Product User Guide – IASI Level 1c FCDR release 1

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Document Change Record

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V2	17 April 2019		New version for DRR
V2B	2 May 2019		Final version for DRR
V2D	2 October 2019		Final version after reply to the RIDs and EUM QA review
V2E	12 November 2019		Final version

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Table of Contents

1 Introduction

1.1 Purpose and Scope

The purpose of this guide is to provide users with detailed information about Release-1 of the Fundamental Climate Data Record (FCDR) of reprocessed Metop-A Infrared Atmospheric Sounding Interferometer (IASI) Level 1c product. The main objective for the IASI measurements is to provide high resolution atmospheric emission spectra to derive temperature and humidity profiles with high spectral and vertical resolution and accuracy. Additionally, it is used for the determination of trace gases such as ozone, nitrous oxide, carbon dioxide and methane, as well as land and sea surface temperature, emissivity and cloud properties.

The scope of this document is to explain the data and method used to derive the FCDR, the format of the product and to give some information concerning the validation of the data record. Reference documents listed in §1.3 provide complementary information.

This document describes the Metop-A IASI level 1c Release 1 data record. This release consists of one data record generated by version 7.4 of the EUMETSAT operational IASI processing chain and the most recent updated auxiliary files provided by CNES, using the full orbit level 0 products retrieved from the EUMETSAT archive.

This release comprises level 1c data from Metop-A satellite for the period ranging from the 10th of July 2007 until the 31st December 2017. The IASI L1c product contains infrared radiance spectra at 0.25cm^{-1} sampling. The level 1c product has for each sounder pixel 8461 spectral samples covering the range between 645 cm^{-1} and 2760 cm^{-1} wavenumbers. It can be regarded as an FCDR, i.e., a long-term data record of calibrated and quality-controlled sensor data designed to allow the generation of homogeneous products that are accurate and stable enough for climate monitoring and data assimilation for re-analysis of the recent climate.

This guide provides:
1. Specifications of the data record;
2. Scientific details of the generation and definition of the data record;
3. Characteristics and limitations of the product, aiming to assist the users in the decision of whether they can or should use this data record for their applications;
4. Technical details of the format and how to order the data record, as well as information on the mechanisms to provide feedback.

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1.2 Applicable documents

	Document Name	EUMETSAT reference
AD1.	IASI level 1: Product Guide	EUM/OPS-EPS/MAN/04/0032
AD2.	IASI level 1 Product Format Specification	EUM.EPS.SYS.SPE.990003
AD3.	IASI L1 Day-2 product specifications	EUM/OPS-EPS/SPE/08/0231
AD4.	Validation Report – IASI-A Level 1c FCDR release 1	EUM/RSP/REP/18/1024768

1.3 Reference documents

Number	Document Reference
RD1.	EPS Generic Product Format Specification, EPS/GGS/SPE/96167
RD2.	Object oriented IDL EPS Product Reader: User Manual, EUM/OPS-EPS/MAN/08/0029,
RD3.	IASI Quarterly Performance Report, CNES , https://iasi.cnes.fr/sites/default/files/drupal/201710/default/iasi_m02_quarterly_2010-12_2011-02_0.pdf
RD4.	Chalon, G., Cayla, F., and Diebel, D., 2001: "IASI: An Advanced Sounder for Operational Meteorology", Proceedings of the 52nd Congress of IAF, Toulouse France, 1-5 Oct. 2001.
RD5.	Siméoni, D., Astruc, P., Miras, D., Alis, C., Andreis, O., Scheidel, D., Degrelle, C., Nicol, P., Bailly, B., et al., 2004: Design and development of IASI instrument, SPIE Conference, August 2004.
RD6.	GCOS-154, 2011: Systematic Observation Requirements for Satellite-Based Products for Climate, 2011 Update, December 2011, 139 pp.
RD7.	Hébert, P., D. Blumstein, C. Buil, T. Carlier, G. Chalon, P. Astruc, A. Clauss, D. Siméoni, B. Tournier, 2004: IASI Instrument: technical description and Measured Performances. Proceedings of the 5th International Conference on Space Optics (ICSO 2004), 30 March –2 April 2004, Toulouse, 49 - 56.
RD8.	Hilton, F., R. Armante, T. August, C. Barnet, A. Bouchard, C. Camy-Peyret, V. Capelle, L. Clarisse, C. Clerbaux, P. Coheur, A. Collard, C. Crevoisier, G. Dufour, D. Edwards, F. Faijan, N. Fourrié, A. Gambacorta, M. Goldberg, V. Guidard, D. Hurtmans, S. Illingworth, N. Jacquinet-Husson, T. Kerzenmacher, D. Klaes, L. Lavanant, G. Masiello, M. Matricardi, A. McNally, S. Newman, E. Pavelin, S. Payan, E. Péquignot, S. Peyridieu, T. Phulpin, J. Remedios, P. Schlüssel, C. Serio, L. Strow, C. Stubenrauch, J. Taylor, D. Tobin, W. Wolf, and D. Zhou, 2012: Hyperspectral Earth Observation from IASI: Five Years of Accomplishments. Bull. Amer. Meteor. Soc., 93, 347–370, https://doi.org/10.1175/BAMS-D-11-00027.1
RD9.	EUMETSAT data policy, link to the pdf file

