EUMETSAT

IASI Level 2 Product Guide

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Document Change Record

Version/Date	Section	Description of change
v1 17/12/2004	Full document	First issue of the document.
v2 31/10/2008	Section 2 Section 3 Sections 4 & 8 Sections 6.2 - 6.6 Appendix B Appendix F General	Update to reflect start of Metop/IASI-L2: Additional references RD10, 25, 26, 74-79. Deleted reference RD59 which duplicates RD58. Configuration history added. Minor text additions and corrections. Additional dissemination details. Updates to sentences for Level 1c & Level 2. - GIADR table: Field sizes for PRESSURE_LEVELS_OZONE and SURFACE_EMISSIVITY_WAVELENGTHS corrected, affecting offsets and total record size. - MDR table: Updates to several values for scaling factor, dimensions, field size affecting ATMOSPHERIC_OZONE, INTEGRATED_OZONE, INEGRATED_N2O, INTEGRATED_CH4, SURFACE_EMISSIVITY, DATA_SIZES; also offsets and total record size corrected. Other general layout improvements and typo corrections.
v2A 12/11/2008	Section 4	New section 4.3.2 inserted “Vertical resolution of the temperature and humidity profiles”.
v2B 07/04/2009	Full document Section 3 Section 5.1 Section 6.5 Section 10 General	Document restructured - App. F & G renamed as Sec. 10 & 11, and common appendices removed to keep as separate document. Configuration history tables updated. EPSView description replaced by text on available generic tools. Table 6-7: Added lists of BUFR descriptor sequences. - Updates to Field Size and Offset values in GIADR & MDR to correspond to adopted default values of parameters NEW & NLO. Explanatory paragraph added near start of section. - Description of MDR.CLOUD_PHASE updated to include value 255. - Descriptions in NAVIGATION_STATUS bitfield updated to correspond with those in PFS. Various minor editorial updates, correction of typos and hyperlinks.

Version/Date	Section	Description of change
v2C 03/12/2010	 Section 2 Section 3 Section 4 Section 8 Section 9.3 (now) General	Most of the updates relate to release of new PPF software version 5.1. Added references RD27 to RD31. Configuration History table updates including new PPF s/w versions. Sec. 4.2.2.2: Fewer cloud detection tests. Sec. 4.2.2.3: Simplified determination of cloud top height and fractional cloud cover. New section 4.2.3.5 “Temperature & water vapour profiles” – additional retrievals result in availability of temperature profiles for >50% of field of view where previously only 10-12%. Sec. 4.3.2: Clarification of cloudiness flags. Merged with Section 9 and introduced the four Product Validation Reports applicable to ‘Day 2’ operations. Added note on bit numbering convention used (different from IASI-L2 PGS). Updates to descriptions for FLG_IASICLR, FLG_CLDTST and FLG_IASICLD. Other minor textual and hyperlink updates.
v2D 14/03/2011	 Section 1 Section 2 Section 3 Section 4 Section 5 Section 6 Section 8	L2Pcore GHRSST updates: Added text. Added references RD32, 33, 42, 80-85. Configuration History - new PPF s/w version 5.1.1. New Sec. 4.2.4 & 4.4. New Sec. 5.3. New Sec. 6.2.3 & 6.6. Table 6-1 additions. New Sec. 8.2.
v2E 25/03/2011	Section 11	New section (forgot to include with v2D).
v2F 20/10/2011	Section 3 Section 4	• Added table giving the IASI L2P Core SST Single Sensor Error Statistics updates. • New version of IASI L2 PPF- V5.2.1. • More description added in Sec. 4.4 regarding the bias and standard deviation used for quality information. • Added section 4.6 on the IASI L2 product status.
v2G 19/07/2012	Section 3	• Update Table 3-2 and Table 3-3

Table of Contents

Table of Figures

Table of Tables

1 INTRODUCTION

This user guide is intended to support the users of EUMETSAT Polar System (EPS) IASI Level 2 products. It provides information about the products available, how to access them, how to extract and interpret the data, and it also aims to help the user in choosing a product for a particular application.

In Appendix A, a full list of EPS products generated at EUMETSAT is given. These products will be addressed in this guide:

IASI Level 2 full product

- Temperature profiles
- Humidity profiles
- Columnar ozone amounts in thick layers
- Surface temperature
- Surface emissivity
- Fractional cloud cover
- Cloud top temperature
- Cloud top pressure
- Cloud phase
- Total column N_2O
- Total column CO
- Total column CH_4
- Total column CO_2
- Error covariance matrix
- Processing and quality flags

IASI Level 2 GTS product

- Temperature profiles
- Humidity profiles
- Surface temperature

IASI Level 2Pcore product

- Skin sea surface temperature
- Uncertainty estimates
- Quality levels and flags
- Wind speed

The above products are generated by the EPS Core Ground Segment from IASI instruments on board the Metop platforms. Note that EUMETSAT generates Level 2 from IASI Level 1c products, which are also generated and distributed to users. If you are interested in IASI Level 1c radiance products, their processing, formats, dissemination means and applications, you might want to check the *IASI Level 1 Product Guide* instead.

For further questions not addressed in this guide, on these or other EPS products, you are welcome to access the EUMETSAT Polar System pages on our website www.eumetsat.int, or to contact directly the EUMETSAT User Services Helpdesk. These pages should be the main interface for information on access to all EPS products. Comprehensive information on the NWP SAF and their products and activities can also be found on the EUMETSAT website and on the relevant SAF webpage www.nwpsaf.org.

2 REFERENCE DOCUMENTS

The following documents have been used to compile the information in this guide. Some of them are referenced within the text, others are provided here for further reading.

2.1 EPS programme documents

[RD10]	EPS End User Requirements Document	EUM.EPS.MIS.REQ.93.001
[RD11]	EPS Generic Product Format Specification	EPS/GGS/SPE/96167
[RD12]	IASI Level 1 Product Format Specification	EUM.EPS.SYS.SPE.990003
[RD13]	IASI Level 2 Product Format Specification	EPS.MIS.SPE.980760
[RD14]	IASI Instrument Specification	IA-SP-1000-201-CNE
[RD15]	Spécification Technique de Besoin du logiciel opérationnel IASI	IA-SB-2100-9462-CNE
[RD16]	Dossier de définition des algorithmes IASI	IA-DF-0000-2006-CNE
[RD17]	IASI Level 2 Product Generation Specification	EPS.SYS.SPE.990013
[RD18]	EPS Programme Calibration and Validation Overall Plan	EUM.EPS.SYS.PLN.02.004
[RD20]	U-MARF LEO Format Descriptions	EUM/OPS/USR/06/1855
[RD21]	EUMETCast Technical Description	EUM TD 15
[RD22]	EPS System Requirements Document	EUM.EPS.SYS.REQ.93001
[RD23]	EPS Products for GTS Distribution	EUM.EPS.SYS.TEN.02.008
[RD24]	EPS Product file naming for EUMETCast	EUM/OPS-EPS-TEN/07/0012
[RD25]	BUFR Descriptors for IASI Level 2 Data	EUM/OPS/TEN/07/2410
[RD26]	EPS Product Validation Report: IASI L2 PPF	EUM/MET/REP/07/0224
[RD27]	Metop Space to Ground Interface Specification	MO-IF-MMT-SY0001
[RD28]	An Improved Artificial Neural Network CO Retrieval for IASI L2 Processor	EUM/MET/TEN/09/0232
[RD29]	Vertical Temperature and Humidity Profiles within IASI L2 PPF v5: Non-Regression Tests and Validation Results	EUM/MET/TEN/09/0448
[RD30]	Surface Emissivity within IASI L2 PPF v5	EUM/OPS-EPS/TEN/10/0203
[RD31]	IASI L2 Surface Temperature: PPF v5 Validation Results	EUM/MET/TEN/10/0188
[RD32]	Single Sensor Error Statistic Scheme for IASI Level 2 Sea Surface Temperature	EUM/MET/DOC/11/0142
[RD33]	Validation of IASI L2Pcore sea surface temperature	EUM/MET/DOC/10/0472

See www.eumetsat.int for more information on the project.

2.2 SAF documents

See www.nwpsaf.org for more information on the NWP SAF project

2.3 GHRSST documents

[RD42]	The Recommended GHRSST Data Specification Revision 2.0	www.ghrsst.org/modules/documents/documents/GDS2.0_TechnicalSpecifications_v2.0.pdf

2.4 Papers, reports and other technical documentation

[RD45]	Manual on the Global Telecommunication System	WMO - No. 386
[RD46]	World Meteorological Organization Manual on Codes	WMO - No. 306
[RD51]	Assessing the impact of radiometric noise on IASI performances	U. Amato, V. Cuomo and C. Serio *Int. J. Remote Sensing*, vol. 16, N°15, 2927-2938, 1995
[RD52]	The information content of clear sky IASI radiance and their potential for numerical weather prediction	P. Prunet, J.-N. Thepaut, V. Casse *QJRMS*, 124, pp 211-241, 1998
[RD53]	The GEISA system in 1996 : toward an operational tool for the second generation vertical sounders radiance simulation	N. Jacquinet-Husson et al. *JSQRT*, 59, N°3-5, 511-527, 1998
[RD54]	The effects of nonlinearity on analysis and retrieval errors	J.R. Eyre *UKMO Forecasting Research Technical Report* N°252
[RD55]	Notes on IASI Performance	A.D. Collard *UKMO Forecasting Research Technical Report* N°256
[RD56]	Result from the first UKMO IASI fast radiative transfer model intercomparison	V.J. Sherlock *UKMO Forecasting Research Technical Report* N°287
[RD57]	ISEM-6: Infrared Surface Emissivity Model for RTTOV-6	V.J. Sherlock *UKMO Forecasting Research Technical Report* N°299

[RD58]	An inversion algorithm using neural networks to retrieve atmospheric CO total columns from high-resolution nadir radiances	J. Hadji-Lazaro, C. Clerbaux and S. Thiria *JGR*, Vol 104, N°D19, Pages 23,841-23,854, 1999
[RD60]	Assimilation of carbon monoxide measured from satellite in a three-dimensional chemistry-transport model	C. Clerbaux, J. Hadji-Lazaro, D. Hauglustaine, G. Mégie, B. Khattatov and J.F. Lamarque *J. Geophys. Res.*, 106, D14,15, 385-394, 2001
[RD61]	Cloud filter for CO retrieval from IMG infrared spectra using ECMWF temperature and POLDER cloud data	J. Hadji-Lazaro, C. Clerbaux, P. Couvert, P. Chazette and C. Boonne *Geophys. Res Lett*.,28,12,2397-2400, 2001
[RD62]	Channel selection methods for Infrared Atmospheric Sounding Interferometer radiances	F. Rabier, N. Fourrié, D. Chafaï and P. Prunet *Q.J. R. Meteorol. Soc.*, 128,1011-1027, 2002
[RD63]	Balloon borne calibrated spectroradiometer for atmospheric nadir sounding	Y. Té, P. Jeseck, C. Camy Peyret, S. Payan, G. Perron and G. Aubertin *Applied Optics*, Vol 41, N°30, 6431-6441, 2002
[RD64]	Retrieval of CO from nadir remote-sensing measurements in the infrared by use of four different inversion algorithms	C. Clerbaux, J. Hadji-Lazaro, S. Payan, C. Camy-Peyret, J. Wang, D.P. Edwards and M. Lo *Applied Optics*, Vol. 41,N° 33, 7068-7078, 2002
[RD65]	First satellite ozone distributions retrieved from nadir high-resolution infrared spectra	S. Turquety, J. Hadji-Lazaro and C. Clerbaux *Geophys. Res. Lett.*, Vol.29,N°24,2198, 2002
[RD66]	Remote Sensing from the infrared atmospheric sounding interferometer instrument. 1. compression, denoising and first-guess retrieval algorithm	F. Aires, W.B. Rossow, N.A. Scott and A. Chédin *J. Geophys. Res.*,107,D22,4619-4635,2002
[RD67]	A Regularized Neural Net Approach for Retrieval of Atmospheric and Surface temperatures with the IASI instrument	F. Aires, A. Chédin, N.A. Scott and W.B. Rossow *J. Appl. Meteor*,41,144-158, 2002
[RD68]	Remote Sensing from the infrared atmospheric sounding interferometer instrument 2. Simultaneous retrieval of temperature, water vapor and ozone atmospheric profiles	F. Aires, W.B. Rossow, N.A. Scott and A. Chédin *J. Geophys. Res.*,107,D22,4620-4631, 2002
[RD69]	Simulation of uplooking and downlooking high-resolution radiance spectra with two different radiative transfer model	R. Rizzi, M. Matricardi and F. Miskolczi *Applied Optics*,41,6,940-956, 2002

[RD70]	The feasibility of monitoring CO2 from high resolution infrared sounders	A. Chédin, R. Saunders, A. Hollingworth, N. Scott, M. Matricardi, J. Etcheto, C. Clerbaux, R. Armante, C. Crevoisier *J. Geophys. Research*, Vol. 108, N° D2, 4064-4083, 2003
[RD71]	Spectroscopic measurements of halocarbons and hydrohalocarbons by satellite-borne remote sensors	P.F. Coheur, C. Clerbaux and R. Rolin *J. Geophysical Res.*, Vol. 108,N° D4,4130, 2003
[RD72]	ISSWG Line by Line Intercomparison Experiment	S.A. Tjemkes, T. Patterson, R. Rizzi, M.W. Shephard, S.A. Clough, M. Matricardi, J. Haigh, M. Hopfner, S. Payan, et al *J. Quant.Spectrosc. Rad. Transf*, 77(4),433-453, 2003
[RD73]	RTIASI-4, a new version of the ECMWF fast radiative transfer model for the infrared atmospheric sounding interferometer	M. Matricardi *ECMWF Technical Memorandum* N° 425, 63pp, 2003
[RD74]	The operational IASI Level 2 Processor	Schlüssel, P., T.H. Hultberg, P.L. Phillips, T. August, X. Calbet *Adv. in Space Res.*, 36, 982-988, 2005
[RD75]	Validation of the operational IASI level 2 processor using AIRS and ECMWF data	Calbet, X., P. Schlüssel, T. Hultberg, P. Phillips, T. August *Adv. Space Res.*, 37, 2299-2305, 2006
[RD76]	Classification of IASI inhomogeneous scenes using co-located AVHRR data	Phillips, P., P. Schlüssel *Proc. SPIE*, 5979, 29-41, 2005
[RD77]	Technical note: Analytical estimation of the optimal parameters for the EOF retrievals of the IASI Level 2 Product Processing Facility and its application using AIRS and ECMWF data	Calbet, X., P. Schlüssel *Atmos. Chem. Phys*., 6, 831-846, 2006
[RD78]	An introduction to the EUMETSAT Polar System	Klaes, K.D., M. Cohen, Y. Buhler, P. Schlüssel, R. Munro, J.-P. Luntama, A. Von Engeln, E. Ó. Clerigh, H. Bonekamp, J. Ackermann, J. Schmetz *Bulletin of the American Meteorological Society*, 88, 1085-1096, doi:10.1175/BAMS.88.7.1085, 2007.
[RD79]	Operational trace gas retrieval algorithm, for the Infrared Atmospheric Sounding Interferometer	Turquety, S., J. Hadji-Lazaro, C. Clerbaux, D. A. Hauglustaine, S.A. Clough, V. Cassé, P. Schlüssel, G. Mégie *J. Geophys. Res.*, 109, D21301, doi:10.1029/2004JD004821, 2004
[RD80]	Toward improved validation of satellite sea surface skin temperature measurements for climate research	Donlon, C.J., P.J. Minnett, C. Gentemann, T.J. Nightingale, I.J.Barton, B. Ward, and M.J. Murray *J. Climate*, 15**,** 353–369, 2002

[RD81] Diurnal signals in satellite sea surface temperature measurements	Gentemann, C.L., C.J. Donlon, A. Stuart-Menteth, and F.J. Wentz *Geophys. Res. Let.*, 30, 3, 1140
[RD82] Diurnal warm-layer events in the western Mediterranean and European shelf seas	Merchant C. J., M.J. Filipiak, P. Le Borgne, H. Roquet, Autret Emmanuelle, J-F. Piolle, S. Lavender *Geophys. Res. Let.*, 2008, 35
[RD83] Observations of the oceanic thermal skin in the Atlantic Ocean	Donlon, C.J. and I.S. Robinson, *Journ. Geophys. Res.*, 102, C8, 1997
[RD84] A numerical study of the effects of anomalous North Atlantic atmospheric conditions on the infrared measurement of sea surface temperature from space	Minnett, P., *J. Geophysical Research*, 91, C7, 1986
[RD85] Operational SST retrieval from METOP/AVHRR validation report	Le Borgne, P., G. Legendre, A. Marsouin, and S. Pere, *Ocean and Sea-Ice SAF CDOP report*, Version 2.0, July 2008

3 IASI LEVEL 2 PRODUCTS CONFIGURATION HISTORY

In the following table the current versions on the operational Ground Segment are shown on a white background.

