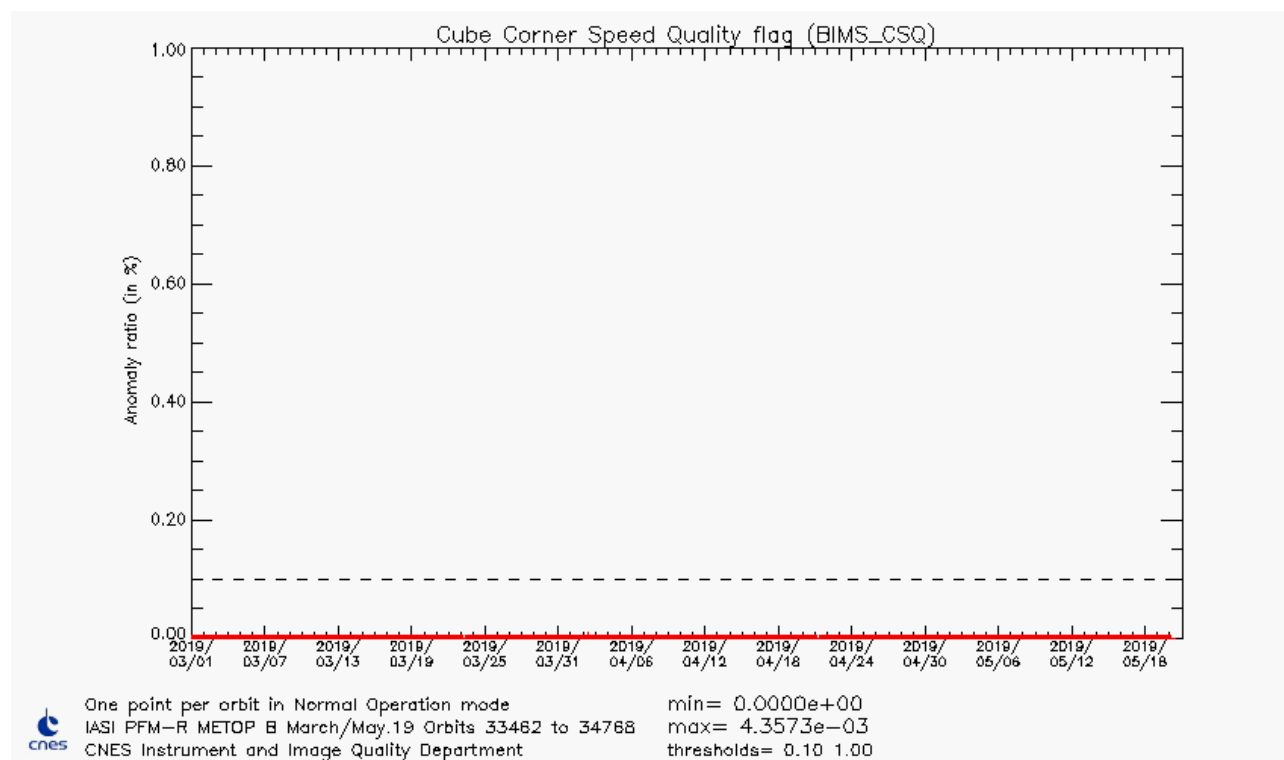




Figure 12 : Number of CSQ

Only 1 CSQ occurred during the period, not visible on the graph due to the very small proportion of data that 1 event represents.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 27 Of: 54
--	--	---

### 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.

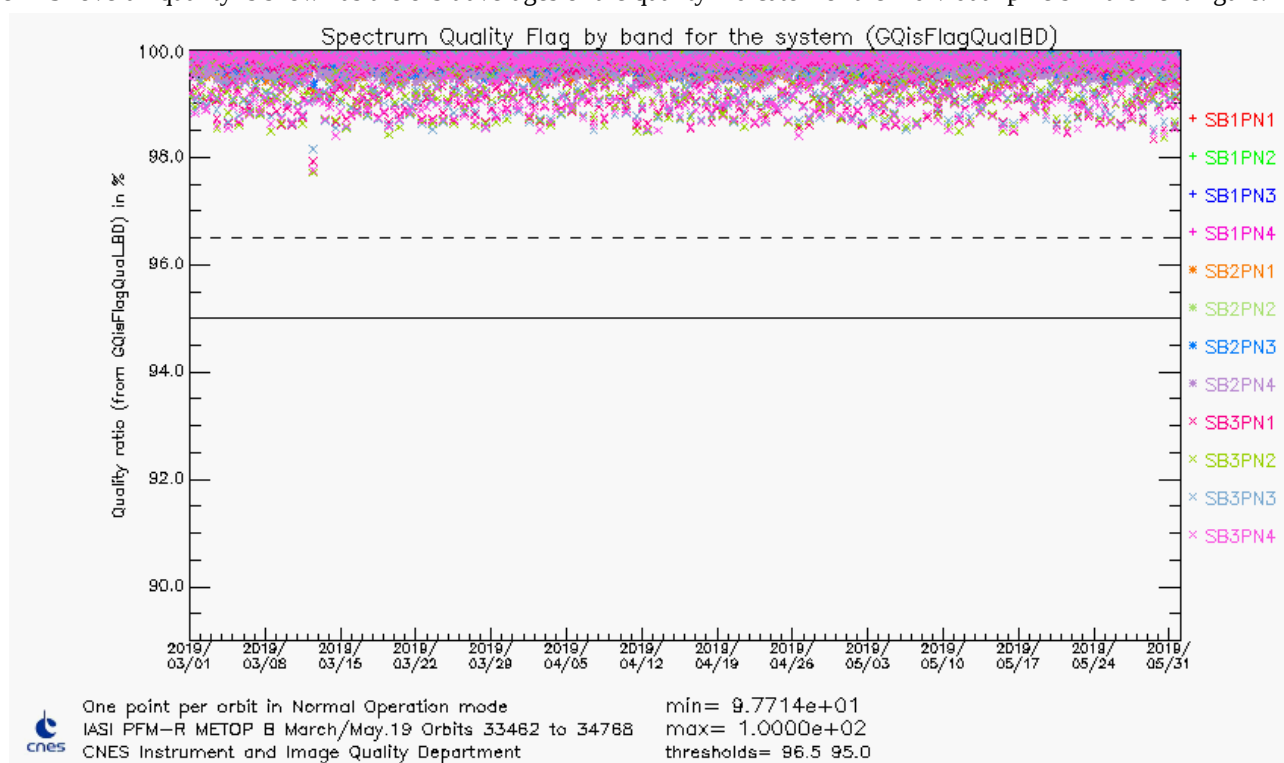


Figure 13 : IASI L1 data quality orbit average (% of good by PN and SB)

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

The geographical distribution of the IASI product overall quality for the 4 pixels is shown in Figure 14.

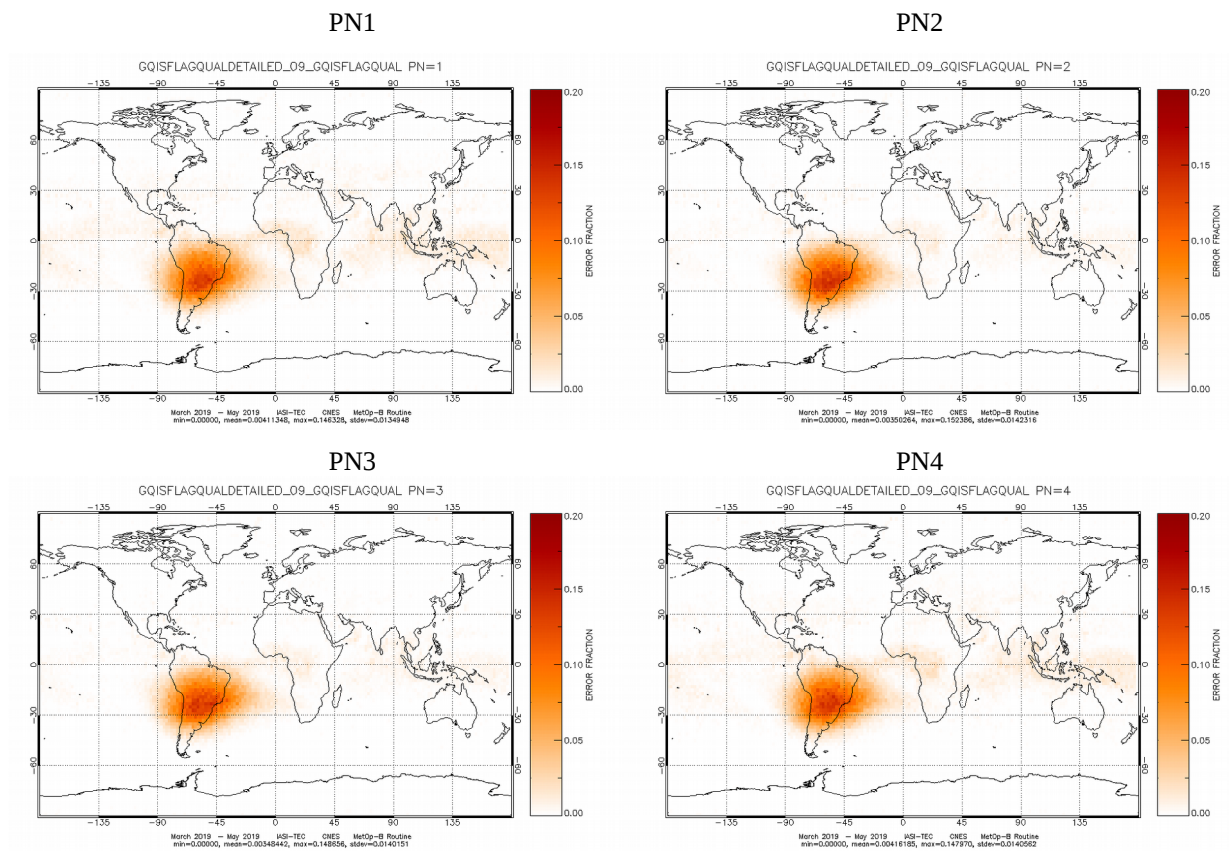


Figure 14 : IASI product overall quality spatial distribution (per pixel)

The main contributors are the spikes (mainly in band 3, which is the band the most sensitive to the spikes).

#### 4.4.2 Main flag and quality indicator parameters

All the quality indexes that follow are general L1 quality indexes of sounder products.

GQisQualIndex – average – is the average general quality index of the sounder products.

GQisQualIndexIIS is the IASI integrated imager (IIS) images quality index.

GQisQualIndexSpect is the spectral quality index of the sounder products.

GQisQualIndexRad is the radiometric quality index of the sounder products.

GqisQualIndexLoc is the ground localisation quality index of the sounder products.

MDptPixQual is a quality index for IASI integrated imager (IIS) that represents a fraction of not dead pixels.

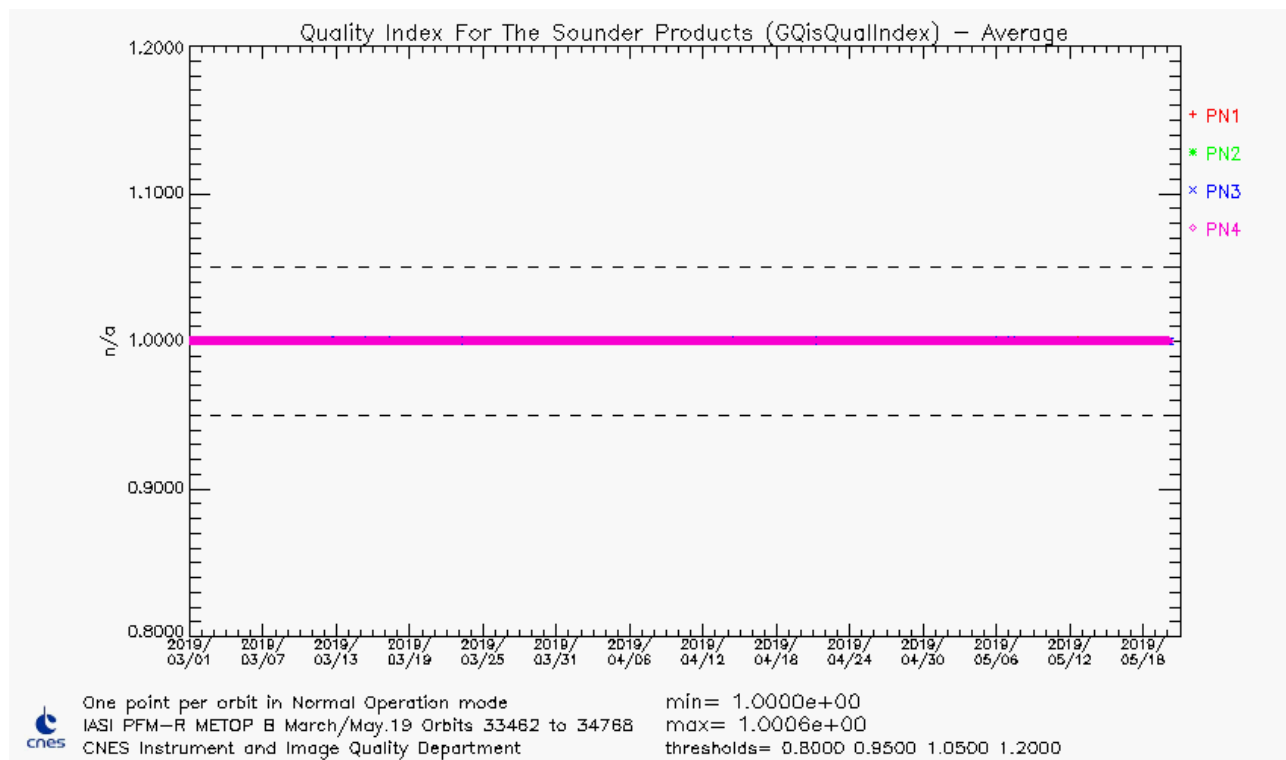


Figure 15 : GQisQualIndex average (L1 data quality index for IASI sounder)

