EUMETSAT

IASI Level 1 PCC Product Generation Specification

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2C	28/06/2010		Use channel numbering from 1 to 8461 (instead of 0 to 8460) Updated the outlier detection method to let the outlier threshold depend on signal and detector.

Table of Contents

1 Introduction 4
1.1 Purpose and Scope 4
1.1.1 Document Structure 4
1.2 Requirements Hierarchy and Precedence 4
1.3 Terminology 4
1.4 Applicable and Reference Documents 4
1.5 Abbreviations and Acronyms 5
2 Overview 6
3 System and Operations Concept 7
3.1 System Concept 7
3.1.1 IASI PCC PPF States 8
4 Requirements Listing 10
4.1 High Level Requirements 10
4.2 L1C PCS Requirements 11
4.3 L1C PCR Requirements 11
5 Supporting Science 12
5.1 Contents of the Configuration File 12
5.2 Decoding of Level 1C spectra 12
5.3 Computation of PC Scores 12
5.4 PFS Encoding of PC Scores 13
5.5 Residual and ResidualRMS 14
5.6 PFS Encoding of PC Residuals 14
Appendix A Main Product Header Fields to be Changed by the PPF 16
Appendix B Format of IASI_IPO Dynamic Auxiliary Data File 18
Appendix C Example Configuration File 19

1 INTRODUCTION

1.1 Purpose and Scope

This document is the Infrared Atmospheric Sounding Interferometer (IASI) Level 1 Principal Component Compression (PCC) Product Generation Specification (PGS). Its purpose is to present all requirements specific to the IASI PCC Product Processing Facility (PPF), which are not already covered in the Core Ground Segment Requirements Document (CGSRD) [AD1] and the other applicable documents.

1.1.1 Document Structure

- Section 1 is this introduction.
- Section 2 provides a short overview of the IASI PCC PPF functionality.
- Section 3 presents the system and operations concept.
- Section 4 contains the detailed requirements for the IASI PCC PPF.
- Section 5 contains additional information referenced by the requirements in Section 4.

1.2 Requirements Hierarchy and Precedence

In the event of conflict between higher level and lower level requirements, the higher level ones shall take precedence. Similarly, in the event of conflict between these PPF requirements and those contained in CGSRD [AD1], the latter shall take precedence.

1.3 Terminology

The Generic Product Format Specification (GPFS) Section 2.4 specifies default "Undefined Values for Data Types". The IASI Level 1 PCC Product Format Specification (PFS) [AD6] does not override these default undefined values. The default undefined value depends on the data type of the PFS field and will be referred to as GPFS "undefined" value within this document. A table with the GPFS "undefined" value for the relevant data types is provided below.

PFS Type ID	GPFS "undefined" value
byte	-128
integer2	-32768
integer4	-2147483648

1.4 Applicable and Reference Documents

Ref.	Document Title and Reference Number
[AD1]	EPS Core Ground Segment Requirements Document, EPS/GGS/REQ/95327
[AD2]	Generic Product Format Specification, EPS.GGS.SPE.96167
[AD3]	EPS Mission Conventions Document, EPS/SYS/SPE/990002
[AD4]	IASI Level 1 Product Format Specification, EUM.EPS.SYS.SPE.990003
[AD5]	HDF-5 User Manual

[AD6]	IASI Level 1 PCC Product Format Specification, EUM/OPS-EPS/SPE/08/0195
[RD1]	A C L Lee and S Bedford: "Support Study on IASI Level 1c Data Compression", EUMETSAT Contract EUM/CO/03/1155/PS
[RD2]	Future Dissemination Approach for IASI level 1 Products, EUM/STG-OPSWG/23/08/DOC/11
[RD3]	Operational Dissemination of IASI Data using PC Compression, EUM/OPS-EPS/TEN/08/0202
[RD4]	Generation of eigenvector files for the IPCC PPF, EUM/OPS-EPS/SPE/08/0200
[RD5]	EPS Programme Auxiliary Data Inventory, EUM/EPS/SYS/LIS/00/002
[RD6]	M Goldberg, L Zhou, W Wolf, C Barnet and M Divakarla: "Applications of Principal Component Analysis (PCA) On AIRS Data", Proc. of SPIE, 2005, vol. 5655
[RD7]	P Antonelli, H Reveercomb, L Stromovsky, W Smith, R Knuteson, D Tobin, R Garcia, H Howell, H Huang and F Best: "A principal component noise filter for high spectral resolution infrared measurements", Journal of Geophysical Research, 2004, vol. 109
[RD8]	Dossier de définition des algorithmes IASI, IA-DF-0000-2006-CNE
[RD9]	IASI Level 2 Product Generation Specification, EPS.SYS.SPE.990013
[RD10]	EARS Operational Service Specification, EUM/OPS/SPE/01/0839