Date introduced	*Product format version*		*PFS version [RD13]*	*PGS version [RD16]*	*Comments*
	Major number	*Minor number*			
19/10/2006	10	0	6.5	5.3	
10/09/2008	10	0	V.7B/v8	5.6/V.7	

Table 3-1: IASI Level 2 document versions

IASI L2 PPF software version	*Date introduced on GS1*	*Comments*
4.0	27/11/2007	
4.2	29/04/2008	
4.3	12/08/2008	
4.3.1	20/10/2008	
4.3.2	21/01/2009	
4.3.3	29/03/2010	
5.0.6	14/09/2010	Sensing start time 13:14:57 UTC Improved Temperature profiles + CO and O_3 total columns + CO and N_2O produced for pixels 3 and 4.
5.1	02/12/2010	Sensing start time 10:59:57 UTC Production and dissemination of cloudy T, q retrievals.
5.1.1	14/03/2011	CO and N_2O are disseminated for the four pixels.
5.2.1	20/10/2011	Sensing start time 9:59:59 UTC (orbit #25952)

IASI L2 PPF software version	*Date introduced on GS1*	*Comments*
		Improved cloud screening for cloudy T, q retrievals Fixed polar cloud-top pressure retrievals Changed RTM to **RTTOV-10**
5.3	28/02/2012	Implementation of alternative method (chi square) for retrieval of cloud properties in cases where the CO2 slicing fails. + An additional cloud test has been implemented based on the relative in homogeneity of the AVHRR channel 4 and 5 within the IASI FOV. The result of the new cloud test is available in the product in bit 7 of FLG_IASICLD, but is not taken into account for the selection of cloud free pixels for retrievals.
5.3.1	16/07/2012	Bug fixed regarding some “holes” in L2 water vapour profiles + to prepare the future M01 products.

Table 3-2: IASI Level 2 PPF software versions

	Quality levels				*Match-up data set period*	*Date introduced in the Ground Segment*
	2	*3*	*4*	*5*		
Bias (K)	-0.24	-0.46	-0.39	-0.34	04/2010 - 09/2010	14/03/2011
Std (K)	0.42	0.35	0.36	0.41		
Bias (K)	-0.31	-0.34	-0.34	-0.14	09/2010 - 03/2011	29/09/2011
Std (K)	0.36	0.25	0.30	0.32		
Bias (K)	-0.37	-0.37	-0.42	-0.25	04/2011 – 03/2012	16/07/2012
Std (K)	0.41	0.31	0.39	0.36		

Table 3-3: IASI L2P Core SST Single Sensor Error Statistics updates

4 IASI LEVEL 2 PRODUCTS OVERVIEW

4.1 The IASI instrument

The Infrared Atmospheric Sounding Interferometer is composed of a Fourier transform spectrometer (IASI) and an associated Integrated Imaging Subsystem (IIS). The Fourier transform spectrometer provides infrared spectra with high resolution between 645 and 2760 cm^{-1} (3.6 µm to 15.5 µm). The IIS consists of a broad band 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 main goal of the IASI mission is to provide atmospheric emission spectra to derive temperature and humidity profiles with high 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 and emissivity and cloud properties.

4.1.1 IASI Level 2 processing and data usage

The IASI Level 2 processing foresees not only the usage of the IASI Level 1c radiance spectra but also of the ATOVS measurements namely AMSU-A L1b, AVHRR L1B, MHS Level 1b and ATOVS L2 products. Additionally, the IASI L2 processing makes usage of NWP data. The mapping of ATOVS measurements onto the IASI Instantaneous Field Of Views (IFOVs) is therefore an essential part of the processing. In the following section the IASI sampling and the synchronisation and collocation with the ATOVS instruments is discussed before the L2 processing itself is introduced in Section 4.2.

4.1.2 Sampling characteristics of IASI and collocation with ATOVS

IASI is an across-track scanning system with scan range of ±48° 20´, symmetrically with respect to the nadir direction. A nominal scan line covers 30 scan positions towards the Earth and two calibration views. One calibration view is into deep space, the other is observing the internal black body. The scan starts on the left side with respect to the flight direction of the spacecraft.

The elementary (or effective) field of view (EFOV) is the useful field of view at each scan position. Each EFOV consists of a 2 × 2 matrix of so-called instantaneous fields of view (IFOV). Each IFOV has a diameter of 14.65 Millirad (mrad) , which corresponds to a ground resolution of 12 km at nadir and a satellite altitude of 819 km. The 2 × 2 matrix is centred on the viewing direction. The instrument points spread function (PSF) is defined as the horizontal sensitivity within an IFOV. The IFOV diameter (D = 14.65 mrad) is defined so that the integral of the PSF over this circular area is larger than 95 %. The non-uniformity within the inner 80 % of the IFOV (D=11.72 mrad) is not larger than ± 5 %. The IIS field of view is defined by a square area of 59.63 x 59.63 mrad, consisting of 64 × 64 pixels and covering the same area as the IASI EFOV.

The instrument scans in a step and stare modus. Each interferogram is acquired within 151 ms. The 30 Earth interferograms per scan line are taken in equally spaced time intervals every 8/37 second so that a synchronisation with AMSU is reached. Figure 4-1 summarises the synchronisation of IASI with the ATOVS instruments AMSU and MHS.

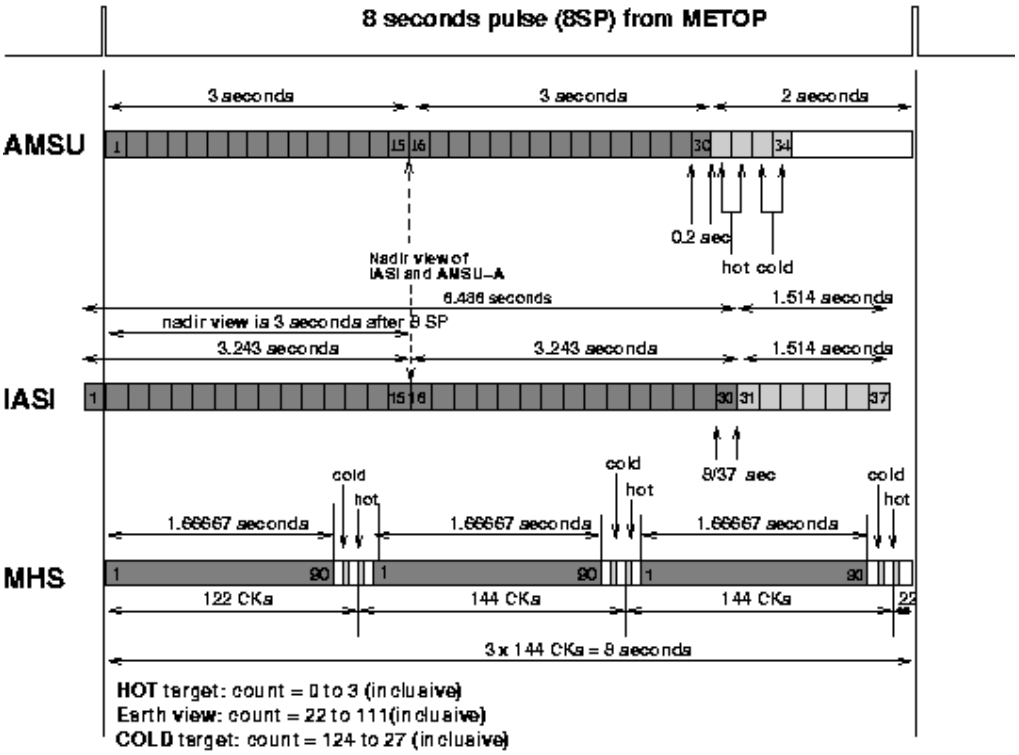

Figure 4-1: Synchronisation of IASI, AMSU-A and MHS

Characteristics	*Value*	*Unit*
Scan type	step and stare	–
Scan rate	8	s
Stare interval	151	ms
Step interval	8/37	s
Number of Earth scans / line - EFOV	30	–
Swath	±48.333	deg
Swath width	±1100	km
IFOV - shape at nadir	circular	–
IFOV - size at nadir	12	km
IFOV - size at edge of scan line across track	39	km
IFOV - size at edge of scan line along track	20	km

Table 4-1: IASI scanning characteristics

Within the IASI Level 2 processing, the measurements from the ATOVS instruments and the ATOVS L2 products are used. The collocation between IASI and the ATOVS instruments is shown in the following figures.

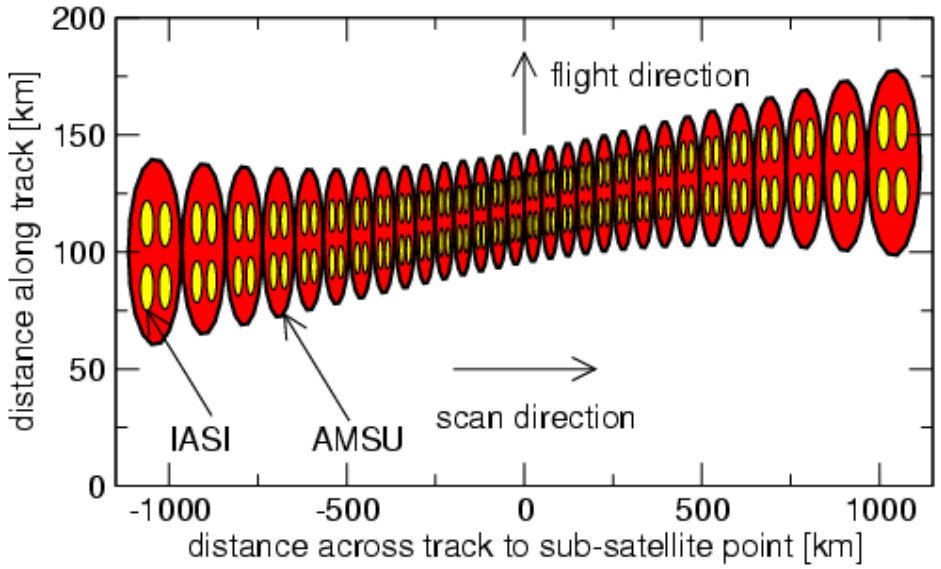

Figure 4-2: Collocation of IASI (yellow) and AMSU (red). The distance along and across track is given in km.

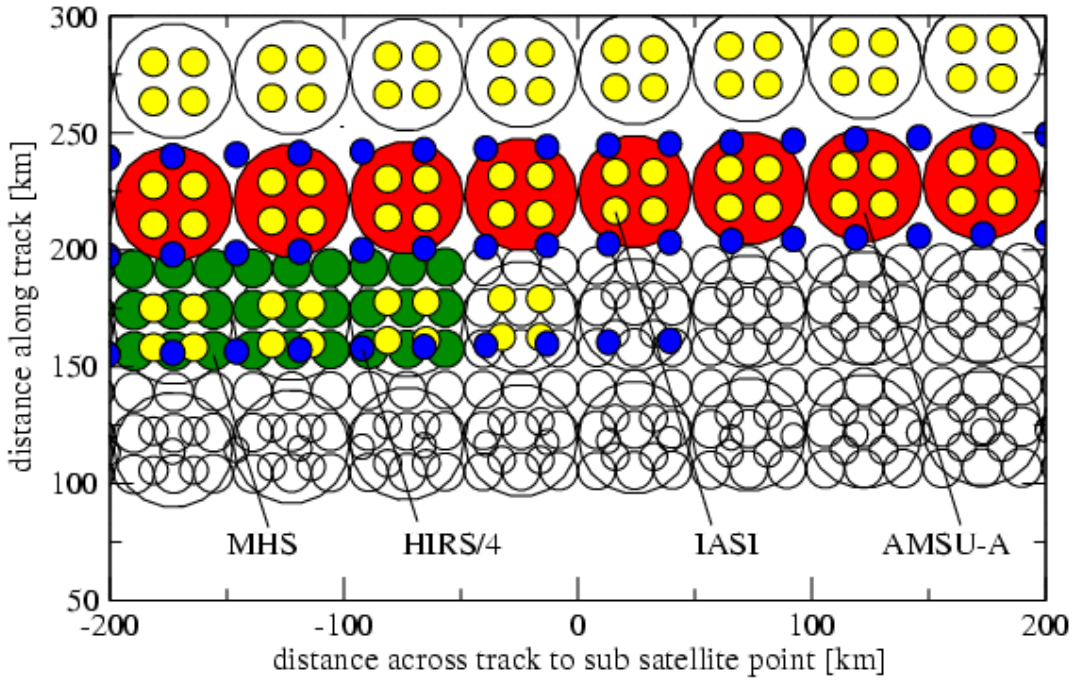

Figure 4-3: The collocation between IASI (yellow), AMSU (red), MHS (green) and HIRS (blue) is shown for four scan lines near nadir

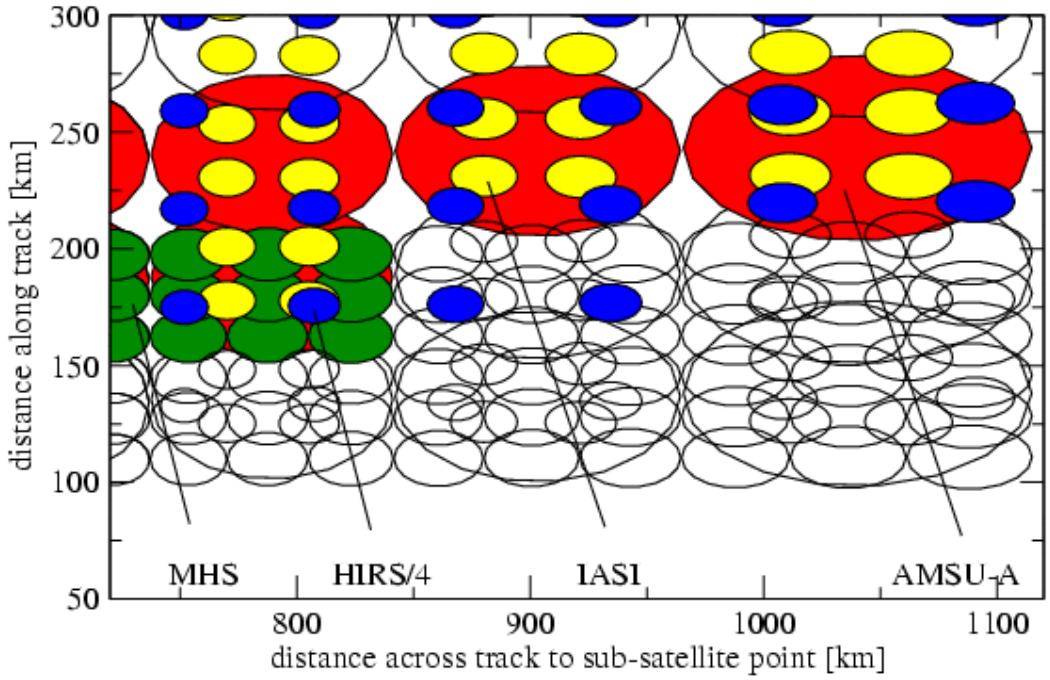

Figure 4-4: The collocation between IASI (yellow), AMSU (red), MHS (green) and HIRS (blue) is shown at the end of the IASI scan line

4.2 Overview of the Level 2 processing

The objectives of the IASI Level 2 ground processing is the derivation of geophysical parameters from the radiance measurements. The following parameters are derived during IASI Level 2 processing:

- Temperature profiles
- Humidity profiles
- Columnar ozone amounts in thick layers
- Surface temperature
- Surface emissivity
- Fractional cloud cover
- Cloud top temperature
- Cloud top pressure
- Cloud phase
- Total column N_2O
- Total column CO
- Total column CH_4
- Total column CO_2
- Error covariance
- Processing and quality flags

The processing is performed in synergy with the ATOVS instrument suite, AVHRR and forecast data from numerical weather prediction.

The nominal input of IASI Level 2 processor consists of:

- IASI L1c products
- AMSU L1b products
- MHS L1b products
- AVHRR cloud mask and surface or cloud top temperature
- ATOVS Level 2 products
- NWP forecast data

In the following sections an overview of the IASI Level 2 processing is given.

4.2.1 IASI Level 2 pre-processing

During the pre-processing phase the geolocation is extracted from L1C data for individual IASI IFOVs. The topography and surface type (land/water) within the IASI IFOV are extracted from a Land-Sea database and a Digital Elevation Model (DEM). A quality flag is generated indicating whether the geolocation of the IASI IFOV is valid (FLG_IASIBAD). The flag FLG_LANSEA summarises the topography and the surface type (land/water).

The validity of the input data is checked by comparing the data against valid bounds and evaluating the quality flags. The input data consist of the ATOVS data Level 1 and Level 2, the AVHRR cloud mask and the surface and cloud top temperature, the IASI Level 1c radiance spectra, and the NWP forecast data.

The ATOVS Level 2, AMSU Level 1, MHS Level 1 and AVHRR cloud mask and surface or cloud top temperature (S/CTT) measurements are collocated with the IASI IFOV. The results from collocation of AVHRR and IASI are stored in a correlation mask which is later used for accessing the AVHRR pixel within a IASI IFOV. The flags FLG_ATOVINT and FLG_AVHAVL summarise the results from this task.

The NWP forecast data are interpolated on to the position of the IASI IFOV. Depending on the availability and quality the data are accepted and passed to the next processing step. The quality and processing flag FLG_NWPBAD is generated.

With the AVHRR correlation mask, by taking into account the IASI sounder point spread function and the AVHRR cloud mask, the weighted fractional cloud cover and the weighted S/CTT distributions are calculated for the individual IASI IFOV. Up to three different cloud top temperatures for up to three different cloud formations are calculated. The flag FLG_IASICLR summarises the results from this task.

4.2.2 IASI Level 2 cloud detection and retrieval selection

4.2.2.1 Choice for pure IASI or combined IASI/ATOVS/AVHRR retrieval

Based on the availability of input data and its quality, the choice is made between four different combinations of input data for the retrieval. The retrieval can be based on a combination of IASI/AVHRR, IASI/ATOVS or IASI/AVHRR/ATOVS, or a IASI stand-alone retrieval. Finally the flag FLG_RETCHC specifies the retrieval choice.

4.2.2.2 Cloud detection

The cloud detection is performed based on the combined information of the IASI L1c spectra and the AMSU-A data. Five different cloud detection tests are executed and the relevant flags are set accordingly (FLG_CLDTST and FLG_IASICLD). These include the following tests:

Cloud detection		
Test name	***Type of test***	***Measurements used***
Test A	Window channel test	IASI; NWP forecast, ATOVS L2, or climatology
Test B	IASI inter-channel regression test	IASI stand-alone
Test C	IASI–AMSU-A inter-channel regression test	IASI and AMSU-A
Test D	AVHRR test	IASI stand-alone
Test E	CO_2-slicing test	IASI stand-alone

Table 4-2: IASI Level 2 cloud detection tests

If ATOVS data are not available, only the IASI stand-alone cloud detection tests will be executed.