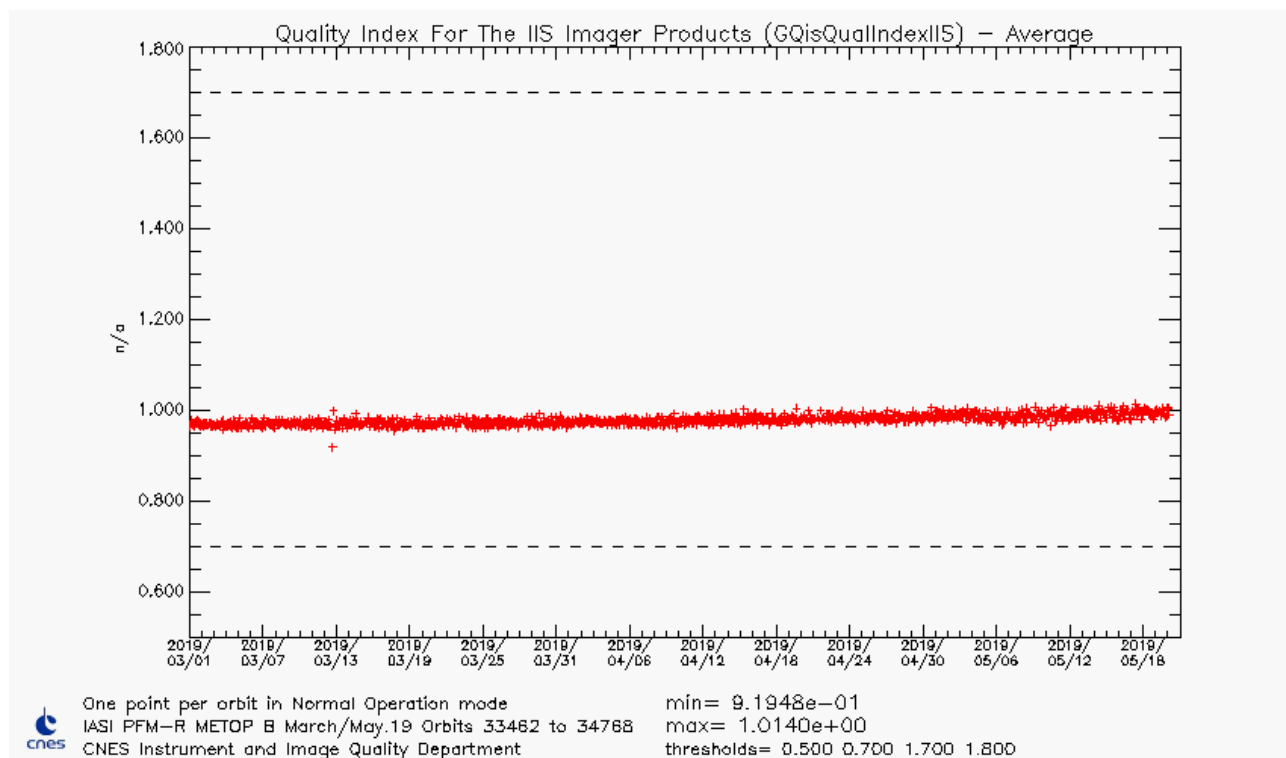




Figure 16 : GQisQualIndexIIS average (L1 data quality index for IASI Integrated Imager)

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 30 Of: 54
--	--	---

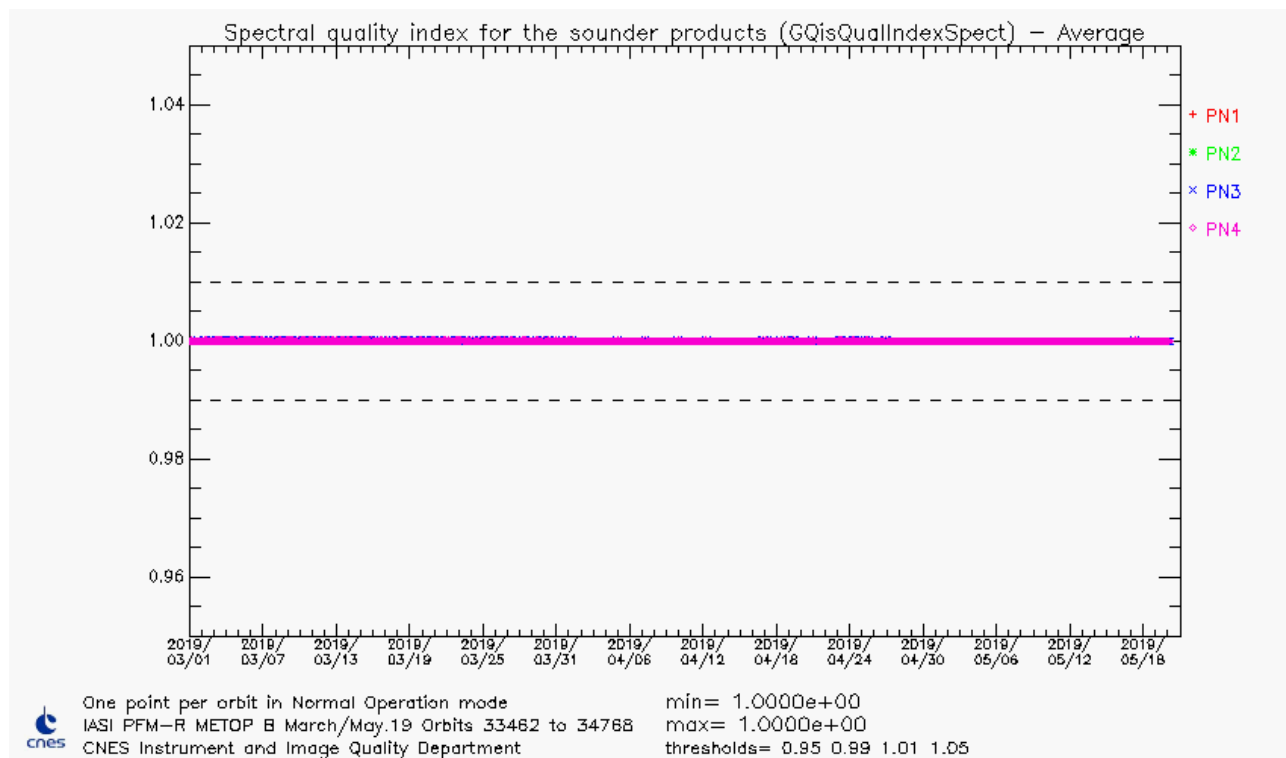


Figure 17 : GQisQualIndexSpect average (L1 data index for spectral calibration quality)

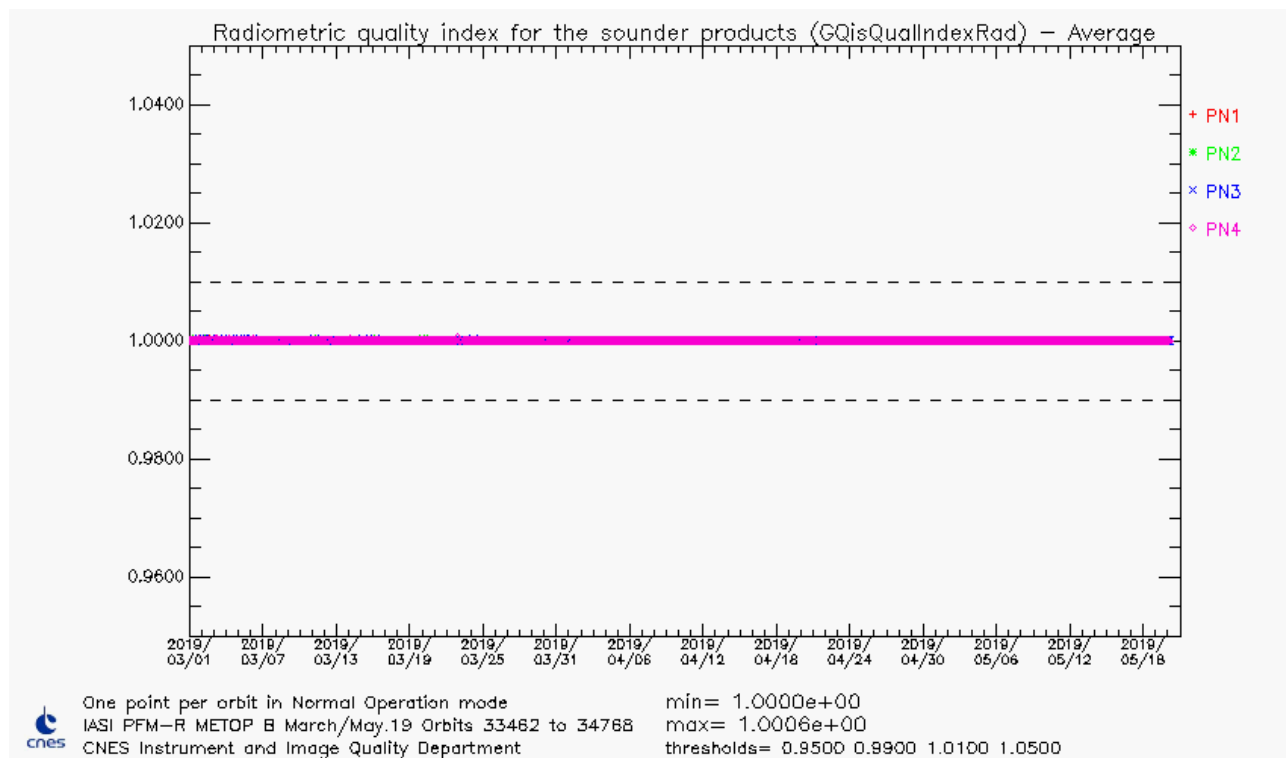


Figure 18 : GQisQualIndexRad average (L1 data index for radiometric calibration quality)

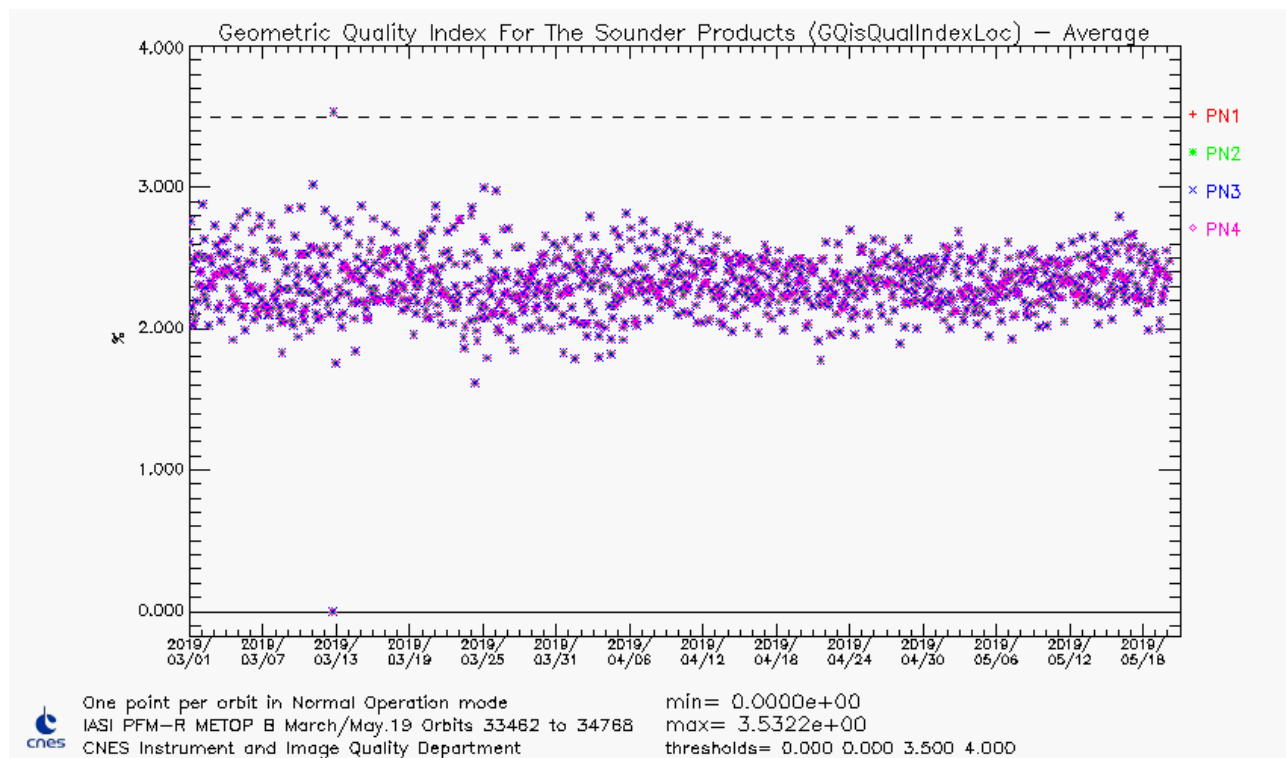


Figure 19 : GQisQualIndexLoc average (L1 data index for ground localisation quality)

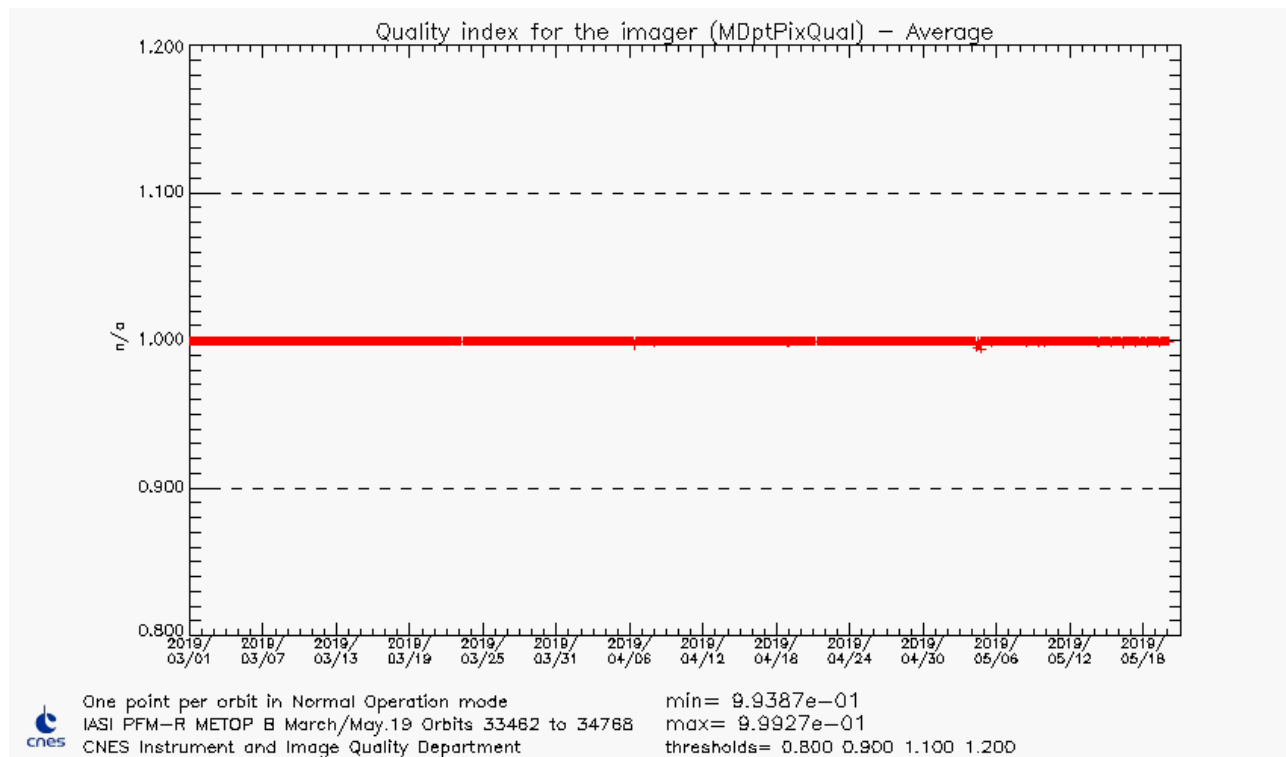


Figure 20 : MDptPixQual average (L1 quality index for IASI integrated imager, fraction of not dead pixels)