1.5 Abbreviations and Acronyms

BLAS Basic Linear Algebra Subprograms
CGSRD Core Ground Segment Requirements Document
EARS EUMETSAT Advanced Retransmission Service
EPS EUMETSAT Polar System
GEADR Global External Auxiliary Data Record
GIADR Global Internal Auxiliary Data Record
GPFS Generic Product Format Specification
G/S Ground Station
HDF Hierarchical Data Format
IASI Infrared Atmospheric Sounding Interferometer
M&C Monitoring and Control
MDR Measurement Data Record
PCC Principal Component Compression
PCR Principal Component Residuals
PCS Principal Component Scores
PFS Product Format Specification
PGE Product Generation Environment
PPF Product Processing Facility
RMS Root Mean Square

2 OVERVIEW

This section provides a short overview of the IASI PCC PPF functionality.

The purpose of the IASI PCC PPF is to apply Principal Component Compression (PCC) to IASI L1C radiance spectra. PCC works by representing multidimensional data, like IASI spectra, in a lower dimensional space, which accounts for most of the variance seen in the data. This space is spanned by a truncated set of the eigenvectors of the data covariance matrix. By noise-normalising the spectra prior to the application of the compression technique, the ability to fit the data is enhanced by avoiding giving too much weight to variance caused by noise [RD7].

The PCC is applied individually to each of the three IASI spectral bands.

Two output products are generated by the IASI PCC PPF, with product types PCS (= Principal Component Scores) and PCR (= Principal Component Residuals) respectively (both with INSTRUMENT_ID = IASI and PROCESSING_LEVEL = 1C):

1. Product type PCS: This product contains a copy of a subset of the MDR fields (including geolocation, quality flags, satellite and sun angles, etc.) from the input IASI_xxx_1C product as well as the PC scores from which noise-reduced radiances can be reconstructed.
2. Product type PCR: This product contains the noise-normalised difference between the original radiances in the IASI_xxx_1C product and the noise-reduced radiances reconstructed from the IASI_PCS_1C product.

Three eigenvector files (one for each of the spectral bands) are needed for the application of the PCC. The file names of the eigenvector files used for the compression are included in the PCS (and PCR) products – the same files must be used to reconstruct noise-reduced radiances from the PC scores. The eigenvector files are static auxiliary data files of type IASI_EV1, IASI_EV2 and IASI_EV3 respectively. Their format and the reconstruction steps are specified in the IASI L1C PCC Product Format Specification [AD6].

A description of the IASI instrument is given in the IASI Level 2 PGS [RD9] and the processing required for deriving the IASI Level 1C data is specified in [RD8].

3 SYSTEM AND OPERATIONS CONCEPT

3.1 System Concept

The external data flows are defined as follows:

Inputs:

Level 1C dataflow: Corresponds to the IASI Level 1C data flow received from the CGS. The data origin can be any of the supported satellites via the CDA or via the NOAA exchange link.

Processing Configuration: These are the user-configurable parameters that are to be used for the processing. They consist of three static auxiliary data files (the eigenvector files) formatted in HDF5 as specified in [AD6] and an XML configuration file with contents as specified in Section 5.1. They define, together with the version of the installed processing software, the configuration of the processing that is used to derive the products.

Outputs:

Level 1C PCS and PCR_Products: The Level 1C PCS and PCR products are defined in the IASI Level 1 PCC Product Format Specification [AD6].

OutlierSpectra (IASI_IPO): Dynamic auxiliary file containing mean and standard deviation of the noise-normalised residual as well as outlier spectra. HDF5 format is described in Appendix B.