4.2.2.3 Determination of cloud top height and fractional cloud cover

If clouds are detected in the field of view, the CO_2-slicing method is used to estimate the fractional cloud cover and the cloud top pressure for the IASI IFOVs. The success of the method depends on the contrast between cloud and surface signals being greater than instrument noise, as long as IASI-measured radiance is provided in the input to the algorithm.

The CO_2 slicing algorithm is based upon a fixed, pre-selected number of CO_2 channels and a reference channel. The effective cloud amount is estimated from the radiance within a window channel and by making use of the previously-retrieved cloud top pressure. If the cloud top pressure estimated from a particular CO_2 channel (together with the reference channel) does not support an estimate of the effective cloud amount in the interval [0, 1], based upon the radiance in the window channel, then that CO_2 channel is excluded from the initial set of pre-selected channels. The algorithm fails for those IFOVs where all the pre-selected CO_2 channels are excluded as a consequence of this test. The cloud top pressure estimates from the individual CO_2 channels passing the test are analysed in order to find out those CO_2 channels whose estimates belong to the most populated class. The weighted mean of these cloud top pressure estimates is the retrieved cloud top pressure. If the retrieved cloud top pressure value is greater than 570 hPa (i.e. lower down in the atmosphere) and the forecast temperature profile shows a temperature inversion in the lower troposphere, then the retrieved cloud top pressure is calculated simply as the weighted mean of those estimates below the base of the inversion.

In these IASI L2 products, the cloud characterisation solely comes from the exploitation of IASI measurements, through the CO_2-slicing method. No combination with AVHRR fractional cloud cover and cloud-top temperature is performed for the current version of the algorithm.

The fractional cloud cover, the cloud top height, the cloud top temperature and the number of cloud formations are part of the Measurement Data Record (MDR) (FRACTIONAL_CLOUD_COVER, CLOUD_TOP_TEMPERATURE, CLOUD_TOP_PRESSURE and NUMBER_CLOUD_FORMATIONS). In this algorithm version, the number of cloud formations does not exceed 1.

Additionally the cloud phase is estimated for cloudy IASI IFOVs by evaluation of the infrared window regions between 8–9 and 11–12 µm. The cloud phase is part of the MDR (CLOUD_PHASE).

A summary based on information from the previous cloud detection tests is generated. The fractional cloud cover is evaluated against thresholds and used to determine whether an IFOV is clear, partly cloudy, or cloudy. The results of the cloud detection and height assignment are summarised in the cloud flags FLG_CLDSUM and FLG_CLDFRM. Based on this information, the retrieval selection flag FLG_RETCHC is updated as well.

No explicit thin cirrus detection algorithm is currently performed, so the corresponding flag FLG_THICIR is set to the default value.

4.2.2.4 Selection of clear, cloudy or cloud-clearing retrieval

The retrieval type is selected with respect to the results of the cloud processing. The options are the clear sky retrieval on an IFOV basis, cloudy retrieval in single IFOVs, and the cloud clearing option for partly cloudy field of views. The cloud clearing is specified to be performed using four IFOVs. That option is the subject of research work and not implemented in the operational processor yet. Also note that the iterative retrieval can produce a full profile as long as cloud fraction remains below a given threshold. Finally, a clear retrieval can be selected for completely cloudy IASI IFOVs where the profiles are derived only above the cloud top. The flag FLG_FINCHC is set accordingly.

For increasing cloud cover, the choices are as follows:

clear IFOV	--->	*increasing cloud cover*	--->	*completely cloudy IFOV*
clear retrieval	cloudy retrieval	variational cloud clearing	clear retrieval	above cloud top

4.2.3 IASI Level 2 product retrieval

4.2.3.1 Determination of climatological profiles and surface parameters

According to the geographic location and time of the IASI measurement, the climatological profiles and surface parameters are extracted from a database together with their covariance.

4.2.3.2 IASI channel or super channel selection

The iterative retrieval can be configured to use a sub-set of IASI channels or super channel clusters. The purpose of the super channel clustering is to reduce the number of channels by combining channels with redundant information. They consist of linear combinations of IASI channels with highly correlated radiances. The choice depends on the configuration and data availability. Super channels are only generated if the iterative retrieval is selected.

4.2.3.3 IASI first retrieval

The first retrieval is generated using IASI alone or IASI in combination with ATOVS. The type of the first retrieval is specified by the flag FLG_FINCHC; either the EOF (Empirical Orthogonal Function) regression retrieval or the neural network retrieval can be used. Channels in the short-wave region of the IASI spectrum are excluded from the retrieval.

The super-saturation of the retrieved water vapour profile is examined. If super-saturation is found these values are set to the corresponding saturation value. The flag FLG_SUPSAT indicates whether super-saturation occurred and how many levels are affected. The temperature profile is examined with respect to super-adiabatic conditions. If a super-adiabatic temperature gradient is recognised the temperature is set to temperature representing an adiabatic temperature lapse rate. The flag FLG_SUPADI indicates whether super-adiabatic conditions occurred and how many layers are affected.

The results from the first retrieval can constitute the final product or be the first guess for the subsequent iterative retrieval. The state vector from this retrieval contains the temperature, humidity and ozone columns in thick layers, the surface temperature, surface emissivity, and the columnar amounts of carbon monoxide, methane, nitrous oxide and carbon dioxide.

The profiles and surface parameters from the first retrieval are checked for completeness and validated, results are summarised by FLG_FGCHECK.

4.2.3.4 IASI iterative retrieval

If profiles and surface parameters from the first retrieval are within valid bounds (FLG_FGCHECK) they are passed into the Fast Radiative Transfer Model (FRTM) to calculate the synthetic IASI brightness temperature spectra and the Jacobians (a matrix of the partial derivatives of the brightness temperature with respect to the profile and surface parameters). Out of bound values of the first retrieval are replaced by climatology data. Information which is not part of the retrievals but needed as input for the FRTM, e.g. trace gas profiles, is taken from the climatological background.

Based on the pre-selection and availability, the background state vector and its inverse covariance matrix are made available for the retrieval process. The background state vector does not contain information which is used within the iterative retrieval, e.g. ATOVS L2 data are not used as background information if the ATOVS data are used in the iterative retrieval. The flag FLG_SELBAC identifies the used background state vector.

A cost function is then minimised by iteration of the state vector and calculating new brightness temperature spectra and Jacobians until an acceptable solution is found according to predefined criteria.

The information about the convergence of the iteration is given by FLG_ITCONV. The number of iterations is in FLG_NUMIT. The results from the residual check are given by FLG_RESID.

The results of the iterative retrieval are passed to the quality control. A quality control flag (FLG_QUAL) is generated indicating whether the accuracy of the retrieved IASI Level 2 product is in alignment with the EURD requirements.

4.2.3.5 Temperature and water vapour profiles

The number of available temperature profiles derived in the IASI L2 product covers on average over 50% of the IASI field of view. There are two types of temperature profile, derived by the optimal estimation (= iterative retrieval) and linear (or EOF) regression retrieval methods respectively:

1. Optimal estimation retrieval (see Section 4.2.3.4) is used for those fields of view found to be clear sky by the cloud detection scheme. The derived temperature profiles constitute 10-12 % of the IASI field of view.
2. Additional profiles are retrieved by linear regression for fields of view which are considered "clear enough" by the regression method itself, but did not pass the strict cloud detection scheme.

The two types of temperature profile have different characteristics and can be discriminated with the help of the processing and quality flags within the products. The most detailed information is available in FLG_FINCHC in the native products, where bit 14 is set if the temperature profile comes from optimal estimation and bit 0 is set if it comes from regression. In the BUFR encoded product, FLG_QUAL can be used to distinguish the two types of temperature profile as this flag is only set to a value different than zero if an optimal estimation retrieval was successfully performed. For the best quality only the optimal estimation retrieved temperature profiles should be considered.

The yield of water vapour profiles is comparable to that of the temperature profiles, but in this case all profiles are obtained by regression.

4.2.4 Derivation of Single Sensor Error Statistics for the IASI SST L2Pcore product

The most significant part of the GHRSST L2P specification is the Single Sensor Error Statistics (SSES). These are observational error estimates provided at pixel level as a bias and standard deviation.

Each observation is assigned a quality level from 0 to 5, where 0 is missing data, 1 is bad data (such as cloud), 2 is the worst useable data, and 5 is the best quality, as given in Table 4-5. Quality levels for this product have been defined by stratifying against integrated water vapour, calculated by integrating IASI water vapour profiles from the IASI Level 2 products with pressure level information, as well as taking into account available cloud analysis.

The SSES bias and standard deviation are then calculated for each quality level from analysing differences between satellite SSTs collocated with drifting buoys in a matchup database, using six months' worth of data. The SSES bias and standard deviations are provided to the processor for each quality level within a look-up table (LUT). The LUT is updated on a six-monthly to yearly time-frame.

For more details, see [RD32].

4.3 IASI Level 2 product characteristics

4.3.1 General

Table 4-3 summarises the requirements for the IASI Level 2 products with respect to product accuracy, sampling and timeliness as they can be found in the EPS End User Requirements Document (EURD, [RD10]).

Product	*Accuracy*	*Sampling*	*Timeliness*
Temperature	1 K (2 K stratosphere)	IFOV	3 h
Relative humidity	10 %	IFOV	3 h
Cloud cover	10 %	IFOV	3 h
Cloud top temperature	2 K	IFOV	3 h
Cloud top height	300 m	IFOV	3 h
Integrated CH_4	< 20%	250 km	3 h
Integrated N_2O	< 20%	250 km	3 h
Integrated CO	< 10%	250 km	3 h

Table 4-3: Requirements for IASI Level 2 products

4.3.2 Vertical resolution of the temperature and humidity profiles

Users should consider carefully the definition of the IASI temperature and humidity profile products, before deciding to use them for their particular application. The IASI sounding products represent thermodynamic states of deep atmospheric layers of variable depths. The reason is the integrating nature of the radiation measurements at the top of the atmosphere. The number of independent pieces of information which are determined in the temperature and moisture profiles are of the order of 14 and 10 respectively, but the number varies with atmospheric situation. Profiles retrieved from radiance measurements are smoothed versions, where the smoothing functions are the so-called averaging kernels.

An example of a set of averaging kernels is shown in Figure 4-5 and Figure 4-6 for temperature and humidity, respectively. Two things can be seen: the vertical extent over which a particular kernel averages, and the amplitude, showing how sharply a kernel peaks at a particular height. Higher amplitudes indicate more information about the corresponding layer. An amplitude of 1 would indicate perfect measurements at a distinct level; however this is purely hypothetical and does not exist. Nevertheless, the retrieved profiles are represented on a fine vertical grid for the reason that the averaging kernels vary with atmospheric situation. Consequently, the vertical resolution and the centre altitudes of the resolved layers vary too. The actual variation is not known *a priori*, so the retrieval is performed on a fixed, fine pressure grid and the smoothing is represented by the *a posteriori* error covariance matrix, which is part of the product and represented on the same pressure grid. The off-diagonal elements of the covariance matrix describe the inter-relationship between the state-vector elements and provide information about the actual vertical resolution.

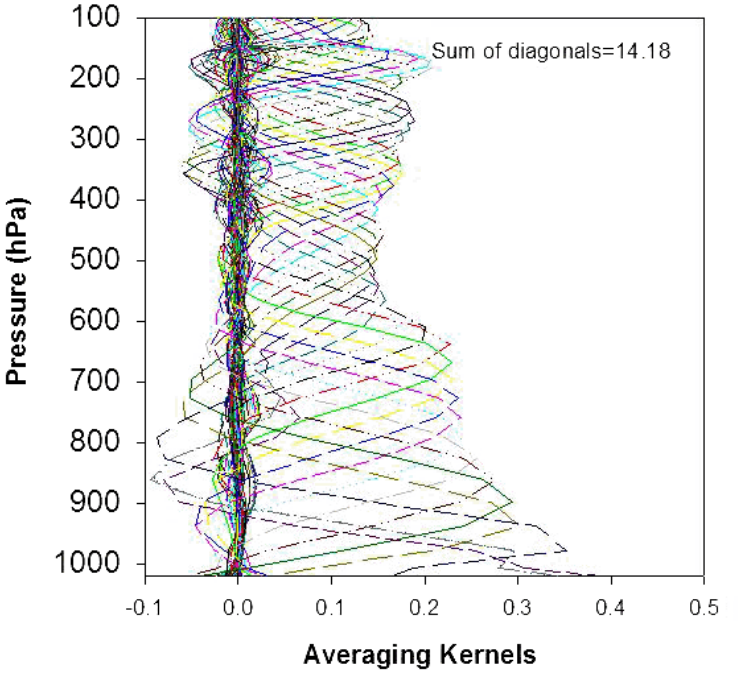

Figure 4-5: Averaging kernels for temperature profiles for a mid-latitude summer situation in Lindenberg 2007

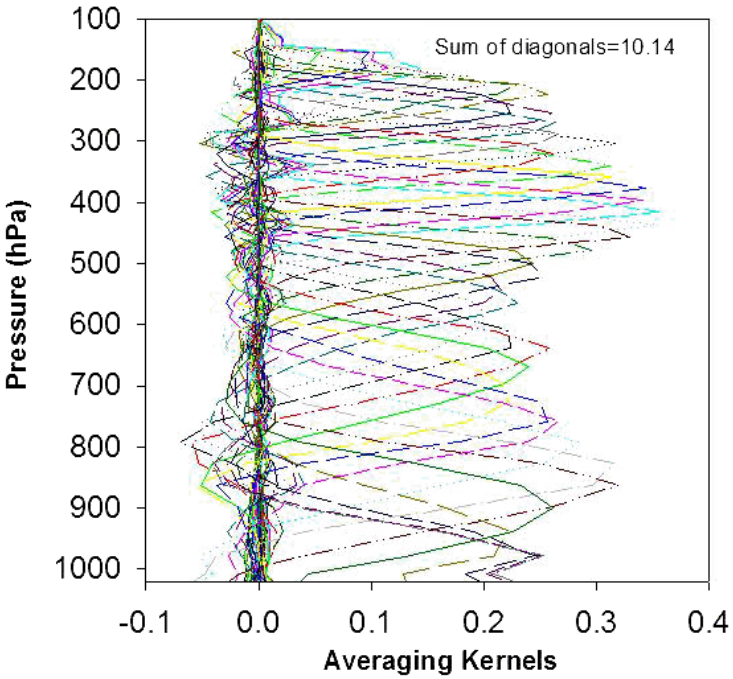

Figure 4-6: Averaging kernels for humidity profiles for a mid-latitude summer situation in Lindenberg 2007

4.3.3 Quality and processing information

The quality of the retrieved profiles depends largely on the setting of the inversion for clear, partly cloudy or cloudy conditions, as shown in the validation report [RD26]. That setting is reflected and summarised for each IFOV in flags FLG_CLDFRM and FLG_CLDSUM, which respectively indicate the number of cloud formations with the origin of their height assignments, and which instruments detected clouds. (A further flag FLG_IASICLR indicates cloud but using only AVHRR collocated information.) The flags can be used in the absence of additional information to screen the clear sky soundings. The FRACTIONAL_CLOUD_COVER parameter can be used to qualify the situation further.

Flag FLG_QUAL may indicate errors outside the EURD threshold. It is sufficient that the error for one of the levels exceeds the limit in order to have that flag set. IASI retrievals do not use much information about the uppermost levels included in the product, consequently the errors for these levels are larger – typically around 10 K. In such situations, the IFOVs are flagged as being outside the EURD threshold, whether or not the error in the lower levels remains within that threshold.

It is planned to provide values of the off-diagonal terms of the error covariance matrix for all levels in the field ERROR_DATA of the product.

4.3.4 Instrument mode and navigation information

The instrument mode is indicated by the IASI Level 1c flag GEPSIasiMode. The flag indicates whether the instrument is operated in normal scan mode or external calibration mode.

The navigation information is given at IFOV level. Information about the satellite's roll, pitch and yaw angles are given by ATITUDE_ANGLES, the time in seconds associated with it is given in TIME_ATTITUDE. The spacecraft's altitude is given in the SPACECRAFT_ALTITUDE variable (values are in km).

The bit string NAVIGATION_STATUS contains further detailed information about the navigational status.

4.3.5 Quality and processing information in the product

A number of quality and processing information flags are generated during the Level 2 processing. These flags are distributed as part of the IASI Level 2 product and are associated with individual IFOVs. Table 4-4 contains the description of the IASI Level 2 processing and quality flags. The possible values and the conditions are described individually in Section 9. The flags do not only indicate the quality and completeness of the IASI L1c product but also inform about the choices made in the IASI Level 2 processing.