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1.4 Acronyms and Abbreviations

The table below lists acronyms and abbreviations used in this document:

ACRONYM	MEANING
ATBD	Algorithm Theoretical Baseline Document
AVHRR	Advanced Very High Resolution Radiometer
BUFR	Binary Universal Form for the Representation of meteorological data
CDR	Climate Data Record
CF	Climate and Forecast
CNES	Centre National d'Etudes Spatiales
DOI	Digital Object Identifier
ECMWF	European Centre for Medium-Range Weather Forecasts
EPS	EUMETSAT Polar System
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FCDR	Fundamental Climate Data Record
FOV	Field of View
GSICS	Global Space-based Inter-calibration System
IASI	Infrared Atmospheric Sounding Interferometer
IIS	Integrated Imaging Subsystem
JPEG	Joint Photographic Experts Group
LEO	Low Earth Orbit
MDR	Measurement Data Record
METOP	Meteorological operational satellite
MPHR	Main Product Header
NAS	Network Attached Storage
NETCDF	network Common Data Form
NRT	Near Real Time
NWP	Numerical Weather Prediction
PNG	Portable Network Graphics
TEC	Technical Expertise Center (of Cnes)
TIFF	Tagged Image File Format
WMO	World Meteorological Organisation

1.5 Definitions

IASI data levels definition:

- Level 1a - Decoded spectral and image data after additional radiometric calibration corrections, spectral calibration appended, location and co-location with AVHRR/3 images.
- Level 1b - Re-sampled spectrum.
- Level 1c - Re-sampled spectrum with apodisation.

Product types:

- Fundamental Climate Data Record - a well-characterised, long-term data record, usually involving a series of instruments, with potentially changing measurement approaches, but with overlaps and calibrations sufficient to allow the generation of products that are accurate and stable, in both space and time, to support climate applications. FCDRs are typically calibrated radiances, backscatter of active instruments, or radio occultation bending-angles. FCDRs also include the ancillary data used to calibrate them [RD6].

2 Background

The full IASI level 1 products overview is detailed in section 4 of [AD1]. The following part of this section only highlights specific selected parts. The rest of the document only describes level 1c data.

IASI is an infrared sounder providing atmospheric and surface information [RD4, RD5]. It is composed of a Fourier-transform spectrometer and an associated Integrated Imaging Subsystem (IIS). The Fourier transform spectrometer provides infrared spectra with high spectral resolution between 645 and 2760 cm^{-1} (3.6 µm to 15.5 µm), see Table 1. The IIS consists of a broadband radiometer with a high spatial resolution. However, the IIS information is only used for co-registration with the Advanced Very High Resolution Radiometer (AVHRR). The IASI instruments are mounted on the Metop satellite series[1]. Metop-A and Metop-B were launched in 2006 and 2012, respectively. The Metop-C satellite is the last of the series and was launched on the 6th of November 2018. The instruments onboard Metop-A, -B, and –C are called IASI-A, IASI-B, and IASI-C respectively.

Band	Wave number (cm^{-1})	Wavelength (µm)
1	645 – 1210	8.26 – 15.50
2	1210 – 2000	5.00 – 8.26
3	2000 - 2760	3.62 – 5.00

Table 1: *IASI's three spectral bands.*

To achieve a global coverage, the IASI instrument observes the Earth up to a viewing angle of 48.3 degrees on either side of the satellite track (Figure 1). For each view, the instrument analyses an atmospheric cell of about 3.3 degrees x 3.3 degrees, or 50 km x 50 km at nadir. Each cell is analysed simultaneously by a 2 x 2 array of detectors. This geometrical arrangement, combined with the step-by-step scanning mode, gives IASI a field of view that is compatible with the other instruments on the platform. The pixel diameter of 12 kilometres is a trade-off between radiometric performance and statistics indicating the likelihood of acquiring valid measurements, depending on cloud cover.

[1] In this document, IASI instrument on board Metop-A, -B, and –C are called IASI-A, IASI-B, and IASI-C respectively. Only IASI-A data have been reprocessed in the release 1.