#### 4.4.3 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 L0 noise estimation (CE)

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

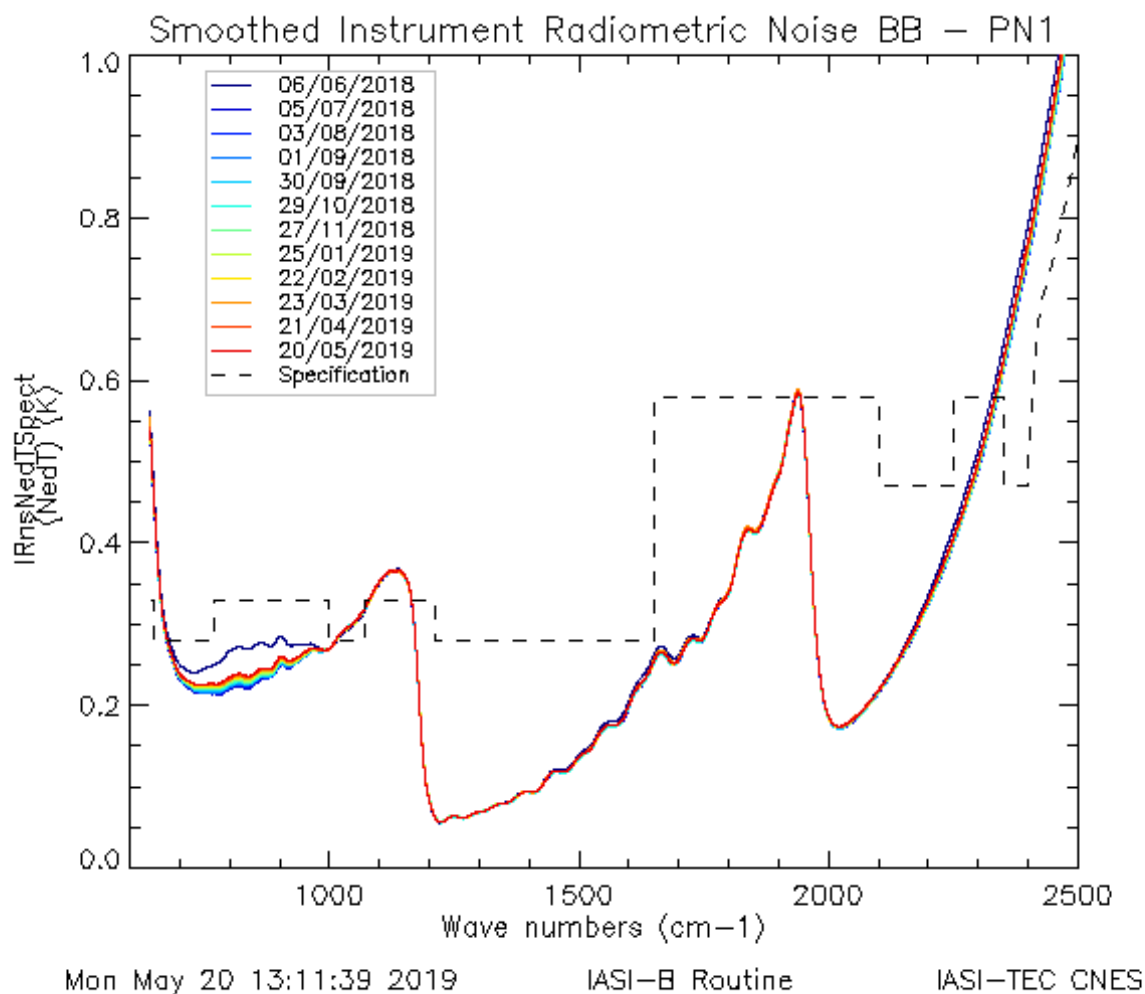


Figure 21 : Instrument noise evolution between start and end of the period

The instrument noise has decreased after the decontamination performed end June 2018 and is very stable apart from ice effect especially between 700 and 1000  $\text{cm}^{-1}$ . This point will be developed in section 4.5.4.1.



## 4.5.2 Radiometric Calibration

The radiometric calibration allows to convert an instrumental measurement into a physical value. 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 on-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

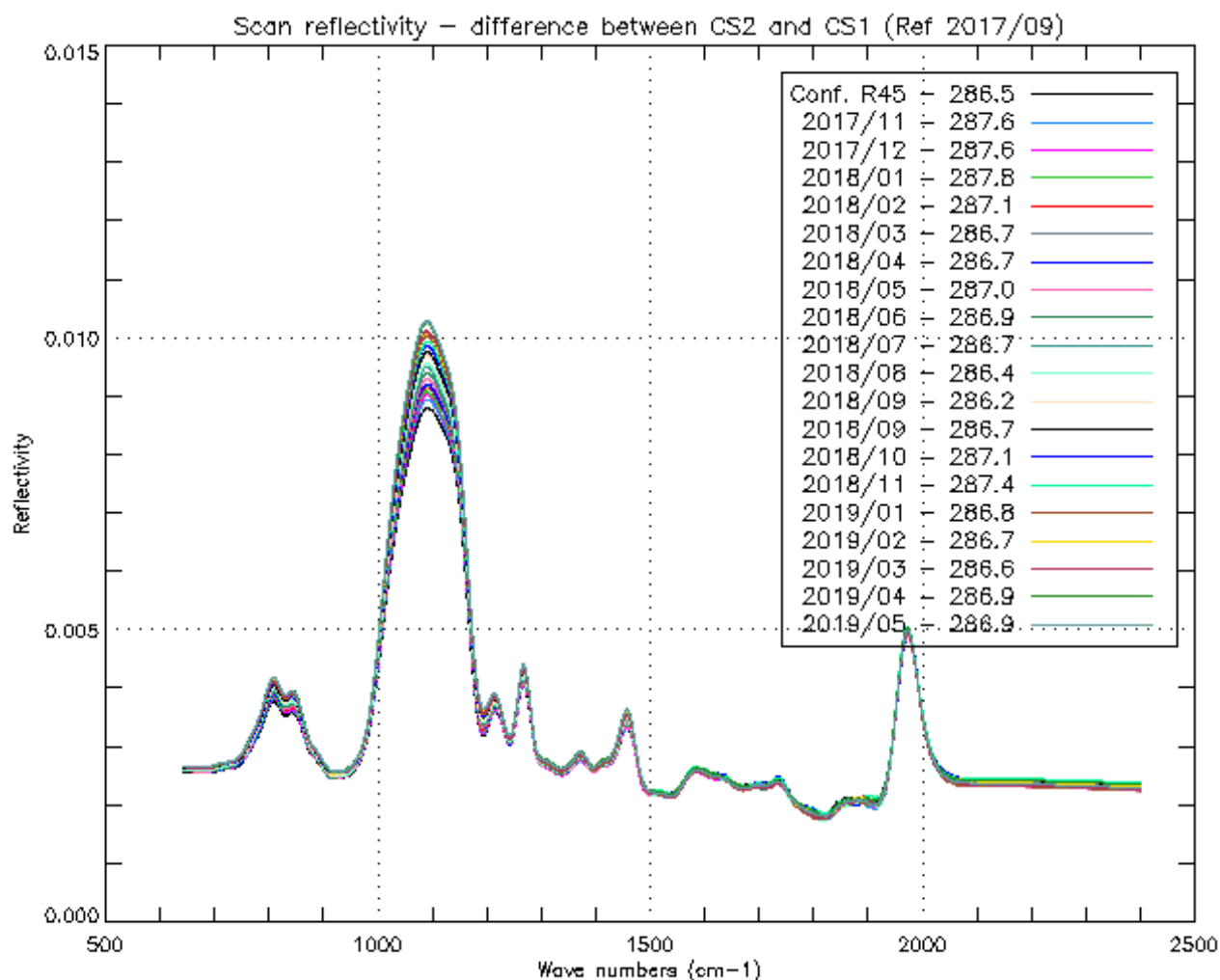
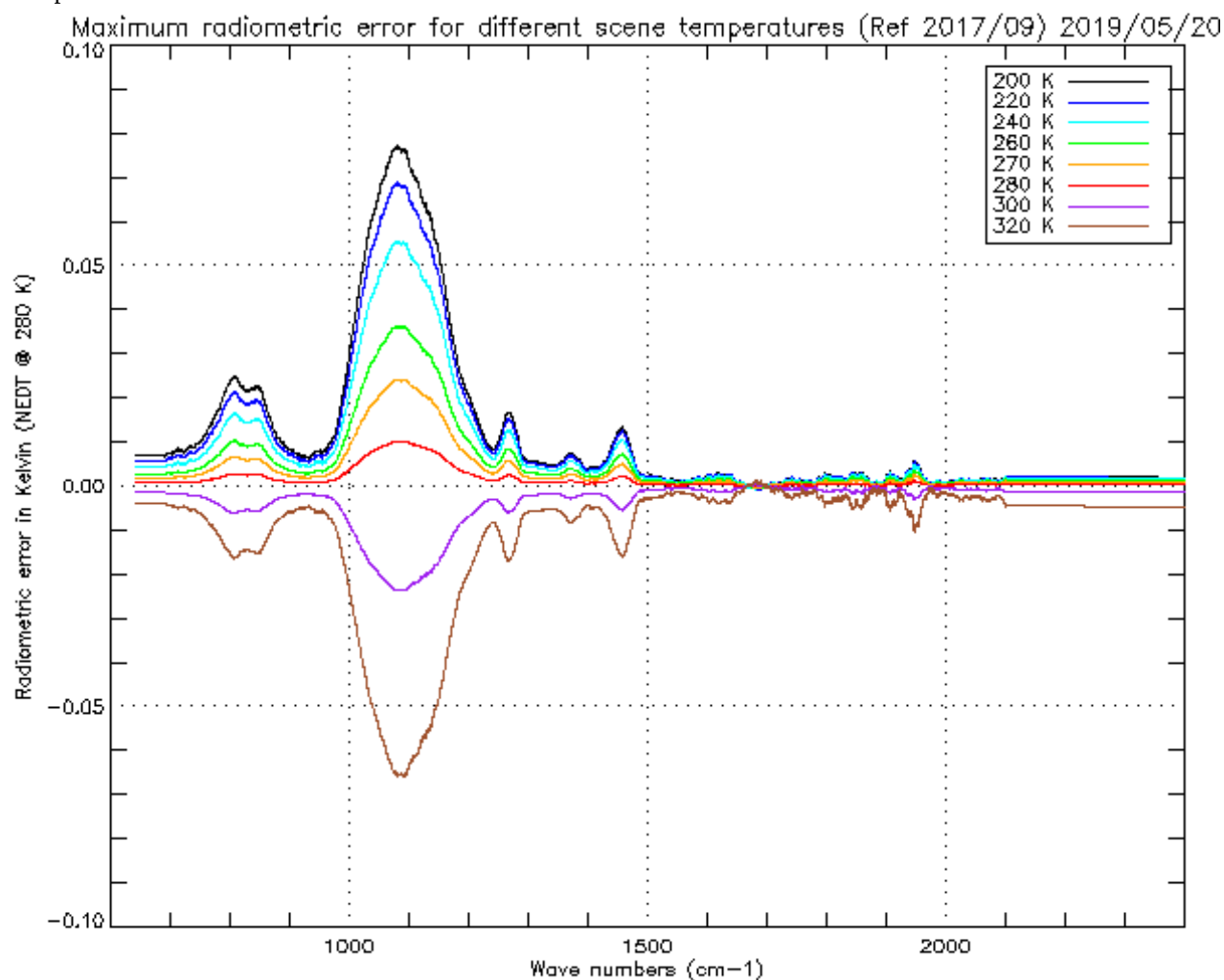


Figure 22 : Scan mirror reflectivity evolution



The reference reflexivity (in black) is the one computed on external calibration data from September 18<sup>th</sup> 2017. We see a slight evolution within [1000-1100 cm<sup>-1</sup>] band. Values for wavenumbers greater than 2400 cm<sup>-1</sup> 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 23 : Radiometric calibration error due to scan mirror reflectivity dependency with viewing angle Maximum effect on SN1 for different scene temperature.  
Done with the period November 17 / May 19*

In any cases radiometric calibration maximum error is lower than the specification (0.1K). The scan mirror reflectivity law (on ground configuration), prepared with September 18<sup>th</sup> routine External Calibration data, has been updated in the operational ground segment on November 2<sup>nd</sup> 2017.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 35 Of: 54
--	--	---

### Internal black body

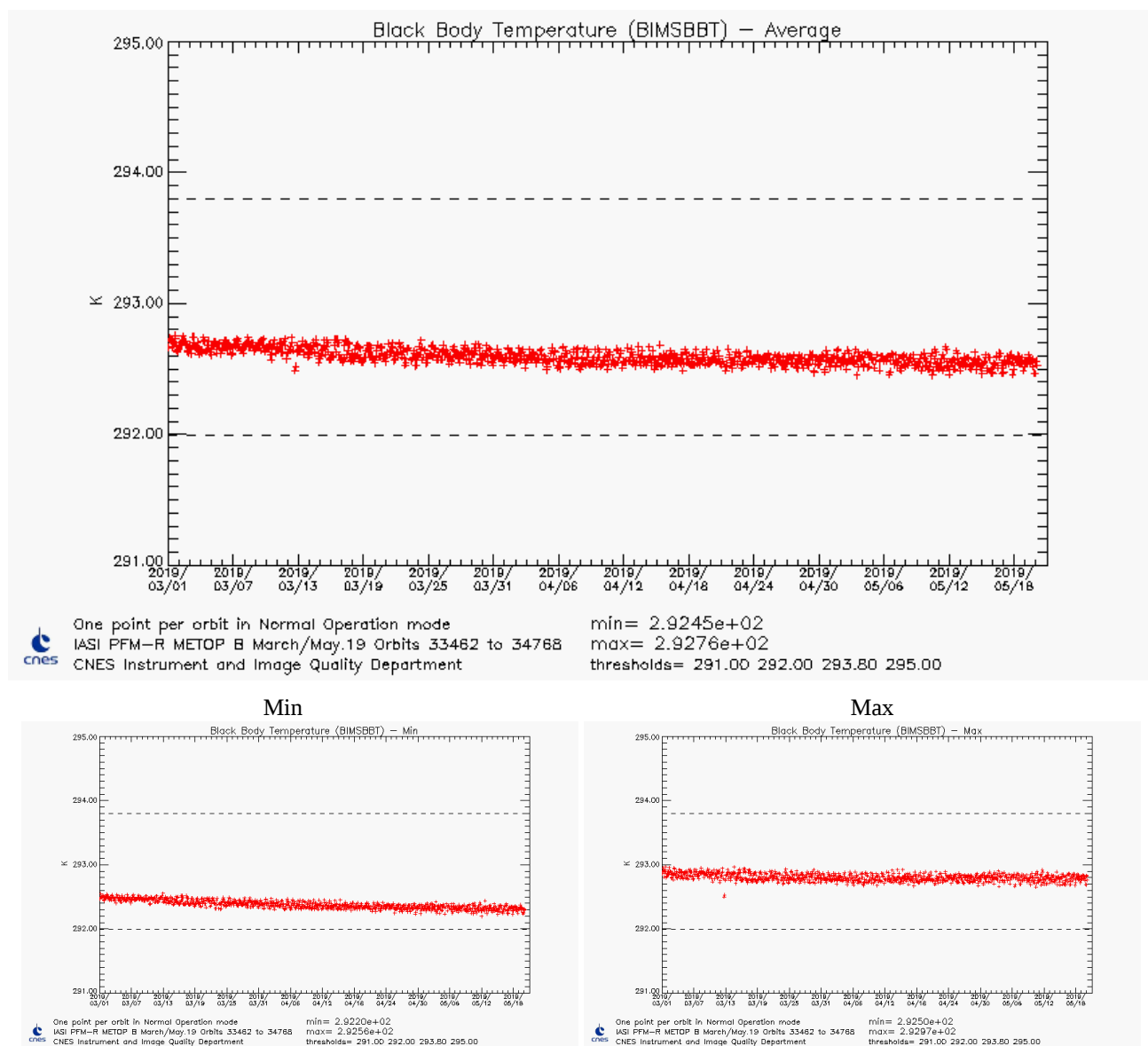




Figure 24 : Black Body Temperature

The black body temperature is stable.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 36 Of: 54
--	--	---