Flag name	*Description*
FLG_ATOVCLR	Cloud flag for ATOVS products
FLG_ATOVCMP	Completeness of ATOVS products
FLG_ATOVINT	Interpolation of ATOVS to IASI
FLG_AVHAVL	Completeness flag for AVHRR products

Flag name	*Description*
FLG_AVHBAD	Validation flag for AVHRR products
FLG_CHNSEL	Channel selection
FLG_CLDAVH	Number of cloud formations analysed in AVHRR
FLG_CLDFRM	Number of cloud formations and origin of height assignment
FLG_CLDPHA	Cloud Phase
FLG_CLDSUM	Summary indicating which instruments see clouds
FLG_CLDTST	Cloud tests that are executed
FLG_DAYNIT	Discrimination between day and night
FLG_FGCHECK	Check whether first guess retrievals passed to iterative retrieval
FLG_FINCHC	Final choice of retrieval
FLG_FRCSEL	Selection of fractional cloud cover from IASI/ATOVS or AVHRR
FLG_IASIBAD	Validation flag for IASI Level 1 product
FLG_IASICLD	Results of cloud test
FLG_IASICLR	IASI IFOV clear, partly cloudy or cloudy (as determined using AVHRR collocated information only)
FLG_INITIA	Retrieval initialisation
FLG_ITCONV	Convergence of the iterative retrieval
FLG_ITRBOU	Validation of iterated state vector
FLG_LANSEA	Specifies surface type
FLG_NUMIT	Number of iterations used for retrieval
FLG_NWPBAD	Validation flag of NWP forecast
FLG_QUAL	Quality and completeness of the retrieval
FLG_RESID	Retrieval residual acceptance flag
FLG_RETBOU	Identification of out-of-bounds state vector elements
FLG_RETCHC	Choice of combined or IASI stand-alone retrieval
FLG_SATMAN	Indication of satellite manoeuvre
FLG_SELBAC	Selection of background state
FLG_SFCAVH	Indication of AVHRR derived surface temperature
FLG_SFCTOP	Validation flag for surface type and topography
FLG_SUNGLNT	Identification of sun glint

Flag name	*Description*
FLG_SUPADI	Indication of super-adiabatic conditions in final retrieval
FLG_SUPSAT	Indication of super-saturation in final retrieval
FLG_THICIR	Thin cirrus cloud test
FLG_THICOR	Thin cirrus has been corrected for
FLG_VARCLR	Cloud clearing by variational analysis
FLG_STER	Representation of retrieval errors. Determines content and size of data in MDR.ERROR_DATA.

Table 4-4: IASI Level 2 processing and quality flags

A detailed explanation on the format is given later in the Level 2 EPS format description (Section 9 and Appendix C.1). Further details can be found in [RD13] and [RD17].

4.4 IASI Level 2Pcore SST product

In addition to the surface temperature provided by the IASI L2 product, the IASI L2Pcore dataset provides the same SST, following the GHRSST specification. The SST retrieval is performed and provided by the IASI L2 processor. The IASI L2P is referred to as ‘core’ as it does not contain all the auxiliary information (including sea-ice, aerosol, SST background) as specified in a full GHRSST L2P file. These are the main constituents of the IASI L2Pcore SST: skin sea surface temperature, uncertainty estimates (SSES), quality levels and flags, and wind speed.

The IASI SST is representative of the temperature of the upper 20 micrometres of the ocean surface. Ocean and atmospheric models in general use a sub-skin or foundation SST (representing the same measurement at night-time) to be able to characterise the overall heat capacity of the ocean. The skin SST is usually cooler than the sub-skin SST by around 0.17 K [RD80] at high wind speeds, although during the day-time in regions of high insolation and low wind speed this is reversed and the skin SST can become several degrees warmer than the foundation SST ([RD81], [RD82], [RD83]). The wind speed is included in the products.

Moreover, the GHRSST Data Specification [RD42] defines quantities referred to as Single Sensor Error Statistics (SSES). These comprise a bias and standard deviation between comparisons of night-time satellite and *in situ* drifting buoy SSTs collocated within a matchup dataset. The SSES provides uncertainty estimates for the IASI SST observations grouped into quality levels ranging from 2 (worst useable quality) to 5 (best quality). Since water vapour variations in the atmosphere influence the biases and uncertainties in SST retrievals (e.g. [RD84]), the thresholds between each quality level are determined from the value of integrated water vapour (from the IASI L2 processor) per observation. The thresholds were determined by comparing IASI integrated water vapour with IASI SST and climatology SST differences, where it was observed that in general the drier atmospheres displayed the smallest biases.

Table 4-5 shows the quality levels 1 to 5 based on the thresholds of IASI integrated water vapour. A look-up table of SSES bias and standard deviations for each quality level is computed from a 6-months match-up dataset and used to update the operational processor configuration twice a year. These regular updates do not affect the SST values, only the quality information assigned to them. The quality levels are included in the products.

Quality level	*Data quality*	*Integrated water vapour*	*IASI L2 PPF flags*	*Comment*
0	No data	–	Flg_lansea eq 1 or no SST data.	No data available, or over land.
1	Bad	–	Flg_lansea eq 0. Ts(0) in range. flg_cldtst le 0 OR (flg_cldtst gt 0 AND flg_iasicld eq 0).	Sea only. Cloud test is not performed OR Cloud test is performed AND result is cloudy.
2	First useable quality	3.5+	Flg_lansea eq 0. Ts(0) in range. Flg_cldtst gt 0 AND flg_iasicld eq 0.	Sea only. Cloud test is performed AND result is cloud-free.
3	Fair	1.5 to 2.5	Flg_lansea eq 0. Ts(0) in range. Flg_cldtst gt 0 AND flg_iasicld eq 0.	Sea only. Cloud test is performed AND result is cloud-free.
4	Good	2.5 to 3.5	Flg_lansea eq 0. Ts(0) in range. Flg_cldtst gt 0 AND flg_iasicld eq 0.	Sea only. Cloud test is performed AND result is cloud-free.
5	Best quality	0 to 1.5	Flg_lansea eq 0. Ts(0) in range. Flg_cldtst gt 0 AND flg_iasicld eq 0.	Sea only. Cloud test is performed AND result is cloud-free.

Table 4-5: IASI integrated water vapour thresholds for each SSES quality level

4.5 Summary of IASI Level 2 product applications

Not available for this issue of the user guide.

4.6 Dissemination status of IASI L2 product

The following table presents the dissemination status of each IASI L2 parameter, with the methodology used to retrieve them.

Parameter	*Algorithm*	*Status*
Cloud detection	NWP, AVHRR	Operational
Cloud fraction & height	CO_2-slicing	Operational
Cloud phase	BT difference	Trial
T profiles	OEM	Operational
q profiles	EOF	Operational
SST / LST	EOF	Operational
Emissivity	EOF	Pre-Operational
O_3 total column	OEM	Operational
O_3 partial column	OEM	Pre-Operational
CO	ANN	Operational
N_2O, CH_4, CO_2	ANN	Experimental

Table 4-6: IASI L2 product summary and dissemination

5 DATA VIEWING AND READING

5.1 Generic tools for data reading

Readers for the native EPS format IASI Level 2 products are available online at the EUMETSAT website on the Useful Programs & Tools page.

The products can be read using standard HDF libraries. For more information on HDF5 formats in general, see the HDF5 webpages.

Software capable of reading the WMO formats is available from a variety of sources, including ECMWF.

5.2 BEAT for data reading

The Basic Envisat Atmospheric Toolbox (BEAT) provides a set of tools for ingesting, processing and analysing atmospheric remote sensing data. The primary instruments supported by BEAT are GOMOS, MIPAS and SCIAMACHY (flown on the Envisat satellite). However, BEAT also supports access to data from a wide range of other atmospheric instruments like IASI.

BEAT consists of several modules. These modules can be applications, libraries, interfaces to existing applications (such as IDL and MATLAB), or interfaces to other programming languages (such as Fortran and Python). More options are available in the last version, version 6.4.0, since November 2010.

BEAT is provided by Science & Technology BV and can be downloaded free for non-commercial use via the following link: http://www.science-and-technology.nl/beat/.

5.3 Generic netCDF tools

The IASI L2Pcore SST is produced in netCDF format, in accordance with the GDS 2.0. The product can be read with standard netCDF readers. For more information on netCDF and generic readers, please refer to www.unidata.ucar.edu/software/netcdf/.

6 IASI LEVEL 2 PRODUCT FORMATS AND DISSEMINATION

A description of the dissemination means for EPS products and formats is provided in the following paragraphs, focusing down on IASI products and their formats.

6.1 EPS products available dissemination means

6.1.1 EUMETCast

Global EPS products at different levels will be distributed in near real-time via EUMETSAT's Data Distribution System (EUMETCast). EUMETCast utilises the services of a satellite operator and telecommunications provider to distribute data files using Digital Video Broadcast (DVB) to a wide audience located within the geographical coverage zone which includes most of Europe and certain areas in Africa.

Within the current EUMETCast configuration, the multicast system is based upon a client/server system with the server side implemented at the EUMETCast uplink site (Usingen, Germany) and the client side installed on the individual EUMETCast reception stations. The telecommunications suppliers provide the DVB multicast distribution mechanism. Data/product files are transferred via a dedicated communications line from EUMETSAT to the uplink facility. These files are encoded and transmitted to a geostationary communications satellite for broadcast to user receiving stations. Each receiving station decodes the signal and recreates the data/products according to a defined directory and file name structure. A single reception station can receive any combination of the provided services.

A typical EUMETCast reception station comprises a standard PC with DVB card inserted and a satellite off-set antenna fitted with a digital universal V/H LNB. In addition, users require the multicast client software, which can be obtained via the EUMETSAT User Services.

More detailed information on this service can be found in the EUMETSAT webpage EUMETCast Dissemination Scheme.

Products distributed on EUMETCast can be formatted in a variety of formats, including EPS native format and the WMO formats (BUFR and GRIB).

6.1.2 GTS/RMDCN

A subset of EPS products will be disseminated additionally in near real-time via the Global Telecommunication System (GTS). GTS is the World Meteorological Organization integrated network of point-to-point circuits, and multi-point circuits which interconnect meteorological telecommunication centres. Its purpose is to enable an efficient exchange of meteorological data and products in a timely and reliable way to meet the needs of World, Regional and National Meteorological Centres. The circuits of the GTS are composed of a combination of terrestrial and satellite telecommunication links. Meteorological Telecommunication Centres are responsible for receiving data and relaying them selectively on GTS circuits. The GTS is organised on a three-level basis, namely:

- The Main Telecommunication Network, linking together 3 World meteorological centres and 15 regional telecommunication hubs.

- The Regional Meteorological Telecommunication Networks, consisting of an integrated network of circuits interconnecting meteorological centres in a region, which are complemented by radio broadcasts where necessary. In Europe, the GTS network is supported by the Regional Meteorological Data Communication Network (RMDCN).
- The National Meteorological Telecommunication Networks, which extend the GTS network down to national level.

More detailed information on this service can be found on the WMO website www.wmo.int.

Products distributed on the GTS are in official WMO formats, namely BUFR or GRIB.

6.1.3 EUMETSAT Data Centre

All EPS products and auxiliary data are normally archived and made available to users from the EUMETSAT Data Centre (formerly known as the UMARF or Archive Services) upon request.

The Data Centre can be accessed through the EUMETSAT webpage EUMETSAT Data Centre. Access is through a Web interface, the Online Ordering Application, through which the users are able to browse and order products, manage their user profile, retrieve products, documentation and software libraries, get help, etc.

The Data Centre features include geographical and time sub-setting and image preview. EPS products archived in the Data Centre can be accessed in a variety of formats, including EPS native format and HDF5.

6.2 IASI products dissemination

Table 6-1 summarises the different dissemination means and formats for all IASI Level 2 products.

Format	*Real-Time Direct Broadcast*	*Near-Real-Time dissemination on EUMETCast (timeliness*)*	*Near-Real-Time dissemination on GTS (timeliness)*	*EUMETSAT Data Centre retrieval (timeliness)*	*FTP Access*
EPS native format	–	–	–	IASI Level 2 (8-9 h)	–
HDF5	–	–	–	IASI Level 2 (8-9 h)	–
WMO (BUFR)	–	IASI Level 2 products (3 h)	IASI Level 2 products (3 h)	–	–
NetCDF	–	–	–	IASI SST L2Pcore product (8-9 h)	IASI SST L2Pcore product (4-6 h)

**Timeliness* refers to the elapsed time between sensing and dissemination.

Table 6-1: Summary of dissemination means and formats for IASI Level 2 products

6.2.1 Near-real-time dissemination

The IASI Level 2 products disseminated to users in near real-time are:

- IASI Level 2 products, with a timeliness of 3 h from sensing

The data are disseminated in WMO (BUFR) format, as per Section 6.5 below. A full description of the IASI Level 2 BUFR formats is given in Section 10.

6.2.2 Archive retrieval

The IASI Level 2 products available from the EUMETSAT Data Centre are:

- IASI Level 2

The products are archived as full-dump products, but sub-setting capabilities are provided to the user in the retrieval step. The products are available for the users in the EUMETSAT Data Centre 8 to 9 hours after sensing, either in EPS native format or in HDF5 format.

6.2.3 FTP dissemination

The IASI Level 2Pcore SST products will be available on FTP. Access to the FTP server requires user registration via the EUMETSAT Earth Observation Portal:

www.eumetsat.int/Home/Main/DataAccess/EOPortal

6.3 IASI EPS native product formats

6.3.1 The EPS native formats

6.3.1.1 General overview of the EPS generic product format

All products in EPS native format are structured and defined according to an EPS Generic Product Format. This format is not IASI specific. The general product section breakdown is given, and the following sections will focus on how this generic format is further applied to IASI products.

This description is not aimed at supporting the writing of reader software for the IASI or other EPS products, because readers and product extraction tools are already available (see Section 5). The intention of this and the following sections is to provide enough information to be able to use such available tools and to interpret the retrieved information.

For users interested in writing their own product readers for one or several IASI products in EPS native format, we refer them to the detailed format specifications provided in [RD11] and [RD12].

The general structure of the products is broken down in sections, which contain one or more records of different classes. Every single record is accompanied by a Generic Record Header (GRH), which contains the metadata necessary to uniquely identify the record type and occurrence within the product. The following general structure is followed by all EPS products, where all the sections occur always in the given order.

Header Section	Contains metadata applicable to the entire product. The header section may contain two records, the Main Product Header Record (MPHR) and the Secondary Product Header Record (SPHR).

Global Auxiliary Data Section	Contains information on the auxiliary data that have been used or produced during the process of the product and applies to the whole length of the product. There can be zero or more records in this section, and they can be of two classes: Global External Auxiliary Data Record (GEADR), containing an ASCII pointer to the source of the auxiliary data used, and Global Internal Auxiliary Data Record (GIADR), containing the auxiliary data used itself.

Pointer Section	Contains pointer information to navigate within the product. It consists of a series of Internal Pointer Records (IPR), which include pointers to records within the Global Auxiliary Data, Variable Auxiliary Data and Body Sections that follow.

Global Auxiliary Data Section	Contains information on the auxiliary data that have been used or produced during the process of the product and applies to the whole length of the product. There can be zero or more records in this section, and they can be of two classes: Global External Auxiliary Data Record (GEADR), containing an ASCII pointer to the source of the auxiliary data used, and Global Internal Auxiliary Data Record (GIADR), containing the auxiliary data used itself.

Variable Auxiliary Data Section	Contains information on the auxiliary data that have been used or produced during the process of the product and may vary within a product, but with a frequency in any case less than the measurement data itself. There can be zero or more records in this section, and they can be of two classes: Variable External Auxiliary Data Record (VEADR), containing an ASCII pointer to the source of the auxiliary data used, and Variable Internal Auxiliary Data Record (VIADR), containing the auxiliary data used itself.

Body Section	This is usually the bulk of the product and contains the raw or processed instrument data and associated information. This section contains time-ordered Measurement Data Records (MDR). A particular type of MDR can occur to indicate the location of an unexpected data gap within any product, the Dummy Measurement Data Record (DMDR).

The format of the MPHR, IPRs, GEADR, VEADR and DMDRs is common to all products, while the other records can be of different formats and contents. Sub-classes have an instrument-specific content and format. Every record consists of a series of fields, which can have different data types. See Appendix C for all possible data types.

> ***Important:*** GEADR and VEADR records are included in the products to support processing configuration control for EUMETSAT at product level. They point to the name of auxiliary data files used in the processing, but they are not of any interest or use to the end-user for the utilisation of the products.

Two types of records deserve special description, because they are key to navigate within the products, namely the GRH and the IPR. Their format and the meaning of their fields are detailed in Appendix D.

Table 6-2 gives an example of general structure of the Generic Product Format.

Section	*Record Class*	*Record Subclass*	*Start Time*	*Stop Time*
HEADER SECTION	MAIN PRODUCT HEADER RECORD		T1	T6
	SECONDARY PRODUCT HEADER RECORD		T1	T6
INTERNAL POINTER SECTION	INTERNAL POINTER RECORD (GEADR Subclass A)		T1	T6
	INTERNAL POINTER RECORD (GEADR Subclass B)		T1	T6
	INTERNAL POINTER RECORD (GIADR Subclass A)		T1	T6
	INTERNAL POINTER RECORD (GIADR Subclass B)		T1	T6
	INTERNAL POINTER RECORD (GIADR Subclass C)		T1	T6
	INTERNAL POINTER RECORD (VEADR Subclass A)		T1	T6
	INTERNAL POINTER RECORD (VEADR Subclass B)		T1	T6
	INTERNAL POINTER RECORD (VEADR Subclass C)		T1	T6
	INTERNAL POINTER RECORD (VIADR Subclass A)		T1	T6
	INTERNAL POINTER RECORD (VIADR Subclass B)		T1	T6
	INTERNAL POINTER RECORD (VIADR Subclass C)		T1	T6
	INTERNAL POINTER RECORD (MDR Subclass A)		T1	T6
	INTERNAL POINTER RECORD (MDR Subclass B)		T1	T6
	INTERNAL POINTER RECORD (MDR DUMMY)		T1	T6
	INTERNAL POINTER RECORD (MDR Subclass A)		T1	T6
	INTERNAL POINTER RECORD (MDR Subclass B)		T1	T6
GLOBAL AUXILIARY DATA SECTION	GLOBAL INTERNAL AUXILIARY DATA RECORD	SUBCLASS A	T1	T6
	GLOBAL INTERNAL AUXILIARY DATA RECORD	SUBCLASS B	T1	T6
	GLOBAL INTERNAL AUXILIARY DATA RECORD	SUBCLASS A	T1	T6
	GLOBAL INTERNAL AUXILIARY DATA RECORD	SUBCLASS B	T1	T6
	GLOBAL INTERNAL AUXILIARY DATA RECORD	SUBCLASS C	T1	T6
VARIABLE AUXILIARY DATA SECTION	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS A	T1	T6
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS B	T1	T3
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS B	T3	T6
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS C	T1	T5
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS C	T5	T6
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS A	T1	T2
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS A	T2	T4
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS A	T4	T6
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS B	T1	T6
	VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS C	T1	T6
BODY SECTION	MEASUREMENT DATA RECORD	SUBCLASS A	T1	T2
	MEASUREMENT DATA RECORD	SUBCLASS B	T2	T3
	MEASUREMENT DATA RECORD	DUMMY	T3	T4
	MEASUREMENT DATA RECORD	SUBCLASS A	T4	T5
	MEASUREMENT DATA RECORD	SUBCLASS B	T5	T6

Table 6-2: Generalised schematic of the generic product format

6.3.1.2 Granularity of the EPS products

The Full EPS product is produced by processing a so-called granule of data. One granule contains 3 minutes of instrument data and one granule of IASI data, therefore 22 or 23 IASI scan lines. This is the product size which is also used to archive the data in the EUMETSAT Data Centre. The length in time of the product is contained in the MPHR.

