

# ***ATOVS Level 2 Product Format Specification***

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EUMETSAT  
Am Kavalleriesand 31, D-64295 Darmstadt, Germany  
Tel: +49 6151 807-7  
Fax: +49 6151 807 555  
<http://www.eumetsat.int>

## Document Change Record

<b>Issue / Revision</b>	<b>Date</b>	<b>DCN. No</b>	<b>Changed Pages / Paragraphs</b>
Issue 2 Rev 0	25/5/99		First Issue
Issue 2 Draft B	23/07/99		Addressed RIDs
Issue 3, Draft A	27/6/00	EUM.EPS.SYS.D CN.035	Incorporate change in EPS Generic Product Specification, Issue 3
Issue 4 Draft A	15/11/00		<ul style="list-style-type: none"> <li>• Add GTS Product section</li> <li>• Simplified document layout</li> </ul>
Issue 4 Draft B			LEO/C/TP <ul style="list-style-type: none"> <li>• Removed items redundant with GPFS</li> <li>• Updated signature table</li> <li>• Removed GTS section – covered by PGS document</li> <li>• Added Generic Record Header details</li> <li>• Removed Footer records in line with latest GPFS update</li> </ul>
Issue 5 Rev 0	01/06/01		Issue for CGS PDR
Issue 5 Rev 1	13/06/01		Revised issue for CGS PDR <ul style="list-style-type: none"> <li>• Updated signature table</li> </ul>
Issue 5 Rev 2	10/07/01	EUM.EPS.SYS.D CN.01.079	<ul style="list-style-type: none"> <li>• Annex tables SPHR, GIADR, MDR, ADR updated. VIADR deleted.</li> <li>• Document text updated in accordance with Annex updates</li> </ul>
Issue 6 Rev 0			<ul style="list-style-type: none"> <li>• Combined MDR and ADRs into single MDR. Deleted ADR.</li> <li>• Removed reference to [AD-3] PCD. All information is now contained in [AD-1]</li> <li>• TBC on GEADR RECORD_SUBCLASS indices removed and made are TBD by ASPI</li> <li>• TBC on VEADR RECORD_SUBCLASS indices removed and made are TBD by ASPI</li> </ul>

<b>Issue / Revision</b>	<b>Date</b>	<b>DCN. No</b>	<b>Changed Pages / Paragraphs</b>
Issue 6 Rev 1	07/05/02		<ul style="list-style-type: none"> <li>Added GIADR-1 containing general information on retrieval</li> <li>Added flag information to MDR</li> <li>Moved detailed MDR field specifications from ANNEX to main document for clarity</li> </ul>
Issue 6 Rev 2	14/06/02	EUM.EPS.SYS.D CR.02.119	<ul style="list-style-type: none"> <li>Updated GEADR/VEADR sections compatible with updates to [AD-1]</li> <li>Updated Section 1.1 Purpose and Scope for CDR release</li> <li>See also DCR in Annex</li> </ul>
Issue 6 Rev 3	28/11/02	EUM.EPS.SYS.D CR.02.173	<ul style="list-style-type: none"> <li>Section 4 Occurrence Table updated with removal of SPHR</li> <li>Added GIADR-LEVELS enumerated value descriptions (moved from ANNEX).</li> <li>Added Section 5 – Record Format Version Control.</li> <li>See also DCR in Annex</li> </ul>
	31/01/03	EUM.EPS.SYS.D CR.02.230	<ul style="list-style-type: none"> <li>Added table for bit setting of MDR field OUT_OF_BOUNDS_SCENES_ANALYSIS.</li> <li>See also DCR in Annex</li> <li>Updated signature table</li> <li>Updated CHANNEL_AVAILABILITY_FLAG table to match INPUT_DATA_VECTOR definitions</li> </ul>
Issue 6 Rev 4	12/03/04	EUM.EPS.SYS.D CR.04.016	<ul style="list-style-type: none"> <li>Clarify bit 0 unused in CHANNEL_AVAILABILITY_FLAG table</li> <li>Clarify bit 0 unused in INPUT_DATA_VECTOR_FLAG table</li> <li>Added Table 14 NAVIGATION_STATUS values</li> <li>Add Section 3.4.2 Variance and Covariance Matrix Data</li> <li>Updated Record Subclass Versions Numbers</li> </ul>
Issue 6 Rev 5	13/05/04	EUM.EPS.SYS.D CR.04.043	<ul style="list-style-type: none"> <li>Editorial correction – see change record in Annex for details</li> </ul>

<b>Issue / Revision</b>	<b>Date</b>	<b>DCN. No</b>	<b>Changed Pages / Paragraphs</b>
Issue 6 Rev 6	14/04/08	EPS_AB_DCR_E UM_38	<ul style="list-style-type: none"> <li>• In MDR-2 MEASUREMENT DATA section – see change record in Annex for details.</li> <li>• Caption to Table 12 corrected. Signature list updated.</li> </ul>
v7A	25/08/08		<p>Migrated into Hummingbird. Body contents copied into standard template and reformatted, including redoing table captions with auto-numbering (which corrected some previous number errors) and use of bookmarks for document references and auto-referencing of these in body text.</p> <ul style="list-style-type: none"> <li>• Deleted sentence in Section 1.1 referring to reference AD-3 (replaced by AD-1 – see issue 6.0 update comment).</li> <li>• Section 1.2 (doc structure description) improved.</li> <li>• Supplied caption for table in Section 3.4.2.</li> <li>• Inserted link to Annex file in Hummingbird in Appendix A.</li> <li>• Some typo corrections.</li> </ul>
v7B	19/12/08	EPS_AB_DCR_E UM_78	<ul style="list-style-type: none"> <li>• HIRS_FOV_QUALITY_CONTROL – Bit '24-0' in last table row replaced by '0'.</li> <li>• OUT_OF_BOUNDS_SCENES_ANALYSIS – Bit values 8, 7, ... 2 replaced by 7, 6, ...1 resp., and typo '11 = out of bounds' --&gt; '1 = out of bounds'.</li> </ul>
v7C	19/08/09	ODT_DCR_67	<ul style="list-style-type: none"> <li>• See DCR in Annex.</li> </ul>

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## 1 INTRODUCTION

### 1.1 Purpose and Scope

This document is the Advanced Tiros Operational Vertical Sounder (ATOVS) Level 2 Product Format Specification.

