Local BUFR Descriptors for IASI Level 2 Data

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EUMETSAT
Eumetsat-Allee 1, D-64295 Darmstadt, Germany
Tel: +49 6151 807-7
Fax: +49 6151 807 555
http://www.eumetsat.int

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Document Change Record

Version	***Version Date*** *(as on profile)*	***DCR* No.*** *if applicable*	***Description of Changes***
v1			Initial document created.
v2			Review
v3			Document released to support IASI L2 product release.
v4			Template updated for web delivery.
v4A			New descriptor added.
v4B	17 July 2018		Update document template. Rename from “BUFR Descriptors for IASI Level 2 Data”. Update signature table. Add introduction (Section 1). Add table captions. Restructure section on local BUFR descriptors (now Section 2). Move BUFR Table B entries and code/flag definitions into Section 2. Extend Table 4 to link in fields from PFS format. Remove global descriptors from Table 4. Remove redundant descriptions of global descriptors (FLG_SUNGLINT, FLG_LANSEA, FLG_DAYNIT). Insert additional local descriptors used in IASI L2 products (Table 4). Document change in use of 0-15-045 (Table 5). Fold flag and code table definitions into Section 2. Remove product examples.

DCR = Document Change Request

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None used.

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1 INTRODUCTION

EUMETSAT encodes several IASI Level 2 (L2) products in BUFR. Historically, many of these products have used local descriptors, or even incorrect global descriptors. This document contains the definitions needed in order to produce corresponding tables so that users can read products which use these descriptors. Without this information, it is not possible to process products which make use of the descriptors described herein.

1.1 Purpose

Readers of this document should find the information they need in order to decode and interpret BUFR products produced by EUMETSAT.

1.2 Scope

The intended audience of this document are users of IASI L2 products and maintainers of environments in which these users work, who must assure that the tables required to read the products are available in these environments.

This document details IASI Level 2 products produced by EUMETSAT, which are encoded in BUFR using local table descriptors described in EUMETSAT local table version 1. The descriptions contained in this document are independent of any software used to decode BUFR. For a full description of the BUFR format, see [AD-1].

EUMETSAT ceased using descriptors contained in this document following the adoption of their content in [AD-1]. Guidance on how to interpret products consistently across the transition period is given in [AD-2].

The descriptors found in this document were only used by EUMETSAT until migration to BUFR Master Table 31. Products encoded using this and subsequent Master Table Versions do not contain these descriptors.

1.3 Applicable Documents

Table 1: List of applicable documents.

AD-1	WMO Manual on Codes – International Codes – Volume I.2	WMO-No. 306
AD-2	Migration guide: Local EUMETSAT descriptors to WMO descriptors for IASI Level 2 BUFR products	EUM/SEP/TEN/18/1004055, v1
AD-3	Product User Manual: Near real-time IASI CO	SAF/O3M/ULB/PUM/001 v1B
AD-4	Product User Manual: Near real-time IASI Brescia SO2	SAF/AC/ULB/PUM/002, v1

1.4 Reference Documents

Table 2: List of reference documents.

RD-1	IASI Level 2: Product Format Specification	EPS.MIS.SPE.980760, v9B

1.5 Document Structure

Section 1 General information (this section)

Section 2 Description of each local BUFR entry, and of global BUFR entries which deviate from those described in [AD-1].

1.6 Acronyms

Table 3: Acronyms used in this document.

Acronym	Meaning
AMSU	Advanced Microwave Sounding Unit
ANN	Artificial Neural Network
AVHRR	Advanced Very High Resolution Radiometer
BUFR	Binary Universal Form for the Representation of Meteorological Data
EUMETSAT	European Organisation For the Exploitation of Meteorological Satellites
FORLI	Fast Optimal Retrieval on Layers for IASI
IASI	Infrared Atmospheric Sounding Interferometer
L2	Level 2 (geophysical products)
MHS	Microwave Humidity Sounder
NWP	Numerical Weather Prediction
OEM	Optimal Estimation Method
QC	Quality Control

2 LOCAL BUFR DESCRIPTORS

The descriptors detailed in this section have been used when converting IASI Level 2 data from PFS v6.1 and onwards to BUFR. Further information concerning the IASI Level 2 PFS is found in [RD-1]. Particularities of descriptors related to atmospheric composition are given in [AD-3] and [AD-4].