### 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.

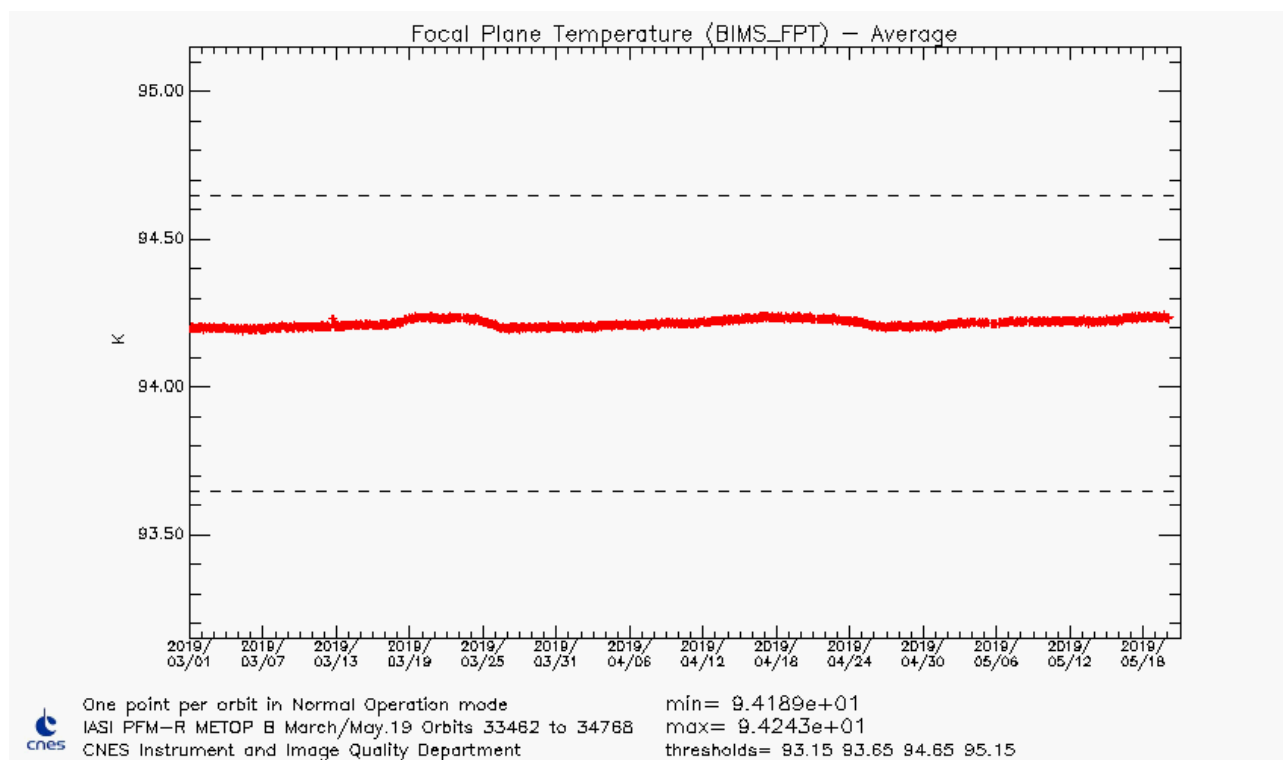


Figure 25 : Focal Plane Temperature

### 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.

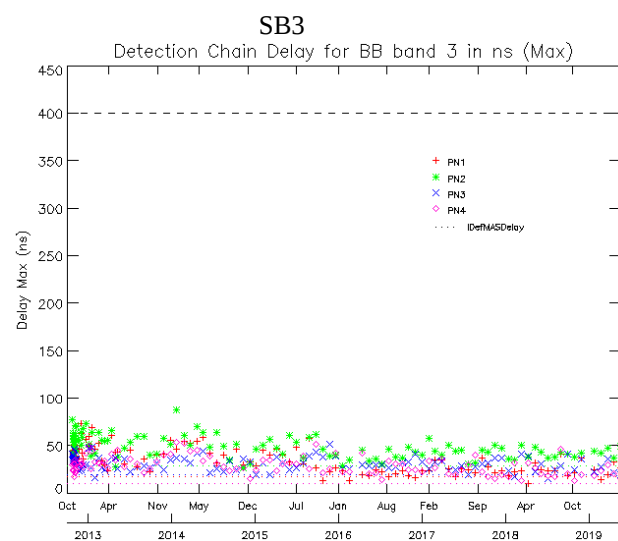
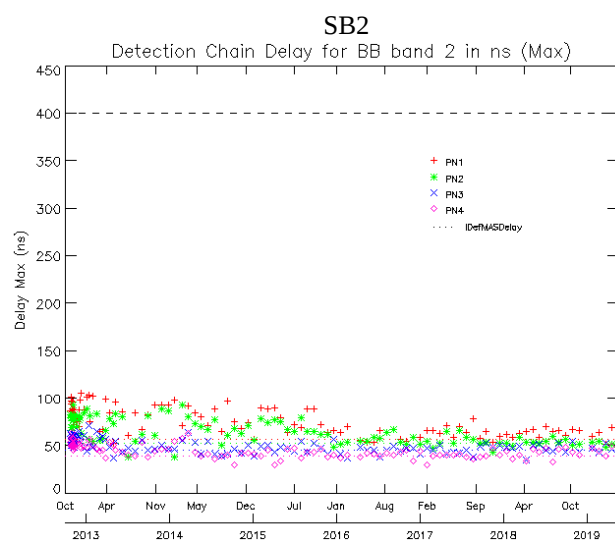
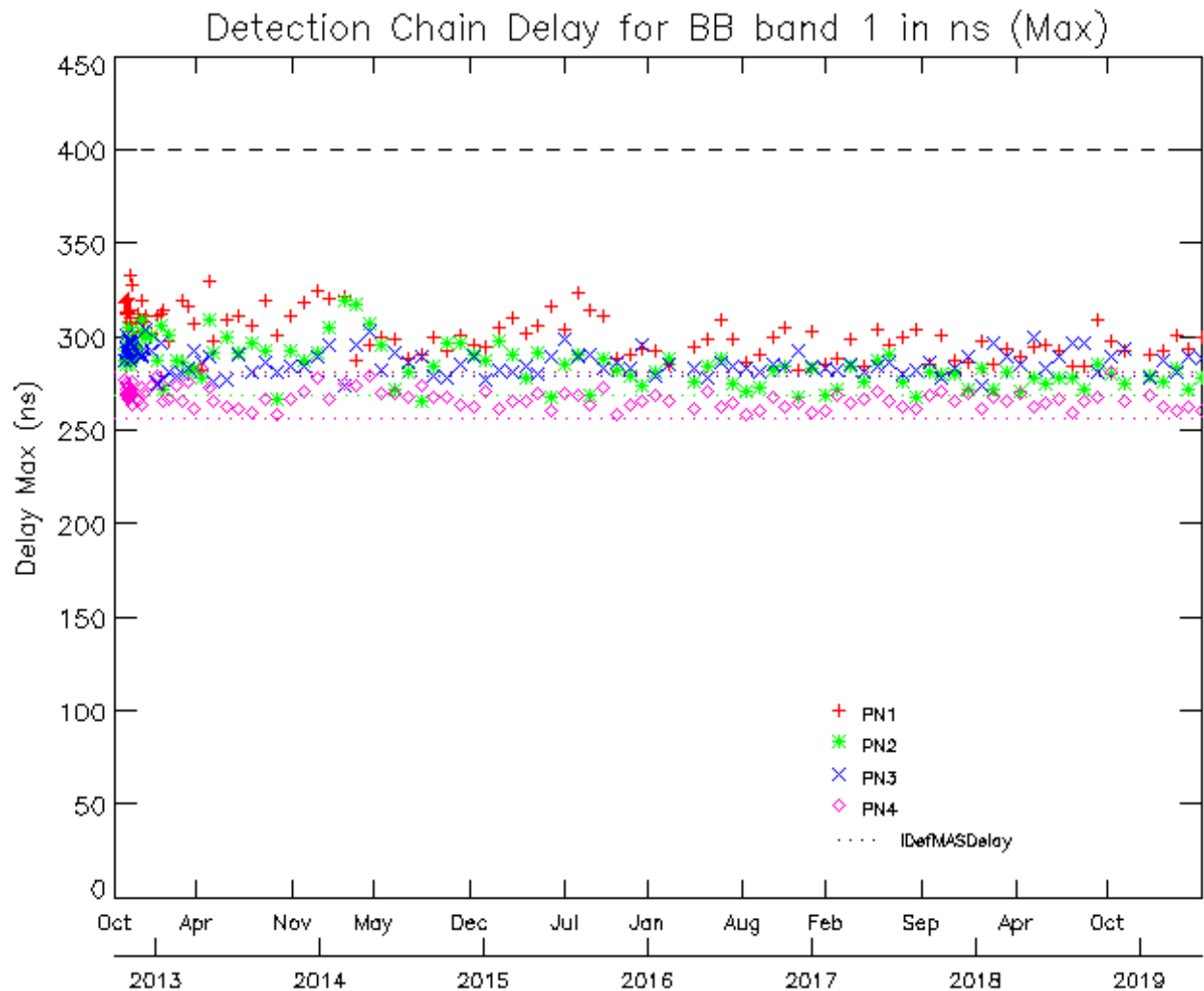




Figure 26 : Monitoring of detection chain maximum delays for all bands

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 38 Of: 54
---	--	---

## 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 outgasing phase consisting in heating the cold box up to 300 K during 20 days (from 22<sup>th</sup> September 2012 until 16<sup>th</sup> October 2012). This operation allows removing most of the initial contaminants coming from IASI and other MetOp instruments. A routine outgasing is then needed from time to time to remove ice contamination, but less and less frequently as the desorption process becomes slower.

The first routine outgassing procedure (shorter duration and at 200K) was done from 10<sup>th</sup> to 14<sup>th</sup> March 2014.

The second one was done from 25<sup>th</sup> to 30<sup>th</sup> November 2015.

The third one was done from 27<sup>th</sup> June to 2<sup>nd</sup> July 2018.

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

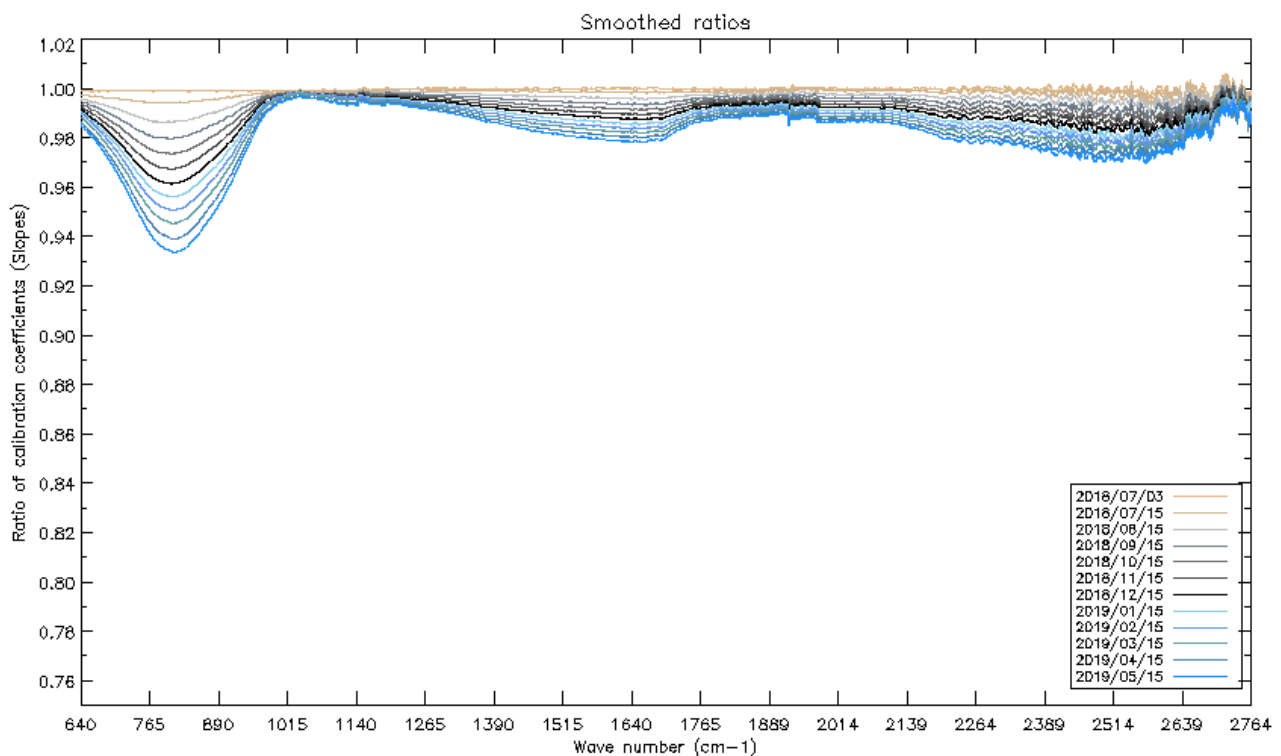




Figure 27 : Ratio of calibration coefficient slopes as a function of wave number and time after the last decontamination

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 39 Of: 54
--	--	---

#### 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.

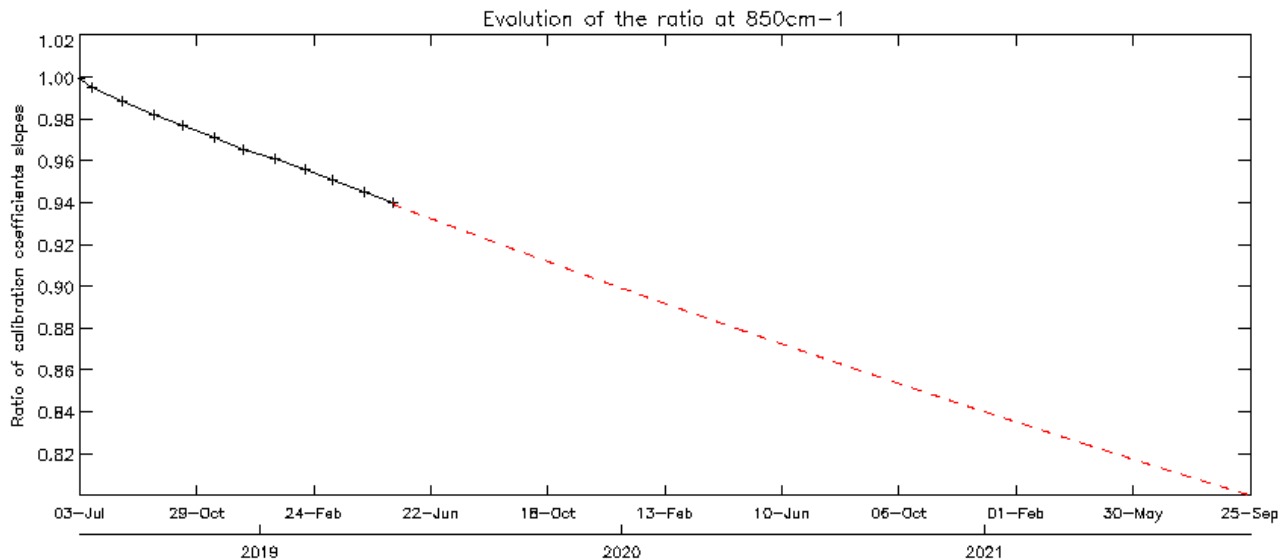




Figure 28 : Temporal evolution of calibration ratio coefficient slopes since the last decontamination. The curve was fitted with a decreasing exponential function to determine a rough date for the next decontamination (relative gain evolution of 0.8)

The loss of instrument gain due to ice contamination is, as expected, decreasing over time.  
The next decontamination is not expected before autumn 2021.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 40 Of: 54
--	--	---

#### 4.5.5 Interferometric Contrast

The interferometric contrast is defined as the interferogram fringe discrimination power. Figure 29 shows temporal evolution of instrument contrast since the beginning of IASI life in orbit for all pixels and all CCD.