6.3.1.3 Product format version control

Every record class and sub-class has an associated record version number contained in its corresponding GRH. In addition, each product has a format version number, which is stored in the MPHR.

6.3.1.4 Product naming convention

File naming convention for EPS products in EPS native format provides a product name that uniquely identifies any product and provides a summary of its contents. The field contents in a product name correspond to those in the MPHR.

<INSTRUMENT_ID>_
<PRODUCT_TYPE>
<PROCESSING_LEVEL>
_<SPACECRAFT_ID>
<SENSING_START>_
<SENSING_END>_
<PROCESSING_MODE>_
<DISPOSITION_MODE>_
<PROCESSING TIME>

Product Name Field / MPHR Field	*Description*	*Size in Characters*
INSTRUMENT_ID	Instrument identification	4
PRODUCT_TYPE	Product Type	3
PROCESSING_LEVEL	Processing Level Identification	2
SPACECRAFT_IUD	Spacecraft identification	3
SENSING_START	UTC Time of start of Sensing Data	15
SENSING_END	UTC Time of end of Sensing Data	15
PROCESSING_MODE	Identification of the mode of processing	1
DISPOSITION_MODE	Identification of the type of processing	1
PROCESSING_TIME	UTC time at start of processing for the product	15

Table 6-3: EPS product name fields and their correspondence with MPHR fields

For the IASI Level 2 product, the resulting product file names are as follows:

Product	*Product name*
IASI Level 2	IASI_SND_02_Mnn_<...>

Table 6-4: Generic IASI Level 2 product names

6.3.2 The IASI Level 2 product formats

Table 6-5 below lists the records to be found in IASI Level 2 products:

Record Name	*Description*	*Usage*	*Subclass ID*
MPHR	Main Product Header Record	Main product identification details	0
GEADR	Global External Auxiliary Data Record	Global auxiliary data set used for the generation of the IASI L2 product not written into the product	0
GIADR	Global Internal Auxiliary Data Record	Pressure levels for temperature, humidity and ozone profiles	0
VEADR	Variable External Auxiliary Data Record	Variable auxiliary data set used for the generation of the IASI L2 product not written into the product	0
MDR	Measurement Data Record Level 2	IASI Level 2 products, processing and quality information	0

Table 6-5: Records found in the IASI L2 format

The IASI Level 2 products are organised as successive scan lines. Each IASI Level 1 MDR product contains one IASI scan line. The IFOV within one scan line are referenced to by the geolocation. The START/STOP timeshare is indicated in the MPHR.

The occurrence of the different records in the Level 2 products is as follows:

Record	*Occurrence*
MPHR	Once per product
GEADR	Once per product
GIADR	Once per product
VEADR	As required
MDR	Once per scan line

Table 6-6: Occurrence of the different records in the IASI L2 product

See Section 9 for more details on the contents and EPS format of the IASI Level 2 products.

6.4 The HDF format

Detailed format descriptions are not currently available. HDF formatted products retrieved from the archive are named like the EPS formatted products (see Section 6.2 above) with an '.h5' extension. The products can be read using standard HDF libraries. For more information on HDF5 formats in general, see the HDF5 webpages.

6.5 The WMO formats

The IASI Level 2 products available in WMO (BUFR) format are summarised in Table 6-7.

Product	*Bulletin header*	*Originating station*	*Descriptor sequence*
Atmospheric temperature and water vapour	IEDX[01-19]	EUMP	0-01-007, 0-01-031, 0-02-019, 0-02-020, 0-04-001, 0-04-002, 0-04-003, 0-04-004, 0-04-005, 0-04-006, 0-05-040, 2-01-133, 0-05-041, 2-01-000, 0-05-001, 0-06-001, 0-05-043, 0-13-038, 0-08-012, 0-08-013, 0-02-022, 0-08-065, 0-40-192, 0-40-193, 0-40-194, 0-40-195, 0-40-196, 0-40-197, 0-40-198, 0-07-024, 0-05-021, 0-07-025, 0-05-022, 0-08-003, 0-10-004, 0-08-049, 0-12-061, 0-08-049, 2-02-126, 0-07-001, 2-02-000, 0-08-003, 1-06-000, 0-31-001, 2-02-131, 2-01-138, 0-07-004, 2-01-000, 2-02-000, 0-12-101, 1-10-000, 0-31-001, 2-02-131, 2-01-138, 0-07-004, 2-01-000, 2-02-000, 2-02-129, 2-01-134, 0-13-002, 2-01-000, 2-02-000 See also [RD25]: *BUFR Descriptors for IASI L2 Data* for more details
Atmospheric ozone	IEDX[21-39]	EUMP	0-01-007, 0-01-031, 0-02-019, 0-02-020, 0-04-001, 0-04-002, 0-04-003, 0-04-004, 0-04-005, 0-04-006, 0-05-040, 2-01-133, 0-05-041, 2-01-000, 0-05-001, 0-06-001, 0-05-043, 0-13-038, 0-08-012, 0-08-013, 0-02-022, 0-08-065, 0-40-192, 0-40-193, 0-40-194, 0-40-195, 0-40-196, 0-40-197, 0-40-198, 0-07-024, 0-05-021, 0-07-025, 0-05-022, 2-02-126, 0-07-001, 2-02-000, 1-07-000, 0-31-001, 2-02-131, 2-01-138, 0-07-004, 0-07-004, 2-01-000, 2-02-000, 0-15-020
Trace gases	IEDX[41-59]	EUMP	0-01-007, 0-01-031, 0-02-019, 0-02-020, 0-04-001, 0-04-002, 0-04-003, 0-04-004, 0-04-005, 0-04-006, 0-05-040, 2-01-133, 0-05-041, 2-01-000, 0-05-001, 0-06-001, 0-05-043, 0-13-038, 0-08-012, 0-08-013, 0-02-022, 0-08-065, 0-40-192, 0-40-193, 0-40-194, 0-40-195, 0-40-196, 0-40-197, 0-40-198, 0-07-024, 0-05-021, 0-07-025, 0-05-022, 2-02-126, 0-07-001, 2-02-000, 0-40-199, 0-40-200, 0-40-201, 0-40-202

Product	*Bulletin header*	*Originating station*	*Descriptor sequence*
Cloud parameters	IEDX[61-79]	EUMP	0-01-007, 0-01-031, 0-02-019, 0-02-020, 0-04-001, 0-04-002, 0-04-003, 0-04-004, 0-04-005, 0-04-006, 0-05-040, 2-01-133, 0-05-041, 2-01-000, 0-05-001, 0-06-001, 0-05-043, 0-13-038, 0-08-012, 0-08-013, 0-02-022, 0-08-065, 0-40-192, 0-40-193, 0-40-194, 0-40-195, 0-40-196, 0-40-197, 0-07-024, 0-05-021, 0-07-025, 0-05-022, 2-02-126, 0-07-001, 2-02-000, 0-08-003, 1-12-003, 2-02-129, 2-01-131, 0-07-004, 2-01-000, 2-02-000, 0-12-101, 2-02-130, 2-01-135, 0-20-081, 2-01-000, 2-02-000, 0-20-056
Surface emissivity	IEDX[81-99]	EUMP	TBD (not disseminated)

Table 6-7: IASI Level 2 products made available in WMO (BUFR) format

The full format description of these products is available in the WMO Manual on Codes [RD46].

The names of the IASI Level 2 products distributed on EUMETCast are specified in [RD24]. They follow the pattern:

iasi_yyyymmdd_hhmmss_metopa_nnnnn_eps_o_<product code>.l2_bufr

where:

Moniker	*Stands for*	
yyyymmdd	the UTC year, month, day of the data start sensing time	
hhmmss	the UTC hour, minute, second of the data start sensing time	
nnnnn	the orbit number	
product code		
	twt	atmospheric temperature and water vapour
	ozo	atmospheric ozone
	trg	trace gases
	ems	Emissivity
	clp	cloud parameters

6.6 The netCDF format

The IASI L2Pcore contains the fields identified in Table 6-8.

Field	*Description*
Latitude	Latitude (degrees North)
Longitude	Longitude (degrees East)
Time	Reference time of SST data array
Sea_surface_temperature	Skin SST measurement values (full resolution)
Sst_dtime	Deviation of observation time from reference time
L2P_flags	Flag qualifying SST input data
SSES_bias	Single Sensor Error Statistics bias
SSES_standard _deviation	Single Sensor Error Statistics standard deviation uncertainty
Satellite_zenith_angle	Satellite zenith angle (degrees)
Solar_zenith_angle	Solar zenith angle (degrees)
Quality_level	L2P data quality, from 2 (= first useable data) to 5 (= best quality)
Wind_speed	10-metre ECMWF wind speed (m/s)

Table 6-8: IASI L2Pcore SST field description

7 IASI LEVEL 2 PRODUCTS PROCESSING ALGORITHMS

The detailed IASI Level 2 processing and algorithm description can be found in the reference documents [RD17].

8 IASI LEVEL 2 PRODUCTS VALIDATION AND MONITORING

8.1 In general

The validation of the IASI Level 2 products has been conducted over two main phases: phase one associated with the initial operational version of the processor (v4, from November 2007 to 14 September 2010), and phase two with the 'Day-2' operational version (v5, from 14 September 2010 onwards).

During the first phase, a comprehensive validation report has been published:

- EPS Product Validation Report: IASI L2 PPF [RD26]

In the second phase, separate reports address the IASI Level 2 products:

- An Improved Artificial Neural Network CO Retrieval for IASI L2 Processor [RD28]
- Vertical Temperature and Humidity Profiles within IASI L2 PPF v5: Non-Regression Tests and Validation Results [RD29]
- Surface Emissivity within IASI L2 PPF v5 [RD30]
- IASI L2 Surface Temperature: PPF v5 Validation Results [RD31]

8.2 IASI L2Pcore SST product

First results can be found in the IASI L2 PPF V.5 surface temperature validation report [RD31]. In addition to that, a validation report more focused on the sea surface temperature has been prepared [RD33] which presents validation results of IASI SSTs compared to drifting buoy SSTs and collocated AVHRR SSTs. The IASI SSTs have a cool bias of around 0.4 K compared to drifting buoys, with standard deviation of ~0.4 K. Three-way error statistics have estimated the IASI SSTs to have an error of ~0.33 K, AVHRR SSTs to have an error of ~0.17 K, and the error on the drifting buoy SSTs to be ~0.20 K. The two validation reports are available on the EUMETSAT website:

www.eumetsat.int/Home/Main/DataProducts/Resources.

Concerning the monitoring, the IASI L2Pcore SSTs are collocated with the OSI-SAF Metop/AVHRR *in situ* dataset [RD85] on a monthly basis. This multi-matchup dataset is used to analyse the biases and standard deviations of IASI SST differences compared to drifting buoy SSTs, to ensure consistency in the results, and to be able to identify any problems should they arise.

9 RECORD DESCRIPTION OF THE IASI LEVEL 2 PRODUCTS

This IASI L2 description corresponds to the IASI Level 2 PFS [RD13] Issue v8A (PFV 10.0) and to the Generic PFS [RD11] Issue v7E.

Note that in order to be able to generate the record size and offset information in the table describing the MDR record, a number of in-principle configurable parameters such as pressure levels, state vector dimension, wavelet levels, etc. need to be set. These assumed typical values are given at the end of this section in the Parameters Table (some of these values may differ from those given in the IASI Level 2 PFS, which represent nominal maximum values). However, in order to interpret the products, the user must use the correct dimension information for the product contained in the GIADR and other records, as highlighted in green and described below.

In the tables below, coloured items have the following meanings:

Compound data type, which consists of at least two basic or other compound data types. The name of the compound data type is shown first, followed by a list of the items contained within it.

Dimension parameter for variable product fields.

Summary of Product Format Version record contents history

	PFV = 10.0
Record name	***Record version***
mphr	2
giadr	3
mdr	3

If more than one version of a record exists, all versions are described below.

Contents:

MDR (name 'mdr', class 8, subclass 1, version 3)

Certain record types with formats common to all products (IPR, DMDR, GEADR, VEADR) are not included below, since they are not relevant to the average user. If required, details of these records can be found in the Generic PFS [RD11].

9.1 MPHR (name 'mphr', class 1, subclass 0, version 2)

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Product Details											
PRODUCT_NAME	Complete name of the product			1	1	1	1	string	67	100	20
PARENT_PRODUCT_NAME_1	Name of the parent product from which this product has been produced. For Level 0 products, this field is filled with lower case x's.			1	1	1	1	string	67	100	120
PARENT_PRODUCT_NAME_2	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	220
PARENT_PRODUCT_NAME_3	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	320
PARENT_PRODUCT_NAME_4	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	420
INSTRUMENT_ID	Instrument identification			1	1	1	1	enumerated	4	37	520
INSTRUMENT_MODEL	Instrument Model identification			1	1	1	1	enumerated	3	36	557
PRODUCT_TYPE	Product Type			1	1	1	1	enumerated	3	36	593
PROCESSING_LEVEL	Processing Level Identification			1	1	1	1	enumerated	2	35	629

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
SPACECRAFT_ID	Spacecraft identification			1	1	1	1	enumerated	3	36	664
SENSING_START	UTC Time of start of sensing data in this object (PDU, ROI or Full Product)			1	1	1	1	time	15	48	700
SENSING_END	UTC Time of end of sensing data in this object (PDU, ROI or Full Product)			1	1	1	1	time	15	48	748
SENSING_START_THEORETICAL	Theoretical UTC Time of start of sensing data in the dump from which this object is derived. This data is the predicted start time at the MPF level.			1	1	1	1	time	15	48	796
SENSING_END_THEORETICAL	Theoretical UTC Time of end of sensing data in the dump from which this object is derived. This data is predicted end time at MPF level.			1	1	1	1	time	15	48	844
PROCESSING_CENTRE	Processing Centre Identification			1	1	1	1	enumerated	4	37	892
PROCESSOR_MAJOR_VERSION	Processing chain major version number			1	1	1	1	uinteger	5	38	929
PROCESSOR_MINOR_VERSION	Processing chain minor version number			1	1	1	1	uinteger	5	38	967
FORMAT_MAJOR_VERSION	Data set Format Major Version number			1	1	1	1	uinteger	5	38	1005
FORMAT_MINOR_VERSION	Data set Format Minor Version number			1	1	1	1	uinteger	5	38	1043
PROCESSING_TIME_START	UTC time of the processing at start of processing for the product			1	1	1	1	time	15	48	1081
PROCESSING_TIME_END	UTC time of the processing at end of processing for the product			1	1	1	1	time	15	48	1129
PROCESSING_MODE	Identification of the mode of processing			1	1	1	1	enumerated	1	34	1177
DISPOSITION_MODE	Identification of the disposition mode			1	1	1	1	enumerated	1	34	1211
RECEIVING_GROUND_STATION	Acquisition Station Identification			1	1	1	1	enumerated	3	36	1245
RECEIVE_TIME_START	UTC time of the reception at CDA for first Data Item			1	1	1	1	time	15	48	1281
RECEIVE_TIME_END	UTC time of the reception at CDA for last Data Item			1	1	1	1	time	15	48	1329
ORBIT_START	Start Orbit Number, counted incrementally since launch			1	1	1	1	uinteger	5	38	1377
ORBIT_END	Stop Orbit Number			1	1	1	1	uinteger	5	38	1415

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
ACTUAL_PRODUCT_SIZE	Size of the complete product		bytes	1	1	1	1	uinteger	11	44	1453
ASCENDING NODE ORBIT PARAMETERS											
STATE_VECTOR_TIME	Epoch time (in UTC) of the orbital elements and the orbit state vector. this corresponds to the time of crossing the ascending node for ORBIT_START		UTC	1	1	1	1	longtime	18	51	1497
SEMI_MAJOR_AXIS	Semi major axis of orbit at time of the ascending node crossing.		mm	1	1	1	1	integer	11	44	1548
ECCENTRICITY	Orbit eccentricity at time of the ascending node crossing	10^6		1	1	1	1	integer	11	44	1592
INCLINATION	Orbit inclination at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1636
PERIGEE_ARGUMENT	Argument of perigee at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1680
RIGHT_ASCENSION	Right ascension at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1724
MEAN_ANOMALY	Mean anomaly at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1768
X_POSITION	X position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1812
Y_POSITION	Y position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1856
Z_POSITION	Z position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1900
X_VELOCITY	X velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	1944
Y_VELOCITY	Y velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	1988
Z_VELOCITY	Z velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	2032
EARTH_SUN_DISTANCE_RATIO	Earth-Sun distance ratio - ratio of current Earth-Sun distance to Mean Earth-Sun distance			1	1	1	1	integer	11	44	2076
LOCATION_TOLERANCE_RADIAL	Nadir Earth location tolerance radial		m	1	1	1	1	integer	11	44	2120
LOCATION_TOLERANCE_CROSSTRACK	Nadir Earth location tolerance cross-track		m	1	1	1	1	integer	11	44	2164