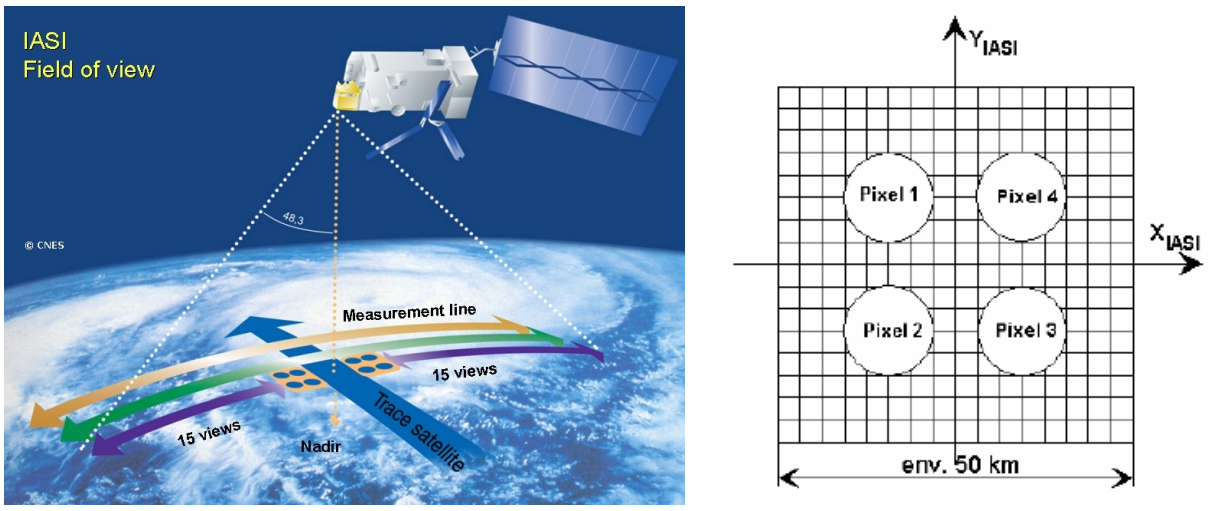

Figure 1: *The IASI observing system (left, www.cnes.fr). Field of View (FoV) of the sounder (about 16x16 km) and the imager (about 50x50 km, shown on the right plot).*

IASI Level 1 data is designed for Numerical Weather Prediction (NWP) and climate applications. Due to its high spectral resolution, IASI enables vertically resolved temperature and humidity profiling by sounding the atmospheric absorption bands. Further, it measures O_3, CH_4, CO and N_2O gas constituents and trace gas with a high degree of accuracy [RD7].

The data acquired by IASI are processed operationally at EUMETSAT in near-real-time using a processing chain with on-board and on-ground processing steps. Operational level 1 products include 5 sub-products. Table 2 illustrates the various IASI level 1 products. All along the processing chain, quality flags are processed to ensure that the measurements are within the requirements. Details on requirements in terms of noise equivalent for each processing step can be found in [RD3].

Product Name	Product id	Content
Level 1a	IASI_xxx_1A	Decoded spectral and image data after additional radiometric calibration corrections, spectral calibration appended, location and co-location with AVHRR/3 images.
Level 1b	IASI_xxx_1B	Re-sampled spectrum
Level 1c	IASI_xxx_1C	Re-sampled spectrum with apodisation.
Verification Product	IASI_VER_01	Verification data: raw interferogram and calibration coefficients used on-board.
Engineering Product	IASI_ENG_01	All parameters: output of IASI software used by the CNES Technical Engineering Center (TEC) for evaluation

Table 2: *List of IASI level 1 products. This document addresses only the IASI level 1c reprocessed product that is marked in red.*

Many studies have demonstrated that the quality of the near real-time product is much better compared to the requirements. For that reason, the instrument is used in GSICS as a reference for cross-calibration of other infrared sensors and diverse validation/impact studies [RD8]. The quality of IASI L1c product is also crucial to derive unbiased atmospheric parameters and build homogeneous data records.

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Since 2007, Metop-A IASI Level 1c radiances have been collected. Throughout the time, several changes/updates in the operational processing chain have been implemented. Those changes had some minor impacts on the homogeneity and quality of the data. However, to get a complete stable time series derived with the same processing chain over the period, EUMETSAT has addressed all of the issues in the last reprocessing for the period from the 10th of July 2007 to the 31st of December 2017 to:

- slightly adjust the spectral harmonisation,
- include the detailed flagging (as described in [AD2]) for the on-board processing and the cloud and land/sea information,
- filling data gaps for failed operational Level 0 to Level 1 conversions.

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3 Data Record Overview

The following table describes the IASI-A L1c FCDR.

General	Data record name	IASI level 1c release 1 (CF-001).
	Data record digital identifier	10.15770/EUM_SEC_CLM_0014
	Data record short description	Reprocessed FCDR level 1c IASI data from the Metop-A satellite
	Record type	Fundamental Climate Data Record
	Period covered	10 July 2007 – 31 December 2017
	Content	IASI level 1c products (FCDR)
Instrument	Instrument name	Infrared Atmospheric Sounding Interferometer (IASI)
	Instrument description	The Infrared Atmospheric Sounding Interferometer (IASI) is one of the instruments flying on Metop-A, -B and- C. The IASI L1c product contains infrared radiance spectra at 0.25 cm^{-1} spectral sampling. The level 1c product has for each sounder pixel 8461 spectral samples covering the range between 645 cm^{-1} and 2760 cm^{-1}.
Instrument	Input data	IASI level 0 AVHRR level 1b
	Auxiliary file	Updated ODB, GRD and BRD provided by CNES
	Output data	IASI level 1c data
	Format	The CDR are produced in native-eps
Access	EUMETSAT Data Centre	The data set is available from EUMETSAT Data Centre (https://eoportal.eumetsat.int/)
	Delivery	• ftp (push, online pull and offline delivery with FEDEX)
Coverage	Spatial	• global (each instantaneous FoV ground resolution of 12 km at nadir)
	Temporal	~100 minutes

4 Product definition

This chapter provides summary information on file-size, file content, file formats, and file-names for the Metop-A IASI level 1c Release 1 FCDR.

4.1 Physical definition

IASI level 1c data contain radiance spectra in $mW/m^2/sr/cm^{-1}$. Figure 2 shows an example of a spectrum for the four individual pixels in radiance and temperature for one particular scanline and one particular field of view (FoV).