Monitoring Information: Contains all regular monitoring information on the Product Generation Function, providing the G/S M&C function with the information on the status of the instrument, data, processing functions, processing platforms, links, etc.

Controls:

G/S Commands: This data stream corresponds to the transfer of commands generated by the G/S and controlling the operation of the IASI PCC PPF. Note that these are only influencing the way the processing is done and are not related to any instrument/platform commands.

Mechanisms:

Generic PGE Services: The IASI PCC PPF makes use of the generic PGE services for (amongst others) the communication, the reporting, the monitoring, informing of the processing status, etc.

3.1.1 IASI PCC PPF States

The following figure sets out the states of the IASI PCC PPF and the situations and signals that lead to transitions between those states.

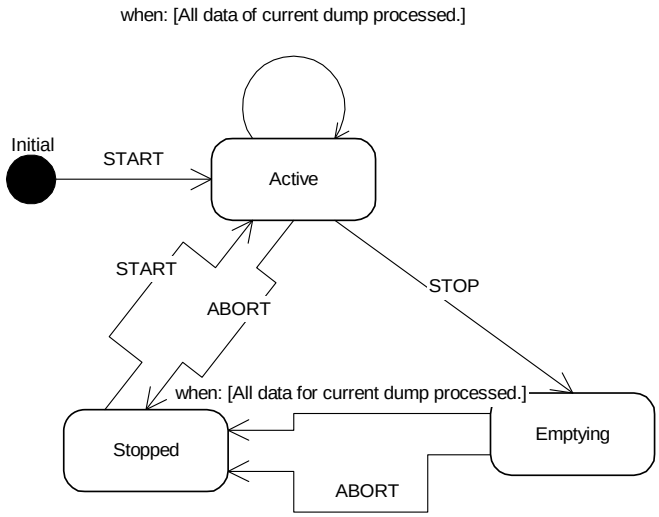

Figure 1: IASI PCC PPF State Transition Diagram

The IASI PCC PPF supports the following states:

Initial

The PPF does not process data. It accepts a START command. On receipt of the START command it enters the Active state.

Active

The PPF processes data.

If the PPF completes the processing of data for an entire dump, it remains in the active state, and processes the data for the next dump if appropriate.

The PPF accepts STOP and ABORT commands. On receipt of the STOP command it enters the Emptying state. On receipt of the ABORT command the current processing shall terminate with no further delay and shall produce no further outputs apart from a user-configurable event notifying the system that it is stopping, and the PPF then enters the Stopped state.

Emptying

The PPF continues to process the data for the entire dump it was processing when it received the STOP command. If it had completed the processing of all data for an entire dump when it received the STOP command, and had not begun processing the next dump, then it sends a user-configurable event notifying the system that it is stopping to the system via the PGE interface and enters the Stopped state.

It does not accept any data pertaining to the next dump. When it has processed all the data pertaining to the current dump, it sends a user-configurable event notifying the system that it is stopping to the system via the PGE interface and enters the Stopped state.

If it receives the ABORT command, the current processing shall terminate with no further delay and shall produce no outputs apart from signalling that it has aborted with an event of user-configurable severity.

Stopped

The PPF does not process data.

Once in the Stopped state, it only accepts a START command.

4 REQUIREMENTS LISTING

4.1 High Level Requirements

IPCC_H_0010	The PPF shall provide all the functionality required to support the following: • Generation of IASI Level 1C PCS products • Generation of IASI Level 1C PCR products • Generation of IASI_IPO dynamic auxiliary data file
IPCC_H_0020	No product model shall be used for the product generation. Instead the contents of the main product header of the PCS and PCR products shall be copied from the Level 1C input product, except for the fields specified in Appendix A.
IPCC_H_0030	All spectra for which: 1) the spectrum is considered an outlier according to the outlier detection method described in Section 5.6 or 2) the coded value of any of the PC scores is outside the feasible interval of the corresponding PFS field type, shall be output in an auxiliary data file together with side information as per the IASI_IPO format (Appendix B).
IPCC_H_0040	The mean and standard deviation of the noise-normalised residuals shall be computed and written to the IASI_IPO output file. These statistics shall be computed once per work order (consistent with the generation of one IASI_IPO output file per work order). Neither outlier spectra nor spectra flagged as bad (for one or more bands) in the IASI L1C product shall be considered for the computation of the residual mean and standard deviation.
IPCC_H_0050	In the case of a processing failure, a IASI PCC snapshot file (dynamic auxiliary data of type IASI_IPD) containing information for post-mortem analysis of the anomaly shall be generated.
IPCC_H_0060	The configuration parameters for the IASI PCC processing shall be read from the static auxiliary data (eigenvector) files specified in the work order and the XML configuration file with contents as specified in Section 5.1.
IPCC_H_0070	If the total number of PC scores configured for a band exceeds the number of eigenvectors in the corresponding eigenvector file, no products shall be produced and the PPF shall stop with an error message.