The generic product format specification used by this document is defined in the EPS Generic Product Format Specification [AD 1].

### 1.2 Structure of the Document

The document is organised in the following sections, including the introduction:

<i>Section</i>	<i>Contents</i>
1	describes the scope of this document.
2	details the product formats for Level 2 products
3	describes the instrument and level specific records for Level 2 products
4	details the occurrence rates of the various records within Level 2 products
5	provides a history of version numbers for the records defined within the document
Appendix A	links to detailed tables describing the record formats

### 1.3 Applicable Documents

<i>Ref</i>	<i>Title</i>	<i>File</i>
AD 1	EPS Generic Product Format Specification	EPS/GGS/SPE/96167
AD 2	EPS Ground Segment ATOVS Level 2 Product Generation Specification	EPS/SYS/SPE/990014

## **2 STRUCTURE OF ATOVS LEVEL 2 PRODUCTS FORMAT**

### **2.1 Form**

The product format for ATOVS Level 2 products is based on the generic product format as described in [AD 1]. This document details the instrument- and level-specific additions required for ATOVS Level 2 products.

### **2.2 Generic Record Header Fields**

All generic record header fields of the instrument/level specific records defined in this document shall have an INSTRUMENT\_GROUP value of ATOVS [AD 1].

### 3 LEVEL 2 RECORDS

#### 3.1 Secondary Product Header Record

There is no SPHR defined for this product.

#### 3.2 Global and Variable External Auxiliary Data Records

The auxiliary datasets that are used by the Level 2 PGF [AD 2] but not written into the product, shall be referenced as specified in [AD 1] by GEADR or VEADR as appropriate.

#### 3.3 Global Internal Auxiliary Data Record

There are two subclasses of GIADR for the Level 2 Product. This is detailed in the Annex (Appendix A) to this document.

##### 3.3.1 Record Subclasses

Record subclass determines the type of auxiliary data referenced.

<i>Subclass</i>	<i>Description</i>	<i>Subclass ID</i>
GIADR-LEVELS	Pressure Levels and Quality Flags	1
GIADR-CONFIG	Processor configuration data	2

*Table 1: GIADR Subclasses*

##### 3.3.2 GIADR-LEVELS Fields

###### 3.3.2.1 RETRIEVAL\_METHOD

<i>Value</i>	<i>Meaning</i>
1	Default method
2	Standalone AMSU Retrieval

*Table 2: RETRIEVAL\_METHOD values*

###### 3.3.2.2 RETRIEVAL\_GRID

<i>Value</i>	<i>Meaning</i>
1	HIRS/4
2	AMSU-A
3	MHS

*Table 3: RETRIEVAL\_GRID values*

###### 3.3.2.3 RETRIEVAL\_DATA\_MAPPING

<i>Value</i>	<i>Meaning</i>
1	Bilinear
2	Nearest Neighbour
3	Spatial weighted average

*Table 4: RETRIEVAL\_DATA\_MAPPING values*



### 3.3.2.4 *FRTM\_ID*

<i>Value</i>	<i>Meaning</i>
1	RTTOV

Table 5: *FRTM\_ID* values

## 3.4 Measurement Data Record

The MDR contains, per scan line, retrieval profiles and associated data and flags. There is one subclass of MDR for the Level 2 product.

The MDR is detailed in the Annex (Appendix A) to this document.

### 3.4.1 MDR Fields

#### 3.4.1.1 *QUALITY\_INDICATOR\_BIT\_FIELD*

If bit is on, statement is true.

<i>Bit</i>	<i>Meaning</i>
31	Do not use scan-line for product generation
30	time sequence error detected with this scan
29	data gap precedes this scan
28	no HIRS calibration
27	no Earth location
26	first good time following clock update
25	instrument status changed with this
24 - 0	not used

Table 6: *QUALITY\_INDICATOR\_BIT\_FIELD* values

#### 3.4.1.2 *TIME\_PROBLEM\_FLAG*

<i>Bit</i>	<i>Meaning</i>
31 – 24	not used
23	time field bad, but can be inferred from previous line
22	time field is bad and cannot be inferred from previous scan line
21	time discontinuity with this scan line
20	scan times repeated, which have been previously accepted
19 – 16	not used
15	scan line not calibrated because of bad time
14	scan line was calibrated using fewer than the preferred number of lines because of proximity to start or end of dump or data gap
13	scan line not calibrated because of insufficient PRT data
12	scan line calibrated with marginal PRT data
11	some uncalibrated channels of this scan
10	uncalibrated due to instrument mode
9 – 8	not used
7	not Earth located because of bad time

<i>Bit</i>	<i>Meaning</i>
6	Earth location questionable because of questionable time code
5	Earth location questionable; only marginal agreement with reasonableness check
4	Earth location questionable. Fails reasonableness check
3 - 0	not used

*Table 7: TIME\_PROBLEM\_FLAG values*

### 3.4.1.3 HIRS\_FOV\_QUALITY\_CONTROL

<i>Bit</i>	<i>Meaning</i>
31	not used
30	set if secondary calibration used
29 - 22	not used
21	HIRS cloud test used
20 - 1	bit n set, if brightness temperature in channel n is physically unreasonable or has not been calculated due to calibration problems
0	bad or missing data

*Table 8: HIRS\_FOV\_QUALITY\_CONTROL values*

### 3.4.1.4 PRE\_PROCESSING\_QC\_WORD

all bits off = acceptable data

<i>Bit</i>	<i>Meaning</i>
31	set if AMSU-A surface types not all the same
30	set if AMSU-A used secondary calibration
29	set if MHS used secondary calibration
28	set if MHS data missing
27	flag for cloud cost set for any mapped AMSU-A (over sea only)
26	Scattering flag for any mapped AMSU-A (over sea only)
25	logistic precipitation probability test, calculated from AMSU-A mapped to HIRS FOV
24	Grody light rainfall test calculated on HIRS grid
23	mismatch between MHS/AMSU-A 89 GHz values
22	mismatch between surface type from topography data set and preprocessing (any AMSU-A)
21 - 4	not used
3	set if AVHRR channel 3 is albedo (3a) not BT (3b)
2	flag for cloud cost, recalculated on HIRS grid
1	flag for scattering index (re-calculated on HIRS grid)
0	set if AMSU-A and MHS data are missing