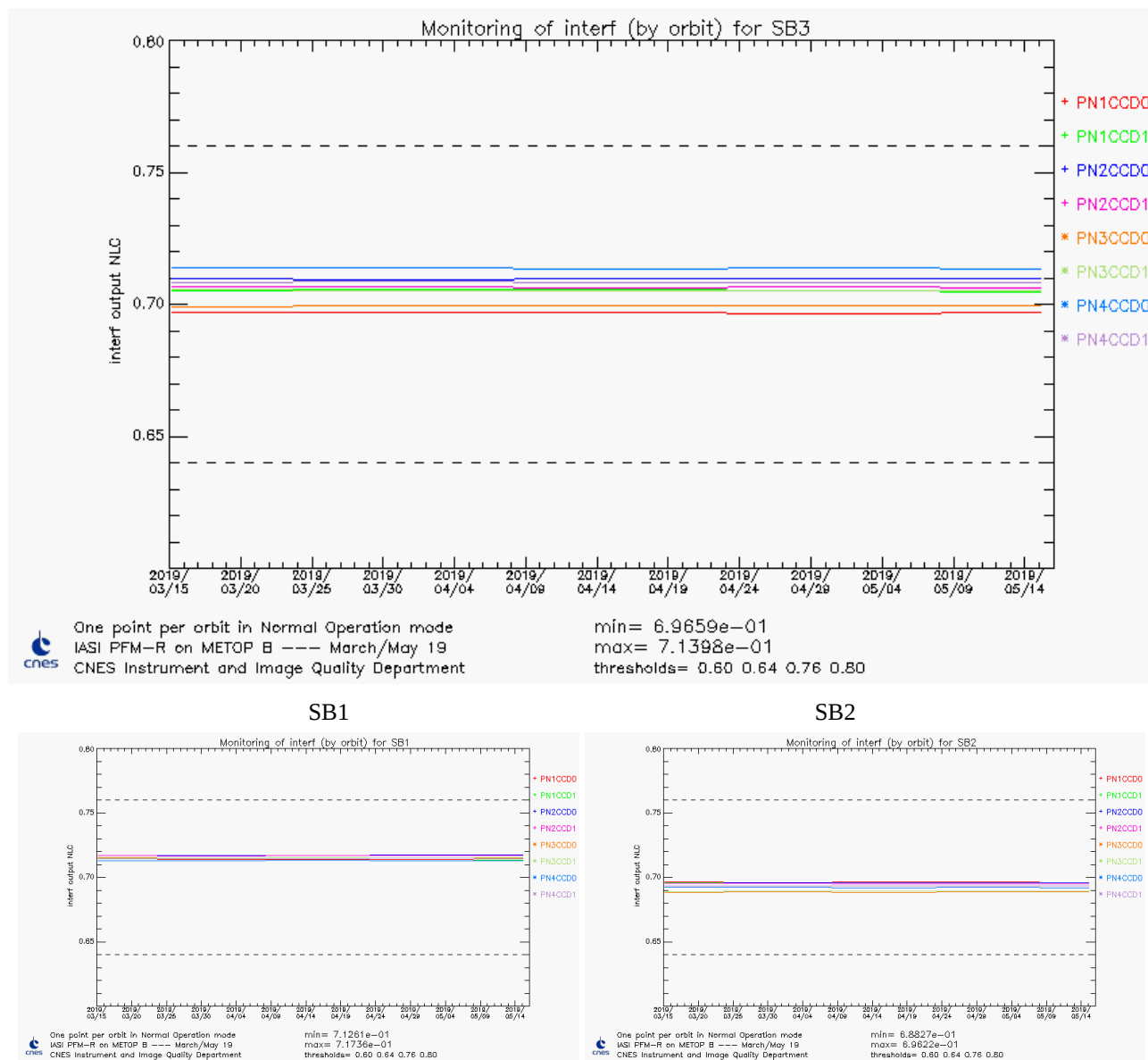


Figure 29 : Contrast Monitoring



#### 4.5.6 Interferogram Baseline

The interferogram baseline is the mean value of the interferogram. Figure 30 shows temporal evolution of the baseline of the raw interferograms on calibration targets (BB and CS). The values are raw values, they are not physical, but the evolution is interesting: as the values are proportional to the energy received from a target and calibration targets are stable, the evolution can show the decrease of instrument transmission or events due to energetic particles.

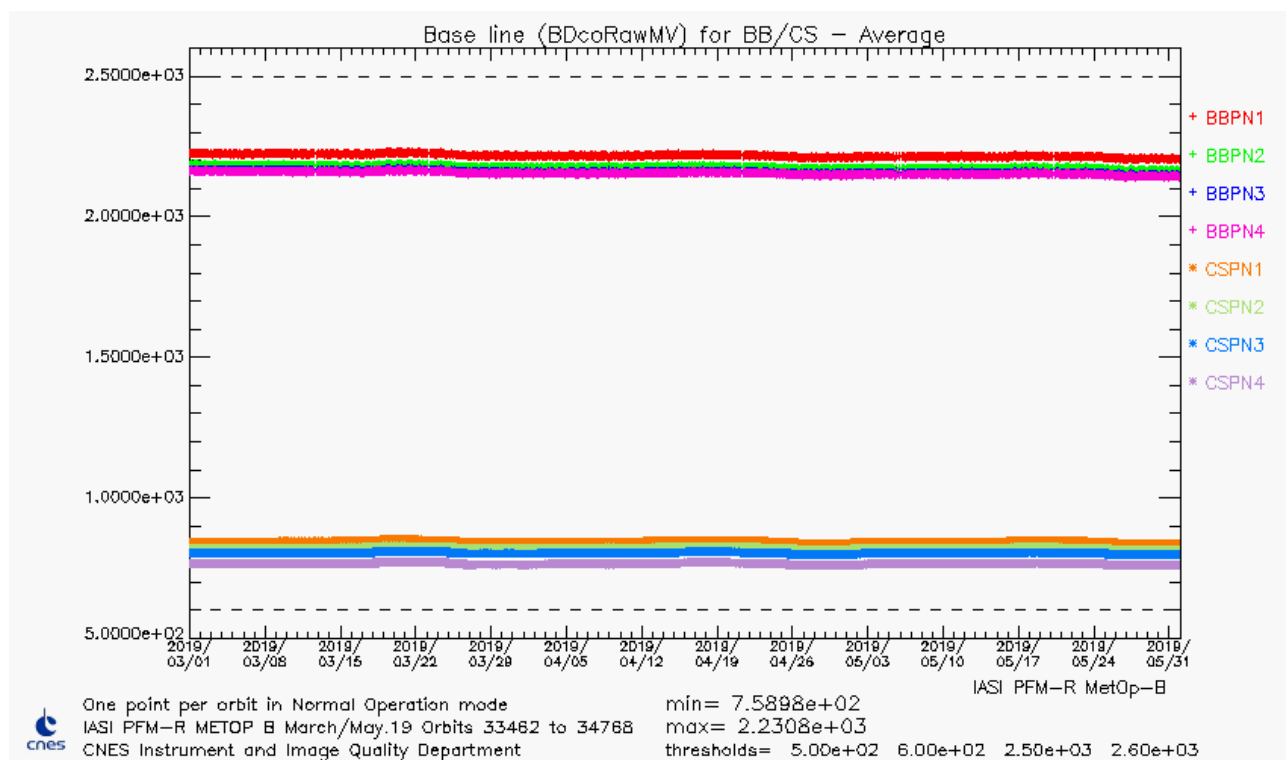




Figure 30 : Monitoring of interferogram baseline

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 42 Of: 54
--	--	---

#### 4.5.7 Detection Chain

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

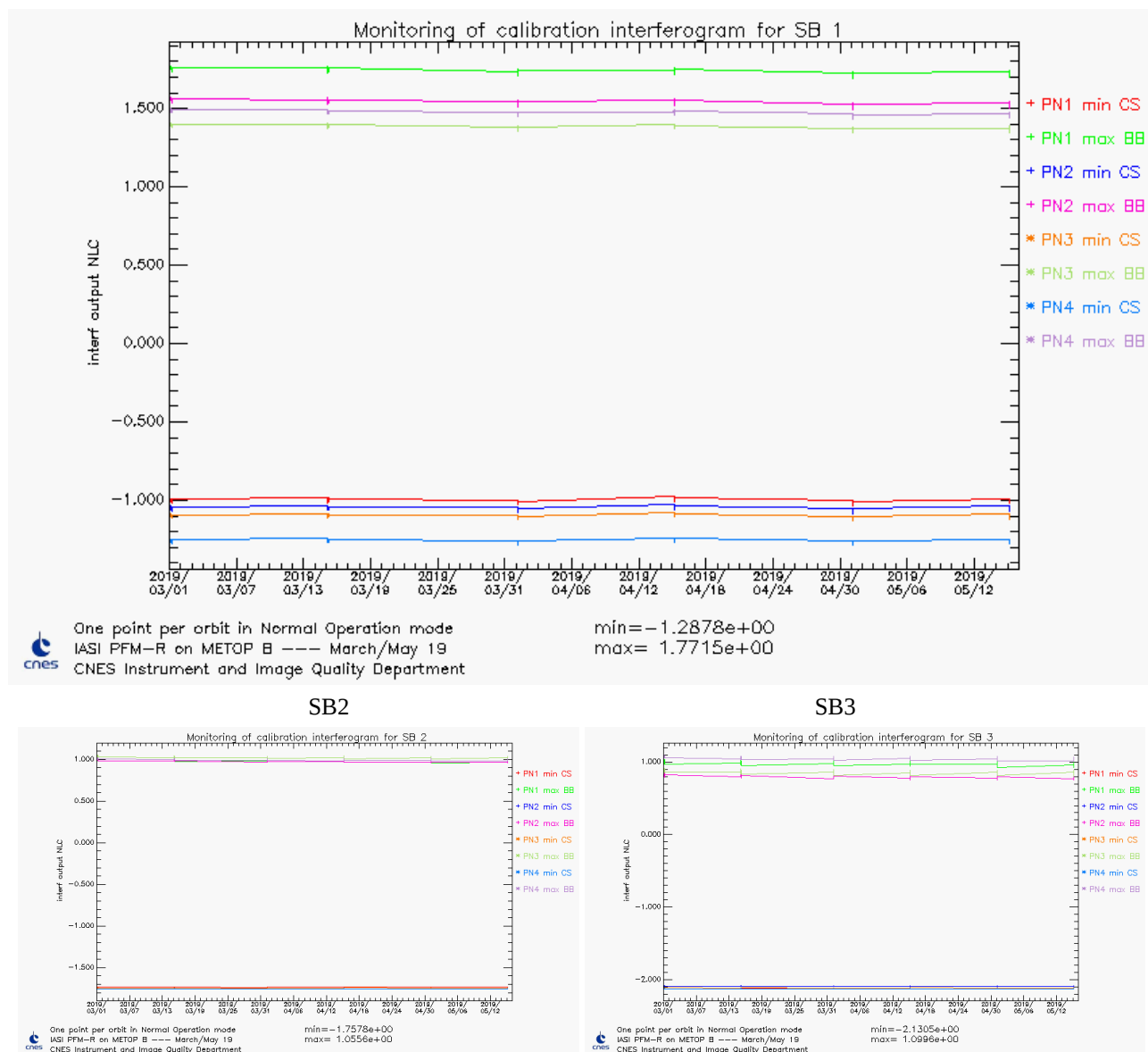




Figure 31 : Monitoring of detection chain margins

Margins are sufficient for the moment. The slight decreasing slope in SB1 (BB) for all pixels is linked to the instrument transmission evolution already mentioned in §4.5.4.1.

#### 4.5.8 Conclusion

The radiometric performances of IASI are nominal and stable. An extrapolation of the current calibration ratio leads to a rough date for the next decontamination at the end of 2021. Scan mirror reflectivity was updated in November 2017. The next update is foreseen in July 2019.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 43 Of: 54
---	--	---

## 4.6 SOUNDER SPECTRAL PERFORMANCES

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 led to stringent specifications:

- A prior knowledge of spectral position better than of  $2 \cdot 10^{-4}$  (design)
- A posterior maximum spectral calibration relative error of  $2 \cdot 10^{-6}$  (after calibration by OPS)

In order to reach the specification of  $2 \cdot 10^{-6}$ , 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.

In addition, a spectral calibration assessment is done over homogeneous scenes when IASI is in external calibration, nadir view.

Since the permanent compensation device stop on 7<sup>th</sup> October 2015, the monitoring of the ghost was cancelled as the data are no more affected by the ghost.

### 4.6.1 Monitoring of the ISRF inputs

#### 4.6.1.1 Position of the interferometric axis

The interferometric axis is the cube corner displacement direction. Its value has changed several times during CalVal due to the various configurations used. Since the end of CalVal, its value is now stable around ( $Y = 1060 \mu\text{rad}$ ;  $Z = 1210 \mu\text{rad}$ ). The central position used in the “spectral database” generation, are  $1000 \mu\text{rad}$  and  $1200 \mu\text{rad}$ , 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”.