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
LOCATION_TOLERANCE_ALONGTRACK	Nadir Earth location tolerance along-track		m	1	1	1	1	integer	11	44	2208
YAW_ERROR	Constant Yaw attitude error	10^3	deg	1	1	1	1	integer	11	44	2252
ROLL_ERROR	Constant Roll attitude error	10^3	deg	1	1	1	1	integer	11	44	2296
PITCH_ERROR	Constant Pitch attitude error	10^3	deg	1	1	1	1	integer	11	44	2340
LOCATION SUMMARY											
SUBSAT_LATITUDE_START	Latitude of sub-satellite point at start of the data set	10^3	Deg	1	1	1	1	integer	11	44	2384
SUBSAT_LONGITUDE_START	Longitude of sub-satellite point at start of the data set	10^3	Deg	1	1	1	1	integer	11	44	2428
SUBSAT_LATITUDE_END	Latitude of sub-satellite point at end of the data set	10^3	Deg	1	1	1	1	integer	11	44	2472
SUBSAT_LONGITUDE_END	Longitude of sub-satellite point at end of the data set	10^3	Deg	1	1	1	1	integer	11	44	2516
Leap Second Information											
LEAP_SECOND	Occurrence of Leap second within the product. Field is set to -1, 0 or +1 dependent upon occurrence of leap second and direction.			1	1	1	1	integer	2	35	2560
LEAP_SECOND_UTC	UTC time of occurrence of the Leap Second (If no leap second in the product, value is null)			1	1	1	1	time	15	48	2595
Record counts											
TOTAL_RECORDS	Total count of all records in the product			1	1	1	1	uinteger	6	39	2643
TOTAL_MPHR	Total count of all MPHRs in product (should always be 1!)			1	1	1	1	uinteger	6	39	2682
TOTAL_SPHR	Total count of all SPHRs in product (should be 0 or 1 only)			1	1	1	1	uinteger	6	39	2721
TOTAL_IPR	Total count of all IPRs in the product			1	1	1	1	uinteger	6	39	2760
TOTAL_GEADR	Total count of all GEADRs in the product			1	1	1	1	uinteger	6	39	2799
TOTAL_GIADR	Total count of all GIADRs in the product			1	1	1	1	uinteger	6	39	2838
TOTAL_VEADR	Total count of all VEADRs in the product			1	1	1	1	uinteger	6	39	2877
TOTAL_VIADR	Total count of all VIADRs in the product			1	1	1	1	uinteger	6	39	2916
TOTAL_MDR	Total count of all MDRs in the product			1	1	1	1	uinteger	6	39	2955
Record Based Generic Quality Flags											

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
COUNT_DEGRADED_INST_MDR	Count of MDRs with degradation due to instrument problems			1	1	1	1	uinteger	6	39	2994
COUNT_DEGRADED_PROC_MDR	Count of MDRs with degradation due to processing problems			1	1	1	1	uinteger	6	39	3033
COUNT_DEGRADED_INST_MDR_BLOCKS	Count of the number of blocks of MDRs degraded due to degraded instrument			1	1	1	1	uinteger	6	39	3072
COUNT_DEGRADED_PROC_MDR_BLOCKS	Count of the number of blocks of MDRs degraded due to degraded processing			1	1	1	1	uinteger	6	39	3111
Time Based Generic Quality Flags											
DURATION_OF_PRODUCT	The duration of the product in milliseconds		ms	1	1	1	1	uinteger	8	41	3150
MILLISECONDS_OF_DATA_PRESENT	The total amount of data present in the product		ms	1	1	1	1	uinteger	8	41	3191
MILLISECONDS_OF_DATA_MISSING	The total amount of data missing from the product		ms	1	1	1	1	uinteger	8	41	3232
Regional Product Information											
SUBSETTED_PRODUCT	Set when product has been subset (e.g. geographically subset using a region of interest filter). Implies the presence of one or more EUMETSAT Data Centre GIADRs in GAD section for product retrieved from Data Centre.			1	1	1	1	boolean	1	34	3273
											Total: 3307

9.2 GIADR (name 'giadr', class 5, subclass 1, version 3)

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GIADR_CONTENTS											

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
NUM_PRESSURE_LEVELS_TEMP	Number of pressure levels for temperature profile retrieval, NLT			1	1	1	1	u-byte	1	1	20
PRESSURE_LEVELS_TEMP	Pressure levels on which retrieved temperature profiles are given	10^2	Pa	NLT	1	1	1	uinteger4	4	360	21
NUM_PRESSURE_LEVELS_HUMIDITY	Number of pressure levels for humidity profile retrieval, NLQ			1	1	1	1	u-byte	1	1	381
PRESSURE_LEVELS_HUMIDITY	Pressure levels on which retrieved humidity profiles are given	10^2	Pa	NLQ	1	1	1	uinteger4	4	360	382
NUM_PRESSURE_LEVELS_OZONE	Number of pressure levels for ozone profile retrieval, NLO			1	1	1	1	u-byte	1	1	742
PRESSURE_LEVELS_OZONE	Pressure layers, defined by 2 pressure levels each, on which retrieved ozone profiles are given	10^2	Pa	2	NLO	1	1	uinteger4	4	32	743
NUM_SURFACE_EMISSIVITY_WAVELENGTHS	Number of wavelengths for surface emissivity retrieval, NEW			1	1	1	1	u-byte	1	1	775
SURFACE_EMISSIVITY_WAVELENGTHS	Wavelengths for surface emissivity	10^4	mu_m	NEW	1	1	1	uinteger4	4	48	776
											Total: 824

9.3 MDR (name 'mdr', class 8, subclass 1, version 3)

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation			1	1	1	1	boolean	1	1	21
MEASUREMENT_DATA											
ATMOSPHERIC_TEMPERATURE	Temperature (for 120 IFOV with up to 90 vertical levels)	10^2	K	NLT	120	1	1	uinteger2	2	21600	22
ATMOSPHERIC_WATER_VAPOUR	Water vapour (for 120 IFOV with up to 90 vertical levels)	10^6	kg/kg	NLQ	120	1	1	uinteger4	4	43200	21622
ATMOSPHERIC_OZONE	Ozone (for 120 IFOV with up to 10 vertical layers)	10^6	kg.m^-2	NLO	120	1	1	uinteger2	2	960	64822
INTEGRATED_OZONE	Integrated ozone (for 120 IFOV)	10^6	kg.m^-2	120	1	1	1	uinteger2	2	240	65782
NUMBER_SURFACE_TEMPS	Number of surface temperatures in IFOV			120	1	1	1	u-byte	1	120	66022
SURFACE_TEMPERATURE	Surface temperature (for 120 IFOV and up to 2 temperatures)	10^2	K	2	120	1	1	uinteger2	2	480	66142
INEGRATED_N2O	Integrated N20 (for 120 IFOV)	10^6	.m^-2	120	1	1	1	uinteger2	2	240	66622
INTEGRATED_CO	Integrated CO (for 120 IFOV)	10^7	.m^-2	120	1	1	1	uinteger2	2	240	66862
INTEGRATED_CH4	Integrated CH4 (for 120 IFOV)	10^6	.m^-2	120	1	1	1	uinteger2	2	240	67102
INTEGRATED_CO2	Integrated CO2 (for 120 IFOV)	10^3	.m^-2	120	1	1	1	uinteger2	2	240	67342
SURFACE_EMISSIVITY	Surface emissivity (for 120 IFOV with up to 20 wavelengths)	10^4		NEW	120	1	1	uinteger2	2	2880	67582
NUMBER_CLOUD_FORMATIONS	Number of cloud formations in IFOV			120	1	1	1	u-byte	1	120	70462

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
FRACTIONAL_CLOUD_COVER	Fractional cloud cover (for 120 IFOV with up to 3 cloud formations)	10^2	%	3	120	1	1	uinteger2	2	720	70582
CLOUD_TOP_TEMPERATURE	Cloud top temperature (for 120 IFOV with up to 3 cloud formations)	10^2	K	3	120	1	1	uinteger2	2	720	71302
CLOUD_TOP_PRESSURE	Cloud top pressure (for 120 IFOV with up to 3 cloud formations)		Pa	3	120	1	1	uinteger4	4	1440	72022
CLOUD_PHASE	Cloud Phase (for 120 IFOV with up to 3 cloud formations) (0 = no cloud, 1 = liquid, 2 = ice, 3 = mixed, 255 = undefined)			3	120	1	1	enumerated	1	360	73462
SURFACE_PRESSURE	Surface pressure		Pa	120	1	1	1	uinteger4	4	480	73822
INSTRUMENT											
INSTRUMENT_MODE	Instrument mode. This is a copy of the MDR-1C flag GEPSIasiMode as defined in the IASI L1 PFS.			1	1	1	1	enumerated	1	1	74302
NAVIGATION_DATA_AT_SCAN_LINE											
TIME_ATTITUDE	Time Associated with Attitude Angles		s	1	1	1	1	uinteger4	4	4	74303
ATITUDE_ANGLES	Attitude Angles: Roll, Pitch, Yaw	10^3	deg	3	1	1	1	integer2	2	6	74307
NAVIGATION_STATUS	Navigation Status Bit Field			1	1	1	1	bitfield (4)	4	4	74313
SPACECRAFT_ALTITUDE	Spacecraft Altitude Above Reference Geoid (MSL)	10^1	km	1	1	1	1	uinteger4	4	4	74317
NAVIGATION_DATA_AT_IFOV											
ANGULAR_RELATION	Angular relationships: solar zenith angle, satellite zenith angle, solar azimuth angle, satellite azimuth angle for 120 IFOV	10^2	deg	4	120	1	1	integer2	2	960	74321
EARTH_LOCATION	Earth Location: latitude, longitude of surface footprint (for 120 IFOV)	10^4	deg	2	120	1	1	integer4	4	960	75281

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
PROCESSING_AND_QUALITY_FLAGS											
FLG_ATOVCLR	Cloud flag for ATOVS products			120	1	1	1	bitfield (1)	1	120	76241
FLG_ATOVCMP	Completeness of ATOVS products			120	1	1	1	bitfield (1)	1	120	76361
FLG_ATOVINT	Interpolation of ATOVS to IASI			120	1	1	1	bitfield (3)	3	360	76481
FLG_AVHAVL	Completeness flag for AVHRR products			120	1	1	1	enumerated	1	120	76841
FLG_AVHBAD	Validation flag for AVHRR products			120	1	1	1	bitfield (1)	1	120	76961
FLG_CHNSEL	Channel selection			120	1	1	1	enumerated	1	120	77081
FLG_CLDAVH	Number of cloud formations analysed in AVHRR			120	1	1	1	enumerated	1	120	77201
FLG_CLDFRM	Number of cloud formations and origin of height assignment			120	1	1	1	bitfield (2)	2	240	77321
FLG_CLDPHA	Cloud Phase			120	1	1	1	enumerated	1	120	77561
FLG_CLDSUM	Summary indicating which instruments see clouds			120	1	1	1	bitfield (2)	2	240	77681
FLG_CLDTST	Cloud tests that are executed			120	1	1	1	bitfield (1)	1	120	77921
FLG_DAYNIT	Discrimination between day and night			120	1	1	1	enumerated	1	120	78041
FLG_FGCHECK	Check whether first guess retrievals passed to iterative retrieval			120	1	1	1	bitfield (2)	2	240	78161
FLG_FINCHC	Final choice of retrieval			120	1	1	1	bitfield (4)	4	480	78401
FLG_FRCSEL	Selection of fractional cloud cover from IASI/ATOVS or AVHRR			120	1	1	1	bitfield (1)	1	120	78881
FLG_IASIBAD	Validation flag for IASI Level 1 product			120	1	1	1	bitfield (2)	2	240	79001
FLG_IASICLD	Results of cloud test			120	1	1	1	bitfield (1)	1	120	79241
FLG_IASICLR	IASI IFOV clear, partly cloudy or cloudy			120	1	1	1	enumerated	1	120	79361
FLG_INITIA	Retrieval initialisation			120	1	1	1	bitfield (1)	1	120	79481
FLG_ITCONV	Convergence of the iterative retrieval			120	1	1	1	enumerated	1	120	79601
FLG_ITRBOU	Validation of iterated state vector			120	1	1	1	enumerated	1	120	79721

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
FLG_LANSEA	Specifies surface type			120	1	1	1	enumerated	1	120	79841
FLG_NUMIT	Number of iterations used for retrieval			120	1	1	1	u-byte	1	120	79961
FLG_NWPBAD	Validation flag of NWP forecast			120	1	1	1	enumerated	1	120	80081
FLG_QUAL	Quality and completeness of the retrieval			120	1	1	1	enumerated	1	120	80201
FLG_RESID	Retrieval residual acceptance flag			120	1	1	1	enumerated	1	120	80321
FLG_RETBOU	Identification of out-of-bounds state vector elements			120	1	1	1	bitfield (32)	32	3840	80441
FLG_RETCHC	Choice of combined or IASI stand alone retrieval			120	1	1	1	bitfield (1)	1	120	84281
FLG_SATMAN	Indication of satellite manœuvre			120	1	1	1	enumerated	1	120	84401
FLG_SELBAC	Selection of background state			120	1	1	1	enumerated	1	120	84521
FLG_SFCAVH	Indication of AVHRR derived surface temperature			120	1	1	1	bitfield (1)	1	120	84641
FLG_SFCTOP	Validation flag for surface type and topography			120	1	1	1	bitfield (1)	1	120	84761
FLG_SUNGLNT	Identification of sun glint			120	1	1	1	enumerated	1	120	84881
FLG_SUPADI	Indication of super-adiabatic conditions in final retrieval			120	1	1	1	enumerated	1	120	85001
FLG_SUPSAT	Indication of super-saturation in final retrieval			120	1	1	1	enumerated	1	120	85121
FLG_THICIR	Thin cirrus cloud test			120	1	1	1	enumerated	1	120	85241
FLG_THICOR	Thin cirrus has been corrected for			120	1	1	1	enumerated	1	120	85361
FLG_VARCLR	Cloud clearing by variational analysis			120	1	1	1	enumerated	1	120	85481
FLG_STER	Representation of retrieval errors. Determines type of data in MDR.ERROR_DATA.			1	1	1	1	enumerated	1	1	85601
DATA_SIZES	Two sizing values for data stored in ERROR_DATA field. Meaning of sizes depends on the FLG_STER [M, N]			2	120	1	1	DATA_SIZES	2	480	85602
M	Length of full state vector, M			1	1	1	1	uinteger2	2	2	
N	Number of wavelets that give approximate 10x compression of covariance matrix, N			1	1	1	1	uinteger2	2	2	

Name	*Description*	*Scaling factor*	*Units*	*Dim1*	*Dim2*	*Dim3*	*Dim4*	*Type*	*Type size*	*Field size*	*Offset*
ERROR_DATA	Contents depend on MDR.FLG_STER field: See below										
If FLG_STER = 0 then Field is empty (No Error Data)											
											Total: 86082
If FLG_STER = 1,2 then											
VARIANCES	Variances of length N (M = length of full state vector, N = 0)			M	120	1	1	vinteger4	5	139200	86082
End If											
											Total: 225282
If FLG_STER = 4 then											
DIAGONAL_VALUES	Diagonal Values of the inverted original covariance matrix (M = length of full state vector, N = number of wavelet coefficients)			M	120	1	1	vinteger4	5	139200	86082
WAVELETS	Wavelet values			N	120	1	1	WAVELET_COEFF	7	3228960	225282
ROW	Row index position of the wavelet			1	1	1	1	u-byte	1	1	
COLUMN	Column index position of the wavelet			1	1	1	1	u-byte	1	1	
COEFFICIENT	Wavelet coefficent value			1	1	1	1	vinteger4	5	5	
End If											
											Total: 3454242

The following flags are of type enumerated, u-byte, or bit string. The types enumerated and u-byte always consist of 1 byte, while the number of bits per bit string can vary but are always a multiple of 8. The convention adopted below when numbering string bits is to refer to the least significant bit as 0 (zero). Please note, if referring to the IASI Level 2 Product Generation Specification [RD17], that in that document the bit numbering starts at 1.

Size of bit strings that can be found in the IASI L2 product:

IASI L2 Bit Strings	
Number of Bits	***Number of Bytes***
8	1
16	2
24	3
32	4
256	32

The bit string encoding is defined in Appendix C.1. Any individual bit in the bit string may be set to 0 or 1. By default all bits are set to zero. The following tables describe in the column ‘Meaning’ the conditions under which the bits are set to 1. If the size of the bit string is larger than the number of used bits, the unused bits are set to zero.

Enumeration DISPOSITION_MODE

Value	***Description***
T	Testing
O	Operational
C	Commissioning

Enumeration FLG_STER

FLG_STER	***Representation of retrieval errors. Determines content and size of data in MDR.ERROR_DATA.***	***Enumerated, length: 1 Byte***
Value	*Meaning*	*DATA_SIZES of ERROR_DATA in IASI L2 MDR*
0	No error variance or covariance given in the product	field does not exist
1	Constant error variances are assigned to the state vector as specified in the user configurable data set	DATA_SIZES(M), M is length of full state vector, N = 0
2	Error variances are calculated in the iterative retrieval	DATA_SIZES(M), M is length of full state vector, N = 0
3	*For future use*	N/A
4	Diagonal elements of the inverted covariance matrix and wavelet coefficients describing the correlation matrix as calculated from the inverse covariance matrix derived in the iterative retrieval.	DATA_SIZES(M) is set to length of FULL state vector. DATA_SIZES(N) is set to the number of wavelet coefficients that are to be stored ERROR_DATA field contains the following: · a 1-D array of V-INTEGER4 of length M containing the diagonal values of the inverted original covariance matrix · an array of length N of a compound variable WAVELET_COEFF. The compound WAVELET_COEFF comprises: · an U-BYTE containing i position of wavelet coefficient · an U-BYTE containing j position of wavelet coefficient · a V-INTEGER4 containing value of the wavelet coefficient Missing state vector elements are given flagged values as per the GPFS.