*Table 9: PRE\_PROCESSING\_QC\_WORD values*

### 3.4.1.5 SURFACE\_TYPE\_ESTIMATE

<i>Value</i>	<i>Meaning</i>
1	bare young ice (i.e. new ice, no snow)
2	dry land (dry with or without significant vegetation)
3	dry snow (snow with water less than 2 % over land)
4	Multi year ice (i.e. old ice with snow [assumed dry])
5	Sea (open water, no islands, ice free, wind speed 0 - 14 m/s)
6	Wet forest (i.e. established forest with wet canopy)
7	Wet land (i.e. non forested land with wet surface)
8	wet snow (i.e. snow with water content > 2%, over land or ice)
9	desert

*Table 10: SURFACE\_TYPE\_ESTIMATE values*

### 3.4.1.6 LAND\_SEA\_COAST\_HIRS, \_AMSU and \_MHS

<i>Value</i>	<i>Meaning</i>
0	sea
1	mixed
2	land

*Table 11: LAND\_SEA\_COAST\_HIRS, \_AMSU and \_MHS values*

### 3.4.1.7 INPUT\_DATA\_VECTOR\_FLAG

<i>Bit</i>	<i>Meaning</i>
63 – 41	not used
40 – 21	HIRS channels (set if used)
20 - 6	AMSU-A channels (set if used)
5 - 1	MHS channels (set if used)
0	Unused

*Table 12: INPUT\_DATA\_VECTOR\_FLAG values*

### 3.4.1.8 CHANNEL\_AVAILABILITY\_FLAG

<i>Bit</i>	<i>Meaning</i>
63 – 41	not used
40 – 21	HIRS channels (set if available)
20 - 6	AMSU-A channels (set if available)
5 - 1	MHS channels (set if available)
0	Unused

*Table 13: CHANNEL\_AVAILABILITY\_FLAG values*

### 3.4.1.9 *OUT\_OF\_BOUNDS\_SCENES\_ANALYSIS*

<b>Bit</b>	<b>Meaning</b>
7	Geolocation 1 = out of bounds)
6	Cloud Flag 1 = cloudy 0 = free)
5	Surface temperature 1 = out of bounds. Check performed when Bit 7 = 0, otherwise defaults to 0
4	Cloud top temperature 1 = out of bounds. Check performed when Bit 7 = 1, otherwise defaults to 0
3	Surface elevation 1 = out of bounds
2	Surface type 1 = out of bounds
1 - 0	Not used Default to 0

*Table 14: OUT\_OF\_BOUNDS\_SCENES\_ANALYSIS values*

### 3.4.1.10 *NAVIGATION\_STATUS*

<b>Bit</b>	<b>Meaning</b>
31 – 17	Not used
16	Earth location corrected for Euler angles
15 – 12	Earth location indicator 0 = earth location available 1 = user ephemeris files older than 24 hours 2 = no earth location available
11 – 8	Spacecraft attitude control 0 = operating in YGC or NOMINAL mode 1 = operating in another mode 2 = attitude exceeds nominal tolerance
7 – 4	Attitude SMODE 0 = NOMINAL mode 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

*Table 15: NAVIGATION\_STATUS values*

### 3.4.2 Variance and Covariance Matrix Data

The data stored at the end of the MDR depend upon the setting of the field `FLG_STER` and are described by the size settings in the field `DATA_SIZES(M, N)` as described in the following table.

<i>FLG_STER</i>	<i>Meaning</i>	<i>Format</i>
<b>0</b>	No error variances or covariances given in the product	<code>DATA_SIZES(M,N)</code> field values set to 0
<b>2</b>	Error variances as calculated in the iterative retrieval	<p><code>DATA_SIZES(M)</code> is set to length of FULL state vector.</p> <p><code>DATA_SIZES(N)</code> is set to 0.</p> <p><code>ERROR_DATA</code> field contains single array of V-INTEGERS of length M that contain the variance values.</p> <p>Where a state vector element has not been retrieved, the variance is given a flagged value (as per GPFS).</p>
<b>4</b>	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.	<p><code>DATA_SIZES(M)</code> is set to length of FULL state vector.</p> <p><code>DATA_SIZES(N)</code> is set to the number of wavelet coefficients that are to be stored</p> <p><code>ERROR_DATA</code> field contains the following:</p> <ul style="list-style-type: none"> <li>• a 1-D array of V-INTEGERS of length M containing the diagonal values of the inverted original covariance matrix</li> <li>• an array of length N of a compound variable <code>WAVELET_COEFF</code>.</li> </ul> <p>The compound <code>WAVELET_COEFF</code> comprises:</p> <ul style="list-style-type: none"> <li>• a U-BYTE containing i position of wavelet coefficient</li> <li>• a U-BYTE containing j position of wavelet coefficient</li> <li>• a V-INTEGERS containing value of the wavelet coefficient</li> </ul> <p>Missing state vector elements are given flagged values as per the GPFS.</p>

*Table 16: FLG\_STER values and corresponding DATA\_SIZES settings*

See the Annex to this document for details of field specifications.

#### **4 OCCURRENCE INFORMATION**

<i>Record</i>	<i>Occurrence</i>
MPHR	Once per product
SPHR	No SPHR defined for this product
GIADR-1	Once per product
GIADR-2	Once per product
MDR	Once per retrieval grid line

Assuming that the ATOVS retrieval grid is the same as HIRS/4, then a line may be assumed to occur once every 6.4 seconds.

## 5 RECORD FORMAT VERSION CONTROL

This section provides version numbers for the records defined within this document.