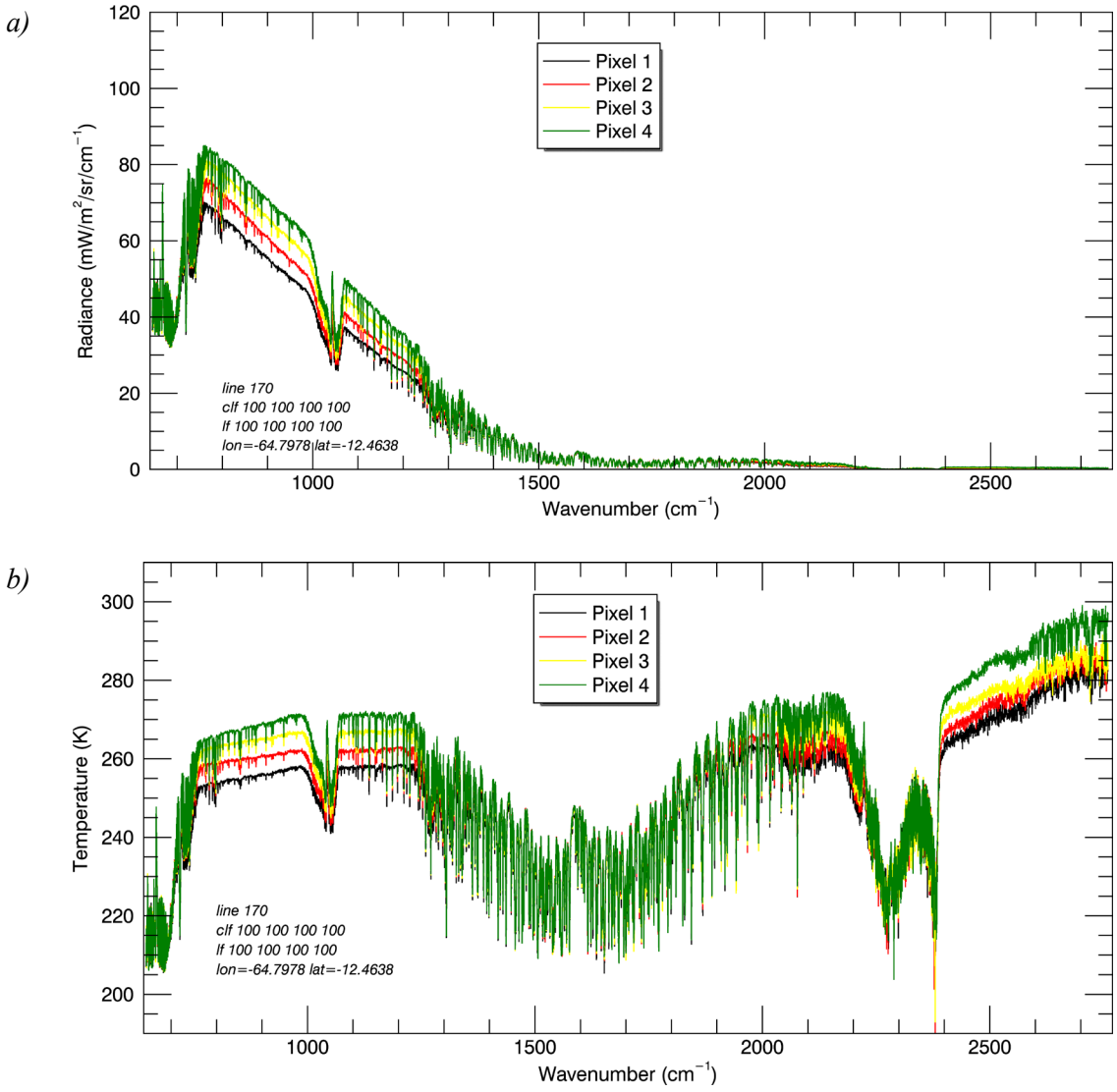

Figure 2: *Example of a IASI spectra for the 4 individual pixels in radiance (a) and brightness temperature (b) for IASI onboard Metop-A on the 12th January 2008 at 13:17, for the scanline 170 and the FoV=15.*
(IASI_xxx_1C_M02_20080112131754Z_20080112145658Z_R_O_20171023180920Z_010)

4.2 Data file contents

Each file contains data from one full IASI dump (Svalbard to Svalbard). [AD1] describe IASI level 1 products. [AD2] and [AD3] provides information on the product format. A total of 52078 level 0 dumps were used for the reprocessing. As illustrated by Figure 3, each IASI dump is made of two parts of an IASI orbit that is defined from Equator to Equator crossing.