Enumeration INSTRUMENT_ID

Value	*Name*	*Description*
AMSA	AMSU-A	
ASCA	ASCAT	
ATOV	ATOVS	instruments: AVHRR/3, HIRS/4, AMSU-A, MHS
AVHR	AVHRR/3	
GOME	GOME	
GRAS	GRAS	
HIRS	HIRS/4	
IASI	IASI	
MHSx	MHS	
NOAA	All NOAA	instruments specific to Level 0 NOAA product
SEMx	SEM	
ADCS	ADCS	
SBUV	SBUV	
xxxx	No specific instrument	
HKTM	VCDU34	data specific to Level 0

Enumeration INSTRUMENT_MODE

Value	*Description*
N/A	TBD

Enumeration INSTRUMENT_MODEL

Value	*Description*
0	Reserved
1	Flight Model 1
2	Flight Model 2
3	Engineering Model
4	Protoflight Model

Enumeration PROCESSING_CENTRE

Value	*Description*
CGS1	First EUMETSAT EPS Core Ground Segment
CGS2	Second EUMETSAT EPS Core Ground Segment
NSSx	NOAA/NESDIS
RUSx	Reference User Station
DMIx	DMI, Copenhagen (GRAS SAF)
DWDx	DWD, Offenbach (Climate SAF)
FMIx	FMI , Helsinki (Ozone SAF)
IMPx	IMP, Lisbon (Land SAF)
INMx	INM, Madrid (NCW SAF)
MFxx	MF, Lannion (OSI SAF)
UKMO	UKMO, Bracknell (NWP SAF)

Enumeration PROCESSING_LEVEL

Value	*Name*
00	Level 0
01	Level 1
1A	Level 1a
1B	Level 1b
1C	Level 1c
02	Level 2
03	Level 3
xx	No Specific Level

Enumeration PROCESSING_MODE

Value	*Name*	*Description*
N	Nominal	NRT processing
B	Backlog Processing	
R	Reprocessing	
V	Validation	

Enumeration PRODUCT_TYPE

Value	*Description*
ENG	IASI engineering data
GAC	NOAC Global Area Coverage AVHRR data
SND	Sounding Data
SZF	ASCAT calibrated s0 data at full resolution
SZO	ASCAT calibrated s0 data at operational resolution (50 km)
SZR	ASCAT calibrated s0 data at research resolution (25 km)
VER	IASI verification data
xxx	No specific product type specified
AIP	NOAA AIP/SAIP data
TIP	NOAA TIP/STIP data
HRP	HRPT data
LRP	LRPT data

Enumeration RECEIVING_GROUND_STATION

Value	*Name*
SVL	Svalbard
WAL	Wallops Island, Virginia
FBK	Fairbanks, Alaska
SOC	SOCC (NESDIS Satellite Operations Control Centre), Suitland, Maryland
RUS	Reference User Station

Enumeration SPACECRAFT_ID

Value	*Description*
xxx	No specific spacecraft
M01	METOP 01
M02	METOP 02
M02	METOP 03
N15	NOAA-K
N16	NOAA-L
N17	NOAA-M
N18	NOAA-N
N19	NOAA-N'

Enumeration FLG_AVHAVL

FLG_AVHAVL	*Completeness flag for AVHRR products*	*Enumerated, 1 Byte*
Value	*Meaning*	
0	AVHRR mask has been created and data are available	
1	AVHRR mask could not be created (missing side information)	
2	AVHRR data are only partly, but sufficiently available to fill the mask	
3	AVHRR data are not or not sufficiently available to fill the mask	

Enumeration FLG_CHNSEL

FLG_CHNSEL	*Channel selection*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	No selection made or selection invalid	
1	Selection of all IASI channels as per user-configuration	
2	Selection of a subset of IASI channels due to lacking data	
3	Selection of super channels as per user configuration	
4	Selection of subset of super channels due to lacking data	

Enumeration FLG_CLDAVH

FLG_CLDAVH	*Number of cloud formations analysed in AVHRR*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	No cloud formation has been identified	
1	One cloud formation has been identified	
2	Two cloud formations have been identified	
3	Three cloud formations have been identified	

Enumeration FLG_CLDPHA

FLG_CLDPHA	*Number of cloud phases*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	The IASI IFOV is cloud free	
1	Phase of one cloud formation could be determined	
2	Phases of two cloud formations could be determined	
3	Phases of three cloud formations could be determined	
4	The cloud phases could not be determined	

Enumeration FLG_DAYNIT

FLG_DAYNIT	*Discrimination between day and night*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	Day	
1	Night	
2	Twilight	

Enumeration FLG_IASICLR

FLG_IASICLR	*IASI IFOV clear, partly cloudy or cloudy (as determined using AVHRR collocated information only)*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	The IASI IFOV is clear	
1	The IASI IFOV is partly cloudy	
2	The IASI IFOV is completely cloudy	

Enumeration FLG_ITCONV

FLG_ITCONV	*Convergence of the iterative retrieval*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	The iteration did not converge, sounding rejected	
1	Iteration did not converge, sounding accepted	
2	Iteration converged, sounding accepted	

Enumeration FLG_ITRBOU

FLG_ITRBOU	*Validation of iterated state vector*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	Iteration did not exceed valid bounds	
1	Iterated state vector exceeds valid bounds	

Enumeration FLG_LANSEA

FLG_LANSEA	*Specifies surface type*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	The IASI IFOV is completely covered by water	
1	The IASI IFOV is completely covered by land, the variability of the surface topography is low	
2	The IASI IFOV is completely covered by land, the variability of the surface topography is high	
3	The IASI IFOV covers land and water, the variability of the surface topography is low	
4	The IASI IFOV covers land and water, the variability of the surface topography is high	

U-Byte FLG_NUMIT

FLG_NUMIT	*Number of iterations used for retrieval*	*U-byte, length: 1 Byte*
Value	*Meaning*	
0	No iterations	
N	Number of iterations of the retrieval	

Enumeration FLG_NWPBAD

FLG_NWPBAD	*Validation flag of NWP forecast*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	NWP data are normal and complete	
1	NWP data are normal but incomplete	
2	NWP data have out of bounds values, adjacent values could be assigned	
3	NWP data are corrupted or missing and could be partly used only	
4	NWP data are corrupted or missing and could not be used	
5	NWP data are not available	

Enumeration FLG_QUAL

FLG_QUAL	*Quality and completeness of the retrieval*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	No successful retrieval	
1	Complete retrieval, errors within EURD objective	
2	Incomplete retrieval, errors within EURD objective	
3	Complete retrieval, errors within EURD threshold	
4	Incomplete retrieval, errors within EURD threshold	
5	Complete retrieval, errors outside EURD threshold	
6	Incomplete retrieval, errors outside EURD threshold	

Enumeration FLG_RESID

FLG_RESID	Retrieval residual acceptance flag	Enumerated, length: 1 Byte
Value	Meaning	
0	Residual check was not passed, sounding rejected	
1	Residual check passed, sounding accepted	

Enumeration FLG_SATMAN

FLG_SATMAN	Indication of satellite manoeuvre	Enumerated, length: 1 Byte
Value	Meaning	
0	The platform is not undergoing a manoeuvre	
1	The platform is undergoing a manoeuvre, nominal processing	
2	The platform is undergoing a manoeuvre, no processing	

Enumeration FLG_SELBAC

FLG_SELBAC	Selection of background state	Enumerated, length: 1 Byte
Value	Meaning	
0	No background state vector selected	
1	ATOVS level 2 selected as background state vector	
2	Climatology selected as background state vector	
3	NWP forecast selected as background state vector	
4	Previous retrieval selected as background state vector	

Enumeration FLG_SUNGLNT

FLG_SUNGLNT	*Identification of sun glint*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	No sun glint	
1	IASI observes sun glint	

Enumeration FLG_SUPADI

FLG_SUPADI	*Indication of super-adiabatic conditions in final retrieval*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	No super adiabatic layering	
N	Super-adiabatic conditions in N layers	

Enumeration FLG_SUPSAT

FLG_SUPSAT	*Indication of super-saturation in final retrieval*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	No super saturation of water vapour	
N	Super-saturation at N levels	

Enumeration FLG_THICIR

FLG_THICIR	*Thin cirrus cloud test*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	No thin cirrus detected	
1	Thin cirrus detected	
2	Test failed or not executed	

Enumeration FLG_THICOR

FLG_THICOR	*Thin cirrus cloud test*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	The IASI data have not been corrected	
1	The IASI data have been corrected for thin cirrus	

Enumeration FLG_VARCLR

FLG_VARCLR	*Cloud clearing by variational analysis*	*Enumerated, length: 1 Byte*
Value	*Meaning*	
0	The IASI IFOV has been initialised for variational cloud clearing	
1	The IASI IFOV has not been initialised for variational cloud clearing	

Bitfield NAVIGATION_STATUS

Length 4 bytes

NAVIGATION_STATUS		*Bit string, length: 4 Byte*
Bit position	*Meaning*	
31 - 17	not used	15
16	If bit set to 1, Earth location corrected for Euler angles	1
15 - 12	Earth location indicator, if value: 0 = Earth location available, 1 = user ephemeris files older than 24 hours, 2 = no earth location available	4
11 - 8	Spacecraft attitude control, if value 0 = NOMINAL mode, 1 = operating in another mode, 2 = attitude exceeds nominal tolerance, 3 = operating in another mode and attitude exceeds nominal tolerance	4
7 - 4	Attitude SMODE: 0 = NOMINAL mode,	4

NAVIGATION_STATUS		Bit string, length: 4 Byte
Bit position	Meaning	
	1 = rate nulling mode, 2 = YGC mode, 3 = search mode, 4 = coast mode	
3 - 0	Attitude mode: 0 = NOMINAL mode/no test, 1 = yaw axis test in progress, 2 = roll axis test in progress, 3 = pitch axis test in progress	4
Total		***32***

Bitfield FLG_ATOVCLR

Length 1 bytes

FLG_ATOVCLR	Cloud flag for ATOVS products	Bit string, length: 1 Byte
Bit number and Value	Meaning	
0 (all Bits set to 0)	ATOVS L2 is cloud-free	
Bit 0 = 1	ATOVS L2 is partly cloudy	
Bit 1 = 1	ATOVS L2 is completely cloudy	
Bit 2 = 1	ATOVS L2 cloud information is incomplete	
Bit 3 - 7 = 0	not used	

Bitfield FLG_ATOVCMP

Length 1 byte

FLG_ATOVCMP	*Completeness of ATOVS products*	*Bit string, length: 1 Byte*
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	ATOVS product is complete	
Bit 0 = 1	AMSU-A1 level 1 is incomplete	
Bit 1 = 1	AMSU-A2 level 1 is incomplete	
Bit 2 = 1	MHS level 1 is incomplete	
Bit 3 = 1	ATOVS level 2 is incomplete	
Bit 4 - 7 = 0	not used	

Bitfield FLG_ATOVINT

Length 3 bytes

FLG_ATOVINT	*Interpolation of ATOVS to IASI*	*Bit string, length: 3 Byte*
Bit number and Value	***Meaning***	
Bit 0 = 1	ATOVS Level 2 data are not available	
Bit 1 = 1	ATOVS Level 2 data are incomplete	
Bit 2 = 1	ATOVS Level 2 data from a single sounding are very close to the IASI IFOV and have been selected to match it	
Bit 3 = 1	ATOVS Level 2 data from three or more soundings have been interpolated to the IASI IFOV	
Bit 4 = 1	ATOVS Level 2 data from two soundings have been averaged to the IASI IFOV	
Bit 5 = 1	ATOVS Level 2 data from a single sounding, not very close to the IASI IFOV have been selected to match the IASI IFOV since no other soundings are available for an interpolation.	
Bit 6 = 1	AMSU-A Level 1 data are not available	
Bit 7 = 1	AMSU-A Level 1 data are incomplete for cloud detection	
Bit 8 = 1	AMSU-A Level 1 data are incomplete for retrieval	
Bit 9 = 1	AMSU-A Level 1 data from a single sounding are very close to the IASI IFOV and have been selected to match it	
Bit 10 = 1	AMSU-A Level 1 data from three or more soundings have been interpolated to the IASI IFOV	
Bit 11 = 1	AMSU-A Level 1 data from two soundings have been averaged to the IASI IFOV	
Bit 12 = 1	AMSU-A Level 1 data from a single sounding, not very close to the IASI IFOV have been selected to match the IASI IFOV since no other soundings are available for an interpolation.	
Bit 13 = 1	MHS Level 1 data are not available or incomplete for retrieval	
Bit 14 = 1	MHS Level 1 data from a single sounding are very close to the IASI IFOV and have been selected to match it	
Bit 15 = 1	MHS Level 1 data from three or more soundings have been interpolated to the IASI IFOV	
Bit 16 = 1	MHS Level 1 data from two soundings have been averaged to the IASI IFOV	
Bit 17 = 1	MHS Level 1 data from a single sounding, not very close to the IASI IFOV have been selected to match the IASI IFOV since no other soundings are available for an interpolation.	
Bit 18 - 23 = 0	not used	

Bitfield FLG_AVHBAD

Length 1 bytes

FLG_AVHBAD	*Validation flag for AVHRR products*	*Bit string, length: 1 Byte*
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	AVHRR products are normal	
Bit 0 = 1	AVHRR data are degraded according to level 1 flags	
Bit 1 = 1	AVHRR products are missing or corrupted (not indicated by level 1 flags)	
Bit 2 = 1	AVHRR side information is missing or corrupted (not indicated by level 1 flags)	
Bit 3 = 1	AVHRR products are of degraded quality (not indicated by level 1 flags)	
Bit 4 = 1	AVHRR products assume out of bounds values (not indicated by level 1 flags)	
Bit 5 - 7 = 0	not used	

Bitfield FLG_CLDFRM

Length 2 bytes

FLG_CLDFRM	*Number of cloud formations and origin of height assignment*	*Bit string, length: 2 Byte*
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	The IASI IFOV is clear	
Bit 0 =1	Cloudy but no height assignment possible	
Bit 1= 1	One cloud formation with ATOVS height assignment	
Bit 2= 1	Two cloud formations with ATOVS height assignment	
Bit 3= 1	Three cloud formations with ATOVS height assignment	
Bit 4= 1	One cloud formation with NWP forecast height assignment	
Bit 5 = 1	Two cloud formations with NWP forecast height assignment	
Bit 6 = 1	Three cloud formations with NWP forecast assignment	
Bit 7 = 1	One cloud formation with climatological height assignment	
Bit 8 = 1	Two cloud formations with climatological height assignment	

FLG_CLDFRM	Number of cloud formations and origin of height assignment	Bit string, length: 2 Byte
Bit number and Value	**Meaning**	
Bit 9 = 1	Three cloud formations with climatological height assignment	
Bit 10 = 1	The height assignment of first cloud formation is ambiguous	
Bit 11 = 1	The height assignment of second cloud formation is ambiguous	
Bit 12 = 1	The height assignment of third cloud formation is ambiguous	
Bit 13 - 15 = 0	not used	

Bitfield FLG_CLDSUM

Length 2 bytes

FLG_CLDSUM	Summary indicating which instruments see clouds	Bit string, length: 2 Byte
Bit number and Value	**Meaning**	
0 (all Bits set to 0)	The IASI IFOV is clear as identified by AVHRR, ATOVS and IASI	
Bit 0 = 1	AVHRR has been examined for clouds	
Bit 1 = 1	IASI has been examined for clouds	
Bit 2 = 1	IASI/ATOVS has been examined for clouds	
Bit 3 = 1	AVHRR indicates partly cloudy	
Bit 4 = 1	AVHRR indicates cloudy	
Bit 5 = 1	IASI indicates partly cloudy	
Bit 6 = 1	IASI indicates cloudy	
Bit 7 = 1	IASI/ATOVS indicates partly cloudy	
Bit 8 = 1	IASI/ATOVS indicates cloudy	
Bit 9 - 15 = 0	not used	

Bitfield FLG_CLDTST

Length 1 bytes

FLG_CLDTST	*Cloud tests that are executed*	*Bit string, length: 1 Byte*
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	No cloud test has been executed	
Bit 0 = 1	Test A has been executed	
Bit 1 = 1	Test B has been executed	
Bit 2 = 1	Test C has been executed	
Bit 3 = 1	Test D has been executed	
Bit 4 = 1	Test E has been executed	
Bit 5 - 7 = 0	not used	

Bitfield FLG_FGCHECK

Length 2 bytes

FLG_FGCHECK	***Check whether first guess retrievals passed to iterative retrieval***	***Bit string, length: 2 Byte***
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	Retrieved values are all within valid bounds	
Bit 0 = 1	Temperature profile is out of valid bounds	
Bit 1 = 1	Water-vapour profile is out of valid bounds	
Bit 2 = 1	Ozone profile is out of valid bounds	
Bit 3 = 1	Surface temperature is out of valid bounds	
Bit 4 = 1	Surface emissivity is out of valid bounds	
Bit 5 = 1	CO column is out of bounds	
Bit 6 = 1	N2O column is out of valid bounds	
Bit 7 = 1	CH4 column is out of valid bounds	
Bit 8 = 1	CO2 column is out of valid bounds	
Bit 9 - 15 = 0	not used	