<i>Record Subclass</i>	<i>Format Version Number</i>	<i>Issue Defined</i>
<b>GIADR-CONFIG</b>	<b>2</b>	<b>6.3</b>
	1	6.2 (CDR)
<b>GIADR-LEVELS</b>	<b>3</b>	<b>6.4</b>
	2	6.3
	1	6.2 (CDR)
<b>MDR-2</b>	<b>4</b>	<b>6.6</b>
	3	6.4
	2	6.3
	1	6.2 (CDR)

*Table 17: Record Format Version Numbers*

**APPENDIX A            DETAILED SPECIFICATION OF ATOVS LEVEL 2 DATA RECORDS**

In the following Annex, detailed format specifications for all these Variable Internal and Measurement Data Records in ATOVS Level 2 products are included:

- GIADR-CONFIG
- GIADR-LEVELS
- MDR-2

You can get this Annex as a separate spreadsheet. Ask for the document reference:  
EPS.MIS.SPE.980759.ANX



<b>This Document</b>	
<b>Title</b>	ATOVS LEVEL 2 PRODUCT FORMAT SPECIFICATION TABLES
<b>Reference Number</b>	EPS/MIS/SPE/980759
<b>Revision History</b>	
<b>Issue 4 Draft B</b>	Made SPHR ASCII format
	Removed records that are redundant with GPFS
	Updated Types
<b>Issue 5 Revision 0</b>	Issue for CGS PDR
<b>Issue 5 Revision 1</b>	Revised Issue for CGS PDR
<b>Issue 5 Revision 2</b>	Correct version for CGS PDR.
	SPHR: Added general information and data/code identifiers
	GIADR: Added pressure level grids. Moved flags to ADR.
	MDR: Removed cloud phase. Added tropopause height, total column cloud liquid water and total column precipitable water
	ADR: Added navigation data, flag information, earth observations and quality indicators
	VIADR: Removed. Data moved to ADR.
<b>Issue 5 Revision 3</b>	Merged ADR-2 fields into MDR-2
<b>Issue 6 Revision 0</b>	Populated flags for pre-processing and retrieval
<b>Issue 6 Revision 1</b>	Gave GIADRs descriptive names
	Moved detailed MDR field descriptions into main document for clarity
<b>Issue 6 Rev 2</b>	Removed SPHR worksheet - no record defined
	Corrected field types and array dimensions in MDR-2
<b>Issue 6 Rev 3</b>	GIADR-LEVELS: all "number of levels" fields made unsigned
	GIADR-LEVELS: pressure level arrays made variable size dependent upon number of pressure levels defined
	GIADR-CONFIG - major/minor version number fields made unsigned
	Made GIADR-CONFIG RETRIEVAL_METHOD the default user-selected method for the product.
	MDR.TIME_ATTITUDE made unsigned (compatible with ATOVS L1 products)
	MDR.EULER_ANGLE scale factor changed to 3 and data type changed to integer2 (compatible with ATOVS L1 products)
	MDR.ANGULAR_RELATION scale factor changed to 2 (compatible with ATOVS L1 products)
	Removed following fields from GIADR-CONFIG because they are duplicated in the MDR: LEVEL_2_FORMAT_VERSION_NUMBER, LEVEL_2_FORMAT_YEAR, LEVEL_2_FORMAT_DAY_OF_YEAR and SATTELLITE_ALTITUDE
	Removed GIADR-LEVELS.PRODUCT_QUALITY_INDICATOR as it is duplicated on GIADR-CONFIG

	Removed GIADR-L:LEVELS.AMSU_STANDALONE_LEVELS as this is covered by the retrieval method flag in GIADR-CONFIG and the number of temp levels flag ion GIADR-LEVELS
	GIADR-CONFIG: Enumerated values moved to main text for clarity
	GIADR-CONFIG: Removed field MAPPING_ALGORITHM_ID. Redundant with RETRIEVAL_DATA_MAPPING field.
	GIADR-CONFIG: Moved FRTM-ID within the record to a group it with similar data.
	Moved GIADR-CONFIG:PRODUCT_QUALITY_INDICATOR to start of record.Delete redundant version in GIADR-LEVELS
	MDR.TOTAL_COLUMN_CLW renamed to MDR.CLW and made an array to correspond to the pressure array for CLW in GIADR-LEVELS.
	ATMOSPHERIC_WATER_VAPOUR changed field type to from u-integer2 to u-integer4 and change scaling factor to 6.
	<b>EUM.EPS.SYS.DCR.02.230</b>
	MDR: Changed SURFACE_EMISSIVITY scale factor from 0 to 4
	MDR: Added units of % and SF of 2 to FRACTIONAL_CLOUD_COVER_FIELD
	MDR: Changed CHANNEL_AVAILABILITY_FLAG and INPUT_DATA_VECTOR_FLAG to bitst(64) from integer4
	MDR: Changed arrays from 2 x NP to NP, datatype to boolean and updated descriptions for following fields
	<i>CHANNEL_AVAILABILITY_FLAG</i>
	<i>MAPPED_CLOUD_FLAG</i>
	<i>MAPPED_INPUT_DATA_FLAG</i>
	<i>CLOUD_CLEARING_FLAG</i>
	<i>FIRST_GUESS_INITIALISATION</i>
	MDR: OUT_OF_BOUNDS_SCENES_ANALYSIS: Changed to data type bitst(8) and changed array from 6 x NP to NP.
	<b>EUM.EPS.SYS.DCR.04.016</b>
<b>Issue 6 Rev 4</b>	COMPOUNDS: Added new COMPOUND data type WAVELET_COEFF
	GIADR-LEVELS: Changed SF for EMISSIVITY_WAVELENGTHS to 3
	MDR-2: Changed SF for field SURFACE_TEMPERATURE to 2
	MDR-2: Changed SF for field CLOUD_TOP_PRESSURE to 1
	MDR-2: Changed SF for field TROPOSPHERE_HEIGHT to 1
	MDR-2: Changed SF for field CLW to 3
	MDR-2: Changed SF for field TOTAL_COLUMN_PREC_WATER to 3
	MDR-2: Changed SF for field HIRS_VIS_RAD to 3
	MDR-2: Changed SF for field EARTH_LOCATIONS to 4