4.2 L1C PCS Requirements

IPCC_S_0010	The spectra to be compressed shall be read from the field GS1cSpect of the IASI L1C input file and be decoded to physical units as specified in [AD4] and recalled in Section 5.2.
IPCC_S_0020	The PC scores shall be computed from the decoded IASI L1C spectra individually for each of the three bands by projecting the radiances onto a truncated eigenvector space as described in Section 5.3. For computational efficiency, the simultaneous compression of several spectra using matrix-matrix multiplication instead of repeated matrix-vector multiplications, which would result from compression of each spectrum individually, is recommended. This makes an efficient use of the processor cache possible (by using efficient implementation of matrix-matrix multiplication, for example provided by a Level 3 Basic Linear Algebra Subprograms (BLAS) library) and can speed up execution time considerably.
IPCC_S_0030	The PC scores shall be computed for all IASI L1C spectra in the input file within the sensing time interval given in the work order, independent of any quality flags.
IPCC_S_0040	PFS fields common to the IASI_xxx_1C and IASI_PCS_1C products shall be copied from the input file without any modification.
IPCC_S_0050	Residual RMS shall be computed individually for each band based on noise-normalised residuals prior to quantisation, as specified in Section 5.5.
IPCC_S_0060	The PC scores shall be quantised as specified in Section 5.4 before being written to the IASI_PCS_1C product.
IPCC_S_0070	If a quantised PC score falls outside the range of the data type of its PFS field ([-2147483647...2147483647], [-32767...32767] or [-127…127] respectively), an alarm shall be generated.

4.3 L1C PCR Requirements

IPCC_R_0010	Reconstruction residuals shall be computed in noise-normalised space as specified in Section 5.4.
IPCC_R_0020	The residuals shall be quantised as specified in Section 5.7 before being written to the IASI_PCR_1C product.
IPCC_R_0030	If a quantised residual falls outside the range of its type ([-127...127]), an alarm shall be generated.

5 SUPPORTING SCIENCE

This section contains various types of information, including pseudo-code, intended to support and clarify the requirements specified in the previous section. Pseudo-code is given for specification purposes only and is not intended to pre-empt the implementation.

5.1 Contents of the Configuration File

The IASI PCC PPF needs additional configuration not contained in the eigenvector (IASI_EVx) files [AD6]. These additional pieces of information shall be read from an XML configuration file. The additional pieces of information are (for each band x=1,2,3):

Number of scores (per storage width). (nbrScoresBxP1, nbrScoresBxP2, nbrScoresBxP3)
Outlier threshold (on the normalised residual RMS for detector 1). (outlierThresholdBxD1)
Outlier threshold (on the normalised residual RMS for detector 2). (outlierThresholdBxD2)
Outlier threshold (on the normalised residual RMS for detector 3). (outlierThresholdBxD3)
Outlier threshold (on the normalised residual RMS for detector 4). (outlierThresholdBxD4)
Outlier slope. (outlierSlopeBx)
Quantisation factor for the scores. (scoreQuantisationFactorBx)
Quantisation factor for the residuals. (residualQuantisationFactorBx)

An example configuration file is shown in Appendix C.

5.2 Decoding of Level 1C spectra

Prior to the compression, the L1C radiances shall be decoded using the information provided in the IASI GIADR-SCALEFACTORS record.