In addition to using local descriptors, EUMETSAT also used a BUFR Table B entry, described in Table 4, which differed from that found in [AD-1], until migrating to use BUFR Master Table Version 30. This means that for IASI Level 2 data from EUMETSAT using BUFR Master Tables 29 and below, software will not be able to process this descriptor without modification. Since Master Table Version 30, the version of this entry which is used is identical to that in [AD-1].

Table 4: Local BUFR Table B entry used in EUMETSAT BUFR products up to and including Master Table Version 29

Descriptor	*Name*	*Units*	*Scale*	*Reference*	*Width*
0-15-045	Sulphur dioxide	DU	0	0	10

2.1 BUFR Table B Local entries

The BUFR Table B local entries used for the IASI level 2 PFS v 6.1 products are summarised in Table 5.

Table 5: Local BUFR Table B entries used in EUMETSAT BUFR products, local table version 1, and the PFS fields from which they are derived, if relevant

Descriptor	*Name*	*Units*	*Scale*	*Reference*	*Width*	*PFS field*
0-10-220	Pressure (high precision)	Pa	-1	0	30	SURFACE_PRESSURE
0-12-222	Retrieval error for temperature	Numeric	4	-10e5	21	TEMPERATURE_ERROR
0-13-222	Retrieval error for water vapour	Numeric	4	-10e5	21	WATER_VAPOUR_ERROR
0-15-222	Retrieval error for ozone	Numeric	4	-10e5	21	OZONE_ERROR
0-40-197	Satellite manoeuvre indicator	Code table	0	0	3	FLG_SATMAN
0-40-199	Integrated N2O density	kg m^{-2}	6	0	16	INTEGRATED_N2O
0-40-200	Integrated CO density	kg m^{-2}	7	0	16	INTEGRATED_CO
0-40-201	Integrated CH4 density	kg m^{-2}	6	0	16	INTEGRATED_CH4
0-40-202	Integrated CO2 density	kg m^{-2}	3	0	16	INTEGRATED_CO2
0-40-216	General retrieval quality flag for SO2	Code table	0	0	4	SO2_QFLAG
0-40-217	Dust Index	Numeric	1	0	8	FLG_DUSTCLD
0-40-220	Quality indicator for atmospheric temperature	Numeric	1	0	8	FG_QI_ATMOSPHERIC_ TEMPERATURE
0-40-221	Quality indicator for atmospheric water vapour	Numeric	1	0	8	FG_QI_ATMOSPHERIC_ WATER_VAPOUR
0-40-222	Quality indicator for atmospheric ozone	Numeric	1	0	8	FG_QI_ATMOSPHERIC_ OZONE
0-40-223	Quality indicator for surface temperature	Numeric	1	0	8	FG_QI_SURFACE_ TEMPERATURE
0-40-230	Cloud formation and height assignment (Modified)	Flag table	0	0	5	FLG_CLDFRM
0-40-231	Cloudiness summary (replacement of 0-40-193)	Code table	0	0	3	FLG_CLDNES
0-40-232	Validation flag for IASI level 1 product (modified)	Code table	0	0	3	FLG_IASIBAD
0-40-233	Validation flag of AMSU-A level 1 data flow	Code table	0	0	3	FLG_AMSUBAD
0-40-234	Cloud tests executed and results	Flag table	0	0	16	FLG_CLDTST
0-40-235	Retrieval initialisation	Flag table	0	0	8	FLG_INITIA
0-40-236	Convergence of the iterative retrieval	Code table	0	0	3	FLG_INCONV
0-40-237	Validation flag of MHS level 1 data flow	Code table	0	0	3	FLG_MHSBAD
0-40-238	Validation flag of NWP forecast	Code table	0	0	3	FLG_NWPBAD
0-40-239	Indication of super-adiabatic and super-saturation in final retrieval	Flag table	0	0	8	FLG_PHYSCHECK