	MDR-2: Changed data type of field EARTH_LOCATIONS to integer4
	MDR-2: Changed data type of field HIRS_IR_BT to unsigned
	MDR-2: Changed data type of field HIRS_VIS_RAD to unsigned
	MDR-2: Changed data type of field AMSU_BT to unsigned
	MDR-2: Changed data type of field MHS_BT to unsigned
	MDR-2: Set SF for SCANLINE explicitly to 0
	MDR-2: Changed data type for field SURFACE_TYPE_ESTIMATE to enumerated
	MDR-2: Renamed field MATRIX_DATA_SIZES to DATA_SIZES
	MDR-2: Renamed field COVARIANCE_MATRIX to ERROR_DATA
	MDR-2: Changed array size of DATA_SIZES to 2 x NP
	MDR-2: Added new field FLG_RETBOU
	MDR-2: Changed array size of FLG_STER to 1
	MDR-2: Added format definitions of ERROR_DATA based on setting of FLG_STER
	PARAMS:Updated definition of M and N
<b>Issue 6 Rev 5</b>	<b>EUM.EPS.SYS.DCR.04.43</b>
	Editorial correction. Scale factors in following fields brought in line with document change record:
	ANGULAR_RELATION
	TERRAIN_ELEVATION
	EARTH_LOCATION
	HIRS_IR_BT
	HIRS_VIS_RAD
<b>Issue 6 Rev 6</b>	<b>EPS_AB_CDR_EUM_38</b>
	In MDR-2 MEASUREMENT DATA section:
	1. Field FRACTIONAL_CLOUD_COVER replaced by SURFACE_PRESSURE. Description "Fractional cloud cover (for NP FOV)" replaced by "Surface pressure (for NP FOV)". Scaling factor 2 replaced by 1. Units % replaced by hPa.
	2. CLW scale factor changed from 3 to 4.
	3. TOTAL_COLUMN_PREC_WATER scale factor changed from 3 to 2.
<b>Version 7A 25/08/08</b>	Migrated into Hummingbird. Contents identical with issue 6.6.
<b>Version 7B 19/12/08</b>	No changes to annex.
<b>Version 7C 19/08/09</b>	<b>ODT_DCR_67</b>
	In MDR-2 FLAG/QUALITY INFORMATION section:

	Fields HIRS_FOV_QUALITY_CONTROL & PRE_PROCESSING_QC_WORD: Type specification corrected from 'integer4' to 'bitst(32)'.
<b>Version 7D 22/02/11</b>	<b>ODT_DCR_236</b>
	MDR-2, field ANGULAR_RELATION: Added Description note on azimuth angle range.



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FIELD	DESCRIPTION	SF	UNITS	DIM1	DIM2	DIM3	TYPE	TYPE SIZE	FIELD SIZE	OFFSET
<b>RECORD_HEADER</b>	Generic Record Header			1	1	1	REC_HEAD	20	20	0
<b>QUALITY FLAGS</b>										
<b>PRODUCT_QUALITY_INDICATOR</b>	product quality indicator			1	1	1	u-integer4	4	4	20
<b>GENERAL INFORMATION</b>										
<b>RETRIEVAL_METHOD</b>	This is the default method that has been selected in user configuration.		N/A	1	1	1	enumerated	1	1	24
<b>RETRIEVAL_GRID</b>	Selected retrieval grid		N/A	1	1	1	enumerated	1	1	25
<b>RETRIEVAL_GRID_SAMPLING</b>	Sampling of retrievals per nth pixel and mth line		N/A	2	1	1	u-integer2	2	4	26
<b>NUM_GRID_POINTS</b>	Number of points along a scan line for the selected retrieval grid size, NP		N/A	1	1	1	u-integer2	2	2	30
<b>RETRIEVAL_DATA_MAPPING</b>	Retrieval data mapping method		N/A	1	1	1	enumerated	1	1	32
<b>FRTM_ID</b>	identifier for FRTM		N/A	1	1	1	enumerated	1	1	33
<b>ORBIT_PERIOD</b>	nominal orbit period		sec	1	1	1	integer2	2	2	34
<b>Algorithm Ids</b>										
<b>RETRIEVAL_ALGORITHM_VERSION</b>	version of level 2 algorithm word 1: major vn # word 2: minor vn #		N/A	2	1	1	u-integer2	2	4	36
<b>AMSU_DATA_PREP_ALGO_VERSION</b>	version of AMSU-A Data preparation algorithm word 1: major vn # word 2: minor vn #		N/A	2	1	1	u-integer2	2	4	40
<b>MHS_DATA_PREP_ALGO_VERSION</b>	version of MHS Data preparation algorithm word 1: major vn # word 2: minor vn #		N/A	2	1	1	u-integer2	2	4	44

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<b>HIRS_DATA_PREP_ALGO_VERSION</b>	version of HIRS Data preparation algorithm word 1: major vn # word 2: minor vn #		N/A	2	1	1	u-integer2	2	4	48
<b>MAPPING_ALGORITHM_VERSION</b>	version of mapping algorithm word 1: major vn # word 2: minor vn #		N/A	2	1	1	u-integer2	2	4	52
<b>FRTM_VERSION</b>	version of FRTM word 1: major vn # word 2: minor vn #		N/A	2	1	1	u-integer2	2	4	56
<b>HIRS_LIMB_COR_VERSION</b>	version number of the HIRS limb correction coefficients 0 = not done		N/A	2	1	1	u-integer2	2	4	60
<b>HIRS_BIAS_COR_VERSION</b>	version number of the HIRS bias correction 0 = not done		N/A	2	1	1	u-integer2	2	4	64
<b>HIRS_SURF_EMIS_COR_VERSION</b>	version number of HIRS surface emissivity correction data set 0 = not done		N/A	2	1	1	u-integer2	2	4	68
<b>HIRS_CLOUD_COR_ID</b>	identifier of HIRS cloud correction method 0 = not done		N/A	2	1	1	u-integer2	2	4	72
<b>AMSU_LIMB_COR_VERSION</b>	version number of AMSU limb correction coefficients 0 = not done		N/A	2	1	1	u-integer2	2	4	76
<b>AMSU_ANTENNA_COR_VERSION</b>	version number of AMSU antenna correction coefficients 0 = not done		N/A	2	1	1	u-integer2	2	4	80
<b>AMSU_SURF_EMIS_COR_VERSION</b>	version number of AMSU-A surface emissivity correction data set 0 = not done		N/A	2	1	1	u-integer2	2	4	84