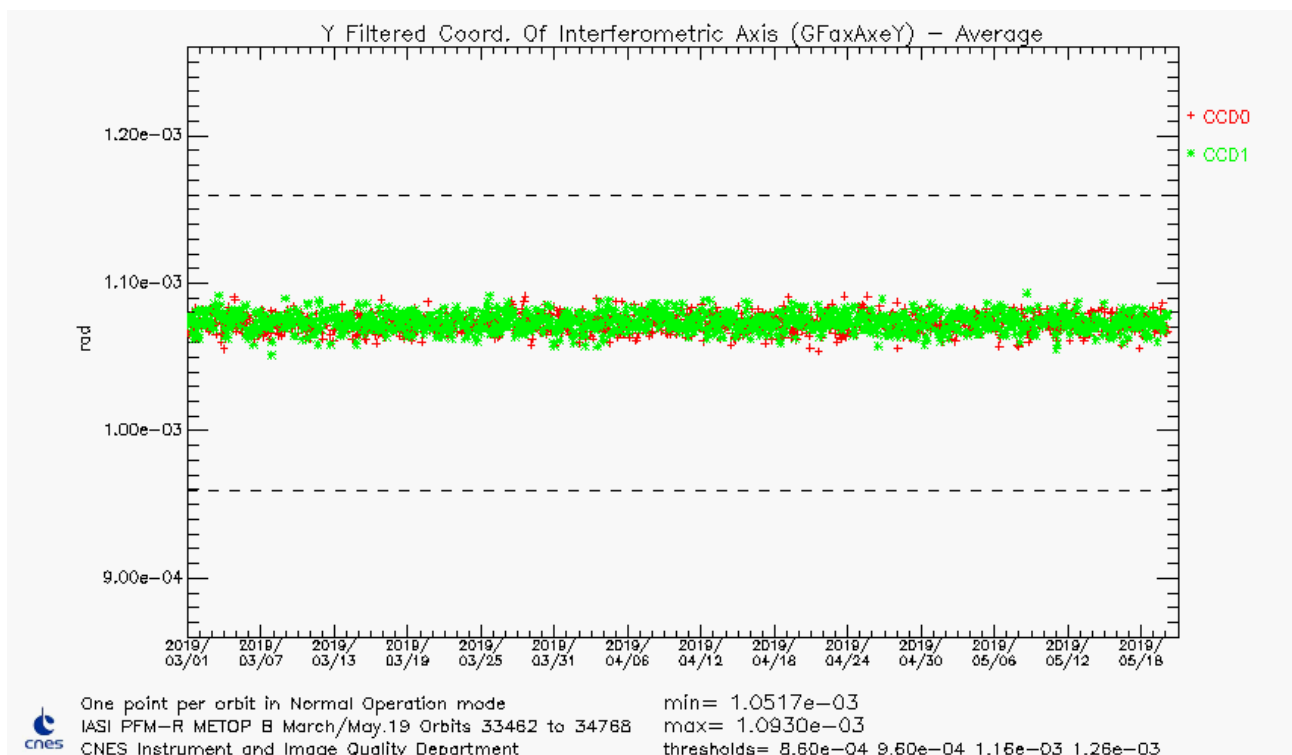


Figure 32 : GFAxAxisY average (Y filtered coordinates of sounder interferometric axis)

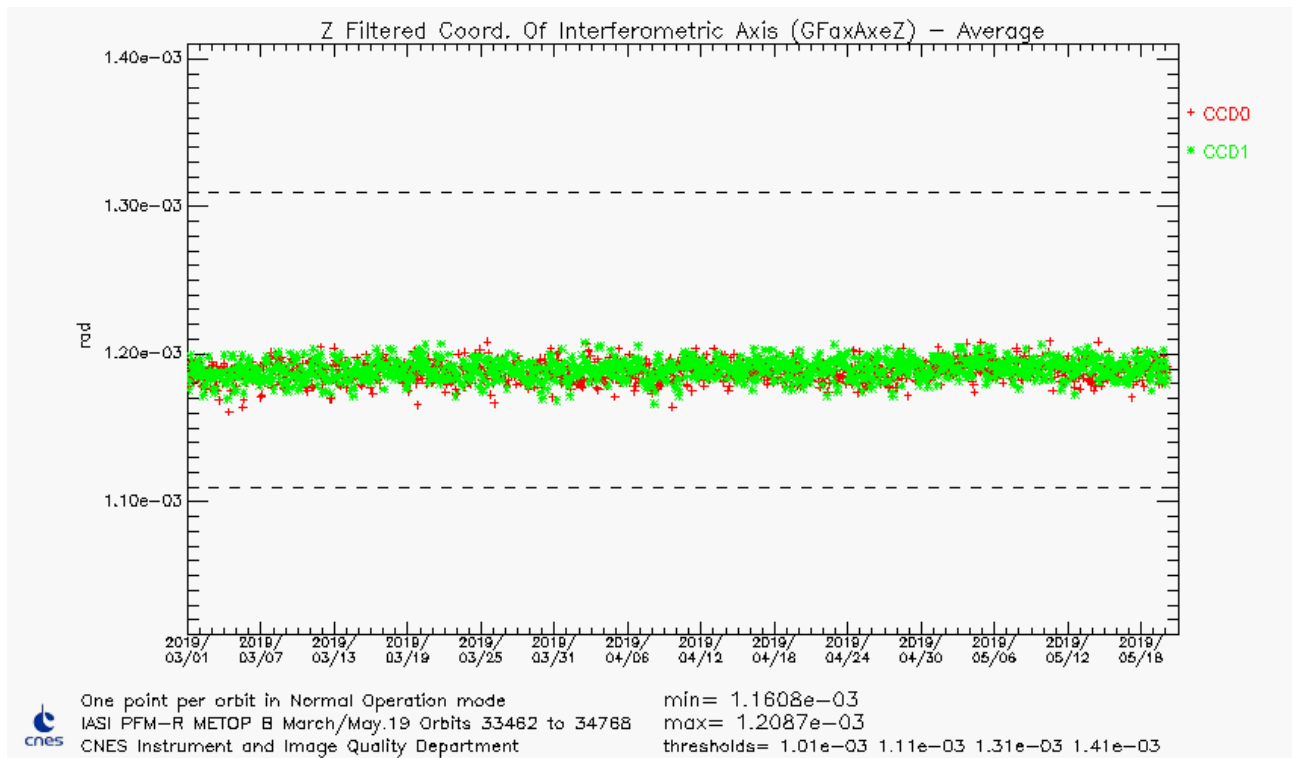


Figure 33 : GFaxAxeZ average (Z filtered coordinates of sounder interferometric axis)

#### 4.6.1.2 Cube Corner constant offset

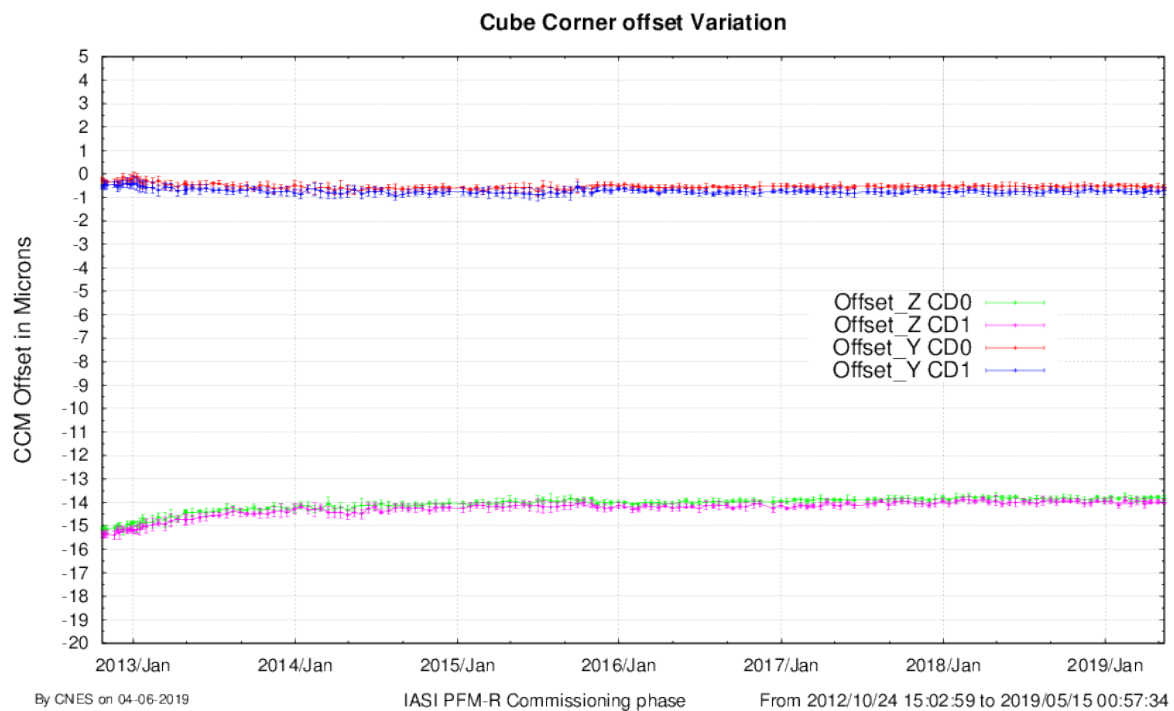




Figure 34 : Cube Corner offset variation

Reference cube corner offsets, used in the spectral database of the period (ODB 12), are  $-0.48 \mu\text{m}$ ,  $-0.61 \mu\text{m}$ ,  $-14.54 \mu\text{m}$  and  $-14.64 \mu\text{m}$ , 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.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 45 Of: 54
--	--	---

#### 4.6.1.3 Cube corner velocity

Refer to REVEX, paragraph 5.5.

#### 4.6.1.4 Interferometer optical bench temperature

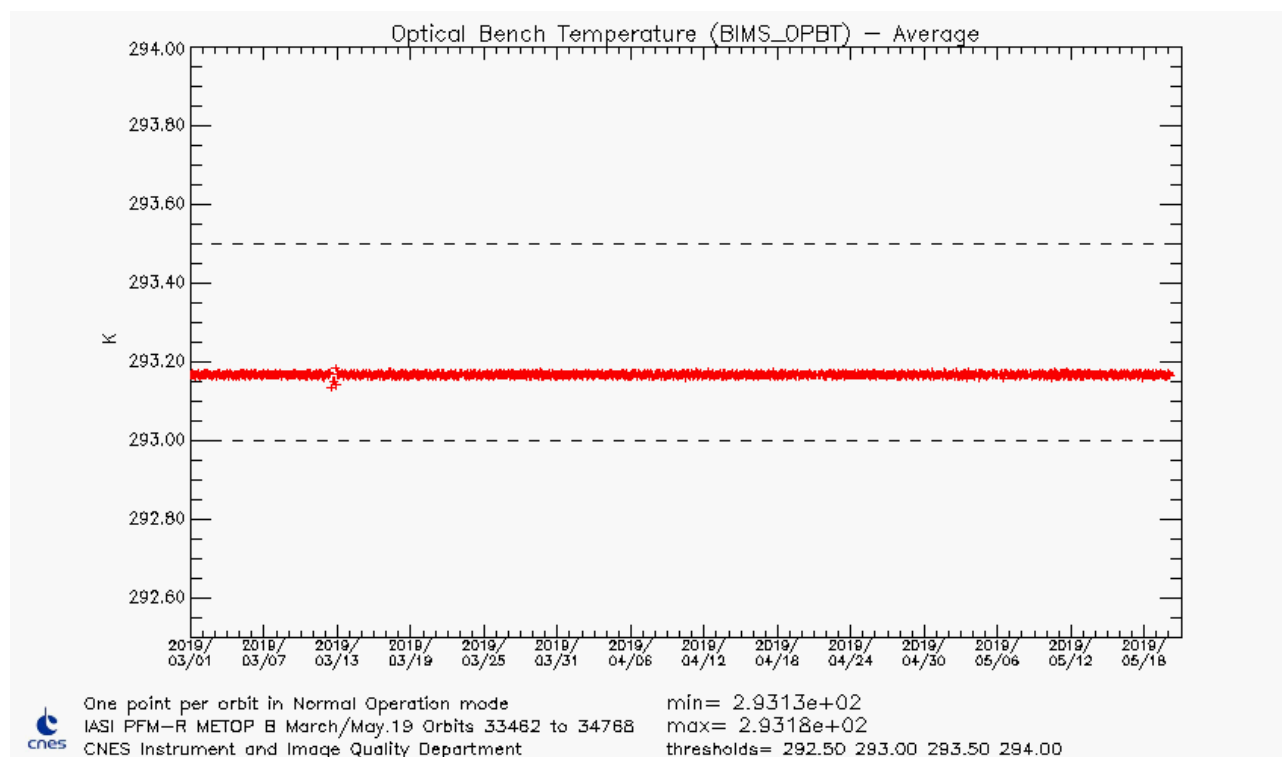


Figure 35 : Optical bench Temperature



#### 4.6.2 Spectral calibration assessment

Absolute spectral calibration assessment and Interpixel spectral calibration assessment are performed during routine External Calibration on Earth views at nadir (SP 15) and synthesized once a year.

Refer to REVEX, paragraph 6.6.2.

#### 4.6.3 Conclusion

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

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 46 Of: 54
---	--	---

## 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 0.3AVHRR pixel while the IIS/sounder co-registration has to be better than 0.8mrad.

### 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.

The sonder/IIS coregistration error is lower than 100 $\mu$ rad (eq. 100m on ground).

### 4.7.2 IIS / AVHRR co-registration

The IIS/AVHRR co-registration is permanently estimated by the L1 processing chain.

Note that AVHRR channels 4 and 5 are within the IIS spectral filter. The spatial resolution of the IIS (0,7km) is close to AVHRR (1km).

The IIS/AVHRR offset guess in the ground segment configuration is used when the algorithm of correlation between IIS and AVHRR does not converge (typically over homogeneous scenes).