Descriptor	*Name*	*Units*	*Scale*	*Reference*	*Width*	*PFS field*
0-40-240	Number of iterations used for retrieval	Numeric	0	0	8	FLG_NUMIT
0-40-242	General retrieval quality flag	Numeric	0	0	3	FLG_GENRET
0-40-243	IASI CO retrieval flags	Flag table	0	0	31	CO_BDIV
0-40-244	Number of vectors describing the characterization matrices	Numeric	0	0	8	CO_NPCA
0-40-245	Number of layers actually retrieved	Numeric	0	0	8	CO_NFITLAYERS
0-40-246	Number of CO profiles retrieved in scanline	Numeric	0	0	8	CO_NBR
0-40-247	Air partial columns on each retrieved layer	molecules / cm²	-20	0	16	CO_CP_AIR
0-40-248	A-priori partial columns for CO on each retrieved layer	molecules / cm²	-13	0	16	CO_CP_CO_A
0-40-249	Scaling vector multiplying the a priori CO vector in order to define the retrieved CO vector	Numeric	5	0	26	CO_X_CO
0-40-250	Main eigenvalues of the sensitivity matrix	Numeric	5	0	31	CO_H_EIGENVALUES
0-40-251	Main eigenvectors of the sensitivity matrix	Numeric	6	-10e8	31	CO_H_EIGENVECTORS
0-40-252	Retrieval flags part 1 processing and inputs potential errors	Flag table	0	0	13	FLG_BDIV
0-40-253	Retrieval flags part 2 diagnostics on the retrieval	Flag table	0	0	21	FLG_BDIV (continued)

2.2 Flag and code table definitions

This section gives the bit and code figure assignments for all flag and code tables listed in Section 2.1.

Table 6: 0-40-197 Satellite manoeuvre indicator

Code Figure	*Description*
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
3-6	Reserved
7	Missing value

Table 7: 0-40-216 General retrieval quality flag for SO_2

Code Figure	*Description*
9	Default value

11	T/P from forecasts in the absence of IASI L2 products

Table 8: 0-40-230 Cloud formation and height assignment

Bit No	*Description*
1	Cloud products retrieved with the χ^2 method.
2	Cloud products retrieved with the CO_2-slicing.
3	Height assignment performed with statistical first guess retrieval.
4	Height assignment performed with NWP forecasts.
All 5	Missing value.

Table 9: 0-40-231 Cloudiness summary

Code Figure	*Description*
1	The IASI IFOV is clear
2	Small cloud contamination possible
3	The IASI IFOV is partially covered by clouds
4	High or full cloud coverage
5-6	Reserved
7	Missing value

Table 10: 0-40-232 Validation flag for IASI level 1 product

Code Figure	*Description*
0	The IASI measurements and side information are available and of good quality for L2 processing
1	The IASI L1c products are of degraded quality according to IASI L1c flags, no L2 processing.
2	Quality control indicates that the IASI L1c data are of degraded quality (not indicated by the IASI L1c flags), no L2 processing.
3-6	Reserved
7	Missing value

Table 11: 0-40-233 Validation flag AMSU-A level 1 data flow

Code Figure	*Description*
0	The expected AMSU measurements are available, of good quality and collocated with IASI for processing.
1	AMSU-A data are available but of degraded quality (according to AMSU L1 flags or QC tests) and not used for processing.
2	No coincident (time and space) AMSU measurements available for processing.
3-6	Reserved
7	Missing value

Table 12: 0-40-234 Cloud tests executed and results

Bit No.	*Description*
1-3	Reserved
4	IASI cloud optical thickness indicates a cloud.
5	IASI cloud optical thickness computed.
6	AVHRR heterogeneity test indicates a cloud.