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<b>AMSU_BIAS_COR_VERSION</b>	version umber of AMSU bias correction 0 = not done		N/A	2	1	1	u-integer2	2	4	88
<b>MHS_LIMB_COR_VERSION</b>	version number of MHS limb correction coefficients 0 = not done		N/A	2	1	1	u-integer2	2	4	92
<b>MHS_ANTENNA_COR_VERSION</b>	version number of MHS antenna correction coefficients 0 = not done		N/A	2	1	1	u-integer2	2	4	96
<b>MHS_SURF_EMIS_COR_VERSION</b>	version number of MHS surface emissivity correction dataset 0 = not done		N/A	2	1	1	u-integer2	2	4	100
<b>MHS_CLOUD_COR_ID</b>	version number of MHS cloud correction method 0 = not done		N/A	2	1	1	u-integer2	2	4	104
<b>MHS_BIAS_COR_VERSION</b>	version number of MHS bias correction 0 = not done		N/A	2	1	1	u-integer2	2	4	108
<b>PRIOR_DATA_COV_VERSION</b>	version number for prior data error covariance		N/A	2	1	1	u-integer2	2	4	112
<b>OBS_DATA_COV_VERSION</b>	version number for error covariance for observation data		N/A	2	1	1	u-integer2	2	4	116
<b>AMSU_TRET_REGR_COEF_VERSION</b>	version number of AMSU standalone temperature retrieval coefficients		N/A	2	1	1	u-integer2	2	4	120
<b>AMSU_TPW_REGR_COEF_VERSION</b>	version number of AMSU standalone TPW retrieval coefficients		N/A	2	1	1	u-integer2	2	4	124
<b>AMSU_QTOT_REGR_COEF_VERSION</b>	version number of AMSU standalone CLW retrieval coefficients		N/A	2	1	1	u-integer2	2	4	128



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<b>AMSU_DELTA_COR_VERSION</b>	version number of AMSU standalone retrieval delta correction coefficients		N/A	2	1	1	u-integer2	2	4	132
<b>SURF_TYPE_COV_VERSION</b>	version number of surface type covariance matrices		N/A	2	1	1	u-integer2	2	4	136
<b>SURF_TYPE_MEAN_VERSION</b>	version number of surface type means		N/A	2	1	1	u-integer2	2	4	140
<b>PROF_EXTR_COEF_VERSION</b>	version number of profile extrapolation coefficients		N/A	2	1	1	u-integer2	2	4	144
<b>FRTM_FAST_COEF_VERSION</b>	version number of fast radiative transfer model coefficients		N/A	2	1	1	u-integer2	2	4	148
<b>FRTM_GAMMA_COEF_VERSION</b>	version number of fast radiative transfer model gamma coefficients		N/A	2	1	1	u-integer2	2	4	152
<b>GIADR-2</b>										<b>156</b>

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 Worksheet: GIADR-LEVELS

FIELD	DESCRIPTION	SF	UNITS	DIM1	DIM2	DIM3	TYPE	TYPE SIZE	FIELD SIZE	OFFSET
RECORD_HEADER	Generic Record Header			1	1	1	REC_HEAD	20	20	0
<b>PRESSURE LEVEL DEFINITION</b>										
NUM_T_PRESSURE_LEVELS	number of pressure levels for temperature retrieval profiles, NTL			1	1	1	u-integer2	2	2	20
T_PRESSURE_LEVELS	(Note this figure also depends on the retrieval method chosen in GIADR-CONFIG)	2	hPa	NTL	1	1	integer4	4	180	22
NUM_Q_PRESSURE_LEVELS	number of pressure levels for humidity retrieval profiles, NQL			1	1	1	u-integer2	2	2	202
Q_PRESSURE_LEVELS	pressure levels on which humidity profiles are retrieved	2	hPa	NQL	1	1	integer4	4	180	204
NUM_CLW_PRESSURE_LEVELS	number of pressure levels for CLW retrieval, NCL. NCL = 1 implies total column CLW retrieval.			1	1	1	u-integer2	2	2	384
CLW_PRESSURE_LEVELS	pressure levels on which CLW profiles are retrieved. If NCL = 1, then the retrieval is for total column and the pressure level here should be set to 0).	2	hPa	NCL	1	1	integer4	4	4	386
NUM_FRTM_PRESSURE_LEVELS	number of pressure levels in the Fast Radiative Transfer Model, NFL			1	1	1	u-integer2	2	2	390
FRTM_PRESSURE_LEVELS	pressure levels of the fast radiative transfer model	2	hPa	NFL	1	1	integer4	4	180	392
NUM_EMISSIVITY_WAVELENGTHS	Number of wavelengths for which surface emissivity is derived, NEW			1	1	1	u-integer2	2	2	572
EMISSIVITY_WAVELENGTHS	Wavelengths for which surface emissivity is derived	3	microns	NEW	1	1	integer4	4	80	574
<b>GIADR-2</b>										654