Pseudo-code I. (decoding of radiances)

```
Input sets:
P  = [0 .. IDefScaleSondNbScale [
K  = [1 .. 8461]
KP(K,P) = [IdefScaleSondNsFirst(P) – IdefNsfirst ..
           IdefScaleSondNsLast(P)  – IdefNsfirst] * P

Input data:
GS1cSpect(K) (mixed units)     // from IASI L1C MDR
IdefSondScaleFactor(P)         // from IASI GIADR-SCALEFACTORS

Output:
R(K)   (unit: W/m^2/sr/m^-1)

Algorithm:
R(K) = sum(KP(K,P), GS1cSpect(K)*pow(10, -IdefSondScaleFactor(P))
```

5.3 Computation of PC Scores

NBSxP1 + NBSxP2 + NBSxP3 PC scores shall be computed for band x, corresponding to the NBSxP1 + NBSxP2 + NBSxP3 first eigenvectors in band x as shown in the pseudo-code below.

Pseudo-code II (compression of radiances in band x)

```
Input sets:
K  = [FirstChannel .. FirstChannel+NbrChannels [
P  = [1 .. NBSxP1 + NBSxP2 + NBSxP3]

Input data:
R(K) [unit: W/m2/sr/m-1]           // decoded radiance as per section 5.2
Noise(K) [unit: W/m2/sr/m-1]       // from eigenvector file
Eigenvectors(K,P)                  // from eigenvector file

Output:
PcScoresBx(P)                      // PC scores in band x

Algorithm:
PcScoresBx(P) = sum(K, (R(K)/Noise(K) - Mean(K))*Eigenvectors(K,P))
```

5.4 PFS Encoding of PC Scores

Before the PC scores enter the product they must be quantised (divided by the quantisation factor and rounded to the nearest integer).

Within each band, three different types (Signed 4-byte Integer, Signed 2-byte Integer and Signed Byte) shall be used for encoding the PC scores in the IASI_PCS_1C product. This is because the range of the PC scores decreases rapidly with PC rank and therefore a higher number of bytes are required to encode the leading PC scores than the subsequent PC scores.

If a quantised PC score falls outside the range of its type, the GPFS "undefined" value shall be used for this particular score (as well as for the corresponding ResidualRMS). Furthermore this shall be flagged in the DEGRADED_PROC_MDR field. (It is expected that the number of fields of each type will be configured such that this will never happen in practice.)

Pseudo-code III (encoding of PC scores in band x)

```
Input sets:
P1 = [1 .. NBSxP1]
P2 = [NBSxP1 + 1 .. NBSxP1 + NBSxP2]
P3 = [NBSxP1 + NBSxP2 + 1 .. NBSxP1 + NBSxP2 + NBSxP3]
P  = [1 .. NBSxP1 + NBSxP2 + NBSxP3]

Input data:
PcScoresBx(P)                      // output from pseudo-code II
SQ = ScoreQuantisationFactor(x)    // from config file

Output:
PcScoresBxP1(P1)                    // for MDR-PCS
PcScoresBxP2(P2)                    // for MDR-PCS
PcScoresBxP3(P3)                    // for MDR-PCS

Algorithm:
PcScoresBxP1(P1) = round(PcScoresBx(P1)/SQ)
PcScoresBxP2(P2) = round(PcScoresBx(P2)/SQ)
PcScoresBxP3(P3) = round(PcScoresBx(P3)/SQ)
```

5.5 Residual and ResidualRMS

The residual is computed as the noise-normalised difference between the decoded L1C radiances and the reconstructed radiances based on the quantised PC scores as shown in the pseudo-code below. If the compression failed in a band (by having a quantised PC score falling outside the range of its type), the residual in the band shall be set to zero and the ResidualRMS to GPFS "undefined" value.