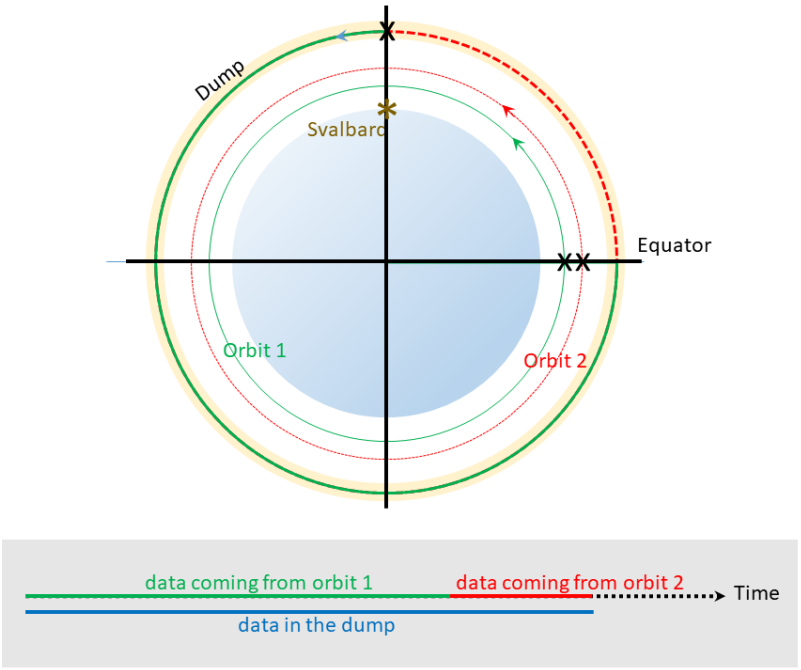

Figure 3: *Simplistic view of the data included in a dump file. The outer circle shows that data included in a dump contains 3/4 of data coming from the orbit 1 (green) and 1/4 of data from the orbit 2 (red).*

4.3 Data and file name format description

Reprocessed native EPS files can be identified by their filenames for which the processing mode is set to ***R***. A reprocessed IASI level 1c filename follows the convention:

Convention	<instrument>_<product_type>_<processing_level>_<satellite>_<sensingstart>_<sensing_stop>_<processing_mode>_<disposition_mode>_<processing_time>_<reprocessing_baseline>
Product name	IASI_xxx_1C_M02_20070710072358Z_20070710090558Z_R_O_20171005143111Z_0100

Table 3: *IASI level 1c filename description*

4.4 Product generated

The operational processing of IASI level 1c data is summarised in Figure 4.

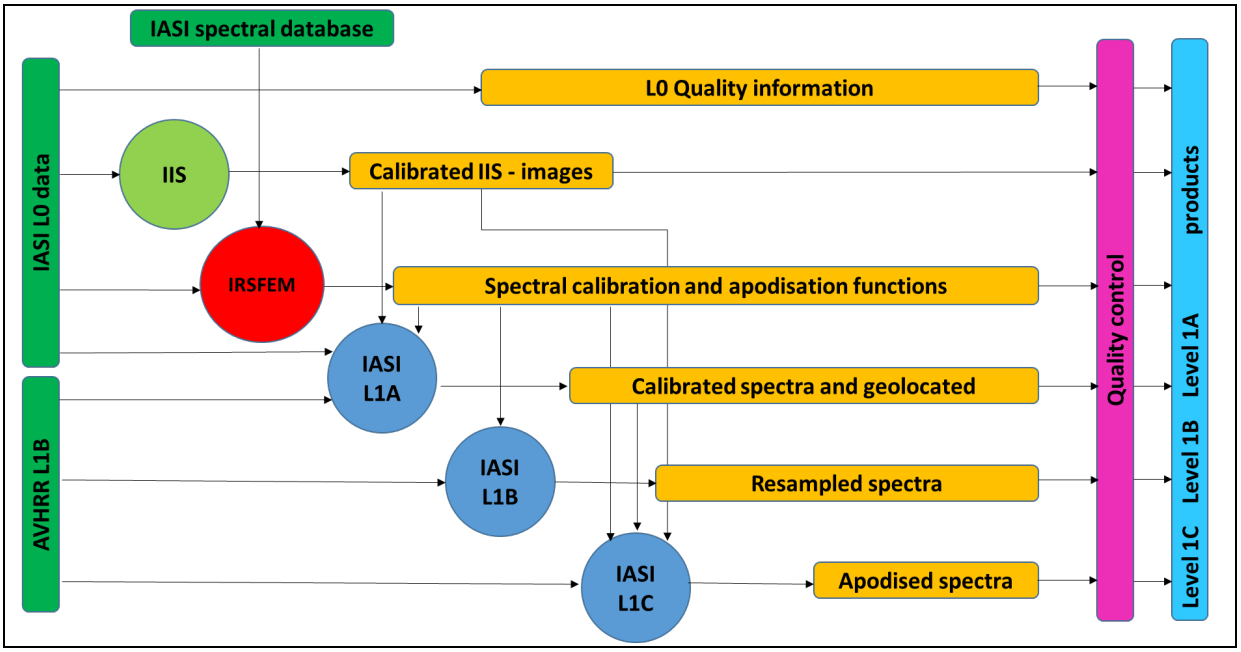

Figure 4: *Level 1 processing chain including IASI level 0, AVHRR L1b and the IASI spectral database.*

Only the IASI level 1c data are archived and accessible to the users. The reprocessing was done by EUMETSAT, using version 7.4.0 of the IASI processor. The reprocessing used the last updated auxiliary files provided by CNES, and the full orbit level 0 products retrieved from the EUMETSAT archive.

4.5 Time coverage

The data record has been generated for the time period from the 10th of July 2007 to the 31st of December 2017.

4.6 Format

The data record is produced and archived in EUMETSAT EPS native format. It can also be requested in BUFR, netCDF, JPEG, PNG, and TIFF formats.