Bitfield FLG_FINCHC

Length 4 bytes

FLG_FINCHC	***Final choice of retrieval***	***Bit string. length: 4 Byte***
Bit number and Value	***Meaning***	
Bit 0 = 1	EOF regression for temperature profile	
Bit 1 = 1	EOF regression for water-vapour profile	
Bit 2 = 1	EOF regression for ozone profile	
Bit 3 = 1	EOF regression for surface temperature	
Bit 4 = 1	EOF regression for surface emissivity	
Bit 5 = 1	ANN retrieval for temperature profile	

FLG_FINCHC	*Final choice of retrieval*	*Bit string. length: 4 Byte*
Bit number and Value	*Meaning*	
Bit 6 = 1	ANN retrieval for water-vapour profile	
Bit 7 = 1	ANN retrieval for ozone retrieval	
Bit 8 = 1	ANN retrieval for carbon monoxide	
Bit 9 = 1	ANN retrieval for methane	
Bit 10 = 1	ANN retrieval for nitrous oxide	
Bit 11 = 1	ANN retrieval for carbon dioxide	
Bit 12 = 1	ANN retrieval for surface temperature	
Bit 13 = 1	ANN retrieval for surface emissivity	
Bit 14 = 1	Iterative retrieval for temperature profile	
Bit 15 = 1	Iterative retrieval for water-vapour retrieval	
Bit 16 = 1	Iterative retrieval for ozone profile	
Bit 17 = 1	Iterative retrieval for surface temperature	
Bit 18 = 1	Iterative retrieval for surface emissivity	
Bit 19 = 1	Iterative retrieval for carbon monoxide	
Bit 20 = 1	Iterative retrieval for methane	
Bit 21 = 1	Iterative retrieval for nitrous oxide	
Bit 22 = 1	Iterative retrieval for carbon dioxide	
Bit 23 = 1	Full clear sky retrieval	
Bit 24 = 1	Full cloudy retrieval without cloud clearing	
Bit 25 = 1	Full cloudy retrieval with variational cloud clearing	
Bit 26 = 1	Retrieval above cloud top	
Bit 27 - 31 = 0	not used	

Bitfield FLG_FRCSEL

Length 1 bytes

FLG_FRCSEL	*Selection of fractional cloud cover from IASI/ATOVS or AVHRR*	*Bit string, length: 1 Byte*
Bit number and Value	*Meaning*	
Bit 0 = 1	IASI/ATOVS derived fractional cloud cover is higher	
Bit 1 = 1	AVHRR derived fractional cloud cover is higher	
Bit 2 = 1	IASI/ATOVS derived cloud top height is higher	
Bit 3 = 1	AVHRR derived cloud top height is higher	
Bit 4- 7 = 0	not used	

Bitfield FLG_IASIBAD

Length 2 bytes

FLG_IASIBAD	***Validation flag for IASI Level 1 product***	***Bit string, length: 2 Byte***
Bit number and Value	***Meaning***	
Bit 0 = 1	IASI data are degraded according to IASI level 1 flags	
Bit 1 = 1	Missing or corrupted level 1 data (not indicated by level 1 flags)	
Bit 2 = 1	Missing or corrupted side information (not indicated by level 1 flags)	
Bit 3 = 1	Out of bounds radiance (not indicated by level 1 flags)	
Bit 4 = 1	Out of bounds AVHRR radiance analysis	
Bit 5 = 1	Minor degradation, product retrieval is possible without data modification	
Bit 6 = 1	Minor degradation, product retrieval is possible with data replacement/modification as foreseen	
Bit 7 = 1	Degradation, cloud processing is not or only partly possible with IASI	
Bit 8 = 1	Degradation, EOF regression retrieval is only possible using bands 1 and 2	
Bit 9 = 1	Degradation, EOF regression retrieval is not possible	
Bit 10 = 1	Degradation, ANN temperature and water-vapour retrieval is not possible	
Bit 11 = 1	Degradation, ANN trace gas retrieval is not possible	
Bit 12 = 1	Degradation, iterative retrieval is only possible with subset of super-channels	
Bit 13 = 1	Major degradation, no product retrieval possible	
Bit 14 - 15 = 0	not used	

Bitfield FLG_IASICLD

Length 1 bytes

FLG_IASICLD	*Results of cloud test*	*Bit string, length: 1 Byte*
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	The IASI IFOV is clear	
Bit 0 = 1	Test A has detected clouds	
Bit 1 = 1	Test B has detected clouds	
Bit 2 = 1	Test C has detected clouds	
Bit 3 = 1	Test D has detected clouds	
Bit 4 = 1	Test E has detected clouds	
Bit 5 - 7 = 0	not used	

Bitfield FLG_INITIA

Length 1 bytes

FLG_INITIA	*Retrieval initialisation*	*Bit string, length: 1 Byte*
Bit number and Value	*Meaning*	
Bit 0 = 1	IASI first retrieval included	
Bit 1 = 1	AVHRR included	
Bit 2 = 1	AMSU-A Level 1 included	
Bit 3 = 1	MHS Level 1 included	
Bit 4 = 1	ATOVS Level 2 included	
Bit 5 = 1	NWP included	
Bit 6 = 1	Climatology included	
Bit 7 = 0	not used	

Bitfield FLG_RETBOU

Length 32 bytes

FLG_RETBOU	*Identification of out-of-bounds state vector elements*	*Bit string, length: 32 Byte*
Bit number and Value	*Meaning*	
0 (all bits set to 0)	All state vector elements within valid bounds	
Bit 0 - (N-1) = 1	State vector element N out of valid bounds	

Bitfield FLG_RETCHC

Length 1 bytes

FLG_RETCHC	*Choice of combined or IASI stand alone retrieval*	*Bit string, length: 1 Byte*
Bit number and Value	***Meaning***	
Bit 0 = 1	AVHRR included	
Bit 1 = 1	ATOVS Level 2 included in cloud processing	
Bit 2 = 1	ATOVS Level 2 included in retrieval initialisation	
Bit 3 = 1	AMSU-A Level 1 included in cloud processing	
Bit 4 = 1	AMSU-A Level 1 included in retrieval	
Bit 5 = 1	MHS Level 1 included in retrieval	
Bit 6 - 7 = 0	not used	

Bitfield FLG_SFCAVH

Length 1 bytes

FLG_SFCAVH	*Indication of AVHRR derived surface temperature*	*Bit string, length: 1 Byte*
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	No surface temperature calculated	
Bit 0 = 1	Sea surface temperature has been calculated	
Bit 1 = 1	Land surface temperature has been calculated	
Bit 2- 7 = 0	not used	

Bitfield FLG_SFCTOP

Length 1 bytes

FLG_SFCTOP	*Validation flag for surface type and topography*	*Bit string, length: 1 Byte*
Bit number and Value	***Meaning***	
0 (all Bits set to 0)	The surface types and topography extracted is valid	
Bit 0 = 1	The surface types are not valid	
Bit 1 = 1	The surface types are incomplete	
Bit 2 = 1	The topography is not valid	
Bit 3 = 1	The topography is incomplete	
Bit 4- 7 = 0	not used	

Parameters Table

Parameter	*Value*	*Description*
M	232	Length of complete state vector
N	3844	Number of wavelets that give approximate 10x compression of covariance matrix
NEW	12	Number of wavelengths for emissivities
NLO	4	Number of pressure levels for ozone profiles
NLQ	90	Number of pressure levels for water vapour profiles
NLT	90	Number of pressure levels for temperature profiles

10 BUFR DESCRIPTOR SEQUENCES FOR THE IASI LEVEL 2 PRODUCT

10.1 BUFR descriptor sequences of the reduced IASI Level 2 product on the GTS

Section 1

Octet No.	*Value*
1-3	Length of section 1
4	0
5	3
6	254
7	0
8	Bit 1 = 0; Bits 2-8 = 0
9	3
10	Configurable, static
11	Configurable, static
12	Configurable, static
13	Year of the Century
14	Month
15	Day
16	Hour
17	Minute
18-	0

Section 2

Optional, no content is foreseen.

Section 3

Atmospheric Temperature Bulletin Template:

Descriptor Reference (F-X-Y)	*Element Name*	*Code*	*Description or comment*
0-01-007	satellite id	3	METOP1
0-01-031	id of originating centre	254	EUMETSAT
0-02-019	satellite instrument	221	IASI
0-02-020	satellite classification	61	EPS
0-04-001	year		
0-04-002	month		
0-04-003	day		
0-04-004	hour		
0-04-005	minute		
0-04-006	second		
0-05-001	latitude (high acc)		

Descriptor Reference (F-X-Y)	*Element Name*	*Code*	*Description or comment*
0-06-001	longitude (high acc)		
1-06-030	repeat following 6 descriptors 30 times		
0-07-004	pressure		
2-01-132	change width		Reset to allow 0.0 to 409.4 K
2-02-129	change scale		Reset to allow 0.00 to 655.34 K
0-12-001	temperature/dry bulb temperature		atmospheric temperature
2-02-000	reset scale		
2-01-000	reset width		

Water Vapour Bulletin Template:

Descriptor Reference (F-X-Y)	*Element Name*	*Code*	*Description or comment*
0-01-007	satellite id	3	METOP1
0-01-031	id of originating centre	254	EUMETSAT
0-02-019	satellite instrument	221	IASI
0-02-020	satellite classification	61	EPS
0-04-001	year		
0-04-002	month		
0-04-003	day		
0-04-004	hour		
0-04-005	minute		
0-04-006	second		
0-05-001	latitude (high acc)		
0-06-001	longitude (high acc)		
1-02-030	repeat following 2 descriptors 30 times		
0-07-004	pressure		
0-13-001	specific humidity		Allows 0.00000 to 0.16383 kg/kg

Ozone Bulletin Template:

Descriptor Reference (F-X-Y)	*Element Name*	*Code*	*Description or comment*
0-01-007	satellite id	3	METOP1
0-01-031	id of originating centre	254	EUMETSAT
0-02-019	satellite instrument	221	IASI
0-02-020	satellite classification	61	EPS
0-04-001	year		
0-04-002	month		
0-04-003	day		

Descriptor Reference (F-X-Y)	*Element Name*	*Code*	*Description or comment*
0-04-004	hour		
0-04-005	minute		
0-04-006	second		
0-05-001	latitude (high acc)		
0-06-001	longitude (high acc)		
1-02-030	repeat following 2 descriptors 30 times		
0-07-004	pressure		
0-13-001	integrated ozone density		

Surface Temperature Bulletin Template:

Descriptor Reference (F-X-Y)	*Element Name*	*Code*	*Description or comment*
0-01-007	satellite id	3	METOP1
0-01-031	id of originating centre	254	EUMETSAT
0-02-019	satellite instrument	221	IASI
0-02-020	satellite classification	61	EPS
0-04-001	year		
0-04-002	month		
0-04-003	day		
0-04-004	hour		
0-04-005	minute		
0-04-006	second		
0-05-001	latitude (high acc)		
0-06-001	longitude (high acc)		
2-01-132	change width		Reset to allow 0.0 to 409.4 K
2-02-129	change scale		Reset to allow 0.00 to 655.34 K
0-12-061	skin temperature		
2-02-000	reset scale		
2-01-000	reset width		

10.2 BUFR descriptor sequences of the IASI Level 2 product disseminated on EUMETCast

The BUFR descriptor sequences for dissemination on EUMETCast will be added as soon as information is available.

11 NETCDF Format Specification for the IASI l2PCORE SST Product

```
Netcdf 20101026002057-EUM-L2P_GHRSST-SSTskin-IASI_A-eumetsat_metopa_20101026
_20846-v02.0-fv01.0 {
dimensions:
        time = 1 ;
        nj = 765 ;
        ni = 120 ;
variables:
float   lat(nj, ni) ;
        lat:long_name = "latititude" ;
        lat:units = "degrees_north" ;
float   lon(nj, ni) ;
        lon:long_name = "longitude" ;
        lon:units = "degrees_east" ;
float   time(time) ;
        time:long_name = "reference time of sst file" ;
        time:units = "seconds since 1981-01-01 00:00:00" ;
short   sea_surface_temperature(time, nj, ni) ;
        sea_surface_temperature:long_name = "sea_surface_skin_temperature" ;
        sea_surface_temperature:units = "kelvin" ;
        sea_surface_temperature:_FillValue = -32768s ;
        sea_surface_temperature:add_offset = 273.15 ;
        sea_surface_temperature:scale_factor = 0.01 ;
        sea_surface_temperature:valid_min = -135s ;
        sea_surface_temperature:valid_max = 5685s ;
        sea_surface_temperature:coordinates = "lon lat" ;
        sea_surface_temperature:source = "EUMETSAT IASI L2 PPF version 5.1.1" ;
short   sst_dtime(time, nj, ni) ;
        sst_dtime:long_name = "time difference from reference time" ;
        sst_dtime:units = "seconds" ;
        sst_dtime:_FillValue = -32768s ;
        sst_dtime:add_offset = 0 ;
        sst_dtime:scale_factor = 1 ;
        sst_dtime:valid_min = -32767s ;
        sst_dtime:valid_max = 32767s ;
        sst_dtime:coordinates = "lon lat" ;
short   l2p_flags(time, nj, ni) ;
        l2p_flags:long_name = "L2P flags" ;
        l2p_flags:_FillValue = -32768s ;
        l2p_flags:coordinates = "lon lat" ;
        l2p_flags:flag_meanings = "infrared microwave ocean land ice lake river sun_glint" ;
        l2p_flags:flag_masks = "1 1 2 2 4 8 16 64" ;
        l2p_flags:flag_values = "0, 1, 0, 2, 4, 8, 16, 64" ;
byte    sses_bias(time, nj, ni) ;
        sses_bias:long_name = "SSES bias error based on confidence flags" ;
        sses_bias:units = "kelvin" ;
        sses_bias:_FillValue = -128b ;
        sses_bias:add_offset = 0 ;
        sses_bias:scale_factor = 0.01 ;
        sses_bias:valid_min = -127b ;
        sses_bias:valid_max = 127b ;
        sses_bias:coordinates = "lon lat" ;
byte    sses_standard_deviation(time, nj, ni) ;
        sses_standard_deviation:long_name = "SSES standard deviation error based on
        confidence flag" ;
        sses_standard_deviation:units = "kelvin" ;
        sses_standard_deviation:_FillValue = -128b ;
```

```
        sses_standard_deviation:add_offset = 1 ;
        sses_standard_deviation:scale_factor = 0.01 ;
        sses_standard_deviation:valid_min = -127b ;
        sses_standard_deviation:valid_max = 127b ;
        sses_standard_deviation:coordinates = "lon lat" ;
byte    satellite_zenith_angle(time, nj, ni) ;
        satellite_zenith_angle:long_name = "satellite zenith angle" ;
        satellite_zenith_angle:units = "angular_degree" ;
        satellite_zenith_angle:_FillValue = -128b ;
        satellite_zenith_angle:add_offset = 0 ;
        satellite_zenith_angle:scale_factor = 1 ;
        satellite_zenith_angle:valid_min = -90b ;
        satellite_zenith_angle:valid_max = 90b ;
        satellite_zenith_angle:coordinates = "lon lat" ;
byte    solar_zenith_angle(time, nj, ni) ;
        solar_zenith_angle:long_name = "solar zenith angle" ;
        solar_zenith_angle:units = "angular_degree" ;
        solar_zenith_angle:_FillValue = -128b ;
        solar_zenith_angle:add_offset = 90 ;
        solar_zenith_angle:scale_factor = 1 ;
        solar_zenith_angle:valid_min = -90b ;
        solar_zenith_angle:valid_max = 90b ;
        solar_zenith_angle:coordinates = "lon lat" ;
byte    quality_level(time, nj, ni) ;
        quality_level:long_name = "quality_level" ;
        quality_level:units = "code" ;
        quality_level:_FillValue = -128b ;
        quality_level:add_offset = 0 ;
        quality_level:scale_factor = 1 ;
        quality_level:valid_min = 0b ;
        quality_level:valid_max = 5b ;
        quality_level:coordinates = "lon lat" ;
byte    wind_speed(time, nj, ni) ;
        wind_speed:long_name = “10m wind speed” ;
        wind_speed:units = “ms-1” ;
        wind_speed:height = “10m” ;
        wind_speed:_FillValue = -128b ;
        wind_speed:add_offset = 0 ;
        wind_speed:scale_factor = 1 ;
        wind_speed:valid_min = 0b ;
        wind_speed:valid_max = 127b ;
        wind_speed:coordinates = "lon lat" ;
        wind_speed:source = “ECMWF forecast”
        wind_speed:time_offset = 6 ;

// global attributes:
        :Conventions = "CF-1.4" ;
        :title = "Sea Surface Temperature from METOP-A IASI" ;
        :mmr_url = "" ;
        :references = "N/A" ;
        :institution = "L2P produced by  EUMETSAT" ;
        :contact = "User Service Helpdesk http://www.eumetsat.int" ;
        :gds_version_id = "2.0_rev_1.1" ;
        :netcdf_version_id = "4.1.1" ;
        :creation_date = "2010-10-26Z" ;
        :product_version = "00.1" ;
        :history = "N/A" ;
        :platform = "MetOpA" ;
```

```
        :sensor = "IASI" ;
        :spatial_resolution = "12km at nadir" ;
        :start_time = "00:20:57Z" ;
        :stop_time = "02:16:54Z" ;
        :start_date = "2010-10-26Z" ;
        :stop_date = "2010-10-26Z" ;
        :northernmost_latitude = 89.6217f ;
        :southernmost_latitude = -89.7583f ;
        :easternmost_longitude = 179.9964f ;
        :westernmost_longitude = -179.9913f ;
        :file_quality_level = 3 ;
        :source_data = "IASI_L2" ;
        :comment = "Core L2P without auxiliary data" ;
              data:

 time = 3.225699e+08 ;
}
```