Pseudo-code IV (Residual and ResidualRMS in band x)

```
Input sets:
K  = [FirstChannel .. FirstChannel+NbrChannels[
P1 = [1 .. NBSxP1]
P2 = [NBSxP1 + 1 .. NBSxP1 + NBSxP2]
P3 = [NBSxP1 + NBSxP2 + 1 .. NBSxP1 + NBSxP2 + NBSxP3]
P  = [1 .. NBSxP1 + NBSxP2 + NBSxP3]

Input data:
R(K) [unit: W/m2/sr/m-1]           // decoded radiance as per section 5.2
Noise(K) [unit: W/m2/sr/m-1]       // from eigenvector file
Mean(K)                            // from eigenvector file
PcScoresBxP1(P1)                   // from MDR-PCS
PcScoresBxP2(P2)                   // from MDR-PCS
PcScoresBxP3(P3)                   // from MDR-PCS
Eigenvectors(K,P)                  // from eigenvector file
SQ = ScoreQuantisationFactor(x)    // from config file

Output:
Residual(K)     // noise normalised residual before quantisation
ResidualRMS     // ResidualRMS in band x

Algorithm:
Residual(K) = R(K)/Noise(K) –
               ( Mean(K)
                 + SQ*sum(P1, PcScoresBxP1(P1)*Eigenvectors(K,P1))
                 + SQ*sum(P2, PcScoresBxP2(P2)*Eigenvectors(K,P2))
                 + SQ*sum(P3, PcScoresBxP3(P3)*Eigenvectors(K,P2)) )

ResidualRMS = sqrt(sum(K, Residual(K)*Residual(K))/NbrChannels)
```

5.6 Detection of outlier spectra

For detection of outliers the residual RMS is adjusted by subtracting the sum of all individual radiances times a configurable 'outlier slope' before comparing it to a pixel (detector) dependent threshold as detailed in the pseudo-code below.

Pseudo-code V (detection of outlier spectra, band x)

```
Input sets:
K  = [FirstChannel .. FirstChannel+NbrChannels [
Detector  = [1 .. 4]

Input data:
R(K) [unit: W/m2/sr/m-1]           // decoded radiance as per section 5.2
ResidualRMS                        // ResidualRMS in band x
OutlierThreshold(Detector)         // Detector dependent threshold value
```

```
                                    // from config file
OutlierSlope                        // Slope from config file
D                                   // Pixel number

Output:
isOutlier                           // Boolean indicator of outlier spectra

Algorithm:
isOutlier = (ResidualRMS – OutlierSlope*sum(K, R(K))) > OutlierThreshold(D)
```

A spectrum is considered an outlier if 'isOutlier' is true for at least one of the three IASI bands.

5.7 PFS Encoding of PC Residuals

Before the PC residuals enter the PCR product they must be quantised (divided by the quantisation factor and rounded to the nearest integer).

If a quantised residual falls outside the range of its type (-127 to 127), it shall be set to the GPFS "undefined" value.

Pseudo-code VI (encoding of PC residuals)

```
Input sets:
K = [1 .. 8461]

Input data:
Residual(K)                         // output from pseudo-code IV
RQ = ResidualQuantisationFactor(x)  // from config file

Output:
PccResidual(K)                      // for MDR-PCR

Algorithm:
PccResidual(K) = round(Residual(K)/RQ)
```

APPENDIX A MAIN PRODUCT HEADER FIELDS TO BE CHANGED BY THE PPF

The table below contains a list of all MPHR fields (together with typical values taken from an example IASI_PCS_1C product). Yellow fields shall be set by the IASI PCC PPF according to specifications in [AD1] and [AD2]. White fields shall be copied without modification from the MPHR of the input product.