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

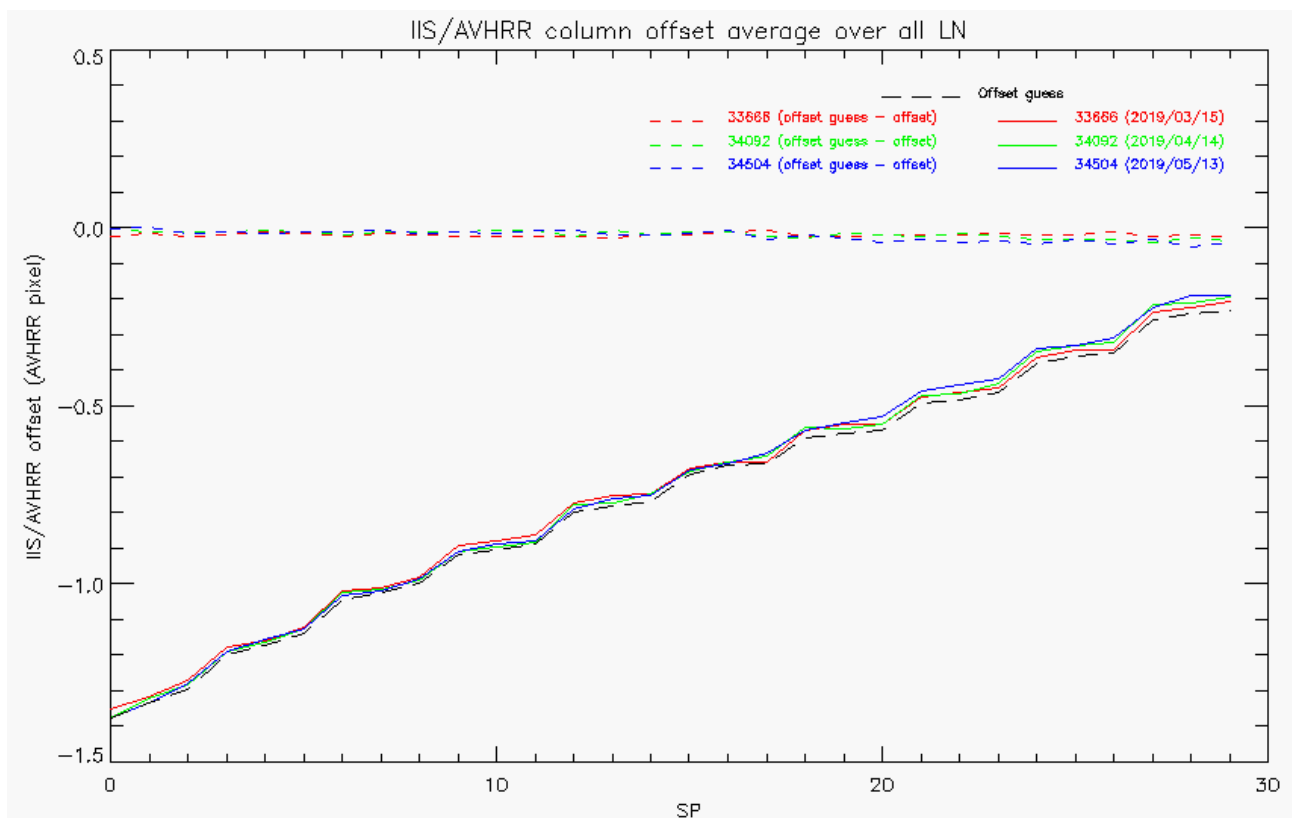


Figure 36 : Column offset (black) guess vs. column offset averaged over all lines (LN) as a function of the scan position (SP=SN), and orbit number (across track IIS/AVHRR offset)

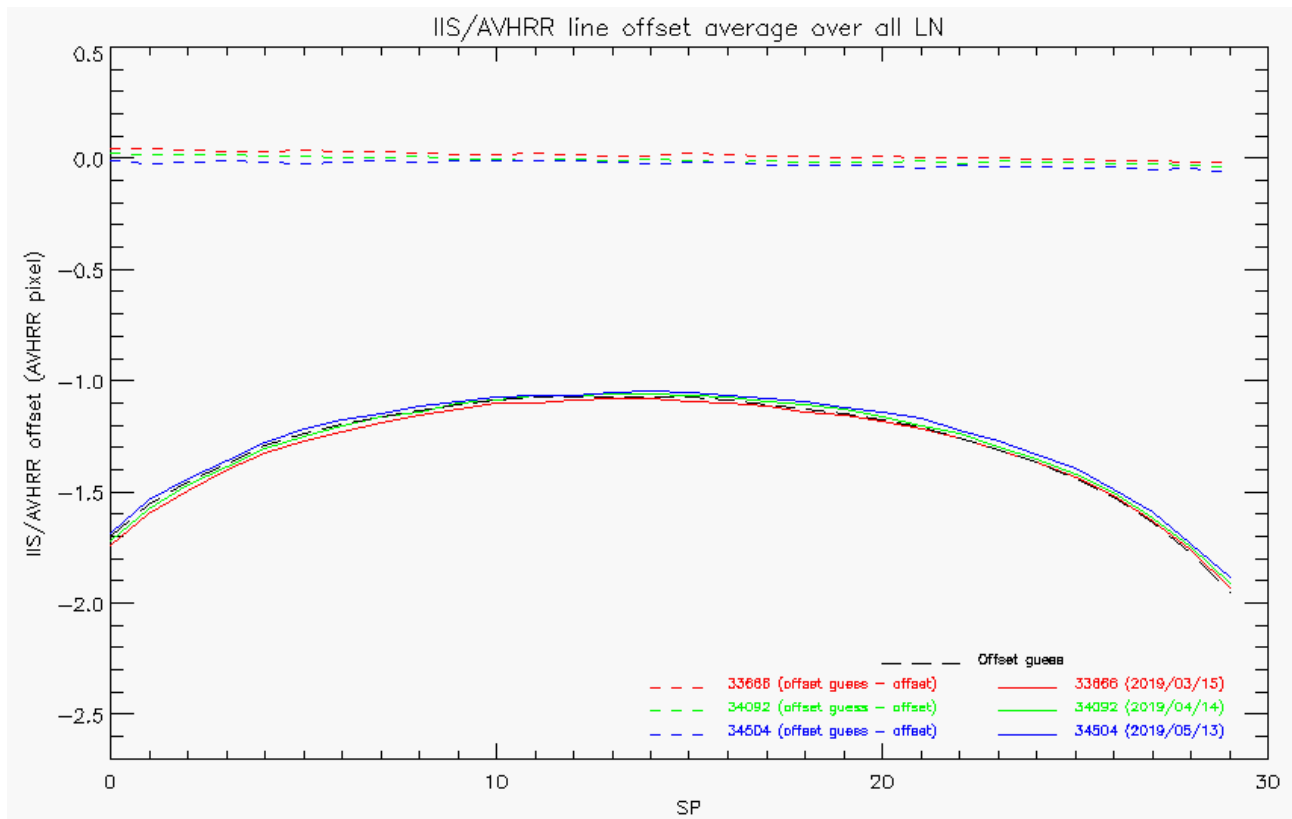


Figure 37 : Line offset guess (black) vs. line offset averaged over all lines (LN) as a function of the scan position (SP=SN), and the orbit number (along track IIS/AVHRR offset)

For both across track and along track, the residuals between measured and IIS/AVHRR offset guess in the ground segment configuration are lower than 0.1 AVHRR pixel for all viewing angles, that is equivalent to 100m on ground.

The values are stable.



### 4.7.3 Conclusion

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

IIS-sounder co-registration is stable at about 100 $\mu$ rad which is equivalent to 100m on ground (specification : < 0.8 mrad).

IIS-AVHRR offset is lower than two pixels and stable over time: less than 0.1 AVHRR pixels over three months (specification: < 0.3 AVHRR pixel).

IASI pixel centre location accuracy in AVHRR raster is around 200m. The geolocation of IASI pixels are thus considered stable and well within specification (5 km).

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 48 Of: 54
--	--	---

## 4.8 IASI-B INTER-CALIBRATION WITH IASI-A, CRIS AND AIRS

The objective of the radiometric and spectral inter-calibration between IASI-B, IASI-A, CrIS and AIRS is to perform an external monitoring of the IASI performances and to ensure the consistency of the hyperspectral TIR sensors and in particular the continuity of the IASI mission. We aim here at checking the performance of the radiometric absolute calibration accuracy of 0.5K per IASI channel, and of the spectral absolute calibration accuracy of 2 ppm.

The inter-calibration is performed with the SIC software. The methodology is described in the technical note DA.2. Roughly, the methodology is based on the construction of a database in which each data is the difference IASI-B – IASI-A, IASI-B – CrIS or IASI-B - AIRS over a common observation made by both sounders. “Common” means same place, same time and same viewing conditions so that the only difference is not geophysical but due to a calibration bias. Statistics over this database emphasize the radiometric and spectral biases.

### 4.8.1 IASI-B inter-calibration with IASI-A

For IASI-B / IASI-A, the common observations are the overlapping areas between two consecutive orbits of MetOp-A and MetOp-B. They always exhibit a temporal gap of ~50 min between IASI- A and B (with the two cases “A before B” and “A after B”), and the geometries of the observations are different and generally off-nadir with opposite angles. These two drawbacks are minimized by a pre-filtering performed to only use the most stable and homogeneous scenes, using the geolocation, Cld\_AVHRR and ECMWF information. Each scene is then a regional averaging of the soundings. The comparison is performed at native spectral resolution.

Figure 38 gives the mean and standard deviation of  $\Delta T$  @ 280K for one year of data. We see that IASI-A and IASI-B are very well cross-calibrated, with biases lower or equal to 0.1K in absolute value, except at the beginning of B1 where the bias reaches 0.15 K. The global bias in B1 has decreased compared to previous years, due to the update of the on-board non linearity correction tables for B1 detectors of IASI-B since the 2<sup>nd</sup> August 2017. For information, we checked that the distribution of the surface temperature of the scenes in the database covers a large range (from 220K to 280K).

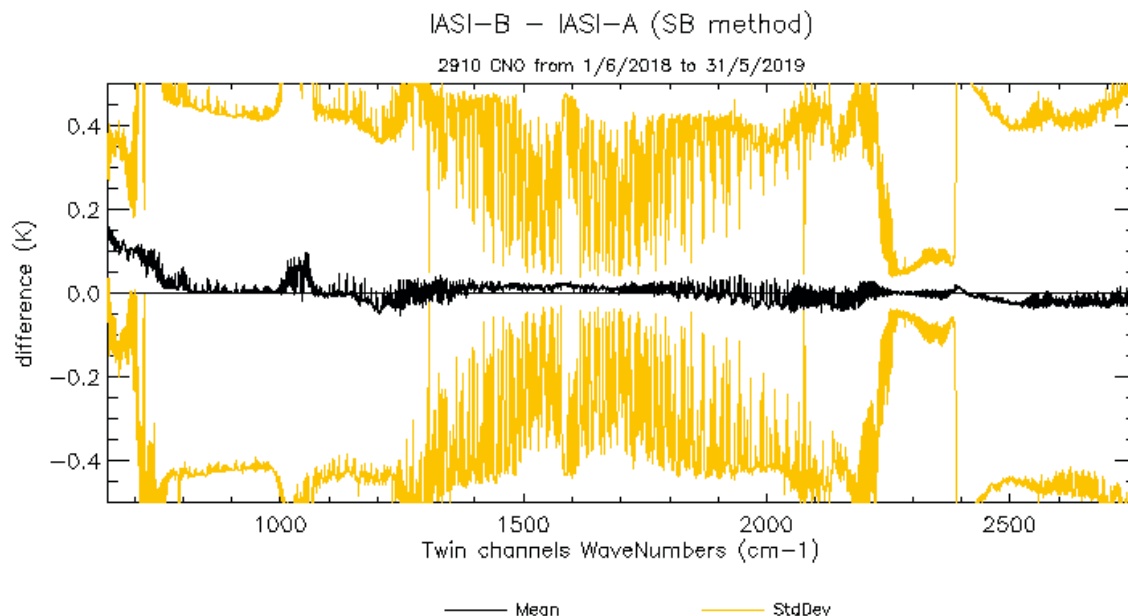


Figure 38 : Mean (black curve) and standard deviation (yellow) of the difference in brightness temperature IASI-B – IASI-A



Figure 39 shows the temporal evolution of three broad pseudo-channels, corresponding approximately to the IASI bands 1, 2 and 3 (more precisely, to their overlapping with the CrIS and AIRS coverage). For the spectral band 2 and 3, we see that the difference between IASI-B and IASI-A is stable over time until the end of February. For the spectral band 1, the new non-linearity correction hasn't been applied on IASI-A yet, but it has been applied on IASI-B since 2018, so the difference is steeper between IASI-B and IASI-A. Since February, the biases are increasing for the 3 pseudo-channels due to the drift of METOP-A orbit.

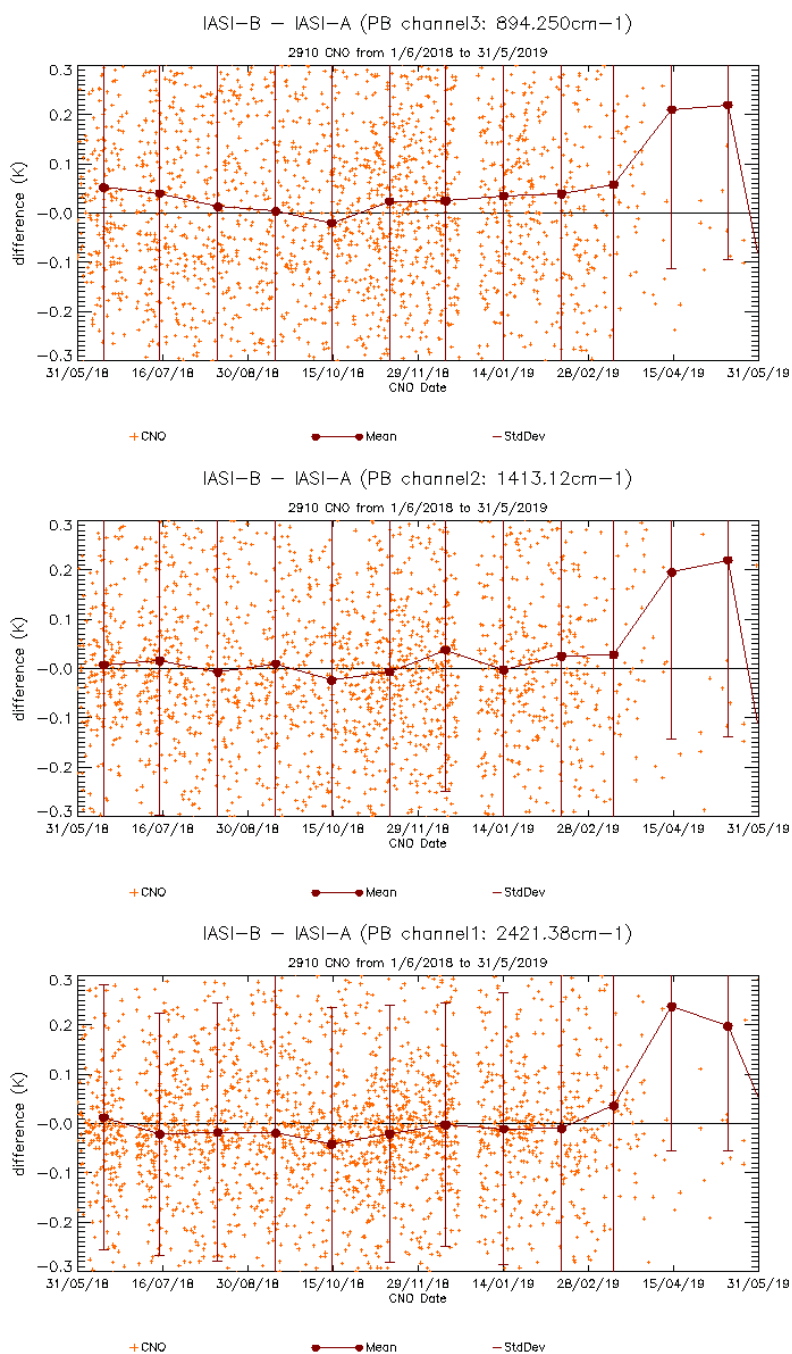




Figure 39 : Temporal evolution of differences IASI-B – IASI-A in brightness temperature spectrally integrated over the approximate three IASI bands

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 50 Of: 54
---	--	---

The spectral inter-comparison is performed on the same spectra as the radiometric inter-comparison. For each common observation, a cross-correlation of both spectra is performed in 30 small spectral windows for different spectral shifts. The maximum of correlation gives the actual spectral shifts expressed in  $\Delta\nu/\nu$ . Figure 40 gives the mean of  $\Delta\nu/\nu$  over the complete dataset. We see that the spectral bias between IASI-B and IASI-A is lower than 1 ppm in absolute value, which is compliant with the specification of 2 ppm for most channels. The channels out of specification are due to the perturbation of the cross-correlation by noise.