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 Worksheet: MDR-2

FIELD	DESCRIPTION	SF	UNITS	DIM1	DIM2	DIM3	TYPE	TYPE SIZE	FIELD SIZE	OFFSET
RECORD_HEADER	Generic Record Header			1	1	1	REC_HEAD	20	20	0
<b>GENERIC QUALITY INDICATORS</b>										
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation	NA	NA	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation	NA	NA	1	1	1	boolean	1	1	21
<b>MEASUREMENT DATA</b>										
ATMOSPHERIC_TEMPERATURE	Temperature (for NP FOV with NTL vertical levels)	2	K	NTL	NP	1	u-integer2	2	5040	22
ATMOSPHERIC_WATER_VAPOUR	Water vapour (specific humidities for NP FOV with NQL vertical levels)	6	kg/kg	NQL	NP	1	u-integer4	4	10080	5062
SURFACE_TEMPERATURE	Surface temperature (for NP FOV)	2	K	NP	1	1	u-integer2	2	112	15142
SURFACE_EMISSIVITY	Surface emissivity (for NP FOV with NEW wavelengths)	4		NEW	NP	1	u-integer2	2	2240	15254
SURFACE_PRESSURE	Surface pressure (for NP FOV)	1	hPa	NP	1	1	u-integer2	2	112	17494
CLOUD_TOP_TEMPERATURE	Cloud top temperature (for NP FOV)	2	K	NP	1	1	u-integer2	2	112	17606
CLOUD_TOP_PRESSURE	Cloud top pressure (for NP FOV)	1	hPa	NP	1	1	u-integer2	2	112	17718
TROPOPAUSE_HEIGHT	Tropopause height	1	hPa	NP	1	1	u-integer2	2	112	17830
CLW	cloud liquid water content	4	kg/m**2	NCL	NP	1	u-integer2	2	112	17942
TOTAL_COLUMN_PREC_WATER	total precipitable water	2	kg/m**2	NP	1	1	u-integer2	2	112	18054
<b>NAVIGATION DATA AT SCAN LINE LEVEL</b>										
SCAN_LINE	scan line number	0		1	1	1	u-integer4	4	4	18166
TIME_ATTITUDE	Time Associated with Attitude Angles	0	s	1	1	1	u-integer4	4	4	18170
EULER_ANGLE	Euler Angles: Roll, Pitch, Yaw	3	deg	3	1	1	integer2	2	6	18174
NAVIGATION_STATUS	Navigation Status Bit Field	0	N/A	1	1	1	bitst(32)	4	4	18180
SPACECRAFT_ALTITUDE	Spacecraft Altitude Above Reference Geoid (MSL)	1	km	1	1	1	u-integer4	4	4	18184
<b>NAVIGATION DATA AT SCAN POSITION</b>										
SCAN_POSITION	number of the scan position for which retrieval is made			NP	1	1	u-integer2	2	112	18188
ANGULAR_RELATION	Angular relationships: solar zenith angle, satellite zenith angle, solar azimuth angle, satellite azimuth angle - (for NP FOV). Note: azimuth angle range is -180 to +180, where minus is west and plus is east.	2	deg	4	NP	1	integer2	2	448	18300
TERRAIN_ELEVATION	terrain elevation	0	m	NP	1	1	integer2	2	112	18748
EARTH_LOCATION	Earth Location: latitude, longitude (for NP FOV)	4	deg	2	NP	1	integer4	4	448	18860
<b>EARTH OBSERVATIONS</b>										
HIRS_IR_BT	HIRS channels 1-19 Brightness temperatures	2	K	19	NP	1	u-integer4	4	4256	19308
HIRS_VIS_RAD	HIRS Channel 20 radiance	2	W/m**2/s r/cm**-1	NP	1	1	u-integer4	4	224	23564

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<b>AMSU_BT</b>	AMSU-A channels 1-15 Brightness temperatures	2	K	15	NP	1	u-integer4	4	3360	23788
<b>MHS_BT</b>	MHS channels 1-5 Brightness temperatures	2	K	5	NP	1	u-integer4	4	1120	27148
<b>FLAG/QUALITY INFORMATION</b>										
<b>QUALITY_INDICATOR_BIT_FIELD</b>	Quality indicator at scan line level from pre-processing.		N/A	1	1	1	u-integer4	4	4	28268
<b>TIME_PROBLEM_FLAG</b>	Time problem code at scan line level		N/A	1	1	1	u-integer4	4	4	28272
<b>HIRS_FOV_QUALITY_CONTROL</b>	HIRS quality control word for each field of view		N/A	NP	1	1	bitst(32)	4	224	28276
<b>PRE_PROCESSING_QC_WORD</b>	Pre-processing quality control word with flags		N/A	NP	1	1	bitst(32)	4	224	28500
<b>SURFACE_TYPE_ESTIMATE</b>	Surface type from pre-processing		N/A	NP	1	1	enumerated	1	56	28724
<b>SURFACE_COST_FUNCTION</b>	cost function from surface identification	2	N/A	NP	1	1	integer4	4	224	28780
<b>SCATTERING_INDEX</b>	Scattering index	2	N/A	NP	1	1	integer4	4	224	29004
<b>PRECIPITATION_PROBABILITY</b>	Precipitation probability from pre-processing	2	N/A	NP	1	1	integer4	4	224	29228
<b>MEDIAN_FLAG_MHS</b>	Median test MHS		N/A	NP	1	1	integer4	4	224	29452
<b>MHS_VARIABILITY</b>	MHS 89 GHz variability		N/A	NP	1	1	integer4	4	224	29676
<b>OUT_OF_BOUNDS_SCENES_ANAL</b>	0 = ok 1 = out of bounds		N/A	NP	1	1	bitst(8)	1	56	29900
<b>LAND_SEA_COAST_HIRS</b>	surface type HIRS		N/A	NP	1	1	enumerated	1	56	29956
<b>LAND_SEA_COAST_AMSU</b>	surface type AMSU on HIRS		N/A	NP	1	1	enumerated	1	56	30012
<b>LAND_SEA_COAST_MHS</b>	surface type MHS		N/A	NP	1	1	enumerated	1	56	30068
<b>HIRS_STANDALONE_CLOUD_DETECT</b>	0 = not used 1 = clear		N/A	NP	1	1	boolean	1	56	30124
<b>HIRS_DAY_NIGHT_FLAG</b>	0 = day 1 = night		N/A	NP	1	1	boolean	1	56	30180
<b>PERCENTAGE_CLOUDY_FOV</b>	percentage of AVHRR cloudy fields of view	2	%	NP	1	1	Integer2	2	112	30236
<b>BIAS_CORRECTION_HIRS</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30348
<b>BIAS_CORRECTION_AMSU</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30404
<b>BIAS_CORRECTION_MHS</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30460
<b>LIMB_CORRECTION_HIRS</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30516
<b>LIMB_CORRECTION_AMSU</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30572
<b>LIMB_CORRECTION_MHS</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30628
<b>ANTENNA_CORRECTION_AMSU</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30684
<b>ANTENNA_CORRECTION_MHS</b>	0 = not done 1 = done successfully		N/A	NP	1	1	boolean	1	56	30740
<b>INPUT_DATA_VECTOR_FLAG</b>	Sounding channels used for retrieval:		N/A	NP	1	1	bitst(64)	8	448	30796
<b>CHANNEL_AVAILABILITY_FLAG</b>	Availability of channels in HIRS, AMSU and MHS		N/A	NP	1	1	bitst(64)	8	448	31244
<b>MAPPED_CLOUD_FLAG</b>	Flag to indicate mapped cloud cover set if cloud cover was mapped, not set else		N/A	NP	1	1	boolean	1	56	31692
<b>MAPPED_INPUT_DATA_FLAG</b>	Flag to indicate mapped input data set if input data were mapped, not set else		N/A	NP	1	1	boolean	1	56	31748
<b>CLOUD_CLEARING_FLAG</b>	Flag to indicate whether cloud clearing was performed set if cloud clearing was performed, not set else		N/A	NP	1	1	boolean	1	56	31804
<b>FIRST_GUESS_INITIALISATION</b>	Flag to indicate whether first guess initialisation was performed set if FG initialisation was performed, not set else		N/A	NP	1	1	boolean	1	56	31860
<b>SURFACE_PRESSURE_FLAG</b>	0 = selected from forecast 1 = climatological value		N/A	NP	1	1	boolean	1	56	31916
<b>DISTANCE_REJECTION_FLAG</b>	IREJGUESS		N/A	NP	1	1	integer2	2	112	31972