PRODUCT_NAME:[IASI_PCS_1C_M02_20080110144154Z_20080110144458Z_N_C_20080110162146Z]
PARENT_PRODUCT_NAME_1:[IASI_xxx_1C_M02_20080110144152Z_20080110144500Z_N_C_20080110161013Z]
PARENT_PRODUCT_NAME_2:[xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
PARENT_PRODUCT_NAME_3:[xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
PARENT_PRODUCT_NAME_4:[xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
INSTRUMENT_ID:[IASI]
INSTRUMENT_MODEL:[1]
PRODUCT_TYPE:[PCS]
PROCESSING_LEVEL:[1C]
SPACECRAFT_ID:[M02]
SENSING_START:[20080110144155Z]
SENSING_END:[20080110144459Z]
SENSING_START_THEORETICAL:[20080110140000Z]
SENSING_END_THEORETICAL:[20080110153900Z]
PROCESSING_CENTRE:[CGS2]
PROCESSOR_MAJOR_VERSION:[1]
PROCESSOR_MINOR_VERSION:[0]
FORMAT_MAJOR_VERSION:[1]
FORMAT_MINOR_VERSION:[0]
PROCESSING_TIME_START:[20080110162146Z]
PROCESSING_TIME_END:[20080110162214Z]
PROCESSING_MODE:[N]
DISPOSITION_MODE:[C]
RECEIVING_GROUND_STATION:[SVL]
RECEIVE_TIME_START:[20080110153330Z]
RECEIVE_TIME_END:[20080110153339Z]
ORBIT_START:[6363]
ORBIT_END:[6364]
ACTUAL_PRODUCT_SIZE:[00002464266]
STATE_VECTOR_TIME:[20080110132825000Z]
SEMI_MAJOR_AXIS:[7204606915]
ECCENTRICITY:[1203]
INCLINATION:[98671]
PERIGEE_ARGUMENT:[69293]
RIGHT_ASCENSION:[72049]
MEAN_ANOMALY:[290831]
X_POSITION:[-3654066870]
Y_POSITION:[6205632382]
Z_POSITION:[-652667]
X_VELOCITY:[1423173]
Y_VELOCITY:[829065]
Z_VELOCITY:[7356244]
EARTH_SUN_DISTANCE_RATIO:[6]
LOCATION_TOLERANCE_RADIAL:[0]
LOCATION_TOLERANCE_CROSSTRACK:[0]
LOCATION_TOLERANCE_ALONGTRACK:[0]
YAW_ERROR:[0]
ROLL_ERROR:[0]
PITCH_ERROR:[0]
SUBSAT_LATITUDE_START:[0]
SUBSAT_LONGITUDE_START:[0]
SUBSAT_LATITUDE_END:[-81227]
SUBSAT_LONGITUDE_END:[-179045]
LEAP_SECOND:[0]
LEAP_SECOND_UTC:[xxxxxxxxxxxxxxZ]
TOTAL_RECORDS:[33]
TOTAL_MPHR:[1]
TOTAL_SPHR:[0]

TOTAL_IPR:[000005]
TOTAL_GEADR:[3]
TOTAL_GIADR:[1]
TOTAL_VEADR:[0]
TOTAL_VIADR:[0]
TOTAL_MDR:[000023]
COUNT_DEGRADED_INST_MDR:[1]
COUNT_DEGRADED_PROC_MDR:[1]
COUNT_DEGRADED_INST_MDR_BLOCKS:[0]
COUNT_DEGRADED_PROC_MDR_BLOCKS:[0]
DURATION_OF_PRODUCT:[183562]
MILLISECONDS_OF_DATA_PRESENT:[183562]
MILLISECONDS_OF_DATA_MISSING:[0]
SUBSETTED_PRODUCT:[0]

APPENDIX B FORMAT OF IASI_IPO DYNAMIC AUXILIARY DATA FILE

Outlier spectra, if encountered, are written to a dynamic auxiliary data file formatted in HDF5 as follows.

Name	Type	Data Type	Rank	Dim 1	Dim 2	Description
/L1Cfile	Attribute	string	0			Name of parent IASI L1C file.
/EV1file	Attribute	string	0			Name of IASI_EV1 file.
/EV2file	Attribute	string	0			Name of IASI_EV2 file.
/EV3file	Attribute	string	0			Name of IASI_EV3 file.
/NbrOutliers	Attribute	32-bit integer	1	1		Number of outlier spectra found.
/NbrScores	Attribute	32-bit integer	1	3		Number of PC scores per band.
/OutlierThreshold	Attribute	32-bit integer	1	3		Threshold on residual RMS (per band) for declaring outlier.
/ScoreQuantisationFactor	Attribute	32-bit integer	1	3		PC score quantisation factor per band.
/ResidualQuantisationFactor	Attribute	32-bit integer	1	3		Residual quantisation factor per band.
/LineNumber	Dataset	32-bit integer	1	/NbrOutliers		Outline spectra line number within the parent IASI L1C file (line numbers starting from 0).
/PixelNumber	Dataset	16-bit integer	1	/NbrOutliers		Outline spectra pixel number within the parent IASI L1C file (from 0 to 119).
/RecordStartTime	Dataset	64-bit floating-point	1	/NbrOutliers		Record start time of outlier spectra.
/Longitude	Dataset	32-bit floating-point	1	/NbrOutliers		Longitude of outlier spectra.
/Latitude	Dataset	32-bit floating-point	1	/NbrOutliers		Latitude of outlier spectra.
/GQisFlagQual	Dataset	boolean	2	/NbrOutliers	3	L1C quality flag of outlier spectra.
/ResidualRMS	Dataset	32-bit floating-point	2	/NbrOutliers	3	Noise-normalised residual RMS per band for outlier spectra.
/PccResidual	Dataset	8-bit integer	2	/NbrOutliers	8461	Quantised noise-normalised residuals of outlier spectra.
/L1cRadiance	Dataset	32-bit floating-point	2	/NbrOutliers	8461	Decoded IASI L1C outlier spectra. [Unit: $W/m^2/sr/m^{-1}$]
/Statistics/NbrCases	Attribute	32-bit integer	1	1		Number of spectra used for the residual statistics.
/Statistics/ResidualMean	Dataset	32-bit floating-point	1	8461		Noise-normalised residual mean.
/Statistics/ResidualStdv	Dataset	32-bit floating-point	1	8461		Noise-normalised residual standard deviation.