The EPS native format is structured and defined according to a generic EPS product format, which is not IASI-specific. Details of the EPS native generic format specification are given in [RD1] and specific IASI parts can be found in [AD2] and [AD3]. The general structure of the format is broken down into sections, which contain one or more records of different classes. A native EUMETSAT generic EPS format reader is available [RD2].

The Binary Universal Form for the Representation of meteorological data (BUFR) is a binary data format maintained by the World Meteorological Organization (WMO). The Manual on Codes and tables defined by WMO can be found on the WMO website.

4.7 Product description

The content description of the IASI level 1 products is provided in section 9.3 of [AD1]. Appendix 1 of this document gives the list of parameters contained in one Measurement Data Record (MDR).

5 Product change/validation summary

The Metop-A IASI Level 1c reprocessed data were validated [AD4], and each update of the processing chain has been analysed by comparing the operational level 1c product with the reprocessed level 1c product over the same period (before/after the change).

The reprocessing was has taken into account the following evolutions in the processing chain:

a) The "Day-2 evolution" algorithms (product format changes, quality flags, as well as cloud and land/sea information),

b) The slight improvement of the spectral harmonization in February 2011 (affecting mainly the CO channels),

In addition, the reprocessing has filled the gaps found in the time-series. The impact was shown to be positive on the data quality. This FCDR has no known limitation for any application including trend analysis

6 Product ordering

Access to the data record can be granted to all users without charge, provided they comply with the EUMETSAT Data Policy described in [RD9] and the following EUMETSAT webpage: *https://www.eumetsat.int/website/home/AboutUs/WhoWeAre/LegalFramework/DataPolicy/index.html*.
To access data, users need to register with the EUMETSAT Data Centre. Once registered, users can order the data by means of a written request sent to EUMETSAT's helpdesk.

6.1 Registering with the Data Centre

To register with the EUMETSAT Data Centre, carry out the following:

1 Register in the EUMETSAT EO-Portal (*https://eoportal.eumetsat.int/*) by clicking on the New User – Create New Account tab;

2 After finalisation of the registration process, an e-mail is sent to the e-mail address entered in the registration. Click the confirmation link in the e-mail to activate the account;

3 Login and subscribe to the Data Centre Service by going to the Service Subscription Tab and selecting Data Centre Service. Follow the instructions provided to add the necessary information.

6.2 Ordering Data

The data record described in this product user guide can also be ordered via the EUMETSAT User Service Helpdesk in Darmstadt, Germany. Please send a written request to the Helpdesk, e-mail *ops@eumetsat.int,* indicating the data record that you wish to order, including its Digital Object Identifier (DOI) number: *10.15770/EUM_SEC_CLM_0014.*

7 Product support and feedback

For enquiries about the Metop-A IASI FCDR described in this product user guide, please contact the EUMETSAT User Service Helpdesk by e-mail: *ops@eumetsat.int.*

8 Product referencing

The data record described in this product user guide has a unique DOI that should be used for referencing. The product's filename acts as a unique identifier for each product. Please note that the DOI is not included in the BUFR files.

9 Acknowledgments

EUMETSAT is grateful to CNES/TEC for scientific collaboration and technical support.

APPENDIX A LIST OF NATIVE EPS FORMAT MDR CONTENT

The following file contents are shown as an example, which was retrieved using idl reading software similar to [RD2].