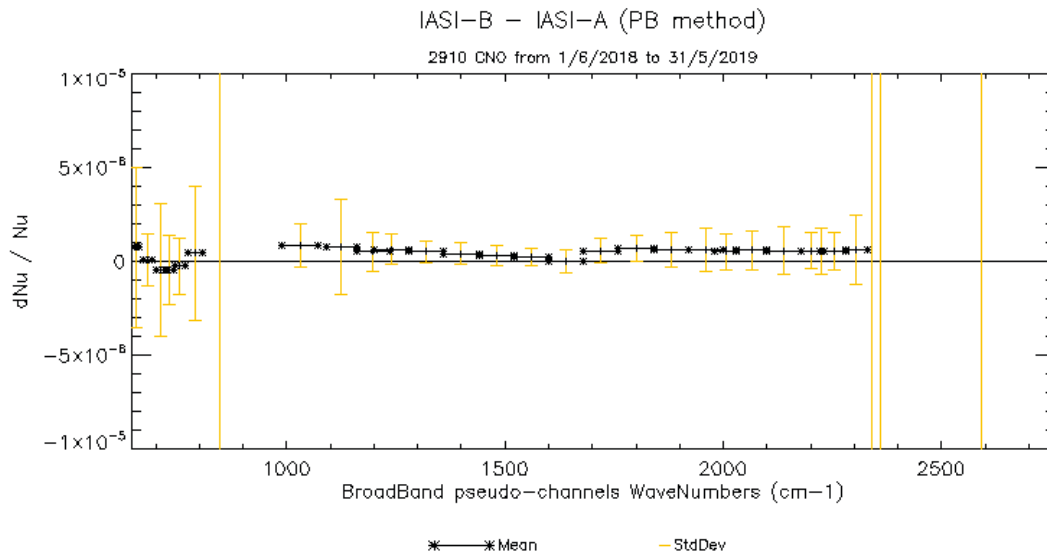


Figure 40 : Mean (black curve) and standard deviation (yellow curve) of the difference spectral calibration  $\Delta\nu/\nu$  between IASI-B and A.

Figure 41 shows the temporal evolution of the difference spectral calibration  $\Delta\nu/\nu$  between IASI-B and A in the spectral window centered on 2200cm-1. We see that the IASI-A/IASI-B spectral inter-calibration is very stable.

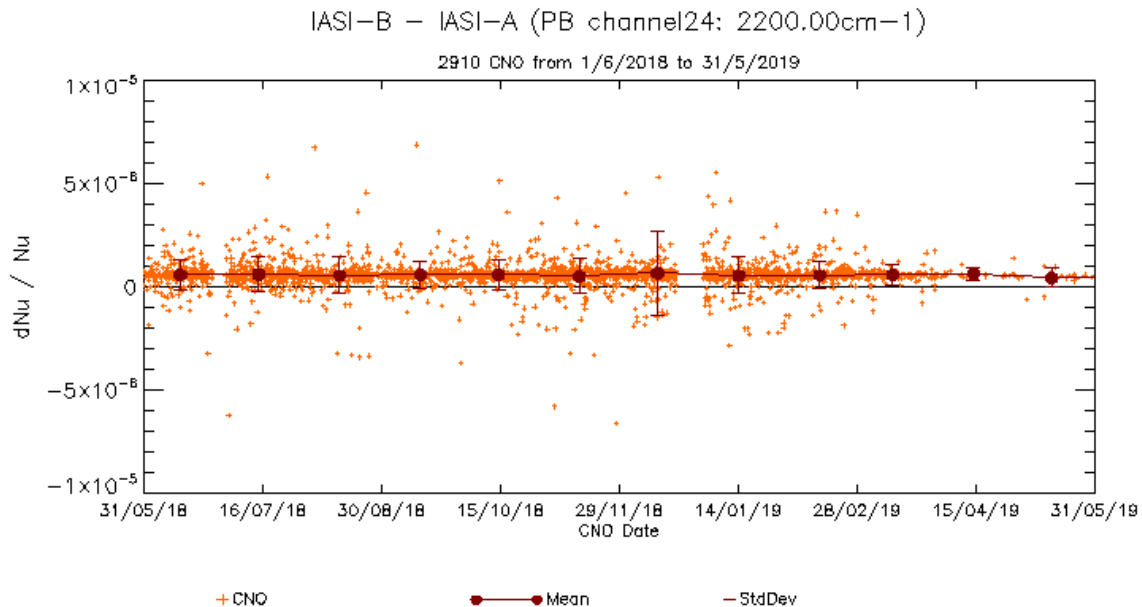




Figure 41 : Temporal evolution of the difference spectral calibration  $\Delta\nu/\nu$  between IASI-B and A in the spectral window centered around 2200cm-1.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 51 Of: 54
--	--	---

#### 4.8.2 IASI-B inter-calibration with CrIS

Since last quarterly report, we do not receive enough CrIS-NPP products so the inter-calibration between IASI-B and CRIS was suspended.

#### 4.8.3 IASI-B inter-calibration with AIRS

For IASI-B and AIRS, the basis of the algorithm is similar to that IASI-B / IASI-A, but now the database is filled with Simultaneous Nadir Overpasses, occurring at high latitudes (because of the differences in the local time of the orbits). Each scene is a regional averaging of the soundings, with a spectral reduction in broad pseudo-bands. Because of the differences in spectral resolution, no spectral inter-calibration is performed.

Figure 42 shows the mean and standard deviation of IASI-B - AIRS for one year of data. We see that IASI-B and AIRS are very well cross-calibrated, with biases lower or equal to 0.15K in absolute value (except for 2 pseudo-bands).

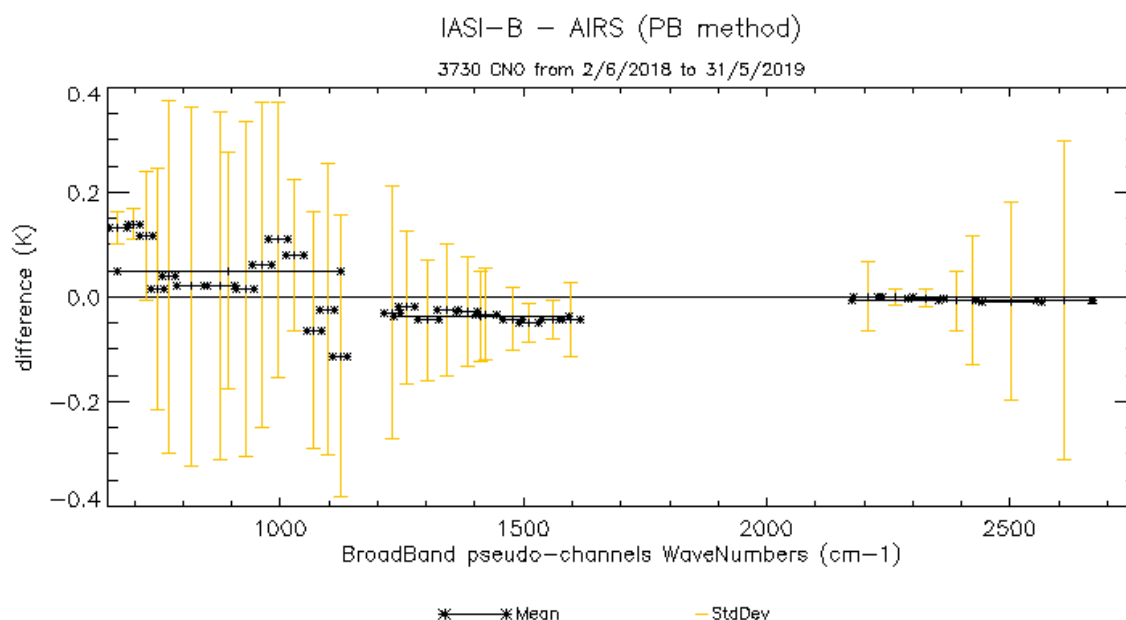


Figure 42 : Mean (black curve) and standard deviation (yellow) of the difference in brightness temperature IASI-B – AIRS.



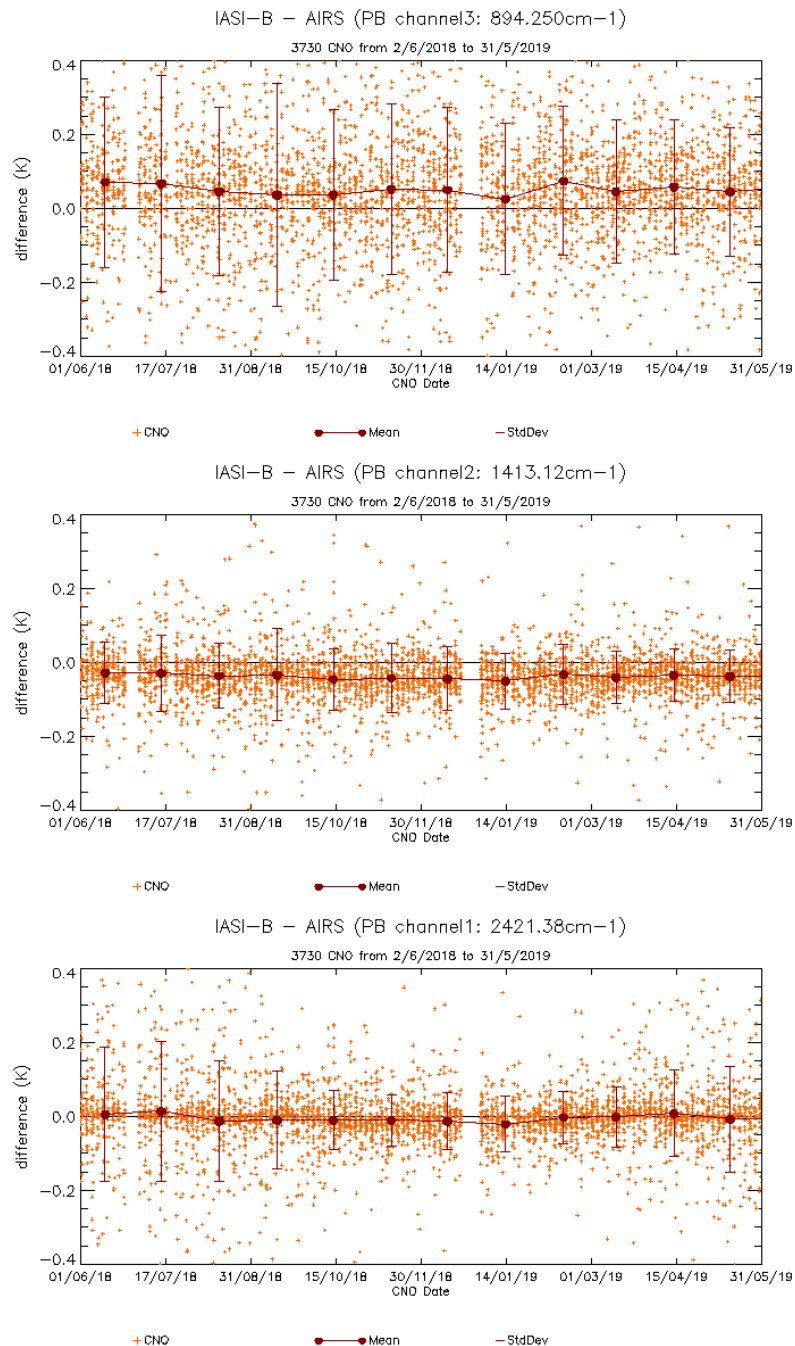


	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 52 Of: 54
---	--	---

Figure 43 shows the temporal evolution of the three broadest pseudo-channels, corresponding approximately to the IASI bands 1, 2 and 3 (more precisely, to their overlapping with the AIRS coverage). We see that the difference between IASI-B and AIRS is very stable with time. For IASI-B / AIRS no large temporal gaps are observed.



**Figure 43 :** Temporal evolution of the differences IASI-B – AIRS in brightness temperature over the approximate three IASI bands, with monthly mean.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 53 Of: 54
--	--	---

## **4.9 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 on one monthly external calibration in three and the monitoring is performed one time a year for REVEX.

### **4.9.1 IIS Radiometric Noise Monitoring**

Refer to REVEX, paragraph 6.9.1.

### **4.9.2 IIS Radiometric Calibration Monitoring**

Refer to REVEX, paragraph 6.9.2.

## **5 IASI TEC SOFTWARE AND INTERFACES**

### **5.1 IASI TEC EVOLUTION**

No evolution within the period.

### **5.2 SIC EVOLUTION**

No evolution within the period.

### **5.3 EUMETCAST INTERFACE**

EUMETCast dissemination is used for Near Real Time data reception by IASI TEC at CNES, Toulouse. Each orbit, L1 ENG, L1 VER, and AVHRR 1B products are received under continuous series of 3 minutes PDU. Full dumps are reconstructed by the EUMETCAST terminal and pushed to a IASI TEC server. Since August 2012, NPP/CrIS PDU are also received to perform inter-comparison with IASI.

In case of failure of the prime EUMETCAST station, products remain available several days on a redundant station.



The behaviour of the EUMETCAST reception is nominal.

No evolution within the period.

### **5.4 FTP INTERFACE**

IASI L0 full dumps are available in Near Real Time on a EUMETSAT FTP server. The IASI TEC software automatically downloads products from the EUMETSAT FTP server.

The reception of L0 products at IASI TEC is nominal.

	 Metop-B	Doc n°: IA-RP-2000-4479-CNE Issue: 1.0 Date: 01/06/2019 Sheet: 54 Of: 54
--	--	---

## 6 **CONCLUSION AND OPERATIONS FORESEEN**

Please visit <https://iasi.cnes.fr> to get IASI news.

### 6.1 **SUMMARY**

The IASI PFM-R instrument is fully operational.

The instrument configuration is the nominal one.

The main events are :

- CSQ on 2 April 2019
- DPS Pixel mode Acquisition anomaly on 8 April 2019
- In Plane manoeuvre on 8 May 2019

### 6.2 **SHORT-TERM EVENTS**

- Update of Scan mirror reflectivity coefficients in July 2019
- Moon avoidance on 20 August and 18 September 2019

### 6.3 **OPERATIONS FORESEEN**

- Next equalization on October 2019

*End of document*