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<b>RETRIEVAL_REJECTION_FLAG</b>	retrieval quality check 1 = inversion rejected	0 = ok		N/A	NP	1	1		boolean	1	56	32084
<b>CLEAR_CLOUDY_RETRIEVAL_FLAG</b>		0 = clear 1 = cloudy		N/A	NP	1	1		boolean	1	56	32140
<b>SURFACE_EMISSIVITY_FLAG</b>		0 = ok 1 = retrieval not performed due to bad emissivity over land		N/A	NP	1	1		boolean	1	56	32196
<b>FLG_RETBOU</b>		Retrieved state vector element out-of-bounds check: 0 = ok, 1 = out-of-bounds		NA	NP	1	1		bitst(256)	32	1792	32252
<b>FLG_STER</b>		Representation of retrieval errors. Determines type of data in MDR.ERROR_DATA.	0		1	1	1		enumerated	1	1	34044
<b>DATA_SIZES</b>		Two sizing values for data stored in ERROR_DATA field. Meaning of sizes depends on the FLG_STER [M, N]			2	NP	1		u-integer2	2	224	34045
<b>ERROR_DATA</b>												
<b>ERROR_DATA</b>	Contents depend on MDR.FLG_STER field: See below											
<b>SIZE OF THE RECORD</b>											<b>See Below</b>	

**FLG\_STER = 0**

No Error Data

FIELD	DESCRIPTION	SF	UNITS	DIM1	DIM2	DIM3	TYPE	TYPE SIZE	FIELD SIZE	OFFSET
<b>ERROR_DATA</b>	Field is empty	NA	NA	0	0	0	NA	NA	NA	34269
<b>SIZE OF THE RECORD</b>										<b>34269</b>

**FLG\_STER = 1 or 2**

M = length of full state vector

N = 0

FIELD	DESCRIPTION	SF	UNITS	DIM1	DIM2	DIM3	TYPE	TYPE SIZE	FIELD SIZE	OFFSET
<b>VARIANCES</b>	Variances of length N			M	NP	1	V-INTEGGER4	5	32480	34269
<b>SIZE OF THE RECORD</b>										<b>66749</b>

**FLG\_STER = 4**

M = length of full state vector

N = number of wavelet coefficients

FIELD	DESCRIPTION	SF	UNITS	DIM1	DIM2	DIM3	TYPE	TYPE SIZE	FIELD SIZE	OFFSET
<b>DIAGONAL_VALUES</b>	Diagonal Values of the inverted original covariance matrix			M	NP	1	V-INTEGGER4	5	32480	34269
<b>WAVELETS</b>	Wavelet values			N	NP	1	WAVELET_COEFF	7	376320	66749
<b>SIZE OF THE RECORD</b>										<b>443069</b>

Field Type	Size in Bytes
bitst(8)	1
boolean	1
byte	1
char(1)	1
e-char(1)	1
enumerated	1
u-byte	1
bitst(16)	2
char(2)	2
e-char(2)	2
integer2	2
u-integer2	2
bitst(24)	3
char(3)	3
e-char(3)	3
bitst(32)	4
char(4)	4
integer4	4
u-integer4	4
v-integer4	5
short cds time	6
WAVELET_COEFF	7
bitst(64)	8
integer8	8
long cds time	8
u-integer8	8
general time	15
REC_HEAD	20
bitst(256)	32
char(88)	88
char(400)	400
char(800)	800

NOTE: Table must be sorted into ascending order

Parameter	Value	Description
1	1	Numbers make Excel formulae easier!
2	2	
3	3	
4	4	
5	5	
6	6	
15	15	
19	19	
M	116	Length of full state vector (NEW+NQL+NTL+NCL+5)
N	960	Number of wavelets that give approximate 10x compression of covariance matrix
NEW	20	Typical number of wavelengths for emissivity
NP	56	Typical number of points along a grid scan line
NQL	45	Typical number of pressure levels for water vapour retrieval
NTL	45	Typical number of pressure levels for temp retrieval
NCL	1	Typical number of levels for cloud liquid water content
NFL	45	Typical number of levels for the FRTM