7	AVHRR heterogeneity test executed.
8	IASI-AVHRR ANN cloud test indicates a cloud.
9	IASI-AVHRR ANN cloud test executed.
10	AVHRR integrated cloud fraction indicates a cloud.
11	AVHRR integrated cloud fraction assessed.
12	AMSU cloud test indicates a cloud.
13	AMSU cloud test executed.
14	IASI Window cloud test indicates a cloud.
15	IASI Window cloud test executed.
All 16	Missing value

Table 13: 0-40-235 Retrieval initialisation

Bit No.	*Description*
1-4	Reserved
5	MHS included
6	AMSU included
7	IASI included
All 8	Missing value

Table 14: 0-40-236 Convergence of the iterative retrieval

Code Figure	*Description*
0	OEM not attempted
1	OEM aborted because first guess residuals too high
2	The minimisation did not converge, sounding rejected
3	The minimisation did not converge, sounding accepted
4	The minimisation converged but sounding rejected
5	The minimisation converged, sounding accepted
6	Reserved
7	Missing value

Table 15: 0-40-237 Validation flag of MHS level 1 data flow

Code Figure	*Description*
0	The expected MHS measurements are available, of good quality and collocated with IASI for processing.
1	MHS data are available but of degraded quality (according to MHS L1 flags or QC tests) and not used for processing.
2	No coincident (time and space) MHS measurements available for processing.
3-6	Reserved
7	Missing value

Table 16: 0-40-238 Validation flag of NWP forecast

Code Figure	*Description*
0	The expected NWP forecasts are available, of good quality and collocated with IASI for processing.

1	The expected NWP forecasts are available but of suspect quality, not used for processing.
2	No coincident NWP forecasts available for processing.
3-6	Reserved
7	Missing value

Table 17: 0-40-239 Indication of super-adiabatic and super-saturation in final retrieval

Code Figure	*Description*
1-3	Reserved
4	Supersaturation conditions in the OEM retrieval
5	Superadiabatic conditions in the OEM retrieval
6	Supersaturation conditions in the first guess
7	Superadiabatic conditions in the first guess
All 8	Missing value

Table 18: 0-40-243 IASI CO retrieval flags

Bit No.	*Description*
0	An error has been detected
1	Message from L1
2	Message from L2
3	Message from ancillary data
4	Message from fitting procedure
8	Quality flag
9	Level 2 “from linear regression” (F_Qual), report a pixel where L2 are not full trusted
10	Empty field or data
11	Missing surface pressure value
12	Radiance filtering
13	Polar regions
14	Location in the night
15	Negative altitude
16	Cloud covered scene
17	Scene above the sea
18	Scene above desert
19	Skin temperature
20	Skin temperature differential
21	Spectral line contrast too weak
22	Maximum number of iterations exceeded
23	Negative partial columns
24	Matrix ill conditioned
25	Fit diverged
26	Error in gsl usage
27	Residuals “biased”
28	Residuals “sloped”
29	Residuals rms large

Bit No.	*Description*
30	Weird averaging kernels
31	Ice presence detected

Table 19: 0-40-252 CO Retrieval flags part 1 processing and inputs potential errors

Bit No.	*Description*
1	An error has been detected
2	Message from L1
3	Message from L2
4	Message from ancillary data
5	Message from fitting procedure
6	File opening
7	File reading
8	Quality flag
9	Level 2 "from linear regression"(F_Qual), report a pixel where L2 are not fully trusted
10	Empty field or data
11	Missing surface pressure value
12	Radiance filtering
All 13	Missing value

Table 20: 0-40-253 CO Retrieval flags part 2 diagnostics on the retrieval

Bit No.	*Description*
1	Radiance filtering
2	Polar regions
3	Location in the night
4	Negative altitude Surface below mean sea level
5	Cloud covered scene
6	Scene above the sea
7	Scene above desert
8	Skin temperature
9	Skin temperature differential
10	Spectral line contrast too weak
11	Maximum number of iterations exceeded
12	Negative partial columns
13	Matrix ill conditioned
14	Fit diverged
15	Error in gsl usage
16	Residuals “biased”
17	Residuals “sloped”
18	Residuals rms large
19	Weird averaging kernels
20	Ice presence detected