- MDR

```
help,(*(*mdr)[1])

* Structure IASI_MDR_1C_FMV_11, 60 tags, length=2767996, data length=2728908:
   GRH                           STRUCT    -> READ_GRH Array[1]
   DEGRADED_INST_MDR             BYTE      Array[1]
   DEGRADED_PROC_MDR             BYTE      Array[1]
   GEPSIASIMODE                  BYTE      Array[4]
   GEPSOPSPROCESSINGMODE         BYTE      Array[4]
   GEPSIDCONF                    BYTE      Array[32]
   GEPSLOCIASIAVHRR_IASI         STRUCT    -> VINTEGER4 Array[2, 4, 30]
   GEPSLOCIASIAVHRR_IIS          STRUCT    -> VINTEGER4 Array[2, 25, 30]
   OBT                           BYTE      Array[6, 30]
   ONBOARDUTC                    STRUCT    -> SHORT_CDS_TIME Array[30]
   GEPSDATIASI                   STRUCT    -> SHORT_CDS_TIME Array[30]
   GISFLINORIGIN                 LONG      Array[2]
   GISFCOLORIGIN                 LONG      Array[2]
   GISFPDS1                      LONG      Array[2]
   GISFPDS2                      LONG      Array[2]
   GISFPDS3                      LONG      Array[2]
   GISFPDS4                      LONG      Array[2]
   GEPS_CCD                      BYTE      Array[30]
   GEPS_SP                       LONG      Array[30]
   GIRCIMAGE                     UINT      Array[64, 64, 30]
   GQISFLAGQUAL                  BYTE      Array[3, 4, 30]
   GQISFLAGQUALDETAILED          BYTE      Array[2, 4, 30]
   GQISQUALINDEX                 STRUCT    -> VINTEGER4 Array[1]
   GQISQUALINDEXIIS              STRUCT    -> VINTEGER4 Array[1]
   GQISQUALINDEXLOC              STRUCT    -> VINTEGER4 Array[1]
   GQISQUALINDEXRAD              STRUCT    -> VINTEGER4 Array[1]
   GQISQUALINDEXSPECT            STRUCT    -> VINTEGER4 Array[1]
   GQISSYSTECIISQUAL             ULONG     Array[1]
   GQISSYSTECSONDQUAL            ULONG     Array[1]
   GGEOSONDLOC                   LONG      Array[2, 4, 30]
   GGEOSONDANGLESMETOP           LONG      Array[2, 4, 30]
   GGEOIISANGLESMETOP            LONG      Array[2, 25, 30]
   GGEOSONDANGLESSUN             LONG      Array[2, 4, 30]
   GGEOIISANGLESSUN              LONG      Array[2, 25, 30]
   GGEOIISLOC                    LONG      Array[2, 25, 30]
   EARTH_SATELLITE_DISTANCE      ULONG     Array[1]
   IDEFSPECTDWN1B                STRUCT    -> VINTEGER4 Array[1]
   IDEFNSFIRST1B                 LONG      Array[1]
   IDEFNSLAST1B                  LONG      Array[1]
   GS1CSPECT                     INT       Array[8700, 4, 30]
   IDEFCOVARMATEIGENVAL1C        STRUCT    -> VINTEGER4 Array[2, 100]
   IDEFCCSCHANNELID              LONG      Array[6]
   GCCSRADANALNBCLASS            LONG      Array[4, 30]
   GCCSRADANALWGT                STRUCT    -> VINTEGER4 Array[7, 4, 30]
   GCCSRADANALY                  LONG      Array[7, 4, 30]
   GCCSRADANALZ                  LONG      Array[7, 4, 30]
   GCCSRADANALMEAN               STRUCT    -> VINTEGER4 Array[6, 7, 4, 30]
   GCCSRADANALSTD                STRUCT    -> VINTEGER4 Array[6, 7, 4, 30]
   GCCSIMAGECLASSIFIED           BYTE      Array[100, 100, 30]
   IDEFCCSMODE                   BYTE      Array[4]
   GCCSIMAGECLASSIFIEDNBLIN      INT       Array[30]
```

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```
   GCCSIMAGECLASSIFIEDNBCOL      INT       Array[30]
   GCCSIMAGECLASSIFIEDFIRSTLIN   STRUCT    -> VINTEGER4 Array[30]
   GCCSIMAGECLASSIFIEDFIRSTCOL   STRUCT    -> VINTEGER4 Array[30]
   GCCSRADANALTYPE               BYTE      Array[7, 30]
   GIACVARIMAGIIS                STRUCT    -> VINTEGER4 Array[30]
   GIACAVGIMAGIIS                STRUCT    -> VINTEGER4 Array[30]
   GEUMAVHRR1BCLDFRAC            BYTE      Array[4, 30]
   GEUMAVHRR1BLANDFRAC           BYTE      Array[4, 30]
   GEUMAVHRR1BQUAL               BYTE      Array[4, 30]
```

- GIADR content

```
help,GIADR,/structure
** Structure <28d6828>, 3 tags, length=361048, data length=228446, refs=1:
   TYPE                          STRING    'GIADR'
   GIADR0                        STRUCT    -> IASI_GIADR_0_FMV_11 Array[1]
   GIADR1                        STRUCT    -> IASI_GIADR_1_FMV_11 Array[1]


help,GIADR.GIADR1,/struct
** Structure IASI_GIADR_1_FMV_11, 6 tags, length=88, data length=84:
   GRH                           STRUCT    -> READ_GRH Array[1]
   IDEFSCALESONDNBSCALE          INT       Array[1]
   IDEFSCALESONDNSFIRST          INT       Array[10]
   IDEFSCALESONDNSLAST           INT       Array[10]
   IDEFSCALESONDSCALEFACTOR      INT       Array[10]
   IDEFSCALEIISSCALEFACTOR       INT       Array[1]

help,GIADR.GIADR0,/structure
** Structure IASI_GIADR_0_FMV_11, 13 tags, length=360944, data length=228346:
   GRH                           STRUCT    -> READ_GRH Array[1]
   IDEFPSFSONDNBLIN              LONG      Array[4]
   IDEFPSFSONDNBCOL              LONG      Array[4]
   IDEFPSFSONDOVERSAMPFACTOR     STRUCT    -> VINTEGER4 Array[1]
   IDEFPSFSONDY                  LONG      Array[100, 4]
   IDEFPSFSONDZ                  LONG      Array[100, 4]
   IDEFPSFSONDWGT                STRUCT    -> VINTEGER4 Array[100, 100, 4]
   IDEFLLSSRFNSFIRST             LONG      Array[1]
   IDEFLLSSRFNSLAST              LONG      Array[1]
   IDEFLLSSRF                    STRUCT    -> VINTEGER4 Array[100]
   IDEFLLSSRFDWN                 STRUCT    -> VINTEGER4 Array[1]
   IDEFIISNEDT                   STRUCT    -> VINTEGER4 Array[64, 64]
   IDEFDPTIISDEADPIX             BYTE      Array[64, 64]
```

- MPHR - Example for the file
  IASI_xxx_1C_M02_20130101001158Z_20130101015357Z_R_O_20180206133918Z