Table 1: HDF 5 objects in IASI_IPO

APPENDIX C EXAMPLE CONFIGURATION FILE

```
<?xml version="1.0" encoding="us-ascii"?>

<!--
  *  Description:
  *         Configuration file for the IASI PCC PPF.
-->

<IpccPpfConfig>
  <McsConfig>
    <FacilityId>PC</FacilityId>
    <SendStatusInterval>15</SendStatusInterval>
  </McsConfig>

  <Processing>
    <nbrScoresB1P1>   1  </nbrScoresB1P1>
    <nbrScoresB1P2>  41  </nbrScoresB1P2>
    <nbrScoresB1P3>  48  </nbrScoresB1P3>

    <nbrScoresB2P1>   2  </nbrScoresB2P1>
    <nbrScoresB2P2>  61  </nbrScoresB2P2>
    <nbrScoresB2P3>  57  </nbrScoresB2P3>

    <nbrScoresB3P1>   1  </nbrScoresB3P1>
    <nbrScoresB3P2>  44  </nbrScoresB3P2>
    <nbrScoresB3P3>  35  </nbrScoresB3P3>

    <outlierThresholdB1D1> 1.0947 </outlierThresholdB1D1>
    <outlierThresholdB1D2> 1.1427 </outlierThresholdB1D2>
    <outlierThresholdB1D3> 1.1215 </outlierThresholdB1D3>
    <outlierThresholdB1D4> 1.0768 </outlierThresholdB1D4>

    <outlierThresholdB2D1> 1.0993 </outlierThresholdB2D1>
    <outlierThresholdB2D2> 1.0006 </outlierThresholdB2D2>
    <outlierThresholdB2D3> 1.0024 </outlierThresholdB2D3>
    <outlierThresholdB2D4> 1.0019 </outlierThresholdB2D4>

    <outlierThresholdB3D1> 0.9902 </outlierThresholdB3D1>
    <outlierThresholdB3D2> 0.9899 </outlierThresholdB3D2>
    <outlierThresholdB3D3> 1.0418 </outlierThresholdB3D3>
    <outlierThresholdB3D4> 1.0628 </outlierThresholdB3D4>

    <outlierSlopeB1> 0.031742 </outlierSlopeB1>
    <outlierSlopeB2> 0.23556 </outlierSlopeB2>
    <outlierSlopeB3> 3.7215 </outlierSlopeB3>

    <scoreQuantisationFactorB1> 0.5   </scoreQuantisationFactorB1>
    <scoreQuantisationFactorB2> 0.5   </scoreQuantisationFactorB2>
    <scoreQuantisationFactorB3> 0.5   </scoreQuantisationFactorB3>

    <residualQuantisationFactorB1> 0.5   </residualQuantisationFactorB1>
    <residualQuantisationFactorB2> 0.5   </residualQuantisationFactorB2>
    <residualQuantisationFactorB3> 0.5   </residualQuantisationFactorB3>

  </Processing>
</IpccPpfConfig>
```