```
help,IASI_mphr,/struct
** Structure <28d2308>, 79 tags, length=1176, data length=1172, refs=1:
   RECORD_CLASS                  BYTE         1
   INSTRUMENT_GROUP              BYTE         0
   RECORD_SUBCLASS               BYTE         0
   RECORD_SUBCLASS_VERSION       BYTE         2
   RECORD_SIZE                   ULONG             3307
   RECORD_START_TIME             STRUCT    -> SHORT_CDS_TIME Array[1]
   RECORD_STOP_TIME              STRUCT    -> SHORT_CDS_TIME Array[1]
   PRODUCT_NAME                  STRING
'IASI_xxx_1C_M02_20130101001158Z_20130101015357Z_R_O_20180206133918Z'
   PARENT_PRODUCT_NAME_1         STRING
'IASI_xxx_00_M02_20130101001152Z_20130101015359Z_N_O_20130101005620Z'
```

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   PARENT_PRODUCT_NAME_2          STRING
'xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'
   PARENT_PRODUCT_NAME_3          STRING
'xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'
   PARENT_PRODUCT_NAME_4          STRING
'xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'
   INSTRUMENT_ID                  STRING    'IASI'
   INSTRUMENT_MODEL               STRING    '1'
   PRODUCT_TYPE                   STRING    'xxx'
   PROCESSING_LEVEL               STRING    '1C'
   SPACECRAFT_ID                  STRING    'M02'
   SENSING_START                  STRING    '201301010011158Z'
   SENSING_END                    STRING    '201301010015357Z'
   SENSING_START_THEORETICAL      STRING    'xxxxxxxxxxxxxxZ'
   SENSING_END_DUMP_THEORETICAL   STRING    'xxxxxxxxxxxxxxZ'
   PROCESSING_CENTRE              STRING    'CDR_'
   PROCESSOR_MAJOR_VERSION        STRING    '8'
   PROCESSOR_MINOR_VERSION        STRING    '0'
   FORMAT_MAJOR_VERSION           STRING    '11'
   FORMAT_MINOR_VERSION           STRING    '0'
   PROCESSING_TIME_START          STRING    '20180206151308Z'
   PROCESSING_TIME_END            STRING    '20180206151749Z'
   PROCESSING_MODE                STRING    'R'
   DISPOSITION_MODE               STRING    'O'
   RECIEVING_GROUND_STATION       STRING    'SVL'
   RECEIVE_TIME_START             STRING    'xxxxxxxxxxxxxxZ'
   RECEIVE_TIME_END               STRING    'xxxxxxxxxxxxxxZ'
   ORBIT_START                    STRING    '32183'
   ORBIT_END                      STRING    '32184'
   ACTUAL_PRODUCT_SIZE            STRING    '2087846438'
   STATE_VECTOR_TIME              STRING    '20121231234251000Z'
   SEMI_MAJOR_AXIS                STRING    '7204511744'
   ECCENTRICITY                   STRING    '1176'
   INCLINATION                    STRING    '98671'
   PERIGEE_ARGUMENT               STRING    '74438'
   RIGHT_ASCENSION                STRING    '63171'
   MEAN_ANOMALY                   STRING    '285720'
   X_POSITION                     STRING    '6016507581'
   Y_POSITION                     STRING    '-3959007916'
   Z_POSITION                     STRING    '3571082'
   X_VELOCITY                     STRING    '-915424'
   Y_VELOCITY                     STRING    '-1369214'
   Z_VELOCITY                     STRING    '7355474'
   EARTH_SUN_DISTANCE_RATIO       STRING    '0'
   LOCATION_TOLERANCE_RADIAL      STRING    '0'
   LOCATION_TOLERANCE_ALONGTRACK  STRING    '0'
   LOCATION_TOLERANCE_CROSSTRACK  STRING    '0'
   YAW_ERROR                      STRING    '0'
   ROLL_ERROR                     STRING    '0'
   PITCH_ERROR                    STRING    '0'
   SUBSAT_LATITUDE_START          STRING    '73989'
   SUBSAT_LONGITUDE_START         STRING    '171312'
   SUBSAT_LATITUDE_END            STRING    '72455'
   SUBSAT_LONGITUDE_END           STRING    '142600'
   LEAP_SECOND                    STRING    '0'
   LEAP_SECOND_UTC                STRING    'xxxxxxxxxxxxxxZ'
   TOTAL_RECORDS                  STRING    '771'
   TOTAL_MPHR                     STRING    '1'
   TOTAL_SPHR                     STRING    '0'
   TOTAL_IPR                      STRING    '3'
```

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TOTAL_GEADR                    STRING    '0'
TOTAL_GIADR                    STRING    '2'
TOTAL_VEADR                    STRING    '0'
TOTAL_VIADR                    STRING    '0'
TOTAL_MDR                      STRING    '765'
COUNT_DEGRADED_INST_MDR        STRING    '1499'
COUNT_DEGRADED_PROC_MDR        STRING    '390'
COUNT_DEGRADED_INST_MDR_BLOCKS STRING    '0'
COUNT_DEGRADED_PROC_MDR_BLOCKS STRING    '0'
DURATION_OF_PRODUCT            STRING    '6119971'
MILLISECONDS_OF_DATA_PRESENT   STRING    '6119971'
MILLISECONDS_OF_DATA_MISSING   STRING    '0'
SUBSETTED_PRODUCT              STRING    '0'
```